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# **NATIONAL AGRICULTURAL RESEARCH SYSTEM IN INDIA: History, Vision, Mandate, Organization and Functions**

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## **Introduction**

Agriculture continues to remain a major sector of the Indian economy. It contributes 26 per cent of GDP, provides 60 per cent of employment and continues to be the primary source of living for 70 per cent of the population. Technological progress in agriculture is, therefore, crucial for the overall economic development of the country.

The total geographical area is estimated at 328.8 m. ha. The gross cropped area is about 180 m. ha, of which 35 m. ha are under double cropping. Rice is the most important crop followed by wheat, pulses, oilseeds, sorghum, and maize. Cotton and sugarcane are the principal commercial crops. India has one-half of the buffalo and one-sixth of the cattle population of the world. It ranks first in goat and sixth in sheep population. It has a vast potential of fishing resources comprising 2.02 m. sq. km of Exclusive Economic Zone (EEZ), 7,517 km of coastline, 29,000 km of rivers, 1.7 m. ha of reservoirs, 0.902 m. ha of brackish water areas, and 0.753 m. ha of tanks and ponds.

The climatic setting is highly diverse, ranging from tropics in the south to warm, temperate subtropics in the north. The extreme east receives very high rainfall, while in the extreme west the rainfall is very low and erratic. Nearly one-third of the country receives an annual rainfall of less than 75 cm. Two-thirds of the agriculture is rain fed and is prone to vagaries of monsoonal aberrations like drought. The arid zones occupy nearly 320,000 sq. km mainly in the States of Rajasthan, Gujarat and Haryana. In addition, a cold desert of 84,000 sq. km exists in cold regions like in Ladakh.

Nearly one-sixth of the land area has serious limitations for crop production such as erosion, aridity, water logging, acidity, salinity, and alkalinity. It is estimated that nearly 80 m. ha of cultivated area requires soil conservation measures. The problems of salinity and water logging have appeared within a few years of the introduction of irrigation. An estimated 7 m. ha of land are affected by salinity and alkalinity, the majority of which occur in the potentially fertile irrigated areas of the Indo-Gangetic alluvial plains.

India has an estimated 176 m. ha of surface water and 57 m. ha of ground water potential. As against an ecologically safe level of 30 per cent, only about 20 per cent of the land area is under forest cover. About 2 million people, mostly in the North- Eastern Hill Region, follow shifting cultivation involving 11 m. ha of land causing serious environmental degradation and ecological imbalance. Indiscriminate destruction of forests coupled with irrational use of soil and water resources have resulted in land degradation at an alarming rate of 1.5 m. ha every year.

The food grain production has increased by nearly four times from 51 m. tons in 1950-51 to over 212 m. tons in recent years. Milk production has increased from 17 m. tons in 1950-51 to nearly 92 m. tons in 2003-04, while egg production has increased phenomenally from 1,032 m. to over 32,000 m. during the same period. The total catch of inland and marine fish has increased from 0.75 m. tons in 1950-51 to around 6.2 m. tons in 2003-04. Nevertheless, livestock and fisheries potential remains largely under-exploited compared to that of food crops.

### **National Agricultural Research System (NARS)**

India has built up a fairly advanced agricultural research system. The Indian NARS is one of the largest systems in the world. The effective functioning of this system, in close association with education and extension systems, has greatly contributed to the rapid growth of agriculture after independence.

### **Historical Perspectives**

The Famine Commission Report of 1880 led to the creation of the Departments of Agriculture at the Center as well as in the Provinces with the primary duties of undertaking scientific enquiry and improvement in agriculture apart from famine relief. Dr J.A. Voelcker, Consulting Chemist to the Royal Agricultural Society of England, laid the foundation for agricultural research in India in 1890s. His recommendations led to the appointment of the Imperial Agricultural Chemist in 1892, the Imperial Mycologist in 1901, and the Imperial Entomologist in 1903. This was the beginning of inducting scientific temper into agriculture. Most importantly, his work was instrumental for the establishment of the Imperial (now Indian) Agricultural Research Institute in 1905 at Pusa, Bihar. Agricultural Colleges were also established at Pune, Kanpur, Sabour, Nagpur, Coimbatore, and Lyallpur (now in Pakistan). Organized scientific research on the problems of livestock started with the establishment of the Imperial Bacteriological Laboratory (now known as Indian Veterinary Research Institute) at Mukteswar in 1889. This was preceded by the establishment of Veterinary Colleges at Bombay, Calcutta, Madras, and Lahore (now in Pakistan).

With the constitutional changes of 1919, responsibility for agriculture was transferred to the Provincial Governments. On the recommendation of the Royal Commission on Agriculture (1928), the Imperial Council of Agricultural Research (ICAR) was established as a Registered Society in 1929, which was funded mainly through a lump sum grant from the Government and the proceeds from the cess levied on certain commodities exported from India. After independence, the Council was renamed as the Indian Council of Agricultural Research (ICAR) on June 10, 1948.

In addition to the ICAR, a number of Central Commodity Committees were established to deal with research in respect of particular crops or commodities. These Committees were semi- autonomous bodies financed by grants from the Government of India, or by income from the cess levied on particular commodities. The Indian Central Cotton Committee was established in 1921 and set the tone for an organized research on the basis of a network. Its success subsequently led to the establishment of a number of other Commodity Committees,

viz. Indian Lac Cess Committee in 1931; Indian Central Tobacco Committee in 1945; Indian Central Oilseeds Committee in 1947; Indian Central Areca nut Committee in 1949, and Indian Central Spices and Cashew nut Committee in 1958.

After independence, the research system has undergone some major changes. First, a number of State Agricultural Universities were established following the recommendations of the first Joint Indo-American Team in 1955. The first one was established in 1960 at Pantnagar in Uttar Pradesh and other States followed suit. There are now 37 Agricultural Universities spread over different States. In addition, there are four National Institutes of the ICAR, which are involved in higher agricultural education at the postgraduate level. These are: (i) Indian Agricultural Research Institute (IARI), New Delhi; (ii) Indian Veterinary Research Institute (IVRI), Izatnagar; (iii) National Dairy Research Institute (NDRI), Karnal; and (iv) Central Institute of Fisheries Education (CIFE), Mumbai. These Institutes have Deemed University status, and offer their own degrees and diplomas in agriculture and allied areas. There is also a Central Agricultural University (CAU) at Imphal to cater to the needs of North-Eastern States.

Second, on the basis of critical reviews and specific policy issues emanating from the recommendations of various Review Committees, the ICAR was reorganized first in 1965 to bring centrally sponsored research activities relating to crops, commodities, animal sciences, and fisheries under one umbrella. The Commodity Committees were abolished and their research institutes as well as those under the Ministry of Food and Agriculture were merged with the ICAR so that problems of agricultural research could be viewed in their totality. The rules and bye-laws of the Council were revised to make it functionally more effective, technically competent and autonomous. The Governing Body was reconstituted, making it pre-eminently a body of scientists and those with interest in or knowledge of agriculture. An eminent agricultural scientist was appointed as the Executive Head of the ICAR and was designated as the Director General.

Though this greatly increased its responsibilities, the Secretariat of ICAR continued to be an attached office of the Department of Agriculture (DOA), thus limiting its effectiveness. In particular, the personnel policies and recruitment system were not found appropriate. Later, the second reorganization, following the appointment of another Review Committee in 1973, conferred on it greater autonomy and flexibility in operation, management and recruitment. A new, but small, Department of Agricultural Research and Education (DARE) was set up in the Agriculture Ministry to provide the ICAR with necessary linkage to deal directly with the Central and State Governments on the one hand and the International Organizations on the other, without going through the Department of Agriculture. The Director General of the Council concurrently became the Ex-officio Secretary (DARE) to the Government.

The composition of the Council was modified so as to restrict the membership and make it a more business-like body with the Minister for Agriculture as its President. The Governing Body was also restructured and made much more effective with the Director General as its Chairman. The country was divided into eight agro-ecological zones and Regional Committees were set up for each of these zones. To broad base the decision-making

process at the institute level, Management Committees were set up under the Chairmanship of their respective Directors. A new personnel policy was evolved and an All India Service called the Agricultural Research Service (ARS) was created in 1975 to facilitate optimum utilization of the available manpower. Consequently, a new Agricultural Scientists Recruitment Board (ASRB), with an eminent scientist as a full-time Chairman and assisted by two scientists as Members, was established to recruit scientists to various positions in the ICAR.

To ensure complementarity in the research programmes of different institutions and provide a mechanism for joint evaluation of new technologies by the scientists through multi-location testing, the concept of All India Coordinated Research Projects was evolved. The first one, the All India Coordinated Maize Improvement Project, was launched in 1957. The concept was later extended to other crops, commodities, animal species, and several other areas of research.

Thirdly, an innovative programme known as the National Agricultural Research Project (NARP) was launched in 1979, with World Bank support, to strengthen the regional research capabilities of the Agricultural Universities to undertake location-specific and need-based research on the basis of identified agro-climatic zones. Finally, a major programme called the National Agricultural Technology Project (NATP) was launched in 1997, with the World Bank support, mainly to consolidate the gains of NATP through technology assessment and refinement.

## **The Present System**

India has one of the largest agricultural research systems in the world with the largest number of scientific personnel of any developing country engaged in research and education relating to agriculture and allied areas. The research system includes approximately 30,000 scientists and more than 100,000 supporting staff actively engaged in research related to agriculture. Although the total number of scientists engaged in agricultural research in India looks very impressive, it compares less favourably with many developed nations in the world. The research system has evolved over years of innovation and experimentation, and it has withstood the test of time remarkably well.

The present agricultural research system comprises essentially two main streams, viz. the ICAR at the national level and the Agricultural Universities at the state level. Besides, several other agencies such as the Conventional / General Universities, Scientific Organizations, and various Ministries / Departments at the Center, and also Private or Voluntary Organizations participate directly or indirectly in research activities related to agriculture (Figure 1).

### **1. The ICAR System**

#### **a) Mission:**

*Sustainable growth of Indian agriculture by interfacing education, research and extension initiatives complimented with efficient and effective institutional, infrastructure and policy support, that will create a proper fit between the humanity and its habitat.*

**b) Vision:**

*“To harness science to ensure comprehensive and sustained physical, economic and ecological access to food and livelihood security to all Indians, through generation, assessment, refinement and adoption of appropriate technologies.”*

**c) Mandate:**

- (i) *To plan, undertake, aid, promote and coordinate education, research and its application in agriculture, agro-forestry, animal husbandry, fisheries, home science and allied sciences.*
- (ii) *To act as a clearinghouse of research and general information relating to agriculture, animal husbandry, fisheries, home science and allied sciences through its publications and information system, and instituting and promoting transfer of technology programmes.*
- (iii) *To provide, undertake and promote consultancy services in the fields of education, research, training and dissemination of information in agriculture, agro-forestry, animal husbandry, fisheries, home science and allied sciences.*
- (iv) *To look into the problems relating to broader areas of rural development concerning agriculture, including post-harvest technology by developing co-operative programmes with other organizations such as the Indian Council of Social Science Research (ICSSR), Council of Scientific and Industrial Research (CSIR), Bhabha Atomic Research Center (BARC) and the Universities.*
- (v) *To do other things considered necessary to attain the above objectives of the Society.*

Among the major scientific organizations in the country, ICAR is unique in having concurrent responsibility for both research and education. As an apex body at the national level, ICAR is mainly responsible for the promotion and coordination of agricultural research in the various branches of agriculture and allied sciences in the country. In addition to its promoting and coordinating roles, ICAR is also directly involved in undertaking research at the national level, basic as well as applied, on diverse problems facing production of crops, animals, fisheries, etc., with the objective of evolving new production technologies suited to different agro-climatic conditions. Just as the University Grants Commission (UGC) plays a major role for the general education in the country, ICAR plays a similar role in the area of agricultural education. The Charter of the ICAR also includes extension education, which is carried out through a network of projects and other mechanisms.

**Organizational Structure**

As a Registered Scientific Society, ICAR now enjoys an autonomous status and it follows *mutatis mutandis* Government of India rules and regulations. It observes all procedures for the preparation of its plan, their scrutiny and approval by the Planning Commission, Finance Department, etc. The Minister for Agriculture in the Government of India is the President and the Minister of State for Agriculture is the Vice-President of ICAR. The Agricultural Scientists Recruitment Board (ASRB), charged with the responsibility of recruiting



scientists as well as for looking after their career advancement in the ICAR system, is headed by a full-time Chairman who is assisted by two eminent scientists as Members. The Chief Executive of ICAR is the Director General, who is an eminent senior agricultural scientist. He concurrently acts as the Ex-officio Secretary (DARE) to the Government of India. He advises the Government on all matters connected with agricultural and animal husbandry research and education in the country that are referred to him.

In its functioning, ICAR is assisted by a number of bodies which provides direction and guidance on policy, technical, administrative, financial and other matters concerned with the national agricultural research and education efforts.

- i) **General Body:** It is the supreme body, which transacts the business of ICAR. It is presided over the Minister for Agriculture in his capacity as the President of the Society and its membership is large. It is represented by many Ministers in the Center as well as the States, elected representatives of the people, representative of rural interests, farmers, Chairmen of Scientific Organizations, Director General (ICAR), Vice-Chancellors of Agricultural Universities, Directors of ICAR Institutes, technical representatives, and others. It meets at least once in a year and reviews the progress and performance of ICAR and gives such policy directions as it may deem fit to the Governing Body and other constituent units of the Society.
- ii) **Governing Body:** It is the chief executive and decision-making authority, and is responsible for the governance of ICAR as a whole. It is pre-eminently a body of scientists and those with interest in or knowledge of agriculture, and is presided over by the Director General. It manages, administers, directs, and controls all the affairs and funds of ICAR, subject to the byelaws and orders of the Society. It prescribes policies, approves all research programmes and exercises control over the budget of ICAR. It meets once in three months and its decision will be final after approved by the President of ICAR.
- iii) **Standing Finance Committee:** It is a subsidiary of the Governing Body with members drawn from it, and is presided over by the Director General of ICAR. It examines the annual budget of ICAR and the financial implications of all the proposals, including research projects, before submitting to the Governing Body for approval. It also scrutinizes the Ad hoc Research Schemes and has the responsibility of operating the Agricultural Produce Cess Fund. Similar to the Governing Body, this Committee also meets once in a quarter and its decision will become final after approval by the President of the Society.
- iv) **Norms and Accreditation Committee:** It determines the norms for financial assistance by ICAR to the Agricultural Universities and ensures maintenance of high standards of education in agricultural and animal sciences in the country. It essentially consists of five Vice-Chancellors of the Agricultural Universities and

is presided over by the Director General of ICAR. Its functioning is supported by the ICAR Review Teams which visit the Universities and determine their programmes that need additional support and recommend financial assistance to them. The recommendations of this Committee are considered first by the Standing Finance Committee from the financial angles before sending for approval of the Governing Body.

- v) **Scientific Panels:** The Scientific Panels in different disciplines advise the ICAR on technical matters related to agricultural research, education and extension education. These Panels comprise 18-20 experts who are chosen from different scientific institutions, Universities and other agencies all over the country. There are 24 such Panels functioning in the ICAR and they scrutinize the technical soundness and feasibility of the project proposals submitted by various agencies. Besides considering schemes of research, these Panels may also advise the Governing Body on technical matters and draw its attention to gaps in the current research and education efforts. In addition to these Panels, the ICAR has also four Interdisciplinary or Joint Panels to consider schemes for collaboration in research with other agencies. The recommendations of these Panels are considered by the Standing Finance Committee from the financial angles before they are re-considered and finally approved by the Governing Body.
- vi) **Regional Committees:** The Governing body of ICAR has constituted eight Regional Committees on the basis of eight agro-ecological regions identified in the country. The Director General, ICAR is the Chairman of these Committees. Other members of the Regional Committee comprise i) members of the ICAR Society residing in the region, ii) Chairmen of the Development Councils constituted by the Department of Agriculture of the Government of India located in the region, iii) Directors of ICAR Institutes in the region, iv) Scientists / Technical representatives of the Agricultural Universities, State Development Departments related to agriculture, animal husbandry, fisheries, etc., Central Institutes, and Department of Agriculture of the Union Ministry of Agriculture, and v) farmers nominated by the President of the Society. One of the Directors of the ICAR Institutes in the Region acts as the Member-Secretary. There is an Assistant Director General at the ICAR Headquarters to coordinate the work of all the Regional Committees. These Committees meet once a year. The primary functions of these Committees include i) to review the status of agricultural research and education in the region, and ii) to analyze, discuss and make recommendations on the location-specific problems of agriculture, animal husbandry, fisheries and forestry peculiar to the region. The proceedings and recommendations of these Committees are put up to the Governing Body for information.

On the technical side, the Director General is assisted by eight Subject Matter Divisions, one each in the fields of i) Crops, ii) Natural Resources Management iii) Education, iv) Animal

Science, v) Extension, vi) Horticulture, vii) Fisheries, and viii) Agricultural Engineering. A Deputy Director General (DDG) heads each Division, and they are entrusted with the overall responsibility for the preparation, scrutiny, review, and technical supervision and guidance of the research schemes and projects within their respective disciplines. They are, in turn, assisted by 23 Assistant Directors General (ADGs) and other senior scientists dealing with sub-disciplines within these eight major areas. These Technical Divisions guide and service all the ICAR institutes. There is a Plan Implementation and Monitoring (PI&M) Unit and a Project Implementation Unit (PIU) headed by ADGs. There is yet another Director (NATP), who looks after the World Bank-aided National Agricultural Technology Project.

On the Administrative side, the Director General is assisted by the Secretary, ICAR and a number of administrative units like International Cooperation Division, Finance Division, Personnel Division, and Publications and Information Division. Each of these Divisions is headed by a Director who assists the Director General in the respective area. There are also a number of Under Secretaries and other supporting staff. The Joint Secretary in the Ministry at the Center is the Financial Adviser of ICAR. The Director General and the Secretary of ICAR are assisted by an Internal Financial Adviser in the preparation and control of the budget.

### ***Research Infrastructure***

Although agriculture is a State subject, ICAR has established many Central Research Institutions over the years to meet the agricultural research needs of the country. These are essentially meant for: (i) implementing research mandates extending beyond the administrative boundaries of the States; (ii) pursuing basic research not undertaken by most Agricultural Universities; (iii) evaluating research results through multi - location testing; and (iv) developing manpower for Agricultural Universities and other agricultural institutions.

The ICAR directly administers 47 Research Institutes in the areas of crop, animal and fishery sciences. They are:

#### ***A. National Institutes:***

The institutes engaged in research, teaching and training for manpower development include:

- ❖ Indian Agricultural Research Institute (IARI), New Delhi.
- ❖ Indian Veterinary Research Institute (IVRI), Izatnagar.
- ❖ National Dairy Research Institute (NDRI), Karnal.
- ❖ Central Institute of Fisheries Education (CFIE), Mumbai.
- ❖ National Academy of Agricultural Research Management (NAARM), Hyderabad.

#### ***B. National Bureaux:***

In order to collect, conserve and initiate such measures as would lead to long-term productivity of basic resources like plants, animals, fish, microorganisms, soil and water, the ICAR has established five national bureaux. They are:

- ❖ National Bureau of Plant Genetic Resources (NBPGR), New Delhi.
- ❖ National Bureau of Animal Genetic Resources (NBAGR), Karnal.
- ❖ National Bureau of Fish Genetic Resources (NBFGR), Lucknow.
- ❖ National Bureau of Soil Survey & Land Use Planning (NBSS & LUP), Nagpur.

- ❖ National Bureau of Agriculturally Important Microorganisms (NBAIM), New Delhi.

### **C. Central Research Institutes:**

There are forty-two institutes carrying out basic and applied research on specific crops and transferring the results thereof. They are:

#### **a) Crop Science Institutes:**

- ❖ Central Rice Research Institute (CRRI), Cuttack.
- ❖ Central Research Institute for Jute and Allied Fibers (CRIJAF), Barrackpore.
- ❖ Central Tobacco Research Institute (CTRI), Rajahmundry.
- ❖ Indian Grassland and Fodder Research Institute (IGFRI), Jhansi.
- ❖ Sugarcane Breeding Institute (SBI), Coimbatore.
- ❖ Indian Institute of Sugarcane Research (IISR), Lucknow.
- ❖ Central Institute of Cotton Research (CICR), Nagpur.
- ❖ Vivekananda Parvatiya Krishi Anusandhan Shala (VPKAS), Almora.
- ❖ Indian Institute of Pulses Research (IIPR), Kanpur.

#### **b) Horticulture and Plantation Crops Institutes:**

- ❖ Indian Institute of Horticultural Research (IIHR), Bangalore.
- ❖ Central Institute for Subtropical Horticulture (CISH), Lucknow.
- ❖ Central Institute of Temperate Horticulture (CITH), Srinagar.
- ❖ Central Tuber Crops Research Institute (CTCRI), Trivandrum.
- ❖ Central Plantation Crops Research Institute (CPCRI), Kasargod.
- ❖ Central Institute for Arid Horticulture (CIRH), Bikaner.
- ❖ Central Potato Research Institute (CPRI), Shimla.
- ❖ Indian Institute of Spices Research (IISR), Calicut.
- ❖ Indian Institute of Vegetable Research (IIVR), Varanasi.

#### **c) Resource Management Institutes:**

- ❖ Central Soil and Water Conservation Research and Training Institute (CSWCR&TI), Dehradun
- ❖ Central Soil Salinity Research Institute (CSSRI), Karnal
- ❖ Central Arid Zone Research Institute (CAZRI), Jodhpur
- ❖ Central Research Institute for Dry land Agriculture (CRIDA), Hyderabad
- ❖ ICAR Research Complex for North-Eastern Hill Region (ICAR-NEH), Barapani
- ❖ ICAR Research Complex for Goa (ICAR-GOA), Ela
- ❖ ICAR Research Complex for Eastern Region (ICAR-ER), Patna
- ❖ Central Agricultural Research Institute (CARI) for Andaman and Nicobar Islands, Port Blair
- ❖ Indian Institute of Soil Science (IISS), Bhopal

#### **d) Technological Institutes:**

- ❖ Central Institute of Agricultural Engineering (CIAE), Bhopal
- ❖ Central Institute for Research on Cotton Technology (CIRCT), Bombay
- ❖ National Institute of Research on Jute and Allied Fiber Technology (NIRJAFT), Calcutta
- ❖ Indian Lac Research Institute (ILRI), Ranchi

- ❖ Central Institute of Post-harvest Engineering and Technology (CIPET), Ludhiana

**e) Animal Science Institutes:**

- ❖ Central Sheep and Wool Research Institute (CSWRI), Avikanagar
- ❖ Central Institute for Research on Goats (CIRG), Makhdoom
- ❖ Central Avian Research Institute (CARI), Izatnagar
- ❖ Central Institute for Research on Buffaloes (CIRB), Hisar
- ❖ National Institute of Animal Nutrition and Physiology (NIANP), Bangalore

**f) Fisheries Institutes:**

- ❖ Central Inland Fisheries Research Institute (CIFRI), Barrackpore
- ❖ Central Marine Fisheries Research Institute (CMFRI), Cochin
- ❖ Central Institute of Fisheries Technology, (CIFT), Cochin
- ❖ Central Institute of Brackish-water Aquaculture (CIBA), Chennai
- ❖ Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar

**g) Social Science Institutes:**

- ❖ Indian Agricultural Statistics Research Institute (IASRI), New Delhi
- ❖ National Center for Agricultural Economics and Policy Research (NCAP), New Delhi

**D. Project Directorates**

Because of the importance and magnitude of the work involved in a single commodity like rice, wheat and poultry, or a group of commodities like oilseeds, pulses and vegetables, ICAR has upgraded some of its research infrastructure/projects with added responsibilities, and designated them as Project Directorates. Except for the size and magnitude of work involved, these are basically the same as the Coordinated Research Projects. Additionally, they do undertake some research besides playing such national service roles like maintenance and supply of germplasm, organizing off-season nursery to promote and speed up research interests, monitoring pests and diseases, forecasting and issuing clearly warning about the pests and diseases outbreak, and performing such duties as a lead center in relation to their respective subject matter, and so on. There are now eleven of them under operation. They are:

**a) Crop Sciences:**

- ❖ Directorate of Rice Research (DRR), Hyderabad.
- ❖ Directorate of Wheat Research (DWR), Karnal.
- ❖ Directorate of Oilseeds Research (DOR), Hyderabad.
- ❖ Directorate of Cropping Systems Research (DCSR), Modipuram.
- ❖ Project Directorate of Maize (PDM), New Delhi.
- ❖ Project Directorate on Soybean (PDS), Bhopal.
- ❖ Project Directorate of Biological Control (PDBC), Bangalore.

**b) Animal Sciences:**

- ❖ Project Directorate on Cattle (PDC), Meerut.
- ❖ Project Directorate on Poultry (PDP), Hyderabad.
- ❖ Project Directorate on Animal Disease Monitoring and Surveillance (PDADMS), Bangalore.
- ❖ Project Directorate on Foot and Mouth Diseases (PDFMD), Mukteshwar.

### ***E. National Research Centers***

The National Commission on Agriculture recommended setting up of 'Centers of Fundamental Research' headed by eminent scientists in particular areas. Consequently, the ICAR conceived the idea of setting up a number of National Research Centers (NRCs). The concept of NRCs revolves around the need for concentrated attention with a mission approach by a team of scientists from different disciplines. They work under a senior leader on selected topics, which have direct or indirect relevance to resolving national problems in a particular crop or commodity or a problem area of research. These centers are designed to concentrate on those crops and commodities not well served by the research institutes. Unlike the institutes, these centers do not have divisional set-up for individual disciplines nor have regional stations. They feed the national network of research with new materials, technology and information for subsequent adoption in the different production-oriented research programmes. The NRC for Groundnut was the first to be established in 1979. There are now 31 such Centers, covering a wide range of areas like crops, horticulture, animal species, fisheries, resource management, etc. Some of the NRCs may grow into full-fledged institutes once their standard of work is established and if the subjects assume greater national importance.

#### ***a) Crop Sciences:***

- ❖ National Research Center for Agro-Forestry (NRCAF), Jhansi.
- ❖ National Research Center for Banana (NRCB), Thiruchirapalli.
- ❖ National Research Center for Cashew (NRCC), Puttur.
- ❖ National Research Center for Citrus (NRCC), Nagpur.
- ❖ National Research Center for Grapes (INRCG), Pune.
- ❖ National Research Center for Groundnut (NRCG), Junagudh.
- ❖ National Research Center for Integrated Pest Management (NRCIPM), New Delhi.
- ❖ National Research Center for Litchi (NRCL), Muzaffarpur.
- ❖ National Research Center for Makhana (NRCM), Patna.
- ❖ National Research Center for Medicinal and Aromatic Plants (NRCMAP), Anand.
- ❖ National Research Center for Mushroom Research & Training (NRCMRT), Sholan.
- ❖ National Research Center for Oil Palm (NRCOP), Peddavagi
- ❖ National Research Center for Onion and Garlic (NRCOG), Pune.
- ❖ National Research Center for Orchids (NRCO), Pakyang.
- ❖ National Research Center on Plant Bio-technology (NRCPB), New Delhi.
- ❖ National Research Center for Rapeseed and Mustard (NRCRM), Bharatpur.
- ❖ National Research Center for Seed Spices (NRCSS), Ajmeer.
- ❖ National Research Center for Sorghum, NRCS), Hyderabad
- ❖ National Research Center on Soybean (NRCS), Indore.
- ❖ National Research Center of Water Technology for Easter Region (NRCWTER), Bhuvaneswar.
- ❖ National Research Center for Weed Science (NRCWS), Jabalpur
- ❖ National Research Center on DNA Finger printing (NRCDFP), New Delhi.

#### ***b) Animal & Fishery Sciences:***

- ❖ National Research Center on Camel (NRCC), Bikaner.
- ❖ National Research Center for Equines (NRCE), Hisar.

- ❖ National Research Center on Meat and Meat Products (NRCMMP), Hyderabad
- ❖ National Research Center on Mithun (NRCM), Jharnapani.
- ❖ National Research Center for Pigs (INRCP), Ghuhati.
- ❖ National Research Center on Yak (NRCY), Dirang.
- ❖ National Research Center for Coldwater Fisheries (NRCCF), Nainital.
- ❖ High Security Animal Disease Laboratory (HSADL), Bhopal.

**c) Others:**

- ❖ National Research Center for Women in Agriculture (NRCWA), Bhubaneswar.
- ❖ National Center for Values and Ethics (NCVE), New Delhi.

**F. Research Schemes / Projects**

In addition to its institute-based research, ICAR promotes research schemes / projects in agriculture and allied areas to resolve location-specific problems. It is involved in a cooperative endeavor with other research organizations in carrying out multidisciplinary research programmes. Such promotional schemes fall under the following categories.

**a) All India Coordinated Research Projects (AICRPs):**

These projects have been essentially conceived as an instrument to mobilize available scientific resources to find effective solutions for the national problems of agricultural production through inter-institutional interactions. The projects are developed as multidisciplinary and problem-oriented projects with a major emphasis on multi-location testing of new materials/production systems. They provide opportunities for scientists working on similar problems in different institutions to come together, discuss and exchange ideas, information, and materials for mutual benefit. They also provide them with facilities for multi-location testing of improved technologies developed by various subsystems in different agro-climatic regions. The projects constitute an effective national grid of coordinated experiments by integrating different institutions and disciplines.

The All India Maize Improvement Project, launched by the ICAR in 1957 to improve maize production using hybrids, was the forerunner of this approach. Its remarkable success led to the extension of this approach to all the major crops and other areas like animal science, fisheries, soils, agricultural engineering, horticulture, etc. Subsequently, many such coordinated projects were initiated. Each project is generally sanctioned for a period of 5 years and is headed by a full-time Project Coordinator with a Coordinating Unit to assist him. These Units are located either in the ICAR Institutes or the Agricultural Universities depending upon the location of the project. They are responsible for all the technical, financial and administrative matters as well as for organizing regular workshops. The technical programmes of the individual projects are carried out by many cooperating centers located in the participating institutions. Regular workshops, either annual or biennial, are organized by the individual projects in which the technical programmes are finalized. The Project Coordinator is guided and serviced on all matters by the concerned Assistant Director General in the ICAR headquarters.

There are 91 such projects, with majority of them currently operating in Agricultural Universities and ICAR Institutes, and some of them at other institutions. Crop sciences have 32 projects; Horticulture has 14 projects; Natural Resource Management has 15 projects; Engineering and Technology have 12 projects; Animal Sciences and Fisheries have 17 projects; and Education has a single project. They are:

***i) Crop Sciences:***

- ❖ AICRP on Acarology
- ❖ AICRP on Agricultural Ornithology
- ❖ AICRP on Arid Legumes
- ❖ AICRP on Wheat and Barley
- ❖ AICRP on Castor
- ❖ AICRP on Chickpea
- ❖ AICPP on Cotton
- ❖ AICRP on Forage Crops
- ❖ AICRP on Groundnut
- ❖ AICRP on Jute and Allied Fibers
- ❖ AICRP on Honeybees
- ❖ AICRP on Linseed
- ❖ AICRP on Maize
- ❖ AICRP on Small Millets
- ❖ AICRP on Mullarp
- ❖ AICRP on Nematodes
- ❖ AICRP on National Seed Project
- ❖ AICRP on Pearl Millet
- ❖ AICRP on Pesticide Residues
- ❖ AICRP on Pigeon pea
- ❖ AICRP on Rapeseed & Mustard
- ❖ AICRP on Rodent Control
- ❖ AICRP on Safflower
- ❖ AICRP on Sesame and Niger
- ❖ AICRP on Sorghum
- ❖ AICRP on Soybean
- ❖ AICRP on Sugarcane
- ❖ AICRP on Sunflower
- ❖ AICRP on Under-utilized & Under-Exploited Crops
- ❖ AICRP on Tobacco
- ❖ AICRP on Rice
- ❖ AICRP on White Grubs

***ii) Horticulture Sciences:***

- ❖ AICRP on Arid Fruits
- ❖ AICRP on Betel vine
- ❖ AICRP on Cashew
- ❖ AICRP on Floriculture



- ❖ AICRP on Mushrooms
- ❖ AICRP on Palms
- ❖ AICRP on Post-harvest Technology
- ❖ AICRP on Potato
- ❖ AICRP on Subtropical Fruits
- ❖ AICRP on Spices
- ❖ AICRP on Fruits
- ❖ AICRP on Tropical Fruits
- ❖ AICRP on Tuber Crops
- ❖ AICRP on Vegetable

**iii) Natural Resource Management:**

- ❖ AICRP on Agro-forestry
- ❖ AICRP on Biological Nitrogen Fixation
- ❖ AICRP on Cropping Systems
- ❖ AICRP on Diara Lands
- ❖ AICRP on Dry land Agriculture
- ❖ AICRP on Long-term Fertilizer Experiment
- ❖ AICRP on Microbiological Decomposition
- ❖ AICRP on Micronutrients and Secondary Nutrients & Pollutant Elements
- ❖ AICRP on Soil Test and Crop Response
- ❖ AICRP on Soil Physical Constraints
- ❖ AICRP on Management of Salt-affected Soils and Saline Water in Agriculture
- ❖ AICRP on Water Management
- ❖ AICRP on Weed Control
- ❖ AICRP on Ground Water
- ❖ AICRP on Agricultural Meteorology

**iv) Engineering and Technology:**

- ❖ AICRP on Agricultural Drainage
- ❖ AICRP on Energy Requirements in Agricultural Sectors
- ❖ AICRP on Farm Implements and Machinery
- ❖ AICRP on Human Engineering & Safety Studies in Agriculture
- ❖ AICRP on Organic Farming
- ❖ AICRP on Application of Plastics in Agriculture
- ❖ AICRP on Post-harvest Technology
- ❖ AICRP on Power Tillers
- ❖ AICRP on Processing, Handling & Storage of Jaggery and Khandsari
- ❖ AICRP on Renewable Energy Sources
- ❖ AICRP on Utilization of Animal Energy
- ❖ AICRP on Network Programme for Development of Technology Package for Organic Farming

**v) Animal Sciences and Fisheries:**

- ❖ AICRP on Animal Genetic Resources
- ❖ AICRP on Buffalo Breeding
- ❖ AICRP on Crop Based Animal Production Systems

- ❖ AICRP on Embryo Transfer
- ❖ AICRP on Goats
- ❖ AICRP on Pigs
- ❖ AICRP on Sheep Improvement
- ❖ AICRP on Food and Mouth Disease
- ❖ AICRP on Network on Hemorrhagic Septicemia
- ❖ AICRP on Agricultural Byproducts as Animal Feed
- ❖ AICRP on Animal Diseases Monitoring and Surveillance
- ❖ AICRP on Network on Gastro-intestinal Parasitism
- ❖ AICRP on Network on Bluetongue
- ❖ AICRP on Network Programme on Micronutrients in Animal Nutrition and Production
- ❖ AICRP on Processes Upgradation of Indigenous Milk Products
- ❖ AICRP on Network on Buffalo
- ❖ AICRP on Network on Agricultural Byproducts as Animal Feed

**vi) Education:**

- ❖ AICRP on Home Science

The expenditure on these projects has increased steadily and nearly one-fourth of the ICAR's budget is now spent on these projects. The complement of staff, determined on the basis of the technical work assigned and the nature of operation, are provided by the participating institutions, but paid for by the ICAR. The expenditure is shared by the ICAR and the collaborating institutions on 75:25 basis. A high degree of accountability, based on continuous monitoring, is a noteworthy feature of these projects. Outstanding achievements have been made through these projects, and the development of such an approach has been a source of inspiration to many developing countries.

**b) National Agricultural Research Project (NARP):**

Agricultural Universities, which have a state-wide mandate for agriculture, did not have a strong base for research at the regional level. Most of the funds provided were utilized for developing the University main campuses, thus neglecting the regional research needs. To overcome this, the ICAR launched in 1979, with World Bank assistance, a novel scheme known as National Agricultural Research Project (NARP) to strengthen the regional research capabilities of these Universities for conducting need-based, location-specific and production-oriented research in identified agro-climatic zones. Under this project, each State is divided into a contiguous set of agro-climatic zones on the basis of climate, soils, crops and ecology. There are 131 such zones in the country with 125 zones in 17 States and Union Territories, and 6 zones in the North Eastern Region. In each zone, a major regional research station with a multidisciplinary team of scientists is established or strengthened.

The strengthening is accomplished by providing funds for incremental scientific and supporting staff, laboratory, equipment, transport, operating costs, and other physical facilities. The Agricultural University, on its part, has to provide funds for land, cultivation and station maintenance. The project also provides for strengthening the office of the Director of Research

in these Universities for coordinating the research activities undertaken by these stations more effectively. An inventory of resources and systems of cultivation are prepared for each zone to serve as a basic document known as 'Status Report' for identifying regional research needs. Farming systems research with emphasis on multidisciplinary approach to problem solving and establishment of a closer linkage between research and extension at the grassroots level with active participation of farmers are the essential components of this project. In the zonal workshops, organized at the beginning of each cropping season, research station scientists, developmental staff, and farmers' representatives review the progress and plan for the future based on actual needs. The project is guided and serviced by the NARP Directorate located in the ICAR headquarters. The progress of the project is regularly monitored by the Agricultural University and the ICAR, and is also reviewed periodically by the Special Mission of the World Bank. The ICAR's assistance is available for a period of five years after which the responsibility for continuing the project rests with the University.

The Project had the IDA support of \$ 27 million in the first phase, which was about 50 per cent of the project cost. The first phase laid major emphasis on cereals, pulses and oilseeds under rain fed conditions. In this phase, nearly 109 sub-projects were approved and it was closed in September 1985 after having used \$19.5 million of the \$ 27 million credit. The second phase on NARP, under implementation since February 1986, is intended to intensify and continue the process of decentralizing agricultural research. In addition to financing the sub-projects not completed under the first phase, this phase provides support for special research projects in irrigated farming, animal drawn equipments horticulture including post-harvest technology, commercial crops, agro-forestry, and animal nutrition. The second phase had an estimated cost of \$110.9 million of which the IDA credit is \$ 72.1 million. On the recommendation of the mid-term review committee, the second phase of the project was extended up to 1994.

Strengthening of regional research on a scientific agro-climatic basis has been the most significant positive development that has taken place through the implementation of NARP in the organization of agricultural research in the country. In spite of some minor problems, the project has achieved its main objective of helping to strengthen the regional research capabilities of the Agricultural Universities and decentralize agricultural research. The project has created an awareness of developing mission-oriented, problem-specific, relevant research with multidisciplinary thrust, and thus has made considerable impact in many areas where enough attention was not paid earlier.

#### ***g) National Agricultural Technology Project:***

With a view to raising the efficiency of resource use for technology generation and assessment as well as transfer, i.e. involving both agricultural research and extension, ICAR has initiated the major National Agricultural Technology Project (NATP) in 1998 with the financial support provided by the World Bank to the tune of US \$ 243 million. After successful completion of five years, the project came to an end in 2004. The project essentially focused on the following components:

- ☞ Organization & Management (O&M) Reforms

- ☞ Agro-ecosystem Research
- ☞ Innovations in Technology Dissemination
- ☞ Competitive Grants Scheme

Of these, agro-ecosystem research constituted the major activity. This component concentrated on the following areas:

- ☞ Location-specific Production Systems Research (PRS) in the programme mode.
- ☞ Cross-cutting Mission Mode Research to support location-specific PSR.
- ☞ Teams / Centers of Excellence to support strategic research related to PSR.

### ***Production Systems Approach Under NATP:***

Indian agriculture has made great strides in agricultural production and productivity through massive application of science and technology. The green revolution technologies have brought it to the fore the new issues of 'production – protection' of natural resources for sustainable development of agriculture. In order to address issues of location-specific research, through the development of more knowledge-based technologies, better information and research management systems, the ICAR has delineated the country into 20 agro-ecoregions (AER) and 60 agro-ecosubregions (AESR) using the criteria of soils, physiography, bio-climate and length of growing period. With a view to capturing the importance of socioeconomic endowments, market support and service sector in agricultural development, the ICAR has focused research programmes under NATP on the production systems approach and also goes beyond it by integrating all the system components for determining the systems productivity and profitability. Under NATP, the country has been divided into five agro-ecosystems. On the basis of potentials and constraints, a number of production systems have been identified in each agro-ecosystem. Each production system was improved, in terms of agricultural productivity, profitability and sustainability, through specific research programmes to achieve specific national goals and objectives.

#### ***i) Concepts:***

- ***Arid Agro-ecosystem***
  - Agri-silvi-horti-pastoral production system
  - Livestock and brackish water fish production system
- ***Coastal Agro-ecosystem***
  - Fish and livestock production system
  - Agri-horti production system
- ***Hill and Mountainous Agro-ecosystem***
  - Agri-horti-production system
  - Livestock and fish production system
- ***Irrigated Agro-ecosystem***
  - Rice-wheat production system
  - Cotton-based production system
  - Sugarcane-based production system
  - Livestock-based production system
- ***Rain fed Agro-ecosystem***
  - Rain fed rice production system

Pulse-based production system  
Oilseed-based production system  
Cotton-based production system  
Coarse cereal-based production system

***ii) Themes under Production Systems:***

- ✿ Natural resources management (NRM)
- ✿ Integrated pest management (IPM)
- ✿ Integrated plant nutrient management (IPNM)
- ✿ Water management (WM)
- ✿ Biodiversity (BD)
- ✿ Biotechnology (BT)
- ✿ Post-harvest technology and value addition (PHT&VA)

***c) Technology Mission in Agriculture:***

In the Seventh Five Year Plan, a mission-oriented approach to technology development was emphasized to faster relevance and to provide motivation for establishing organic working linkages between different sectors, which otherwise remained compartmentalized. The Steering Group on Science and Technology, constituted by the National Planning Commission, has identified several Technology Missions under different sectors. The Technology Mission on Oilseeds Research was set up in April 1986, to provide research and technology support to make the country self-reliant in edible and non-edible oils. The Mission concentrated its attention on major oilseed crops like groundnut, rapeseed, mustard, soybean, sunflower, safflower, linseed, sesamum, and niger. It also gives priority to non-edible oilseed crops to meet the requirements of industry. The Mission envisaged an integrated approach involving different developmental, scientific, input, banking, and marketing agencies. A total of 180 districts are earmarked for the purpose.

The Department of Agriculture and Cooperation in the Ministry of Agriculture and the ICAR were the principal implementing agencies. The Additional Secretary to the Government of India in the Department of Agriculture and Cooperation was the Mission Director. Four Sub-Missions shared the operational responsibilities. These included: (a) Production Technology (R&D) Sub-Mission for which the Director General of ICAR is the Chairman; (b) Input Supply and Production Sub-Mission for which the Additional Secretary to the Government of India is the Chairman, and the Agricultural Commissioner is the Co-chairman; (c) Post-harvest Technology and Processing Sub-Mission for which the Scientific Advisor to the Planning Commission is the Chairman; and (d) Pricing, Transport, Procurement and Marketing Sub-Mission for which the Additional Secretary to the Government of India was the Chairman.

A quarterly review of all the developmental activities were done to effect mid-term corrections. An expert team was set up recently to review the progress. Because of its significant achievement within a short span of four years by increasing the production of oilseeds to over 20 million tons, the Mission was continued during the Eighth Plan Period.

**d) Ad hoc Research Schemes:**

ICAR generates a Cess Fund by levying a custom duty at the rate of 0.5 per cent *ad valorem* on 25 articles of agricultural produce exported from India. It supports a large number of short-term, result-oriented ad hoc research schemes by utilizing the Agricultural Produce Cess Fund, which roughly works out to Rs.60 million a year. The schemes aim at filling critical gaps in the scientific field and are implemented by the ICAR Institutes, Agricultural and General Universities, Private Institutions and Voluntary Organizations. There are a little over 600 such ad hoc schemes currently in operation. The topics of the schemes could be identified by the individual scientists or institutions, or selected out of the recommendations made in the ICAR Regional Committee Meetings, Vice Chancellor's Conferences, or in similar forums. The schemes are generally sanctioned for three years. Some of them are exploratory in nature and may lead to development of larger country-wide projects.

**e) Centers of Advanced Studies:**

In order to improve faculty competence and develop infrastructure for better research and training, ICAR with the support of UNDP has set up, since 1971, several Centers of Advanced Studies in selected disciplines in Agricultural Universities and ICAR Institutes. These Centers were established to encourage the pursuit of excellence through collaboration between scientists of outstanding ability with their counterparts in similar institutions abroad, and thus accelerate the attainment of international standards in specific fields of agricultural research and education. They also focus on modernizing faculty capability and physical facilities for advanced research and educational programmes so as to reduce India's dependence on foreign countries for advanced training in these fields.

These Centers have been able to modernize and consolidate their programmes on an interdisciplinary basis, augment their infrastructure facilities, and provide specialized training to their scientists. Interaction with scientific institutions abroad and advanced level training in India and abroad through fellowship programme have made it possible to build up a cadre of highly competent professional scientists. These Centers also brought about considerable interaction among scientists within the country by organizing All India Workshops, Seminars and Conferences.

So far, 28 such Advanced Centers have been established, with 17 of them located in the ICAR Institutes and the rest in the Agricultural Universities. They have made good use of the combined support of the ICAR, UNDP, UNESCO, and FAO. The Centers have become the nuclei for high quality research and training in the concerned disciplines.

**f) Special Schemes:**

ICAR launched in 1978 a special scheme known as 'Professors of Eminence and National Fellows' to identify individuals of outstanding merit, who could provide leadership in the development of 'Schools of Thought' in specific areas by undertaking fundamental research in agriculture and allied areas. Under this scheme, scientists work on specific projects formulated by them in the ICAR Institutes and Agricultural Universities. ICAR with the cooperation of the host institutions provide physical and infrastructure facilities liberally for operating their projects,

and the incumbents operate with considerable financial and administrative autonomy. Since 1959, ICAR has also been operating the 'Emeritus Scientists' scheme to support eminent retired scientists, enabling them to continue their research in various fields of agriculture and allied sciences. The scheme provides research grants to retiring scientists of established repute in ICAR Institutes and Agricultural Universities. ICAR supports this scheme from the Agricultural Produce Cess Fund.

### ***Research Planning, Monitoring and Evaluation***

The ICAR is responsible for agricultural research planning at the national level. Its headquarters scrutinizes and sanctions research schemes received from its own institutes as well as from other institutions. The research schemes are first technically examined by the concerned Subject Matter Divisions in the headquarters and put up for consideration before the Scientific Panels. Once they are found technically sound, they are later examined for financial implications by the Standing Finance Committee. Finally, they are placed before the Governing Body for approval.

In the ICAR system, the broader mandate and research programmes are decided by the headquarters, and the responsibility for the formulation of all research projects rests with the institutes. The institute scientists submit annually their research proposals in a standard proforma known as the Research Project File (RPF), which are discussed by the Research Councils at the divisional level in larger institutes followed by the Staff Research Councils (SRCs) at the institute level. The SRCs are attended by the institute scientists under the chairmanship of the Director. The new proposals as well as the on-going projects are evaluated by the SRC and approved by the Director. Some of the major criteria used to evaluate new proposals in the SRC meetings are farmers' problems and needs, urgency of research problem, compatibility with institutes' mandate, socioeconomic benefits, ease and cost of adoption by farmers, and contribution to knowledge. The proportion of multidisciplinary projects is showing an increasing trend.

The key to the success of agricultural research efforts in the ICAR system has been the in-built mechanism of research monitoring and evaluation. At the institute level, they are carried out through the SRCs, and through a comprehensive review by specially constituted Quinquennial Review Teams (QRT) once in five years. In the case of coordinated research projects, they are evaluated at the workshops and through mid-term appraisal committees, which review the work from time to time. The progress of ad hoc research schemes is monitored through regular reports, which are examined by the Scientific Panels. Overall monitoring of different research schemes is undertaken by the Subject Matter Divisions at the ICAR headquarters, and the overall implementation of the plan schemes by the Plan Implementation and Monitoring Unit.

## **2. The Agricultural Universities System**

As agriculture is a State subject, the responsibilities for research, education and extension rest with the State Governments. Prior to 1960, agricultural research in the States, essentially on local problems, was carried out by the State Departments of Agriculture supported by Agricultural Colleges. During the past 40 years, research and education have

been transferred to the Agricultural Universities, and the State Departments of Agriculture organize extension services. The Universities are supported by their respective State Governments. ICAR provides financial support and assists their research and education programmes.

The University Education Commission (1949) recommended the setting up of 'Rural Universities'. This was endorsed by the two Joint Indo-American Teams in 1955 and in 1959, as well as the Ford Foundation Study Team in 1959. In 1960, the Agricultural Universities Committee constituted under the Chairmanship of Dr Ralph W. Cummings prepared certain guidelines for the establishment of Agricultural Universities in different States, and the ICAR gave necessary support. The first Agricultural University was established at Pant Nagar in Uttar Pradesh in 1960, patterned on the Land-Grant System of the United States. The Second Education Commission (1964-66) recommended at least one Agricultural University in each State, and ICAR prepared a Model Act in 1966. All the States have now at least one Agricultural University each. Though the Model Act specifies that only one University shall be established in each State, which was later endorsed by the National Commission on Agriculture, many States have established multiple Universities to meet regional needs. There are at present 37 Agricultural Universities, including the Central Agricultural University in the North Eastern Region. These include Veterinary and Animal Science Universities, in some of the States. Some Agricultural Universities, as in Maharashtra State, have affiliated colleges. This goes against the provisions of the Act. In 1978, a Review Committee appointed by the ICAR reviewed the functioning of each Agricultural University and made a number of recommendations. In 1988, the USAID evaluated the impact of Agricultural Universities and made several suggestions for improvement.

Agricultural Universities are autonomous institutions established by an Act of State Legislature. Although the administrative structure differs somewhat from State to State, the general outlines are similar. As Chancellor, the State Governor is the nominal head of the University. In some States, the Agriculture Minister acts as the Pro-Chancellor. The Vice-Chancellor is the Chief Executive of the University. In some States, more than one University has been established through a Common Act; their activities are coordinated through a State level Agricultural Research and Education Coordination Committee. Of the 37 Agricultural Universities in the country, some are mono-campus while the others are multi-campus Universities. The number of teaching campuses in each University varies from 1 to 10.

- ❖ Acharya N.G. Ranga Agricultural University (ANGRAU), Hyderabad
- ❖ Assam Agricultural University (AAU), Jorhat
- ❖ Dr Balasahib Sawant Kokan Krishi Vidyapeeth (BSKKV), Dhapoli
- ❖ Bidhan Chandra Krishi Vishwa Vidyalaya (BCKVV), Mohanpur
- ❖ Birsa Agricultural University (BAU), Ranchi
- ❖ Chandra Shekhar Azad University of Agriculture & Technology (CSAUA&T), Kanpur
- ❖ Central Agricultural University (CAU), Imphal
- ❖ Chaudhary Charan Singh Haryana Agricultural University (CCSHAU), Hissar
- ❖ Govind Ballabh Pant University of Agriculture & Technology (GBPUA&T), Pantnagar



- ❖ Gujarat Agricultural University (GAU), Sardar Krushinagar
- ❖ Indira Gandhi Krishi Vishwa Vidyalaya (IGKVV), Raipur
- ❖ Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV), Jabalpur
- ❖ Kerala Agricultural University (KAU), Vellanikara
- ❖ Maharana Pratap University of Agriculture & Technology (MPUA&T), Udaipur
- ❖ Maharashtra Animal & Fishery Sciences University (MA&FSU), Nagpur
- ❖ Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri
- ❖ Marathwada Agricultural University (MAU), Parbhani
- ❖ Narendra Deva University & Technology (NDUA&T), Faizabad
- ❖ Navsari Agricultural University (NAU), Navsari
- ❖ Orissa University of Agriculture & Technology (OUA&T), Bhubaneswar
- ❖ Pandit Deen Dayal Upadhyaya University of Veterinary and Animal Sciences (PDDUV&AS), Mathura
- ❖ Punjab Agricultural University (PAU), Ludhiana
- ❖ Dr Punjabrao Deshmukh Krishi Vidyapeeth (PDKV), Akola
- ❖ Rajasthan Agricultural University (RAU), Bikaner
- ❖ Rajendra Agricultural University (RAU), Pusa
- ❖ Rani Durgawati University (RDU), Jabalpur
- ❖ Sardar Vallabh Bhai Patel University of Agriculture & Technology (SVBPUA&T), Meerut
- ❖ Sher-E-Kashmir University of Agricultural Sciences & Technology (SKUAS&T), Srinagar
- ❖ Sher-E-Kashmir University of Agricultural Sciences & Technology (SKUAS&T), Jammu
- ❖ Ch Shraavan Kumar Krishi Vishwa Vidyalaya (SKKVV), Palampur
- ❖ Tamil Nadu Agricultural University (TNAU), Coimbatore
- ❖ Tamil Nadu Veterinary & Animal Sciences University (TNVASU), Chennai
- ❖ University of Agriculture Sciences (UAS), Bangalore
- ❖ University of Agriculture Sciences (UAS), Dharwad
- ❖ Uttar Banga Krishi Vishwa Vidyalaya (UBKVV), Pundibari
- ❖ West Bengal University of Animal & Fishery Sciences (WBUA&FS), Kolkata
- ❖ Dr Yashwant Singh Parmar University of Horticulture & Forestry (YSPUH&F), Solan

### ***Research Infrastructure***

Basically, the research infrastructure consists of an Experiment Station at the main campus and a number of Regional Research Stations and Substations located in different parts of the State. There are around 500 such Research Stations belonging to the 37 Universities, working on location-specific problems. Generally, the research programmes are headed by the Directors of Research, who are assisted by the Associate Directors of Research located at the Regional Research Stations within the State. Some Agricultural Universities have established Advanced Centers by combining related subjects in areas such as plant protection, genetics and plant breeding, agricultural engineering, agricultural economics, water technology, etc. In order to undertake need-based and location-specific research, a network of Zonal Agricultural Research and Extension Centers have been established since 1979 with assistance from the

World Bank under NARP. These Centers numbering around 131 in the country, each located in a distinct agro-climatic zone, is a part of the Agricultural Universities System.

### ***Research Planning, Monitoring and Evaluation***

Agricultural Universities have State-wide responsibility for research in agriculture. In those States where there is more than one University, the research responsibilities are shared on the regional basis. To ensure relevant research planning, their efficient implementation and proper evaluation, each Agricultural University has Research Council or a Research Advisory Committee as an apex body for policy formulation and coordination of research activities. This body, chaired by the Vice-Chancellor comprises Director of Research, Director of Extension Education, Deans of constituent colleges, representatives of State Departments and farmers. It reviews periodically the overall status of research activities in the University, and determines their priorities and future direction. Research is organized under; (i) University research; (ii) Postgraduate student research; and (iii) Coordinated research programmes.

The Director of Research, who is the overall in-charge of research, prepares an annual plan indicating the main thrusts of research within the broad directions given by the Research Advisory Committee. The Directorate of Research is responsible for research review and evaluation, and timely publication of research results and reports. By and large, the individual scientists formulate research projects, which are then scrutinized by the concerned Department Head, examined at the Faculty/Departmental level and finally approved by the University Research Advisory Committee. Thereafter, the Director of Research and Department Heads provide funds and facilities to the scientists. In respect of research done by teachers and postgraduate students, the Director of Research acts in coordination with the Deans/Principals of the respective colleges.

Special mechanisms exist for the planning, monitoring, and evaluation of ICAR supported programmes in the Agricultural Universities. In the case of Coordinated Projects, the University scientists work in close co-operation with others from the ICAR Institutes and other Universities through the mechanism of All India Workshops conducted periodically. Ad hoc research schemes formulated by the University scientists are first scrutinized by the Scientific Panels and approved by the ICAR. These schemes are continuously monitored and evaluated by the ICAR in collaboration with the University. In the case of NATP, the programmes implemented by various research institutions are constantly monitored and reviewed by the University concerned, the ICAR, and the World Bank Missions.

In most Agricultural Universities, the Research Evaluation Committees attended by the scientists and extension subject matter specialists provide the much-needed in-house review mechanism within the Universities to examine the findings and data support emerging from various research projects. Only when the results are substantiated from trials, both on the experimental farms and farmers' fields, recommendations are made for large-scale implementation.

### **3. Other Agencies**

#### **A. General Universities:**

Many General Universities with well-developed faculties in agriculture, or strong departments engaged in areas such as genetics, plant physiology, mycology, entomology, biochemistry, economics, chemistry, marine biology, home science, etc. have made distinctive contributions to agricultural research in the country. Besides, the Central Universities like the Banaras Hindu University, Shanti Niketan, etc. have Institutes/Schools of Agricultural Sciences, which are engaged in research in agriculture and allied areas, some of which are supported by the ICAR.

#### **B. Scientific Organizations:**

Many other scientific organizations either directly undertake research, or sponsor and support programmes related to agriculture. The Council of Scientific and Industrial Research (CSIR), through its network of National Laboratories, provides research support in areas like processing of agricultural products, recycling of agricultural wastes, development of various agro-chemicals, etc. The Indian Council of Medical Research's (ICMR) research on the nutritional qualities of various agricultural produce including toxicity and occupational health of agricultural workers have greatly helped the ICAR in planning its research programmes. Some of the areas in which the Bhabha Atomic Research Centre (BARC) is actively engaged are the development of newer varieties of crops and preservation of agricultural produce. The Indian Space Research Organization (ISRO) is helping the research system to assess India's soil and water resources.

Technological institutions like IIT, Kharagpur, are active in the fields of agricultural engineering, soil and water management, and agronomy. The Department of Science and Technology (DST) promotes research on genetic engineering, post-harvest technology, and areas of basic sciences supportive to agriculture. The Department of Non-Conventional Energy Sources works on the utilization of solar and wind energies, and biogas for agricultural purposes. The Department of Meteorology is actively engaged in research on crop-weather forecasting. The Department of Ocean Development is involved in assessing the fishery resources in the country and promotes research in the area of fisheries.

In addition, institutions like the National Dairy Development Board (NDDB) under the Agriculture Ministry; various Commodity Boards like Silk, Coffee, Rubber, Tea, and Cardamom Boards under the Commerce Ministry; and the Forest Research Institute and Wasteland Development Board under the Ministry of Forestry and Environment help in strengthening the agricultural research system in the country.

#### **C. Private Sector:**

Involvement of private sector in agricultural research is of considerable importance in the overall development of agriculture in the country. In mid 1960s, several private companies started programmes mainly to develop hybrid maize, sorghum and bajra. Research on vegetables started in late 1960s. Private sector research is confined mainly to breeding crop hybrids, certain plantation crops, agro-chemicals, poultry, and agricultural machinery.

Private sector research in seed industry has grown very rapidly. Several private companies are now engaged in the production of hybrid seeds of a variety of crops like cotton, sorghum, bajra, maize, vegetables, red gram, rice, etc., and a small seed export industry has also emerged. There are a number of private companies undertaking plant-breeding research, and several others are involved in plant protection research. Besides their own research stations, these companies conduct experiments on farmers' fields. They test the bio-efficiency of insecticides and herbicides that are new to India as well as synthesize new compounds. Private research in poultry sector is of paramount importance. Although Government introduced exotic birds in commercial poultry industry, they were popularized by the private sector and many companies are now actively engaged in it. Many other large industrial concerns are engaged in research on shrimps and shrimp feed.

Some private companies undertake major research and development programmes for the improvement of tractors and irrigation pumps. Research on tractors seems to be primarily aimed at improving quality, fuel efficiency and engine durability. Some companies are now moving into agricultural implements. Research in pump industry is aimed at increasing the efficiency of pumps through improved design and better materials. Some companies are even experimenting with non-conventional sources of power. Historically, private companies in the processing and plantation sector have been a very important source of new agricultural technology. Some of the prominent ones include Indian Sugar Mills Association, Southern Planters Association, Textile Mills Association, Silk Industry, etc. Some large firms are involved in research on animal nutrition, plant growth regulators, biotechnology like tissue culture in cardamom, sugarcane, coconut and tea, bio-fertilizers, etc. Research in the area of tree farming including in vitro culture and tree breeding is also receiving attention of private firms.

Some of the well-established institutions such as Allahabad Agricultural Institute, Bharatiya Agro-Industries Foundation, Wool Research Association, and United Planters Association of South India undertake short-term, mission-oriented research projects supported by the ICAR for multi-location testing of varieties and agro-techniques.

In order to promote scientific research and the participation of industry in it, the Government through the Income Tax Act of 1961 has offered certain tax concessions relating to the expenditure on scientific research. The involvement of private agencies in agricultural research is gaining momentum with greater sophistication in technological development and the prospects of high returns on investment in agriculture.

#### **4. Linkages Among the Subsystems**

Strong working relationships and complementarity in research efforts amongst the components of the research system is necessary in order to optimize resources and check avoidable duplication. The ICAR, as the coordinating agency at the national level, has established close-working relationships with the Agricultural Universities and other agencies involved directly or indirectly in agricultural research through formal arrangements and informal exchanges.

At the policy making level, the Vice-Chancellors of Agricultural Universities are represented in the Governing Body, and in the Norms and Accreditation Committee of the ICAR. The senior level research managers of the ICAR, in turn, are represented in the Management Boards of these Universities. The Regional Committees of the ICAR provide an important forum for the scientists from these two agencies to come together and look at the regional research needs. Through Interdisciplinary Scientific Panels of the ICAR, the experts from the Agricultural Universities play a critical role in selecting research programmes at the national level as well as at the regional level. More importantly, various research schemes of the ICAR like the AICRPs, NATP, and ad hoc research schemes provide opportunities for the two subsystems to work jointly on problems of national as well as regional relevance.

As far as the General Universities are concerned, they participate in research activities under different types of research schemes and projects financed by different agencies. Through the AICRPs and ad hoc research schemes, these Universities have established linkages with the ICAR and Agricultural Universities subsystems. Joint programmes in specific areas like plant physiology, biological nitrogen fixation, biotechnology, etc. have been taken up by the ICAR with scientists working in these Universities. ICAR has also established close linkages with various scientific organizations like CSIR, ICMR, ISRO, BARC, etc. through Joint Panels. Problems of mutual interest have brought the ICAR closer to various Departments and Ministries at the Center to find solutions through collaborative research efforts.

## **5. International Co-operation**

International co-operation has played a significant role in developing and strengthening the research system in India. Many developed countries like USA, UK, USSR, Canada, Australia, Japan, several European countries; Charitable Institutions, etc.; Rockefeller and Ford Foundations; various International Agencies like FAO, UNDP, UNESCO, World Bank, etc.; and the International Agricultural Research Centers under the Consultative Group on International Agricultural Research (CGIAR) System have contributed extensively to the cause of agricultural research in India. Spectacular achievements in increasing the food production have raised the country's image considerably, and the bilateral arrangements have changed from the erstwhile donor-donee status to relationship of equal partnership in research. The reciprocity and mutuality of interests with the less developed and as well as the technologically advanced countries are the essence of international co-operation.

The Government has authorized ICAR, assisted by the DARE, to enter into bilateral co-operative agreements with several countries and agencies. The mode of collaboration normally follows the pattern of: (a) exchange of germplasm of plant and animal origin; (b) exchange of scientific and technical information; (c) visits of scientists and experts; (d) training of scientists; and (e) infrastructure development.

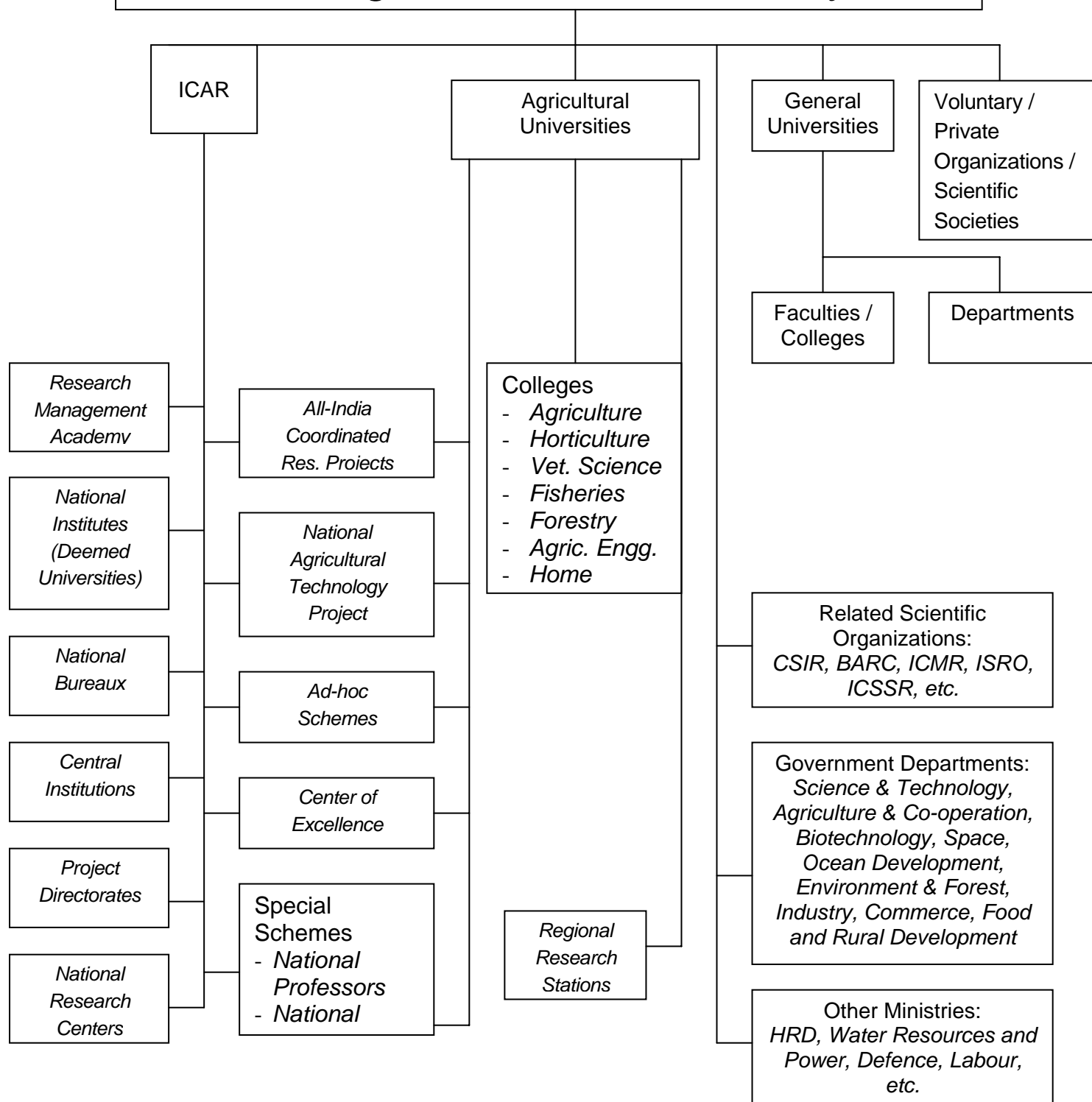
Some of the major avenues of international collaboration are: (i) Bilateral co-operation at the Government level; (ii) Bilateral co-operation between ICAR and counterpart foreign institutes; (iii) Interaction with Agricultural Research Centers under the CGIAR System; (iv)

Foreign-aided projects funded by USDA, Ford Foundation, IDRC, UNDP, World Bank, and USAID; (v) Science and Technology Initiative signed by the late Prime Minister Indira Gandhi and the US President Ronald Reagan; (vi) Participation in the regional projects under ESCAP and SAARC programmes; and (vii) Consultancy and training in the field of agricultural research in developing countries. International collaboration has provided a mechanism to draw upon the global stock of knowledge, scientific talent and material, and for institution building to address many of the research needs in the country. The agricultural research system in India has reached a stage in its development where it could take a more active role in joint research with foreign scientists as equal partners as well as in training scientists from other countries.

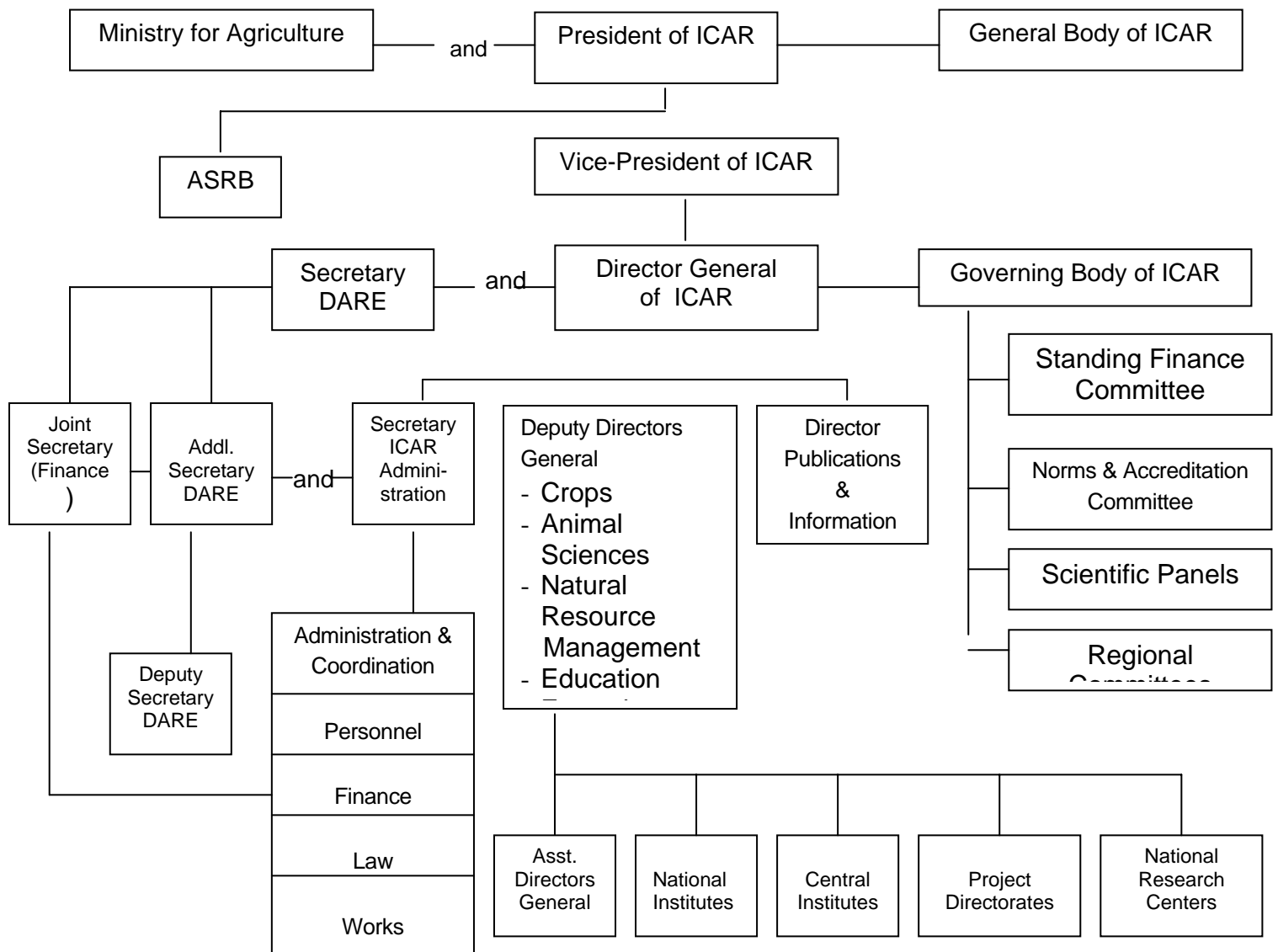
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# National Agricultural Research System

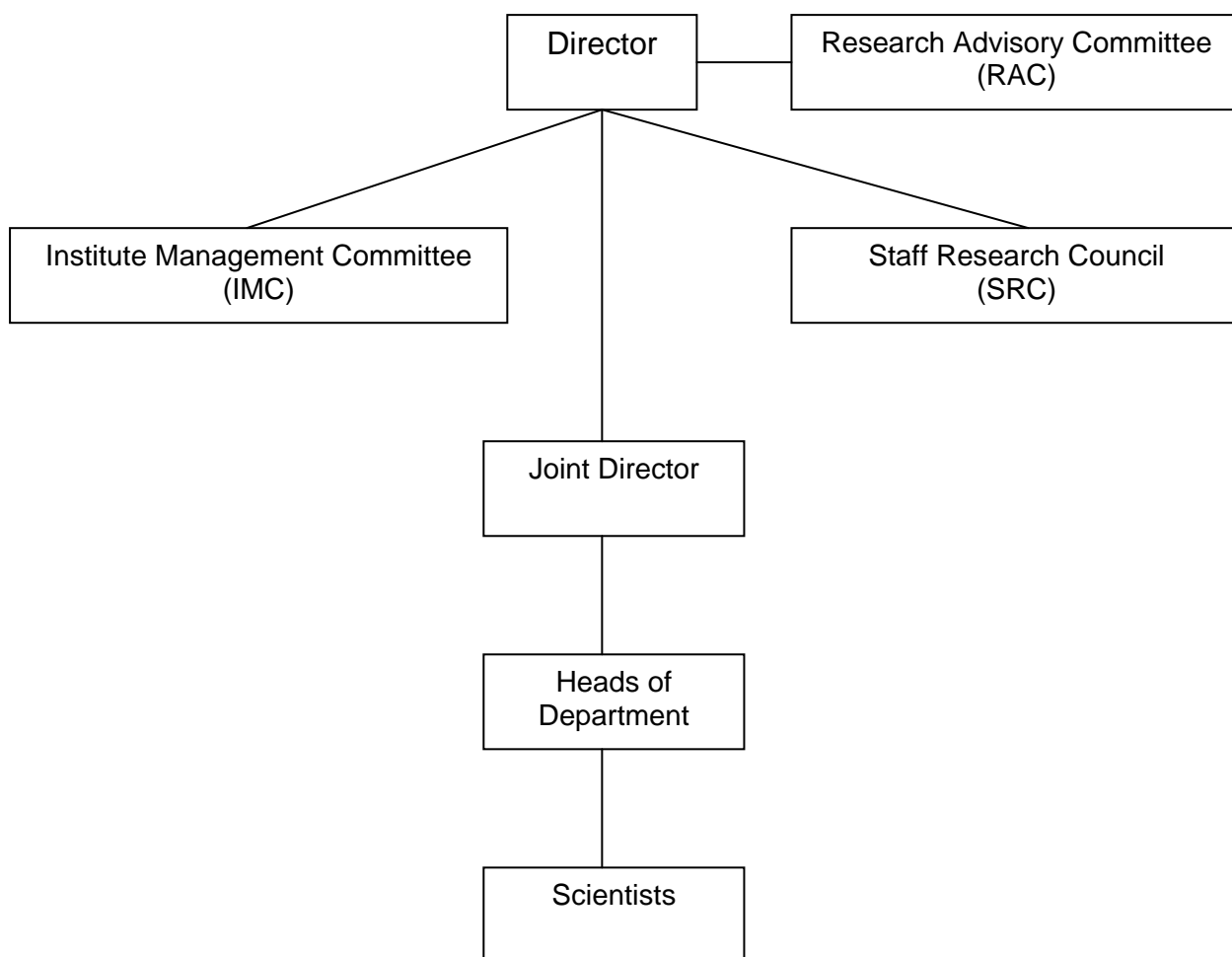


# Organization of ICAR

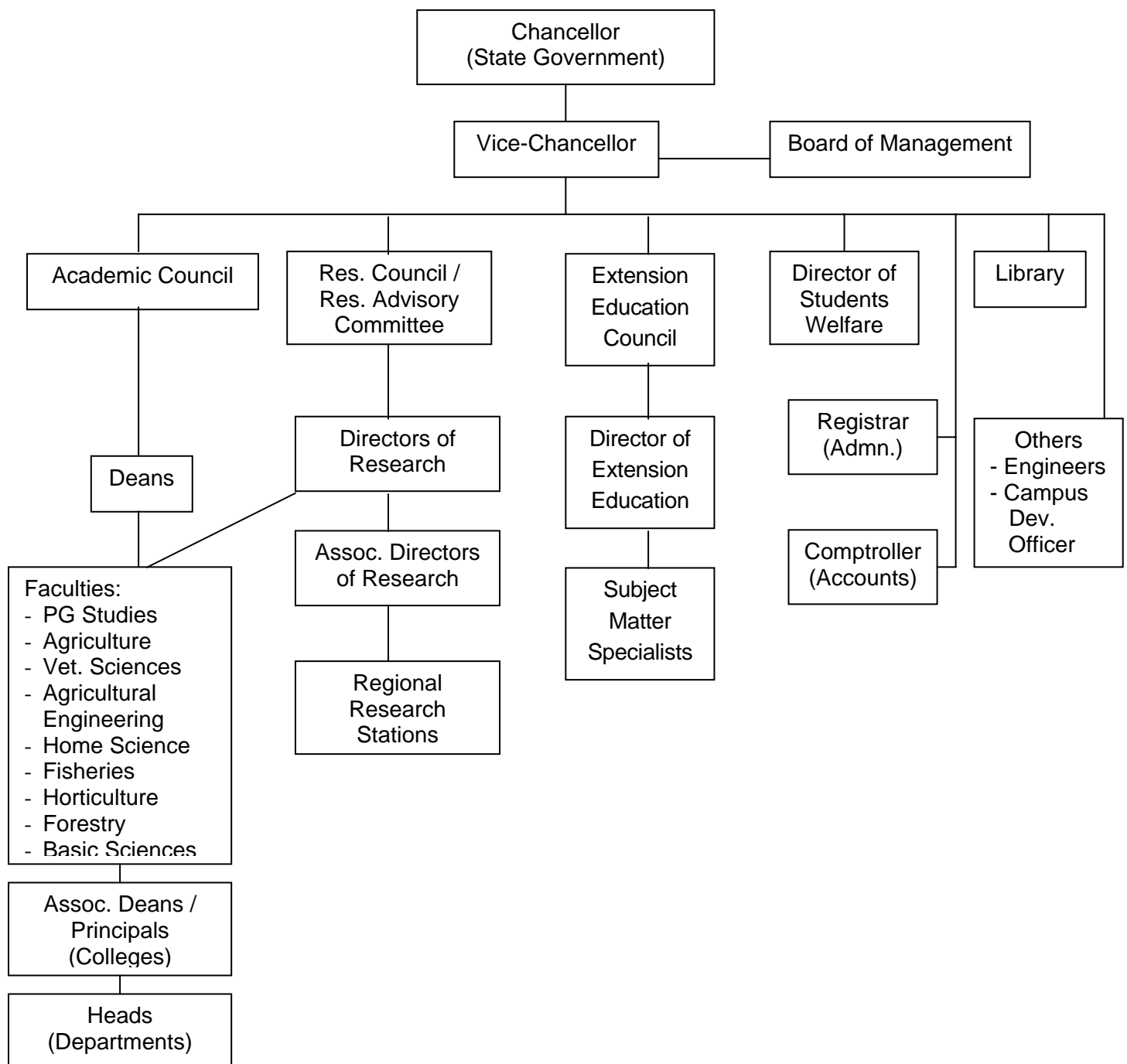




# Organizational Structure of ICAR Institutes



# Organizational Structure of Agricultural Universities



# **AGRICULTURAL RESEARCH SYSTEMS IN THE WORLD**

**T. Balaguru**

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## **Introduction**

Basic framework for a nation's research need in agriculture is provided by its National Agricultural Research System (NARS). Developed as well as the developing countries have built up their NARS over years of innovation and experimentation to cater to their internal requirements (relevant agricultural technologies to meet the needs of various stakeholders and beneficiaries) and external demand (commercialization through export). NARS in developed nations are shaped mainly by the external demands in relation to the internal needs. On the other hand, developing country NARS are mostly influenced by the internal needs; of late only, the external demands slowly started having their influence to keep pace with the ramifications of World Trade Agreement (WTA).

The past colonial history had a very significant influence on the organization and functioning of many developing country NARS in Africa, Asia and Latin America. In Sub-Saharan Africa, Britain had very great influence, followed by France, Germany, Belgium and Portugal; in Asia by Britain; in Indochina by France; in Indonesia by Holland; and in Latin America by Spain and France.

While Some of the NARS in countries like Nepal and Ivory Coast are relatively small and simple, those in countries like China and India are very large and much more complex. In comparison with developing countries, the private sector plays a very significant role in the NARS of developed nations. NARS in some selected developed and developing countries are presented below.

## **1. NARS in United States of America**

The American NARS essentially comprises Government supported research institutions in public sector and institutions supported by the private industry. Under the Government set-up, the Federal Department of Agriculture directs most of its efforts towards basic and/or applied research on problems of national importance; and the State level agencies primarily focus on problems of regional/local/relevance, but also work on problems of national or regional significance in cooperation with the Federal Department or other State level agencies.

Agricultural research at the Federal level is coordinated and controlled by the Director of Science and Education. He controls both the Agricultural Research Service (ARS) of the United States Department of Agriculture (USDA), and the Co-operative State Research Service (CSRS), which is responsible for administering the Federal, grants to State Agricultural Experiment Stations. The main centre and administrative headquarters of ARS (under USDA) is located at the Agricultural Research Centre in Beltsville, Maryland. Seven research divisions located at this Centre concentrate on basic research that can be applied on a nation-wide scale. Besides the Beltsville Centre, there are four Regional Research Laboratories of USDA at (i) Windsor, Pennsylvania; (ii) Peoria, Illinois; (iii) New Orleans, Louisiana; and (iv) Albany, California. To deal with basic research on problems indirectly related to agriculture, there are Pioneering Research Laboratories at Beltsville and Regional Laboratories, as well as on some University Campuses. The Central Project Office Serves as a control Centre at the national level through review of all the research proposals and maintenance of uniform project records. Coordination of research among the State agencies rests with CSRS.

At the State level, agricultural research is carried out by Agricultural Experiment Stations (funded by the concerned State) that are either independent agencies or form an integral part of the State Universities or Land Grant Colleges. In the Land Grant Colleges, there is integration of teaching, research and extension functions, the coordination of which rests with the concerned Heads of Department. Funded by USDA and with the active participation of scientists from various Laboratories and Experiment Stations, Coordinated Corn Improvement Programme was started in 1926. Its success has led to further extension of the programme to all other major crops, and a high degree of resource use efficiency was achieved.

The Director of Science and Education, and USDA are advised by the following four Committees:

- a) **National Agricultural Research Advisory Committee:** It provides the administration with broad policy level advice, besides reviewing the national goals of agricultural research.
- b) **Committee on Agricultural Science:** It continuously evaluates the research projects that are funded by the Federal Government, and also assists in planning and coordinating federal research programmes through Review Panels.
- c) **Agricultural Research Planning Committee:** Chaired by the Director of Science and Education, and represented by the research agencies of USDA, State Universities and Land Grant Colleges, this Committee is mainly concerned with the coordination between the Federal and State Departmental research programmes.
- d) **Commodity and Functional Advisory Committee:** It provides a direct link between USDA and various professional groups of farmers, for whom the research is of vital interest, on the basis of specific commodities.

The two distinct features of American NARS are: (i) greater involvement of private industry (accounting for nearly one-half of the total investment in agricultural research, through their own programmes or providing support to other agencies) leading to drastic reduction in input cost by engaging in activities such as seed production, evaluation of agro-chemicals, processing of agricultural products and extension of new technology; and (ii) major focus on basic research, coupled with greater concern for environmental protection.

## 2. NARS in Great Britain

In Great Britain, there are two distinct agencies for agricultural research, viz. Agricultural Research Council (ARC) for basic research and the Ministry of Agriculture for applied research. Under the Secretary of State for Education and Science, the ARC is represented by 15-18 members (four of them are scientists/Government Officials and the rest are farmers) and it administers 75 per cent of the funds available for agricultural research. Ten Research Stations and 15 Research Units (usually not permanent) operate under the direct control of ARC. It also provides financial support to 14 Agricultural Research Institutes, Universities and other bodies of special investigations. Through Ad hoc 'Visiting Groups' ARC reviews the research programmes at each establishment once in 5-6 years.

Research in the Ministry of Agriculture is carried out at its own Laboratories in areas such as livestock health, plant pathology, pest control and fisheries. Besides its advisory role,

the National Agricultural Advisory Service of the Ministry extensively carries out experiments on its farms. The private industry directly works on problems concerning agricultural chemicals, animal feed and machinery, and it also supports research at various Universities.

### **3.NARS in France**

Agricultural research in France received a special impetus after the Second World War, with the establishment of National Institute of Agricultural Research (*Institute National de Recherches Agronomiques* – INRA), which controls all Government funds earmarked for agricultural research. The INRA is responsible for organization of all Government scientific research activities in agriculture, publication of research results and maintenance of liaison with other public services concerned with agriculture. It undertakes research on crop production, animal husbandry, fisheries, forestry, conservation and transformation of agricultural products, economics and social sciences.

Though funded by the Federal Government, INRA enjoys a large measure of financial autonomy and flexibility in the administration of its research units. Its research programmes are decided by the *Conseil Supérieur de la Recherche Agronomique*, which functions within the framework of the Ministry of Agriculture. Under INRA, there are two National Centres, one for Plant Production Research (NCPPR) and another for Animal Husbandry Research (NCAHR). The NCPPR carries out basic research in areas such as Agronomy, Bioclimatology, Plant Physiology, Phytopharmacy, Food Technology, Plant Breeding and Genetics, Plant Diseases and Agricultural Zoology. The NCAHR concentrates on basic research relating to Animal Nutrition, Animal Physiology, Animal Genetics, Animal Husbandry, Veterinary Research and Animal Products. For undertaking applied research in the above said areas, these two National Centres have Regional Centres (11 and 7, respectively). There are also 68 Regional Stations, with each one specializing in one type of production.

Research carried out by the Faculty of Agricultural Schools, through 33 Stations, are incorporated with the INRA programmes. Private institutions also support research in the areas of Plant Breeding and Agro-chemicals (pesticides and fertilizers) in a number of Research Laboratories/Experiment Stations. A specialized Experimental Information Service Unit (*Serviced Experimentation et de Information*) is responsible for maintaining liaison between research and extension services, both Government and Private Industry.

### **4. NARS in Australia**

Agricultural research in Australia is mainly carried out by various Government Agencies, ably supported by some sections of Private Industry. Under the Government set-up, research is carried out by the Commonwealth Scientific and Industrial Research Organization (CSIRO), State Departments of Agriculture, Universities and the Australian Centre for International Agricultural Research (ACIAR). The CSIRO conducts basic and applied research on various aspects of production having widespread significance and requiring mid to long-term commitment. The State Departments mainly concentrate on problems of regional/local importance for developing improved production techniques at the farm level. Similarly, the Universities (Educational Institutions) carry out basic/applied research on relevant problems of regional/local significance.

The ACIAR supports agricultural research in developing countries in specific areas in which Australia has special competence. It also commissions research by Australian Institutes (National level) in partnerships with research groups in developing countries. Private Industry

supports research in areas such as evaluation of fertilizers, pesticides, veterinary medicines and agricultural machinery, as well as seed and livestock production.

## 1. NARS in China

China has one of the largest and more complex NARS in the world. Scientific research in agriculture dates back to early 1920s. Prior to the establishment of the Chinese Academy of Agricultural Sciences (CAAS) in 1957, there was one Coordination Committee (set up in 1955) for coordinating agricultural research in China. Operating under the Ministry of Agriculture, the CAAS coordinates most of the agricultural research. Besides its coordinating function, it has also established a network of National Research Institute (35 in number) and it guides research programmes in various provinces (29 in number).

The National Research Institutes under CAAS undertake research in (i) basic sciences with academic disciplines, (ii) various crops and domestic animals and (iii) agro-economics, information on agricultural sciences and technology. Each of the 29 provinces (autonomous regions) has their respective Academies of Agriculture or Animal Husbandry Sciences. Research Institutes under these Academies work on location-specific technologies problems. Agricultural Colleges and Universities (64 in number, with Beijing Agricultural University as the largest) contribute very significantly through adaptive research. There is one Research Institute in almost each city to conduct development research in one or the other field.

## 2. NARS in Developing Countries

The developing country NARS have evolved over the years, and there exists wide variations, in terms of organizations and management of agricultural research, across the countries in Africa, Asia and Latin America. The former Colonial rulers had great influence on the structure and functioning of their NARS. There is greater diversity, i.e., from typical bureaucratic control under the Ministerial Departments to relating autonomous structure; and from practically with no coordination to well-orchestrated coordination. The developing country NARS can be broadly grouped into four major categories. They are:

### a) Ministry Model

Research is organized in one or more line Departments within the bureaucratic structure of one or more Ministries. The basic feature of this model is that the institutions responsible for research have a low degree of control over decision-making, particularly in matters concerning resource management. The NARS falling under this category include:

| Asia and<br>the South Pacific   | Continents   |  | West Asia<br>and<br>North Africa |
|---|--|--|----------------------------------|
|   | Africa<br>(South of Sahara)  | Latin America<br>&<br>The Caribbean  |                                  |
| Fiji<br>Indonesia<br>Myanmar<br>Nepal<br>South Korea<br>Thailand<br>Western Samoa | Botswana<br>Cameroon<br>Malawi<br>Kenya<br>Somalia<br>Zambia<br>Zimbabwe | Coasta Rica<br>El Salvador<br>Jamaica<br>Ncaragua<br>Paraguay<br>Guyana<br>Uruguay | Cyprus<br>Syria<br>Turkey        |

### **b) Autonomous Model**

Research responsibilities are placed within an administratively independent organization. The basic characteristic of this format is that decision-making with respect to programme, administrative policy and resource allocation matters is exercised through an independent Board of Directors or Governors. Research is carried out predominantly, both in commodity and territorial terms. The NARS belonging to this category are:

| Asia and<br>the South Pacific | Continents                      |   | West Asia<br>and<br>North Africa |
|-------------------------------|---------------------------------|---|----------------------------------|
|                               | Africa<br>(South of Sahara)     | Latin America<br>&<br>The Caribbean                                     |                                  |
| Malaysia                      | Ethiopia<br>Madagascar<br>Sudan | Argentina<br>Chile<br>Colombia<br>Guatemala<br>Mexico<br>Panama<br>Peru |                                  |

### **c) Multi-Organizational Model**

Research is carried out by several different agencies like Ministries, Autonomous/semi-autonomous Agencies, Universities, etc. The basic tenet of this model is the independent nature of agencies in their working, without the existence of a Central Coordinating authority. Some of the NARS most typical of this model are:

| Asia and<br>the South Pacific | Continents  |                                     | West Asia<br>and<br>North Africa      |
|-------------------------------|---|-------------------------------------|---------------------------------------|
|                               | Africa<br>(South of Sahara)   | Latin America<br>&<br>The Caribbean |                                       |
| Sri Lanka                     | Ghana<br>Ivory Coast<br>Mauritius<br>Mozambique<br>Tanzania<br>Zane |                                     | Cyprus<br>Egypt<br>Morocco<br>Tunisia |

### **d) Agricultural Research Council Model**

It represents a variant of the autonomous research organization, emphasizing the coordination function, with less direct involvement in research activities. Autonomy and greater influence over programme policy matters, through an independent Board of Directors or Governors, is the key distinguishing features of this model. Research is carried out in a multi-organizational situation within central coordinating body. The major NARS of this type are:

| Asia and<br>the South Pacific                  | Continents                                     |                                     | West Asia<br>and<br>North Africa |
|--|--|-------------------------------------|----------------------------------|
|  | Africa<br>(South of Sahara)                    | Latin America<br>&<br>The Caribbean |                                  |
| Bangladesh<br>India<br>Pakistan<br>Philippines | Burundi<br>Central Africa<br>Nigeria<br>Rwanda | Brazil<br>Cuba                      |                                  |

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# INTERNATIONAL AGRICULTURAL RESEARCH CENTRES

Compiled by **Dr T. Balaguru**, NAARM, Hyderabad

## I. International Agricultural Research Centres belonging to the Consultative Group on International Agricultural Research (CGIAR)

### 1. Centro Internacional de Agricultura Tropical – CIAT (International Centre for Tropical Agriculture)

**Headquarters** : A.A. 6713, Cali, Colombia  
**Phone** : (57-2) 4450 000 (Direct), 1-650-833-6625 (via USA)  
**Fax** : (57-2) 4450 073 (Direct), 1-650-833-6626 (via USA)  
**E-mail** : [ciat@cgiar.org](mailto:ciat@cgiar.org)  
**Website** : [www.ciat.cgiar.org](http://www.ciat.cgiar.org)

**Focus:** To contribute to the alleviation of hunger and poverty in tropical countries by applying science to the generation of technology that will lead to lasting increases in agricultural output while preserving the natural resource base. Research is conducted on germplasm development of **beans, cassava, tropical forages**, and **rice** for Latin America, and on resource management in humid agro-ecosystems in **tropical America**, including **hillsides, forest margins, and savannas**.

**Training/Fellowship:** Multidisciplinary training courses are offered in agro biodiversity, institutional linkages, crop improvement, pest and diseases, soil and production systems and land management.

### 2. Centre for International Forestry Research – CIFOR

**Director General** : David Kaimowitz  
**Headquarters** : P.O. Box. 6596, JKPWB, Jakarta, Indonesia  
**Phone** : 62-251-622 622  
**Fax** : 62-251-622 100  
**E-mail** : [cifor@cgiar.org](mailto:cifor@cgiar.org)  
**Website** : [www.cifor.cgiar.org](http://www.cifor.cgiar.org)

**Focus:** To contribute to the sustained well-being of people in developing countries, particularly **in the tropics**, through collaborative strategic and applied research in **forest systems and forestry**, and by promoting the transfer of appropriate new technologies and the adoption of new methods of social organization for national development.

### 3. Centro Internacional de Mejoramiento de Maiz y Trigo – CIMMYT

**Director General** : Timothy Reeves  
**Headquarters** : Apdo. Postal 6-641, 06600, Mexico, D.F., Mexico  
**Phone** : 52 -55-5804 2004  
**Fax** : 52 -55-5804 7558 / 52 -55 - 5804 7559  
**E-mail** : [cimmyt@cgiar.org](mailto:cimmyt@cgiar.org)  
**Website** : [www.cimmyt.org](http://www.cimmyt.org)

**Focus:** To help the poor by increasing the productivity of resources committed to maize and wheat in developing countries, while protecting the environment, through agricultural research and in concert with national research systems.

**Training/Fellowships:** Trainings are offered in the field of Maize, wheat, economics, natural resources and biotechnology

#### 4. Centro Internacional de la Papa – CIP

**Director General** : Hubert Zandstra  
**Headquarters** : P.O. Box 1558, Lima, Peru  
**Phone** : (51-1) 349 6017 / 5783 / 5777  
**Fax** : (51-1) 317 5326  
**E-mail** : [cip@cgiar.org](mailto:cip@cgiar.org)  
**Website** : [www.cipotato.org](http://www.cipotato.org)

**Focus:** To contribute to increased food production, the generation of sustainable and environmentally sensitive agricultural systems, and improved human welfare by conducting coordinated, multidisciplinary research programs on **potato** and **sweet potato** by carrying out worldwide collaborative research and training, by catalyzing collaboration among countries in solving common problems, and by helping scientists worldwide to respond flexibly and successfully to changing demands in agriculture.

**Training / Fellowships:** Trainings relating to potato, sweet potato, andean root and tuber crops. Distance education in Technology Assisted Learning (TAL) is also provided at CIP.

#### 5. International Center for Agricultural Research in the Dry Areas – ICARDA

**Director General** : Adel El-Beltagy  
**Headquarters** : P.O. Box. 5466, Aleppo, Syria  
**Phone** : (963-21) 2213 433 / 2225 012 / 2225 112  
**Fax** : (963-21) 2213 490  
**E-mail** : [icarda@cgiar.org](mailto:icarda@cgiar.org)  
**Website** : [www.icarda.cgiar.org](http://www.icarda.cgiar.org)

**Focus:** To meet the challenges posed by a harsh, stressful, and variable environment in which the productivity of winter rainfed agricultural systems must be increased to higher sustainable levels in which soil degradation must be arrested and possibly reversed, and in which water use efficiency and the quality of the fragile environment need to be ensured. ICARDA has a world responsibility for the improvement of **barley, lentils** and **faba bean** and a regional responsibility in **West Asia** and **North Africa** for the improvement of **wheat, chickpea, forages** and **pasture**. ICARDA emphasizes rangeland improvement, small ruminant management and nutrition, and rainfed-farming systems associated with these crops.

**Training / Fellowships:** Individual and Groups training for scientists and technicians to conduct research independently. Research Fellowships and Senior Research Fellowships are provided for junior and senior researchers respectively with a non-degree-training programme. Graduate students at a university can carry out their research in M.Sc. / Ph.D. at ICARDA.

## 6. International Center for Living Aquatic Resources Management- ICLARM

**Director General** : Meryl J. Williams  
**Headquarters** : 11960, Bayan Lepas, P.O. Box. 500, GPO 10670  
Penang, Malaysia  
**Phone** : (604) 626 1606  
**Fax** : (604) 626 5530  
**E-mail** : [iclarm@cgiar.org](mailto:iclarm@cgiar.org)  
**Website** : [www.iclarm.org](http://www.iclarm.org)

**Focus:** To improve the production and management of **aquatic resources**, for sustainable benefits to present and future generations of low-income producers and consumers in developing countries, through international multidisciplinary research in partnership with national agricultural research systems. The declining state and threatened sustainability of **fisheries** due to over fishing exacerbated with poverty and pollution, and the potential for increase in aquaculture production, call for research which includes understanding of the dynamics of **coastal** and **coral reef** resource systems and of integrated agriculture-aquaculture systems, investigating alternative management schemes in these systems, and improving the productivity of key species.

## 7. International Centre for Research in Agroforestry – ICRAF

**Director General** : Dennis Garrity  
**Headquarters** : P.O. Box. 30677, Nairobi, Kenya  
**Phone** : (254-2) 524 000, 1-650-833 6645 (via USA)  
**Fax** : (254-2) 524 001, 1-650-833 6646 (via USA)  
**E-mail** : [icraf@cgiar.org](mailto:icraf@cgiar.org)  
**Website** : [www.cgiar.org/icraf](http://www.cgiar.org/icraf)

**Focus:** To mitigate tropical deforestation, land depletion, and rural poverty through improved **agro-forestry** systems. **Trees** in farming systems can increase and diversify farmer income, make farming systems more robust, reverse land degradation, and reduce the pressure on natural forests. ICRAF carries out research with national agricultural and forestry research systems, non-governmental organizations, and other research partners, and is focused on two major thrusts: finding alternatives to slash and burn agriculture in the **humid tropics**; and overcoming land depletion in **sub-humid** and **semi-arid Africa**.

**Training / Fellowships:** Group and individual training in agro-forestry research and development

## 8. International Crops Research Institute for the Semi-Arid Tropics – ICRISAT

**Director General** : Willam D. Dar  
**Headquarters** : Patancheru 502 324, Andhra Pradesh, India  
**Phone** : (91-40) 3296 161 to 3296 179 / 918455 / 40283 / 43064  
**Fax** : (91-40) 3241 239 / 3296 182  
**E-mail** : [icrisat@cgiar.org](mailto:icrisat@cgiar.org)  
**Website** : [www.icrisat.org](http://www.icrisat.org)

**Focus:** To conduct research leading to enhanced sustainable food production in the harsh conditions of the **semi-arid tropics**. ICRISAT's main crops – **sorghum**, **finger**

**millet, pearl millet, chickpea, pigeon pea, and groundnut** – are not generally known in the world's more favourable agricultural regions, but they are vital to life for the one-sixth of the world's population that lives in the **semi-arid tropics**. ICRISAT conducts research in partnership with the national agricultural systems that encompasses the management of the region's limited natural resources to increase the productivity, stability and sustainability of these and other crops.

**Training / Fellowships:** Genetic mapping, QTL analysis, IPM, Project management, Agricultural research management. Graduate students at a university can carry out their research in M.Sc. / Ph.D. at ICRISAT.

## 9. International Food Policy Research Institute - IFPRI

**Director General** : Per Pinstrup-Anderson  
**Headquarters** : 2033 K Street, Washington, D.C., USA  
**Phone** : (1-202) 8625 600  
**Fax** : (1-202) 4674 439  
**E-mail** : [ifpri@cgiar.org](mailto:ifpri@cgiar.org)  
**Website** : [www.ifpri.org](http://www.ifpri.org)

**Focus:** IFPRI was established to identify and analyze alternative national and international strategies and policies for meeting the food needs of the developing world on a sustainable basis, with particular emphasis on low-income countries and on the poorer groups in those countries. While IFPRI's research is specifically geared to contributing to the reduction of hunger and malnutrition, the factors involved are many and wide-ranging, requiring analysis of **underlying processes** and extending beyond a narrowly defined food sector. IFPRI collaborates with governments and private and public institutions worldwide interested in increasing food production and improving the equity of its distribution. Research results are disseminated to policymakers, administrators, policy analysts, **researchers and other concerned with national and international food and agricultural policy**.

**Training/Fellowships:** Training for capacity strengthening activities serve institutions and individuals in the developing world, with an emphasis on South Asia, Southeast Asia, Central Asia, China, Latin America and sub-Saharan Africa. IFPRI established a postdoctoral fellowship program for new Ph. Ds from developing countries who have received their degree from a developing-country institution.

## 10. International Water Management Institute – IWMI

**Director General** : Frank Rijsberman  
**Headquarters** : P.O. Box. 2075, Colombo, Sri Lanka  
**Phone** : (94-1) 787 404 / 784 080  
**Fax** : (94-1) 786 854  
**E-mail** : [iwmi@cgiar.org](mailto:iwmi@cgiar.org)  
**Website** : [www.cgiar.org/iwmi](http://www.cgiar.org/iwmi)

**Focus:** IWMI's mission is to improve water and land resources management for food livelihoods and nature. To identify the larger issues related to water management and food security. To develop, test and promote management practices and tools. To clarify the link between poverty and access to water and to help developing countries build their research capacities to deal with water scarcity and related food security issues.

## 11. International Institute of Tropical Agriculture – IITA

**Director General** : P. Hartmann  
**Headquarters** : Oyo Road, PMB 5320, Ibadan, Nigeria  
**Phone** : (234-2) 2412 626 or 871-1454 324 (via INMARSAT)  
**Fax** : (234-2) 2412 221 or 871-1454 325 (via INMARSAT)  
**E-mail** : [iita@cgiar.org](mailto:iita@cgiar.org)  
**Website** : [www.iita.cgiar.org](http://www.iita.cgiar.org)

**Focus:** IITA conducts research and outreach activities, with partner programs in countries of Sub-Saharan Africa, to help those countries increase food production on an ecologically sustainable basis. IITA seeks to improve the food quality, plant health, and postharvest processing of its mandate crops – **cassava, maize, cowpea, soybean, yam and banana and plantain** – while strengthening national research capabilities.

**Training/Fellowships:** Agricultural research management, crop management. Graduate students at a university can carry out their research in M.Sc. / Ph.D. in genetics and plant breedings, entomology, pathology, agronomy etc at IITA.

## 12. International Livestock Research Institute – ILRI

**Director General** : Hank Fitzbugh  
**Headquarters** : P.O. Box. 30709, Nairobi, Kenya  
**Phone** : (254-2) 630 743  
**Fax** : (254-2) 631 499  
**E-mail** : [ilri-kenya@cgiar.org](mailto:ilri-kenya@cgiar.org)  
**Website** : [www.cgiar.org/ilri](http://www.cgiar.org/ilri)

**Focus:** To increase animal health, nutrition, and productivity (i.e. milk, meat, traction) by removing constraints to **tropical livestock** production, particularly among small-scale farmers to protect environments supporting animal production against degradation by tailoring production systems and developing technologies that are sustainable over the long-term; to characterize and conserve the genetic diversity of indigenous **tropical forage** species and **livestock** breeds; and to promote equitable and sustainable national policies for the development of animal agriculture and the management of natural resources affected by animal production, encouraging, in particular those policies that support strategies for reducing hunger and poverty, for improving food security, and for protecting the environment.

**Training / Fellowships:** To improve livestock production by training personnel from the institutes within the national agricultural research systems (NARS). Graduate students at a university can carry out their research in M.Sc. / Ph.D. in Biosciences, sustainable production systems at ILRI.

## 13. International Plant Genetic Resources Institute – IPGRI

**Headquarters** : Via dei Tre Denari 472/a 00057 Maccarese (Fumicino), Rome, Italy  
**Phone** : (39-06) 61181  
**Fax** : (39-06) 6197 9661  
**E-mail** : [ipgri@cgiar.org](mailto:ipgri@cgiar.org)  
**Website** : [www.ipgri.cgiar.org](http://www.ipgri.cgiar.org)

**Focus:** To encourage, support and engage in activities to strengthen the conservation and use of plant genetic resources worldwide, with special emphasis on developing countries, by undertaking research and training and by providing scientific and technical information.

**Training/Fellowships:** Plant genetic resources, eco-graphic surveys, increasing genetic variations

#### 14. International Rice Research Institute – IRRI

**Director General** : Ronald P. Cantrell  
**Headquarters** : P.O Box. 3127, Makati City 1271, **Manila**, Philippines  
**Phone** : (63-2) 8450 563 / 8450 569  
**Fax** : (63-2) 8450 606  
**E-mail** : [irri@cgiar.org](mailto:irri@cgiar.org)  
**Website** : [www.irri.cgiar.org](http://www.irri.cgiar.org)

**Focus:** To improve the well-being of present and future generations of **rice** farmers and consumers, particularly those with low incomes, by generating and disseminating rice-related knowledge and technology of short and long-term environmental, social, and economic benefit and by helping to enhance national rice research.

#### 15. West Africa Rice Development Association – WARDA

**Director General** : Kanayo F. Nwanze  
**Headquarters** : 01 B. P. 2551, Bouake 01, Cote d Ivoire  
**Phone** : (225) 3163 4514  
**Fax** : (225) 3163 4714 / 2022 7865  
**E-mail** : [warda@cgiar.org](mailto:warda@cgiar.org)  
**Website** : [www.warda.cgiar.org](http://www.warda.cgiar.org)

**Focus:** WARDA's work is aimed at strengthening the capability of agricultural scientists in **West Africa** for technology generation to increase the sustainable productivity of intensified **rice**-based cropping systems in a manner that improves the well-being of resource-poor farm families and that conserves and enhances the natural resource base. Research covers rice grown in **mangrove swamps, inland valleys, upland conditions, and irrigated conditions**.

**Training/Fellowships:** Rice technology production. Graduate students at a university can carry out their research in M.Sc. / Ph.D. in Agronomy, soil chemistry, genetics and plant breeding and molecular biology at WARDA.

### II. Other International Agricultural Research Centres

#### 1. Asian Vegetable Research and Development Centre - AVRDC

**Director General** : Tsou, Samson C.S.  
**Headquarters** : P.O.Box. 42, Shanhua, Tainan 741, Taiwan, R.O.C.  
**Phone** : 886 6 583 - 7801  
**Fax** : 886 6 583 - 0009  
**E-mail** : [avrdc@netra.avrdc.org.tw](mailto:avrdc@netra.avrdc.org.tw)  
**Website** : [www.netra.avrdc.org.tw/docs/intro.html](http://www.netra.avrdc.org.tw/docs/intro.html)

**Focus:** To enhance the nutritional well being and raise the incomes of poor people in the rural and urban areas of developing countries through improved methods of vegetable production, marketing and distribution, which take into account the need to preserve the quality of the environment.

**Training / Fellowships:** Training in vegetable research and development, and IPM

## 2. Centro Agronomico Tropical de Investigacion y Ensenanza – CATIE (Centre for Research and Learning in Tropical Agronomy)

**Director General** : Pedro Ferreira  
**Headquarters** : P.O. Box. 7170, Turrialba, Costa Rica  
**Phone** : (506) 556 6431  
**Fax** : (506) 556 1533  
**E-mail** : [research@catie.ac.cr](mailto:research@catie.ac.cr)  
**Website** : [www.catie.ac.cr](http://www.catie.ac.cr)

**Focus:** To promote and stimulate research and technical cooperation in **animal, plant and forest production**, with the objective of providing alternatives for satisfying the needs of the American tropics, especially the countries of the **Central American isthmus** and the **Caribbean**.

**Training / Fellowships:** Training is a part of the commitment of CATIE to the development of agriculture and renewable natural resources of the member countries and orientates its action towards the requirement of national and regional institutions.

Collaborative M.Sc and Ph.D. programmes are offered with the U.S., U.K. and German Universities.

## 3. International Board for Soil Research and Management – IBSRAM

**Headquarters** : P.O. Box. 9-109, Bangkok, Thailand  
**Phone** : (662) 941 2500  
**Fax** : (662) 561 1230  
**E-mail** : [info@ibsr.org](mailto:info@ibsr.org)  
**Website** : [www.ibsr.org](http://www.ibsr.org)

**Focus:** To assist and speed applications of soil science in the interest of increasing sustainable food production in developing countries.

## 4. International Centre of Insect Physiology and Ecology – ICIPE

**Director General** : Hans R. Herren  
**Headquarters** : Nairobi, Kenya  
**Phone** : 254 2 861680 - 802501  
**Fax** : 254 2 803360 - 860110  
**E-mail** : [icipe@icipe.org](mailto:icipe@icipe.org)  
**Website** : [www.icipe.org](http://www.icipe.org)

**Focus:** The mandate of ICIPE is to (i) research in integrated control methodologies for **crop and livestock insect pests** and for **insect vectors** of tropical diseases and (ii) strengthen the technological capacities of the developing countries in insect science and its application through training and collaborative work.



## 5. International Fertilizer Development Centre - IFDC

**Director General** : Amit H. Roy  
**Headquarters** : P.O. Box. 2040, Muscle Shoals, Alabama, 35662 USA  
**Phone** : 1 256 - 381 - 6600  
**Fax** : 1 256 - 381 - 7408  
**E-mail** : [general@ifdc.org](mailto:general@ifdc.org)  
**Website** : [www.ifdc.org](http://www.ifdc.org)

**Focus:** To help the developing countries solve their food-deficit problems by focusing on the development of fertilizers and fertilizer practices to meet the special needs of their tropical and subtropical climates and soils.

**Training / Fellowships:** Training on knowledge of Fertilizer industry in developing the skill of managers and professionals

## 6. Caribbean Agricultural Researches and Development Institute - CARDI

**Headquarters** : University Campus, St. Augustine, Trinidad, and W.I.  
**Phone** : 1 868 645 1205 / 1206 / 1207 / 3573 / 8120 / 8121  
**Fax** : 1 868 645 1208  
**E-mail** : [itservices@cardi.org](mailto:itservices@cardi.org)  
**Website** : [www.cardi.org](http://www.cardi.org)

**Focus:** To accelerate sustainable agricultural development through strategic management of those processes that generate, transfer, adapt and commercialize appropriate technology, which will improve the social and economic well being of Caribbean peoples.

## 7. Tropical Soil Biology and Fertility Program – TSBFP

**Headquarters** : Nairobi, Kenya  
**Phone** : 254 2 622 584  
**Fax** : 254 2 622 733  
**E-mail** : [tsbinfo@tsbf.unon.org](mailto:tsbinfo@tsbf.unon.org)

**Focus:** To contribute to human welfare and the conservation of the environment in the tropics by developing improved practices for sustaining tropical soil fertility through the management of biological processes and organic resources, in combination with judicious use of inorganic inputs.

## 8. International Centre for Integrated Mountain Development - ICIMD

**Director General** : Gabriel Campbell  
**Headquarters** : 4/80, Jawalakhel, G.P.O. Box. 3226, Kathmandu, Nepal  
**Phone** : (977 1) 525313  
**Fax** : (977 1) 524 509 / 536 747  
**E-mail** : [icimod@cimod.org.np](mailto:icimod@cimod.org.np)  
**Website** : [www.icimod.org](http://www.icimod.org)

**Focus:** To help promote development of an economic and environmentally sound mountain ecosystem and to improve the living standards of mountain populations. It



works mainly at the interface between research and development and acts as a facilitator for generating new mountain specific knowledge of relevance to mountain development.

#### **9. CAB International - CABI**

**Director General** : Denis Blight  
**Headquarters** : Nosworthy Way, Wallingford, Oxon 8DE, U.K.  
**Phone** : 44 (0) 1491 – 832 111  
**Fax** : 44 (0) 1491 – 833 508  
**E-mail** : [corporate@cabi.org](mailto:corporate@cabi.org)  
**Website** : [www.cabi.org](http://www.cabi.org)

**Focus:** To collect, analyse and disseminate information on agriculture, forestry, the management of natural resources and related science including human nutrition and health.

#### **10. Australian Centre for International Agricultural Research - ACIAR**

**Director General** : Bob Clements  
**Headquarters** : Traeger Court, Fernhill Park, Bruce ACT 2617, Australia  
**Phone** : (61-2) 6217 0500  
**Fax** : (61-2) 6217 0501  
**E-mail** : [aciarc@aciarc.gov.au](mailto:aciarc@aciarc.gov.au)  
**Website** : [www.aciarc.gov.au](http://www.aciarc.gov.au)

**Focus:** ACIAR directs it to mobilize Australia's research capacity to help solve agricultural research problems of developing countries. Thus the Centre allocates about three-quarters of its research and development budget to promoting bilateral development-related research collaboration between Australia and individual developing countries. The remaining quarter provides Australia's contribution to the institutes of the international agricultural research system.

**Training / Fellowship:** ACIAR awards 10 fellowships each year to developing country scientist involved in ACIAR Projects to undertake Master or Ph.D. training at Australian Universities.

#### **11. The Cooperative Research Centre for Legumes in Mediterranean Agriculture - CLIMA**

**Headquarters** : The University of Western Australia, Nedlands, Perth, WA 6907  
**Phone** : 61 (08) 9380 2505  
**Fax** : 61 (08) 9380 1140  
**E-mail** : [clima@cyllene.uwa.edu.au](mailto:clima@cyllene.uwa.edu.au)  
**Website** : [www.general.uwa.edu.au/u/climaweb/](http://www.general.uwa.edu.au/u/climaweb/)

**Focus:** It focuses on legumes for sustainable agriculture in the Mediterranean climate of southern Australia. Research and training cover a wide range of disciplines, genetic engineering of legumes and bacteria to assessment of farmer attitudes about risk and a new species.

## **12. International Institute for Land Reclamation and Improvement - ILRI**

**Headquarters** : Wageningen, The Netherlands  
**Phone** : 31 317 495 549  
**Fax** : 31 317 495 590  
**E-mail** : [ilri@ilri.nl](mailto:ilri@ilri.nl)  
**Website** : [www.ilri.nl](http://www.ilri.nl)

**Focus:** To undertake applied research on the sustainable development of irrigated agriculture. To hold annual, post-graduate training courses on irrigation, drainage, and related subjects. To provide technical support and specialists advisory services to irrigation and drainage projects abroad.

## **13. The World Bank - WB**

**Director General** : James D. Wolfensohn  
**Headquarters** : 1818 h Street, NW, Washington D.C.  
**Phone** : (202) 477 1234  
**Fax** : (202) 477 6391  
**E-mail** : [wbes@worldbank.org](mailto:wbes@worldbank.org)  
**Website** : [www.worldbank.org](http://www.worldbank.org)

**Focus:** To fight poverty with passion and professionalism lasting results. To help people help themselves and their environment by providing resources, sharing knowledge, building capacity and forging partnership in the public and private sector.

## **14. Canadian International Development Agency - CIDA**

**Headquarters** : 200 Promenade du Portage, Hull, Quebec, KIA 0G4  
**Phone** : (819) 997 - 5006  
**Fax** : (819) 953 - 6088  
**E-mail** : [info@acdi-cidas.gc.ca](mailto:info@acdi-cidas.gc.ca)  
**Website** : [www.cida.gc.ca](http://www.cida.gc.ca)

**Focus:** It supports sustainable development activities in order to reduce poverty and to contribute to a more secure, equitable and prosperous world.

## **15. Japan International Research Centre for Agricultural Sciences - JIRCAS**

**Director General** : Takahiro Inoue  
**Headquarters** : Tsukuba, Japan  
**Phone** : 81 – 298 – 38 – 6313 / 6330  
**Fax** : 81 – 298 - 6316  
**E-mail** : [head@jircas.affrc.go.jp](mailto:head@jircas.affrc.go.jp)  
**Website** : [www.jircas.affrc.go.jp](http://www.jircas.affrc.go.jp)

**Focus:** To promote the advancement of agriculture, forestry, and fisheries in developing regions of the world through integrated collaborative research programmes. The new research strategy is to develop production and utilization systems in sustainable agriculture, forestry and fisheries in harmony with the environment by conducting research on such topics. To rehabilitate, maintain and improve the utilization of natural resources, with emphasis placed on tropical forest and coastal eco-systems.

## **16. Centre on Integrated Rural Development for Asia and the Pacific - CIRDAP**

**Headquarters** : Dhaka, Bangladesh  
**Phone** : 9556 131 / 9558 751 / 9564 776  
**Fax** : 880 - 2 - 9562 035  
**E-mail** : [cirdap@citechno.net](mailto:cirdap@citechno.net)  
**Website** : [www.cirdap.org.sg](http://www.cirdap.org.sg)

**Focus:** To assist national action, to promote regional cooperation, to act as a servicing institution for its member countries for promotion of integrated rural development through research, action research, pilot project, training and information dissemination. Amelioration of rural poverty in the Asia-Pacific region has been the prime concern of CIRDAP. The programme priority of CIRDAP are set under 4 areas of concern; agrarian development, institutional / infrastructure development, resource development including human resources and employment.

## **17. The Overseas Development Institute - ODI**

**Director General** : Simon Maxwell  
**Headquarters** : 111, Westminster Bridge Road, London SE2 7 JD, U.K.  
**Phone** : 44 (0) 20 - 7922 0300  
**Fax** : 44 (0) 20 – 7922 0399  
**E-mail** : [odi@odi.org.uk](mailto:odi@odi.org.uk)  
**Website** : [www.odi.org.uk](http://www.odi.org.uk)

**Focus:** Our mission is to inspire and inform policy and practice which lead to the reduction of poverty, the alleviation of suffering and the achievement of sustainable livelihoods in developing countries. We do this by locking together high-quality applied research, practical policy advice, and policy-focused dissemination and debate. We work with partners in the public and private sectors, in both developing and developed countries.

**Training / Fellowships:** The ODI Fellowship Scheme places up to twenty young economists a year on attachment to the governments of developing countries. There are currently 40 Fellows working in 17 countries in Africa, the Caribbean and the Pacific.

## **18. International Institute for Environment and Development - IIED**

**Headquarters** : 3 Endsleigh Street, London WC1H 0DD, U.K.  
**Phone** : 44 (0) 20 – 7388 2117  
**Fax** : 44 (0) 20 – 7388 2826  
**E-mail** : [resource.centre@iied.org](mailto:resource.centre@iied.org)  
**Website** : [www.iied.org](http://www.iied.org)

**Focus:** IIED aims to provide expertise and leadership in researching and achieving sustainable development at local, national, regional and global levels. In alliance with others we seek to help shape a future that ends global poverty and delivers and sustains efficient and equitable management of the world's natural resources

### **19. International Development Research Centre - IDRC**

**Headquarters** : P.O. Box. 8500, Ottawa, ON K1G 3 HP, Canada.  
**Phone** : 1 (613) 236 6163  
**Fax** : 1 (613) 238 7230  
**E-mail** : [info@idrc.ca](mailto:info@idrc.ca)  
**Website** : [www.idrc.org](http://www.idrc.org)

**Focus:** To help communities in the developing world find solutions to social, economic and environmental problems through research.

### **20. Food and Agriculture Organization - FAO**

**Director General** : Jacques Diouf  
**Headquarters** : Viale delle Tesse di Caracalla, 00100, Rome Italy  
**Phone** : 39 06 5705  
**Fax** : 39 06 5705 3152  
**E-mail** : [fao-hq@fao.org](mailto:fao-hq@fao.org)  
**Website** : [www.fao.org](http://www.fao.org)

**Focus:** To raise levels of nutrition and pursuit of food security and standard of living, to improve agricultural productivity and to better the condition of rural population.

## **III. South-South Cooperation**

### **1. Third World Academy of Sciences (TWAS)**

**Head Quarters** : c/o The Abdus Salam International Centre for Theoretical  
**Physics (ICTP), Strada Costiera 11, 34014, Trieste, Italy**  
**Phone** : 39 – 40 – 2240 387  
**Fax** : 39 – 40 – 224 559  
**E. Mail** : [twas@ictp.trieste.it](mailto:twas@ictp.trieste.it)  
**Website** : [www.ictp.trieste.it](http://www.ictp.trieste.it)

**Focus:** Grants for scientific meetings in developing countries; research grants programme; associate membership scheme at centres of excellence in the south; TWAS south-south fellowship programme; spare parts for scientific equipment; professorships in science and sustainable development; fellowships for post-doctoral research and post-graduate studies; lectureships in science and sustainable development.

### **2. Third World Network of Scientific Organizations (TWNSO)**

**Head Quarters** : TWNSO Secretariat, c/o The Abdus Salam International  
Centre for Theoretical Physics (ICTP), P.O. Box. 586,  
Strada Costiera 11, Trieste, Italy  
**Phone** : 39 – 040 - 2240 386  
**Fax** : 39 – 040 - 224 559  
**E. Mail** : [twngo@ictp.trieste.it](mailto:twngo@ictp.trieste.it)  
**Website** : [www.ictp.trieste.it](http://www.ictp.trieste.it)

***Focus:*** Grants to institutions in the south for joint research projects; TWNSO prizes in Agriculture and in technology; prizes for promoting the public understanding of science; profile of science ministries; academies and research council in the south; inventory of research and training institutions of excellence in the south; network of international centres for sustainable development in the south.

# **TRANSGENICS**

**R.V.S.Rao**

Principal Scientist, NAARM, Hyderabad

Transgenics or genetically modified organisms (GMOs) are defined as those organisms with a gene or genetic construct of interest that has been introduced by molecular or recombinant DNA techniques. These exclude organisms produced by conventional breeding as well as organisms produced by intra-organism rearrangement of genetic material by physical or by chemical means.

The transgene(s) which when integrated and expressed stably and properly, confer either a new trait to the organism, which was hitherto not present or enhance an already existing trait.

## **Major steps in creation of transgenic Plants and animals**

Gene isolation,  
Selection of vector,  
Cloning of desired gene,  
Specific gene transfer,  
Expression of desired gene.

## **Steps involved in creating transgenic plants in laboratory**

Transfer of suitable explants from the species involved --- Growing the explant on appropriate nutrient medium in vitro --- Induction of callus (an undifferentiated mass of cells) resulting in callus formation --- Preparation of a transgene(s) (gene construct) with promoter --- Gene transfer in to the callus using suitable protocol --- Selecting an appropriate marker system --- Selection of transformed calli --- Regeneration of plantlets from transformed calli --- Transfer of plantlets to pots in the laboratory --- Laboratory evaluation of transgenic seedlings --- Further genotypic and phenotypic analyses.

## **Steps involved in creating transgenic animals in laboratory**

**Collection of one celled embryos in pronuclear stage --- Preparation of plasmid suspension with the desired transgene(s) --- Microinjection of plasmid suspension in to the most accessible pronucleus of one celled embryo --- Oviductal implantation of the transformed embryo in to a pseudopregnant recipient female --- Evaluation of the progeny after their birth by Southern blot hybridization or a related techniques for presence of foreign DNA.**

## **Applications of Transgenics**

Engineering for biotic stress resistance  
– Resistance to insect  
– Resistance to diseases,  
Abiotic stress tolerance,  
Engineering for herbicide tolerance,  
Engineering pollution control,  
Reducing post harvest losses,  
Development of value-added food products,

Floriculture and molecular breeding,  
Transgenic plants as bioreactors.

### Transgenic crops with herbicide resistance

| Herbicide      | Crop   |
|----------------|--|
| Glyphosate     | Soybean, maize, cotton, rape, wheat                  |
| Glufosinate    | Tomato, sugarbeet, wheat, rape, rice, potato, peanut |
| 2,4-D          | Cotton, tobacco                                      |
| Atrazine       | Potato, rape, tobacco                                |
| Dalapon        | Tobacco  |
| Bromoxynil     | Cotton   |
| ALS inhibitors | Maize, tobacco, flax, rape, sugarbeet                |

### ***Mechanisms of action of different herbicides and basis of achieving resistance against them in transgenic plants***

| Active principle of herbicide      | Inhibited pathway                | Target product | Use            | Basis of resistance                              |
|------------------------------------|----------------------------------|----------------|----------------|--|
| Amino acid biosynthesis inhibitors |                                  |                |                |  |
| Glyphosate (Roundup)               | Aromatic amino acid biosynthesis | EPSPS          | Broad spectrum | Over expression of EPSPS gene bacterial aroA gen |
| Sulphonylurea and Imidazolinones   | Branched chain amino acids       | ALS            | Selected crops | Mutant ALS gene                                  |
| Phosphinothric in (Basta)          | Glutamine                        | GS             | Broad Spectrum | Gene amplification bar gene : detoxification     |
| Photosynthesis inhibitors          |                                  |                |                |  |
| Atrazine (lasso)                   | Photosystem II                   | Qb(32kDa)      | Selected Crops | Mutant PsbA gene GST gene: detoxification        |
| Bromoxynil (Buctril)               | Photosynthesis                   |                | Selected crops | Bxn gene: detoxification                         |

### Antibodies and antibody fragments produced in transgenic plants

| Antibody form                 | Valency | Antigen                                      | References               |
|-------------------------------|---------|--|--------------------------|
| Single domain (dAb)           | 1       | Substance P (neuropeptide)                   | Benvenuto et al., 1991   |
| Single chain Fv               | 1       | Phytochrome                                  | Pirek et al., 1993       |
| Single chain Fv               | 1       | Artichoke mottled crinkle virus coat protein | Tavladoraki et al., 1993 |
| IgM (lambda)                  | 2       | NP(4-hydroxy-3-nitrophenyl) acetyl hapten    | During et al., 1993      |
| Fab;IgG(Kappa)                | 2       | Human creatine kinase                        | De Neve et al., 1993     |
| IgG (Kappa)                   | 2       | Transition state analog                      | Hiat et al., 1989        |
| IgG (Kappa)                   | 2       | Fungal cutinase                              | Van Engelen et al. 1994  |
| IgG (Kappa) and IgG/A hybrids | 2       | S. mutans adhesion                           | Ma et al., 1994          |
| SIgA/G                        | 4       | S. mutans adhesion                           | Ma et al., 1995          |

**Table 2. Coat protein-mediated resistance**

| Virus group | Resistance Induced to                       | Host   | Source of Coat protein                 | Reference  |
|-------------|---|--|--|--|
| Tobamovirus | TMS<br>TMS<br>ToMV<br>ToMV<br>TMGMV<br>SHMV | Tobacco<br>Tobacco<br>Tobacco<br>Tobacco<br>Tobacco<br>tobacco | TMV<br>TMV<br>TMV<br>TMV<br>TMV<br>TMV | Powell-Abel et al. 1986<br>Nelson et al. 1988<br>Nelson et al. 1989<br>Stark et al. 1990<br>Stark et al. 1989<br>Stark et al. 1989<br>Anderson et al. 1989 |
| Potexvirus  | PVX<br>PVX<br>PVX<br>PVX                    | Tobacco<br>Potato<br>Tobacco<br>tobacco                        | PVX<br>PVX<br>TMV<br>AIMV              | Henway et al. 1988<br>Hockama et al. 1988<br>Anderson et al. 1989<br>Anderson et al. 1989  |
| Cucumovirus | CMV<br>CMV                                  | Tobacco<br>tobacco   | TMV<br>CMV                             | Anderson et al. 1989<br>Cuozzo et al. 1988   |
| AIMV        | AIMV<br>AIMV<br>AIMV<br>AIMV                | Tobacco<br>Alfalfa<br>tomato<br>Tobacco                        | AIMV<br>AIMV<br>AIMV<br>TMV<br>TSV     | Loesch-Fries et al. 1987<br>Halk et al. 1989<br>Tuner et al. 1987<br>Anderson et al. 1989<br>Van Dan et al. 1988a  |
| Harvirus    | TSV   | tobacco  | TSV                                    | Van Dun et al. 1988a   |
| Tobravirus  | TRV<br>PEBV                                 | Tobacco<br>tobacco   | TRV<br>TRV                             | Van Dun et al. 1987<br>Van Dan and Bol 1988  |
| Potyvirus   | PVY<br>PVY<br>TEV<br>TEV<br>TEV             | potato<br>tobacco<br>tobacco<br>tobacco<br>tobacco             | PVY<br>SMV<br>SMV<br>PaRVS<br>TVMV     | Lawson et al. 1990<br>Stark and Beachy 1989<br>Stark and Beachy 1989<br>Long et al. 1990<br>Murphy et al. 1990   |



|            |       |            |       |                             |
|------------|-------|------------|-------|-----------------------------|
|            | TVMV  | tobacco    | TVMV  | Murphy et al. 1990          |
| Carlavirus | PVS   | N debneylt | PVS   | Mackenzie and Tremaine 1990 |
| Nepovirus  | TBRV  | tobacco    | GCMV  | Candresee (pers. Comm.)     |
| Furovirus  | BNYVV | Sugar beet | BNYVV | Kallerhof et al. 1990       |

### Field reality of transgenics

- Field trials and commercialization of transgenic crops
- Genetically modified crops
- Global market for transgenic crops
- Transgenic crops – what next?
- R & D on transgenic crops

#### *Transgenic field crops*

##### **Plants**

Tobacco  
Alfalfa  
Cotton  
Sunflower  
Moth Bean  
Soybean  
Safflower  
Green Bean  
Cowpea  
Chickpea

##### **Method and gene transferred**

At, NPT-II  
At, NPT-II  
At, NPT-II  
At, NPT-II  
At, NPT-II  
At,GUS  
At,GUS  
At,GUS  
EL,GUS  
At,NPT-II

#### **Transgenic vegetable crops**

##### **Plants**

Carrot  
Tomato  
Cucumber  
Potato  
Oil seed rape  
Lettuce  
Cauliflower  
Celery  
Brinjal  
Sugarbeet  
Bell pepper  
Peas  
Cabbage  
Sweet potato

##### **Method and gene transferred**

Ar, NPT-II  
At, NPT-II  
Ar, NPT-II, At, Ar, NPT-II  
At, NPT-II  
At, NPT-II  
At, NPT-II  
Ar, mannopine, At, NPT-II,  
At, NPT-II  
At, NPT-II  
At, NPT-II  
At, GUS  
At, NPT-II  
At, GUS  
MB, GUS

### Transgenic fruit crops Plants

Walnut  
Apple  
Peach  
Grapevine  
Papaya

Strawberry  
Citrus spp.  
Apricot  
Peach

### Method and gene transferred

At, NPT-II  
Ar, NPT-II  
At, Octopine  
At, NPT-II  
MB, NPT-II, At,  
Cp gene  
At, GUS  
At, GUS  
At, cp gene  
At, GUS

### Transgenic forest plants Plants

Poplar  
Douglas fir  
Neem  
Black spruce  
Jack Pine  
Willows  
Madagascar  
Foxglove  
Red spruce & White spruce  
Larch  
Sweetgum  
Sandalwood

### Method and gene transferred

At, NPT-II, 'aroA'  
At, Octopine, NPT- II  
At, Octopine, NPT-II  
E1, CAT  
E1, CAT  
At, NPT-II  
Ar, Agropine  
At, GUS  
MB, GUS, NPT-II  
MB, GUS, NPT-II  
At, NPT-II, Bt gene  
At, NPT-II

### Transgenic lines in advanced stage of development or field testing in India

| Institute  | Crop    | Transgene inserted | Aim   | Current status   |
|--|---------|--------------------|---|--|
| Central Tobacco Research Institute                       | Tobacco | Bt toxin gene      | Resistance to tobacco caterpillar ( <i>Spodoptera litura</i> )      | One season of contained field trial completed; further evaluation under progress |
| Central Potato Research Institute, Shimla                | Potato  | Bt toxin gene      | Resistance to Potato Tuber Moth ( <i>Phthorimaea operculella</i> )  | Ready to undertake glasshouse trials   |
| Indian Agricultural Research Institute (IARI), New Delhi | Brinjal | Bt toxin gene      | Resistance to shoot and fruit borer ( <i>Leucinodes arbonalis</i> ) | Two seasons of field trials over; further evaluation in progress                 |
| IARI, New Delhi  | Rice    | Bt toxin gene      | Resistance to yellow stem Borer ( <i>Scirpophaga incertulas</i> )   | Ready for greenhouse trails  |

|   |                 |                               |   |   |
|---|-----------------|-------------------------------|---|---|
| IARI, New Delhi                               | Tomato          | 8t toxin gene                 | Resistance to fruit Borer (Helicoverpa armigera)      | One season field trial over; further evaluation in progress |
| IARI, New Delhi                               | Cabbage         | Bt toxin gene                 | Resistance to Diamond Back Moth (Plutella xylostella) | Ready for green house trial                                 |
| IARI, New Delhi                               | Tomato          | ACC synthase gene             | Delayed fruit ripening                                | Ready for greenhouse trials                                 |
| IARI, New Delhi                               | Brassica Juncea | Annexin gene from Arabidopsis | Tolerance to moisture stress                          | Field trial in progress                                     |
| IARI, New Delhi                               | Potato          | Osmotin                       | Tolerance to moisture stress                          | Ready for greenhouse trials                                 |
| Directorate of Rice Research (DRR), Hyderabad | Rice            | Bt toxin gene                 | Resistance to Yellow stem border                      | Ready for greenhouse trials                                 |

| <b>Institute</b>                            | <b>Crop</b>       | <b>Transgene</b>           | <b>Aim inserted</b>                        | <b>Current status</b>   |
|---|-------------------|----------------------------|--|---|
| DRR, Hyderabad                              | Rice              | Chitinase gene             | Resistance to sheath blight disease        | Ready for greenhouse trials   |
| Bose Institute, Calcutta                    | Rice              | Bt. toxin gene             | Resistance to Yellow Stem Borer            | Greenhouse trials in progress   |
| Delhi University South Campus, Delhi        | Mustard rapeseed  | Bamase and Barstar         | Pollination control for hybrid development | Ready for field trials  |
| Jawaharlal Nehru University, New Delhi      | Potato            | Ama-t gene from Amaranthus | To improve nutritional quality             | Transgenic lines under evaluation under containment conditions                                |
| Central institute of cotton research Nagpur | Cotton            | Bt toxin gene              | Resistance to lepidopteran insect pest     | Greenhouse trials in progress   |
| M/s Proagro PGS India Ltd., New Delhi       | Mustard/ Rapeseed | Bamase and Barstar         | Pollination control for hybrid development | Contained field trials in more than 15 locations over; Open-field research trials in progress |
| M/s Proagro PGS India Ltd.                  | Tomato            | Bt toxin gone              | Resistance to lepidopteran insect pests    | One season contained field trial over; further trials in progress                             |
| M/s Proagro PGS India Ltd                   | Brinjal           | Bt toxin gene              | Resistance to lepidopteran insect pests    | Glasshouse experiments in progress  |

|                           |             |                     |  |   |
|---------------------------|-------------|---------------------|--|---|
| M/s Proagro PGS India Ltd | Cauliflower | Barnase and Barstar | Pollination control for hybrid development | Glasshouse experiments in progress          |
| M/s Proagro PGS India Ltd | Cauliflower | Bt toxin gene       | Resistance to insect pests                 | Glasshouse experiments in progress          |
| M/s Proagro PGS India Ltd | Cabbage     | Bt toxin gene       | Resistance to insect pests                 | Glasshouse experiments in progress          |
| M/s Mahyco Mumbai         | Cotton      | Bt toxin gene       | Resistance to lepidopteran insect pests    | Field trials in over 40 locations completed |

### **Biosafety concerns**

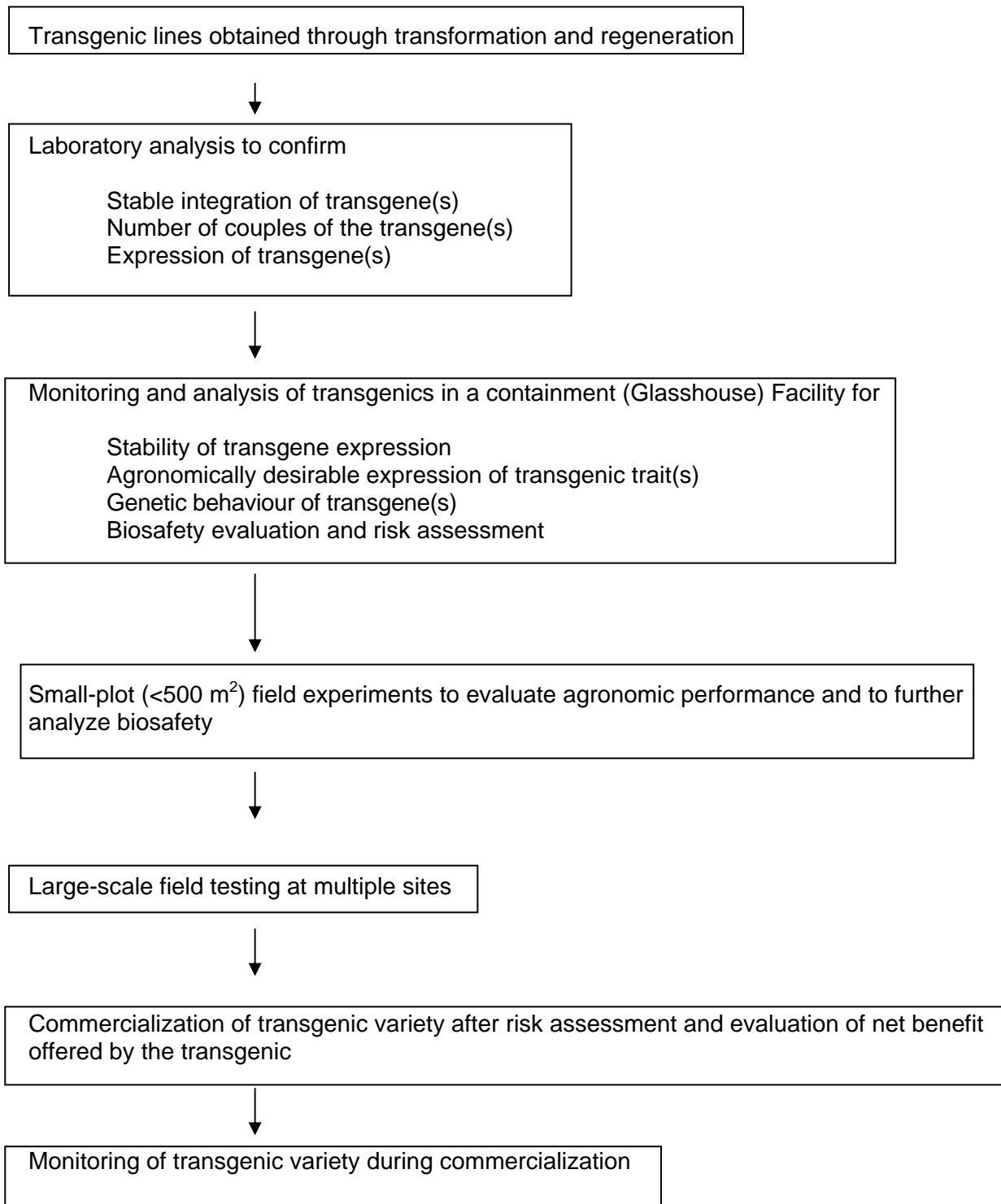
- Criticism on transgenics
- Mechanisms and potentials different from conventional breeding methods
- Incomplete knowledge about living systems impedes assessment of risks
- Surprise effects on environment
- Few studies on associated risks
  
- Risk assessment
- Recognition and characterization of possible unwanted impacts or hazards
- Estimation of scale and severity of a possible unwanted impact
- Assessment of chance of a specified unwanted impact to occur
- Quantification of risk
- Assessment of importance of some estimated risks against the background of possible costs and benefits.
  
- Gene flow or dispersal from transgenics
- Proximity of the transgenic with compatible wild relatives
- Sexual compatibility between crop plant and wild species or weed
- Mating system and mode of pollination
- Synchronization of flowering of crop and wild relative or weed
- Relative fitness of weed-crop hybrid
- Mode of seed dispersal
- Nature of transgenic character itself
  
- Strategies to prevent gene flow or transgene escape
- Isolation zone
- Trap crop
- Male sterility
- Other strategies
  - Removal of flowers from transgenic plants
  - Removal of sexually compatible species
  - Chloroplast transformation (cytoplasmic DNA)
  
- Biosafety of antibiotic-resistance markers
- Non target effects
- On honey bees, green lacewing, ladybird beetle, parasitic wasps, birds, rodents and mammals

- Weedliness or Invasiveness of transgenics
- Creation of Super-weeds
- Creation of Super Viruses through heteroencapsidation or recombination
- Food safety and allergenicity

### **Regulations and risk assessment**

- Why regulate
- Kinds of regulations – product vs process
- Regulations in various countries
- Three tier mechanism of evaluation of transgenics in India
- Institutional Biosafety Committee (IBSC)
- Review committee on Genetic Manipulation (RCGM) under Department of Biotechnology (DBT)
- Genetic Engineering Approval Committee (GEAC) of Ministry of Environment And Forests (MoEF) followed by approval from Ministry of Agriculture (MoA) after approval from All India Coordinated Trials.
- State Biotechnology Coordination Committee (SBCC) and District Level Committees (DLC) are also involved in the inspection and monitoring of the experiments at the field sites.
- Biosafety guidelines'
- When, where and how the trials should be carried out?
- Can the transgenic plant escape, survive and multiply in the wild or as a weed in the region of the proposed trial?
- Can the gene dispersal through pollen occur in the trial under the proposed experimental protocol?
- Avoidance of possible risks from commercialization which escaped from notice during evaluation.
- Monitoring of transgenic crops
- Potential risks identified during safety assessment
- Scientifically sound objectives and protocols
- Period of monitoring should be defined case by case
- Field trials and commercialization
- Balanced and dynamic regulatory system

## Transgenic Plants – From the Lab to the Field



### New developments

- Genetic use restriction technologies (GURTs)
- Terminator gene technology
- Verminator gene technology

## **The challenges**

Intellectual Property Rights (IPR)  
Plant breeder's rights  
Farmer's privileges  
Socio-economic implications

Impact on farm saved seed, biodiversity, access of input delivery systems to small farmers, extension services, inequality of income and wealth, potential trade shifts, competition in a liberalized and globalized market etc.

Ethical issues

Concentration of key technologies in the hands of few  
Expensive for resource poor farmer  
Impartiality, transparency and fairness in administration of trust with regard to genetic resources  
Respect for national regulations and international conventions  
Responsibility and integrity in science

Public awareness and acceptance

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# WTO AND AGRICULTURE

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## WTO – The Historical Background

Attempts to reform global trade are not new. Immediately following the Second World War, an attempt was made by around 50 nations to create an organization of the of the “Bretton Wood” type like the International Bank for Reconstruction and Development, popularly called the World Bank, and the International Monetary Fund, to oversee arrangements of international commerce, An ambitious charter, including besides trade disciplines, rules on commodity agreements, restrictive business practices, international investment and services was drawn up to set in place this proposed international organization to be called “International Trade Organizations” (ITO). Although the ITO charted was finally agreed upon at Havana in March 1948 after several years of deliberations, many countries, especially the United States of America, failed to obtain ratification of this Charter in their national legislatures. The result was

### BOX 1

#### THE GATT ROUNDS

| <i>Year</i> |                              | <i>Place/Name</i>  |                  |
|-------------|------------------------------|--|------------------|
|             |                              | <i>Subject Covered</i>   | <i>Countries</i> |
| 1947        | Geneva                       | Tariffs  | 23               |
| 1949        | Annecy                       | Tariffs  | 13               |
| 1951        | Torquay                      | Tariffs  | 38               |
| 1956        | Ganeva                       | Tariffs  | 38               |
| 1960-1961   | Ganeva<br>(Dillion<br>Round) |  |                  |
| 1964-1967   | Ganeva<br>(Kennedy<br>Round) | Tariffs and anti-dumping<br>measures   | 62               |
| 1973-1979   | Geneva<br>(Tokyo<br>Round)   | Tariffs, non-tariff measures,<br>“framework” agreements.   | 102              |
| 1986-1994   | Geneva<br>(Uruguay)          | Tariffs, non-tariff<br>measures, rules, services,<br>Intellectual property dispute<br>Settlement, textiles, agriculture<br>Creation of WTO. etc. | 123              |

that the International Trade Organization never came into existence (WTO, 1988). But what did come into existence was the General Agreement on Tariffs and Trade (GATT).



From its birth in 1947, GATT attempted to create a “framework that would regulate international trade stimulates international commerce” (Healy et al.). Although GATT continued to dominate the rules of international commerce during the past five decades, GATT remained an agreement without a formal organization to enforce the rules set out for conducting international trade the rules were at best provisional and interim. Since the Agreements were never ratified in the legislatures of member’s countries (called “contracting parties”), they were not permanent.

Attempts were, however, made in successive GATT Rounds of negotiations to progressively make global trade freer, liberal and predictable (Box1).

Following the Uruguay Round of negotiations, the longest and most talked about round of trade talks between nations, GATT was replaced by the World Trade Organization. The WTO agreements include the GATT agreements but in an expanded form to cover more sectors such as agriculture. Also, unlike the GATT that was till then concerned only with trade in goods the scope of the WTO has been enlarged to include trade in services and trade in ideas. The WTO is different from GATT in that the rules governing international trade are no longer provisional and interim but are permanent in nature. It is also an organization that has been constituted to oversee multilateral global trade to ensure that there is fair and undistorted trade between national and to settle trade disputes between signatory countries, now called “members”. The multilateral trading system envisaged under WTO is based on the principles of non-discrimination, which implies equal treatment of all trading partners and equality of treatment between locally produced goods and foreign goods; free trade, which implies reduction of barriers in order to encourage trade; and predictability, which implies openness through binding. The keywords here are competitiveness and efficiency and the objective is to provide a level playing field to all countries in so far as trade with other nations is concerned. The WTO seeks to eliminate all kinds of artificial interventions in so far as trade among countries is concerned based upon the principles of non-discrimination, predictability, and free and more competitive trade so that countries are able to cash on their comparative advantages in production of agricultural commodities.

### **Agreement on Agriculture (AoA)**

The Agreement forms a part of the Final Act, which was a consequence of the Uruguay Round of multilateral trade negotiations, signed on 15<sup>th</sup> April 1994. The Agreement is expected to provide a basis for a long-term reform of agriculture trade and domestic farm policies over the years to come. The agreement primarily aims at creating a fair competition amongst all member countries. There are many distortions which very strongly prevent achieving the objectives outlined. While attempting to remove these distortions, each of the member countries would essentially address their own trade interest.

It is necessary to recognize the trading block as a whole that primarily consists of two groups:

***One involving countries that have very strong export potential; and***

The other of those which are import-dependent and also have a domestic activity to protect.

Undoubtedly, there are a number of countries interested in promoting their exports and also in protection of their exports and also in protection of their domestic market.

Agreement on Agriculture (AoA) focuses on four important components namely, market access, removal of quantitative restrictions, domestic support measures and

reduction in trade distorting subsidies. The details of compliance required under AoA are as follows:

### **Market Access**

Tariffication-change from non-tariff to tariff, thereby rationalizing the access.

Negotiable restrictions on tariff and binding lines drawn for tariffs.

Guaranteed access at a pre-decided share of domestic market.

Special safeguard measures for importers.

Safeguards against eventualities like-import surge, world price fluctuations and developing economies.

### **Export Competition**

Defined limits on budget expenditure on existing export subsidies. Phased programs to reduce it.

Ban on introducing new export subsidies.

Adherence to food aid rules.

Other subsidies should not be applied that would undermine the cut in export subsidies.

Export credit and credit guarantees to be covered under a separate agreement.

### **Domestic Support Policies**

Reduction in total distorting domestic subsidies.

Separate treatment for developing countries.

Exemption for developing countries based on aggregate measures of support.

Thus, the agriculture text of the Uruguay Round agreement deals with two disciplines. One, relating to the border measures and the second, concerning the domestic distortions in the agricultural economy, which are required to be calculated and put together as per the recommended formula to determine what is known as aggregate Measure of Support (AMS) which is reflected as a percentage of the aggregate value of agricultural output. After calculating AMS, the stipulated allowance is 5 percent for developed nations and 10 percent for developing nations. More clearly, when developed nations exceeded the recommended limit of 5 percent, they were required to lower it by 20 percent over six years from January 1, 1995. Whereas developing nations are required to reduce Estimated Measure of Support (EMS) by 13.3 percent in a span of ten years. It may be noted that excepting Bhutan, none of the South Asian countries have an AMS level beyond 10 percent.

Under the provision of market access clause, it is required that the member countries convert all the existing quantitative trade restrictions to tariff on in other words resort to the process of tariffication. The tariff rates shall have to be below the bounded tariff rates

agreed by the member countries. Such tariffication processes are expected to go down by an average of 36 percent in case of developing countries. But a quick examination of pre Uruguay Round tariff rates would reveal that the developed countries had excessively high tariffs along with non-tariff barriers and a 36 percent reduction by the developed countries may not mean much. Therefore it becomes very necessary to examine, analyze and ascertain the product-wise, tariff and non-tariff barriers for pre-Uruguay Round of 1986, Pre-WTO 1993-94 and the present 1999-2000 periods.

Clarification of non-tariff barriers undertaken by the WTO members shows a similar advantage for the developed countries. FAO has estimated that the average tariffs (*ad valorem* and specific duties taken together) for the OECD countries for the first year of the implementation of the tariff reductions (i.e. 1995) was 214 percent for wheat (186 percent for wheat flour), 197 percent for barley, 154 percent for maize and 11 percent for rice, respectively. In case of the developing countries, on the other hand, the average bound rate of duty (including those that tariffied) for the three major cereals are 84 percent of wheat, 90 percent for maize and 89 percent for rice, respectively.

With the more dominant players in the global agricultural scenario intent upon keeping their market share in a manner that blatantly violates and AoA, the possibilities of additional market access for the developing countries that could take advantage of a genuine opening up of trade in this sector have remained a mirage.

AoA also bound the countries to ensure a minimum market access, that is importing at least 3 percent of the agricultural products consumed-without quantitative restrictions – which would have to be raised up to 5 percent over six years from January 1, 1995. However, this is not a problematic stipulation for countries like India, Pakistan and Bangladesh, which are covered under article XVIII B of GATT. The article points out that countries having a balance of payment (BoP) problem can use quantitative restrictions as a measure.

The second important component under the AoA relates to export competitiveness. This focuses on providing an atmosphere of free trade by removing the barriers to trade and trade distorting subsidies existing in the member countries. The Most Favoured Nations (MFN) treatment also comes under the purview of providing free export competitiveness.

Export subsidies are the most distorting trade tool because the level and direction of trade is directly determined by government subsidies. Today, the European Union (EU) is the only substantial export subsidizer-nearly all other countries agreed not to use or have only limited recourse to use, export subsidies in the last round of negotiations. EU farmers, responding to domestic prices frequently twice the world price, produce more products than can be consumed in Europe, but at such high prices that they subsidies push other competitive suppliers out of the market (which is expensive and unfair) and discourage production in countries that have comparative advantage in agricultural production (which is wasteful and is threatening both to the environmental and to future farm production needs).

The discipline regarding export subsidy presents an inherent advantage for the larger trading countries like the US and the members of the EU which have used export subsidies to increase their shares in the global market. AoA provides that countries not using any subsidies during the period 1986-88 (which has been identified as the “base period” for the Agreement) are prohibited from introducing any new subsidies in the WTO regime. As a result of this stipulation, a relatively small number of countries, which have been using export subsidies, were given the opportunity to use these subsidies. For instance, in case of wheat,

the top five users of export subsidized wheat exports (which was over 50 million tons) every year between 1986 and 1990. It has been estimated that even when all the cut backs in line with the commitments in the AoA are in place, These five exporters would be able to channelise about 40 million tons of subsidized wheat into the world markets, which roughly accounted for about 40 percent of the wheat trade in the mid-1990s. The corresponding figures for coarse cereals are 22 percent and poultry 25 percent.

The third important aspect relates to the domestic policies and the support measures provided in the domestic economy. This includes phasing out of trade distorting domestic subsidies. Domestic support is contained in the Green Boxes and Blue Boxes. It is very important to have a general understanding of the contents of these two boxes. The green box criteria have not been clearly defined and the presumption that the support contained in the Green Box has utmost minimal trade-distorting effects is also not completely true. The direct payments given to the farmers give boost to their income. Payments given to the farmers, though not having any direct relevance to the production, enable the farmers to slowly use such incomes for increasing their production level. Thus, it becomes highly necessary to revisit the decision to exempt the Green Box subsidies from the over all AMS.

Domestic subsidy programs are often the root cause of other trade-distorting policies. Subsidy policies that increase domestic prices above world price level can be maintained only if price-competitive imports are restricted. Additionally, over-production generated by high domestic prices can be sold on world markets only with export subsidies that bring the price down to the world price. While reigning in distortive domestic subsidy programs has value in its own right for rationalizing agricultural production, the WTO negotiations will focus on their trade-distorting elements.

### **Implication of AoA on India**

Implications of AoA on India may focus on the following salient features:

Because of extremely diversified agriculture sector, we may not be able to effectively participate in international trade as it involves huge investment.

The diverse regions will be at the receiving end both from the point of view of attracting investments towards agriculture as well as the non-availability of plough back surplus in advancing agriculture sector.

India's comparative advantage in certain commodities may help in increasing the exports. However, this depends on continued positive international demand and continued advantage between the domestic and world prices.

Necessity to stabilize the non-consistent, volatile nature across markets.

Specific steps needed to design schemes for reduction of export marketing costs as well as the domestic and international freight charges by recasting the present subsidy regime.

There may be sudden spurt in import of certain commodities specially the commodities the prices of which are less in world market.

The higher production costs may lead to reduced exports.

There is a need to fine-tune the balance between domestic demand, exportable surplus and imports.

The cheap imports of food grain may bring misery to farmers particularly in backward areas.

The process may lead to corporatisation of Indian Agriculture and a large number of small and marginal farmers may become landless.

Conversion of Indian agriculture into cash crops or export-oriented crops may raise the question of food security.

Heavy investment needed to provide value addition to agricultural commodities.

Only a handful of MNCs may control agriculture sectors-and thus create havoc from inputs to the price of finished products.

India should strongly seek a hefty reduction in domestic support to agriculture by the developed countries. India could ask for first capping up this support, at product-specific level, eliminating all spikes, and then negotiate for major reduction in support. India may also negotiate for the right to impose countervailing duties in agriculture equivalent to the export subsidy and/or domestic support by the exporting country on specific commodities. To build a strong case on these lines, India needs to invest a bit on research on these issues than in rhetoric.

A country like India needs, therefore, to prepare itself for competing with low-cost farm products rather than expecting a significant rise in their prices via reform-induced reduction in the export surpluses from the developed countries. Incidentally, this scenario should serve to dispel fears that those of the least developed countries which are net importers of food stand to lose heavily on account of the rise in the prices of food following the reduction of farm support in the developed countries.

Among the more significant issues included in the AoA that has not been adequately addressed is the one concerning the non-trade concerns. The non-trade concerns include the crucial dimension of food security, the importance of which cannot be underestimated for a country of India's size. In this context, it may be emphasized that food security cannot be achieved merely by relying on trade. This is mainly because of the fact that the global buffers have been adjusting downwards over the past few years as a result of which the demand-supply position could become extremely tenuous. In such a situation, the squeeze on global surpluses would seriously affect the prospects for the other net food importing developing countries.

It can thus be argued that the AoA should focus on providing opportunities for the domestic production systems to be beefed up in order to meet the objective of food security. For this to be achieved, considerable re-ordering of the priorities of the AoA in the forthcoming negotiations would be required, and this would only be possible if the developing countries can display adequate negotiating strength.

As the signatory of the WTO, India has to abide by the stipulations on agricultural trade. This obviously requires the country to take following steps:

To quantify AMS to agriculture, India would have to go for tariffication of all non-tariff measures.

Progressive lowering of AMS of both kinds which are produce-specific subsidies and input subsidies.

Offer market access by lowering the existing level of tariff protection.

Slash exports subsidies on commodity albeit gradually by notification the WTO through schedule.

Keeping in view these constraints that Indian farming is faced with; the government should take maximal advantage of the support measures provided in the WTO Agreement as well as, if required, negotiate for perpetuation of support regime to agriculture. The categories that are not to be accounted for in AMS, under the existing provision of support measures, and so are not subject to reduction under WTO are:

### **Green Box Measures**

These comprise government assistance for researchers, pest and disease control, training extension and advisory services. They also include public stock building for food security purpose and domestic food assistance direct payments to producers for income insurance etc.

### **S&D Box Measure**

This allows for special and differential treatment as regards investment subsidies in agriculture and agriculture inputs services.

### **Blue Box Measure**

This permits due payment under production limiting programs and has relevance for USA and other developed nations.

So If India has to become internationally competitive in agribusiness, the Government must not lose time in devising an elaborative policy program for support to the country's agriculture under the special measures of green box and S&D to ensure rise in production, enhancement of quality and decrease in cost per unit of production. The country would have to carry out these in a time-bound manner for overcoming its farming constraints and strengthen its pluses to secure a stronger position in the global agricultural trade. It goes without saying that for sustaining high levels of economic growth, particularly in the WTO regime, there is no escape from agricultural reforms. These reforms have to be multifaceted and be directed to increase incentives to produce, make technology and render other supply-side factors more effective. Besides, there is a need to rationalize subsidies and promote investment and, importantly, ensure an effective protective cover for the poor. Such multi-faceted reforms can usher in a higher growth in agriculture while triggering growth in other sectors and influencing positively the country's economy at large.

The produce-specific support for Indian agriculture in the year 1995-96 the year for which latest official information from WTO is available-was negative to the extent of 38.5% (Gulati, 2001). However, because of the recent fall in the international prices of farm products and the steep rise in the minimum support or procurement prices for wheat and rice in the country, it is possible that the rate of dis-protecting would now be much lower. Since the non-product specific support amounts of 7.5% of the value of agricultural production, the AMS to Indian agriculture could still be well below the deminimis of 10% in terms of the Uruguay Round stipulations. As it is, input subsidies to resource poor farmers, which come

under non-product specific support, are exempt from reduction commitments under the WTO provision. If India avails of this, the non-product specific support may come down to less than half of what is being shown.

In view of this, it may not be in India's interest to fight within the WTO for greater domestic support to agriculture, especially if it can blunt our opposition to slow reduction in farm support and inadequate access to markets in the advanced countries. For its further public growth, Indian agriculture is in need for substantial public investments in irrigation, power, roads, and agricultural research and extension, rather than subsidies on inputs. Indeed, there is a consensus now among planners and policy makers that the declining investment in agriculture is basically attributable to the mounting subsidies on irrigation, power and fertilizers (Government of India, Planning Commission, 2001).

As for the protection through tariffs, India has already negotiated tariff bindings at the level of 100% for raw commodities, 150% for proceed agro-commodities and 300% for most edible oils. These may be considered sufficient to protect the relevant commodities against cheaper imports sustained by high domestic support in countries of their origin. If prices of edible oils have fallen steeply in the country recently, despite high tariff bindings at 300%, it is due to the failure of our market intelligence, lack of alertness and inability to act promptly to raise import duties (Chand, 2000; Gulati, 2001).

The share of exports of agriculture and allied products on the total exports declined from 18.9 percent during 1997-98 to 17.8 percent during 1998-99. During the same period, the value of exports of agriculture and allied products amounted to US\$ 5994 million, showing a decline of 9.6 percent from a level of US\$ 6634 million in 1997-98. As against this, agricultural imports related to food and other items constituted 5.8 percent of the total imports during 1998-99, as compared to 4.0 percent during the previous year. During 1998-99, the value of agricultural imports aggregated US\$ 2409 million as against US\$ 1678 million during the previous year recording a growth of 43.6 percent.

The public sector capital investment in agriculture has been declining from Rs.4970 crore in 1994-95 to Rs. 4776 crore in 1995-96 and further to 4347 crore in 1996-97 which, of course, marginally improved to Rs 416 crore (at 1993-94 prices) in 1997-98. The private sector investment in agriculture has been registering an increasing trend over the last four years. It increased from Rs. 13244 crore in 1994-95 to Rs. 15555 crore in 1996-97 and further to Rs. 16579 crore in 1997-98. The rising trend in the private investment in agriculture is attributable mainly to accelerated flow of institutional credit. Government may have to create conducive climate for timely repayment of bank credit as problem of high over dues and subsequent building up of high over dues and subsequent building up of huge non-performing assets in farm sector has very adversely affected in increasing the flow of credit.

Co-ordination among the various ministers and departments-ministries for agriculture, commerce, finance, APEDA, RBI, NABARD on one hand and with state governments on the other-has to improve considerably. Market information with regard to international trade, production, prices, quality, seasonality, surplus/deficit, etc. should be promptly and timely collected, analyzed and disseminated among the producers and exporters.

Immediate survey needs to be undertaken to identify those pockets which have all the required infrastructure to support export oriented crops so as to take full advantage of market access. Private sector in close co-operation of the NABARD can formulate projects for raising export-oriented crops and area can be designated as agricultural export promotion zone where all facilities should be provided to facilitate production, processing

and export. Policy to restructure the small and marginal holdings through prevention of fragmentation of holding and accelerating the pace of consolidation of smallholdings. Comprehensive review of land reforms and formulating a new policy on land reforms including land and water resources. Involvement and commitment of state governments for playing a positive role in the development of agriculture in the light of WTO requirements.

Indian farming has on one hand serious challenges to contend with and on the other, has huge opportunities. As a geographically vast country with 329 million hectare land and with great diversity in genetic resources and agro climate, possibly cultivation of every crop is possible in the country. When WTO rules come into force, our global competitiveness will be judged on the basis of our ability to produce food and fiber of international quality at a comparatively lower cost. With growing urbanization, there is a shortage of land under agricultural crops even as the food requirement is growing substantially. So we are required to augment food productivity in the available land.

Apart from meeting the domestic requirement, India, with its rich genetic resource bases, undoubtedly has considerably large potential which if harnessed would place the country in the forefront of the global agricultural trade. However, before realizing this goal, the assessment of our existing potential and shortcomings is essential. Besides enormous genetic bases and agro climatic diversity, India has the strengths in its cheap labor and enterprising farmers. The lacking are the low level of mechanization, predominantly small landholdings, practice of conventional as also outmoded farming practices, low use of farm inputs, poor post-harvest handling and poor irrigation facilities. The constraints in an ample measure negate the available strengths at present.

The fundamental daunting task facing India today is stepping up food productivity to address the need of our burgeoning population but also exploiting our vast export potential for our farm produce. In WTO-directed trade regime, competitiveness of a country will be assessed by its relative advantage. Currently, USA produces wheat at merely 60 percent of the cost at which India produces it. Likewise, in several other items, India's per unit cost of production is on a higher side of the world average. In this situation, either the farmers have to consider shifting cultivation of the crops which prove to be cost-effective or bring down the cost of production. That is much unlikely, keeping in view of the socio-economic, cultural and food habit related causes.

What India can do most in these circumstances is to push up productivity and slash cost of production. This can be accomplished by speedier commercialization of biotechnological derived research products, right use of inputs, greater farm mechanization and practice of effective plant production measures. To prevent losses, efficient due importance would have to be given to post-harvest, as there is more waste of fruits and vegetables in the country than what is consumed in the UK.

### **Liberalization policy pertaining to Agriculture**

The Government of India initiated economic liberalization process in the 1990's. Some of the specific liberalization policies pertaining to Agriculture include the following:

- |      |   |
|------|---|
| 1991 | Removing a few items from negative list of imports, shifting of commodities out of the restrictive list, shifting a few items from OGL to limited permissible list. A system of advanced exporters with duty free access to imports procedures simplified.<br>EXIM scripts facilities for a number of agricultural commodities and allied products like fish products, cashew, fish, fresh fruits, vegetables, cut flowers, |
|------|---|



|               |  |
|---------------|--|
|               | plants, plant material, spices, packed fruits, vegetable products, instant tea, instant coffee, etc.<br>Decanalisation of jute pulp, Manila Grass, Raw fibre, Raw jute in imports and decanalization of castor oil, molasses and sugar.  |
| 1992-97       | Duty free licensing scheme for agricultural exporters, introduction of special import license.<br>Reduction in number of restricted items to 215.<br>Agricultural imports other than cereals, oilseeds, and edible oil decanalized.<br>Quantitative restriction removed on agricultural commodities.<br>Export controls on all common varieties of rice abolished.<br>Import of palm oil put on OGL<br>All edible oils except coconut oil and palm oil on OGL.<br>Export control on sunflower seeds, rapeseed and mustards removed.<br>Sugar imports delicensed. |
| 1997-01       | Import restrictions on cloves, cinnamon and cassava converted to canalization.<br>Export of sterilized milk, vegetable oil except groundnut oil delicensed.<br>Pulses, paddy, rice continue on the list of export.   |
| April<br>2002 | 80 items broadly coming under the agriculture and allied sectors were removed from the list of items having quantitative Restrictions  |

### ***Tariff Policy Revised***

In a bid to boost agricultural exports particularly food grains, government is considering a proposal for granting WTO-compatible subsidies to reduce the costs of marketing exports of agricultural products. The WTO agreement on agriculture permits developing countries to provide support for handling, upgrading and other processing costs as well as to reduce the cost of international and internal transport and freight. A significant aspect of the WTO provision is that developing countries are not required to undertake any reduction commitments in respect of the export subsidies pertaining to freight and transport.

Export-Import policy for 2001 unveiled by the Union Government lifted Quantitative Restriction (QR) on imports and announced a strategy to promote agricultural export as a step towards achieving a one percent share in global trade. It was estimated that every one percent switch would divert about Rs. 8500 crores additionally in favour of agriculture and about \$20 billion would be transferred to the agriculture sector from the non-agricultural sector in the next few years. This additional rural purchasing powers would create a phenomenal effective demand. Market access initiative would be launched to assist the industry with a product and country specific focus. Several concessions had been announced for the special economic zones (SEZ) including developer's infrastructure status under Income Tax Act. The Exim policy asserted that the market access initiative announced would strengthen "commercial intelligence" in a bid to push up exports to \$75 billion in 3 years.

It also established "war rooms" containing high power teams to monitor import levels of 300 sensitive items including poultry, milk, fruit, and other edible items, allaying farmers' fear that the Exim policy had opened the floor gates to cheap imports. The government will establish "regional rural motor" by boosting agri exports through various measures. This will

lead to internationalization of India's agriculture and the terms of trade which had long been in favour of industry were expected to shift in favour of agriculture.

#### **4. India's New Farm Policy and WTO**

Agriculture in India has been significantly important from the point of view of food security as well as overall economic growth. India having been the signatory of the WTO will have to reorient its agricultural development policy taking into consideration the prescriptions of the WTO so as to ensure that India can take full advantage of the provision of the WTO and minimize the adverse impact of these provisions.

International prices of agricultural commodities, exchange rate and cost of products are the important parameters that have major influence on competitiveness of the farm sector, but India has no control over the international prices of the farm commodities. However, through reducing the cost of production it is possible to improve the competitive strength of the farm sector. India is proud of being ranked first in milk production and second in fruits, vegetables, wheat and rice, However, productivity per unit has been very low, cost of productions high and quality needs to be improved considerably.

Privatisation of agriculture and price protection to farmers in the post-Quantitative Restrictions (QRs) regime will be part of the government's strategy to synergies agricultural growth. The focus of the new policy is on efficient use of resources and technology. Making credit available to farmers and protecting them from seasonal and price fluctuations are the salient features of the policy. Over the next two decades it (the policy) aims to attain a growth rate in excess of four percent per annum in the agricultural sector.

In view of dismantling of QRs on imports as per the WTO Agreement on agriculture, the policy has recommended formulation of commodity-wise strategies and arrangements to protect farmers from the adverse impact of undue price fluctuations in the world market and promote exports. The government would enlarge coverage of the futures markets to minimize fluctuations in commodity prices as also for hedging their risks. The policy hoped to achieve sustainable development of agriculture, create gainful employment on a self sustaining basis in rural areas, raise standards of living for farming communities, preserve environment and a serve as a vehicle for building a resurgent national economy.

To promote agricultural exports. The commerce ministry is preparing a new policy which proposes providing farmers the latest biotechnology and extensive market intelligence, greater support under the WTO-compatible green and amber boxes, removing restrictions on inter-state movement of commodities, and assisting corporates interested in export-oriented between the departments of commerce, agriculture and biotechnology. These three departments need to now act in unison instead of spreading their promotional efforts thinly. The vital difference between the new policy and all previous efforts would be that we would now be completely market driven in our approach.

Instead of producing the commodity and then finding foreign buyers at that price, the policy is likely to focus on first conducting extensive market surveys abroad to fully understand the price and quality each market is looking for. Efforts would be made to get sensitive foreign market information in real time to both farmers and exporters so that products and prices get aligned accordingly. Units located in the new contiguous, commodity-specific Agricultural Export Zones in particular, would be benefited by this information gathering.

This approach, coupled with the latest seeds and biotechnology to increase per hectare productivity, is expected to be especially valuable in the exports of products like cut flowers,

fruits and vegetables, and spices where India already has a advantage. Economic of scale and brand building can only emerge in agricultural exports when large companies enter to sector. To facilitate this, corporate farming is the only answer. If stat governments can introduce laws which can enable both farmers and companies to join together in moving from farm-to-market in a profitable way, agri exports would get an immediate boost.

For commodities such as oil meals which are faced with the problem of dwindling supplies of high-priced domestic seeds, the ministry is exploring the possibility of establishing a tariff rate quota especially for miller-exporters. Oil meal exporters may be allowed to import a fixed quantity of oilseeds at a concessional tariff for local crushing, provided they undertake to garner equivalent /higher forex through meal exports.

For staples like sugar, wheat and rice, the commerce ministry is in favour of fixing a export quota for at least five years to enable exporters better develop markets and trading relationships in a highly competitive international market. In groundnuts and sesame seeds, the ministry is seeking to actively tackle the issue of aflatoxin infection by bringing them under the purview of APEDA, which can then set up labs to test export consignments and spend funds on educating farmers about better growing practices. Exports of pulses are in doldrums at present because the government has made it mandatory to send all consignments in 5-kg retail packaging. Restrictions like these are expected to be eased too.

Under WTO, green box measures are the least trade-distorting and include R&D, extension, food security stocks, disaster payments and structural adjustments, The amber box, however, contains measures such as market price support, direct payments and input subsidies, which are subject to careful review and reduction over time. The Indian agriculture will have to move away from subsistence agriculture, where farmers were producing just enough to meet their needs, to agriculture of plenty, where there is enough left for exports.

The new agriculture policy aims to encourage private sector investment in agriculture, particularly, in areas of agricultural research, human resource development, post harvest management and marketing. Now what is required is recognition of R&D in private sector by permitting it to acquire adequate land for research and offering incentives for such R&D centers in seed industry.

On the tax structure, the policy says the structure of taxes on food grains and other commercial crops would be reviewed and rationalized,. It is paradoxical that conventionally grown saplings of fruit trees are subsidized while there is no subsidy for technology intensive plantlets raised by tissue culture. The need is to provide adequate initial support to tissue culture industry by way of subsidy and lower power tariff.

Now the moot issue is how to achieve these ambitious targets. The agricultural output is primarily dependent on the quality of seeds used and availability of adequate water, besides weather conditions. The quality of seeds act as a prime mover for realizing the potential of all other major inputs while fertilizers, crop protection chemicals and irrigation facilitate it to realize its full potential. There is a need to change some of the government policies if the agriculture production is to increase. One of the reasons for poor yields is the fragmentation of land-holding due to the Land Ceiling Act. There is a need to consolidate the land so that agriculture can become more productive and remunerative. The government also needs to work in irrigation. With proper infrastructure coupled with high-yielding seeds, India can easily double its agricultural production in the next few years.

There is also a need to set up quality parameters for export of agricultural produce. These quality parameters must confirm to the world standards. The quality standards in

developed countries are much higher than those prevalent in India at present. In the absence of these quality standards, India cannot take advantage of the opening up of international market. India can also become a leading exporter of organic foods. With the poor farmers having no resources to use fertilizers and pesticides in their farms, this handicap can be converted into an opportunity by developing certification standards for organic food, educating farmers to grow the crop as per these standards, certifying the produce as organic and exporting it to the developing world. This would help in improving the economic status of these poor farmers.

Agricultural research, extension and education system requires to be totally reoriented to meet the new requirements in the light of WTO prescriptions. The focus of the system should now be significant reduction in the cost of production, enhancing the productivity of crops per unit quantity of resources utilized and improvement in the quality of produce/products. Considerable attention should be paid to evolve the varieties of crops which have built-in mechanism to resist insects, pests and diseases as well as they possess ability to thrive under drought or semi drought conditions.

WTO will have no effect on seed industry. Even before WTO the seeds were allowed to be imported into India under an import permit. The import permit is not to restrict imports of seeds but to enforce the plant quarantine law so that new plant diseases are not introduced in the country. The seeds will continue to be imported as earlier. However, the best quality seeds are not coming to India, as there is no Plant Variety Protection Act. Under WTO, a Plant Variety Protection Act is due to be passed in Parliament, hopefully in the next Session. This 'sui generis' system, while giving protection to the plant breeders, also gives rights to farmers to save seeds for the next crop. After adoption and implementation of this Act newer and better seeds can come into India. The protection of plant varieties under the Act will also see renewed research in breeding better seeds by Indian seed companies. India is one of the most cost-efficient producers of hybrid seeds and has the potential to emerge as seed producer for the entire world.

It is high time to consider appointing an agricultural commission to thoroughly study all areas of agricultural research, extension and education in the context of WTO's agreement. WTO should be seen as an opportunity to take advantage of the opened up international trade for agricultural produce rather than as a threat.

## **Conclusions**

The WTO Agreement on Agriculture has so far not made much difference in the world supply situation of agricultural commodities as the countries providing most of the support and protection to agriculture are able to comply with agreement without major changes. The reform they have initiated is expected to bring in structural change in their agriculture, which will help them in effectively competing in the world market. With a large amount of fallow land available at their disposal and ability to develop and adopt technology quickly, these countries are expected to be the major source of supply of agricultural commodities in the future also.

There are several deficiencies noticed in the existing Agreement on Agriculture, which is favorable to the developed countries. Export subsidies provided by a few wealthy countries are prevalent only in agriculture and AoA provisions allow them to continue. "Dirty tariffication", tariff peaks, tariff escalation, tariff rate quota practiced by the developed countries, and reduce opportunities for export of agricultural commodities from countries like India. The developed countries reduce opportunities for export of agricultural commodities from countries like India. The developed countries are able to protect their core agricultural commodities/products through adequate tariff levels and special safeguards. In addition, SPS and TBT measures

such are used to reduce their market access to developing countries. There is a lack of clarity with respect to some clauses such as computation of Aggregate Measurement of Support and tariff rate quotas. Above all, the level of support to agriculture continues to be high in the developed countries.

With the growing internal demand arising out of increase in population and income, India will have to strive hard to meet the domestic demand for agricultural commodities. As of now very few major commodities have export competitiveness. Comprehensive models built to simulate world agricultural production; demand and prices suggest that India may be able to export rice to the tune of about 2.8 million tonnes per year by 2009/10. However, India will have to import wheat and corn to meet the domestic requirements.

India needs to take adequate care to negotiate effectively in the next round of WTO negotiation on agriculture. The major emphasis has to be in terms of reducing overall support to agriculture. While export subsidy elimination has been debated considerably; the other support to agriculture in the blue and green boxes is not given much attention. It is important to note that unless the total amount of support to agriculture is considerably reduced it is difficult for countries like India to compete in the world market. Therefore emphasis should be in terms of reduction in the total support to the *de minimis* level before being able to implement elimination of blue box and export subsidy, and AoA. Special safeguards should be available to the developed countries such as India. It is also essential to have a ceiling on the bound tariff a country can have on any agricultural commodity/products. Adequate measures with respect to enhancing administration in tariff quota and streamlining AMS calculations will have to be emphasized.

The existing bound tariff levels seem to be sufficient for most of the commodities in India. In the case of corn though the simulation result suggested a very high bound tariff (116%), India will have to keep the domestic prices at par with the world prices in order to make its poultry sector competitive. However, the existing tariff level of 15% can be negotiated for a higher level in order to avoid easy access to domestic market.

India needs to develop strategies to enhance exports and prevent possible large-scale imports. Concerted efforts would be needed to increase the production through productivity increases, as there are significant problems in terms of land availability and degradation and increasing competition for water resources from urban and industrial users. Technology development and adoption at primary production and post harvest stages will play a major role in meeting the domestic requirements and enhancing competitiveness. India is required to enhance the competitiveness of the agricultural commodities.

Although India enjoys advantages in exporting some commodities, in the post GATT period international trade would become highly competitive and the competitive advantage of some of these commodities would be lost due to the infrastructure advantage prevalent in the competing countries. Therefore infrastructure development for efficient movement, Handling, grading, packaging, processing, trade network and information dissemination systems is required on a priority basis. Building infrastructure is also important to improve production efficiency of post-harvest operations.

The policy making process also needs reform to facilitate domestic agriculture to compete in the international market. Ability to tune policies to the requirements of international market and their effective implementation need to be enhanced. In order to facilitate policy formulation, commodity management system needed to be initiated where in both long and short-term supply, demand and prices in the domestic and international markets are continuously tracked and necessary measures needed to be taken are proactively identified.

# HEALTH AWARENESS

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## Introduction

There is a saying

***“When money is lost - nothing is lost; when health is lost – big thing is lost”.***

As per W.H.O, “Health is a state of complete physical, mental and social well being and not merely an absence of a disease or infirmity”.

**Physical Health** – Signs of a physically healthy person are good complexion, clean skin, bright eyes, good muscle, good appetite, good sleep, regular activity of bowel and bladder, smooth, easy, co-ordinated body movements. All the organs of the body function normally.

**Mental Health** – Mental health is not merely an absence of mental illness. It is defined as “a state of balance between the individual and the surrounding world, a state of harmony between oneself and others”.

Physical and mental healths are inter-related. That is why we call sound mind in a sound body.

A mentally healthy person will have following characteristics:

- a) a mentally healthy person is free from internal conflicts; he is not at ‘war’ with himself.
- b) He is well adjusted. He accepts criticism and not easily upset.
- c) He has a strong sense of self-esteem.
- d) He knows himself – his needs, problems and goals – this is known as self-actualization.
- e) He has a good self-control
- f) He faces problems and tries to solve them intelligently i.e. coping with stress and anxiety.

**Social Health** - It is the quantity and quality of an individual’s interpersonal ties and the extent of involvement with the community. Social health includes the level of social skills one possesses, social functioning and the ability to see oneself as a member of a larger society.

**Spiritual Health** – It refers to that part of the individual, which reaches out and strives for meaning and purpose in life. It includes integrity, principles and ethics, the purpose in life, commitment to some higher being and belief in concepts that are not subject to ***“state of art”*** explanation.

## Factors causing ill health or diseases:

Health is multi-factorial. The factors, which influence health, lie both within the individual and externally in the society in which he or she lives. These are:

- (i) Heredity
- (ii) Environment
- (iii) Life style

- (iv) Socio-economic condition
- (v) Health services

**Heredity** - The physical and mental traits of every human being are to some extent determined by the nature of his genes at the time conception. The genetic make-up cannot be altered after conception. A number of diseases are now known to be of genetic origin, e.g. – Chromosomal abnormality, errors of metabolism, mental retardation, Diabetics etc.

**Environment** - Can be classified as external and internal environment. The internal environment of man consists of each and every cell, tissue, organ, organ system and their harmonious functioning within the system.

External environment consists of those things to which man is exposed after conception.

It is an established fact that environment has a direct impact on the physical, mental and social well being of those living in it. The environmental factors ranging from housing, water supply, psychosocial stress and family structure through social and economic support system.

**Lifestyle** – It means, “*the way people live*” and reflects a whole range of social values, attitudes and activities. It is composed of cultural and behavioural patterns and lifelong personal habits e.g.- smoking, alcoholism etc.

Healthy life styles are essential for maintenance of good health. Many current day health problems are associated with life style changes e.g. coronary artery disease, obesity, lung cancer, drug addiction etc.

**Socio-economic condition** – Definitely this factor will influence the health of the people. For the majority of world's people, health status is determined primarily by their level of socio-economic development, e.g., per capita GNP, education, nutrition, employment, housing etc.

**Health Services** – These are health and family welfare services for prevention and treatment of diseases and promotion of health. The purpose is to improve the health status of the community. For example, immunization of children can prevent the occurrence of specific diseases. Provision of safe water can prevent mortality and morbidity from water-borne diseases. The care of pregnant women would contribute to the reduction of maternal and child morbidity and mortality.

### **Responsibility of maintenance of health:**

Health is a fundamental human right and for its maintenance, the following are responsible:

The person himself, his family members, community, state and international, all are responsible for maintenance of health.

However, it is the individual who is responsible for his own health. By adopting good health habits and life style enrichment, one can lead a healthy life.

**Good Health Habits** – Early rising, regular bowel movements, regularly taking care of personal hygiene, balanced diet exercise, sleep, all constitute good health habits.

Disciplined approach in each and every activity in life will keep an individual healthy.

**Bad Habits** – Smoking, alcohol abuse, drug addiction are lead habits and cause premature deaths. All are aware of ill effects of smoking, alcohol abuse and drugs.

Smoking causes chronic bronchitis, emphysema, lung cancer, cancer of mouth, lips, tongue, staining of teeth, bad odour and coronary artery diseases.

**Alcohol** – intake of small quantity 30ml/day for a period of 4-5 days a week may not be harmful. In fact, it causes dilatation of coronary artery and is good for heart. But consumption of more alcohol will cause fat deposition in coronary arteries and cause CAD. Alcohol causes gastritis, mal-absorption, and vitamin deficiency, cirrhosis of liver.

**Drug abuse:** causes dependency, addiction, loss of appetite, malnutrition, gastritis, depression and other mental diseases.

### Food and Nutrition

To maintain sound health one should take balanced diet, preferably vegetarian diet with lots of salads, green vegetables and fruits, milk.

Try to avoid non-vegetarian food, except fish, which contain good cholesterol, HDL can be taken. Oils/fat consumption should be restricted to 25-30 gms/day per person.

Make a habit of filling up your stomach by 60% of its capacity. 40% should be kept empty for water and air. Out of 60% 20% to be filled by cereals, 20% by vegetables and 20% by fruits. Don't take water while taking food. Take water after ½ to 1 hour of taking food.

Keep one day fast in a week.

### Obesity

Frequent eating without much exercise will lead to overweight and obesity, which is a risk factor for development of D.M., CAD, and Hypertension. One should maintain optimum body weight by strict diet control and performing regular exercise. One should calculate his/her BMI.

BMI (Body mass index) – This is calculated by the formula

$$\text{Weight in kg}/(\text{Height in Meter})^2$$

- (i) Normal BMI is between 18.5 to 22.5
- (ii) Grade I obesity – BMI = 22.6 to 25.9
- (iii) Grade II obesity – BMI = 26.0 to 29.9
- (iv) Grade III obesity – BMI = > 30

**Diabetes Mellitus** – In India now about 4% of total population is suffering from Diabetes. It is estimated that about 6% population will suffer from Diabetes by 2025.

The main causes of developing diabetes are obesity, overeating, lack of exercises, family history and stress. Diabetes has lot of complications e.g., heart diseases, nephropathy, retinopathy, stroke, Ischaemic ulcers of foot, Gangrene etc.



## **CAD – Coronary artery disease:**

Risk factors are:

- (i) Age
- (ii) Gender
- (iii) Heredity
- (iv) Hypertension
- (v) Diabetes
- (vi) High Cholesterol
- (vii) Obesity
- (viii) Smoking
- (ix) Alcohol
- (x) Lack of exercise
- (xi) Stress

CAD cause less blood supply to the heart, blockage of arteries and heart attack.

### **Prevention of CAD**

- i) Maintain optimum weight
- ii) Avoid smoking and drinking alcohol
- iii) Regular exercise, yoga, Pranayamas

**Life style enrichment** - Once we know the causative factors of ill health and disease, we must adopt disciplined effort regarding our personal hygiene, diet, habits, sleep, regular exercise, yoga, pranayamas to maintain good health.

- Carry out periodical investigations e.g., blood sugar, cholesterol, ECG, Kidney function tests
- Check B.P. regularly
- Take immunizations for prevention of specific diseases.

Responsibility lies mostly on individuals to maintain his/her health. One should be disciplined in all activities in life, and then only, it is possible to lead a healthy long life.

# WTO AND AGRICULTURAL RESEARCH AND DEVELOPMENT

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## **Introduction:**

WTO came into being recently but the recognition of potential of trade relations of intellectual property were started quite earlier. The history of trade relations with intellectual property protection started with the patents from 1474 (Republic of Venice) to Germany in 16<sup>th</sup> century to Statute of Monopoly Act (1624) of Britain and initiation of patent law in US in 1787, of course Switzerland had different approach than most European nations in the beginning later changed its policy due to pressure from Germany, the important considerations in the case of patenting were,

- Natural law and reward for incentives
- Monopoly for incentives
- Exchange for secrets

The trade relations influenced due to patenting etc, thereby bringing change at regional level leading to various treaties at various times, most important of these are

- Paris convention of 1883, which deals with industrial property
- Bern convention of 1886, which deals with art and literary works

## **Establishment of GATT and Way to WTO:**

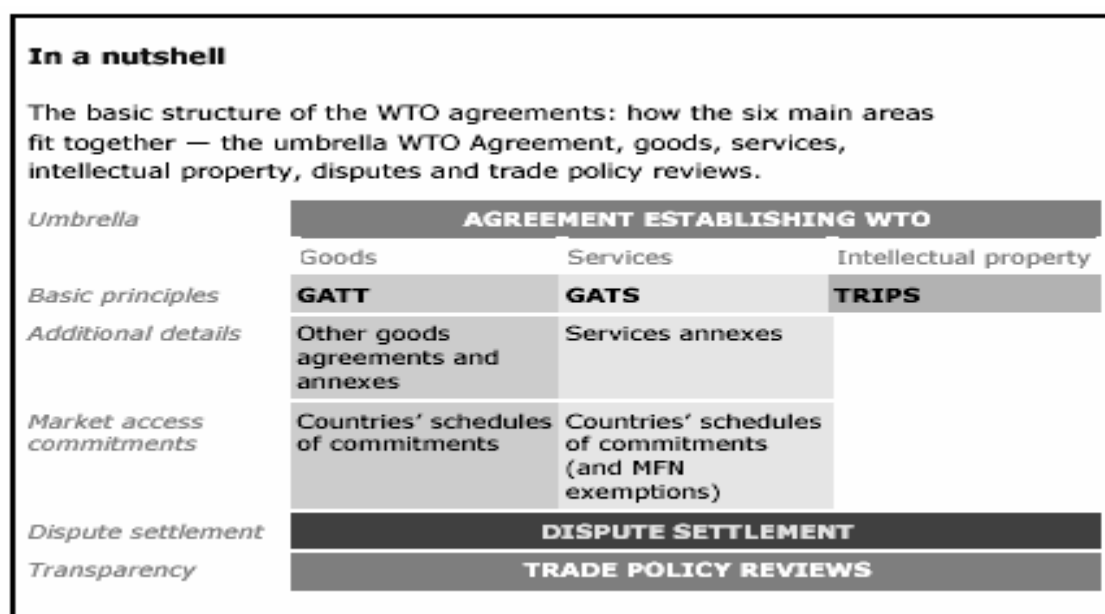
With these and various other treaties most of developed world started thinking of forums and then came General Agreement on Tariffs and Trade (GATT)-1947, it was a trade agreement, later it was realized that trade can not be protected without protecting the industrial property (which later changed to intellectual property). The issues were discussed at various forums like Tokyo round, finally Uruguay Round (1986-1994) helped to develop World Trade Organization in 1995 through Marakesh Agreement. At present there are 150 member countries of WTO.

The conversion from GATT to WTO had some basic principles, which were incorporated, at various forums during the development phase of WTO; these are 1. National Treatment, 2. Most Favored Nations, 3. Market Access.

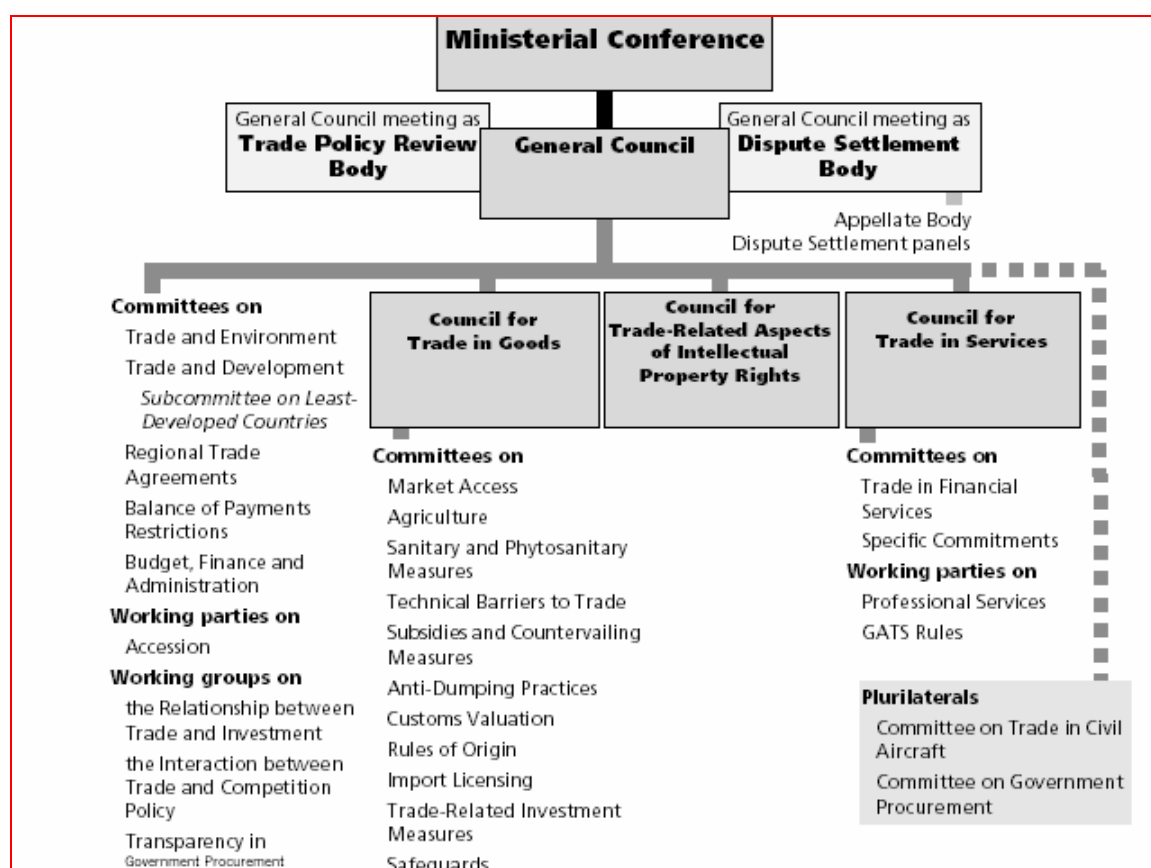
## **Structure of WTO:**

WTO consist of Marakesh agreement, and four annexures, it can be taken as complete package except annexure 4. The studies were made in details, the WTO structure can be shown as given on next page.

## WTO- Constituent Agreements:



## WTO- Administrative Structure:



## The Agreements under WTO

There are 23 agreements in various sectors as given below:

1. Agreement Establishing the WTO: Marakesh Agreement
- Annex-1A Agreements for goods
  2. General Agreement on Tariffs and trade (GATT) 1947
  3. GATT 1994
  4. Textiles and Clothing- Terminated from 1 January 2005, integrated with GATT
  5. Agreement on Agriculture
  6. Sanitary and Phyto-sanitary Measures
  7. Technical Barriers to Trade
  8. Trade-Related Investment Measures
  9. Anti-dumping
  10. Customs Valuation
  11. Preshipment Inspection
  12. Rules of Origin
  13. Import Licensing Procedures
  14. Subsidies and Countervailing Measures
  15. Safeguards
- Annex-1B: Agreement for services
  16. General Agreement on Trade in Services
- Annex-1C: Agreement for intellectual property
  17. Trade-Related Intellectual Property Rights
- Annex-2: Dispute settlement procedures
  18. Dispute Settlement
- Annex-3: Agreement for transparency
  19. Trade Policy Reviews
- Annex-4: Plurilateral agreements
  20. Trade in Civil Aircraft
  21. Government Procurement
  22. International Dairy Agreement – Terminated from 1 January 1998
  23. International Bovine Meat Agreement- Terminated from 1 January 1998

### *Agreements most related Agric. R&D,*

- Sanitary and Phytosanitary Measures
- Technical Barriers to Trade
- Trade-Related aspects of Intellectual Property Rights
- Dispute Settlement
- Subsidies and Countervailing Measures
- Anti-dumping

### **Types of intellectual property**

The areas covered by the TRIPS Agreement

- Copyright and related rights
- Trademarks, including service marks
- Geographical indications
- Industrial designs
- Patents
- Layout-designs (topographies) of integrated circuits
- Undisclosed information, including trade secrets

## WTO and Multilateral Organizations:

WTO is not a UN organization but it has relationship in one or other form with various organizations under UN umbrella or other organizations which are intergovernmental but of independent nature, these are:

1. UN itself

2. World Intellectual Property Organization (WIPO)
3. Food and Agricultural Organization
4. World Health Organization
5. UNCTAD
6. Non UN organizations and conventions
  - International convention for protection of new varieties of plants (UPOV)
  - International plant protection convention (IPPC)
  - Convention on Biological Diversity (CBD)

### **WIPO and its Functions:**

WIPO is mainly responsible for administration of 23 treaties, it has membership of 179 countries and staff is around 900 employees which contribute for following global patenting system, which consist of Madrid system, Hague system and Lisbon system and also Arbitration and mediation center. WIPO is also responsible mainly for WIPO copyright treaty, WIPO phonogram and performances treaty, and patent cooperation treaty. Important exploratory questions about WIPO are,

1. What is patent cooperation treaty
2. How international patent applications are facilitated
3. Relationship of international patent system to national patent system of the countries
4. Patent search- how it is done and role of wipo in it
5. Filing international patents
6. After patent filing procedure mainly in case of disputes
7. Patents and dispute settlement at wipo

### **WTO-WIPO Relationship:**

From my training point of view these are the two most important organization, these organizations have different membership, but function very closely, the relationship of the organizations can be studied with the view of following analytical points,

1. The cooperation agreement of 1996
2. Facilitation of WTO induced changes like helping countries to draft TRIPS enforced changes in legislations
3. Enforcement of WTO regulations, while WTO is more or less of legal nature, the WIPO is more of consultative and of academic in nature
4. Dispute settlement, the two organizations have their own dispute settlement mechanism
5. Development of intellectual property system
6. Capacity building

### **WTO and Role of Agricultural Scientists:**

#### ***Developing international and national intellectual property systems-***

For learning in the area of development of international, regional and national IP protection systems, the major emphasis must be given to the following,

1. TRIPS enforcement (Govt to Govt actions) in development of international system.  
The conflicting objectives in TRIPS-CBD relationships
2. View of developing and develop countries towards TRIPS-CBD relationships
3. Regional IPR protection systems such as,
  - a. Europeans Union (EPVO and EPO)
  - b. African IP system (ARIPO and OAPI)

4. National system with respect to patent, trademark, GI, copyright, plant variety etc

### **Protection of PGR, biodiversity, GI's and traditional knowledge related to plants-**

*Understand the issues and organizations given below and develop action plan accordingly.*

- a. Organizations like CGIAR institutes, commission on PGR
- b. Conventions like UPOV, CBD, IPPC, international undertaking on PGR
- c. Issues like MTA, Confidentiality agreement, Access, Benefit Sharing, community rights, disclosure of source of origin, prior informed consent, community intellectual rights, GI and TK

### **Implications of GATS**

#### ***Understanding GATS and its implications to developing countries-***

Most Favoured Nation (MFN) treatment-

Favour-one, favour-all, MFN means treating one's trading partners equally on the principle of non-discrimination. Under GATS, if a country allows foreign competition in a sector, equal opportunities in that sector should be given to service providers from all other WTO members. (This applies even if the country has made no specific commitment to provide foreign companies access to its markets under the WTO.) MFN applies to all services, but some special temporary exemptions have been allowed. When GATS came into force, a number of countries already had preferential agreements in services that they had signed with trading partners, either bilaterally or in small groups. WTO members felt it was necessary to maintain these preferences temporarily. They gave themselves the right to continue giving more favourable treatment to particular countries in particular services activities by listing MFN exemptions, alongside, their first sets of commitments. In order to protect the general MFN principle, the exemptions could only be made once; nothing can be added to the lists. They are currently being reviewed as mandated, and will normally last no more than ten years.

#### **Commitments on market access and national treatment-**

Individual countries commitments to open markets in specific sectors and how open those markets will be the outcome of negotiations. The commitments appear in schedules that list the sectors being opened, the extent of market access being given in those sectors (e.g. whether there are any restrictions on foreign ownership), and any limitations on national treatment (whether some rights granted to local companies will not be granted to foreign companies). So, for example, if a government commits itself to allow foreign banks to operate in its domestic market, that is a market-access commitment. And if the government limits the number of licenses it will issue, then that is a market-access limitation. If it also says foreign banks are only allowed one branch, while domestic banks are allowed numerous branches, that is an exception to the national treatment principle. These clearly defined commitments are bound like bound tariffs for trade in goods, they can only be modified after negotiations with affected countries. Because unbinding is difficult, the commitments are virtually guaranteed conditions for foreign exporters and importers of services and investors in the sector to do business. Governmental services are explicitly carved out of the agreement and there is nothing in GATS that forces a government to privatize service industries. In fact the word privatize neither even appear in GATS nor does it outlaw government or even private monopolies. The carve-out is an explicit commitment by WTO governments to allow publicly funded services in core areas of their responsibility. Governmental services are defined in the agreement as those that are not supplied commercially and do not compete with other

suppliers. These services are not subject to any GATS disciplines, they are not covered by the negotiations, and commitments on market access and national treatment (treating foreign and domestic companies equally) do not apply to them. GATS approach to making commitments means that members are not obliged to do so on the whole universe of services sectors. A government may not want to make a commitment on the level of foreign competition in a given sector, because it considers the sector to be a core governmental function or indeed for any other reason. In this case, the government's only obligations are minimal, for example to be transparent in regulating the sector, and not to discriminate between foreign suppliers. In the field of agriculture, agricultural education and agricultural services do come under the purview of GATS, the negotiations are still going on and various countries have different perceptions with respect to opening these sectors to foreign service suppliers, or even to ask other countries to open these sectors for providing the services.

### **Agricultural Scientists and WTO dispute settlement system:**

*This is the interesting area to study, which mainly consisted of in-depth analysis of legal cases related to agriculture (mainly agreement on agriculture, SPS, TBT, TRIPS), the inferences are made to develop the cases in future. The dispute settlement process and the complex issues related to WTO should be understood in more effective way. The following are main points where learning must be made regarding these issues,*

1. Agreement on dispute settlement understanding
2. Dispute settlement body of WTO structure and functions
3. Constitution of WTO panels and its functioning
4. Appellate body role and function vis-à-vis WTO panels
5. Arbitration system and role of member countries
6. Retaliations system- situations for use of retaliation system
7. Infringement of basic principles of WTO.

### **Conclusion:**

The agricultural scientists have to play greater role in protecting the interest of the nation. The major strategic issues for this are comprehensive understanding of WTO law, protecting intellectual property rights, appropriate technology development in accordance with certain agreements like SPS and TBT, and strengthening the case of the country in the situation of international disputes.

# INTELLECTUAL PROPERTY RIGHTS IN INDIAN AGRICULTURE

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## Introduction

Since independence, India has tried to effectively use science and technology for its advancement as major economy in the world. The ushering of “Green Revolution” to support the country’s efforts for increasing food productivity has been to due timely interventions based on scientific acumen and technology. Despite these successes, newer challenges like declining and degenerating natural resources, increasing population, emphasis on quality food, nutrition, healthcare and access to better livelihoods are surmounting. There is a growing need to be able to meet these through adoption of newer technologies including biotechnological approaches. Added to this, changes at global level after advent of WTO, has started to build technology-led enterprises with knowledge, as an asset fetching remunerations. Research today is poised to come out of its sheltered existence to a more open era and help institutions face competition. This paper attempts to discuss the requirements as identified in the Agreement on Trade –related Intellectual Property (TRIPS) and developing of the national instruments for these. It provides a basic understanding of various points raised in this agreement and mode by which the nation has complied with all the requirements and balancing the socio-economic needs of the stakeholders and the society.

## Background

From the inception of General Agreement on Tariffs & Trade (GATT) in 1947, there have been eight rounds of multilateral trade negotiations. The eighth Uruguay Round (UR), the longest, was launched in September 1986 in Punta del Este and was signed nearly eight years later in Marrakesh in April 1994. India, being a member of GATT since its inception, was committed to be a part of the round and therefore became a signatory to the World Trade Agreement (WTA)<sup>1</sup>, which brought the most significant single package of changes to the International Trading Regime. Agriculture was included as an important issue and this led to the creation of a completely new framework of rules by World Trade Organization, an institution that has replaced GATT (WTO, 2003.) Until the Uruguay Round, agriculture received special treatment under GATT trade rules through exemption, exceptions and loopholes from most of the treaties when applied to manufactured goods. As a result, the GATT allowed countries to use measures disallowed for other sectors (e.g. Export Subsidies) and enabled countries to maintain a multitude of non-tariff barriers that restricted trade in agricultural products. From a situation where controls on domestic trade policies in agriculture did not effectively exist, countries had to move to a situation where well-defined constraints on import barriers, export subsidies and domestic support were to be in place at an international level. Apart from this, agricultural technology was poised to be used in trade and institutions forced to gear themselves to face competition. The, Final Act comprises of 18 Multi-lateral and 4 Pluri-lateral agreements and 16 articles & 4 annexes. Annexe 1C of the agreement encompasses TRIPS. Some of the issues in this have a direct impact on farmers’ livelihoods, food security and the economic development of the country. However, the most

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<sup>1</sup> Refer: [http://www.wto.org/english/docs\\_e/legal\\_e/legal\\_e.htm#finalact](http://www.wto.org/english/docs_e/legal_e/legal_e.htm#finalact)



conscientious agreement that affects the functioning of research system has been the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS).

### **Agreement on Trade-Related Intellectual Property Rights (TRIPS)**

This agreement sought to recognize the widely varying standards in the protection and enforcement of intellectual property rights and the lack of a multilateral framework of principles, rules and disciplines dealing with international trade in counterfeit goods. It was contended that these have been a growing source of tension in international economic relations. Rules and disciplines were needed to cope with these tensions and thus limit international trade in counterfeit goods. To that end, the agreement addressed the applicability of basic GATT principles and those of relevant intellectual property agreements; the provision of adequate intellectual property rights and the provision of effective enforcement. (WTO, 2001a) Four provisions were provided:

- ★ Provision of adequate intellectual property rights.
- ★ Provision of effective enforcement measures for those rights.
- ★ Multilateral dispute settlement.
- ★ Transitional arrangements.

Part I of the agreement contains the basic principles, such as Article 3: National Treatment: "Each Member shall accord to the nationals of other Members treatment no less favorable than it accords to its own nationals with regard to the protection of intellectual property", and Article 4: Most-Favored Nation Treatment: "With regard to the protection of intellectual property, any advantage, favor, privilege or immunity granted by a *Member to the nationals of any other country shall be accorded immediately and unconditionally to the nationals of all other Members.*"

Part II of TRIPS then goes through each type of intellectual property one at a time, describing the standards and rights in each case. These include:

- ★ **Copyrights** (books, paintings, films, computer programs, certain databases, sound recordings, etc). Members must comply with the latest version (Paris 1971) of the Berne Convention for the Protection of Literary and Artistic Works. Rental rights are detailed, giving authors control over whether or not their computer programs, films, etc. can be commercially rented to the public. Requires that works such as sound recordings be protected from unauthorized copying for at least 50 years.
- ★ **Trademarks** (brand names, product logos, etc). Defines what qualifies as a trademark: "Any sign [words, numbers, pictures, etc.] or any combination of signs, capable of distinguishing the goods or services of one undertaking from those of other undertakings, shall be capable of constituting a trademark." The right to prevent third parties from using "identical or similar signs for goods or services" is given to owners of registered trademarks, and registration is renewable indefinitely.
- ★ **Geographical Indications** (place names used to identify products, such as "Champagne" and "Roquefort" cheese). Members must provide legal means so that "interested parties" can stop the use of such geographical indications for products that do not originate from the used place name or do not have the usual characteristics associated with that place name.
- ★ **Industrial Designs**. If new or original, industrial designs must be protected for at least 10 years, allowing the owner of such a design to prevent the manufacture, sale or importation of products that are considered to have used a copy of that design.
- ★ **Layout design for integrated circuits**.

- ★ **Patents** (for inventions). Members must comply with the 1967 Paris Convention for the Protection of Industrial Property, protecting patents for at least 20 years from the date of filing (with the provision that if the patent holder does not take the product to market, then a government can issue a "compulsory license" to a competitor who will). Member countries are allowed to exclude certain items from "patentability", such as "diagnostic, therapeutic and surgical methods for the treatment of humans and animals; plants and animals other than micro-organisms, *and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes. However, Members shall provide for the protection of plant varieties either by patents by an effective sui generis system or by any combination thereof.*"
- ★ **Trade secrets and undisclosed information.** Undisclosed Information. Institutions must be able to legally protect against disclosure or use of "undisclosed information" such as trade secrets, so long as it has commercial value because of its secrecy, and that reasonable steps have been taken to keep it that way. Members shall protect undisclosed information, which is secret in the sense that it is not generally known among or readily accessible to persons, has commercial value because it is secret; and has been subject to reasonable steps under the circumstances, by the person lawfully in control of the information, to keep it secret. (Part II, Section.7: Art.39.1 & 2.) Members, when submitting un-disclosed test or other data, for the marketing of new pharmaceutical or of agricultural chemical products, shall protect such data against unfair commercial use. In addition, Members shall protect such data against disclosure, except where necessary to protect the public or unless steps are taken to ensure that the data are protected against unfair commercial use. (Art.39.3)
- ★ **Anticompetitive practices in contractual licenses.** In view of licensing practices that restrain competition with adverse effect on trade impeding technology transfer, member countries are encouraged to provide legislations that discourage restrictive practices but consistent with TRIPs. These are country specific but guided by international principles.

Part III of TRIPS goes on to describe how member countries must provide effective means for enforcing these intellectual property rights (whether for foreign or domestic holders) and they must apply strong enough penalties to deter further violations. It specifies details on how such enforcement should be handled, such as rules for obtaining evidence, injunctions, damages, destruction of illegally copied goods, making of such copying on a commercial scale a criminal offense, and so on. While Part IV deals with the acquisition and maintenance of IPRs, Part V provides for dispute prevention and settlement. To effect these, the Part VI identifies various transitional arrangements for member countries. Developing countries like India were given the option to comply till 2005 under transitional arrangements.

Until 1989 developing countries including India, refused to enter into detailed negotiations on standards. But the threat of unilateral retaliatory trade sanctions played a role in changing the stand of many developing countries on this matter. For example, China, Brazil, India, Taiwan and Thailand were "investigated" under the 'Special 301' section of the US Trade Acts, and many other countries (e.g. Argentina, Andean Group countries) were repeatedly threatened with trade sanctions in order to obtain changes in their IPR regimes. USA, in fact lodged a complaint with DSB in 1996 on non-compliance by India that was upheld even after an appeal (WTO, 1997). Thus, India has amended all the relevant legislations for the various forms of intellectual property as per the mandatory requirements of GATT by January 1, 2000. The time frame for implementation was 2005 and the

necessary rules for process of implementing the acts have now been completed including the recent amendment of Indian Patent (Amendment) Act, 2005 along with the rules.<sup>2</sup>

Some of the legal instruments passed by the Indian Parliament as part of compliance to the TRIPS are:

- ★ The Patents Act, 1970 (39 of 1970)
- ★ The Patents (Amendment) Act 1999 (17 of 1999)
- ★ The Patents (Amendment) Act 2002 (38 of 2002)
- ★ The Patents (Amendment) Act 2005 (15 of 2005)
- ★ The Patent Rules, 2003 (vide S.O.493 (E), dated 2<sup>nd</sup> May, 2003, published in the Gazette of India, Extra., Pt. II, Sec.3(ii) dated 2<sup>nd</sup> May, 2003.
- ★ The Geographical Indications of Goods (Registration & Protection) Act, 1999
- ★ Rules (2001) to GI Act, 1999 (Vide G.S.R. 176 (E), dated 8<sup>th</sup> March, 2002, published in the Gazette of India, Extra, Pt.II, Sec.3 (i), dated 8<sup>th</sup> March, 2002.
- ★ The Copyright Act, 1957 (14 of 1957)
- ★ The Copyright (Amendment) Act, 1983 (23 of 1983) (w.e.f. 9-8-1984).
- ★ The Copyright (Amendment) Act, 1984 (65 of 1984) (w.e.f. 8-10-1984).
- ★ The Copyright (Amendment) Act, 1992 (13 of 1992) (w.e.f. 28-12-1991).
- ★ The Copyright (Amendment) Act, 1994 (38 of 1994) (w.e.f. 10-5-1995).
- ★ The Copyright (Amendment) Act, 1999, (w.e.f. 15-1-2000).
- ★ The Copyright Rules, 1958. The Act came into force on 21<sup>st</sup> January 1958, vide S.R.O.269. The rules were amended by the Copyright (Amendment) Rules, 1984, Vide G.S.R. 602(E), dated 9<sup>th</sup> August 1984. The Copyright (Amendment) Act, 1983 came into force on 9<sup>th</sup> August 1984, vide G.S.R. 602(E) dated 9<sup>th</sup> August 1984. The rules were further amended by the Copyright (Amendment) Rules, 1995; vide G.S.R. 383(E), dated 5<sup>th</sup> May 1995 (w.e.f. 10-5-1995). The Copyright (Amendment) Act, 1994 came into force on 10<sup>th</sup> May 1995, vide S.O. 421(E), dated 5<sup>th</sup> May 1995.
- ★ The Trade and Merchandise Marks Act, 1958
- ★ The Trade Marks Act, 1999 (47 of 1999)
- ★ The Trade Marks Rules, 2002 (vide G.S.R. 114 (E), dated 26<sup>th</sup> February 2002, published in the Gazette of India, Extra, Pt. II, Sec. 3(i), dated 26<sup>th</sup> February 2002.
- ★ The Designs Act, 2000 (16 of 2000)
- ★ The Designs Rules, 2001 (Vide S.O.414 (E), dated 11<sup>th</sup> May 2001, published in the Gazette of India, Extra. Pt.II, Sec.3 (ii), dated 11<sup>th</sup> May 2001.
- ★ Draft Designs (Amendment) Rules 2003
- ★ The Protection of Plant Varieties and Farmers Rights Act, 2001 (PPV &FR Act) (53 of 2001)
- ★ The Protection of Plant Varieties and Farmers Rights Rules, 2003 (Vide G.S.R. 738 (E), Published in the Gazette of India, Extra., Pt. II, Sec. 3 (i), dated 12<sup>th</sup> September, 2003.
- ★ The Semiconductor Integrated Circuits Layout-Design Act, 2000 (37 of 2000)
- ★ The Semiconductor Integrated Circuits Layout-Design Rules, 2001 (Vide G.S.R. 892 (E), dated 10<sup>th</sup> December, 2001, published in the Gazette of India, Extra, Pt. II, Sec.3 (ii), dated 10<sup>th</sup> December, 2001.

With the framing, enacting and operationalization of all these above legislations, India is now become compliant with TRIPs and the researchers in agriculture need to become aware of these provisions to build their research programs towards strong IP instruments where required. The enabling scenario at the national level and the visible long-term benefits in creating a sustainable livelihood in the rural landscape, it will be useful to devote scientific resources to creating, maintaining and enforcing product standards, creating a brand and

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<sup>2</sup> Available at: <http://www.patentoffice.nic.in/ipr/patent/patents.htm>

policing its use in external markets. Concurrently efforts to authenticate all traditional knowledge and practices considered being part of heritage and which can be labeled as 'prior art' must be pursued by the scientists especially in the public systems. Issues of generation, protection and exploitation of IP are assuming importance and the nations, especially the Third World countries like India, need to be concerned about (Ganguli, 2000). With the functioning of the IP offices in the country, researchers need to become aware of these provisions and use them to build portfolios for themselves and their stakeholders.

The issues towards defense of indigenous innovation and the recognition of the contribution of our biodiversity are also interwoven in IP building for researches based on agro-biodiversity. Articles 8 and 15 of the Convention on Biodiversity (CBD) center on the theme of the sovereign rights of states over their natural resources. Article 8(j) is particularly important because it recognizes the rights of indigenous farming communities in India and Pakistan and their traditional knowledge and practices. This article enunciates three rights. First, it acknowledges farmers' traditional rights over their biological resources. Second, it stipulates that wider application of farmers' knowledge, innovations and practices is subject to their approval and involvement. Third, it calls for the equitable sharing of ensuing benefits. All three rights, needed to be embodied in a national legislation, and can provide ownership and protection of local resources. Article 15 of the CBD, regarding access to genetic resources, is also important for providing a framework for regulating access to genetic resources and their use by foreign organizations and corporations.

Several cases like those of Basmati, Wheat, and neem in last five years have thrown up this very fact to lawmakers and policy makers of the country. *Grant of such patents, which have linkages to indigenous knowledge of the country, needs to be addressed at national and international levels.* As per TRIPS, the issue of ownership is to be determined by national law, creating an institutional framework in Third World countries, safeguarding the rights of local people. It would make it mandatory for such corporations to share their profits with the indigenous communities. It is also realized by this case analysis, that creating an IPR regime would include establishing more comprehensive patent laws; incorporating geographical indications into patent legislation and creating a *sui generis* system to protect plant varieties. Thus, national acts like the PPVFR Act, 2001 and Biodiversity Act, 2002 that were passed by GOI to protect issues of rights to local knowledge holders and comply with provisions in the CBD are some major changes in the Indian IP law. Concurrently, initiatives taken in the various provisions of The Patent Amendment Act, 2002 and in the Third Amendment of Indian Patent Act of March 2005<sup>3</sup>, passed recently by the Parliament are indicative of the intention of GOI to safeguard national interests and the rights of the local knowledge holders in this era of threats due to globalization.

An analysis of these cases also brings out several issues related to IPR and illustrates the complexities and inter-connections between the various aspects of IPR such as patents, trademark, geographical indication and rights of farmers who had developed and preserved the traditional lines, work of scientists, interests of traders and exporters. The implications of the different IPRs in the market place and international trade are also implicit. With several players having their stake, it is certain that several hurdles would surface as has been in the long time taken for preparing the case of basmati for re-examination.<sup>4</sup> The smaller holdings

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<sup>3</sup> Agence France Presse .2005.Indian parliament passes patents bill amid criticism by health activists. March 23, 2005.

At:[http://news.yahoo.com/news?tmpl=story&cid=1507&u=/afp/20050323/hl\\_afp/healthindiaawtopatent\\_050323153747&printer=1](http://news.yahoo.com/news?tmpl=story&cid=1507&u=/afp/20050323/hl_afp/healthindiaawtopatent_050323153747&printer=1)

<sup>4</sup> As per the March 2005 communiqué in Geographical Indications Journal, from the Geographical Indications Registry, Govt .of India, G.I. application no.14 has been filed for Basmati rice in class 30 under goods of Rice

in diverse areas and conflicting reports on differences in traditional and HYV of crops, do make it more difficult for India to sort out the multiple claims. It is now clear that with molecular testing techniques standardized, DNA-based certification would be a useful mode to identify true varieties and help define the claims of ownership. (Chakraborty and Sethi, 2001; Singh *et al*, 2004).

The demands of the present time has also come for us to have a better understanding of Patent Law at international levels, the method of their jurisprudence, compilation of all published information and other documents on issues relating our agro-biodiversity leading to bearing a huge cost of the legal engagement. The creation of Traditional Knowledge Digital Library (TKDL) by the GOI is a welcome step to authenticate traditional knowledge (TK) on par with industrial property systems. This facility has evolved a scientific classification approach named as Traditional Knowledge Resource Classification (TKRC), which would enable retrieval of information on TK in a scientific and rational manner. Its linkage to International Patent Classification (IPC) would help patent examiners at the global level and increase patent examination substantially. This was one of main lessons emanating in the Basmati case when accession to data of traditional growing of Basmati in this subcontinent was not available to most patent offices internationally. The recent decision of World Intellectual Property Organization (WIPO) to select two science journals published by CSIR, namely, Indian Journal of Traditional Knowledge (IJTK) and Medicinal and Aromatic Plant Abstracts (MAPA) as mandatory reference literature for international patent authorities is an important step for the recognizing a need to look for evidences as “prior art” from Third World countries during patent examination. India is now part of a select group of 13 countries whose science journals are in minimum documentation list of Patent Cooperation Treaty (PCT). In fact, it is the only developing nation in that group which consists of 12 more developed countries (Sunderajan, 2005).

Finally, the positive indicators of the fast developments in the national IP regime are facts like developing countries can defend their property, putting adequate documented information at the disposal of patent offices in the developed world. The recent victories in neem, basmati cases signals good omen for many in developing countries who feel threatened in this competitive, globalized international market and also forces them to be vigilant and prepared.

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# CONFERENCE MANAGEMENT

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Conferences and meetings are expensive as precious time and money have to be expended in organizing and conducting these events. It is estimated that it takes over 300 executive man hours to arrange a two-day conference for about 200 people; added to that are the secretarial time, administrative costs, cost to the organization of gathering 200 people together, and of course, the 'lost opportunity' cost of taking these delegates away from their normal work. Conferences, seminars, meetings, symposia, and workshops do form a regular part of the activities of a research organization. In order to get the best out of these activities, it is necessary to plan and organize them effectively. The term 'Conference' is used in a broader connotation in the title, to include all types of scientific gathering.

Though one might feel that organizing conferences is a daunting and thankless job, it is not true. Infact, on the other hand, the task is varied, challenging, and rewarding, notwithstanding the heavy workload. It is, therefore, necessary that the whole process is approached in a systematic manner.

## Definitions

Different terminologies are used to define the different types of gathering. Some of the commonly used terminologies and the normally accepted meanings of these terminologies are listed below.

**Conference:** A large event for a large gathering of hundreds or even thousands of people, to engage in discussion with the aim of accomplishing a limited task within a restricted period of time. Conferences may involve complex social programmes, exhibitions, and displays. Many conferences have international audiences and are events of national and international interest. The words 'convention' and 'congress' are used with much the same meaning.

**Meeting:** A meeting is usually a much smaller event, involving a few, discussing round a boardroom table, to discuss matters of mutual interest and to arrive at collective decisions. However, the word "meetings" is also used in a wider sense to describe conferences, meetings, and seminars collectively.

**Seminar:** A small to medium sized gathering, from as few as a dozen or so up to around 150 people. Seminars are usually a medium - duration activity of up to about three or four days, where group of experienced people share their experience to educate or inform delegates. In a seminar, the flow of information is one-way, from the rostrum to the delegates.

**Workshop:** This is similar to a seminar in terms of duration and participation, but involves a small gathering of people to discuss specific topics, to exchange ideas, to solve particular problems, and to explore issues at greater depth. Participants are resources in the workshop. Recommendations are to be brought out at the end of workshops.

**Plenary session:** Plenary sessions are those part of a programme where all the delegates are present.

**Syndicate or break-down sessions:** In many events, the delegates are invited to split up into smaller groups (often called syndicates) to get wider participation quickly on a very limited subject. The term 'Buzz group' is also used to designate these small split-up groups.

## **Planning the Conference**

A conference planner is required to perform various roles in meeting the complex needs. A conference planner has to be an administrative executive, a planner, an information Co-ordinator, a presentation specialist, and a consultant. Each of these functions requires somewhat different skills and abilities.

It is necessary to answer five basic questions before any arrangements are made or any decisions are taken about a proposed event. The entire plan for the event, its style, type, length, content, and its eventual worth will depend upon the answers to these questions. These are called the five W's of conference planning. They are:

### **i) Why do we need to hold it?**

Conferences can do much more than passing on information. Even where the main objective is to pass on information to delegates, the total information flow is much more than that covered in the formal sessions. In fact, the informal discussions that take place outside the formal sessions, during a conference, are rather more valuable, as delegates get a chance to learn from each other. A sensible conference organizer, therefore, has to allow plenty of time in the programme for exchange of this kind. The decision whether or not to hold a conference will, therefore, be based not only upon the relative costs of putting across certain information, but also on the gains in human values that the conferences might bring about.

### **ii) What do we want to achieve?**

This question relates to the setting up of the objectives and deciding as to how these objectives can be met. The objectives will help us to decide what information has to be passed on to the delegates. Having established the objectives, it is possible to decide what has to be done to meet them. In fact, the whole length, style, content of the event, and the sort of venue needed are all dictated by this consideration.

### **iii) Who should attend?**

This is a function of the objectives which have been set by the earlier question. A conference organizer should select the right type of people for the conference.

### **iv) When should the event be held?**

Major factors to be considered in deciding the date of the event are:

a) The planning time that is needed for the actual conduct of the event. This is dependent on how big the event is and how long will it take to plan and arrange. It is to be remembered that everything takes more time than anticipated. Other factors which affect this planning time include finding speakers, printing, preparation of audio-visual aids, finding venue, etc. It is necessary to ensure that we make realistic estimates of the time needed for these various activities. It is always better to compromise on dates, or even to cancel an event, rather than rush the planning. The lead time needed for some of the major international conferences is several years, and even small seminars and training programmes have to be normally planned six to nine months ahead.



b) The timing of the event may also be affected by the key dates which cannot be altered. For example, an annual workshop cannot be held before the harvest of the crop and analysis of data.

c) Yet another important factor is the availability of people, who are to attend the event. For example, it is unwise to hold a workshop or seminar for managers or policy makers during March as it would be difficult for these people to leave their headquarters or organization during that time, as it marks the end of the financial year. Similarly, it may be rather difficult to get a group of people together during summer holidays.

d) Availability of speakers and equipment, which are vital for the event, could also play a role in deciding the dates for the event.

#### **v) Where should it be held?**

This is one of the most important and difficult tasks which a conference organizer might face. This is detailed below.

##### **a. Venue - room arrangement**

The style of seating layout will be dependent upon the number of delegates and the type of event. The options available are given in figure 1. They are:

- i) Class room
- ii) Board room
- iii) 'U' Shape or horse-shoe type arrangement
- iv) Theatre

Classroom layout may be the most appropriate when the delegates need to write and take notes. Special chairs with writing rests may also be provided as an alternative. This arrangement takes space but allows delegates to spread papers and write. This is ideal for a training programme but not suitable for large meetings.

Boardroom layout is ideal for meetings involving discussion and decision taking. It is suitable for groups up to about 30 people.

'U' shaped layout is good for small educational meetings which involve discussion between delegates or where an intimate atmosphere is needed. This type of arrangement facilitates formation of groups for group discussion, since the arrangement consists of dismantable tables. This type of arrangement is best suited for workshops.

A theatre layout is ideal for situations involving participation of large number of delegates. Ideally, seats should be fixed to a tiered or sloping floor. This type of arrangement is best suited for conferences.

##### **b. Room facilities**

The room should:

- i) Be large enough - for the delegates to sit comfortably with adequate space available for projection facilities.
- ii) Provide needed illumination - a low-level illumination during projection is needed to permit note-taking and to maintain a social atmosphere. Adequate

dimming devices should be made available; if not, there should be a facility to use only a proportion of the normal fitted lights during projections.

- iii) Provide adequate electrical control - control for dimming lights should be at a convenient point so that dimming is done as soon as projection appears on the screen; electrical supply for the projector should remain alive when room lights are dimmed or put off. Again, fans should be working when lights are put off or dimmed.
- iv) Provide good ventilation - ventilation should be independent of the room darkening devices.
- v) Be acoustically good - the quality of the room should be such that one can hear everything from any place. A sharp, ringing echo indicates poor acoustics. Any loud noise or clearly audible speech coming from outside the room should be controlled or eliminated.
- vi) Have a sufficiently high ceiling to enable the screen to be raised to a level so that all the delegates can see the projection easily.

#### **c. Platform arrangement**

Preference and circumstances will decide the arrangement of the platform. The person chairing the session will be seated at a table, generally centre-stage, provided with microphones from which he or she will introduce the session and the speaker. The latter will either talk from this same table or from a lectern, which should also be provided with a microphone. The obligatory carafe of water and glasses should be on the table and a further glass of water on the lectern. When the slides are shown, the hall will be in darkness; ensure that there is light on the lectern at that time so that the speaker can read his/her script. There should also be a pointer or devices such as a laser pointer, that point with a spot of light to enable the speaker to pinpoint on the screen as and when he/she speaks. Lighting is usually controlled by the projectionist - dimming when slides are shown, returning to full light when the visuals or the presentations end. If there is no projectionist, it will be the responsibility of the conference organizer to do this or make arrangements for this. Name cards for the chair person and the speakers should be prepared for quick identification. For table person it should stand on the table and one should make sure that the name of the speaker is on the lectern as he/she speaks. This labelling is particularly helpful when there is a panel session and all speakers are on the platform. Speakers may probably prefer to operate their own slides, if they have any to show. Overhead projector is very handy for this purpose. Felt-tipped pens for writing on the overhead transparencies should be made available. It will be worthwhile to keep a spare lamp for the overhead projector. The position of the screen and also of the projectors should be carefully checked.

#### **The event**

The culmination of days/months/years of preparation and planning is the event; and your long planning, work, and foresight bear fruit in those few hours or days of the actual event. There are many administrative responsibilities for the conference organizer during the event. Some of the main tasks are:

- i) Registration of delegates - the registration procedures should be efficient and quick, the staff courteous and pleasant.

- ii) Exception handling - any delegate having a problem or asking for information of any kind should be directed to a separate desk staffed sufficiently to handle this aspect.
- iii) Messages and information - an information and messages board should also be set up in the reception area.
- iv) Reception of VIPs and speakers.
- v) Rehearsal room - it is good to set aside a rehearsal room where speakers can sit quietly and go over their scripts, brief projection staff, and load slide magazines. A projection manager is to be identified to receive speakers and to co-ordinate the presentations.
- vi) Press and TV coverage - a PRO should be identified to handle this.
- vii) A post box and a public telephone are useful - however, be cautious in letting the delegates use the telephones.

### **Conference proceedings**

There are three options available to publish the proceedings of a conference, which should be looked at during the initial planning phase itself. The options available are:

- i) To publish it in one's own journal. Infact, the journals of many learned societies consist entirely of the proceedings of the conferences held by them. This ensures circulation to members and all subscribers, thereby enhancing the journal contents without bringing in any extra expenditure.
- ii) If there is no internal journal published, it may be possible to request the journal of another society to do this job.
- iii) If there is enough material, it may be worthwhile considering the proceedings being published as a book through a commercial publisher, for a fee. Of course, this decision will depend on assessing, initially, how many purchasers, in addition to the delegates, will be there for such a publication.

It is essential to convey the types of publication that will emerge out of the conference proceedings, in the letter of invitation itself, when we ask for text of the papers and permission to reproduce them in the proceedings. It is also essential to decide, at the planning stage itself, as to whether the proceedings will be published after the conference or will be made available at the conference itself. Though it is a good idea to bring out the conference proceedings before the conference as the speakers feel generally very happy to have their papers published quickly, co-operation for this is not easily achieved. The alternative, therefore, is to publish it immediately after the conference, incorporating the discussions held and any conclusions reached.

It is equally important that a scientist knows as to how to write a conference report. Conferences have become so popular in recent years that conference report literature has become a very substantial portion of the total literature in many areas of science. There are three important things which need to be considered as regards the conference report. They are i) Most conference proceedings are one-shot, ephemeral publications, not purchased widely by science libraries around the world; thus, because of limited circulation and availability, they fail to fulfill one of the fundamental tests of a valid publication ii) Since most

conference reports are either review papers or preliminary reports, presenting data and concepts that may still be inconclusive, conference reports do not qualify as primary publications iii) Conference reports are normally not subjected to peer review or to a strict reviewing, except for a minimal editing; therefore, due to lack of any real quality control, many publishers consider conference proceedings volumes as non-primary.

The type of proceedings that will be brought out will, therefore, indicate the way the report should be written. If the proceedings is adjudged to be primary (which the editor will clearly indicate), the manuscript should be prepared in the journal style. We should give the full experimental details, and we should present both data and the discussion of the data as circumspectly as we would for the paper of a prestigious journal. If, on the other hand, the proceedings is not a primary publication, the style of writing should be quite different. The fundamental requirement of reproducibility, inherent in a primary publication, may then be ignored. The manuscript need not, and should not, have a Materials and Methods section. Again, the intricate details that might be required for a peer to reproduce the experiments need not be provided; nor is it necessary to provide the usual literature review.

When the conference report is not a primary scientific paper, it should only be prepared in the form of an extended abstract. An extended abstract is usually limited to one or two printed pages, or 1,000 to 2,000 words. In the extended abstract, the problem is stated, the methodology used is stated but not described in detail, and the results are presented briefly with two or three illustrations (any combination of tables, graphs, or photographs). Then, the meaning of the results is speculated about, often at a considerable length. A description of related or planned experiments, in the author's own laboratory or in the laboratories of colleagues working on related problems, is also indicated. A conference report should serve the purpose of a true preliminary report. It should present and encourage speculation, alternative theories, and suggestions for future research.

The editor of the proceedings, usually the organizer of the conference, is the sole arbiter of questions relating to manuscript preparation. If the editor distributes Instructions to Authors, it should then be properly followed. Conference reports are seldom rejected. However, if one plans to participate in a conference, then whatever guidelines/rules are indicated should be strictly followed. If all contributors follow the instructions/rules, whatever they are, then the resultant volume is likely to exhibit reasonable internal consistency and it will be a credit to all concerned.

Whenever we are involved with the editing or publishing of a proceedings volume, we should make sure that a published copy is sent to the Institute for Scientific Information for inclusion in the Index to Scientific and Technical Proceedings. This would facilitate wider publicity for the conference proceedings.

A conference is a highly complex operation with many diverse elements, that are not entirely under our control, welded into an integrated whole, a whole which is an important event for those who come to attend the conference. It is, therefore, essential that a conference organizer plays a major role in ensuring the success of the event. One way to ensure success is that we approach the organization of any conference in a methodical way is by preparing various checklists and by working through them. Different checklists need to be prepared for different committees, which will be formed for organizing and conducting a conference. A model checklist is given in Appendix 1 and a conference calendar, which lists a checklist of what to do and when to do, is given in Appendix 2. These should provide an idea to the conference organizers in preparing the required checklists and calendar for effectively planning and conducting conferences. Prior knowledge and properly prepared checklists do help a lot in organizing conferences; in spite of these, if one runs into some

difficulties, nothing better can replace a fellow conference organizer or a friend with experience, who can supplement our own.

### **For further reading**

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## **A Model Checklist**

### **Conference centre**

Contract and/or exchange of letters setting out facilities hired, and conditions and charges for the letting  
 Written confirmation of any alterations or additions  
 Conference programme announcement  
 Programme/handbook giving place and time of registration, catering, sessions, social, and all other events.  
 Catering brief with the time and place of meals, coffee, and tea breaks  
 Projection brief stating what public address and projection facilities are needed, where and at what times a projectionist is required  
 Rooming list

### **Speakers**

Formal letter of invitation  
 Letter acknowledging agreement to speak  
 Conference programme arrangement with brief notes for speakers  
 Final documents : personal letter, joining instructions, expenses claim form, invitations, tickets, preprints, etc.

### **Transport**

Specification of transport needs  
 Conference handbook with schedule confirming final transport requirements, stating destinations, time, and place for pick-up and return  
 Labels with destinations for display in vehicles.

### **Delegates**

`Flyer' of call for papers  
 Programme announcement with registration forms  
 Letter acknowledging the registration  
 Final documents : joining instructions, attendance list, invitations, tickets, preprints, etc.  
 On arrival : badges, bags, programme supplement, maps, receipt for payment of registration fees, etc.

### **Exhibitors**

Prospectus with `flyer'  
 Confirmation of booking with invoice  
 Final documents : as for delegates plus special note with plan of exhibition area, directions for access, erection of exhibit, details of special facilities.

### **Miscellaneous**

Directional signs  
 Name boards for chairpersons and speakers in different sessions  
 Reception/registration desk  
 Projection-trial room/rehearsal room

**Conference Calendar : A checklist of what to do and when to do it**

**Eleven months to conference**

- Make committees
- Prepare committee task sheets
- Develop main conference budget
- Convene executive committee meeting
- Convene programme meeting - all committees

**Ten months to conference**

- Develop programme sessions and events
- Initiate speaker recruitment
- Initiate sponsor solicitation
- Initiate exhibitor solicitation
- Determine delegate fees and expenses
- Complete main conference budget

**Nine months to conference**

- Continue - Speaker recruitment
  - Sponsor solicitation
  - Exhibitor solicitation
- Initiate panelist recruitment
- Develop pre-registration procedures
- Print delegates registration forms

**Eight months to conference**

- Complete programme sessions and events
- Complete speaker recruitment
- Continue panelist recruitment
- Distribute preliminary programme
- Distribute registration forms
- Distribute accommodation forms
- Continue - Sponsor solicitation
  - Exhibitor solicitation

**Seven months to conference**

- Complete speaker arrangements
- Complete panelist recruitment
- Initiate pre-registration process
- Prepare conference tender documents
- Distribute conference tender forms to suppliers
- Confirm conference room requirements
- Continue - sponsor solicitation
  - exhibitor solicitation

### **Six months to conference**

- Complete panelist arrangements
- Continue pre-registration process
- Acquire local attractions literature
- Acquire tourist literature

### **Five months to conference**

- Continue - sponsor solicitation
  - exhibitor solicitation
  - pre-registration process
- Develop conference room layout
- Develop dining room layout
- Complete tender calls for materials and supplies

### **Four months to conference**

- Continue sponsor solicitation
- Complete exhibitor solicitation
- Distribute exhibitor contracts
- Complete all materials, supplies, arrangements
- Complete conference room layouts
- Complete dining room layouts
- Complete pre-registration process
- Mail hotel accommodation acceptance forms

### **Three months to conference**

- Continue sponsor solicitation
- Complete exhibitor arrangements
- Prepare final programme
- Final programme meeting - all committees
- Confirm conference room layout and dining room layout with the venue people

### **Two months to conference**

- Print formal programme
- Contact media
- Hire outside staff, if needed
- Prepare conference evaluation questionnaire
- Distribute detailed speakers' instructions
- Confirm menus, refreshments with the hotel/suppliers

### **Four weeks to conference**

- Mail formal programme to delegates
- Train hosting staff

### **Three weeks to conference**

- Complete media room layout
- Train registration staff



**Two weeks to conference**

- Complete media requirements
- Begin daily monitoring of conference deliveries to venue

**Seven-six-five-four days to conference**

- Begin filling delegates' kits
- Complete filling delegates' kits
- Distribute kits to local delegates

**Three days to conference**

- Advertising commences

**Two days to conference**

- Open conference office

**One day to conference**

- Open registration counter
- Open media counter
- Open hospitality centre
- Set up exhibits
- Conference staff move into the venue

**Post-conference: Week one**

- Transcription of proceedings
- Preparation of thank you letters
- Payment of conference accounts

**Post-conference: Week two**

- Edit conference proceedings
- Payment of conference accounts
- Mail conference thank you letters

**Post-conference: Week three**

- Print conference proceedings

**Post-conference: Week four**

- Payment of outstanding conference accounts
- Distribute conference proceedings

# COMPUTER AND PERIPHERAL ESSENTIALS

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The trend in information technology is fast changing, thanks to an equally swift change sweeping across the hardware and peripherals required to launch the IT revolution. It is necessary to understand the nuances of what makes a PC before we plunge into IT applications. There are many deciding factors to choose a right computer and peripherals to suit our needs. An overview of some of the PC essentials are given below.

## 1. MOTHERBOARD AND PROCESSOR

An experience with PC depends on a combination of the processor, the memory, the motherboard, the graphics and sound components and the hard disk that the PC has.

The first two things to consider when buying a PC are the motherboard and the processor, which are interdependent. A particular processor only goes on a particular kind of motherboard. For each kind of motherboard, there might be different brands available, with different features. It is better to choose processor and then decide brand of motherboard, based on its features.

### A. MOTHERBOARD

The motherboard is the base of a PC—all the components fit on it. It also has a master brain called the chipset which decides what will work and how. The motherboard is chosen based on

**i. Processor :** The processor sits on a main board called the motherboard, in a particular slot or socket. This slot determines which processor will go on the motherboard.

**ii. Graphics:** Onboard graphics Motherboards can also be chosen based on whether they have integrated graphics on them or not. The earlier graphics cards used to be PCI cards (fitting on the PCI slot on the motherboard). Later something called the Accelerated Graphics Port, or AGP was developed especially for graphics cards and made graphics faster. There are motherboards that had graphics capabilities built into them. However, the graphics from these are only good enough for browsing, Word, Excel, etc, not for heavy 3D games or graphics. The Intel 810 chipset come with onboard graphics, and are a real money saver. For serious gaming and graphics, we need the AGP slot to be there on the motherboard, and add a graphics card to it. The Intel 815 chipset based motherboards come with onboard graphics, but also have an AGP slot on them, so we can go with onboard graphics initially and get a good graphics card later. The new P4s go on the Intel 850 chipset based motherboards, which have a slot for RDRAM memory modules, and an AGP slot.

□ Look for the number of slots for add-on cards. Apart from the AGP slot, look for the number of PCI slots on the board for- internal modem, TV tuner/video capture cards and other accessories.

□ Look for the number of RAM slots and how much RAM it can take. Some new motherboards have slots to take even 2 GB of RAM.



## B. PROCESSOR

The processor, which is the brain of a PC, is often chosen with price as the main criteria, but changing the processor often means changing the motherboard.

The other extreme, when the budget is unlimited, is to scramble for the latest, fastest processor. There will always be a faster one just around the corner but it should not be exceedingly beyond our requirements, say if our

applications are simply writing documents in Word, browsing the Net and sending and receiving e-mail. Choose the processor keeping in mind our activities on the PC, but don't be stingy either.

Both the processor as well as motherboard should be chosen keeping in mind the fact that they're both very tough to upgrade—because they're expensive and when we change them, we have to change a lot of things along with them, almost like overhauling the PC.

### Types of processors

Pentium and AMD processor are some of the processor options. AMD processors have been around for a long time. The processors that made an impact in recent times are the Duron and the Athlon. Intel has the value option, Celeron and the high-performance processor, P4, while AMD has Duron for value proposition and Athlon for high-end one. Nowadays, processors are coming in as dual core which is a CPU with two separate cores on the same die, each with its own cache. It's the equivalent of getting two microprocessors in one.

A **dual-core processor** uses slightly less power than two coupled single-core processors, principally because of the increased power required to drive signals external to the chip and because the smaller silicon process geometry allows the cores to operate at lower voltages; such reduction reduces latency.

Most of the processors are in **32-bit**. This is the number of bits that can be processed in parallel. Or the number of bits used to represent a single element in a data format. Future software are going to be available in 64 bit format increasingly.

### Realities of bits in Processors

- ❖ A 32 bit CPU can process 32 bits of data at a time. If data has more than 32 bits, processor takes up '32' bits of data first and processes it and then next group of '32' bits of data is taken up for processing
- ❖ Hence a 64-bit CPU performs better than a 32 bit processor
- ❖ 64 bit is very useful for 3d animators, game developers, CAD/CAM engineers, automobile manufacturers
- ❖ A 32 bit CPU can access only 4 GB ( $2^{32}$ ) of main memory while a 64 bit CPU can address up to 17 billion GB which is more than enough for any present and near future application
- ❖ A 64 bit CPU needs 64 bit OS and 64 bit applications to deliver optimum results. Some 64 bit CPUs allow to run 32 bit applications and OS but it is a point of under utilization.

- ❖ A 64 bit processor doubles the bandwidth with the processor core while dual core gives 2 processor cores inside a single processor. A 64 bit is like fitting a car with a more powerful engine while a dual core is fitting the same with 2 engines which may or may not be as powerful as the replaced one.
- ❖ The entry level is 915 chipset while others include 925,945 and 955 chipsets.
- ❖ 945 and 955 based chipsets support dual core processors (called Pentium D).

### **Need of upgrade**

*It is time for upgrade ...*

- When we are moving to a newer operating system(OS). Roughly the memory requirement and the hard disk space requirement doubles as we move to a new version of Windows, for an optimal experience. Intel recommends a P4 for Windows XP.
- When we go for a new set of applications like working with videos, pictures etc.,

### **Precautions in selection of motherboard and processor**

- Take a motherboard that has support for DDR SDRAM, as the prices of DDR are very competitive.
- If we want a basic machine for functions like MS Office, 2D games, etc, look for a motherboard that supports onboard graphics, and which has an AGP slot that will help if we need to add an AGP card at a later date. Also, look for the VIA KM-266/400 Chipset or the nVidia chipset.
  - Mix and match are not possible with processor brands. Don't put an AMD processors on an Intel processor's motherboard, or vice versa. They are two different entities and need their own motherboards.
- Don't go for motherboard for a P 3 which take on a P4. We won't get the P4 performance, since the motherboard doesn't support it. We'll also get into software compatibility issues.
- When we get a new processor, a new motherboard, we need to check if the existing power supply is enough. We'll probably have to go for a new SMPS too.

## **2. GRAPHICS CARD**

A graphics or display card brings to the monitor what's happening inside the PC. The video card can handle all the visual tasks of the PC without processor's intervention. It now has its own processor chip and RAM and capable of complex calculations to give faster and better displays on monitor.

**i. Need of upgrade** When we move to more graphics-intensive games, graphics applications like image editors, design software, Web design programs, desktop publishing software, multimedia content creation software, etc, graphics card should be able to live up to it. But before we get new software that'll need a graphics card upgrade, check whether the motherboard can take a graphics card upgrade. If not, go for a motherboard, and possibly even a processor.

**ii. Budget of upgrade** If we just want to work on Word, Excel, PowerPoint, surf the Net, etc, we don't even need a graphics card—a motherboard with built-in graphics is sufficient. There are some inexpensive low-end cards also available that let us step up our graphics a bit. There would be some that fit onto the PCI slot on motherboard. There are also some low-

end cards that fit onto AGP slots. For example, the SiS series—SiS 6215, 6326, etc, which comes for under Rs 1,500. Check the VRAM, or the video RAM—the graphics card's own RAM. While the low-end cards will offer 4 or 8 MB, the high-end ones can go up to 64 MB.

For serious gaming, we can't invest in a decent graphics card in the price range of Rs 5,000-10,000. This includes the Riva TNT and GeForce2 ranges. While these cards are good enough for most 3D games. The latest games have graphics renderings beyond the capabilities of these cards. But they are good enough to give high resolutions, color depths and refresh rates. Make sure to have an AGP slot on the motherboard.

### **3. SOUND CARD**

The start-up music on a PC, audio alerts on messenger, MP3 music or voice-chat over the Net, sounds from movies and games—it's the sound card that lets all this reach us. With a sound card in a PC, we can also record music or our own voice to PC. Beginning from sound on a motherboard to cards that provide home theater quality, there's a wide range out there to choose from. Most motherboards have begun coming with integrated or onboard audio. This means that PCs based on such motherboards don't have a separate card sitting inside. This sound is good enough for basic purposes like voice chat, telephone calls over the Net, listening to MP3s, and so on.

#### **i. Need of Upgrade**

Instead of onboard sound, if we have a PCI sound card, that is also great for the same purposes. But if the need for sound is beyond that, we need to look for upgrade possibilities. For a multimedia or audio professional, or if we want to watch movies on PC with complete visual and sound effects, we need better sound..

If we have an old motherboard that houses the sound card in an ISA slot, we could upgrade to the current standard—sound cards that go into the PCI slot. The other advantage is that PCI cards are plug-and-play, and we don't need any complicated configuration.

- Prices of sound cards range from Rs 600-17,000, while those of speakers could vary in the range of Rs 500-Rs 28,000. The difference lies in the depth in which sound is recorded, the variety of channels, and sound standards supported. Some sound cards today also use the USB port of a PC, like Creative's Sound Blaster Extigy, which is an external device which is connected from the outside.
- We have to pay attention to the speakers that play its output too. It's no good getting an expensive, high-end sound card and using our regular speakers or vice versa.

#### **ii. Selection of sound card**

*Duplex type:* Go for a full-duplex sound card, as this lets our PC receive and send sound at the same time, like we do on the telephone. Useful for Net telephony. A half-duplex sound card, in contrast will be able to do only one at a time. Most sound cards today are full-duplex, but do check this out.

*Recording depth:* This is measured in bits. A higher figure gives us better fidelity. 16-bit is the standard in sound cards, and 24-bit is the higher end. 64 bit are also now popular.

*Recording and playback rate:* This should at least be 44.1 kHz stereo, the rate at which CD audio is recorded. Anything more than this is even better.

*Signal to noise ratio:* This determines the clarity of the sound. The larger this ratio, the better it is.

*DirectSound 3D support:* A lot of games today use this for DirectSound 3D to build in sound. So most sound cards today support this.

*Connectors:* The box below (Inside a sound card) tells us about some of the connectors a sound card has. Check sound card's manual to see how many connectors it has for various devices, including devices with Firewire ports.

#### 4. RAM



Random access memory (RAM), is an important component of PC. Between the hard disk and the processor, it plays the part of a temporary storage area. While working on a PC, the programs opened refer to the RAM for their functions. It's temporary storage because it's volatile—once we switch off PC, it goes. RAM affects the speed of PC because it stops the processor from going back and forth to the hard disk—instead, it accesses the hard disk and lines up data to be processed by the processor.

##### **Need of RAM:**

RAM is measured in MBs. For those who are not into gaming or high-end graphics, 64 or 128 MB RAM is quite sufficient. The new operating systems need a bit of memory too. The minimum RAM requirement for Windows XP is 64 MB, and Microsoft recommends 128 MB. Though 512 MB memory is standard for desktops at present, it may become 4 GB soon to cater to the needs of memory intensive applications

##### **ii. Upgradability**

There are limited slots for memory. Don't waste any memory modules to avoid running out of empty slots. For instance, if we have four slots for memory, and three are currently occupied by 32MB. If we buy two 64MB, we'll have to toss one of the 32MB.

##### **iii. Present trends**

**Present RAMS are available as DDR 2. Double-data-rate two synchronous dynamic random access memory (DDR2 SDRAM)** is a random access memory technology used for high speed storage of the working data of a computer or other digital electronic device. It has the ability to run its bus at twice the speed of the memory cells it contains.

#### 5. HARD DISK



When dealing with storage space required for the programs and files, space and speed matter. 40 GB hard disks are common and adequate. As the capacity increases, the cost per unit memory reduces. If we need to frequently transport lots of data to office and back, USB hard disk is better. These are mobile hard disks and have a flash RAM that can be

connected to the USB port to store data in capacities of 16, 32, 64, 128 MB and 6 GB, 20 GB. The price range starts from Rs 3,000. A 40 GB 5400 rpm disk costs Rs 4,500. Some brands available in the market are Samsung, Seagate, Maxtor, and Western Digital.

#### **A. Selection features of a hard disk**

i. **The interface speed:** All recent model motherboards and hard disks support the IDE/ATA interface. For those who need to work with huge files at blazing speeds, a SCSI hard disk is the best option. But this will require a SCSI host adapter. The IDE/ATA interface available now is rated at 100 Mbps. But a faster interface alone won't have a great bearing on the performance. The controller too has to support it. That's where your motherboard specs come in.

ii. **Spindle speed:** The faster the speed, better the performance, ranging from 5400 rpm to 7200 rpm for ordinary purposes. For video rendering sort of work, go for higher speeds or opt for SCSI drives that offer even 10000 to 15000 rpm speeds.

iii. **Seek time:** This is measured in milliseconds. How quickly can the disk store or retrieve data influences the disk performance. The lesser the seek time, the faster the disk performance.

Nowadays hard disks are coming with faster spindle speeds, larger caches, better reliability, and increased data transmission speeds. IDE is the commonly used hard disk. New standard known as Serial ATA (Serial Advanced Technology Attachment). is around now and is destined to become "the standard"

#### **B. Tips for better disk management**

- Partition,
- defragment,
- remove temporary files (files with extension .tmp),
- check for bad sectors ,
- remove unused programs regularly,
- regularly scan for viruses,
- protect the data and
- be organized.

## **6. MONITOR**



**Monitor** is the face of PC. The right monitor can make working on the PC a much more pleasant experience for our eyes. There are more and better choices available. The regular monitor is based on cathode ray tube (CRT), suitable to produce certain kinds of images, like motion video. Color calibration (setting the monitors colors to match the print colors for images—useful for graphic designers) is much easier on such monitors. However CRTs take a lot of room on our desk and are usually heavy and bulky. CRTs aren't too comfortable to work on for long hours. Liquid crystal displays contain a thin layer of liquid crystals that bend light when an electric current is applied to them. LCD monitors are much easier on eyes, and consume far less desktop space compared to CRTs.

## **A. FEATURES OF A MONITOR**

### **i. Size and resolution: the bigger, the better**

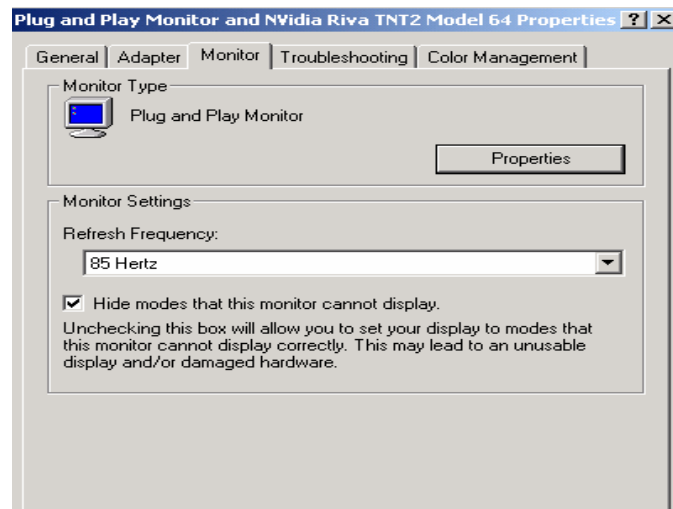
- ❑ Every monitor screen has a fixed number of dots or pixels that get illuminated to form the images we see. The number of dots that get illuminated in a row and column is the monitor resolution. Typical resolutions are 640 x 480, 800 x 600, and 1024 x 768. A higher resolution gives more desktop area to play around with. Keep our screen resolution set to at least 800 x 600 pixels since many programs and utilities are designed to work with at least this resolution
- ❑ Go for the biggest monitor available with the highest resolution supported. 17" monitors are quite affordable at Rs 7000 nowadays, and can greatly enhance the viewable area compared to 15" monitors. 14" monitors are all but obsolete. A designer who may need a 19" or 21" monitor which are expensive (19" costs Rs 18,000 while 21" costs Rs 52,000.)
- ❑ Monitor size and the resolution are interrelated. Generally, the bigger the monitor, the higher we can keep our resolution. Higher resolution mean that we'll be able to keep more windows open at the same time and will have more space on the screen to display. On a 17" monitor, we can work comfortably at 1024 x 768 resolution.
- ❑ Though expensive, LCDs give sharper display and are getting cheaper than they were before.
- ❑ Another category is the flat screens which are good for the best displays, clarity, brighter colors and stronger contrasts.
- ❑ At Rs 80,000 we get an LCD monitor that doubles as a TV with an inbuilt TV tuner, and some basic speakers. Plasma multimedia panels suitable for malls and corporate places. They are great for malls and corporate spaces. These panels come in 40-inch, 42-inch and 60-inch wide screens. They are from Visionaire, Sony, Philips, LG or JVC at prices ranging from Rs 3.5 lakhs to Rs 14 lakhs.

### **ii. Refresh rate: around 75 Hz**

- ❑ Refresh rate is measured in hertz, and all video cards and monitors have a maximum refresh rate at a particular resolution. The refresh rate determines how many times the screen is refreshed in a second. High refresh rate is desirable for continuous image effect but also puts a lot of strain on the viewer's eyes. For a monitor, aim for a refresh rate of around 72-75Hz. Higher refreshes for bigger monitors is preferable though it can spoil the image quality as well.
- ❑ To set refresh rate, go to the Control Panel and double-click on Display. Click the Settings tab, and then the Advanced button. We find the refresh rate setting under the



'Adapter' tab. Set monitor to a resolution that will allow a refresh rate of **at least 70 Hz**. Anything lower causes flicker.



### iii. Color: the right color depth

The color depth determines the number of unique colors monitor can display, and is determined by the video card. Go to 'Settings' tab under display properties for Increasing the color depth to 16-bit color to improve image quality on the screen. A good video card will even support 24-bit and 32-bit colors. It's better to keep the setting to 16-bit since higher color depths mean slowing down the PC.

### iii. Dot pitch: less than 0.3mm

This refers to the horizontal distance between pixels on our screen. A smaller dot pitch leads to sharper images, so always opt for monitors with a low dot pitch. A horizontal dot pitch of 0.26 or less is just fine for a 15" monitor. For a 17" monitor, around 0.3 should be okay.

\* If the dot pitch has been measured diagonally, multiply the value with 0.866 to find out the horizontal dot pitch.

### iv. Controls: digital, not analog

Older 14" and 15" monitors normally came with analog controls for brightness, contrast, horizontal and vertical size adjustments. But newer monitors come with digital controls. These have enhanced controls for color temperature, trapezoid adjustment, and de-gauss. Over a period of regular use, the monitor might show discoloration. This is known as 'gaussing'. A degauss control, if present, takes care of this problem.

## B. STEPS TO ENHANCE A MONITOR'S PERFORMANCE

### Choose the right place

It's important to keep monitor in the right position to reduce eyestrain.

- Keep its screen away from any kind of direct light source, such as a fluorescent tube, or light bulb.
- Don't keep monitor facing towards or directly behind a door or window, if they're close by;

- For an ergonomically correct position, keep the monitor right in front of keyboard

### Keep away from other appliances

Keep the monitor away from items like speakers, UPS, etc. These create strong magnetic fields that can mess up the colors we see on the screen, and even cause color patches.

### Change the settings

- Adjust the display settings properly like refresh rate, resolution, and color depth.
- To change these settings go to the **Control Panel** and double-click on the **Display** icon and click on the **Settings** tab. These settings are determined not only by the monitor, but also the display card hidden inside a computer.

### C. CHECK LIST

- Check the refresh rate—we should get a refresh rate of 80 Hz for our chosen resolution
- Dot-pitch size—0.26 mm or less for a 15-inch monitor and 0.3 or less for a 17-inch
- Digital controls for de-gauss, color temperature, trapezoid adjustment and pincushion adjustment. Stay away from astigmatic monitors—switch the monitor on and check out if the lines appear bent or broken. Avoid monitors with color patches.

NOTE: All prices mentioned are only indicative at the time of preparing this material. There will be price variations.

## 7. KEYBOARD



A keyboard is an input device for giving instructions to the PC. Keyboards range from Rs 475 to Rs 4,500. There are keyboards with 101 to 110 keys, Win 95 keyboards, and multimedia ones. Wireless keyboards are slowly gaining popularity.

## 8. MOUSE



The mouse which connects the user to give instructions to the PC now comes with the USB port connectivity making it extremely easy to install. Radio frequency (RF) mice and keyboards have been around for the past year or so. The best ones in this category are optical cordless mice that have sensors to detect motion. They send info wirelessly to a receiver connected to a PC—which means that we're not tied to the desk. We can be as far away as six feet and we don't even need to be in line-of-sight. But wireless technology has been slow to take off.

## 9. PRINTERS

Go for a

- mono laser if cost per page is the prime concern, and good quality text prints at high speeds are needed or
- a dot matrix printer if per page costs are crucial, and high speeds or quality are not so important, then dot matrix printer is good enough or
- An inkjet for all other purposes

### A. Job-specific printing

For home printing needs like taking prints of a school project, greeting cards, letters and resumes and family photos, we can go for a color inkjet that costs about Rs 6,000 or less. Remember that this is not for heavy-duty printing. They aren't fast, but give good quality text and color prints.

For taking prints of high quality digital pictures, or the sales report that shows the region-wise breakup, or for graphics design which needs to be shown to clients frequently, a color inkjet between Rs 8,000 and Rs 10,000 can do the job. Some of these are sold as photo-quality printers—but we need to use photo paper to take full advantage of the prints. A lot of them also print well on plain paper.

### B. Selection criteria of deskjet printer

**i. Dpi needs:** 200 dpi is good for text prints. For most color prints for the home, 600 dpi is good enough. Most printers below Rs 6,000 offer this resolution. Graphics designers need resolution of 720 dpi and above. For photo-quality, go for 1,200 dpi and above.

**ii. Availability of components:** Check the cost of other components that need replacing and maintenance and their availability.

**iii. Ink-saving methods:** Most inkjets come with techniques that let us gauge how much of ink is left in the cartridges—so we can buy a replacement in time. Some come with translucent covers to let us judge how much ink is left. Others let us find it out from the printer software that we'll load on our PC to run the printer.

**iv. Printer drivers and cables:** We need to check that a printer has drivers for the environment that we're working on, like Mac or Windows 2000. Also ensure that it comes with a cable and with USB support. Most printers today have this, making them extremely easy to setup.

**v. Refills:** Cartridges cost a lot. Prices have come down nowadays with all the major printer firms trying to fight the refills and gray market cartridges. Refills may not be preferable as

some problems are experienced and all printer manufacturers warn of nullifying the warranty in the event of use of any refill.

**vi. Speed and print quality:** The two most important things to look for in a printer are how fast it can print and how good it can print. The speed tests are done at the lowest supported resolution of the printer, whereas the quality tests are done at its maximum resolution.

**vii. Price per page** The price of the printer isn't the sole guiding factor for buying a printer. Running cost is also very important. Check price per every page. Find out the price of the ink cartridges and the number of pages each cartridge can print. For example, if a color cartridge costs Rs 2000 and it can print 200 pages then the price per page would be Rs 10, which means each printout is Rs 10. Do remember to check the coverage taken by the printer manufacturer for this. A cartridge would be rated to give 500 pages with a coverage of 5% of the paper area. Now if we print more than that, the number of pages we'll get using that cartridge would be much less. The number of pages we get also depends on the mode we print in—for instance printing in the Super economy mode would give more pages, while Best mode won't give as many. Also the print speeds for color are lower than printing black text.

**viii. Jam free feature:** While no printer guarantees total jam-free printing, they make dealing with jams a little easier. Keep the paper aligned accurately and see that papers aren't stuck to each other in a stack. It's when the paper going in doesn't go in the direction it should, or when the printer picks up more than one paper at a time that there's a possibility of a jam.

Finally, make sure the printer has the right warranty, the right cables and the right software to go with it.

### **C. Printer availability based on budget:**

#### **Rs 2,500-5,000**

Only inkjet printers will be available in this price range with dpi upto 2400 and 10-17 ppm for black, 5-10 ppm for color(draft mode).

USB and parallel ports can be afforded. Most print on plain paper, envelopes/cards while some on photo paper and transparencies.

#### **Rs 5,000-8,000**

We get both inkjet printers and low-end MFDs up to 4800 dpi (print resolution), and up to 48-bit scanning. We get 10-13 ppm for black, 10-11 ppm for color. USB 1.1/2.0 and parallel is available. Most can give borderless prints and print on photo paper and transparencies.

#### **Rs 8000-15,000**

We get both high-end inkjet and mid-range MFDs up to 5760 dpi (print resolution), and up to 64-bit scanning. 18-20 ppm for black, 12-15 ppm for color. USB 1.1/2.0 , memory cards and wireless are available. We also get photo quality and photo direct printers in this range and Support for a range of paper. Color cartridges are expensive.

#### **Rs 15,000-Rs 25,000**

Direct photo printers and high-end MFDs that support smart cards and print directly from digital cameras are available for this price range with dpi upto 5760 and print speed of 18-22 ppm for black, 12-15 ppm for color. Faxing speed is around 14.4kbps. USB 1.1/2.0 , memory cards and wireless and support for a range of media are available

### **D. Printer recommendation for different users**

#### **I .Home use**

2400 dpi is fine. These give good enough prints.

7-8 ppm speed.

More likely to be printing text, with some color occasionally. Else look at spending a fortune on cartridges.

Local refills may make warranty void, so check with vendor.

## **II Home office use**

Go for high speed—10 ppm upwards.

High resolutions only if we have to show color graphics to clients.

If its only text, and lots of it, look for a low-end printer.

Consider a multi-function device

## **III Designers**

A printer with the highest resolution in our budget.

Support for various media a must.

For high-end photo editing, go for photo printers.

Be prepared to spend a lot on ink cartridges.

Slow printing speeds for best quality prints.



## **10. SCANNERS**

A scanner converts analog data into digital. It copies an electronic image of the document or object we scan on to the PC. We can then work on that image. Most scanners today are based on CCD technology, used for years in devices such as faxes. A desktop scanner has thousands of CCD elements that convert light into an electrical charge. It converts the reflectance into analog voltage and then to digital values. Another technology Contact Image Sensor (CIS) was developed during the late 1990s. The CIS scanners are thinner, lighter, more efficient in terms of use of energy and cheap to manufacture. But when it comes to decent scan results, CIS scanners have not been able to produce good quality scans.

Scanners used to be bulky, expensive devices with average image quality. For high-res, we had to pay big money. Not anymore. Technology has given them a facelift and today we find sleek scanners that don't cost a bomb and are efficient when it comes to details. A resolution of 600 x 1200 dpi, 48-bit color depth and USB 2.0 connectivity are just some of the features that have become standard in a budget scanner, costing around Rs 4-5K.

### **A. Selection Features of a scanner**

**i. Resolution of the scanner :**Resolution refers to the clarity and sharpness of an image. Higher the resolution, sharper would be the picture. While selecting a scanner pay attention to the Optical resolution of a scanner and not the Interpolated resolution. Optical resolution is the actual resolution at which the scanner will capture the image we're scanning. Interpolated resolution is what the scanner uses to make the scanned image sharper. Interpolation is a process of enhancing a scanned image by filling more dots into it. The software goes through the scanned image and figures out the size and color of the dot. Based on that, it inserts more. This makes the image softer. While it's a useful feature, we don't choose one scanner over another purely on this. Till the late 1990s a typical scanner would have a resolution of 300 x 300 dpi, which has now shot up to 600 x 1200 dpi. This is quite decent for home use. Higher resolutions such as 1200 x 2400 dpi are better suited for design professionals.

**ii. Color depth:** This is the number of colors a scanner can recognize and scan. For home or office use, a 24-bit scanner will give very good results while scanning photographs etc. If we work extensively with graphics for publishing, consider a scanner with a higher color depth. Most of the scanners on the market now are 48-bit, which gives saturated color image with 281 trillion colors.

**iii. Free software:** The scanner totally depends on the software to bring out its true colors. Apart from image editing and viewing software, one of the most important programs to have around is the OCR software.

**iii. Easy connectivity to PC:** As against the bygone era of parallel connectivity, the trend now is towards USB connectivity and we'll find that most scanners these days have USB 2.0 connectivity. This means they'll work faster.

**iv. One-button scan:** Most scanners now come with one-button scanning One-touch functionality has become a default with scanners that let us scan, copy, mail to Web or e-mail with just a push of a button.

## **B. Uses of a flat bed scanner**

We can

- Create a digital scrapbook of our choice
- Scan pictures to send over mail to friends and family
- Explore computer art—scan anything and make collages and original works of art
- Make an exclusive e-book collection
- Have fun with pictures—morph, animate them
- Spruce up Website alive with scanned pictures and designs
- Conserve old pictures—turn them digital and store them on CDs
- Give the right impact with presentation—sprinkle it with relevant scanned pictures
- Save time typing when copying from books—scan the text and use OCR to turn it into an editable form
- Scan images for use in newsletters, design catalogues, product brochures, etc
- Get a second opinion—scan past prescriptions and reports, and consult a scientist from another city, state or country over e-mail
- Scan images for use in projects

**Some information on commercially available scanners**

| Company                  | Optical resolution(dpi) | Color depth (bits)                               | Scan-to Web                                  | Buttons                                     | Software bundled   |
|--------------------------|-------------------------|--|--|---|--|
| HP Sj 2300 - Q2957a #ACJ | 600                     | 48   | Yes  | 2—scan and copy                             | Hp Photo & Imaging Software  |
| HP Sj 3500 - Q2807a #ACJ | 1200                    | 48   | Yes  | Scan, copy and e-mail                       | Hp Photo & Imaging Software, HP Memories Disc Creator software ; Hemera  |
| HP Sj 3570 - Q2707a #ACJ | 1200                    | 48   | Yes  | Scan, copy and e-mail                       | —do—   |
| Umax Astra               | 600 x 1200              | 36 bit (48 bit enhanced)                         | No   | One   | Ulead Photo Express 3.0, Readiris 5.0 OCR Software, Adobe Acrobat Reader 4.0+H11:H13   |
| Umax Astra 2500          | 600x1200                | 48 bit   | No   | One   | NewSoft ImageFolio Image Editing Software, ScanSoftTextBridge PRO (OCR   |
| Umax Astra Slim1200      | 1200 x 2400             | 36 bit (48 bit enhanced)                         | No   | One   | Ulead Photo Express 3.0, Readiris 5.0 OCR Software, Adobe Acrobat Reader 4.0   |
| Umax Astra Slim4400 U    | 1200 x 2400             | 48 Bit   | Yes  | One   | Kodak Color Match System — MagicMatch, Automatic and Intelligent Scanner Driver — VistaScan, Adobe Acrobat Reader V4.0   |
| Umax Astra Slim4500 U    | 1200 x 2400             | 48 Bit   | Yes  | One   | MGI Photosuite SE  |
| Canon N 640P Pex         | 600 x 1200              | 14-bit input/8-bit output for each colour (RGB)  | Possible                                     | -   | CanoCraft CS-P, ScanGear Toolbox CS, ArcSoft Photo V   |
| Canon D 646U             | 600 x 1200              | 42-bit input/24-bit output for each colour (RGB) | Possible                                     | -   | CanoScan Setup Utility, ScanGear CS-U, ScanGear Toolbox, OmniPage Pro 9.0, PhotoRecord, ArcSoft Photo Base, and Adobe Acrobat Reader   |
| Canon N1240 U            | 1200 x 2400             | 16-bit input/8-bit output for each colour (RGB)  | Possible                                     | One   | ScanGear CS-U for Windows; ScanGear SC-U for Macintosh (plug-in module); ScanGear ToolBox, ArcSoft PhotoBase, ArcSoft PhotoStudio; ScanSoft OmniPage; Adobe PhotoShop Elements; Adobe Acrobat Reader, and electronic (PDF) manuals for Windows and Macintosh |
| Microtek ScanMaker 3730  | 1200x600                | 42 Bit   | -  | 3—scan, print, e-mail                       | Microtek TWAIN Scan Driver, Presto Page Manager, MGI Photo Suite III SE, ScanSoft TextBridge Pro 8, Adobe Acrobat Reader   |
| Microtek ScanMaker 3800  | 1200x600                | True 48 Bit                                      | Optional: 35mm slide & filmstrip adapter     | 5—scan, copy,PDF/OCR, e-mail, scan- to- Web | Microtek Scanner Driver (PC/Mac), ABBYY FineReader 4.0 Sprint (PC/Mac), Ulead Photo Explorer v7.0 (PC), Ulead Photo Explorer v1.1 (Mac), Adobe Acrobat Reader v5.0 (PC/Mac), Adobe Photo Delux 4.0 (PC), Adobe Photo Shop 5.0 LE (Mac)                       |
| Microtek ScanMaker 4600  | 2400x1200               | 42 Bit   | Optional: 7" x 7" Transparency Media Adapter | -   | Microtek ScanWizard 5 (PC/Mac), ABBYY fineReader 4.0 Sprint OCR (PC/Mac), Ulead Photo Explorer v7.0 (PC), Ulead Photo Explorer v1.1 (Mac), Adobe Acrobat Reader v5.0 (PC/Mac)  |

## 11. UPS

An UPS encompasses battery and some electronics inside that connects PC to the mains power outlet. When the power fails, the UPS continues to power PC from the battery to avoid interruption. Whenever the battery of a UPS starts running out, it begins to beep, indicating PC to shut down. Advanced UPSs connect to the computer's serial port, and use software to force the computer to "gracefully" shut down before powering off.

### A. UPS Vs CVT

A Constant Voltage Transformer (CVT) can only regulate the voltage fed to PC and at best offer protection against spikes and surges. If the power fails, a CVT will turn off, taking away with it any unsaved work on a PC. And if the power keeps going off and coming back repeatedly, hard disk could get damaged. So it's better to invest a little extra in a UPS than to go for a CVT.



### B. Features of a desirable UPS:

All UPSs are identified with two parameters— Volt Amps (VA) rating and the technology followed. The VA rating is the amount of load that a UPS can handle. The load could be anything that is connected to UPS—a PC, printer, etc.

**i. Voltage regulation:** An UPS should have good voltage regulation and not act up if the frequency of the supply varies from the required 50 cycles per second. UPS should be able to isolate itself from the mains power if the incoming voltage is more than 260 or less than 190. Otherwise, such very high or low voltages will reach computer and do it no good. It has special circuitry to eliminate electrical fluctuations and isn't damaged by ordinary fluctuations. Most UPSs can withstand voltages as high as 270 volts. But in some UPSs, a fuse will blow or circuit-breaker will trip. The line voltages (maximum and minimum) at which a UPS can supply power to a PC without switching to battery, is very important for long battery life. A good UPS should not switch to battery even when the line voltage varies by 20% of 220V.

**ii. Power rating:** To calculate the capacity (or VA rating) of UPS, first calculate the operating power of computer and its devices. For instance, at the back of monitor we may find that it's rated at 110 Volts and 1.5 amps—that makes its operating power 165 VA ( $V \times A$ ). In this manner, check the rating of each device—the computer, printer, fax machine, etc, and add up the total power. Usually, 500 VA rating is the most common for home use. Ideally this rating should be able to handle a load equivalent of three Pentium III machines with 15" color monitors. A lot of UPSs available in the market are overrated. So a 500 VA UPS may not actually be of this rating, but much less.

**iii. Technology to pick:** Any UPS should have AVR (automatic voltage regulator) function built in to regulate the supply voltage. An offline UPS is the cheapest and among the most common ones for home use. It lets PC run on mains, keeping itself offline. When mains power fails, it switches to battery through a relay—taking around 5 milliseconds(ms), small enough for the PC to overlook. An online UPS is bigger and more expensive. It always stays online i.e., it supplies always power to PC from battery, and another circuit keeps the battery charged. When the mains fails, the battery keeps on supplying power. So there's no switchover involved, because it's always online. Line-interactive has the best of both but is expensive and provides better power protection.

**iv. Switchover:** Switchover time is the time (<10ms ideally) taken by a UPS to switch to battery when the mains power fails. Another factor is the switchover voltage range. This is the minimum and maximum input voltage that a UPS can take without switching over to battery. Ideally this range is 176-264 V.

**v. Back up:** UPS should give enough backup time so that we can save the work and safely shut down. The backup time given on a UPS is for full load which means the complete load with all connected systems like monitor, printer, scanner, modem etc. Since this is rarely the case, the actual backup time is much more. The backup time in UPS systems is determined by its batteries. Most UPS have built-in maintenance-free batteries. Their rating and quantity determine backup time. Most of them have a backup time of 15-20 minutes at full capacity. UPS-generator combination is needed for longer backup time.

## 12. DIGITAL CAMERA



Digital camera comes with accessories like a

- *battery pack*, Digital cameras consume more power than the film-based cameras do, plus they have the added power consumption of the LCD preview screen. So it's very important that they have enough power to last a good number of shots. It's very important that the battery be rechargeable
- *a memory card*, The 8 MB, 16 MB memory cards that come with camera are just not good enough. Buy an extra 32 or 64 MB card. Floppy-based cameras are also available.
- *an AC power adapter* and
- *something to connect camera to the PC.*



## A. Selection criteria for digital camera

**1. Resolution:** This is usually given in mega pixels. In market, cameras of 4,5, 7 MP are available. Also make sure that the stated resolution is not an interpolated figure. An interpolated resolution is one that has been enhanced after the image has been taken, by adding to the recorded pixels. This enhancement can be easily done on any image manipulation software, so there is no need to pay more for this feature.

### 2. The memory

Normally cameras ship with either some on board memory or a complimentary memory card, neither of which will generally exceed 32 MB. Mostly, if you have 5 MP camera you should be fine with a 256 MB stick.

### 3. Size of Sensor

**Look for the size of the CCD (Charge-coupled device). CCD is akin to the film of non-digital cameras. As a thumb rule, larger the CCD better the image quality irrespective of the MP count. It's something like the difference between a 70mm and 35mm film.**

### 4. PictBridge

PictBridge is the standard for printing photos directly from your digicam. All the printer manufacturers including HP, Canon and Kodak have pictbridge compatible printers available. Note that this feature is important only if you have a PictBridge enabled printer or plan to buy one.

### 5. Startup time

The startup time is the time it takes the camera to be ready to shoot a frame once you press the 'on' button. This again varies quite a bit from camera to camera and can be as low as 1 second.

### 6. Zoom

The zoom is divided into two parts: optical and digital. The optical zoom is the amount the lens zooms in, while the digital zoom is when we actually zoom into an already taken picture. Again, this latter effect is possible in any image manipulation software. Unlike optical zoom, digital zoom is software enhanced and will give you pictures lacking sharpness and clarity and should be avoided wherever possible. The more the optical zoom you have, the better (and more expensive) the digicam. Most cameras today come with a 3x optical zoom coupled with some amount of digital zoom. Since you can use the two in conjunction with each other, camera makers would give you figures like 9x smart zoom or something to trick you into thinking that the camera offers a higher zoom than it actually does.

### 7. Auto focus

Sometimes you just want to click a picture quickly without having time to adjust. At such times the auto focus mode works really well. To test this, just put the camera on auto and click photographs in a variety of settings, say inside the shop, in a dark corner, with the zoom on, and of course in bright sunlight to test if its automatic exposure settings work properly.

## **8. Manual settings**

Even though most digital cameras come with fairly good Auto modes, a lot of manufacturers are increasingly bundling in more and more manual configurability options via either the manual mode or the Program Mode (mostly denoted by P). Ensure that your camera allows you to manually set at least the following features: White Balance, Aperture size, Shutter Speed, ISO (CCD sensitivity) settings and choose the correct metering mode which is the way a camera detects the correct exposure setting, usually Center, Matrix and Spot.

## **9. Burst Mode**

Burst mode is when the camera takes multiple shots in extremely quick successions. A camera can take around 15 shots at a stretch before it needs to write it to the main memory. Note that the speed at which the camera can take the shots as well as the number of shots it can take vary from camera to camera. Also note that the speed at which the camera can write the information to the memory media depends on the media itself. For example, a camera can write fairly slowly on a memory stick but will write faster on a memory stick pro media while the fastest write speeds are achieved on a SD card.

## **10. Flash and recharge**

Depending on the lighting condition as well as the subject being shot, you can choose from the various flash modes available. These are typically Auto, Slow/Synch and Red Eye Reduction. A lot of cameras today support manual flash attachments which let you add an external flash to them. Once you have used the flash you will need to give the camera sometime to recharge the flash before you can re-use it. This is known as Flash Recharge Time and varies from camera to camera and can be from 1 second to 6-7 seconds.

## **11. Image saving format**

If your camera allows you to and you do choose to save the pictures in RAW or TIFF format, the image size will be larger than JPEG and you might not find even a 256 MB stick adequate.

## **Comparison of Analog with Digital Recording Light**

- **Analog**

Black-and-white film is coated with what is called an emulsion layer, which when exposed (i.e., the shutter opens and lets light hit the film) changes the halide crystals chemically. The developing and printing processes translates this into an image. Colour film has three emulsion layers, each one reacting to a primary colour of red, green or blue light. Coupler dyes mix to approximate the actual colour of the light that first hit the film.

- **Digital**

The image sensor in the digital camera is made up of thousands of photosites which turn light energy into digital information. By combining information about hue and intensity, the camera assigns a specific colour to each pixel.

## **Creating an Image**

- **Analog**

In the development process, film is bathed in chemicals to form pure silver. The parts with the least exposure are the most transparent, and the parts that were most exposed to light are black or opaque. This same process is true for colour film, except that the dye couplers are also included in the process. The film is "fixed" to prevent further chemical reactions, creating a negative. To print, a very bright light is shined through the film onto the photographic paper, which is covered with an

emulsion layer very similar to that of film. The negative image now becomes a positive creating the photograph.

- **Digital**

A digital camera records light electrically. This "information" then becomes an image. A microchip inside the camera converts the digital reading from each individual sensor and combines it with information from the surrounding photosites. A colour is assigned to a particular pixel. Thousands or millions of pixels are combined into a single computer file which can then be downloaded.

### 13. WEB CAMERA

Webcams are used to take snapshots or record short video clips which you can then send by e-mail to friends and relatives around the world. Another cool place where Webcams can be put to use is video chat which lets us actually see the person we are chatting with.



#### A. Selection criteria for web camera

**i. Number of resolutions supported:** Webcams support many different resolutions so you can use the pictures for different purposes. For example while video chatting you will use a lower resolution to save bandwidth. And while recording a video, you'd like a higher resolution. That's why this is important.

**ii. Compression formats supported (using bundled software):** After a snapshot or a video clip is captured save it using some format—JPG, or AVI. The more the number of supported formats, the easier it's.

**iii. Operating systems supported:** It is better if it can be launched on a variety of Operating systems like windows, macintosh.

**iv. Bundled software:** The software accompanying some of the Web cams let us video chat, edit our video clips and still images. Some also come with security software—this lets us use Webcam as a security camera.

**v. Average frame rate during playback:** Frame rate refers to the total number of frames played per second. A full motion video has a frame rate of about 30 fps. Higher frame rate is desirable.

**vi. Playback quality:** It should be free from flickering, color mismatches, excessive blurring during playback, etc.

Some of the Webcams available are

- Vcam Eye for PC
- IBM PC Camera
- Logitech QuickCam Home

- NetView PC Camera
- Kensington VideoCAM
- Creative WebCam Go Plus
- Kensington VideoCAM Super VGA
- Logitech QuickCam Pro

## **14. MODEM**

A modem is like a telephone for a computer to communicate with other computers over telephone lines. Broadly, a modem's performance depends on the characteristics of the modem and those of the telephone line it is working with. The condition of telephone lines varies widely across the country. So how your modem works will depend to a large extent on the telephone line.

There're several different types of noise that can happen either individually or in combination in a telephone line. Different modems react differently to these. And there's no way you can identify which of these conditions affect your line. So nobody can correctly predict which modem will work the best on your line.

### **Test it on your phone line**

There's no other way out. You'll have to convince your vendor to test the modem at your place, and to take it back if it does not work properly.

### **Internal or external?**

If you're buying a modem separately, go for an external fax-modem. External ones are easier to install. They cost Rs 2,000 upward. Buy the cheapest one that works okay with your line, giving you a steady high-speed connect for at least an hour.

If you get an internal modem card pre-installed when you buy a new PC, that's okay, if it's a 56 kbps fax-modem. An internal card does have one advantage: it reduces clutter. Again, it helps to check that it's working okay on your line, else you may need to change it

### **Other modem features**

#### **True plug-and-play with USB**

If you're looking for swift installs and convenience, go for a USB modem. They cost about Rs 4,000.

#### **The answering machine modem**

If you're looking for a modem that's also a digital answering machine and a fax machine, go for a message modem. Message modems can store voice messages and faxes even while the PC is switched off. Once the computer is switched on, these messages are transferred to it and can then be heard or viewed. Some also let you retrieve the messages from a remote location—all you have to do is call up your message modem.

## **15. IPODS**

**iPod** is a brand of portable media players designed and marketed by Apple Computer. It stores media on a built-in hard drive, while the smaller iPod use flash memory (ie., with

additional memory). It functions as a mass storage device for storage of user files and can transfer files from and to computer using its memory. With an ipod, there is no need of carrying bulky floppies/ CDs for carrying data and presentations outside. It works on Mac and Windows (present models) platforms. We can keep track of meetings, schedules, deadlines to meet targets, organize our activities using an ipod.

With time, ipods are evolved considering the features of

- lighter weight
- Smaller size
- color displays
- Video playing
- Extendable memory
- Platform compatibility

The present models available are ipod (to play audio), ipod nano (to play audio and view images) and ipod video (to play audio, video and images).

# **SCREENING AND PRIORITIZING FIELD LEVEL OPTIONS**

**S.K. Soam**

Principal Scientist, NAARM

The primary objective of prioritizing options is to utilize scarce research resources efficiently, i.e., maximizing the benefit for the society expected from public expenditure for research. Rigorous prioritization processes are imperative as the research institutions face new challenges because of decrease in research budget and also the farmers demand more accountability from research managers. The present article provides a brief overview on some of the more practical issues in prioritizing options in the context of developmental research. This approach is followed by International Center for Development oriented Research in Agriculture (ICRA), The Netherlands for conducting field studies.

## **Why prioritization?**

- To select best portfolio of research activities
- To review the existing resource allocation
- To clarify the differences of opinion, which provide occasion of debating
- To review existing and novel alternatives
- To provide more transparent institutional management for increasing credibility towards the outside world

## **Methodologies for prioritization**

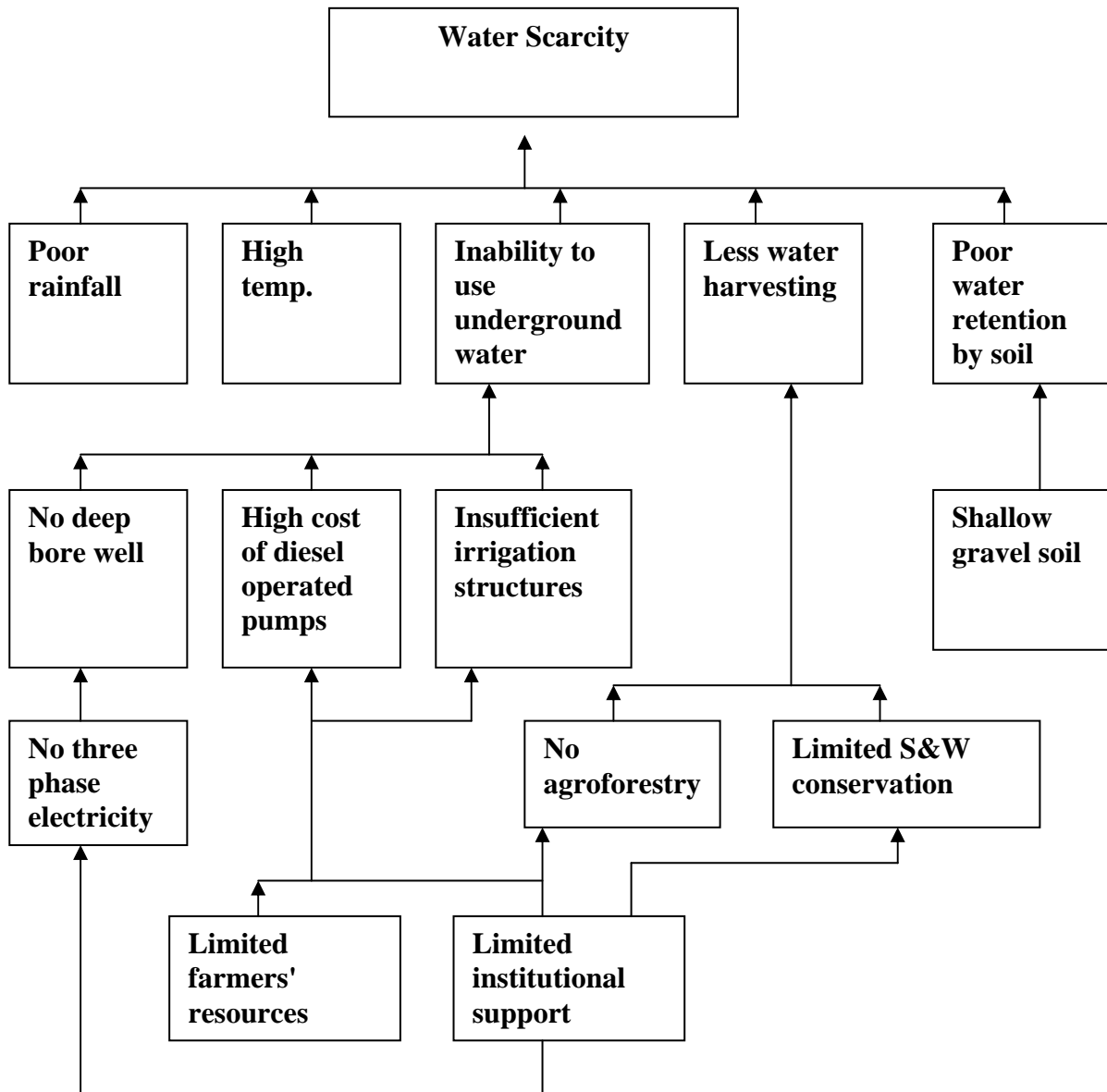
Project planning matrices (the logical framework) in setting up the inputs, outputs, means of verification and assumption of projects used by donors like USAID, other organizations like GTZ uses Objective Oriented Project Planning (OOPP) constructing problem trees around the core problem. The OOPP is particularly useful for setting up and analyzing rural development projects. Good ideas for agricultural research planning can be drawn from it. However neither OOPP nor the logical framework was developed for agricultural research planning at micro level. The other methodologies include Local Environmental Analysis and Assessment of Rural Needs (LEARN), Agricultural Knowledge Information System (AKIS), Strategic Options Development and Analysis (SODA), Organization, Performance, Improvement and Understanding Methodology (OPIUM), Cognitive Mapping, network linked ideas using computer software called COPE.

Three main types of tools are available for prioritizing options, which are used either separately or in combination. They are: 1) Tools for ranking the relative importance of production problems faced by farmers (matrix ranking), scales using various criteria is a fairly obvious step, the main challenge is choosing sufficient, suitable criteria and deciding how to weight them. 2) Tools for examining the cause of problem (problem – causal diagrams), where the cause of the problem is determined and prioritization is done to remove the problem. 3) Tools for screening and prioritizing potential solutions (scoring methods like Analytic Hierarchy Process).

## **Problem-Causal diagram**

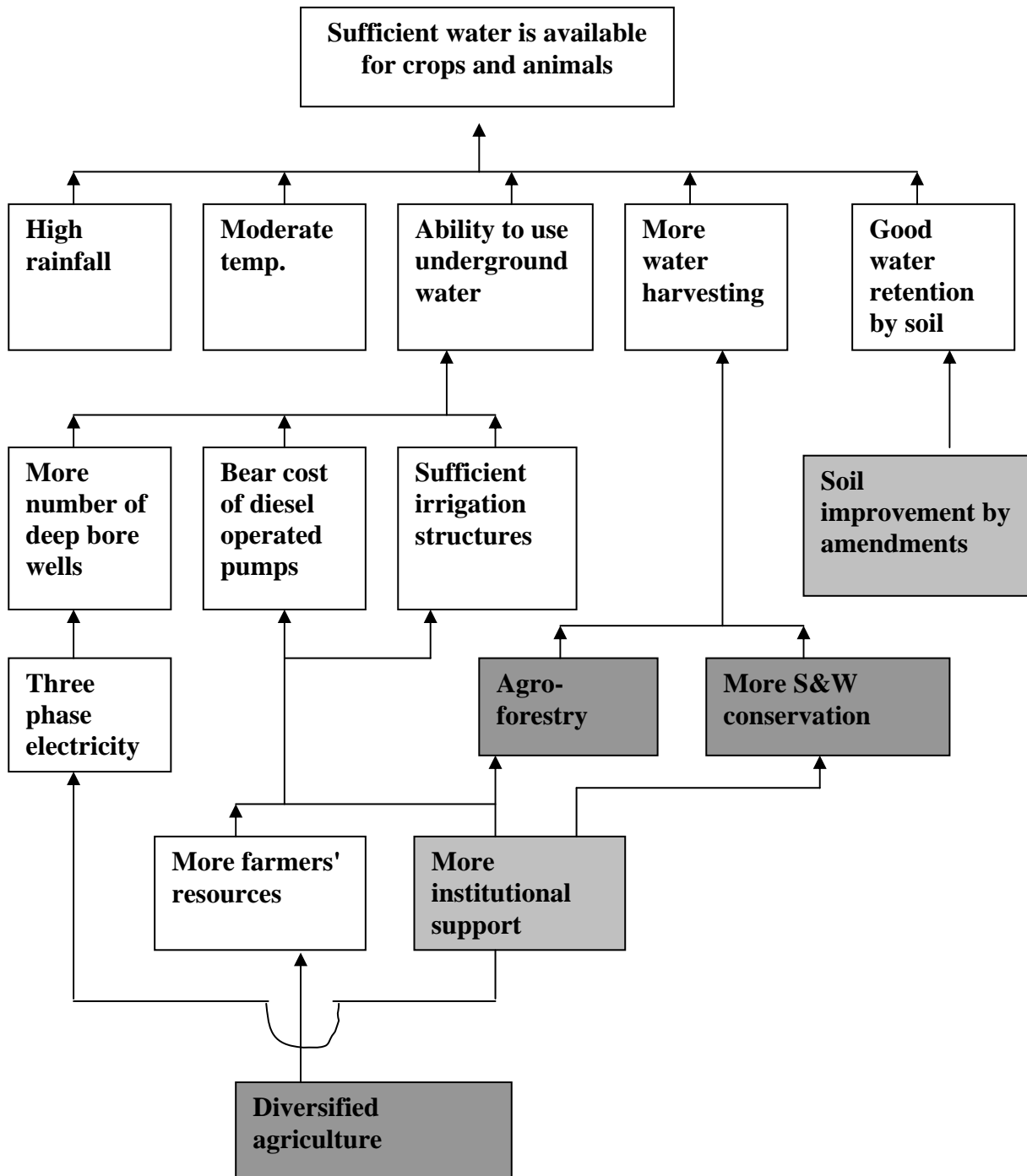
After identifying and ranking the problem, these diagrams will help to identify primary, secondary and tertiary, etc., causes of problem, and will also help in identifying the points of interventions, which can be prioritized using AHP.

### Problem Tree



## Solution Tree

Identify the points of interventions (shaded boxes) for prioritizing options to achieve the goal.





## Analytic Hierarchy Process (AHP)

The AHP is a multi-objective, multi-criteria decision making approach which employ a pair wise comparison procedure to arrive at a scale of preferences among a set of alternatives. It is necessary to break down a complex unstructured problem into the component parts into a hierarchic order. It is a process involving discussions, learning and checking, and also a powerful tool to support good decision making. Unique feature is possibility to calculate a measure of inconsistency for each set of judgements. The property enables to identify errors and to revise adjustment, procedure of AHP is based on three principles:

1. Decomposition of a complex unstructured problem
2. Comparative judgements about its components
3. Synthesis of priorities derived from the judgements

The goal, criteria, sub-criteria and options (projects) identified, judgements are made to compare all criteria in pairs with respect to goal and options (projects), and with respect to each of the criteria at the next higher level. Relative comparisons are based on hard data and on the intuition, experience as well as expertise of decision-makers. AHP explicitly allows subjective judgements recognizing their legitimate role in *ex ante* analysis. Once the verbal judgements are made, they are translated into numbers by means of a fundamental scale presented in Table1.

**Table 1: Fundamental scale for AHP**

| Numerical scale                         | Verbal terms                              |
|---|---|
| 1                                       | Equally important                         |
| 3                                       | Moderately more important                 |
| 5                                       | Strongly more important                   |
| 7                                       | Very strongly more important              |
| 9                                       | Extremely more important                  |
| 2,4,6,8                                 | Intermediate values to reflect compromise |
| Reciprocal scale i.e. 1/3, 1/5, 1/8 etc | Reciprocates the compared element in pair |

To find out corresponding sets of weights, the pair-wise comparison is done where element *i* with element *j* is placed in the position of  $a_{ij}$  in the reciprocal matrix *A* as shown below:

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix}$$

The consistency ratio is determined and sensitivity analysis can be done by AHP computer programme known as "Expert Choice" (Forman and Satty, 1991).

## **When and how field level prioritization is done?**

In the developmental context to prioritize options, first identify problems and opportunities, which deals with the causes and consequences. The next step is screening of options which examines the proposed solutions against the relative impact of each of them in terms of competitiveness, social equity and environmental sustainability. It is most effectively organized in a stepwise manner by following four steps to arrive at the best decision in the best manner.

### **Step 1: Choosing the right people**

Building the right team and decide that who will participate like end users, researchers, decision makers, priority setting core team and facilitators.

### **Step 2: Defining objectives and options**

A sector or sub sector analysis followed by defining research objectives e.g., at national level; objectives have often been grouped in four categories i.e., food security, poverty alleviation, income generation and improved natural resource sustainability. At field level efficiency, reliability, economy and social equity may be the research objectives. The research alternatives must be identified and defined by analysing constraints and opportunities. To assess the research alternatives the evaluation criteria need to be formulated. These criteria normally correspond with measurable indicators for research objectives. When there are several criteria, criteria weighing may be required.

### **Step 3: Choosing right method**

With limited resources, research should clearly be taken only on those alternatives that contribute most to the research objectives. To choose critically, one should estimate how the research alternatives perform on the measurable criteria, often the initial rank order is submitted to sensitivity analysis.

### **Step 4: Preparing for implementation**

Priorities are set in order to be implemented. The priorities, thus, need to be transformed into a resource allocation plan. Finally the process followed and results obtained upto here should be submitted to the wider stakeholder validation.

## **Procedure of prioritizing options at field level**

### **Following steps to be followed to prioritize options and allocate resources at field level**

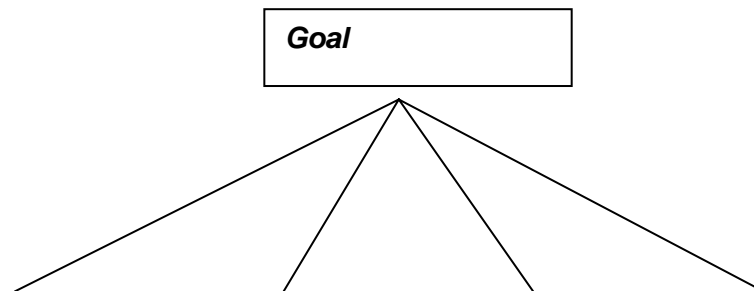
1. Multidisciplinary team conduct systems research for contextual understanding of problems and opportunities, uses various PRA tools.
2. Preferential ranking of problems of the farmers, use analytical tools.
3. Selected problem examined for Problem-Causal analysis, identify intervention points.
4. Formulate research questions based on research hypotheses.

5. Identify research alternatives, resource allocation plans.
6. Generate criteria to evaluate options, check relevancy and applicability of these criteria, find out indicators for these criteria which can be measured either using data, experiences of other countries, expertise and intuitions of team members.
7. Evaluate options using analytic methods, which can be understood by following hypothetical example of Analytic Hierarchy Process (AHP)

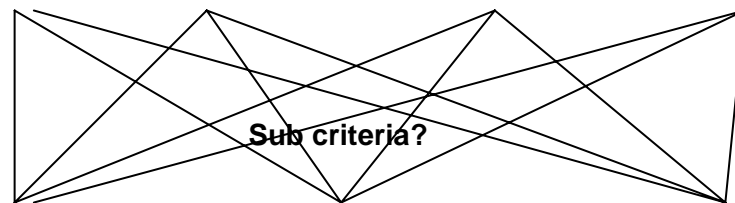
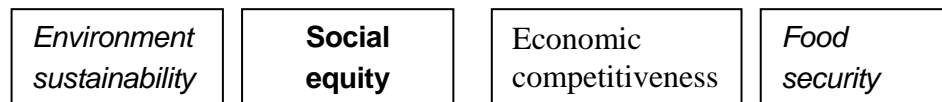
### Step I

#### Decomposition of unstructured problem into hierarchy level

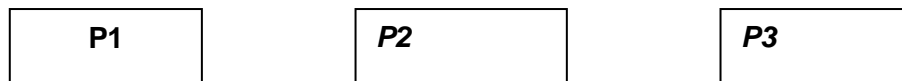
Level- I  
(Goal)



Level- II  
(Criteria)



(Options)



### Step II

#### Judgement matrix for pair wise comparison criteria with respect to goal

Environmental Sustainability- C1, Social Equity- C2

Economic Competitiveness- C3, Food Security- C4

|    | C1  | C2    | C3    | C4    | Eigen Vector<br>Perron vector | Weight | Component of Eigen value* * |
|----|-----|-------|-------|-------|-------------------------------|--------|-----------------------------|
| C1 | (1) | (1/3) | (1/5) | (1/9) | .293                          | .052   | .20                         |
| C2 | (3) | (1)   | (1/3) | (1/3) | .577                          | .103   | .54                         |
| C3 | (5) | (3)   | (1)   | (1/5) | 1.316                         | .235   | .926                        |
| C4 | (9) | (3)   | (5)   | (1)   | 3.408                         | .609   | 2.56                        |

Maximum eigen value ( $\lambda_{max}$ ) = 4.227, C.I. = .075, C.R. = .08

### Step III

#### Judgement matrix for pair wise comparison of options with respect to criteria

- Alternatives (projects) with respect to Environmental sustainability
- Alternatives (projects) with respect to Social equity
- Alternatives (projects) with respect to Eco. competitiveness
- Alternatives (projects) with respect to Food security

##### a. Projects with respect to environmental sustainability

|    | P1  | P2 | P3  | Eigen vector | Local Priority |
|----|-----|----|-----|--------------|----------------|
| P1 | 1   | 6  | 5   | 3.10         | 0.701          |
| P2 | 1/6 | 1  | 1/5 | .321         | 0.072          |
| P3 | 1/5 | 5  | 1   | 1.00         | 0.226          |

( $\lambda_{\max}$ ) = 3.22, C.I.= 0.1, CR= 0.1

##### b. Projects with respect to social equity

|    | P1  | P2  | P3 | Eigen vector | Local Priority |
|----|-----|-----|----|--------------|----------------|
| P1 | 1   | 6   | 5  | 3.10         | 0.721          |
| P2 | 1/6 | 1   | 3  | .793         | 0.184          |
| P3 | 1/5 | 1/3 | 1  | .405         | 0.094          |

( $\lambda_{\max}$ ) = 3.18, C.I. = 0.09, C.R. = 0.1

##### c. Projects with respect to economic competitiveness

|    | P1  | P2 | P3  | Eigen vector | Local Priority |
|----|-----|----|-----|--------------|----------------|
| P1 | 1   | 9  | 5   | 3.55         | 0.734          |
| P2 | 1/9 | 1  | 1/5 | .281         | 0.058          |
| P3 | 1/5 | 5  | 1   | 1.00         | 0.207          |

( $\lambda_{\max}$ ) = 3.11, C.I. = 0.05, C.R. = 0.09

##### d. Projects with respect to food security

|    | P1  | P2 | P3  | Eigen vector | Local Priority |
|----|-----|----|-----|--------------|----------------|
| P1 | 1   | 7  | 5   | 3.27         | 0.730          |
| P2 | 1/7 | 1  | 1/3 | .362         | 0.080          |
| P3 | 1/5 | 3  | 1   | .843         | 0.188          |
|    |     |    |     |              |                |

( $\lambda_{\max}$ ) = 3.04, C.I. = .02, C.R. = .03

## Step IV

### Synthesis to obtain global priority

Matrix of Local priorities, weights and final ranking of the options

| Options<br>(projects)<br>↓ | Local priorities with respect to the criterion<br>(Weights in bracket)<br>⇒ |              |              |              | Global priority* |
|----------------------------|---|--------------|--------------|--------------|------------------|
|                            | C1<br>(.052)  | C2<br>(.103) | C3<br>(.235) | C4<br>(.609) |                  |
| P1                         | .701  | .721         | .734         | .730         | 0.726            |
| P2                         | .072  | .184         | .058         | .080         | 0.082            |
| P3                         | .226  | .094         | .207         | .188         | 0.182            |

THUS PROJECT P1 IS MOST FEASIBLE FOLLOWED BY P3 AND P2

Though prioritization is essentially a centrally lead process but at field level prioritization of options for projects and reviewing resource allocation plans, the discussed procedure is best suited as it takes systems approach, is conducted by multidisciplinary team and ensure the participation of key stakeholders. The prioritizing options at various levels (national, organization, institution, and project leader) are different. The implication is that it is normally best done in a top down fashion and should be clearly linked with budget, while the better information on needs and requirements for agricultural technology is available at the lower level. This situation arises where decision wise a top down approach is most desirable and where information wise a bottom up approach is most useful. The issues regarding linkages between micro level planning and broad based projects needs to be addressed at various levels. The major difficulty of priority setting comes from its forward looking nature. *Ex ante* evaluation is always tricky since there is substantial uncertainty involved. The adoption process is an additional source of uncertainty.

### Suggested reading

Forman, E.H. and Saaty, T.L. (1991). Expert choice software package for IBM, PC.Pittsburgh, PA, USA.

Saaty,T.I. (1980). The Analytic Hierarchy Process: planning, priority setting, resource allocation. New York, Mc Graw Hill

Janssen, W. (1995). Priority setting as a practical tool for research management. In: Bosch,M. and Preuss, H. (eds), Management issues in national agricultural research system: Concepts, instruments and experiences. LIT Verlag, Munster-Hamburg.pp 79-93.

# CHALLENGES AND MANAGEMENT OF AGRICULTURAL EXTENSION IN THE NEW MILLENNIUM

## What is Agricultural Extension?

Agricultural Extension is central in formulating and disseminating knowledge and in teaching farmers to be competent decision-makers. Therefore, extension plays an important and significant role in most agricultural development projects.

It is part of a system of actors who influence farmers' decisions. It includes among others, agricultural researchers, political authorities, planners and administrators, farmer organizations, NGOs, farmer training centres and the media. These actors assume the function of research, information dissemination, training and so on. These actors interact with each other in the context of the Agricultural Knowledge System [AKS].

Further, the primary goal of agricultural extension is to assist farming families in adopting their production and marketing strategies to rapidly changing social, political and economic conditions, so that they can, in the long term, shape their lives according to their personal preferences and those of the community. The task of extension thus, is to improve interactions among actors with the AKS so that farmers have optimum access to any information that could help them enhance their economic and social situation.

## Challenges for Extension in the New Millennium

As we move into the new millennium, it will be increasingly necessary and definitely feasible to take a holistic approach to organize positive change in rural areas. For extension, that means as George Axinn (1977) says, helping farming people towards sustainable increasing productivity - particularly in the small - mixed farming systems in rainfed areas, in upland areas and in other places, which have been neglected. It also demands measuring success in terms of the **consumption** of rural people as well as their **production**. And that, in turn, will require agricultural extension systems which help farm men and women organize themselves in ways which empower them - to lead agricultural extension and to exert enough power and influence over agricultural research system so that they generate useful practical information which fits the needs and interests of those farming people.

Generally, extension has to prepare itself to face six challenges in the new millennium. They are :

1. Control, accountability and sustainability in agriculture
2. Developing a comprehensive Agricultural Extension Policy
3. Addressing the Educational and Technological Needs of Target Clientele
4. Farm Women and Women Extensionists
5. Improving Communication Support in Extension
6. Strengthening Extension Management

## Research-Extension Linkage

So far, extension objectives have been to increase productivity at any cost and in the process have ignored the key issues like clients needs and problems, appropriate technology development and dissemination ensuring input supply and information services, training of farmers and extension personnel for knowledge and skill upgradation to cope up with the technological advancement, marketing and management.

These things are to be made on perfect blending of Research and Extension. Extension will be effective, meaningful and purposeful only when it draws required information from research and feeds to farmers for their use.

### **Emerging Priorities in Extension in the New Millennium**

In the present context of liberalized economy and globalization of agriculture time has come now for agricultural extension to cope up with the changing scenario with its new strategy and approach to reach farmers not only with basket of technological options, but also with information of new market opportunities and gain, more profit and sustainability of income. For the purpose, extension is to be redefined, redesigned and equipped with several solutions to the problems of different groups of farmers, with varied dimensions of land holdings, farmers situations and income. The priorities in these are:

1. Technological options and development in agricultural production process
2. Location specific and need-based extension strategies and approaches
3. Participatory extension for technology development and dissemination
4. Linkages and coordination among concerned development departments and organizations
5. Use of new communication channels and media support in extension
6. Human resources development and management in agricultural extension
7. The cost sharing of extension services and privatization of extension
8. Policy changes required in view of all the above, to build effective extension strategy.

### **Human Resources Management for Agricultural Extension**

The number, quality and gender of human resources available to extension affect the impact of extension programmes (Burton Swanson, 1989). In addition, adequate technical communication, logistical and supervisory support for extension field staff are essential to maintain effective performance. Finally, opportunities for professional development, advancement and recognition are additional factors that influence the performance of extension personnel.

Human Resource Management in Agricultural Extension must address the following issues :

1. Extension coverage
2. Time allocated to educational activities
3. Staffing profile to ensure adequate technical and communications support
4. Staff stability
5. Educational qualifications and training needs
6. Gender related training
7. Professional status
8. Personal management
9. Recruiting more female extension personnel

## **Innovative Extension Strategies and Approaches**

FAO has described eight different extension approaches namely:

1. The general agricultural extension approach
2. Commodity specialized approach
3. Training and visit approach
4. The agricultural extension participatory approach
5. The project approach
6. The cost sharing approach
7. The educational institute approach
8. The farming systems development approach

Further, it is important to choose a particular approach for a desired objective of achieving extension goal considering the following dimensions as suggested by FAO. The dimensions are:

1. The dominant identified problems to which the approach is to be applied as a strategic solution
2. The purposes it has designed to achieve
3. The way in which the control of programme planning is carried on
4. The nature of the field extension personnel including the aspects like field personnel - clientele ration, training, reward systems, gender, service conditions etc.
5. The resources required and various cost involved
6. The typical implementation techniques used

## **Conclusion**

The speaker has attempted to explore and address the issues for the new millennium the agriculture will face. There is no certainty in the rapidly changing world for anything. The recent information technology and communication revolutions have totally changed the perspective of human life and society. Therefore, agricultural extension must also change to be relevant in the new scenario.

## **Suggested Reading**

**Management of Agricultural Extension in the Global Perspective** by R.K. Samanta & S.K. Arora (Ed). B.R. Publishing Corporation, New Delhi, 1997.



# AGRI INFORMATION PORTALS

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It is strongly believed now that the modern ICTs would play a critical role in sustainable agriculture development and agri-business as it provides cost-effective way of responding to the needs of large disadvantaged sections of the population. Internet being the popular media of communication and information, web sites pertaining to agriculture will have immense use in technology dissemination in the farming community and providing business opportunities in rural areas.

Special effort is necessary for developing the portals as the clientele in agriculture constitute the most illiterate and underprivileged group. The portals need to be simple in its use and presentation and amenable to wide variety of applications which include trade and business related information and interaction. The organization and content development of these portals assume paramount importance to make the concept of information kiosk successful.

## **Initiatives in Agri-information portals**

As the majority of Indian populace is in rural areas, networking them can be the most effective solution to bring them on to the main stream of information domain which only a privileged urbanites have access to so far. Several community information systems have been operationalized in the recent times with multiple uses and increased simplicity to endear the rural masses. Some of such systems are:

- **Tarahaat.com**

It is a portal created in the simplified format to connect Indian villager to the rest of the world. TARAhaat provides training and management support to its network of franchised TARAkendras to enable them to provide standardized services and also acts as a central provider of the products and services needed, adapting them to meet the local needs of each region. Tarahaat was launched as a pilot in late 2000 in Bundelkhand, Madhya Pradesh and Uttar Pradesh. In 2001, Tarahaat expanded its operations into Punjab. Tarahaat has 22 centres and is in the midst of a major expansion in Punjab, and in the region. Apart from other issues pertinent to rural citizens, it provides information on agroforestry, crops, fertilizers, chemicals, insects and diseases, loan schemes, organic farming, soil, tractor maintenance, weeds etc., with provision to seek expert advice through email. It offers services of providing daily price variations in the enlisted mandis of the area.

(Source <http://www.tarahaat.com>)

- **Gyandoot**

It is an intranet service provided in Dhar district connecting rural cyber cafes with information on landholder's passbook of land rights and loans, hindi email, rural market, vermi-compost booking etc.,

- **Bhoomi**

It is an e-governance project launched by Govt. of Karnataka to computerize the 20 m land records of 6.7 m landowners with provision to online updation.

#### ▪ **MSSRF Initiatives**

In an experiment under Information Village Research Project in electronic knowledge delivery to the poor, MSSRF has connected ten villages near Pondicherry in southern India by a hybrid wired and wireless network that facilitates both voice and data transfer, and have enabled the villagers to get information that they need and can use to improve their lot. The entire project draws its sustenance from the holistic philosophy of Dr M.S. Swaminathan, which emphasizes an integrated pro-poor, pro-women, pro-nature orientation to development and community ownership of technological tools against personal or family ownership, and encourages collective action for spread of technology.

The *bottom up exercise* involves local volunteers to gather information, feed it into an Intranet and provide access through nodes in different villages. Value addition to the raw information, use of the local language (Tamil) and multimedia (to facilitate illiterate users) and participation by local people right from the beginning are the noteworthy features of the project. Most of the operators and volunteers providing primary information are women, thus giving them status and influence. All centres evolved themselves to meet information demands of community.

A considerable part of information is accessed from the local sources. All the databases are in Tamil except one on below-poverty-line families which is an official document in English. Rural Yellow Pages have also been created, and people are allowed to insert advertisements like knowing who is renting a tractor and at what price.

#### **Agricultural Information included information on**

- ❖ Controlling the borer in Mango
- ❖ Disease control in Brinjal
- ❖ Controlling the borer in Plantain
- ❖ Paddy cultivation methods
- ❖ Fungal diseases affecting rice crops in winter
- ❖ Sugarcane cultivation methods
- ❖ Grasses and their uses
- ❖ Soil testing procedures
- ❖ Seasons and agronomic procedures
- ❖ New Sugarcane variety
- ❖ Earthworm manure production

(Source <http://www.mssrf.org/informationvillage/informationvillage.html>.)

#### ▪ **<http://www.kisan.com>**

This is a dedicated site for marketing the agricultural produce is to promote real time interaction among interdependent sectors of Agri market. One can buy and purchase various farm products using this site.

#### ▪ **<http://www.krishiworld.com>**

Available in hindi and marathi languages. Considers itself as the first agri multilingual portal. It has information on various aspects of agriculture, chat feature and market trends in the state of Maharashtra. It has an online newsletter, which can be subscribed.

#### ▪ **E-choupals:**

The e-choupal initiative is an attempt by ITC to join the urban India of rapid growth and a world-beating IT industry, to the rural one, where 72% of Indians live.

### *Mechanism:*

Traditionally, farm commodities were procured in 'mandis'. The PCs and Internet access (called information kiosk) which are provided at key rural areas enable the farmers to obtain information on mandi prices, good farming practices and place orders for agricultural inputs like seeds and fertilizers. This helps farmers in improving the quality of produce, and also helps in realizing a better price.

Each kiosk is run by a *sanchalak*—a trained farmer. The computer housed in a farmer's house is linked to the Internet via phone lines or by a VSAT connection and serves an average of 600 farmers in 10 surrounding villages within about a 5 km radius. The *sanchalak* bears some operating cost but in return gets commissions for the e-transactions done thru his eChoupal. The warehouse hub is managed by the middle-men called *samyojaks*. The *samyojak* acts as a local commission agent for ITC.

### *The experience:*

There are websites for some of the crops: soya, wheat, coffee and aquaculture (shrimp). The concept is now extended to other crops like Chilli and turmeric with focus on export, domestic and packaged and branded segments. Locations are mostly chosen from the 87% of India's 600,000 villages with under 5,000 inhabitants- typically, over 1,000 and fairly accessible. To the obvious shortages, of phone lines, electricity and literate farmers, the answers are VSAT satellite links, solar batteries and carefully chosen sanchalaks - or "conductors" - whom ITC equips with the technology. ITC intends to reach 100,000 villages in the next decade.

In Badamungalaya, 40km from Madhya Pradesh's capital, Bhopal M.P., farmers use the e-choupal to check prices for their soya beans at the nearest government-run market, look at weather forecasts, order fertiliser and herbicide, and consult an agronomist by e-mail when their crops turn yellow. Some buy life insurance. The local shopkeeper orders salt, flour and sweets. Some rent tractors. School children check their exam results.

<http://www.echoupal.com/NewsRoom/Press/news7.htm>

Soya Choupal - [www.soyachoupal.com](http://www.soyachoupal.com) Soya Choupal, web based initiative of ITC, offers the Soya farmers of India all the information, products and services they need to enhance farm productivity, improve farm-gate price realisation and cut transaction costs. Farmers can access latest local and global information on weather, scientific farming practices as well as market prices at the village itself through this web portal - all in Hindi. Choupal also facilitates supply of high quality farm inputs as well as purchase of soybeans at their doorstep.



Aqua Choupal - [www.aquachoupal.com](http://www.aquachoupal.com) Aqua Choupal, another web based initiative of ITC, offers the Shrimp farmers of the state of Andhra Pradesh all the information, products and services they need to enhance farm productivity, improve farm-gate price realisation and cut transaction costs. Farmers can access latest local and global information on weather, scientific farming practices as well as market prices at the village itself through this web portal - all in Telugu. Aqua Choupal also facilitates supply of high quality farm inputs as well as purchase of Shrimps at their doorstep.

The concept of choupal is extended to rural malls now. Rural retailing initiative called Choupal Sagar in this direction is started rural Madhya Pradesh, 50 kilometres from Bhopal to sell everything from soaps and shampoos to readymade apparel, consumer durables, two wheelers, and even tractors.

#### ▪ **ikisan.com**

ikisan is being developed as a comprehensive Agri Portal to address the Information, Knowledge and Business requirements of various players in the Agri arena viz., Farmers, Trade channel partners and Agri Input/Output companies. Leveraging information Technology and extensive field presence, ikisan is being positioned as an Information/Knowledge exchange and an e-Marketplace. It has various features like market information, crop specific information, information on credit, insurance, fertilizers, weather etc., It has facility for viewing news in English or telugu.

#### Portal evaluation for effective business models

There are no proper guidelines to quantify the effectiveness of a portal and especially if it aims at rural masses. The following exercise assesses select agri-portals in terms of their content, language, site organization, information structure, links, search features and user interface. These results would provide some hints to portal developers, who in turn can pursue their project with far greater insight.

**Exercise :**

To browse agricultural information based URLs and evaluate it for assesment

**Methodology:**

The groups will be identified based on the linguistic knowledge of the trainee and each group shall browse the following URLs

<http://www.agmarknet.nic.in>

**<http://www.agriclinic.com>**

**<http://www.agriwatch.com>**

<http://www.indiaagronet.com>

**<http://www.kisan.com>**

**<http://www.krishiworld.com>**

<http://www.tarahaat.com>

<http://www.nabard.org>

<http://www.ikisan.com>

Each group will browse each URL and answer the questionnaire and give the rating. The group compile the information of the group and give overall rating and submit the report

**GENERAL OBSERVATIONS:**

*Name(s) of reviewer(s) of the site :*

1. Name of URL :
2. Intended clients :
3. Salient features :
  - a.
  - b.
  - c.
  - d.
  - e.

| Topic             | Q.No | Question  | Yes                      | No                       | NA                       |
|-------------------|------|---|--------------------------|--------------------------|--------------------------|
| Home page         | 1.   | Is the home page informative?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                   | 2.   | Is home page designed to reflect the purpose of the site?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                   | 3.   | Is the load time less than 3 seconds?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| * Language        | * 1. | <i>Is there any insulting or derisive language, especially aimed at specific people or institutions?</i>  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                   | * 2. | <i>Is the extent of spelling errors or serious grammar mistakes high in the text?</i>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                   | 3.   | Is the extent of internet jargon, especially popular buzzwords high?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                   | 4.   | Is the technical jargon used too much?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                   | 5.   | Is language or presentation simple and understandable?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Content           | 1.   | Does the content seem to match the mission of the organization and the needs of the audience?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                   | 2.   | Is the site developing its own content or syndicating other source? Is there a good mix of in-depth material? (detailed case studies, articles, and white papers) versus superficial content (press releases, marketing copy) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                   | 3.   | Is there any dynamic database with data abstracting provision?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                   | 4.   | Will it cater to policy makers, scientists, extension activists besides farmers?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Site Organization | 1.   | Is the site organization intuitive and easy to understand   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                   | 2.   | Are non-standard text colours legible with other background defaults?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                   | * 3. | <i>Are there more than three different font styles, sizes in a page?</i>  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                   | * 4. | <i>Does the page require horizontal scrolling at screen /</i>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

window sizes?

|                          |   |  |  |  |
|--------------------------|---|--|--|--|
|                          | * 5. <b>Can functional or meaningful page elements be mistaken for advertising?</b>   | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | * 6. <i>Are large images (&gt;30K) being used solely for visual appeal?</i>   | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | * 7. <i>Is there any blinking text, scrolling marquees or animated GIFs?</i>  | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | * 8. <i>Are pages longer than 4 or more screens in length?</i>  | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | 9. Are cropped and reduced thumbnail images provided to link to full-size versions?   | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | 10. Are background images less than 15K in size?  | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | 11. Is the total size of images on a page less than 30K?<br>If not, state the total size. Select N/A if the site has no graphics.                       | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> |
|                          | 12. Is the text left aligned?   | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | 13. Are web page layouts in site written similarly?   |  |  |  |
|                          | 14. Are important pages accessible for users with disabilities, especially visually impaired users, wherever relevant and illiterates / semi-literates? | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
| Information architecture | 1. Does the title of the page body explain what the page is about?  | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | 2. Is hypertext used to structure large bodies of content, instead of long pages?   | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | 3. Does the textual context of each link tell users what they can expect from following that link?  | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | 4. Do hypertext links relate to the linked content in a relevant, meaningful & unambiguous way?   | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | 5. Is there a provision for feedback?   | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | 6. Are the author's biographical details included?  | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
| Links and Labels         | 1. Are links easy to distinguish from each other?   | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | 2. Are links spread out in documents, or gathered conveniently in sidebars or other groupings?  | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
|                          | 3. Do links open a new browser window?  | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |

|                |  |                          |                          |                          |
|----------------|--|--------------------------|--------------------------|--------------------------|
|                | 4. Does every internal link work?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Search results | 1. Is the search engine easy to use?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                | 2. Are there basic and advanced search functions?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                | 3. Are the search results organized and easy to understand?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| User Interface | 1. Are there any chat or discussion groups?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                | 2. Does every page contain the organization's name and logo?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                | 3. Do pages have an automatic redirect feature?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                | 4. Are links labeled with relative directions `return, back, previous' or `next'?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                | 5. Are clickable regions in an image map clearly marked?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                | 6. Are graphic navigation buttons used without text labels?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                | 7. Does the search feature enable the user to set the scope of any collection being searched?                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                | 8. Does each main logo link to the home page?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                | 9. Are document and chapter headings provided that link back to higher levels of the hierarchy, i.e. the top of the chapter? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                | 10. Are links to large files explicitly mentioned with size?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

*Note : Assign `1' for yes and `0' for No and vice versa for questions marked with `\*\*'*

|   |   |   |
|---|---|---|
| Total marks obtained                    | A | = |
| Total questions responded with Yes / No | B | = |

$$\text{Rating} = \frac{A}{B} \times 100$$



# **AGRICULTURAL EDUCATION: PRESENT SCENARIO AND IMPENDING PROBLEMS**

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## **Introduction**

Organized instruction in Agriculture at the University was introduced in the beginning of the 20th Century when five agricultural Colleges were established in 1907. Agricultural education is constitutionally a state subject and major responsibility rests with the State Government. However, Central Government provides the necessary support and is made responsible for overall coordination of the educational activities in the country. Historically is looked by the colleges and other institutions followed on general universities. After the introduction of agricultural university system most of the general universities have transferred their education along with the research to the agricultural universities in most of the states. Still a number of colleges followed to the general universities in some states continue to involve agricultural education through their own degree programs. At the Central Govt. level ICAR is the main apex body responsible for promoting and coordinating agricultural education in the country. The agricultural universities at the state level and ICAR at the central level are the two main agencies involved in agriculture. Many general universities as well as some private institutions in the states are also involved in agricultural education. In view of the multiplicity of these institutions the task of organization support and coordination of the educational function to ensure maximum efficiency is posing a real problem. The components of agricultural university system in India can be broadly grouped into the following categories :

### **The ICAR Sub system:**

ICAR is having a current responsibility for both agricultural research and education. The central assessment of agriculture is routed through the ICAR and it plays a regulatory role for maintaining standards of agricultural education. It is directly involved in the post-graduate agricultural education though the instruction deemed to be universities in its fold.

### **The Agricultural University Sub System:**

The main stream of agricultural education in India the integration of teaching and extension are the main features of this sub system. The education is made mission oriented and purposeful. Universities are involved in both undergraduate and post-graduate education.

### **General University Sub System:**

The general universities have well established faculties like agriculture and home science and some of the general universities are having constituent and affiliated colleges offering of degrees and related to agriculture and allied fields.

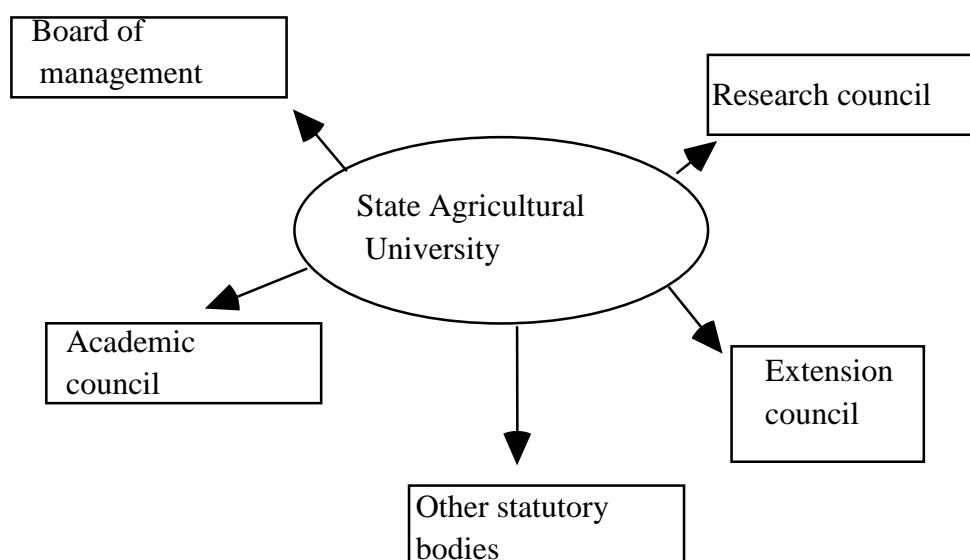
### **Other Central institutions:**

Banaras Hindu University and Viswabharati University have constituent colleges of agriculture, which offer regular undergraduate and post-graduate degree programs in

specific areas of agriculture. Indian Institute of Technology, Kharagpur also offers undergraduate and post-graduate degree programs in the areas related to agricultural engineering, agronomy, etc.

### Governance of Agricultural Universities

Majority of the state agricultural universities follow the model act of ICAR which provides the following authorities for the functioning of the University.



**Figure 1: Functioning of Agricultural University system**

The organizational and operational autonomy is provided by the Board of management. It may be mentioned that some of the Universities deviated from the model act and provided court or General council with the Vice chancellor as the chairman with a membership of large number of representative state legislatures, development departments, men in public life ranging from 50 to 100 members. The functions of all other councils are designated in their constitution.

### Present scenario of State Agricultural Universities:

At present there are 29 state Agricultural Universities out of which the data pertaining to 27 Universities is available from various sources which is presented in Table 1. The total enrollment aggregates to 44,445 with a sanctioned strength of 22,451 scientific staff. The universities have 161 colleges spread over 89 campuses teaching both at UG and PG level. Besides there are 4 deemed to be Universities and one central University. In three of the general Universities agricultural education is part of the curriculum. About 30 private colleges mainly in U.P. Even though these universities are set up under model act of ICAR with similar financial assistance their development is at variance.

The discipline wise students passing is presented in Fig 2. The highest being in Agriculture, followed in Veterinary, home science, Fishery in order. This is true in case of P.G and Doctoral areas of specialization. There is a variance of cost per student from one

university to the other. Discipline wise cost per student is indicated in Table 2.

**Table 2: Discipline wise cost per student in SAU ( In lakhs)**

| <b><u>Discipline</u></b> | <b><u>Cost</u></b> |
|--------------------------|--------------------|
| Agriculture              | 2.59               |
| Veterinary               | 2.56               |
| Home science             | 1.00               |
| Engineering              | 2.16               |
| Fishery science          | 1.96               |
| Diploma                  | 0.21               |

Student teacher ratio in most of the Universities varies from state to state and presented in Table 3. The lowest is in PKV Akola and the highest is in GAU , Dantiwada . In SAU the average student teacher ratio is 7.6.

### **Financial aspects of SAU**

The head wise break up of allocation of budget for Education, Research, Extension and Administration is presented in Table 4. The average allocation appears to be skewed towards research followed by Education, (Fig.3) Administration and Extension in order. The weak extension linkages expressed on various platforms may be due to poor budgetary allocations to extension.

Funding agencies have been investing in State Agricultural Universities aggregating to 4554 projects the costing for 1927 is available. The investment aggregates to 110 crores averaging to each project at 5.84 lakhs.(Table 5 ) The average receipts to universities is indicated in Fig 4. The major share of the receipts come from the states followed by ICAR, University's own resources. The most significant feature of diminishing compound annual rate of growth presented in table 6.

*Table 6 : Investment in Agriculture sector and compound annual growth rate*

| <b>Five-year Plan</b> | <b>Percent share of agriculture in total investment</b> | <b>Compound annual rate of growth (%)</b> |
|-----------------------|---|---|
| Third                 | 16.3  | 6.9                                       |
| Fourth                | 18.3  | 3.4                                       |
| Fifth                 | 18.2  | 10.2                                      |
| Sixth                 | 15.1  | -2  |
| Seventh               | 11.9  | -1.4                                      |
| Eighth                | 18.6  | -   |

The main reason of this decline in investment is the fall of public sector investment or Government budgetary allocation to this sector. Consequently most of the state universities which depend on state funding face financial cut affecting their performance in teaching, research and extension which is the mandate of these Universities.

## **Academic and Management problems in higher agricultural education**

### **Academic**

#### **Curriculum up gradation**

There is a resentment among the Instructors to upgrade the curriculum for the simple reason that the instructional hours are limited and what ever they teach is important for completing the course objectives. One simple method is to promote self learning and individualize the instruction. May be that the Instructors have to spend more time in developing the Self learning modules either of the media. Considerable time can be saved to accommodate new concepts and what ever the students can learn can be imparted through self learning .

#### **Introduction of new courses**

To meet the arising needs of the society it is appropriate to think that new courses like specialization in tissue culture, micro propagation technology, Gene cloning technology etc. should be included either by compartmentalizing the existing courses into the basic course and by offering it as a specialized course.

#### **Diversification of existing courses**

To develop the learners to meet the existing challenges it is appropriate to bring in the diversification of existing course. For example the Agricultural universities offers the course in Home science. Will it not be desirable to micro plan the courses into family relations, consumer education, Parenting, Nutrition, Housing, Careers and career counseling, Home management, Improving the family relations and Improving the communication skills, Education for the disadvantage learners. So the university education aim at diversification of home science course into its micro levels and make it more society friendly.

#### **New concepts that should be appended**

For all the graduation courses develop the farming systems research and extension concepts and sustainability of agricultural development.

#### **Introduction learners to new educational concepts**

Exposure the learners to new educational concepts like the transcendental meditation, yoga, Appreciation of the religion and stress release techniques. This will pay lots of dividends by preparing the learners to meet the challenges of the society in particular and the farmer in general

#### **Standardization of teaching methodology**

It looks desirable to standardize the teaching methodology in agricultural university system. If concrete plans are drawn with certain standardization organizations like ISI and ISO there will be uniformity in the Instruction all over. Rigorous methods employed by these standardization agencies will qualitatively improve the instruction.

## Working for the globalization of the Agricultural Education

The curriculum, content, methodology and the evaluation procedures adopted should have universal acceptability wherever they are employed. For example we can not separate standards in USA and India in case the Universities of the developing and developed countries have to work for the global interests and want that the graduates to be respected all over the world.

Should there be different institutional goals in developing and developed countries except for some considerations as related to the local relevance of teaching and research and extension and programs of service organizations and if yes the technological gaps will be widened and if it is no than we don't work for the globalization of agricultural education.

### Reactions to development

How should institutions react to new developments in world agriculture changing production and processing patterns growing International trade, Marketing competition etc. in science and technology, Molecular biology, Information technology computerization, population planning strategy adopted by these countries, food security for the ever growing population, different life styles, value systems.

### Institutional management

Higher agricultural education suffers from poor institutional management and the administrators should orient for the better institutional management and develop strategic master plan for the optimizing the utilization of resources, human resources and the limited financial allocations. They should develop for the multi disciplinary teams for meeting the arising needs of the society. The administrators should work for functional in country linkages with other educational research institutions, extension services and rural communities. Regarding the financial management the institutions should develop self financing enterprises and marketing of the services.

### Assessment and Evaluation systems

Assessment and evaluation procedures should require drastic modification in terms of evaluating the competency of the learner for meeting the demands of the society and should discourage the evaluators promoting the rote learning. NAARM was contemplating to conduct a workshop towards this goal exclusively for suitable competency based evaluation procedures. The educational and psychological aspects are to be thrown open for discussion.

## **Management problems**

### Inbreeding

Inbreeding of students and teachers has been a matter of great concern. In a recent study conducted by NAARM it is reported that only 17 % of the faculty in Agricultural universities are non locals. The non-local faculty in the Professor's grade is around 25 % followed by the Associate Professor grade and 13 % in Assistant Professor grade. With the initiatives taken by ICAR to keep the National eligibility test, as the prime criteria for induction into the SAU may be the only solution for counteracting with this problem.

### Rotation of Deans/ Directors/ Heads of the Departments

Most of the Universities have implemented the rotation system as a step towards democratization of University department. This system attracted more criticism than appreciation after its introduction. The lack of continuity in management of affairs and lack of leadership in departments and faculties is said to be major problem in such a situation. The whole policy has to be reviewed and respective appointments by tenure basis has to be tried as has been done in ICAR research institutes.

### Planning monitoring and Evaluation

Most of the Universities have well designated cells for planning ,monitoring and evaluation. As these cells now perform routines tasks needs to be strengthened with new assignments and pro-activity towards for development.

### Human resource development

Even though the strength of Faculty is quite large the continuous training is not envisaged as a designed activity. The faculty has to be trained for continuous up gradation of knowledge and skills by design. The establishment of Educational technology cells for in campus training and through a designed training mechanism in abroad may be the solution for this problem. The recently started AHRD project has distinct component of over seas training now assigned to FAO for implementation. Such projects solve such problem partially as the project life is limited.

### University and Industry linkages

The state Agricultural Universities have deliberately strived to achieve effective and operative linkages between research and extension. The state department of Agriculture and Animal husbandry work in close collaboration with the SAUs. It is necessary to build linkage with the industry .Achieving this objective is difficult with this existing philosophy of over compartmentalization of designated functions of SAUs and industries in academic planning. Coordination between trade, commerce and industries such as FICCI, Farmers cooperatives, Government sector industries is desired step in this direction. These linkages will help in :

1. Sharing and optimizing resources
2. Evolution of appropriate technology
3. Adopting and testing imported technology
4. Strengthen teaching and research in Universities
5. Develop feed back mechanism
6. Resource mobilization in Universities

Dr. Swaminathan model for University industry National R&D interaction may be one step ahead in this direction. It is desirable to study this model for adoption.

### ***Rationalization of fees***

The recurring expenditure of universities can be met from the fees to more realistic levels. The fees has not increased for decades together. Consequently the Agricultural education is still the cheapest in India. As per the expert's committee the rates for discriminatory fees has to be raised and provide fee concessions to needy poor students.

Foreign students participation should be encouraged and very high fee should be levied from them.

#### Consultancy services

Some of SAUs have high quality infrastructure and the best of the talents. They can render consultancy with in the country and abroad. Institutional building, curriculum development, organizing training's, joint research projects are some areas of consultancy which can go for under this heading.

#### Economy in operations

Stringent control of wasteful expenditure in fuel stationery and other items, increasing income from farms, office automation, centralizing facilities, pruning of long term and outdated research projects are some of the economy measures suggested

#### Pro-activity for development

Liberal tax concessions in investment in Agricultural education, instituting revolving funds for routines operations, freedom to operate this fund by local functionaries, contacting alumni for generous institutional building, loan facilities from developmental banks. Just like the NAABARD and Industrial developmental bank it is desirable to create Educational developmental bank and operate it for bringing out these Universities with recurring financial crisis.

# PROJECT LOGICAL FRAMEWORK

**S.K. Soam**  
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## Introduction

The logical framework, also known as project-planning matrix, is basically a tool for project design, monitoring and evaluation. It is the matrix in which hierarchy of objectives in the form of narrative summary is placed along with components of key management activities for evaluation, performance measurement and external conditions. The logical framework does not offer anything new because all the components are already known. But the way these components along with concepts are presented, enables to link these components which are readily seen. It also offers opportunity to make logic from scrutiny, monitoring and evaluation point of view. In principle logical framework is a tool for Management By Objective (MBO) style of management and depicted as pair wise matrix of project components and their explanations providing overall picture of project, its impact and project environment, which are generally presented in one or two pages.

## Contextual understanding

The project can't be designed, run, evaluated and monitored in isolation. Always it has to be contextual to various other situations e.g., it is amusing to take up or design a project, which does not contribute to achieve national goal, and no donor will fund such project. If the project objectives are ambiguous, project impact may be non-significant. If project environment is not conducive and full of risks, there are meager chances of success of the project. Therefore, while designing the project, understanding of contextual situation is an essential requirement. In Table-1, this contextual situation is presented. While designing a project, there will always be the hierarchy of objectives which is influenced by the external factors and *vice versa* (Table-2).

**Table-1: Understanding contextual situation**

|                    |                         |
|--------------------|-------------------------|
| The Project        | The Project Environment |
| The Project Impact |                         |

## Donor's attitude

After designing, the projects seek funding either from national or from international donors, many projects fail to attract the funding, some of the responsible reasons related to present discussion are:

- The donors have little time, and projects are not presented in summarized and clearly understood form. Good proposals should respect the time of donors.
- Logical link between different objectives and their concepts is not clearly mentioned.
- Project do not clearly work out the arrangements for verification for monitoring and evaluation; means, at what level of objectives, with which indicators, by which means?
- Risks and Assumptions are not specified with respect to success of project and sustainability of project after funding is stopped.



**Table-2: Basic elements of log frame and influence on external factors**

|            |   |                  |
|------------|---|------------------|
| Goal       | → | External factors |
| Purpose    | → | External factors |
| Output     | → | External factors |
| Activities | → | External factors |

### Structure of logical framework

The logical framework is a matrix as outlined in Table-3. Shield (1993) recommends matrix of four rows and four columns, merging activity with outputs and defining purpose as project objectives, there is no hard and fast rule to follow a particular style. Based on convenience one can choose either.

The column on the left-hand side of table is 'narrative summary' which represents hierarchy level of projects. Item in bottom row are inputs which are required to do activities resulting into outputs, these outputs fulfil the purpose (project objectives) contributing to achieve goal at topmost row (wider objective). Setting outputs and inputs makes easy to identify the missing resources and unachievable outputs. Likewise unnecessary inputs are easier to spot. Project structure at each level is defined in second column from left. Third column contains indicators, which can be used to verify the objectives, but from which source the data will be available to verify hierarchy of objectives, this information is contained in fourth column. The last column occupies the critical assumptions and risks, which can influence the project at each level.

### Components of logical framework

#### *a. Hierarchy of objectives*

Hierarchy of objectives consists of goal, purpose, outputs, activities and inputs. The basis of hierarchy is cause-effect relationship. While constructing this column, separate the cause from effect, use simple and concise statements and strong action verbs. The goal is wider and higher order objective to the project contributes. Purpose is the effect of the project and defined in terms of project objectives. Outputs are the deliveries from the projects. Activities are the actions that must be undertaken in order to accomplish outputs. Inputs are various resources like human, capital, services, equipment, information and databases and other soft and hard requirements needed to do the activities.

**Table-3: Construction of logical framework**

| <b>Hierarchy of Objectives</b> | <b>Objectively Verifiable Indicators (OVI)</b>      | <b>Means of Verification (MOV)</b>                                   | <b>Critical Assumptions &amp; Risks</b>                     |
|--------------------------------|---|--|---|
| Goal                           | Measures to verify accomplishment of goal level     | Sources of data needed to verify status of goal level indicators     | External factors needed for achieving objective in long run |
| Purpose                        | Measures to verify accomplishment of purpose level  | Sources of data needed to verify status of purpose level indicators  | External factors needed for achieving goal                  |
| Output                         | Measures to verify accomplishment of output level   | Sources of data needed to verify status of output level indicators   | External factors needed for achieving purpose               |
| Activities                     | Measures to verify accomplishment of activity level | Sources of data needed to verify status of activity level indicators | External factors needed for achieving outputs               |
| Inputs or resources            | Measures to verify accomplishment of input level    | Sources of data needed to verify status of input level indicators    | External factors for availability of inputs                 |

***b. Objectively Verifiable Indicators (OVI)***

This management tool is based on the concept that if we can measure, we can manage. OVI are performance measurement indicators, and are used to verify accomplishment of hierarchy of objectives. Indicators must be targeted in terms of quantity, quality and time, the indicators at purpose level measure end of the project impact. The indicators should be measurable, sensitive to project activity, critical to project success, and are available when required for decision making. Information about inputs (expenditure) and outputs are commonly available from project reports. Indicators of wider objectives are less easy to define because of less ambiguity at higher level

***c. Means of Verification (MOV)***

Indicators can be assessed for monitoring and evaluation, but from where get the data about the indicators. For this we need some means, the sources of data (MOV) needed to verify the status of objectives at various levels, generally project report and base line reports are the MOV, where necessary information can be traced.

***d. Critical Assumption and Risks***

Many projects fail because of external conditions, which are outside the control of the project but not because their structure is illogical. These conditions include national policies, natural factors, access to resources, political, social and religious factors, etc. While documenting these assumptions, analyze their importance and probability because it helps manage them actively during project design and implementation. Document those important external factors also, which are needed to attain various objectives but not those assumptions certain to happen. The critical assumptions relate to events, which are likely to happen but might not and which appears to out of project control. In some cases project management go beyond and prepare contingency plan to face these assumptions.

## What logical framework is not?

It is not a project summary, does not provide a summary of all relevant information. It is not a tool, which can offer any thing new. It is just logical arrangement of what is already available.

## How to construct logical framework?

Sheild (1993) suggested the following steps to construct the project logical framework.

|                    | Project structure   | Objectively Verifiable Indicators (OVI) | Means of Verification (MOV)             | Critical Assumptions & Risks  |
|--------------------|---|---|---|---|
| Goal               | <b>Step-1</b><br>What is the rationality of project?  | <b>Step-10</b><br>Fill up these columns | <b>Step-10</b><br>Fill up these columns | <b>Step-9</b><br>If the project objectives (purpose) were achieved would this contribute to solve the constraint, if no<br><b>Action:</b> Evaluate assumptions, redesign the project                  |
| Purpose            | <b>Step-2</b><br>What project intends to achieve?   |   |   | <b>Step-8</b><br>If the activities are carried out, would the objectives be achieved, if no<br><b>Action:</b> Evaluate assumptions, redesign the project  |
| Output             | <b>Step-3</b><br>What are expected outputs?   |   |   | <b>Step-7</b><br>Are resources sufficient and all are necessary to achieve the outputs?<br>What assumptions out side control of project?<br><b>Action:</b> Evaluate assumptions, redesign the project |
| Activities         | <b>Step-4</b><br>What services/ actions needed to enable clients to achieve their objectives? |   |   |   |
| Inputs or resource | <b>Step-5</b><br>What inputs are required for carrying out activities and achieving outputs?  |   |   | <b>Step-6</b><br>What must happen before the project commences?   |

## Advantages of using logical framework

- Project managers make their objectives explicit in the beginning itself.
- It presents the key items of project in a manner, which enables the link between them to be readily seen and therefore logic of the project to be exposed to scrutiny.
- Bring clarity in understanding of hierarchy of objectives.
- Help to find out the modalities of monitoring and evaluation.

- States clearly those critical assumptions, which are essential to project success.
- Responsibility of accountability of project management can be fixed.
- Sustainability conditions can be analysed before the project starts. This helps to identify the sustainability of outcome of project after the project has ended.

The logical framework is certainly not an answer to all development problems, but it creates conditions to understand that what project intends to do? And how?' What are the conditions for failure and success? It is also means to find out the realistic conditions for sustainability of project, if funding is stopped. Proper use helps to develop Management By Objectives (MBO) style of managerial functioning.

### **Suggested Reading**

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# SYSTEM DYNAMICS MODELING

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## 1. Introduction

System Dynamics (SD) is a tool to conceptualize, model, and simulate physical as well as social systems. The approach developed by Jay. W. Forrester in 1958 was originally applied to industrial systems. However, system dynamics now a day is being increasingly applied to empirical research in a wide variety of areas such as agriculture, forestry, environment, energy, demography, etc. The SD methodology is built on holistic approach to the system. A system is defined as a set of assemblage of entities (elements or components) interrelated to each other and to the whole so as to achieve a common goal. The interaction between various system elements are so complex that it may not be possible to predict the system response by looking at the properties of each element in isolation. In a conventional approach the behaviour of multivariate systems are analyzed by keeping some of the variables steady and observing the change in the remaining variables. Meaningful results, in such exercises, can be expected only by carrying out a number of experiments and subsequent analysis of massive data. However, in system dynamic approach all variables are allowed to vary freely, thereby creating a real world situation.

## 2. System Dynamics Method

The SD method integrates the principle and concepts of three basic disciplines, (i.) Traditional management or mental model, (ii.) Feedback control theory or Cybernetics, and (iii.) Computer simulation. The cross-fertilization of these aspects aimed at exploiting the strengths of each of the aspects synergistically for visualizing and analyzing the system in a holistic manner. The first aspect *Traditional Management or Mental model* is the starting point for SD methods. This pertains to perceptions and understanding of individuals about a system derived from direct observations and experience. It consists of qualitative mental database and frames of reference both on tangible and intangible fronts. However, a mental model suffer from disadvantages like absence of definite structure, changing assumptions over time, difficulty in validating the assumptions, doubtful assessment of the dynamic consequences, and poor transferability of the model in space and time. The second aspect, the *feedback control theory or Cybernetics* has been brought into the SD to circumvent the above disadvantages of mental model. The feedback is inherent in every system. It helps to filter-out the real information useful for the analysis and establish the causal relationship in the system. It also aids the refinement and structuring of the mental models as well as provides a basis for the development of the mathematical model. The third dimension, *computer simulation* is useful in assessing the dynamic consequence of the system over time. Computer simulation imitates the real system and provides the results very quick. The results from simulation help in gaining insight into the working of a system.

## 3. System Dynamics Modeling

The system dynamics methodology places a heavy emphasis on modeling of the system. The modeling process begins with proper identification of the problem. The system is then conceptualized in the light of this identified problem. Based on this conceptualization,

model is developed. The model is then validated and analysed for system simulation. There are six steps in systems dynamics modeling. These are;

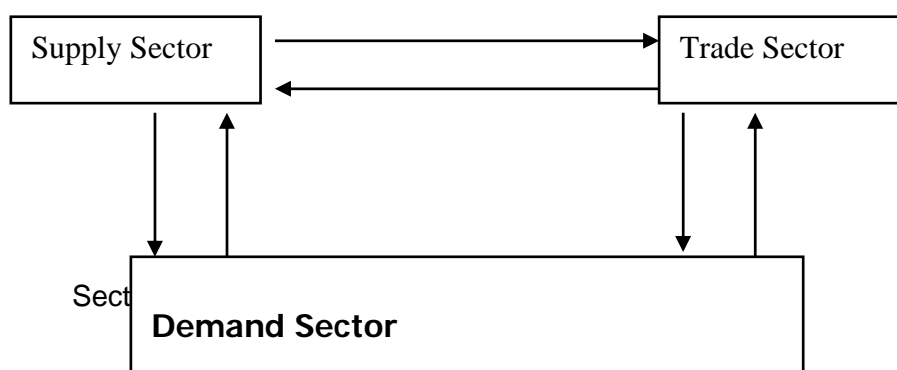
- i. Problem Identification and Definition System
- ii. Conceptualization
- iii. Model Building
- iv. Model Validation and Simulation
- v. Model Analysis and Evaluation
- vi. Policy Recommendation.

The conceptualization of the system is central to system modeling. It requires thorough understanding of the system structure i.e., the interrelationship among the system elements. The diagramming aids become handy in this regard. Various diagramming aids available with SD are as follows:

- i. Sectoral Overview Diagram
- ii. Causal Loop Diagram
- iii. Policy Structure Diagram
- iv. Flow Diagram.

**Sectoral overview diagram** represents the relationship between of various sectors of the system at an aggregate level. A system in general consists of various subsystems or sector. Once these sectors are identified it becomes easier to visualize the broad relationship among them. Each of these sectors is then analyzed in detail by developing independent models. Later the sectoral models are integrated to obtain the behaviour of the whole system, which gives the synergy of the sectoral models. The sectoral overview diagram thus, provides the base for SD modeling and therefore, should necessarily precede other types of detailed diagramming aids. Example of the sectoral overview diagram for Edible Oil System is as under.

Example:



**Causal Loop Diagram (CLD)** depicts the cause and effect relationship among the system elements in a closed loop / circular fashion. CLD is a very versatile tool. It is used for conceptualizing the system, developing model equations, and communicating to others who are not familiar with SD. The causal loop diagramming begins with identification of the causal links between system elements.

*The Causal link:* The cause-effect relationship between two variables (A and B) indicates the impact of first variable (A) on the second one (B), assuming that no other variable influences the second one (B). The variable effecting change (A) is termed as Causal variable and the changed variable (B) is called Effect / Affected variable. An arrow joining both the variables indicates the relationship. The direction of the arrow shows the direction of cause and effect relationship. The relationship can be positive or negative and is shown by a + (plus) or a – (minus) sign on the head of the arrow. The relation is defined as positive if the change in one variable (A) effects change in the other variable (B) in same direction i.e. increase in A results in increase in B. The causation is negative if the change in one variable (A) results a change in the other variable (B) in opposite direction i.e. A increasing B decreasing. For clarity some examples of causal links are given bellow.

I. Factor A affects factor B.

A  $\longrightarrow$  B                      Birth  $\longrightarrow$  Population

II. Positive Relationship: B Increases, when A Increases, i.e., A Enhances B

A  $\xrightarrow{+}$  B                      Yield  $\xrightarrow{+}$  Production

III. Negative relation ship: B Decreases, when A Increases, i.e., A Inhibits B

A  $\xrightarrow{-}$  B                      Production  $\xrightarrow{-}$  Price

The causal links are often justified by a number of methods such as Conservation considerations, Direct observation, Instruction to that effect, Accepted Theory, Hypothesis or assumption, and Statistical evidence.

*The Causal Chain:* It depicts a succession of causations in the system elements. In real systems a large number of variable interact with each other. Another variable also affects the causal variable. For example, total area under a crop; the causal variable for production is also affected by another variable say, Net profit. Representation of all these related links in succession is called the causal chain. It helps in better understanding of the interactions.

### **Examples:**

#### Causal Links

Area  $\xrightarrow{+}$  Production                      Net Profit  $\xrightarrow{+}$  Area

#### Causal Chain

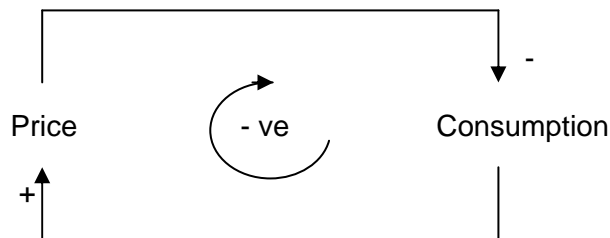
Net Profit  $\xrightarrow{+}$  Area  $\xrightarrow{+}$  Production

**Causal Loop:** In real system there would be some variable, which are both causal and affected. That means the path tracing the cause-effect relationship along the direction of arrow starting from one variable would end at same variable. Such circular cause-effect relationship paths or causal loops provide the foundation block for SD. Each loop is characterized by its polarity. Polarity of the loop is determined by two methods (i) finding the resulting effect whether it is inhibiting or reinforcing (inhibiting is negative and reinforcing is positive) and (ii) counting the number of minus signs (odd numbers is negative and zero or even is positive).

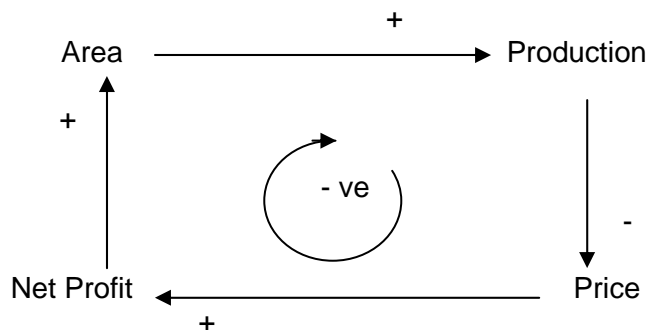
**Behaviour of the loop:** A positive feedback loop is oriented towards inducing increasing and cumulative change leading to exponential growth or decay. A negative feedback loop, on the other hand, is oriented towards reaching and maintaining the steady state of the system, i.e. basically achieving and maintaining stability of the system. Examples of the causal loops are given below.

## I. Negative Feedback Loop

a.)

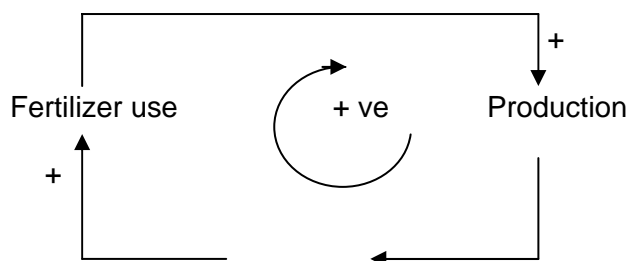


b).

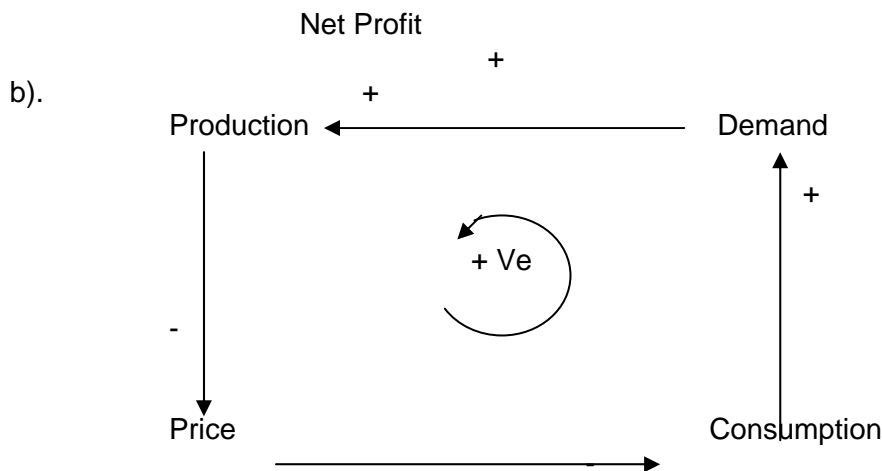


## II. Positive Feedback Loop

a)







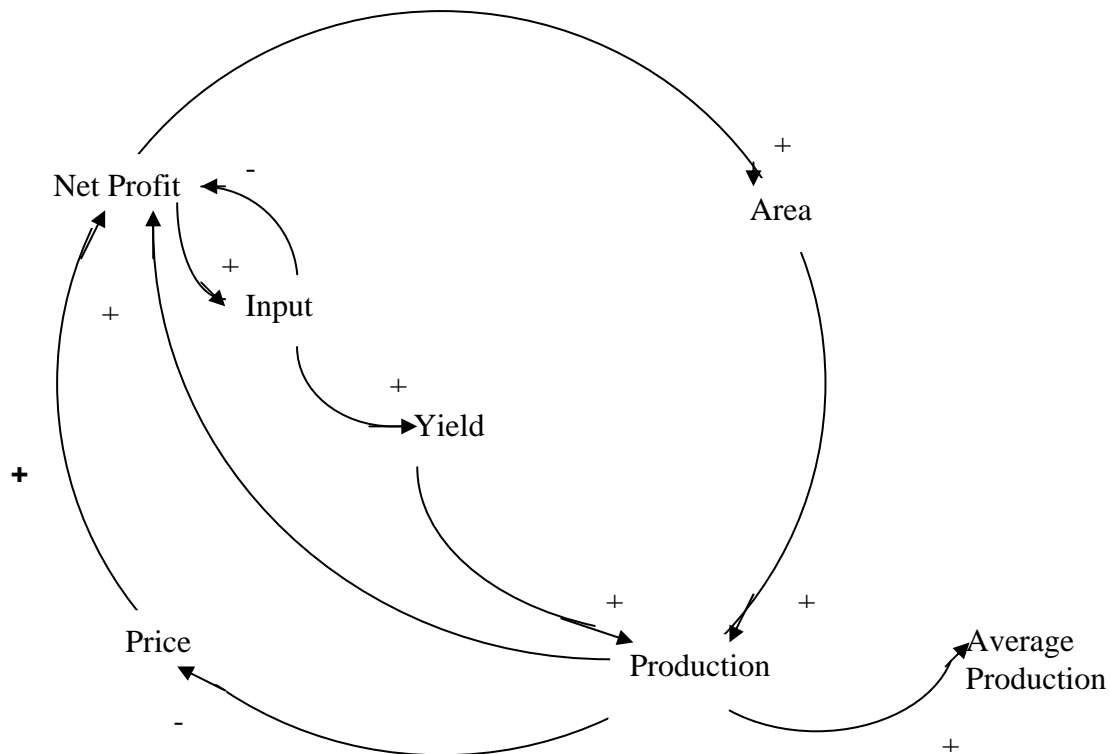
The main concern in drawing the causal loop is to decide on the number of variables to be included in the loop for analysis. Representation with few variables would over simplify the system affecting quality, where as more number of variables may make it unmanageable or too complex. Therefore, a compromise has to be reached between quality and quantity while deciding on number of variables. The List Extension Method helps in this regard.

The list extension method starts with drawing 6 to 8 columns in a paper. These columns are labeled from right to left as Supplementary list, Model list, First extension, Second extension, and so on. The variables related to model objective are enumerated in Model list. For each of these variables in the Model list, the most immediate influencing variables are noted in First extension list. After listing the variables in First extension list for all those in Model list, the Closure test is done by drawing the link lines to see if a causal loop is produced. If no causal loop is formed the exercise is shifted to second extension list for listing the most immediate influencing variables for the variables in first extension list. There after the closure test is repeated. The process terminates after achieving acceptable feedback loops.

This method is useful for complex systems where identification of causal links is difficult. However, the list extension method could be avoided for simple systems for developing causal loop diagram. An example of the List Extension Method is illustrated bellow.

| d. Extension list | 2 <sup>nd</sup> Extension list | 1 <sup>st</sup> Extension list | Model list | Supplementary list        |
|-------------------|--------------------------------|--------------------------------|------------|---------------------------|
| Price             | Net Profit                     | Area                           | Production | Yearly Average Production |
| Input             |                                | Yield                          |            |                           |




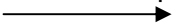
The corresponding Causal diagram is as under.



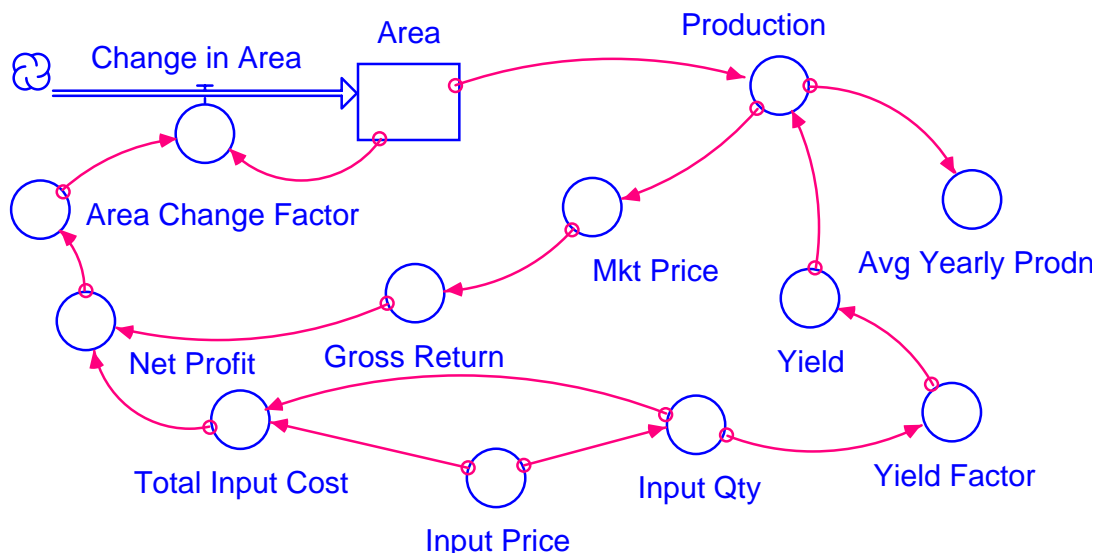
**Policy structure diagram** portrays the overall structure of system depicting the major variables concerning policy considerations or decision-making. The policy structure diagrams are generally developed separately for each sub-systems or sector to be joined latter to present an integrated structure of the entire system. This is often used as a prelude to development of Flow Diagram.

**Flow Diagram** represents the most detailed diagram of the system projecting a clear picture of causal mechanism. The main purpose of this is to facilitate the development of mathematical model for simulation. The flow diagram could be developed directly without drawing other diagrams. However, in such case it may be difficult to visualize all the interactions and relations. Therefore, logically the flow diagram should be developed from either of the three diagrams viz. Causal loop diagram, Policy structure diagram, or Sectoral diagram.

The symbols used for flow diagramming are mostly common to different software used for system dynamics study. In this process a system is modeled though different combinations of four system components, i.e. Reservoirs, Processes, Converters, and Interrelationships. The description, example and symbols for these system components are as under:

| System component   | Description   | Example  | Symbol               |
|--|---|--|----------------------|
| Reservoir<br>         | Where something gets accumulated or diminished over time.             | Population, Water in a dam, Total cropped area   | The Stock            |
| Process<br>           | Activity that determines the value of reservoir.                      | Births or Deaths, Inflow or outflow, Addition or diversion of area.                              | The flow<br><b>T</b> |
| Converter<br>         | The rate at which process operates or state of the reservoir changes. | Birth or death rate, Rate of inflow or outflow, rate of area change, yield, fertilizer use rate. | The converter        |
| Interrelationship<br> | Defines the cause and effect relationship                             |  | The connector        |

A simple flow diagram for the above cited problem of crop production is as under.



**Model Equations:** The structure of flow diagram usually used to develop equations for system simulation. The rate equation describing the converters, i.e. the rate at which the reservoirs change plays an important role in understanding and predicting system behaviour. The five common change patterns in system dynamics are i.) Linear, ii) Exponential, iii) Logistic or 'S' shaped, iv) Overshoot and collapse and v) Oscillation. Depending on the behaviour pattern appropriate modification in equations representing these patterns is made to represent the real behaviour. This may include use of delay functions, table functions etc.

#### 4. Model Validation and Analysis

A model without validation is of very little practical use. A model is said to be valid if its predictions of system performance adequately mimic the real system behaviour. Thus the emphasis is on establishing the degree of confidence in the model. For this the structure and predictive ability of models are validated. *Structural validation* relates to accuracy and correctness of schematic representation of cause and effect relationships of the real system.

Structural validity is judged through equation verification, parameterization and dimensional matching. *Predictive validation* concerns to the extent of closeness the model predicts the trend and behaviour of real system. Predictive validity is checked through baseline, steady state and runaway behaviour pattern of the system. The model is refined and reformulated upon its failure in validation.

A valid model is analysed further for assessing its suitability to explore the systems response to different conditions. This involves two types of analysis i.e. Loop analysis and Sensitivity analysis. The Loop analysis, as the name indicates, refers to analysis of causal loops in the model to identify factors that are likely to influence the system performance. Sensitivity analysis assists in understanding the system behaviour in quantitative terms. It is to assess the sensitivity of the model to the changes in the parameter values. This is done by analyzing the degree of variation in the model output due to change in parameter, initial conditions, interrelationships and structure. It helps in identifying those elements of the system that exercise a high degree of leverage on system behaviour. The SD models after being analysed from various angles is adopted for experimentation and simulation.

A number of software packages are available for system dynamics modeling. One such commonly used software providing direct modeling support is STELLA (Systems Thinking Experiential Learning Laboratory with Animation). A major advantage of this software is it facilitates development of flow diagram on the computer screen directly, and thereby the software developing system equations. It supports problem identification, simulation, and policy analysis phases of SD methodology.

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# CREATIVITY AND PROBLEM SOLVING

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Principal Scientist

Science is fundamentally the output of creativity. The essential activity of science consists of thought, which arises, in creative perception.

What is creativity?

Idea generation is a function of creativity. High intelligence is not required to be creative, but creative people generate many different ideas in a given period of time. There are almost as many ways of defining creativity, as there are writers on this subject. Some of the definitions are as follows:

- Creativity is an the ability to think fast, generate new ideas and deal with problems in effective way
- Creativity is ability to process information in such a way that the result is new, original and meaningful.
- Creativity is merely the generation of new ideas - much of it exists.
- Creativity is to produce and express new, novel and occasionally useful ideas.
- Creativity is the manifestation of uncommon talent in terms of novel ideas and original products commending high professional estimates of their worth. Creativity is normally distributed, just like height, weight and intelligence.

Creative is concerned with developing new ideas, and to do this we need to see the problem from a fresh perspective, which involves escaping from old ideas. Creativity is about the quality and originality that leads to new ways of seeing and novel ideas. It is a thinking process associated with imagination, insight, invention, innovation, ingenuity, invitation, inspiration and illumination.

Some of the highlighted traits of creative people are:

- Tolerance for ambiguity
- Independent thinking
- Not being inhibited by conformity process
- Good verbal communication skills and
- A reasonable but not necessary outstanding level of intelligence.

Creative people are better at asking right questions, to be more sensitive to gaps in knowledge in their field, and opt to study more important problems than others. They appear comfortable with risk taking, open to new experiences and exhibit a high degree of perseverance and discipline.

## **Analytical thinking and Creative thinking**

Analytical thinking is logical and leads to unique or few answers which can be implemented. Creative thinking requires imagination, and leads to many possible answers or ideas. These two types of thinking complement to each other in solving any scientific problem.

**Analytical thinking**

Logical  
Unique or few solutions  
Convergent  
Vertical

**Creative thinking**

Imagination  
Many possible solutions  
Divergent  
Horizontal

Creative thinking is basically divergent process, generating many ideas for solving a problem, whereas analytical thinking is convergent process, narrowing down to unique answers. Creative thinking requires a wide-ranging examination of all the option, including those, which might be considered to be wild or foolish. Hence it is a horizontal way of thinking. Analytical thinking requires deep, and narrow, probing to identify the workable solution. Hence it is a vertical way of thinking process.

**Creative Process**

Creative process suggests imaginative thinking, which is expansive in nature, as opposed to evaluative thinking, which is convergent in character. Much of the literature on creative is devoted to creative problem solving. Clearly to solve a problem effectively, you need the flexibility to use both imaginative and evaluative thought.

Different stages of creative process are (Wallas, 1926):

- Preparation
- Incubation
- Illumination
- Verification

***Preparation:***

In this beginning stage of creative process material is collected from a wide variety of sources. This involves a conscious effort to open up the Universe of discourse and broaden the problem perspective. The emphasis in the preparation stage is on a wide, in formalized, intuitive type of thinking. At this stage it is also important that resistance towards redefining existing concepts is not too strong. Exactly what concepts are chosen, or how precise they are, is of secondary interest. Divergent thinking, which explores many possibilities, rather than convergent thinking, which concentrates on a single line of reasoning, should therefore be great value during the preparation stage. Most tests of creativity and techniques to promote creativity for instance Brainstorming (Osborn, 1953), are primarily intended to measure or stimulate divergent thinking. Convergent thinking is also necessary, and at later stages of the creative process is of primary importance.

It is also a stage at which the scientist puts a lot of effort trying to find answers and may end up in frustration. At this point the questioner/scientist may temporarily give up and turn conscious attention elsewhere, leave the problem to incubate in the unconscious mind, to return later with a fresh mind and attitude towards the problem.

***Incubation***

The mysterious part of the creative process that takes places subconsciously is called incubation. There appears no activity whatsoever occurring, where in fact the creative action is astonishing. In this stage the conscious concentration on the problem ends and instead subconscious data processing may be assumed to take place a large number of the

thought elements are then gone through perhaps a dream like process. This stage can last anywhere from a few hours to many years depending on the complexity of the problem. This is the most important stage of creative process.

### ***Inspiration / Illumination***

The pay off of all the conscious and subconscious mental activity is usually experienced as a flash, an instant insight. This stage is called inspiration or illumination. This period leads to insight, which is usually sudden discovery of previously unrelated ideas, conceived as a solution to the problem. This leads to verification stage.

### **Verification**

At this stage the scientist is concerned with formal control of the results against objective criteria. It is mainly during this stage that traditional scientific reasoning based on deductive logic and isolated cause-effect relationships is applicable. Scientist needs to use various analytical methods such as statistical and simulation methods to arrive at probabilistic solutions

### **Emotional barriers to creative thinking**

- Fear of failing, making a mistake or taking risks
- an inability to tolerate ambiguity
- an overriding need for security
- a preference for judging ideas
- an inability to relax
- Lack of challenge and failure to engage with the task
- Excessive heat
- Lack of access to imagination
- Lack of imaginative control
- Inability to distinguish reality from fantasy

### **Improving creativity**

- Loosen up emotionally and intellectually
- Overcoming perceptual block
- Discipline yourself to think creativity

## **PROBLEM SOLVING AND CREATIVITY**

### ***What is a problem?***

The individuals have a problem when he has a goal, but is uncertain to what series of actions he should perform to reach it. The problem can also be defined as the discrepancy between an existing situation and a desired state of affairs.

Creativity is most intimately linked to problem solving that results in high novelty solutions. To justify the use of the term 'creative thinking' a thought product also has to satisfy the criterion of having some use or value. This requirement may be fulfilled in the way of functional use, as in technical inventions, or in aesthetic value, as in artistic production. The prevailing general theory of human problem solving as presently worked out is not adequately developed to deal with the creativity aspects of problem solving.

Brainstorming is one of the commonly used methods of solving a problem using the concept of creativity.

## **Brainstorming**

Brainstorming is defined as (Geoffrey Rawlinson, 1999):

**A means of getting a large number of ideas from a group of people in a short time."**

- Suspended judgment
- Free-wheel
- Quantity
- Cross-fertilize

Suspended judgment: During brainstorming session no evaluation is allowed. The leader has to enforce this suspended judgment.

Free Wheel: All types of ideas are allowed and recorded. There should not be any barriers or inhibitions in generating ideas.

Quantity: Here the principle is quantity breed's quality. The participants are deliberately encouraged to generate large quantities of ideas.

Cross-fertilize: Here one can develop the ideas suggested by others unlike in scientific conferences. It allows the ideas to be exchanged, developed and changed by the group, under the control of the leader.

## **Stages of brainstorming**

- State the problem and discuss
- Restate the problem
- Warm-up session
- Brainstorming
- Wildest ideas

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# STAKE HOLDER ANALYSIS

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Stake holder Analysis (SA) is the identification of a project's primary, secondary and key stake holders, an assessment of their interests, and the ways in which these interests affect project riskiness and viability. It is linked to both institution appraisal and social analysis. Stakeholder analysis contributes to project design through the logical frame work, and by helping to identify appropriate forms of stake holder participation. This analytic tool also provides enough scope for negotiations, which paves the way of effective linkages through modifying approaches of action plan and developing Terms of Reference (TOR) with various persons, groups and institutions.

## **Who are stakeholders?**

Stakeholders are persons, groups or institutions with interest in the project or programme. Primary stakeholders are those ultimately affected, either positively (beneficiaries) or negatively. Secondary stakeholders are the intermediaries in the aid delivery process. This definition of stakeholder includes both winners and losers and those involved or excluded from decision making process. Key stakeholders are those, who can significantly influence or are important to the success of the project (ODA, 1995). This wide definition clearly includes our selves (researchers) and farmers along with other disciplinary categories such as policy makers, extension officers, relevant government & non governmental organisations.

## **Applications of Stake holder Analysis (SA):**

Although SA can be usefully applied to a wide range of policy and management contexts. It is more relevant in complex situations where there are compatibility problems between objectives and stake holders. It is suggested that SA is particularly relevant to natural resource issues where they are characterized by:

- Cross cutting systems and stake holders interests.
- Multiple users and users of the resources.
- Multiple objectives and concerns
- Temporal trade offs
- Poverty and under representation
- Market failure

Stakeholder analysis can help organisations – public, private or non governmental to work through the implications of a range of different courses of action, and to identify which institutional and individual actors are likely to favour and press for particular kinds of change. Relations with the broader institutional and policy environment can also be explored through this tool. Table 1 illustrates a stake holder analysis of Field Study project of International center for development oriented Research in Agriculture, ICRA, Netherlands. This project aims conversion of Free Range Grazing (FRG) systems to Managed Feeding (MF) systems through balance of grazing and stall feeding (SF) in Bundelkhand region of India. Along the horizontal axis are some possible causes of actions, down the vertical axis are the possible stake holders, divided into three subclasses: actors internal to the organization; external actors internal likely to be affected by the proposed changes; and agencies working in the same geographical area or with related interests.

## Stake holder Typology:

As explained else where in this text, stake holder in any group of people, institutions, organized or unorganized who share a common interest or stake in particular issue, they can be global, national and regional concern down to the level of house hold or intra-house hold. The key and often neglected stake holders in NRM are subsistence farmers and other small scale resource users, but stake holders may equally include policy makers, planners and administrators in government or other organizations, even more nebulous categories such as “future generations”, National Government and wider society is example of stake holder typologies in Tree resources is given in Table 2

**Table -1:** Stake holder vs Courses of action (ICRA – IGFR Field Study, 1998)

| Potential Stakeholders            | Courses of Action |               |                  |                  |
|-----------------------------------|-------------------|---------------|------------------|------------------|
|                                   | Continue FRG      | Convert to SF | More FRG Less SF | More SF Less FRG |
| <u>Internal to Organisation</u>   |                   |               |                  |                  |
| ICRA, IGFR                        | - -               | + +           | -                | + +              |
| Socio- economist                  | +                 | - -           | +                | -                |
| Natural Scientist                 | - -               | +             | -                | + +              |
| <u>External to Organization</u>   |                   |               |                  |                  |
| Small – Livestock Farmer          | + +               | - -           | +                | -                |
| Medium – crop Farmer              | - -               | + +           | -                | +                |
| Large Farmer                      | + +               | - -           | +                | +                |
| Dairy Farmer                      | - -               | + +           | -                | + +              |
| Children                          | - -               | - -           | +                | + +              |
| Old man                           | + +               | - -           | +                | +                |
| Woman                             | - -               | + +           | -                | +                |
| <b>Competition</b>                |                   |               |                  |                  |
| Forest Dept.                      | - -               | + +           | -                | +                |
| Herds man Practising Transhumance | + +               | - -           | -                | -                |

. + / - = Benefit / Loss to specific groups, institutions

Table 2: **Tree resources typology (Grimble et al, 1994)**

| Level                    | Stake holders   | Interests   |
|--------------------------|---|---|
| Global and International | Int. agencies<br>Foreign Govts.<br>Environmental lobbies<br>Future generations                            | Biodiversity conservation<br>Climate regulation<br>Global resource base   |
| National                 | National Govts.<br>Macro planners<br>Urban pressure groups<br>NGO's                                       | Timber extraction<br>Tourism development<br>Resource and Catchment.   |
| Regional                 | Forest Dept.<br>Regional authorities  | Forest productivity<br>Soil loss / degradation  |
| Local off site           | Down stream communities<br>Logging Company<br>Local Officials   | Protected water supply<br>Access to timber supply<br>Conflict avoidance   |
| Local on site            | Forest dwellers<br>Forest fringe farmers<br>Livestock keepers<br>Cottage industry<br>Women fuel collector | Land for cultivation<br>Timber /non timber<br>Forest produce<br>- Grazing / fodder<br>- Cultural sites<br>Fuel wood trees |

### Two approaches to SA in NRM:

Development of SA is based on the contention that many well intended interventions have failed because inadequate attention has been given to the various stake holders and their economic and developmental interests and objectives. Policies and projects have not met their stated objectives because the consequences of the policy are perceived to be adverse by one or more stake holder groups and have therefore led to non cooperation or even opposition by the stake holders.

There are two main branches to recent work on SA used for NRM in developing countries. The first is that developed in the Natural Resource Institute (NRI) deals with SA as a heuristic or analytical tool for better understanding complex situations and predicting future situations and address both conflicts of interests between stake holders and tradeoffs between objectives. A second branch developed by Overseas Development Administration (ODA) focuses on the social aspects of SA and its use as a tool in project design, particularly for the avoidance and management of conflict. The ODA approach of consensus building and developing a workable project, while the NRI approach uses SA as a tool for unpacking the economic interests and inherent conflicts of NRM.

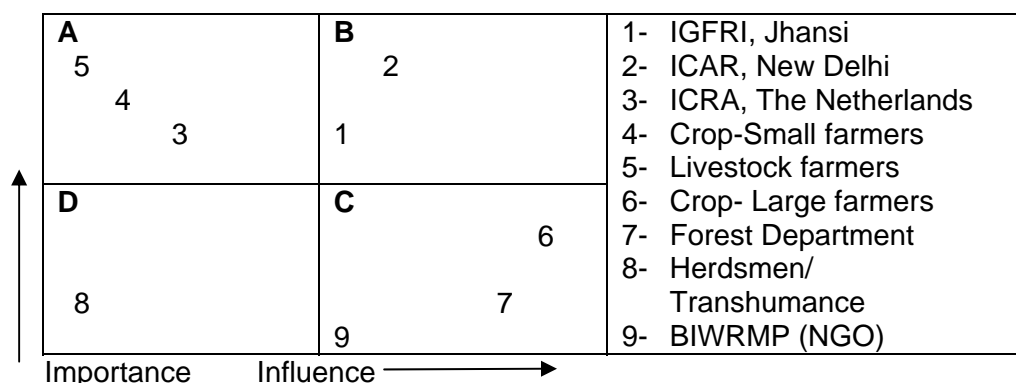
### Methodologies of SA:

#### 1. Stake holder table:

| Stake holder | Interests | Potential Project Impact | Relative Priority of interests |
|--------------|-----------|--------------------------|--------------------------------|
| Primary      |           | + or -                   | 1 – 5                          |
| Secondary    |           | + or -                   | 1 – 5                          |
| External     |           | + or -                   | 1 – 5                          |

## 2. Influence / Importance matrix:

Matrix classification ICRA-IGFRI Field study, 1998 on Conversion from Free Range Grazing (FRG) to Managed Feeding in Bundelkhand, India



### Explanatory note: Implications of Importance/ Influence analysis

**A** – Stakeholders of high importance to the project, but with low influence. They require special initiatives to protect their interests

**B** - Stakeholders appear to have high influence, who are also of high importance for success of the project. Construct good working relationship with them.

**D** - Stakeholders of high influence, can therefore affect project output, but their interests are not the target of the project. Source of significant risk, need careful monitoring and management.

**C** – Stakeholders with low influence on and or importance to project objectives, they are unlikely to be the subject of project activities and management. Require limited monitoring / evaluation

## 3. Pay off matrix

The stake holders interests are evaluated against the available options.

| Technology Option                | Stakeholder1<br>Small farmer | Stakeholder2<br>Medium farmer | Stakeholder3<br>Large farmer |
|----------------------------------|------------------------------|-------------------------------|------------------------------|
| Hoe                              | +                            | --                            | ---                          |
| Animal power                     | ++                           | -                             | ---                          |
| Two wheel tractor<br>(Ownership) | +                            | +++                           | +                            |
| Two wheel tractor<br>(Hire)      | +++                          | +                             | --                           |
| Large tractor<br>(Ownership)     | ---                          | -                             | ++++                         |
| Large tractor<br>(Hire)          | ---                          | -                             | ++                           |

## 3. Participation matrix

Fill the stake holders in following matrix, to find out level of participation of various stakeholders and make planning accordingly, the following is example of ICRA-IGFRI Field study project, 1998

| Stage in Cycle          | Inform             | Consult   | Partnership   | Control   |
|-------------------------|--------------------|---|---|---|
| Identification          |                    | ICAR  | IGFRI<br>ICRA   |   |
| Planning                | Large-Crop farmers | Live stock farmers, Small-crop farmers<br>AH Dept.<br>Forest Dept | ICAR<br>IGFRI<br>ICRA                                 | Field study team<br>Scientific Backstopping Group |
| Implementation          | ICAR<br>ICRA       | Large-crop farmers, Forest Dept, AH Dept, BIWRMP                  | IGFRI<br>ICRA, Small crop farmers, Live stock farmers | Field study team                                  |
| Monitoring & Evaluation | ICRA               | ICAR  | IGFRI<br>ICRA, Small crop farmers, Live stock farmers | External consultants                              |

**5. Problem definition exercise:**

Brainstorming and generating as many ideas as possible.

**Table -3:** A comparison of ODA and NRI Stakeholders approaches

| ODA approach  | NRI approach   |
|---|--|
| Primarily a management and mediating tool   | Primarily a heuristic tool for analysing situations and predicting consequences  |
| Concerned with design, management and implementing the aid projects   | Note concerned solely with project cycle activities but also with improved understanding of NR problems, structural change and policy issues |
| Very closely associated with participatory approaches, particularly of ultimate beneficiaries (small farmers, women )                                     | Not essentially about participation though uses participatory techniques for diagnosis and data collection                                   |
| Concerned the representation of stakeholders rather than the ideas represented. Thus concerns conflicts between them but not tradeoffs between objectives | Equally concerned with tradeoffs between objectives as with conflicts between stakeholders   |
| Identify methods, risks and assumptions for stakeholder cooperation   | Identify patterns and contexts of interaction between stakeholders   |
| Is a social tool with little economic contents  | Is an interdisciplinary tool with strong economic contents   |

Source: ODA (April,1995) and Grimble *et al.* (1993-94)

**Table- 4:** A comparison of ODA and NRI working procedures for SA

| ODA  | NRI   |
|--|---|
| Draw up a list of stakeholders   | Identify the main purpose of the analysis   |
| Draw out stakeholders interests in relation to problem addressed         | Develop an understanding of the systems and its decision makers in relation to problem addressed                  |
| Assess the influence or power of the stakeholders                        | Identify principal stakeholders   |
| Assess the importance or need to satisfy the stakeholders                | Investigate stakeholder interests, characteristics and circumstances  |
| Combine influence and importance in matrix diagram                       | Determine views of stakeholders on relevant questions   |
| Determine how and which stakeholders should participate in project cycle | Assess options for management at all levels, from round table negotiation to expert group analysis and resolution |
| Identify risks and assumptions for stakeholder cooperation               | Identify patterns and contexts of interaction of stakeholders   |

Source: ODA (April,1995) and Grimble *et al.* (1993-94)

**6. Actor identification sheet:**

Why or why not are they stakeholders.

**7. Tracing diversity in mission statements:**

Evaluation of perceptions and performance of stake holders.

**8. Venn diagrams:**

**Limitations of SA:**

1. Though a powerful tool for problem analysis and illuminating the interests of under represented, it cannot in itself provide answers to problems.
2. SA, mirrors the groupings and interest of society and in itself does not try to make changes.
3. The process of analysis can not be extended for examining the role of very large number of stake holders.
4. Can not be tried to quantify stake holders' likely gains and losses, this is inherently qualitative tool and can best be employed as an illustrative aid to decision making.
5. Despite its focus on multiple interests, it remains heavily top-down planning tool.

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# RESEARCH PROGRAMME PLANNING

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Planning of research programmes is a complex task, which requires the consideration of a variety of factors. The research managers must be aware of the research priorities, likelihood of the research programme fulfilling the national research objectives, technical opportunities of research, perceived needs of farmers, technical and resource constraints that may crop up during the execution of research, and a host of many other things while planning research programmes. Studies have pointed out that either one or more of the following deficiencies are normally diagnosed in the research programme planning process. These include:

1. Research objectives are often not well linked to economic and agricultural development objectives
2. Programme activities are not relevant to the needs of the research users nor are they geared to producing technologies easily adopted by them.
3. Not enough is known about the technology available from external sources, thereby resulting in missed opportunities for borrowing technology.
4. Research activities are often proposed without reference to the resources they demand
5. Scarce resource are dispersed among too many activities
6. Researchers and producers' interests are potentially divergent. The researchers, often, tend to work on the scientifically most interesting problems; consequently, the technologies emanating from such research may not be very relevant to farmers. As a result, the adoption rate may be low.
7. Research programmes are often made up of a hodgepodge of projects, activities, and experiments, indicative of a lack of problem - solving objective
8. Researchers tend to overlook socioeconomic and institutional constraints on the adoption of their research results.

All these factors justify the fact that the research programme planning has now become a specialization in its own right.

## **Programme versus Project**

A programme refers to a set of research activities needed to produce the information required by the clients of research in an area. A programme can be national, encompassing activities in several institutions concerned with one area of research; or, it can be at the institutional level, grouping together only the activities of a single institution. A programme is long term in scope and is somewhat continuous. A multi-disciplinary team of scientists is, normally, attached to a programme.

A project is a component of a programme, and it addresses specific research problems. A project operates under explicitly defined time frame, resources, and objectives. A project terminates when its specified set of objectives have been achieved.

### **Agricultural Research Planning**

Planning, basically, is the process of deciding what objectives are to be pursued during the course of a future time, and what have to be done in order to achieve these objectives. This implies that planning has to answer three basic questions, which are i) Where are we now? ii) Where do we want to be? and iii) How can we get there from here? Research Programme Planning need not be considered as stultifying. On the contrary, planning helps to increase the effectiveness of individuals and also of organizations by sharpening the focus of research activities on fewer, most relevant areas for agricultural development, through developing a sense of mission and commitment, and improving the flow of information between the various actors concerned with agricultural research. Planning should not be construed as the use of economic models for allocation of resources. Planning goes beyond the use of models, which are only tools that may or may not be utilized as part of a larger process. Planning is a necessary evil, which needs to be resorted to for bringing about organizational effectiveness and increased output. Nevertheless, planning is certainly not a panacea for all the problems. One of the reasons for planning's poor performance, which is sometimes encountered, lies in the approach used and also in not fully recognizing that the process of planning can be as important as the output. It is, therefore, necessary that planning process has to be done with proper care.

### **Types of Planning**

Planning can be of different types. The type of planning that is resorted to will depend upon the purpose for which the planning is done.

**Long range planning:** It is based on a multi-year forecast of resources and on projection of past trends in terms of research activities and allocation of resources. This planning is characterized by stability, continuity, and predictable changes. However, the environment features high interdependence, uncertainty, rapid technological changes leading to substantial and frequent shifts. By projecting the vision of the past into the future, long range planning cannot accommodate for fundamental environmental changes. It is a static approach to planning. It tends to discourage the generation of creative solutions and it leads to a routine extension of existing activities.

**Short range planning:** Short range plan emphasizes on the solution of problems that need immediate attention and that can be solved in a relatively short time. Normally, plans covering up to one-year fall under this category. This planning is basically a dynamic one, and is adaptable to changing conditions and the emerging needs. This type of planning requires a greater awareness of agricultural realities in order that the plan addresses the emerging issues.

**Strategic planning:** This planning is based on the belief that the future can be influenced by what is done in the present. Strategic planning focuses on an understanding of the environment and of the forces causing changes; it promotes creative thinking for the generation and evaluation of strategic choices leading to the design of alternative scenarios, and the identification of a preferred one amongst them. This approach helps an organization create its future, not just plan for it. Instead of a mere projection of past trends, it centres upon the design of alternative scenarios for the future state of the research system and the



choice of a preferred one. The analysis of the differences between current and desired situation, called gap analysis, gives a measure of the changes that have to occur.

Agricultural research is hard pressed to produce results that will have a likely impact in terms of solving the problems at hand. Being responsive to the needs of farmers is one of the difficulties in agricultural research programme design. Strategic planning precisely emphasizes the analysis of the operating conditions and needs of the clients, and the evolving market opportunities.

The specificity of agricultural research lies in the nature of research itself, which requires long-term investment of the scientists in their subject matter. Plans elaborated without the scientists' involvement run the risk of being seriously distorted at the implementation stage. Promoting the involvement of all concerned with a view to reaching a consensus on main issues, which seems to be the key requisite for the success of agricultural research planning in general, is well served by the strategic planning approach. The implementation of strategic planning requires a participatory approach.

### **Misconceptions about Planning**

Planning is usually seen as a separate function from other managerial functions. It is normally considered as an ad hoc activity in time. It is believed that it has to be carried out by specialists. Whatever be the type of planning strategy that is adopted, it should be remembered that one should not fall into any of the traps of misconceptions that are indicated above. Any planning strategy that is followed in an institute should be well integrated with the budgeting, information, reporting, and organizational behaviour system prevalent in the institute. If not, implementation of any planning process would be a stumbling block.

### **Steps in Agricultural Research Planning**

There are basically three distinct steps that can be distinguished in agricultural research planning. They are:

- i) A national agricultural research policy and strategy
- ii) A long term plan, and
- iii) An action plan, which translates the long-term plan into operational terms for direct implementation.

**i) The national agricultural research policy and strategy:** These are formulated at the policy level and they deal with decision - making on issues such as

- the mandate of the system
- the overall level of investment in agricultural research
- priorities among broad research areas (commodity groups, production systems, or production factors) and their resource allocation
- organizational structures for the system
- linkages between the system and the users; between the system and other sources of knowledge.

At this macro level, priority setting procedures based on socioeconomic and political considerations become very handy.

**ii) The long-term plan:** This is formulated by the individual institutes using the agricultural research policy as a framework. Any type of planning strategy, viz. Long range planning, or strategic planning, may be used. This step involves the identification of long-term programmes. This means the scientific research activities must be organized in programmes, either by commodities, themes, production factors, or systems. At this programme level, priorities are set among sub-programmes or projects, based on a combination of socioeconomic and technical criteria. This provides a link with priority setting at the policy level.

**iii) An action plan:** This third planning step is the translation of the long-term plan into an action plan for direct implementation. This action plan may be a long - term project of a longer duration or a medium - term project of three to five years duration, or a short - term project of about a year duration.

This step consists of formulating research projects that correspond to the areas identified in the long - term programme. For the action plan, scientists prepared project documents which include the problem analysis, research hypothesis, description of the methodology, expected results year by year, schedule of activities, necessary resources, etc. Priority setting of various proposed research projects, by using objective criteria and proper appraisal procedures, help in identifying the most important research projects that can be implemented within the resources available.

### **Research Project Planning Process**

The step three described above consists of formulation of research projects by individual scientists. This project planning, in the context of scientific research, covers atleast three stages. The first stage begins with the identification of the problems. This is a very important step if the research has to address the needs of the clientele group. The problems identified should be in tune with the mandate of the institute and in the line with the policies and priorities set at the national level. A scientist might end up with a couple of problems that need to be researched. The second stage involves the evaluation and prioritization of these problems in the light of the objectives of the organization and the urgency of research needed for these problems. Out of the various problems, the scientist has to select the most important one. The third stage involves the preparation of a research project proposal. This proposal involves the preparation of a detailed project proposal giving time schedules, manpower, and financial requirements. The objectives and benefits from the project are spelled out in the proposal, so that its priority could be established among the various competing projects that are being pursued in the institute. While implementing the research project, it is necessary to have a self-monitoring of the progress of the research activity, with a view to either modify or discontinue the research project in the light of the progress that has been made. The effects of changes in the environment and in the technical objectives can be incorporated at this stage. Thus the research project planning comprises three stages, which are i) problem identification ii) researchable problem selection, and iii) project proposal preparation.

## Levels of Research Project Objectives

While formulating and proposing the research projects, it is necessary to provide a clear, concise statement of project objectives, including the four levels of objectives, viz. inputs, outputs, purposes, and goals. These provide the key indicators that can be used for effective monitoring and evaluation, and also for progress reporting. These four levels of objectives are described briefly below.

i) **Inputs:** These comprise the personnel, physical resources, and financial resources that are needed to achieve the stated outputs. These inputs include manpower, infrastructural facilities, equipment, materials and supplies, transport and travel, utilities and facilities, support services, and funds. The specific requirements can be worked out by developing a proper work plan. In research activities, it is also valid to include leadership and a defined set of research objectives as inputs.

ii) **Outputs:** These include those achievements that are derived directly from the use of the inputs. For example, a maize breeding project with sufficient manpower, facilities, and support (inputs) would be expected to identify or develop, within an estimated time frame, a new variety with desirable characteristics (outputs).

iii) **Purpose:** Purpose indicates what the research project is expected to achieve, once it is completed. In the example of the breeding project, it is assumed that if a variety is identified with desired characteristics (output), then procedures might adopt it leading to production increases (purpose achieved).

iv) **Goal:** It is the ultimate objective for undertaking the research project. In the broad context of national development, it is usually a desired economic achievement for which the attainment of project objectives is necessary but not always sufficient. Using the same example of the maize-breeding project, the expectation is that if better maize technology is available (output), more maize will be produced (purpose), thereby contributing to a national goal of food self-sufficiency. It is obvious that increased maize production alone is not sufficient to ensure national food self-sufficiency.

We can realize a direct cause and effect relationship between input, output, and purpose. This is because, if inputs are provided then outputs will be produced. If outputs are produced then the purpose will be achieved. However, the relationship between the purpose and the goal is less direct and casual, since many exogenous factors are likely to influence the attainment of goal. An indicated earlier, achievement of the project purpose is considered necessary, but not sufficient for achieving the goal. The goal may be achieved, once the purpose is achieved, provided other causal factors are also met. The research manager has much influence over the attainment of objectives only at the input, output, and purpose levels.

Research programme planning is, thus, very sophisticated and is a subject by itself. It calls for concerted efforts of the scientists and managers to make the planning processes and techniques work effectively in any organization.

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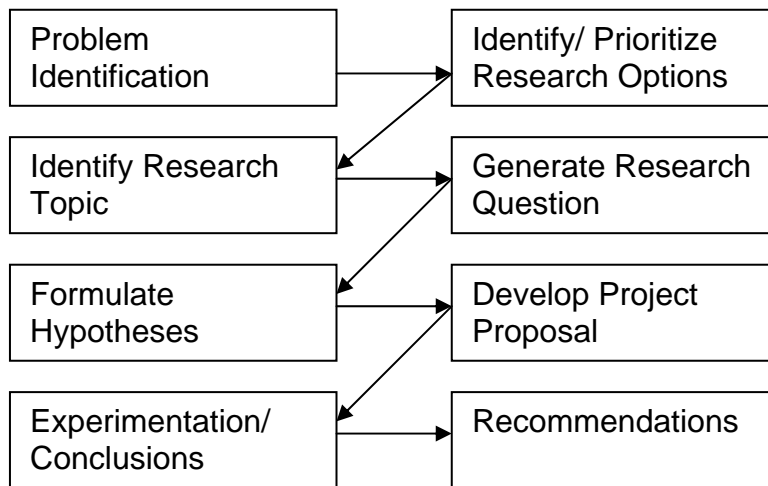
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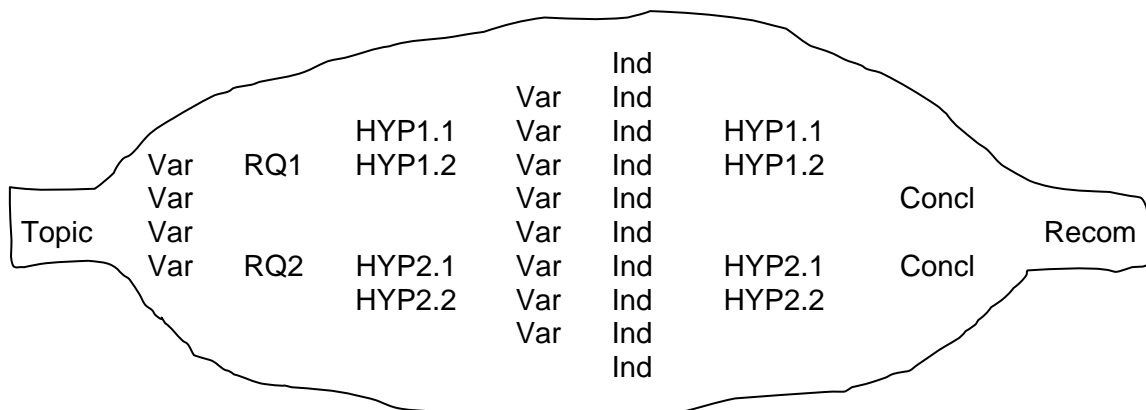
# GENERATING RESEARCH QUESTIONS AND FORMULATION OF TESTABLE HYPOTHESES

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A common mistake of new researchers is to fail to narrow a topic sufficiently or to try to jump from a broad topic or problem itself directly into a research project without first creating a research question or formulating a testable hypotheses. To make research more analytical, especially developmental research, a process needs to be followed before designing a research project to make recommendations. In the present article, we discuss the research approach fitting in following framework.



In conformation with the above approach Sellamna (1998, ICRA) proposed the Double Funnel Notion of Research, which is as follows,



## Selecting a Topic

After problem identification and screening and prioritizing research options, the first step when beginning a research project is to select a topic. There is no formula for selecting a topic but there are many sources, which help to choose topics, they are:

1. *Personal experience*: You can choose a topic based on something that happens to you or those you know
2. *Curiosity based on something in the media*: Sometimes you read a newspaper, magazine article or see a television program and leave with questions.
3. *State of knowledge*: Theoretical explanations are elaborated and expanded.
4. *Problem solving*: Applied research topics often begin with a problem that needs a solution.
5. *Social premiums*: Some topics are hot or offer opportunities
6. *Personal values*: The commitment to a set of religious, political or social values
7. *Every day life*: Potential topic can be found throughout everyday life in old sayings, songs, novels etc.

## From Topic to a Central Research Question

Research projects are designed around research questions. It is possible to phrase many potential research questions for most of the topics or sub questions for a central research question. Before proceeding to design a research project, scientist must narrow and focus the topic. Research questions refer to the relationships among a small number of variables, also observe how questions are normally phrased. The research questions generally become more focused, concrete and disaggregate when you move from central question to sub questions. The research questions should not be too narrow or too broad. Identify a limited number of *variables* and specify the relationship among them, a good research question also specify the *universe* to which the answer to the question can be generalized, the problem causal analysis helps in this exercise; some techniques for narrowing a topic into a research question (Neuman,1997) are as follows,

1. *Examine the literature*: Replicate previous project exactly or with variations, explore unexpected findings discovered in previous projects, follow suggestions an author gives for future research, challenge findings, study intervention process and consider linking relationships
2. *Talk with knowledgeable people*: Various stakeholders like scientists, development officials, NGO"s and farmers
3. *Apply to specific context*: Focus topic onto a specific time period, farm types, farmer categories and geographic units
4. *Define the aim or desired outcome of the study*: Will the research question be for an exploratory, explanatory, or descriptive study? Will the study involve applied or basic research?

Under this background we can see that some questions are good research questions while others are not. For example, the question, "What causes water scarcity?" is not a good research question. A better research question is, "Is cropping pattern adopted by large farmers causes water scarcity?". The second question suggests two variables: cropping pattern (*independent variable*) and water scarcity (*dependent variable*), these variables have relationship; the research question also specify the *universe* (large farmers) to which the answer to the question can be generalized. Table-1 summarize the bad and good research questions.

## From research Question to Hypotheses

Final answers to the research questions are only obtained at the end of the research project. But usually, the answers to these questions are not magic out come of the research process that no one could have foreseen. Once the questions are clear, turn them into hypotheses, i.e. into assertions (affirmations) which precisely indicate what you foresee. Hypotheses are tentative answers to research questions, it forces scientists to state expectations with as many detail as possible, so that mistakes in the design of the solutions are likely to come out and further monitoring and evaluation of research process and it's results are easy. It is difficult to move smoothly from topic to hypotheses, but the leap from a well-formulated research question to hypotheses is easier. Hints about hypotheses are embedded within a good research question. Several hypotheses can be developed for one research question. The following steps can be followed for formulating testable hypotheses.

1. Find out tentative answers to the research question
2. Find out independent and dependent variables
3. Establish the direction of relationship between variables
4. Specify the universe and unit of analysis to which resultant of hypotheses testing could be generalized

**Table-1: Examples of Good and Bad Research Questions**

| Bad Research Question  | Good Research Question  |
|--|---|
| <b>Not Testable, Non scientific-</b> "Is it right not to allow Free Range Grazing (FRG) in forests?" | <b>Exploratory Questions-</b> "Has the incidence of Free Range Grazing (FRG) by small farmers of <i>Bundelkhand</i> changed in the past ten years?"   |
| <b>General Topics, Set of Variables, Not Question-</b> "Land degradation and Free Range Grazing"     | <b>Descriptive Questions-</b> "Is FRG in <i>Bundelkhand</i> , more common in farm households that have higher number, but non productive cattle than those farm households who have less number, but high productive cattle?" |
| <b>Too Vague, Ambiguous-</b> "What can be done to prevent Free Range Grazing?"                       | <b>Explanatory Questions-</b> "Are the Government policies responsible for high grazing intensity in <i>Bundelkhand</i> ?"  |
| <b>Need of more specificity-</b> "Has the incidence of Free Range Grazing risen?"                    |   |

## Sources of Information

At different stages, the information comes from various sources and is obtained by different methods. This is shown in Table- 2.

**Table-2: Sources of information at different stages**

| Source                | Problem, Topic Identification | Generating research Question | Formulating Hypotheses | Identification of Variables | Definition of Indicators |
|-----------------------|-------------------------------|------------------------------|------------------------|-----------------------------|--------------------------|
| Terms of Reference    | 4                             | 4                            |                        |                             |                          |
| Secondary information | 4                             | 4                            | 4                      |                             |                          |
| Resource persons      | 4                             | 4                            | 4                      | 4                           |                          |
| Exploratory survey    | 4                             | 4                            | 4                      | 4                           | 4                        |
| Case studies          |                               |                              | 4                      | 4                           | 4                        |
| Observations          |                               |                              | 4                      | 4                           | 4                        |

The information obtained through above means should specify, four aspects required to define research question and testable hypotheses, these are listed below:

*The unit of analysis*

A unit of analysis can be a village, any geographical boundary administrative or social community, a household, a person, a farmer, a farm household or a farm etc. This is considered to be the object of research, to which the answers of research questions could be generalized.

*The variables*

Variables are quantitative or qualitative characteristics of unit of analysis, in which scientists may be interested, the numerical values could be assigned to quantitative characteristics. Ownership / hire of land or male/ female farmers can be example of variables.

*The nature of relationship*

The hypotheses concern a relationship between two or more variables. Usually the assumption is that the relationship is a cause-effect relationship, where causal or independent variable (X) have an effect on a dependent variable (Y). Hypotheses to be tested may concern various dependent variables, each caused by one or more independent variables.

*The indicators*

The variables are defined at an abstract, conceptual level. They are the construct of mind, but can not be observed as such in the real world. To make them measurable proxies for the variables are called indicators. Many times a variable is measured by more than one indicator.

These four aspects can be understood by an example, say an excursion is proposed for your group now there may be two possibilities,



| Aspects              | First case                    | Second case                  |
|----------------------|-------------------------------|------------------------------|
| Unit of analysis     | Participant of this training  | Excursion                    |
| Independent variable | Money, weather, time          | Money, weather, time         |
| Dependent variable   | Excursion frequency           | Participant of this training |
| Relationship         | Directional                   | Directional                  |
| Indicator            | Rainfall, no. of visit/ month | No. of persons               |

### Some Examples of Process of Topic to Hypotheses

Example of Bankston and Thompson's (1989) study on fire arms in United States

- ❖ **Topic-** Carrying Firearms for Protection
- ❖ **Research Question-** "To what degree do people carry firearms when away from home do so out of a fear of crime"
- ❖ **Hypotheses-** "Whether people who fear crime the most and who believe that a gun will protect them are most likely to carry a firearm, when away from home"

The authors mailed questionnaires to over 4000 white people in Louisiana, asking about their attributes and background in addition to whether they carried a firearm when away from home. In this hypotheses, main *independent variable* is fear of crime, intervening variable is a belief that gun provide protection, *dependent variable* is how often a person carried a gun when away from home, the *universe* for the result may be limited to whites in other areas of southern United States. *The unit of analysis* of the study was the individual.

Example of ICRA-IGFRI (1998) field study on *Annapratha* prevailing in *Bundelkhand*

- ❖ **Research Topic-** Identification of Free Range Grazing (FRG) systems in *Bundelkhand* and opportunities for conversion to Managed Feeding (MF) system.
- ❖ **Variables-** Grazing systems, type of animals, types of farm households.
- ❖ **Research Question 1-** "Is FRG in *Bundelkhand*, more common in farm households that have higher number, but non-productive cattle than those farm households who have less number, but high productive cattle?"
- ❖ **Research Question 2-** "Can silvipasture developments on community lands provide opportunities of conversion from FRG to MF systems to those farmers of *Bundelkhand*, who own low productivity cattle?"
- ❖ **Variables-** Grazing systems, agroecology, type of animals, types of farm households, suitable plant species.
- ❖ **Hypotheses 1** (For Research Question 2) - "More the *Cenchrus ciliaris*, *Stylosanthes hamata* and *Albizzia amara* based silvipasture on community lands, bigger the chances that the farm households, who own low productivity cattle are converted to MF system"
- ❖ **Hypotheses 2** (For Research Question 1& 2) - "In *Bundelkhand* the FRG is mostly practiced by the farm households who have high number but less productive cattle, and not by the farm households who have less number but high productive cattle; and these FRG practicing farm households can be converted to MF system by the development of *Cenchrus ciliaris*, *Stylosanthes hamata* and *Albizzia amara* based silvipasture on community lands"

## Limitations

While refining topic to research question and formulating hypotheses, the practical limitations are always considered, these limitations are,

*Time-* The required time to find real answers by testing hypotheses should always be taken into account. In scientific research, though it's not an easy task, the experienced researchers are best source to help in this matter.

*Cost-* Generation of data and information incur the cost, therefore a practical limitation.

*Resources-* The access and availability of resources like expertise, equipments, information etc. should be taken into account while finalizing research questions and hypotheses.

*Approval by authorities-* Some information like seeing medical records and restricted maps need approval by the authorities will you get it, while finding answers?

*Ethical principles-* These generally refer to serious physical damages to persons, animals or may be related to emotional aspects.

## Suggested reading

Campbell, John P., Richard L. and Charles L. Hulin. (1982). What to study: Generating and developing research questions. Beverly Hill, CA: Sage.

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# GENDER ISSUES IN AGRICULTURE

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## Introduction

Agriculture occupies a key position in the Indian economy providing a source of livelihood for a majority of the population. Successes in agricultural front with high production levels, especially in food grains have indeed been achieved. But more energy in the form of mineral fertilizers, chemical pesticides and farm machinery are required every year to produce the same quantity of farm products (Swaminathan, 1991). The yield plateau of crops in Punjab, Haryana, Western Uttar Pradesh and other states strongly indicate that there is a disturbance in our natural resources management and the present practices are not conducive to sustainable agriculture (Deb, 1994). Area covered by soil degradation has increase by almost 800 lakh hectares. Soil degradation has already consumed 57 per cent of the country's area. Apart from soil erosion, in situ degradation like water logging, salination and nutrient depletion is responsible for a loss of upto 26 per cent of the annual agricultural output today (TERI, 1997). Another major cause of concern, particularly in the core Green Revolution belt, has been the decrease in genetic diversity of major HYV crops, which has increased the potential danger for sudden widespread loss of crops from unknown / uncontrollable diseases (Maji and Bhattacharya, 1994).

Depletion of natural resource base due to deforestation, over grazing, desertification, excessive agricultural intensification, over fishing and agriculture on marginal lands leads to decline in agricultural production potential leading to decrease in the sustaining / carrying capacity of agriculture. Natural resources (soil, water, nutrients) have boundaries and improved management is needed to reverse the degradation of this resource base and develop agricultural production systems that sustain our ecosystem.

**Sustainable agriculture** is the sustainable exploitation of renewable natural resources including annual and perennial cropping, agro-forestry and livestock as well as the conservation measures needed for long-term maintenance of resources. Thus, sustainable agriculture involves sustenance of our agricultural systems. This should be the major emphasis for all technological innovations involving land and water use so that there is no adverse effect on the biological productivity of the resource base in the long run (Deb, 1994).

## Effect of Over Exploitation of Resources on Women

The interrelationship between human factors and natural resources management is complex and has remained at the center of the development debate. It is acknowledged now that economic growth goes side by side with deteriorating conditions of work and living for sizable section of the poor, especially women. This is so because the growth process itself imposes new forms of deprivations, dislocations, exclusion and alienation from the productive resource base. In effect poverty, malnutrition, population, ecology and sustenance of our agricultural systems can no longer be dealt with or even thought of as separate issues. They are interlinked in practice and must be linked in policy formulation, for development to be meaningful, especially if it has to have a positive impact on women.

Historically, women have been the managers of natural resources as they are dependent on them for their livelihood and their family's needs. The consequences of over exploitation of these resources have rendered them scarce. The effect of environmental

degradation and its consequences can be examined from the disturbance of linkages of women with respect to land, water and work.

**Land:** Over grazing of pastoral lands, degradation of land by water, wind erosion, salinity, alkalinity have all resulted in increasing working hours of women as she has to traverse long hours to locate productive areas. Women are linked with forests for their supplies of fuel, fodder and minor forest produce. Non-commercial sources of energy - firewood, crop wastes and cowdung - provides nearly 90% of rural household energy requirements. The rural women collect over 28% of all energy consumed in India in the form of firewood. Most of the 140 million tonnes of firewood burnt annually come from forests. Deforestation and depletion of forest resources and loss of access to and control of forest resources have increased poverty, unemployment and drudgery of rural and tribal women. Soil erosion, water logging, siltation, shifting cultivation, construction of dams and reservoirs, mining and industrial activities and large scale tree felling for commercial purposes have taken a toll on agricultural and forest areas. Thus rural women are forced to work more, walk greater distances for long hours to collect fuelwood, fodder and other household biomass.

**Water:** Discharge of effluents from industries and households have resulted in pollution of surface water and over exploitation of ground water has led to fall in the water table. Natural reservoirs of rainfall have been diminished due to deforestation. Water is thus becoming a scarce commodity. The effect of depleting water resources is more severe on rural women. Women in Rajasthan and Kutch region of Gujarat travel several hours to fetch water to meet their family's needs. Even in high rainfall, hilly regions of Uttar Pradesh and North East deforestation had led to water shortages in summer forcing women to walk several miles in search of water.

**Work:** Poverty and unemployment in rural areas have resulted in large-scale migration to urban areas. Women are being forced to take up more drudgerous jobs as a source of livelihood as most of the migrants are absorbed into the construction sector. Women form the largest work force in agricultural sector. Male out migration from rural areas in some instances is strong enough to suggest a process of "feminization of agriculture" or perhaps more accurately, of self-provisioning food farming. Households headed by women now form on an average in developing countries between 20 to 25 per cent of all rural households. The rural woman's drudgery has thus been doubled with women performing the man's role as well.

Thus women, the sustainer of family's health and prosperity, has slowly become the primary victim of deepening environmental crisis as they are the main users and providers of household biomass.

### **Woman's Contribution to Sustainability**

Even in the larger scenario of rapid exploitation of natural resources woman has inadvertently been contributing to the sustenance by her traditionally assigned role. Domestication of crops is widely believed to have begun by women. Seeds are the source of food and are valued for their quality to maintain genetic continuity. From time immemorial, it has been a woman's domain to sort seed at home by observation and through experience. In doing so, the methods of seed storage were always practised by women. The search for medicinal seeds and plant material for her family, fruit seeds for kitchen gardens and ornamentals to quench her aesthetic needs have all contributed, indirectly, for preservation of seeds and the biodiversity that we are endowed with.

These activities make women trustees and users of crops, land races, forest genetic diversity, medicinal plants and also a source of information on use of local cultivars and various modes of conservation. Maintaining land fertility and sustaining it by adding domestic refuse and cattle dung to land when needed, use of trap crops as barriers, bench terracing and recycling water from water storage ponds to her kitchen gardens are all recognised activities by women practiced out of necessity.

Realizing the importance of stabilizing the coastline planting shelter belts with coconut, arecanut, or grasses for stabilising coastline agriculture has been practiced. The farm are also dependent on the multiple uses of these trees. These are perennial and yield late and women have been involved in growing short duration intercrops to meet their family's nutritional needs.

Caring for livestock comes naturally to women. The most drudgerous jobs in livestock production like cleaning of the cattle sheds, feeding the cattle, collection of fodder etc. always fall on the woman. Care for young animals and backyard livestock is also largely done by women. In caring for sick young animals women have evolved several ethno-veterinary practices.

Many such practices, based on indigenous technical know-how vested with crop husbandry (especially in complex, diverse, risk-prone areas), animal husbandry, fisheries and home management have been traditionally practiced by women. These practices are usually eco-friendly, sustainable, economically viable and are examples of best utilisation of local resources and waste / bi-product recycling and management.

The long association of women with environment can be utilised in the process of solving major environmental problems, by using their traditionally acquired skills and integrating it with scientifically studied and developed techniques. Women have come to be seen as the solution to the development - environment crisis, as major "assets" to be harnessed in initiatives to conserve resources and as "fixers" of ecological problems (Leach, 1992).

## **Technology Development & Women**

The devaluation and marginalisation of indigenous knowledge and skills have disproportionately affected women as they have generally been excluded from the institutions through which modern scientific knowledge is created and transmitted (Agarwal, 1992). There is increasing evidence from agricultural project and program evaluations that insufficient attention to gender issues tends to increase or reinforce gender inequities in ways which hold productivity and welfare below the potential (Carloni, 1983; Dey, 1983; Jones, 1982; Pradhan, 1983). Women have thus far been neglected by and large as human resource in most of the development programmes and strategies. Despite recent agricultural innovations there is no respite for rural women. Where agricultural innovations leads to the reallocation of family labour and the assignment to men of complete control over output and income, without associated changes in the allocation of obligations, welfare and nutritional status of the family may actually decline (IFPRI,1983).

One of the barriers is agricultural extension through which so many innovations and services are channeled. In addition to the pressures which encourage field-level extension staff to work with larger farmers rather than small holders (Leonard, 1977), the fact that most

extension staff are male has meant that, for any farm size or income category, extension agents have tended to work with male farmers rather than female farmers (Swanson *et al*, 1985). A technology development process which is so structured that technical innovations in food cropping simply do not reach a major portion of the farming community makes very little sense.

When new varieties were being developed, little thought was paid to the bi-products and their utilisation in rural existence. These products not only have a role within the domestic economy, they are the input to often complex divisions of labour and enterprise providing income and employment to very many of the rural poor. Collection of household biomass is largely the job of women. Women also use the bi-products in a variety of ways, both for domestic use as well as income generation. Straw from traditional varieties of rice was used as fodder and for thatching. But, straw from short statured, high yielding varieties, developed to prevent lodging, cannot be used for thatching and yield less fodder. Possibly the importance of the contribution of multiple use of biomass to rural economies has been obscured by the concentration on the more favoured, irrigated areas where the high profits from HYVs complement existing, or induce the development of new infrastructures, commercial and industrial networks and livelihood opportunities.

Technologies developed in areas like post-harvest operations have never really studied the inter-relationship that exists between production and post-harvest activities at the domestic level. Post harvest technology was so far being designed from a distance. Studying domestic processing, storage and cooking technologies can lead to development of appropriate technologies that are genderized as well.

Mechanization of agriculture has not been gender sensitive. It has led to large scale dislocation and unemployment among rural women. Harvesters, transplanters and combines usage in field crops is one example.

Failure to perceive women - over half the world's population and important to technology development as producers, workers and consumers - as clients of, or as forming an important constituency for agricultural research is one of the major blocks towards overall development (Jiggins, 1986).

### **Technologies for Empowering Rural Women**

Recognizing the fact that women can and must play an important role in the sustenance of our agricultural systems they have to be involved in the process of evolution of new technologies which are eco-sustainable. Their needs and physical limitations have to be taken into account during technology innovations and development. Training, to disseminate these technologies, must be made a regular feature. The training should be vocational (skill oriented), organised for short duration within her social boundary during the lean months of her involvement in agricultural activities. Suitable Audio-Visual aids can be used to take the message across. Teaching aids like samples, models and visuals that are appealing and interesting must be used to improve the comprehension of the illiterate women and their capacity to retain the message disseminated. Location specific traditional media like folk songs, folk theater and folklore can be utilised to communicate technical information in a effective way.

Ergonomically designed machinery, specially tools and implements, that are genderized can assure rural women employment and add value to the her time. Implements like dibblers, hoes, weeders, seed and fertiliser drills, seed treating drums, pedal operated

pumps and threshers and serrated sickles have been developed, but are yet to be popularised. Improvements in implements like clod breakers, tillers and transplanters have to be made for easy handling by women.

Location specific, remunerative cropping systems that have capacity to enrich the soil, can tap nutrients from different soil layers and which includes legumes and tubers can be developed and suggested for practice. This has the added advantage of breaking pest cycles if properly planned. For example paddy-black gram and paddy-groundnut-green gram cropping system. Inter cropping like sorghum-red gram which have been traditionally practiced has been scientifically proven too, to be suitable to dryland areas. Finger millet and horse gram intercropping is also found to hold lot of promise especially in the marginal lands and risk-prone environments.

Women also need to be provided knowledge and skills in multi-storied cropping which can create favourable micro climate for crops and can tap solar energy efficiently. Eg: betel leaf + moringa, coconut + pepper + banana + pine apple.

Integrated farming systems with inclusion of diversified farming components: Crop (foodgrains / plantation / horticultural crops / cash crops / fodder), Livestock (Dairy / sheep / goat / piggery / poultry ), Allied (sericulture / apiculture / mushroom cultivation) can be suitably packaged and taught to rural women. The scarce resources can be optimally utilised without over exploitation of any one resource and it also helps in risk aversion.

Pest scout concept for use of IPM technology, for differentiating and diagnosing pest/disease/nutrient deficiency symptoms, and taking up preventive and curative measures including predators, parasites, microbes or botanicals (Neem and Karanj), biofertilizers like microbial manures (Azatobactor, Azospirillum, Rhizobium, Azolla), green manures (Sesbania, Crotalaria, green gram, Pongamia), organic manure (FYM, vermicompost) are eco-friendly and sustainable technologies which offer immense scope for employment of women.

Cultural practices such as contour cultivation to prevent soil erosion, summer ploughing, stale seed bed preparation, clean cultivation for weed control, micro watershed development for rain water harvesting, cyclic flooding and drying in rice for water conservation, seed selection and treatments by using germination tests, salt water and hot water, nutrients application on seed, use of pesticides/ botanicals for prevention of seed borne diseases and enhancement of early vigor have to be taught to women.

Hybrid technology, a seed producing activity, involves skillful, finite operations which women have been found to have a natural knack for. The industry recognises this and 70% employees in hybrid seed production are women. However, the wage pattern should be based on skill rather sex which is at present very disproportionate and to the disadvantage of women.

Tissue culture technology offers new scope for conservation and rapid multiplication of cells. This is a highly skillful activity that can be taught to women and thus form an avenue of employment.

Women's role as preservers of forest wealth can be further accentuated by technical knowledge on nursery maintenance - nursery grafts of horticulture and perennial crops-, agro-forestry, silvi-pastures etc. which can also generate additional income. These practices

can be integrated in the farming system itself so that it can also meet the household bio-mass needs too.

Ethno-botanical techniques are part of habits of tribal groups. Information search on ethics and ethos of these women and on modes adopted to choose plants for conservation is needed, to develop a national database. Protecting bio-diversity and genetic conservation and women's role in this process has to be strengthened and policies made to modulate these operations.

Livestock participatory extension services with an objective to empower women with scientific livestock production technologies like "clean" milking concept, new fodder grasses (amenable for multi-cuts and identified for marginal lands) are ways for sustaining production systems. Recycling of wastes and their use as animal or poultry feeds will help the animal husbandry component. Composite fish-culture can also be taken up as part of the integrated farming systems wherever feasible.

But all these sustainable avenues can not be harnessed till policy makers, decision managers and women involve themselves in the decision making process. Technological empowerment must be reinforced by social empowerment. This calls for gender sensitising field extension personnel at all levels and equipping them with new technological advances, knowledge of ecologically sound farming practices and management skills. Para-agricos, on the lines of para-vets, from rural areas, specially women school dropouts, can be trained in scientifically developed, sustainable technologies, provided with tool kits and inducted at grassroots level as barefoot extension specialists.

### **Professional-Rural Women Linkages**

The number of women professionals in the field of agriculture, veterinary science and allied areas are increasing. This human resource can be effectively utilised to cater to the needs of the rural women. To be effective professionals they have to be involved in the process of decision making and thus aim for key positions of planning and policy making in with the formal organisations. They can help genderize research and development in their disciplines.

The Professional-Rural Women linkages can be strengthened through formulation of gender sensitive, location specific, inter-disciplinary research with compulsory involvement of rural women in planning, technology re-assessment and evaluation process through PRA and PTD methods.

More number of women have to be inducted into the formal extension system and provided with facilities like secure accommodation and transport, incentives for off campus activities and due recognition. The professionals and para-agricos have to be given periodic refresher training courses in sustainable technologies to be able to effectively train their rural counterparts. The development and training programmes in IVLP, LLP and KVK should involve more number of women beneficiaries and professional women can play a decisive role in this. Professional women should also handle extension projects targeting rural women.

Professional women should document successful and revalidated indigenous technologies developed by rural men and women and help them gain due recognition. Farm Women's Day should be organised by research institutes with active involvement of all



development departments, NGOs and women entrepreneurs for better awareness, exposure and creation of interest in farm women about new technologies.

Vocational counseling and guidance service should be provided to rural women by professional women in research and development sectors. Data banks may be set up to disseminate information on technologies available for production, processing, bi-product utilisation etc. along with information on training facilities.

Networking of women professionals among themselves and with NGO's and other grass root level social organisations working with rural women should be set into motion and strengthened.

Sustenance of our resources and systems of agriculture are intrinsically linked with women and their roles. If we have to preserve our mother earth, the mother of the family also has to be able to carry on her jest for sustenance in a more scientific way.

### **Intervention Points of Professional women for Farm women**

1. Development of improved farm and home technologies integrating the livelihood opportunities of women in research:

Varieties, cropping sequences, farm management, post-harvest operations, low cost improved implements and tools suited to the needs of farm women standardised in terms of energy, cost and time efficiency and comfort in use based on ergonomics of women, incorporating the indigenous knowledge available, (seed treatment drums, seeders, transplanters, inter-cultivators/weeders, pedal operated threshers, miniaturised grain mills, dal mills, cleaners, graders, maize shellers, ground decorticators), non-pesticidal pest management, smokeless chullah, Solar driers and other non-conventional energy devices etc.

2. Providing counselling and vocational training for knowledge and skill development in areas where women participation is high such as Dairy, sericulture, bee keeping, mushroom cultivation, poultry, rabbitry, livestock management, bio-diversity maintenance, waste land development, pond management (common properties management), nursery management, integrating farming systems, rural crafts, entrepreneurial development and frontier areas such as bio-technology, hybrid seed production, Computer aided water management, renewable energy technologies etc.

Organising women groups for production purpose involving various enterprises and providing specialised short-term and long term training for entrepreneurial development in areas like raw material procurement, processing, storage, quality control and marketing of finished products etc.

Training farm women in safe handling and safety precautions for equipment and pesticides as well as educating on Occupational health hazards and first aid training.

Including research and support components in training. Providing package of technology, services and public policy which function in a mutually reinforcing manner. Technology kits to be designed and distributed

3. Screening the existing technologies and developing inventory by documenting women-specific technologies which are relatively simplified, economical in terms of time and

resources, efficient and capable of drudgery reduction and increasing women employment which will also serve the purpose of setting research priorities suitable for women.

4. On-the-spot guidance and service for the women co-operatives (dairying etc.) Recognising and supporting successful NGOs through technical services. Information shops to be set up in areas where women programmes are implemented for continuous upgrading of knowledge and information.
5. Advocating in the policy making bodies for
  - i) tree pattas for farm women with a right to use tree products
  - ii) legislation that offers social security, health insurance and accident cover maternity benefits, creche & primary health facilities, subsidies extension to farm women at normal times and at times of natural calamities.
  - iii) Comprehensive legislation covering wastelands, degraded forests in and around villages to be distributed to landless labour families in the name of women only.
  - iv) Constituting separate cells in R&D institutes, SAUs for promoting work on women in agriculture and for gender equity evaluation, monitoring and evaluation.
  - v) NCW and its multi-disciplinary task force of professional women to advise Government on documentation preparation for a sub-chapter on 'Women in Agriculture' spelling the Govt.'s proposals related to public policies regarding production and post-harvest technologies, training and re-training, techno-infrastructure including support services, trade, land ownership, wages and credit.
  - vi) Subjecting all research proposals to gender audit before approval.
  - vii) Policy interventions to build in access for resources and enter prizes, such as milch animals, sheep and poultry; short-term operational ownership for women due to leasing land; and joint ownership for existing land resources
6. Launching mass literacy Campaign with the help of State and District level legal aid boards for farm women regarding their rights and awareness creation in the aspects of environmental degradation and consequences.

Getting trained or have awareness on existing constitutional provisions for women in providing equality, opportunity and protection to women in agriculture in order to develop realistic plans for farm women development.

7. Energising extension system through sensitising extension personnel in gender related issues, and through development of technical women cadre in extension on priority basis to serve technological needs of women farmers.

Multi-disciplinary team approach for all extension activities with one women member in the team to study impact of technologies on women and on sustainability of natural resources.

Working along with agricultural labor inspectors for enforcing labour wages for farm women and counselling the farm women labour to get due wages and for awareness creation, working through mahila mandals and panchayats for organised extension work.

Using progressive farm women as potential resource persons to facilitate extension work and to interact with research and extension functionaries. Following peripatetic training following the family approach at the time, duration and location preferred by the farm women.

8. Documentation of the indigenous knowledge of farm women both at home and farm and validating, refining and blending with modern technologies for impact. Documenting the Occupational health hazards, occurrence of accidents for women in various agro-climatic zones and the reasons for the same. Maintaining feedback from farmwomen on working of various tools /implements /equipment.
9. Developing databases for the above publications, professional women available in agriculture field with their specialized areas of work for networking and awareness creation among the organisations dealing with agriculture and women.

Database creation or Agricultural Census with separate section for women to include qualification in terms of different categories of women in agriculture, different categories of agricultural operations to facilitate desired policy shift by the Government. Database creation on activities and multiple roles of farm women in farming systems and farm women needs. Soft ware bank in R&D institutes to include latest technologies, indigenous technologies and success stories /experiences etc.

10. Promoting environmentally friendly concepts on sustainable agriculture such as natural/ organic farming which are traditionally practiced by farm women.
11. Promoting publications on gender issues for sensitising at national and international levels and for interactions, and publications for communicating the women specific technologies in local languages.
12. Organising Mahila goshthis, Farm women Days, Melas, Exhibitions for sharing information and getting direct feedback.

Communicating modern technologies and concepts through various Traditional media specific to a region which are appealing to farm women by working with the traditional artists for the treatment of the knowledge base.

13. Following Participatory approach in appraisal, technology development and transfer. Emphasising on action research and demonstration oriented technology transfer programmes.
14. In Agricultural Education, by formulating a gender-sensitive curriculum with special emphasis on sustainable agriculture.

Through compulsory 'Rural Work Experience Programme' for the agricultural graduates to identify gender-specific technologies, present level of adoption, their impact to provide feedback to the R&D system.

# PROBLEM DIAGNOSIS THROUGH SYSTEMS APPROACH

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Systems approach to a problem takes a broad view, take all aspects into account, and concentrates on interactions between the different parts of the problem. The approach is basically collaborative, participatory and cooperative.

## **Systems terminology**

**Definition:** A system is set of objects (elements) held together with relationship between the objects and between their attributes. The primary attribute of a system is 'wholeness' (Ex: water, family, organisation).

In a system variation of one element affects all other elements and leads to variation of whole system, and conversely, variation of any element depends on all other elements in the system. A system may acquire new qualities not present in its components but retains properties of individual components in a transformed form.

**Sub-system:** System or sub-systems are based on the choice of the level of detail or resolution to describe its activities. Thus a system can be a sub-system of some wider system.

**Structure:** Structure is relationship between components in a system. It can be either permanent / stable or unstable / change slowly. It is an inherent property of a system.

**Component:** Component is that part which cannot be decomposed in subsequent study. If boundary is reduced to such an extent that decision making is an inappropriate activity, system at this level of detail is termed as component.

**Environment:** Environment is what lies outside the system boundary. If the boundary of a system is widened to such an extent such that the control over such large area, system at this level is termed as environment.

**Hierarchy:** System properties have certain hierarchy. Hierarchy is principle according to which entities treated as wholes are built up of smaller entities which are themselves wholes. In a hierarchy, emergent properties denote the levels.

**Organisation:** Organisation relate to viability and stability. Organisation in a system depends more on the nature than on the degree of strength of ties. Tie is a connection between the components. If level of organisation is low then the behaviour of the system is similar to that of a simple sum of its components, while where there is a high level of organisation, the system behaviour is quite different.

**System levels:** Organisation levels can be identified according to degree of complexity. A lower level system can be a building block for a higher level system. For example, molecules make up cell. Cells form organs. Organs constitute organism. Organism emerges as a species. This upward movement corresponds to increasing levels of organisation.

**Wholeness:** Wholeness expresses the integrated properties of set of objects (parts) that are not present in isolated objects. A system will be called 'whole' if all the parts function together

while the entire system is independent of environment and other systems. Wholeness is a special case of order and organisation. Wholeness is not determined by level of organisation, but rather by the degree of tie density within the system i.e. this density being higher than the density of ties between the system and environment.

**Systemic rules:** Some basic systemic **rules** which helps in designing a system are:

- System should have an ongoing purpose or mission
- A system should have at least two components
- Each element is indivisible within a system
- Elements can be real or imaginary
- System interacts as a whole with external world
- A system is more efficient and better organised than any of its components
- Degree of tie density within the system is higher than the density of ties between the system and the environment
- Coupling between components inside a system is stronger than any coupling between its components and environment or components in another system
- Expected changes as a result of choice of root definition be such that conceptual model must be systematically desirable and culturally feasible
- It is not possible to improve one part of the system at the cost of some other part.
- System contains a decision-taking process. It exists in wider system or environments with which it interacts. It has a boundary over which it has control. It has resources at the disposal of decision taking process

### **Systems methodology**

Methodology represents a structured set of guidelines, which enable an analyst to analyse the problem. Methodology is neither a technique (method) nor a philosophy. It has an intermediate status of these two extremes. A philosophy will be a broad guideline whereas a technique is characterised by precise guidelines (ex: solving equation). Methodology needs more flexible definition. Application of methodology may involve use of techniques, but it is the methodology that determines a particular technique is appropriate or not. To be technique oriented has a danger that the problem situation will be distorted to fit the technique; in such case although a solution is guaranteed the solution may not remove the initial concerns. Methodology will lack the precision of a technique but will be firmer than a philosophy. A technique tells 'how' and a philosophy tells 'what' to do and methodology contains both these.

### **Orientation to systems approach**

To view the issue/ problem in systems approach, it is essential to understand the science from the perspective of abstraction and levels of enquiry in the system. Conscious effort is needed to view the events holistically.

### **Abstraction**

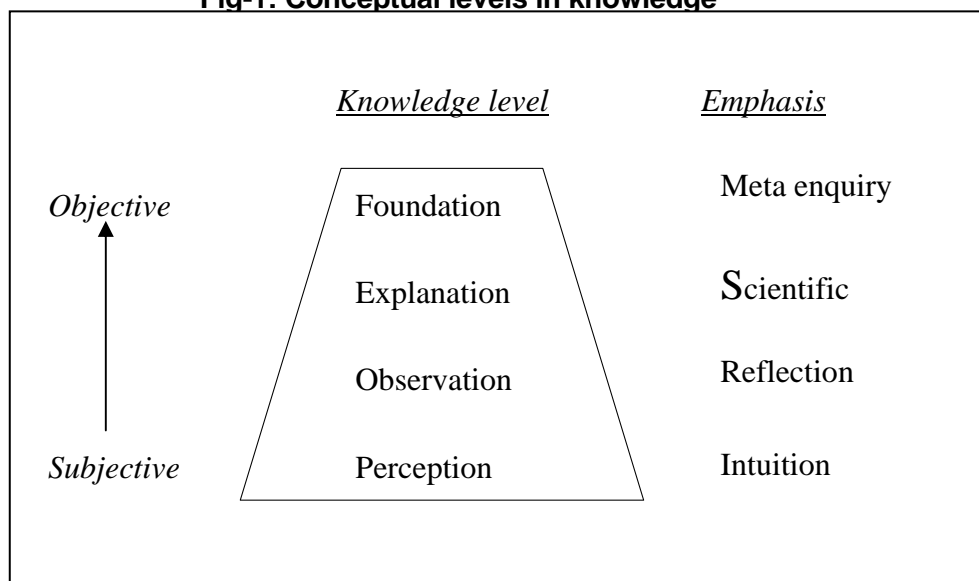
Abstraction refers to an action of mind. It is a mode of enquiry, which seeks to generalise. In usual sense it means to isolate certain characteristics from others. It plays important role in perception of reality and helps to conceptualize bigger systems into simpler presentable forms. For example, a research problem in plant sciences can be viewed as a generic problem in agricultural sciences or as a problem in cereals or as a specific problem in particular cereal crop. Going from specific crop to plant sciences is abstraction. But to describe the problem at higher level forces the scientific method to a more fundamental level as the lower systems are

united at higher level of knowledge. Thus abstraction not only helps to conceptualize higher systems but also forces enquiry at higher knowledge levels.

### Levels of enquiry

To illustrate usefulness and importance of the levels, levels in conceptual system are presented in the Fig-1. The enquiry can be made at the lowest level, i.e. the common sense level (intuition level) where the knowledge about the system is neither processed nor analysed. Whereas, at higher levels of enquiry, the information is processed, tested, and verified. As level of enquiry increases, the description of the system becomes richer and depth of knowledge used becomes higher. In reality, most systems exist in some hierarchy and each level in hierarchy is set to perform certain functions, following certain procedures.

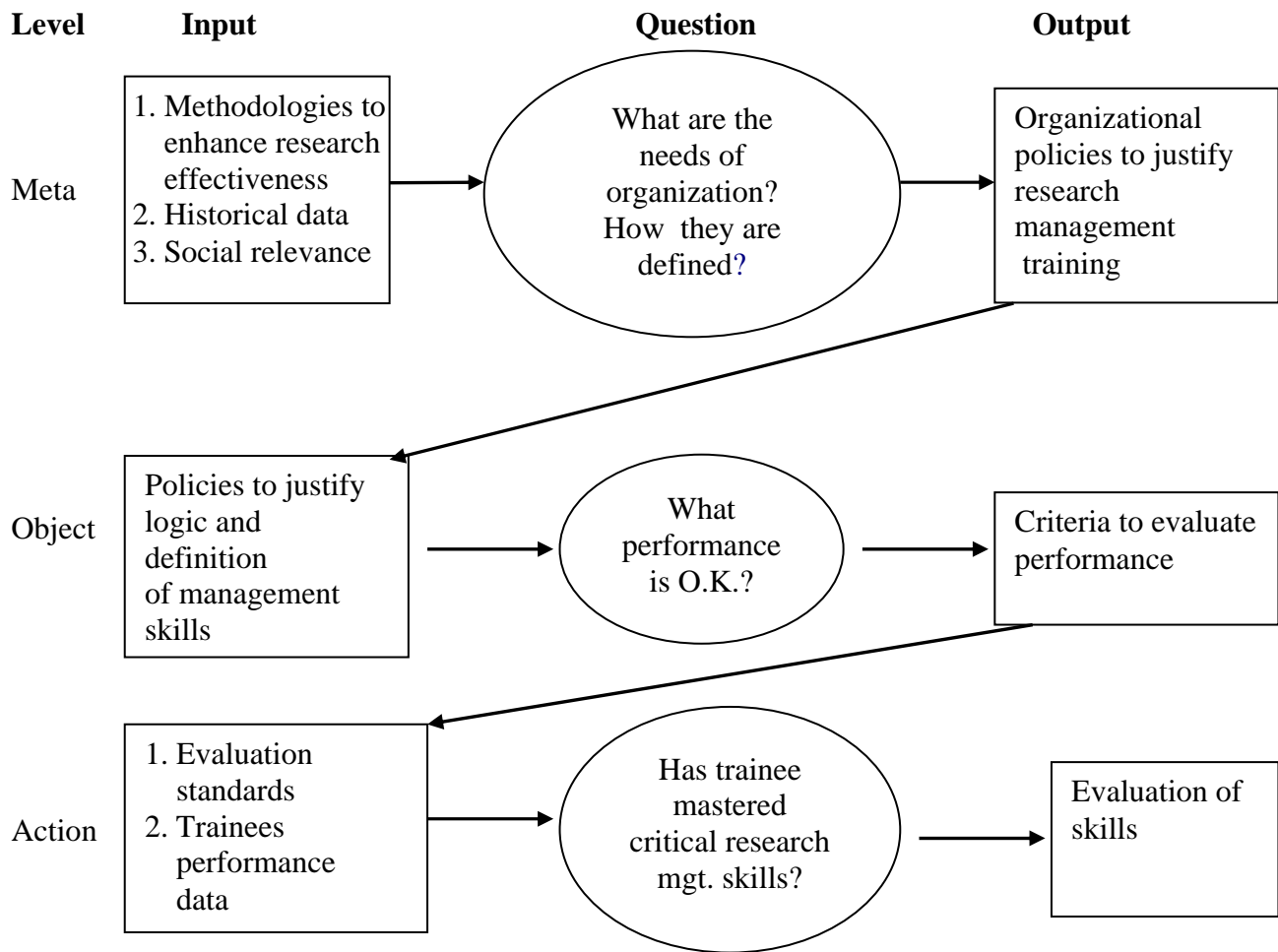
**Fig-1: Conceptual levels in knowledge**



### Hierarchy and levels

The knowledge of levels in the problem system gives the best picture of the system. Fig.-2 illustrates the importance of levels of enquiry and hierarchy in system of training for research management. The system levels delineate the functions of systems at each level. In real systems the problems arise due to shift in function by levels, i.e. higher hierarchy performing lower level functions and low-level functionaries demanding role in higher level functions. In either situation, the system will be under strain and loses the natural process of organisation. Therefore, it is important to create knowledge systems scientifically. An understanding of complexity and levels of enquiry helps to manage the system better.

**Fig.-2: Hierarchy and levels in system of training on research**



# WRITING A RESEARCH PROPOSAL FOR EXTERNAL FUNDING

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## Introduction

One important area of concern in research is writing appropriate proposals for funding. This is required for both the researchers to design and plan their research and for sponsor agencies to evaluate it in the pre-sanction phase and to monitor its progress in the implementation phase.

The formats of most national funding agencies are similar with minor variations. Experts review the projects and few promising projects are approved direct, some are accepted with modifications and fairly large number is rejected. Most rejections were due to inappropriate presentation style. This paper is essentially to bring awareness on this.

While we wish to focus on the planning and writing skills of agricultural research projects, the implementation factors, which can effect the success of a project are hitherto unspecified. One of the basic reason why so many innovations have failed is that implementation tasks have been underestimated and misunderstood (Chambers, 1995; Fullan, 1988). Even well planned projects may go awry due to external factors (Bamberger 1991; Coleman, 1987) or due to inflexibility in implementation (McLaughlin, 1985). However, many of the problems at the implementation level may arise due to ill-planning in the writing phase.

The purpose of this paper is to introduce a step-by-step guide to planning and writing project proposals incorporating project management techniques. To contextualise the various steps and procedures, the project development is discussed with an example project on forecasting of oilseeds. The material here serves two purposes; it provides to prepare a written report for competitive grant and also for planning an analytical study, or both.

**The paper also sets out to examine basis for appropriate framework for project evaluation. The intention is to explore the complex issues encountered and likely to be encountered in managing projects so as to develop appropriate management method. In reality, it aims to offer some fresh perspectives on concerns such as participation, monitoring and evaluation in the management of research projects.**

What is a proposal?

First, it is necessary to clear, about what is meant by 'project proposal'. A project proposal is an undertaking that has:

- short term
- definite objectives
- well defined inputs and outputs
- specifies objective realization within specified costs and quality

Before writing the proposal it is important to understand the skills for project development and the sponsor system.



## **Skills**

Two important skills needed in writing research proposals are:

- management skills
- technical skills

Technical skills are needed to conceive research idea, justify its need, scientific and technical means to satisfy the need. Managerial skills are needed in design and implementation stages and in identification of resources needed to accomplish promised tasks. One of the basic reasons for rejection of many project proposals is due to lack of managerial skill in the initial proposal writing phase. Even technologically sound projects may fail if implementation tasks are ill defined, or external factors such as socio-economic and environmental concerns are not addressed properly. On the other hand, an ill-planned project, even if approved on technical merits alone, it may lead to major set backs in implementation as a result of flaws in the planning and writing phase. While good planning may not by itself guarantee smooth running of a project, poor planning will greatly reduce the chances of its success.

## **Sponsor**

Before writing identify the sponsor agency and relate your and your employer's interests to the sponsor's current interests. The sponsors (DST, DBT, ICAR, CSIR, Commodity boards, etc.) have their own priority areas and the project should broadly fall in to one of the sponsor's current priority area for funding. Most sponsors encourage multi-disciplinary and multi-institutional projects. Each sponsor agency has set procedure for screening, evaluation and grant of projects. An insight in to this helps in making project proposal accordingly. For example DST has Project Advisory Committees in each broad area which does the technical evaluation of the project and gives final recommendation. For adhoc schemes of ICAR, two experts evaluate the projects. In all state-funded agencies, technical evaluation is followed by financial scrutiny to verify the financial norms for approved items or activities.

## **Formats**

The formats of most national funding agencies are similar with minor variations. More details about the sponsors funding priorities and application procedures can be had from their web sites.

ICAR (<http://www.icar.org.in>)

DST (<http://dst.nic.in>)

DBT (<http://dbtindia.nic.in>)

CSIR (<http://www.csir.res.in>)

UGC (<http://www.ugc.ac.in>)

DAE (<http://www.gov.in>)

UGC (<http://www.aicte.ernet.in>)

## **Appraisal**

Most funding agencies adapt some kind of appraisal system to evaluate the projects. Each and every section in the proposal will be evaluated and given some rating or weight. The relative score is used to screen the proposals for funding under competitive grant

schemes. The appraisal criteria are sponsor agency specific. The appraisal criteria relevant to agricultural research projects are given in Fig-.

Each item in the project is evaluated for the above and norms are specified for giving weights to each criteria. International agencies and agencies in the western countries use such objective criteria in screening the proposals. In India, the evaluation is more subjective, but the above criteria form the guiding force.

**Fig-1: Project appraisal criteria relevant to agricultural research projects**

| Criteria                            | Weight (%) |
|-------------------------------------|------------|
| Urgency                             | 15         |
| Ease of adoption                    | 12         |
| Cost of adoption                    | 10         |
| Completion time                     | 10         |
| Lead time                           | 9          |
| Probability of success              | 8          |
| Availability of manpower            | 8          |
| Availability of physical facilities | 8          |
| Cost of the project                 | 7          |
| Economic benefits                   | 7          |
| <b>Contribution to knowledge</b>    | 6          |
| <b>Total</b>                        | 100        |

## Stages of proposal development

### Structure

The project proposal is similar to a research paper, but with future perspective. Developing project proposal follows the structure of a project. The distinct structural elements of a project are:

1. Title
2. Introduction - need, problem statements, aims, and objectives
3. Rationale
4. Research method - means of objective realization
5. Work program – activities, time, resources, indicators and their evaluation norms
6. Budget

Keep in mind that while writing a proposal we are simultaneously planning and ready to execute the work.

### Section-1: Title

Title gives first impression of a proposal and hence it has to be catchy, small and informative. It shall not be same as objective, it has to be shorter but at the same time indicates broadly what is being attempted. Few illustrations are given below:

- Petro crops: Establishment of petro crops farming in wastelands of Rajasthan.
- Progeny testing of young crossbred bulls in rural areas.
- Molecular architecture of photosynthetic membranes.

- Animal and handicraft in the urban system – A national survey.
- Why chickens die in poultry farm?
- Developing a low-cost technology to detect aflatoxin in chicken feed.
- Fishes for the future: Identification and characterization of endangered aquatic species in selected tropical sites.
- Greening the desert: Conserving water in Rajasthan with bunds, tanks and watersheds.

## Section-2: Introduction

### ***Background***

This section concerns with background information, urgency, critical gaps in knowledge and need for the present study. Two pertinent questions that help in developing this section are:

What is the context for the proposal?  
Why is this study needed?

A review of literature would answer the above two questions. While reviewing literature try to ascertain the following:

- Others have not attempted the problem you had in mind
- If secondary data exists it would be economical to use it for your purpose
- You must get primary data from a procedure of your own.

Review may suggest

- Ideas for your own work
- What not to do
- Convince others about your knowledge of past work in the area

Develop background information leading to the need for the present study. Justification for urgency must be reflected in this.

### ***Problem statements***

The background part of introduction deals with a context having a set of problems. In this section, state specific problem of your interest making necessary connection to the context given in the background. Specify limits that can be studied in the time, resources and budget sought. Strive for excellence – not sheer quantity. Developing problem statements is illustrated with the example oilseed project.

### ***Initial statement***

State what the project is expected to do in one statement, preferably in one sentence. In our example it might be something like: A project to estimate the edible oil need in the country by 2020 AD through technological forecasting.

The initial statement clarifies the basic intent. This does not promise meeting the need for edible oils either by production enhancement or imports. The statement is not precise enough to use as a basis for implementation and needs to be developed into further statements.

## **Support statements**

The support statements are an expansion of initial statement into a fuller form via the following formula (Checkland, 1988)

|                    |   |                          |
|--------------------|---|--------------------------|
| A project to       |   |                          |
| do X (aims)        | - | what you want to do;     |
| by Y (means)       | - | how it will be achieved; |
| for Z (objectives) | - | why you want to do it.   |

The expansion of the initial statement to our example project leads to following XYZ statements:

|               |   |   |
|---------------|---|---|
| A project to: |   |   |
| X             | - | <b>develop forecasting model for oilseeds requirement</b> |
| Y             | - | by use of combination of forecasting methods              |
| Z             | - | to advice the policy makers                               |

Although this statement has correct form, its contents remain ill conceived. XYZ statements must be clear and well throughout. The pitfalls in the above XYZ statement are:

|              |  |  |
|--------------|--|--|
| A project to |  |  |
| X -          | Model may or may not lead to developing strategies to meet oilseed requirement   |  |
| Y -          | use of combination of methods will not necessarily answer the question. No check on what is being done is right or wrong |  |
| Z -          | Policy advice can be developed with different subsectors interests in focus  |  |

A stronger XYZ statement, therefore, might be:

|               |  |  |
|---------------|--|--|
| A project to: |  |  |
| X -           | Develop alternate strategies to meet oilseeds requirement  |  |
|               | Y -by identifying need for edible oil, technological advances in oilseeds, transfer of technology issues through brainstorming sessions, expert's opinions and analysis of historic data |  |
| Z -           | to advice policy makers on strategies for sustainable development of oilseeds  |  |

Care to be taken in writing objectives such that they must be measurable or specifiable in some way so as to know the completion. This will facilitate the intensions clearly and it also sets useful criteria for evaluation purpose.

## **Aims and focus**

Large-scale projects funded by international agencies aim at sustainable development and poverty alleviation. In addition, they also focus the project as a means to improve the functioning and efficiency of systems associated with such development activities. Focus on developmental problems or relate to developmental problems as long term goal. Try to relate it to problems like elimination of poverty, increasing productivity, conservation of resources, food security and such.

## **Objectives**

Each objective must be clear with indication to broad and specific measurable out put and possible to accomplish in the specified time frame. While writing the objectives try to answer the following queries.

- What do you want to achieve?
- The objectives are valuable to whom?
- Are they measurable?
- Are they realistic in terms of time and available resources?

If there are multiple objectives, each of the objectives shall lead to a sub-project. Each objective should have a corresponding hypothesis.

Objectives are not to be split unduly. It will be convenient if a multi-disciplinary project is split into number of sub-projects so that each of the objectives can be related to one or two sub-projects directly. One way of doing this is to develop discipline wise sub-projects, to the extent possible.

For the example project on oilseeds the objectives are: Development of policy strategies for sustainable development of oil seeds to meet oil seeds requirement in the country.

## **Section-3: Rationale**

Specify hypothesis corresponding to each of the objectives and involvement of stakeholders. This should not be justification for the project, which appears in introduction.

As a general rule, a formal research should involve a hypothesis, some preliminary information, and a strong hunch suggesting the type of outcome you are likely to find. A hypothesis is to be made as a careful statement of an idea or hunch. The formal study may be preceded by a simple 'test' from which ideas or hunches may evolve. However, some studies can be purely exploratory.

Remember every study provides a piece of information that did not exist prior to the study. What is important is that the evidence adds a significant body of knowledge or some practical significance or both. Specify this in this section.

## **Section-4: Research method**

**This section is purely technical. This should succeed the rationale section and gives answer to questions on how to realize the objectives? Give approaches with details and references wherever possible. There should not be any ambiguity in giving details. Try to specify how using the listed approaches will solve the problem. Identify the stakeholders, partners or team members. Specify details of involvement of stakeholders in detail. List all the activities and show methodologies for each activity explicitly.**

**The facilities available at the host institution to be mentioned clearly. Show that you have not only sufficient scientific and technical skills but also access to facilities and your institution has requisite infrastructure to carry out the project. The**

chief investigator as the manager of the project has to identify quality resources and manage them efficiently for successful completion. The proposal has to document this aspect.

### **Section-5: Work program**

Schedule the work elements listed in the methodology in a sequence indicating the role of each associate. Standard project management techniques like flow chart, gnat chart or PERT network can be used to illustrate this. Specify facilities available and additional resources needed and the method of acquiring resources. Specify time frame activity wise. Give milestones for each objective. Elaborate how the work will be managed. The management arrangements for execution of the project to be specified. This will be important if the project is multi-location or multi-institutional in nature. Most donors require list of equipment with detailed specifications, time, and schedule for procurement and finally the actual users of the equipment. Give details of training and consultancies needed linking their relevance to the project.

### ***Feasibility***

Show that you have not only sufficient scientific and technical skills but also access to facilities and your institution has requisite infrastructure to carryout the project.

### ***Activities***

**All the activities essential to carry out the project are to be identified through the development of an activity network, which consists of actions and shows:**

- All major activities, and
- The logical relationships between them.

The XYZ statements developed for the example project lead to the activity network shown in Fig.1. Some tips in developing activities are listed below.

Usually a project of 2-3 years duration may be resolved to about 10-15 activities. Large number of activities make the project complicated and therefore unhelpful. If the number of activities is large they may be reduced by abstraction – by specifying levels to each activity so that major activities belong to a particular level of detail. Activity at the lowest level shall be scientist specific.

In the example activity network (Fig.2), it is not necessary to specify develop methods and test methods as separate. 'Test method' is a sub-activity of 'develop method'.

Each of the activities in activity network can be analysed as a subsidiary network at a lower level of analysis. For instance the activity 'survey' can be expanded as show in Fig. 3

Note that the activity network is non-linear with multiple feedback loops. Activities begin with verbs (actions).

For the identified activities, set the sequence, time and resources needed. This can be done only after identifying all the sub-activities for each of the activities. For each resource, human or non-human, specify availability and cost. An example of activity resource sheet for oilseed project is given in Fig. 4.

It is unlikely to identify all the resources at the beginning. Keep provision to meet such contingencies during implementation.

### ***Partners***

For each associate, clearly specify their role, the work division and the financial details. In a multi disciplinary project, develop activities for each discipline or associate so as to bring clarity of work elements and accountability.

Relate the training/consultancy needs to the project work. Specify when and where the training has to be provided and whether it can be provided within the country or outside. Give budgetary details for the same.

### ***Quality concerns***

One of the serious concerns of planners is quality of research output. Various indicators have been identified and formulated to identify professional quality. Some distinctive concepts should be available to convey quality in professional out put, i.e. to convey successful and non-successful applications. This has to be peer judgments. If the project is to run successful, then it is important to identify indicators for monitoring and evaluation.

### ***Monitoring and evaluation***

Sponsor would like to have periodic evaluation reports so as to judge the success of project at various stages and if need be assist in mid term corrections. Logical framework analysis with stress on participatory working (participation of stakeholders and interest groups in planning, monitoring and evaluation) is the most widely promoted and used by ISNAR, USDA and CIDA (Mc Lean, 1988). Log frame method intends to structure a debate about objectives with associated inputs and outputs, and assumptions and risks. Following these experiences, NAARM has developed format for agricultural research projects of ICAR (Katyal et al, 1999).

**Log frame method as a project management tool help the participants arrive at agreement on the method to be used and then generate an agreed view of the way in which the project should be managed. The key assumption and risk serves to acknowledge external disturbances during the course of the project. This provides an awareness of source of turbulence with provision for further monitoring and review.**

### ***Indicators***

Specify quantitative indicators to assess the project progress and achievement. Explain how to assess or measure them. Give indicator to each activity. Provide who and how many will be benefited and try to give quantifiable figures. Some typical indicators are:

- ◆ Productivity
- ◆ Returns
- ◆ Poverty alleviation
- ◆ Food security
- ◆ Gender specific impact
- ◆ Conservation

- ♦ Employment generation
- ♦ Use of indigenous knowledge

For each activity set criteria for performance, i.e. give performance indicators and also measure of performance. This will facilitate monitoring of the progress. The key activities and critical parameters for success of project must figure here. Ultimately this information will be used to judge project progress. A simple modified log-frame sheet for the example project on oilseeds is given in Fig.5

## Section-6: Budget

Give year wise and activity wise budget in detail. Justify costly equipment and other facilities. Try to include reasonable inflation while calculating year-wise budget. Give summary budget. Specify budget for each partner if they come from different places and administrative units. In such case, a summary budget for each partner should be provided separately. The various budgets should match the details given in the work program. Avoid over budgeting, as under utilization will be a negative remark.

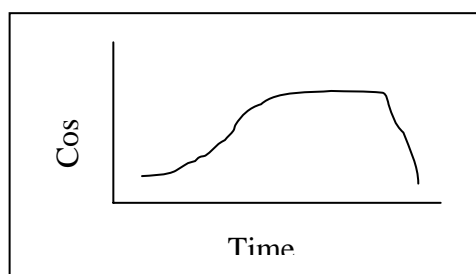
Once all the project activities costs are listed, then split the costs as per the funding agencies format. Most funding agencies need cost details in three heads, viz. establishment (salaries), recurring and non-recurring, to be specified year-wise.

Include bay windows or activities that can be dropped if the sponsor agency gives reduced sanction. Alternatively, if you feel the cost is high, look into sub-activities of each activity and drop the low priority sub-activities and adjust the project cost.

**Fig.6: Budget details of the project**

| S.No. | Head and item details      | Year 1 | Year 2 | Year 3 | Total |
|-------|----------------------------|--------|--------|--------|-------|
| A.    | <b>Establishment</b><br>-- |        |        |        |       |
| B.    | Recurring<br>--            |        |        |        |       |
| C.    | Non-recurring<br>--        |        |        |        |       |
| All   |                            |        |        |        |       |

The fund requirement will be low in the initial phase, rises rapidly during the implementation phase and then falls rapidly at the end. The year-wise splits have to be kept in mind while preparing the budget.



## General Tips

### Logical sequence in writing the proposal

The project proposal is similar to a research paper, but with future perspective. It shall have an abstract, introduction, objectives, methods, expected outcome, time scheduling, and justification for items and budget details. The sequence of various sections



in the project proposal shall be same as described in the project structure. However, the sequence in which each section is to be written need not be the same as in the structure. The logical sequence according to Jugu Abraham (1999), which helps in writing the proposal, is described below.

Write the title and key words first. Following this develop rationale and materials and methods. Develop work program including training details. Provide indicators. Give detailed budget and budget abstract. At this stage write introduction giving background information, urgency and need for the present study. Finally, write the abstract in less than 15 lines.

### ***Style of write-up***

The proposal should be easy to read with short sentences. For every break in the continuity of text, a separate paragraph is to be given. The entire text should be written in future tense. The manuscript should be about 25 typed pages typed with double space and with clear one-inch margin on either side.

### ***Review***

- Check for safe procedures, environmental concerns, and ethical considerations.
- Downplay but do not omit the benefits to your organisation.
- If you have to use “we,” always be unambiguous; clearly identify which scientist or partner will do what.
- Write and sleep on the proposal; then re-read critically. Consult with others; spend time thinking. Listen to comments with patience. Show it to a non-technical person. Try to catch errors, repetitions, and inconsistencies. Get the words right. Edit to shorten and make it clear.

### ***Suggested Reading***

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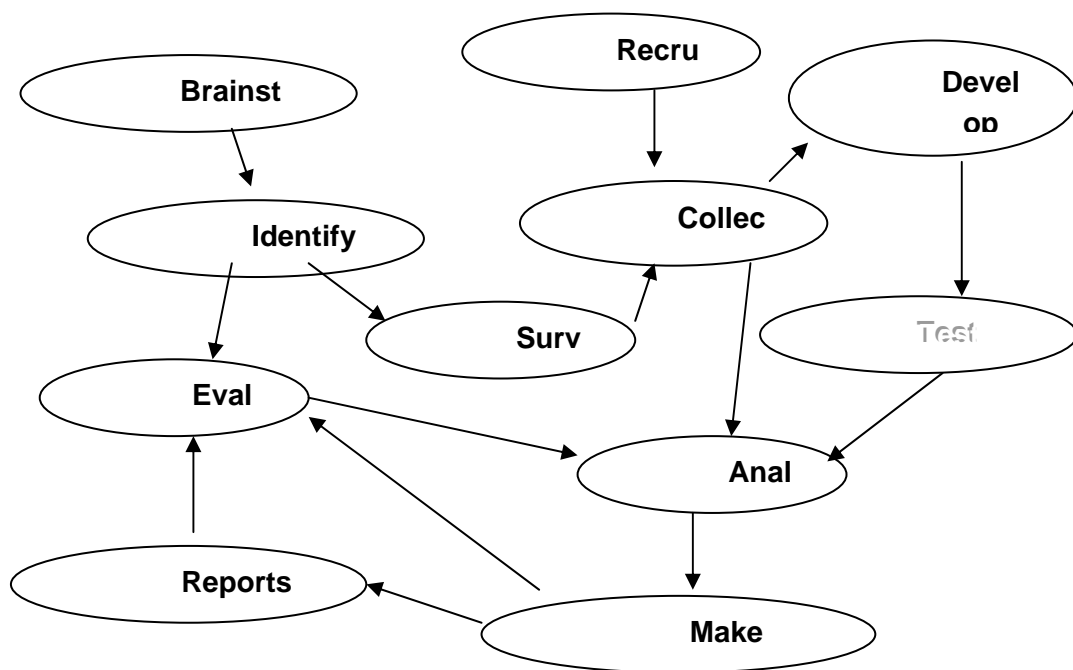
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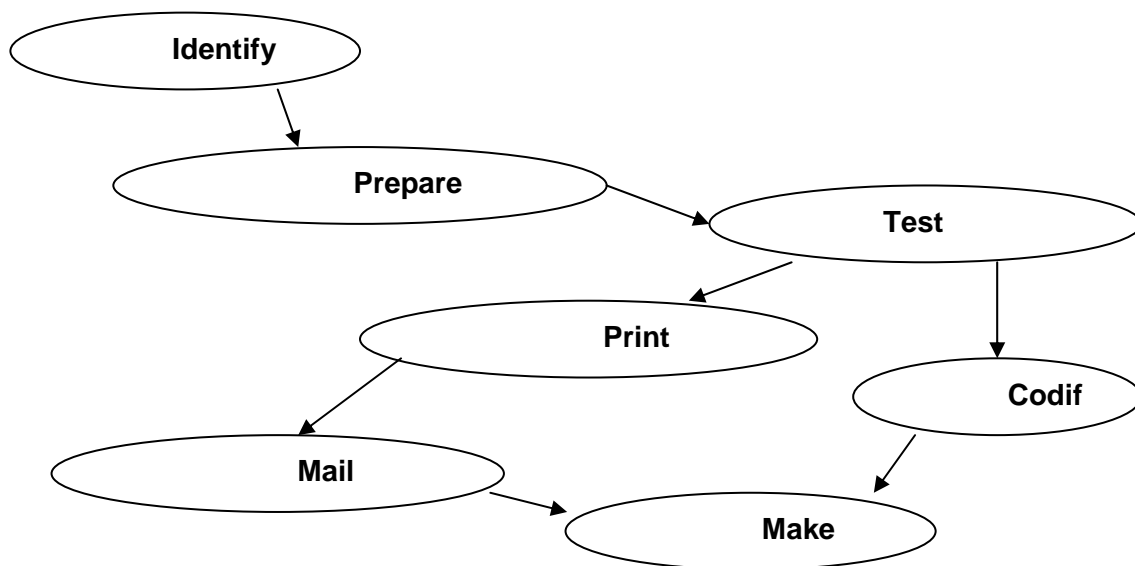
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**Fig. 2: Example activity network for oilseed forecasting project**



**Fig. 3: Example activity network for sub-activity 'Survey' of oilseed project**

**Fig. 4: Activity resource cost sheet for example oilseed project**

| Activity           | Start time       | Duration    | Resource needed                          | Availability | Cost Rs. |
|--------------------|------------------|-------------|--|--------------|----------|
| Staff recruitment  | April 98         | 3 months    | Advertisement Committee                  | No           | 5,00,000 |
| Brainstorming      | Aug 98           | 1 month     | Experts                                  | No           | 50,000   |
| Survey             | July 98          | 12 months   | Printed questionnaires<br>Mailing        | No           | 50,000   |
| Data collection    | July 98          | 6 months    | Data entry operators<br>Field assistants | No<br>No     | 1,80,000 |
| Develop TF methods | Aug 98           | 6 months    | Software<br>TF books                     | No<br>No     | 20,000   |
| Analysis           | Oct 99           | 3 months    | Computer                                 | Yes          | -        |
| Make forecasts     | Jan 2000         | 3 months    | Computer                                 | No           | -        |
| Wetting of reports | Jan 99           | 12 months   | 20 experts                               | No           | 60,000   |
| Evaluation         | Dec 98<br>Dec 99 | 1 week each | Experts                                  | No           | 5,000    |

**Fig. 5: Example log-frame sheet for example oilseed project**

| Activity           | Expected outcome and Performance indicators                  | Measure of performance  |
|--------------------|--|---|
| Staff recruitment  | RA<br>Field Assistants                                       | Release of appointment letter in the first quarter. Acceptance from at least 10 field personnel |
| Brainstorming      | Identification of experts brainstorming                      | Making experts panel<br>Preparation of important issues   |
| Delphic Survey     | Preparation of Delphi panel<br>Preparation of questionnaire  | 150 responses   |
| Data collection    | Data codification and preparation of oilseed database        | Oilseed data from 1970 to 1998 in database  |
| Develop methods    | Test data for different forecasting methods                  | Finalise two methods  |
| Analysis           | Growth rates<br>R&D effort<br>Linking database to GIS        | Growth rates<br>R&D effort index<br>Maps for leading districts & yield                          |
| Make forecasts     | Trend forecast<br>Delphi forecast<br>System dynamic forecast | Comparison of forecasts with past data  |
| Wetting of reports | Wetting of each oilseed forecast report by experts           | Experts feed back for nine oilseeds   |
| Evaluation         | Progress report<br>Peer review of reports                    | Submission of six monthly and annual reports  |

# PRODUCTION SYSTEMS APPROACH

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## Introduction

Improved agricultural technologies, even when considered as technically sound, are of limited value if they are not adopted by the farming community. The traditional technology generation and transfer models, adopted by the research and extension systems, have been found to be inadequate to meet the specific needs of a vast majority of the farmers in the country. New agricultural technologies, developed and transferred by the conventional research and extension efforts, have not been adopted uniformly by the farmers operating under widely varying agro-climatic and socioeconomic environments. When adequate attention is not paid to the basic understanding of the agro-climatic and socioeconomic milieu in which the farmers operate, the technologies evolved by research stations and subsequently transferred are found to be inappropriate to the needs and circumstances of the practising farmers. The potential beneficiaries, particularly those small farmers with limited resources and operating in less favourable natural environment, often do not adopt the new technologies due to various reasons. Some of the major ones are:

- i) lack of awareness about the new technology (illiteracy / ignorance of farmers);
- ii) ineffective extension services;
- iii) non-representation of their agro-climatic and socioeconomic conditions by the research stations where the technologies are developed;
- iv) lack of resources to invest on the required inputs; and
- v) non-availability of inputs on time.

A less frequently heard explanation is that the recommended technologies themselves are simply not appropriate to farmers and their environment.

Farmers generally seek those technologies which increase their income while keeping risks within reasonable bounds under their own circumstances and management practices. The 'Green Revolution' strategy mainly concentrated on the better-off farmers and better-endowed areas with the greatest apparent potential for increased agricultural production. In general, one out of three (far less with dryland agriculture) technologies have been adopted by the farmers. Some of the major reasons for the low adoption of agricultural technologies include:

- i) not matching with the farmers' needs and agro-climatic variables;
- ii) not compatible with the farming system;
- iii) not economically viable
- iv) not operationally feasible; and
- v) not environmentally sustainable.

Agricultural research and development efforts organized traditionally along the disciplinary or commodity lines have lacked a systems perspective. These types of activities are mostly carried out under the conditions that are not representative of farmers' circumstances, with little or no farmer involvement. Inadequacy of the conventional, reductionistic, discipline or commodity-oriented research and extension strategies to solve the problems of small resource – poor farmers operating in complex, diverse and risk-prone environments has led to the development of a more holistic, systemic and interdisciplinary strategy known as production systems approach. The crux of this approach is to develop

and transfer appropriate technologies based upon a clear understanding of various agricultural production patterns under differing agro-ecoregions, with a systems orientation.

## Concepts and Procedures

The production system, as a concept, takes into account different production components such as crops, trees and livestock, and various factors of production such as soil, water, labour, capital, energy and other resources, and the interaction among themselves as well as with the physical, biological and socioeconomic factors. In its broadest sense, the approach views the entire production in a holistic manner and considers interactions in the system. This approach is most appropriately carried out by interdisciplinary teams of researchers who, in association with extensionists, continually interact with the farmers in the identification of problems and in devising ways of solving them. It basically aims at generating and transferring technologies to improve the productivity of various production systems on a sustainable basis.

### 1. Essential Features:

The production systems approach has certain distinctive core characters. These include:

- ***It is holistic:*** The whole production pattern is viewed as a system encompassing interacting subsystems, and no potential enterprise is considered in isolation.
- ***It acknowledges location-specificity of technological solutions:*** Recognizing the location-specific nature of agricultural production problems, it emphasizes on testing and adaptation of technological solutions based on agro-climatic and socio-economic specificities.
- ***It is farmer participatory:*** Farmer participation is ensured at different stages of technology generation and transfer processes such as a system description, problem diagnosis, design and implementation of on-farm trials, and providing feedback through monitoring and evaluation.
- ***It is concerned with 'bottom up' strategy:*** It begins with an understanding of the existing production systems and the identification of key production constraints.
- ***It is interdisciplinary:*** It lays greater emphasis on interdisciplinary cooperation among the scientists from different areas of specialization to solve the production problems that are of concern to farmers.
- ***It emphasizes extensive on-farm activities:*** It involves problem analysis through diagnostic surveys, on-farm testing of developed technologies and providing feedback through evaluation to influence the research agenda of the research stations. It also provides a structural framework for the farmers to express their preferences and apply their evaluation criteria for selecting technologies suiting to their needs and circumstances.
- ***It is dynamic:*** It involves recurrent analysis of the production systems, permitting continuous learning and adaptations.

- ***It recognizes interdependencies among multiple clients:*** The generation, dissemination and adoption of relevant technologies require effective linkages among the policy makers, researchers, developmental agencies and farmers.
- ***It gives weightage to ITK system:*** The indigenous technical knowledge (ITK), which is time-tested at the farmer's level for sustainability through a dynamic process of integrating new innovations into the system as they arise, has to be properly understood by the researchers and utilized in their research activities.
- ***It focuses on actual adoption:*** It is to be judged by the extent to which it influences the production of socially desirable technologies that diffuse quickly amongst specified groups of farmers practising similar production systems.
- \* ***It focuses on sustainability:*** It seeks to harness the strengths of existing production practices, and to ensure that the productivity gains are environmentally acceptable. Towards preserving the natural resource base and strengthening the agricultural production base, it attempts to develop technologies that are environment friendly and economically viable.

## 2. Activities:

The approach requires that researchers should begin the technology generation by learning about the production systems in a wide variety of agro-climatic and socioeconomic contexts. On the basis of this learning, research activities are to be designed, implemented and evaluated by the researchers in association with the developmental agencies and farmers. The process of production systems approach involves a set of interrelated activities, as under:

- ***Target and research area selection:*** Keeping in view the location-specific nature of agriculture, it is important first to broadly categorize different agro-ecoregions based on certain factors influencing agricultural productivity. Under each of these regions, specific production systems need to be identified to serve as the target for future activities.
- ***Problem identification and development of a research base:*** Once the target area is selected and stratified into different production systems, the interdisciplinary team of researchers would then undertake detailed and critical studies of agro-ecological and socioeconomic features. The participatory rural appraisal (PRA) may serve as an important tool for this purpose. Information about the farmers and their environment can be gathered through surveys, review of secondary data, and direct interaction with the farmers, extensionists and key informants. The researchers then analyse and study the opportunities and constraints, and prioritize the needs in consultation with the farmers. Direct communication of the researchers with the farmers increase their understanding of the farmers' needs and environment, and enables the researchers to identify technological alternatives more consistent with the environment.
- ***Planning research:*** Once the problems are identified and prioritized, the next logical step would be to undertake research at the research station and develop potential solutions for solving them. These solutions should then be tested in farmer's field through on-farm testing and fine-tuned to suit different situations.

Critical analysis of the results from the on-farm activities, in terms of biological performance, socio-cultural acceptability and resource requirements, would result in relevant feedback for the researchers.

- **Extension of results:** The identified viable technological alternatives need to be extended to other areas with similar agro-climatic and socioeconomic conditions for wider adoption, through multi-locational testing.

Though the above described steps imply a sequencing of activities, there may be overlapping or even repetition. Though flexibility in the approach is possible, omission of any one of these activities may jeopardize the value of the final results.

## **Production Systems Approach Under NATP**

Indian agriculture has made great strides in agricultural production and productivity through massive application of science and technology. The green revolution technologies have brought it to the fore the new issues of 'production – protection' of natural resources for sustainable development of agriculture. In order to address issues of location-specific research, through the development of more knowledge-based technologies, better information and research management systems, the ICAR has delineated the country into 20 agro-ecoregions (AER) and 60 agro-ecosubregions (AESR) using the criteria of soils, physiography, bio-climate and length of growing period. With a view to capturing the importance of socioeconomic endowments, market support and service sector in agricultural development, the ICAR has focused research programmes under NATP on the production systems approach but goes beyond it by integrating all the system components for determining the system productivity and profitability.

Under NATP, the country has been divided into five agro-ecosystems. On the basis of potentials and constraints, a number of production systems have been identified in each agro-ecosystem. Each production system is proposed to be improved, in terms of agricultural productivity, profitability and sustainability, through specific research programmes to achieve specific national goals and objectives.

### **1. Arid Agro-ecosystem**

Occupying nearly 19 per cent of the area, the hot and cold arid ecoregion experiences a variety of agricultural production problems like low and erratic rainfall, thirsty and hungry soil, land degradation, brackish water, erosion, salinity, waterlogging and insufficient fodder. Following are the two production systems identified in this agro-ecosystem:

- Agri-silvi-horti-pastoral production system
- Livestock and brackish water fish production system

### **2. Coastal Agro-ecosystem**

With an estimated 1.2 million ha of brackish water area and 8129 km long coast line, the coastal agro-ecosystem forms a very valuable resource community, supporting the livelihood security of several million rural poor and also contributing to the national economy in a large measure. Anthropogenic pressure and unfavourable environmental changes causing cyclones, etc. are the major problems faced in this agro-ecosystem. The two production systems commonly found are:



- Fish and livestock production system
- Agri-horti production system

### **3. Hill and Mountainous Agro-ecosystem**

Covering the North Western and North Eastern Himalayan regions, this agro-ecosystem faces production problems such as climatic variations, sloping land, small holdings and absence of irrigation which make hill farming uncertain and unsustainable with productivity at a subsistence level. Mountain agriculture is characterized by complex farming systems encompassing agriculture, animal husbandry, horticulture, fisheries, and agro and social forestry. There are two major production systems, as indicated below:

- Agri - horti - production system
- Livestock and fish production system

### **4. Irrigated Agro-ecosystem**

While continuing to play a crucial role in fulfilling the country's demand for foodgrains, this potential agro-ecosystem faces production problems such as salinity, waterlogging, ground water contamination, insect and weed resistance to chemicals, high levels of chemical residues in food, and yield stagnation of potential crops such as rice and wheat. The four major production systems focused in this agro-ecosystem include:

- Rice-wheat production system
- Cotton-based production system
- Sugarcane – based production system
- Livestock – based production system

### **5. Rainfed Agro-ecosystem**

Occupying about 63 per cent of the total cropped area, this agro-ecosystem is characterized by low productivity and stability. Low and erratic rainfall, degraded and low fertility soil, and harsh temperature regimes are the key features of this agro-ecosystem which is inhabited by resource-poor farmers with low risk-taking ability. Five production systems have been identified in this agro-ecosystem. They are:

- Rainfed rice production system
- Pulse-based production system
- Oilseed-based production system
- Cotton-based production system
- Coarse cereal-based production system

### **Themes under Production Systems**

Research in production system is grouped around eight prominent thematic areas, as indicated below:

- Natural resource management (NRM)
- Integrated pest management (IPM)
- Integrated plant nutrient management (IPNM)
- Water management (WM)
- Biodiversity (BD)
- Biotechnology (BT)
- Post-harvest technology and value addition (PHT & VA)
- Socio-economics and policy (SE & P)

## **Conclusions**

The country is blessed with a vast, agriculturally important natural resource base. To effectively cope with greater diversity of the agro-ecological settings and socio-economic conditions, there is an imperative need for a decentralized approach to the process of technology generation, assessment, transfer and dissemination in production system mode in ecoregional framework. Inadequacy of the conventional, discipline-oriented and commodity specific technology generation and dissemination models to increase agricultural production without causing damage to the agricultural production base has led to a significant shift towards production systems approach. The new approach has greater potential to realize increased productivity and profitability on a sustainable basis.

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# PROJECT BUDGETING

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One of the basic tasks of administration is to facilitate availability of funds and resources for research activities that are consistent with the goals of the research organization. Financial management is one of the strongest tools of research managers for directing, monitoring, and measuring the activities of researchers. Even though the managers may operate under strict financial constraints such as "5 per cent increase over last year's budget and no more", research managers can accomplish a lot with careful financial management.

Financial management, whether in personal life, in business, or in agricultural research, is always critically important. In times of budget constraints, these importance increases and can have immediate and severe programme implications. The financial management must start in the first stages of planning, and then continue through atleast five stages, viz., budgeting, implementing, reporting, evaluating, and auditing, no matter how long the project or programme lasts.

## **Budget**

Essentially, budget is a means of assigning cash values to a sequence of planned future activities. Budgeting is the process that translates organizational intentions into specific tasks, and identifies the resources needed to carry them out. Thus, a budget serves as a forecast, a guide, as well as a plan.

It is often thought that accounting and budgeting are the same; but they are not. Accounting is primarily the documentation of accountability and secondarily a data system for management, whereas budgeting is related to planning and management. In budgeting, it is also important to determine the "enterprise unit" - whether it is the research organization as a whole, the department, the individual project, etc., because a budget communicating to one but built around another loses considerable effectiveness. Again, it is to be kept in mind that the beginning budget is only an outline of the year's pattern of expenditure.

## **Reasons for budgeting**

Budgeting essentially establishes specific financial and operational boundaries for monitoring purposes.

**a) Communication:** Budgeting enforces communication at two levels. At the vertical level, it enforces the first line managers to justify the resources they need to achieve their goals. They will have to explain how the tasks will be performed, and what will be the scope and volume of their activities. Thus, budgeting provides effective communication between superiors and subordinates, and helps affirm their mutual commitment to the organization's goal. At the horizontal level, communication between organizational units, i.e. receivers and providers of services is also enforced.

**b) Co-ordination:** Manifold tasks are performed by the organizational units, and to achieve the desired goals these must be synchronised. Co-ordination implies striking a proper balance between labour, material, and other resources so that the goals are attained at a minimum cost.

**c) Decision-making:** Many questions arise in decision-making process at the time of budgeting. For example, the most effective way of performing the same task, justification of activities, and the resources needed to do the job.

**d) Performance and evaluation:** Budgeting is the most important instrument in the evaluation of manager's/organization's performance. In the light of fixed budget, they can be evaluated from two angles - as planners or as decision-makers. Obviously, those who exceed or underspend their budget are not necessarily bad or good managers. Nevertheless, budgeting establishes the targets that help gauge managerial performance, something that cannot be done by intuition and personal judgement alone.

### **Functions of budgeting in research organization**

Budgeting is a planning process and the budget is the basic communication and co-ordination device of that process, whether between levels of research organization or between the administration and research managers of the organization. It is the end product of the interaction of all the complicated factors that go into planning. It reflects the sum balance between perceived requirements of research resources as determined by scientists, project goals as set forth by the mandate of the institute and the urgency of research, and both existing and availability of limited funds. The end budget, in essence, represents a contract for a period of time between funding sources and organizational administration or between administration and research managers, who agree that in order to achieve certain objectives a specific set of resources are to be provided. Whatever be the level of management that is being considered, this contractual relationship and its understanding is imperative, because it provides both the basic method of motivating change and of evaluating the results.

### **Budgeting methods**

The different types of budgeting that are in use are:

**1. Top-down budgeting:** This involves collecting the judgements and experiences of top and middle managers, and past data that are available concerning similar activities. These managers estimate overall project cost as well as the cost of major sub-projects that comprise it. These estimates are then given to the lower-level managers, who then break down the budget estimates for the specific work packages that comprise the sub-projects. This process continues till the lowest level.

**2. Bottom-up budgeting:** In this method, elemental tasks, their schedules, and their individual budget are constructed through the work breakdown structure. The people concerned with the project are consulted regarding the time and the budget for the various tasks to ensure the best level of accuracy. Initially, estimates are made in terms of resources such as man-weeks and materials, which are later converted in terms of money.

**3. Budget request process:** This is a sensible mixture of top-down and bottom-up budgeting methods. The budget process begins with an invitation from top management asking each division to submit a budget request for the coming year. The division head, in turn, passes the invitation down the organizational ladder. This process repeats at different levels, each of which presumably collects from below, aggregates them, and passes the result back up the organizational ladder.

**4. Activity versus task- oriented budget:** Under traditional budgeting methods, the budget for a project could be split up among different organizational units which, in effect, diffused the

exercise of control. It was rather impossible to determine the actual size of major expenditure categories in a project's budget. In the light of this problem, ways were sought to alter the budgeting process so that budget could be associated directly with the projects that used them. This gave rise to programme budgeting. Programme budgeting refers to a budgeting system that aggregates income and expenditure across projects / programmes. Aggregation by project / programme is in addition to aggregation by organizational unit. Each project has its own budget and in case of pure project organizations, the budget of all projects are aggregated to the highest organizational level. Two forms of programme budgeting that have received importance are Planning - Programming - Budgeting System (PPBS), and Zero Base Budgeting (ZBB).

a) Planning - Programming - Budgeting System: This is basically a programme budgeting and planning system oriented to identifying, planning, and controlling projects that will maximize achievement of the organization's long-run goals. The system focuses on funding those projects that will bring the greatest progress towards organizational goal for the least cost.

b) Zero Base Budgeting: In ZBB, the fundamental desirability of every programme / project is reviewed and justified every year before it received any funding. The objective is to reduce the wastage by culling out projects which have outlived their utility, and are continued simply because of the inertia of policy makers. The ZBB procedure describes each project / programme, evaluates each one, and ranks them in terms of cost / benefit or some other appropriate measure. Funds are then allocated in accordance with this ranking. ZBB procedure challenges the existence of every project, and a project that does not justify a continued funding is sentenced to administrative death. This compels the project leaders to think critically to put forth justifications when defending the existence of their projects.

### **Implications of alternative budgeting methods**

There are many variations as to how the research organizations approach the process of budgeting. These variations can be classified in three ways:

a) Passive versus active involvement: Research tends to evolve over time rather than change in discrete steps. Research administration also may approach the budgeting process in the same way, by assuming last year's budget allocation as a base and change it incrementally according to research resource requests or funds availability. Alternatively, administration may establish a formal budgeting process in which research objectives and resource requirements are carefully analysed, and budget determined according to some criteria.

b) Level of budget unit: Budget may vary according to the point of control and / or responsibility associated with the allocation and expenditure of funds. These may be at the institute level, or at the division level, or at the individual project level.

c) Content of budget: Budget may vary by the extent to which the total resources required to conduct research are considered; whether the research resources are individually allocated to programmes, or to departments, or to projects, or collectively allocated as a pool of research support. The particular approach to the budgeting process reflects the administration's ability to influence control over research programmes.

### **The budgeting process**

The research budget for the organization or research unit may in some cases be static, i.e. determined at the start of the fiscal year and remain unchanged over the year. However, the

more common case is that the budget is dynamic, reflecting the changes as might be brought out by the modifications in the direction of the research processes, and also the changes in the overall research plans as governed by the funding variation. Two aspects of the budgeting process must, therefore, be considered; the initial allocation at the beginning of the year, and the continuous readjustments over the year.

The present system of budgeting and control of expenditure is based on the traditional approach, taking the Institute as one unit, and is further based on taking the approved heads of account. For example, in the preparation of mid-year estimates of likely expenditure or the budget estimates for the coming year, the expenditure figures for a given period of time, under the approved heads of account, are merely extrapolated providing, at the most, for certain degree of inflation. This system does not enable the managers i) to know the inputs required for particular research schemes, and ii) to properly allocate funds leading to optimal utilization of resources. It is, therefore, imperative that a system of project budgeting is necessary, which will take the existing system as given, and then propose a model that will dovetail into the existing one.

### **Project budgeting - Concepts**

Project budgeting can be defined as a process that systematically relates the expenditure of funds to the accomplishment of planned objectives of a research project. Planning is not the only function of the budget system; management of ongoing activities, and control of spending are also implicit in the definition.

Once the broad objectives of a research organization have been identified and a decision has been made on priorities covering the various research project proposals, it is necessary 1) to ensure that the research work proceeds according to the plan 2) to closely watch and monitor the outcome of various research efforts 3) to critically review the research project wherever the outcome of research efforts are not in line with what was expected, or where certain new factors are encountered which were not expected when the research project was proposed, and decide on one of the following alternatives: a) discontinue the project because the expected benefits would not be commensurate with the resources required by the project b) increase the resources allocated to the project because it is still considered important or c) modify the scope of the research project with regard to the resources allocated.

Planning and control are two inseparable functions. On one hand, without planning there is no basis for control; and on the other, without a proper control effort planning becomes incomplete. The extent and thoroughness of planning influence the success to a great extent, or viceversa of the control effort. Similarly, a proper and effective feedback, and monitoring system are essential for the planning function to be really useful.

To facilitate the planning and control efforts, the financial management function should provide procedural and systems support in a research organization. An effective financial planning and control system should necessarily consist of the following essential components.

- i) Project-wise cost estimates as part of the research project proposal, and where possible, an evaluation of the benefits resulting therefrom.
- ii) A system of project-wise accounting, which will show separately the expenses incurred on each research project.
- iii) A system of reporting which will ensure that relevant information is made available, on time, to different levels of management at the institution.

Individual research project proposals are usually the basis for describing, communicating, and guiding research activities. The project proposal should be as detailed as possible, and contain the following information.

- a) The nature and importance of the problem in relation to the major objectives of the organization;
- b) A detailed description of the work proposed to be done, the time required to complete it, and the anticipated outcome;
- c) The benefits arising from the work, the probability of success, the extent of uncertainty involved;
- d) The proposal should have details on:
  - i) Research personnel (in terms of their time spent on the project in man-months or in any other convenient unit) - expenses broken down into salaries, fringe benefits, etc., and specifying the number of employees in each category. The salary of the participating personnel is apportioned to the project in accordance with the time spent by them on the project.
  - ii) materials, stores, and other consumable items required for the project during the year;
  - iii) equipment and facilities required - All research organization have certain common service facilities organized on a departmental basis, such as analytical laboratory, mechanical workshop, technical testing facilities, etc. The budget estimates for equipment and facilities should, therefore, be prepared in three parts: 1) specific items of equipment or instruments to be purchased for particular research projects. 2) planned additions to the common technical and service facilities. 3) the extent to which the common technical and service facilities will be required; the cost of common facilities is not to be included in the project.
  - iv) non-technical personnel, and
  - v) detailed cost estimates for the project, broken down into various items for each year till the date of its expected completion.

In addition to the detailed cost estimate for the coming year, a project-wise description of the work to be undertaken and the outcome / results expected should also form a part of the budget. Some measure of the physical progress of the work of each project is very much needed. The form in which this is to be brought out depends upon the nature of the work undertaken, and the results expected; in most cases, it should be possible to broadly describe as to what is expected to be accomplished. This is an essential part of the annual budget if it is to serve as a useful aid to monitor the work, not only in financial terms but also in physical terms.

### **Assessment of inputs and outputs**

In addition to budgeting the finance, the term project budgeting also includes scheduling of time and resources. A project, well scheduled for time and resources (men and material), with a proper projection on cost estimates will suffer lesser chances of rejection at the hands of research managers. When the project is prepared with thoroughness and in sufficient detail, the tasks involved in preparing the annual budget also become much simpler.

Once the proper statement of the objectives and a detailed articulation of the research are worked out, various outputs and inputs of a research project can be identified. Inputs include manpower, equipment, and other resources such as materials and animals. Output will include the end product of research, like new knowledge, a new technique, a new process, a

new technology, etc. In addition to the existing facilities and infrastructure in the Institute, for some projects, it may be necessary to purchase new equipment or mobilize and integrate manpower and other resources like land, animals, etc. Cost of such inputs will have to be included in the information provided at the initial stages of the research project proposal. A system has to be evolved for taking into account the cost of equipment depending upon the extent of their utilization.

Salaries of not only the scientists involved in the project but also the cost of others associated with the project will also have to be included. This can be done only when details are worked out as to the extent to which existing facilities are to be utilized by a given project. Also, the percentage of time, out of his / her total available time, spent by each scientist on a project will have to be identified and costed for relevant cost estimates. Percentage involvement in the project, as identified in the research proposals, gives an idea as to the amount of contribution a scientist is making to a particular project. It is essential that a scientist knows exactly what his total responsibilities are in various projects, and in other general matters such as administration, teaching and training, extension related activities, and others, and also how much time he proposes to spend on each of these activities. Only then the scientist can decide as to **what percentage of his / her time** will be spent on a new research project. This avoids the name of a scientist being counted full-time for more than one project and his salary being calculated as many times. Instances have also been found wherein the estimated cost of all the research projects in a given year put together exceeded the budget allocations of the Institute for that year. Such a procedure will have to be followed not only for the scientists, but also for the technical staff, research assistants, etc.

The scientific personnel cost are allocated to any given project in proportion to the time spent by them in that project. The time allocation can be conveniently recorded as the percentage of a work year. Assuming that one year has 50 work weeks, each work week spent by any research personnel in the given project amounts to approximately two percent. By estimating the time spent by different personnel in the execution of a project, the total gross salary of various personnel can be apportioned to the project in proportion to the time spent by them.

A research programme that has no definite time table would be of no relevance for planning or for monitoring. Time is important for planning budgets, for co-ordinating with other research activities, and for maintaining a sense of urgency so that the benefits are delivered in the allotted time. Research projects have a tendency to go on for ever; timing and monitoring are required to discipline the research process. Though a project is time-bound, the column on "date of completion" is left blank. Even where it is given, the date seems to be purely intuitive. This is a natural consequence of having broad objectives for a project whose end-product cannot be identified. A proper estimate of time can be made only after the details of work required in the project, and some assessment of the time required to procure the materials, manpower, etc. are worked out.

It is often claimed that it is difficult to convert the output of a research project into any quantifiable measure. The problem is more apparent and complicated in basic research, which yields information mainly in the form of new ideas, concepts, and models, the benefits from which are usually not specific enough to be appropriated by the researcher or the funding agency. Examples include biological nitrogen fixation research, general agro-meteorology studies, genetic manipulation, physiology of nutrient absorption, biology of pests, etc. Applied research, on the other hand, yields results that are specific enough to be appropriated by the researcher or the funding agency. However, for most of the projects, it is possible to assess the benefits that a successful completion of the project would yield.



A research result may also increase the image of the laboratory or develop some scientific expertise in a particular area. There is a method by which various benefits that can accrue out of a research project are identified, and relative importance given to each benefit. In one of the CSIR laboratories, the following benefits were identified, and corresponding weightages were given by the laboratory:

| <b>Weightage</b> | <b>Benefit</b>                      |
|------------------|-------------------------------------|
| 0.70             | Benefit - cost ratio                |
| 0.08             | Employment generation               |
| 0.05             | Prestige value                      |
| 0.05             | Competence building                 |
| 0.04             | Inequality reduction                |
| 0.04             | Strategic importance                |
| 0.02             | Morale raising: publication / Ph.D. |
| 0.02             | Unexpected spin-off benefits        |

A similar exercise can be done for the research projects of the ICAR and State Agricultural Universities (SAU) system also.

Though it may not be possible to do a detailed cost-benefit analysis for each and every project, it is nevertheless useful to have an idea of the total cost and benefits, including those at the utilization stage. This information is essential for any meaningful project selection and allocation of an Institute's resources to various projects.

### **Project-wise accounting and control**

There are three distinct levels in a research organization, for each of which the type of information needed is different. They are, project leader, department/division head, and the top management. The project leader should prepare a detailed cost breakdown on the project in comparison to budgeted amount, and the total cost split into direct cost which would not be incurred but for the project. The divisional head should indicate the cost separately for each of the projects under the charge of the division, and in total for the division. Thus, for the planning and control function of a research organization to be meaningful and effective, the reporting system at the lower levels should be such that it encourages careful study and keen interest in project expenses and progress. The project leaders should have with them the cost information on their projects; they should be aware of the reasons for variations in the cost or progress, and be able to explain to the management. Similarly, the divisional heads should have an intimate knowledge of each and every project under their charge, which in turn, will help them in apprising the top management on the position of the projects.

In order to facilitate a proper budgeting and accounting system to be operative, a proper stores accounting system and method of pricing the materials and stores issued constitute an essential part. Separate accounts should be maintained for each of the research projects. When common facilities and technical services are used by various projects, a proper and systematic method is necessary to work out the cost of such services to be charged against the projects using them. The common facility may be the use of a major equipment such as an electron microscope, or service rendered by the analytical testing laboratory or a workshop. The departments which are called upon to provide such services should be identified and their expenses counted separately, and charged to projects on the basis of the services rendered.

A proper system of review is essential in order to monitor the progress of the projects, not only in terms of physical progress but also in financial terms so that effective control measures can be taken at the appropriate time. It is, therefore, essential that proper information is made available periodically on the progress of work done on each project, the outcome of research in each project in relation to what was expected, and also the total expenses incurred on the project in comparison to what was provided for. A system of periodical review and control enables rational decisions to be made for the effective utilization of time and resources. The frequency of the review system depends upon the specific features and needs of the research Institution.

### **Advantages of project budgeting**

1. Involves persons at all levels in planning and control functions.
2. Forces the proposer of any research project to think in greater detail about the work instead of leaving it vague and ambiguous.
3. Facilitates delegation of power to personnel at lower levels enabling them to take decision on day-to-day affairs without involving the top management.
4. Facilitates enquiry and investigation at lower levels prior to discussion of project cost and progress at the top management level.
5. Guides the management to make a critical appraisal of the projects, in a systematic manner.
6. Helps to track the acquisition of funds for, and the allocation of resources among various areas of research.

### **Difficulties in project budgeting**

There are practical difficulties in preparing detailed cost estimates for each research project, and in evaluating the expected benefits. They are:

1. It may not be possible to accurately estimate the resources required for a particular work because the full programme of work to be done cannot be decided in advance. The direction of research work may have to be modified from time to time depending upon the course of success.
2. Even where the outcome of the research effort can be predicted, it would be extremely difficult to evaluate the benefits arising therefrom because of the many uncertainties inherent in the extent of their application.
3. Pure or basic research projects do not lend themselves to any meaningful cost-benefit assessment.
4. Many of the basic information required for the system has to be furnished by the scientists, who consider this exercise as a waste of time.
5. The benefits arising out of project budgeting and accounting system are not fully appreciated by the research and scientific personnel.
6. Allocation of time to projects and costing of man hours are not properly resorted to, and are considered as difficult.
7. There are too many indivisibilities like infrastructure expenditure, inter-disciplinary research, etc., which do pose a problem in a systematic project-wise budgeting and accounting.

### **Prerequisites for effective budgeting and budgetary control**

The improvement of the financial management of agricultural research is a critical and common goal, which can be achieved by focusing on several basic guidelines and prerequisites.

1. Clear budgeting guidelines and directives from the top management.
2. Availability of good database in respect of past performance.
3. Adequate underlying systems to capture relevant data and to compile them timely.
4. An organization structure with clear definitions of authority and responsibility levels.
5. Demonstration of commitment to the budget by every scientist and at every level in the organization.
6. Monitoring and evaluation of all programmes at all stages.
7. Training to all levels of staff.

As Blanchard and Johnson (1983) had put it:- “Most companies and organizations spend 50 to 70 per cent of their money on people's salaries; and yet they spend less than 1 per cent of their budget to train people”. In fact, more time and money are spent on maintaining the buildings and equipment than on maintaining and developing people.

This only points out the importance of training, which is critical, and rather an urgent requirement.

### **Cost classification and their impact in budgeting**

Cost is a measurement, in monetary terms, of the amount of resources used for a purpose. The various elements which constitute the cost include physical quantities of material, hours of labour, and quantities of other services. The use of these resources is first reckoned in physical terms and measured according to their respective yardsticks. Then, by using the medium of relevant price, rate, salary or wage, the resources consumed are converted into monetary expressions. When the use of these resources is related to a specific purpose, their monetary expression is called cost, such as cost of running a research organization, or cost of executing a research project.

The techniques and process of costing serve a variety of purposes. Costing enables the management to ascertain the cost of a project, programme, etc. This facilitates exercise of necessary control to keep cost pegged to an efficient and economic operation. Control over cost can be effective, only if it is known beforehand as to how much should be spent; in other words, when a proper budgeting has been resorted to.

There are a number of ways in which cost can be classified. Only three classifications are mentioned here because of their relevance to research organizations.

**i) Cost based on type of expenditure:** Salary, non-salary, and equipment fall under this category. Salary includes that of scientists, technicians, and farm labour or temporary staff, which are to be accounted for in the project budget. Non-salary refers to materials or consumables, travel, and others which are needed for the execution of projects. Equipment cost refer to the cost of those equipment which are exclusively to be purchased for projects.

**ii) Cost based on identifiability:** Two types of cost fall under this category, viz. direct and indirect. Direct cost are those which are directly identifiable to a project, whereas indirect cost are those which are allocated to a project by administrative services. The direct cost can be assessed and incorporated in the research project proposal. In addition to this, each project makes use of already existing infrastructural and other related facilities and, therefore, it is necessary to evolve a system by which such inputs may also be costed and included in the total cost of the project.

**iii) Cost based on behaviour:** Fixed cost and variable cost come under this category. Broadly, cost which vary with a change in quantum of output or level of activity are variable cost, and those which change with the passage of time are called fixed cost. Generally, material, travel, and labour cost would vary as the volume of activity changes, but administrative salaries, for example, would vary with the passage of time.

A knowledge of cost classification and its behaviour is important to have a proper approach for budgeting, and also to have an exercise of financial control for the efficient use of resources.

### **Issues and suggestions**

1. A high proportion of the annual allocation of funds for scientific research in India goes for meeting the salaries of scientists (Swaminathan, M.S. 1988. The Hindu, December 22, p.3). It has been pointed out that IRRI spends 50 to 55 per cent of its budget on salaries, and in some national research programmes very high per cent of the budget is spent on salaries. It becomes, therefore, imperative that research programmes which receive comparatively little fund, need to be properly budgeted for efficient utilization of available resources, and also to avoid wastage. When the discretionary element of the budget is small, it has to be husbanded carefully and used as imaginatively as possible.

2. Refereeing of a project proposal is an extensive task, which will include both technical and scientific refereeing as well as organization-cum-economic assessment of the proposal. At present, the practice has been to discuss and approve the research proposals with or without modifications in the Staff Research Council (SRC) meetings. Each project proposal requires a lot of time, attention, and expertise before it is approved. It may not be possible for the SRC to do this task. Unless the project is reviewed in its entirety, both from technical and financial view points, there is every possibility of the project suffering from want of funds at a later date. A project has to be assessed in terms of the following points:

- i) technical viability of the proposal
- ii) scientific validity of the approach to the problem
- iii) whether required facilities are available or can be made available
- iv) whether the objectives of the project fit into the objectives of the organization
- v) what priority should the project get within the Institution, and
- vi) whether cost and benefits, and other input/output analysis have been properly undertaken

In order to conduct the refereeing more meaningfully, following alternatives may be considered:

- i) SRC could meet more frequently;
- ii) A project advisory committee consisting of the senior-most scientist in each discipline within the Institute may be formed, which could assess the project proposals in greater detail with the help of technical cell, and some external experts;
- iii) As far as possible, SRC can be conducted in August so that the project budget proposed can be taken into account while proposing the budget estimate for the next year during September. This is possible only when the proposed time matches with the nature of the crop or commodity or animal species researched by the Institute, and the associated work related to sampling, harvest, compilation of data, etc.

3. As indicated earlier, proper stores accounting system is necessary to ensure a project-wise budgeting and accounting. Most of the research Institutions maintain a stock register for all the stores, materials, and equipment purchased by it and in use. The stock register is only a quantitative record of receipt and issue of stores, materials, and equipment. No distinction is made between consumable items, and durable instruments and equipment. As and when they are bought and paid for, the expenses are booked; the stores records sometimes do not show their cost. Before instituting a system of project-wise accounting, it is necessary to introduce a proper system of stores accounting.

4. In the present system, there is only an expenditure control on the activities of the research organizations without any reference to the outcome of work. This may be essential for bureaucratic purposes but hardly serves as an aid to financial management. In order to ensure that each rupee spent in an Institute results in the maximum benefit in relation to the overall Institute objectives, a much more comprehensive financial management and accounting would be needed.

5. In order to implement changes in the present system and to facilitate a proper project-wise budgeting and accounting, it is necessary to change the role of the accounts officers from a pure expenditure control and voucher documentation officer to one actively participating in financial planning and accounting. This essentially calls for strengthening the accounts wing of the Institutes with adequate manpower.

## **Conclusion**

The benefits that will accrue from a project budgeting system will be worth the efforts needed to introduce the system, provided the importance of the system and the way it functions are understood and accepted by the scientific community in the Institutes. It is easy to reject a system on the ground that it only creates additional work. Though implementing a complex system in a meaningful and useful way is rather difficult, the benefits that will flow out of such a system should serve as a motivating factor in enforcing as well as in accepting the change.

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# RESEARCH PROJECT MONITORING AND EVALUATION

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## **A framework for monitoring in agricultural research**

### **Introduction**

- ❖ Monitoring is a continuous process involving observation, supervision, revision and the documentation of Agricultural Research Activities **in relation to** needs, objectives, expected results and the resources allocated for its execution.
- ❖ Formal or informal instruments can be used for monitoring.
- ❖ A good monitoring system is essential for the efficient management of Agricultural Research.
- ❖ Monitoring activities are common among Agricultural Research Organizations.
- ❖ Frequently, these take a great deal of time from both Scientists and Managers.
- ❖ But, in most cases monitoring is not conducted in an organized and systematic way.
- ❖ Improvements in the monitoring losses can significantly increase its support for decision making as regards ongoing work, periodical evaluations, planning future research and for motivating and guiding scientists.
- ❖ Application of good concepts and guidelines can increase the efficiency of monitoring results.
- ❖ The main criteria should be the usefulness of the information collected, generated and processessed in terms of its effective support in decision making, in documenting research and in motivating and guiding researchers.
- ❖ PM & E methods and mechanisms must be seen within the contest of the regions Agricultural Sector, based on the patterns and tendencies of regional technological development and on institutional policies.

### **Characteristics of Monitoring in Agricultural Research**

#### *Under rated function of monitoring:*

- ❖ While planning and evaluation were associated with conceptual models, monitoring has not.
- ❖ This function has been considered as part of the execution phase of plans and is often seen as control or ongoing evaluatoin.

#### *Learning of the Job:*

- ❖ Most of the people working on monitoring have acquired specialized skills through practice and learning by doing.
- ❖ Very few institutions have technical themes with formal training in the general area of monitoring and eventual in the specific field of agricultural research monitoring.

*Purposes of Monitoring:*

- a) To collect information that will enable ongoing decision making regarding activities, projects, programmes and research centres
- b) To document input use and activities carried out for accountability requirements.
- c) Monitoring activities are concentrated at the operational level of projects and programmes
- d) As an essentially internal activity monitoring is used to check how activities of learning, how resources are being used and which intermediate boards are being fulfilled.
- e) In a few cases, monitoring checks on overall institutional performance which is generally considered as an aspect of evaluation.
- f) Monitoring fulfills the functions of training and support in research and not just for controlling and verifying its execution.

*Monitoring Instruments:*

- ❖ Most methods and instruments used for monitoring are informal and are only partially systematised.
- ❖ Broadly used instruments are field visits and reports prepared by researchers.
- ❖ Some organizations use data bases, periodical reports and budget monitoring for projects and programs.
- ❖ Experimental stations and regional research centres also use field visits, budget monitoring and written reports.
- ❖ At the Institutional level the more widely used monitoring instruments are internal and external reviews, administrative meetings and periodical reports such as Annual Reports.
- ❖ Scientists, Managers, Research Project and Program Leaders usually participate in internal reviews.
- ❖ Specialists or Technical Groups invited from other Institutions generally participate in external reviews.
- ❖ External reviews are primarily used for monitoring projects implemented with external funds for the overall revision of research centres and organizations or when changes in their mandate or budget are contemplated



### *Information for Monitoring*

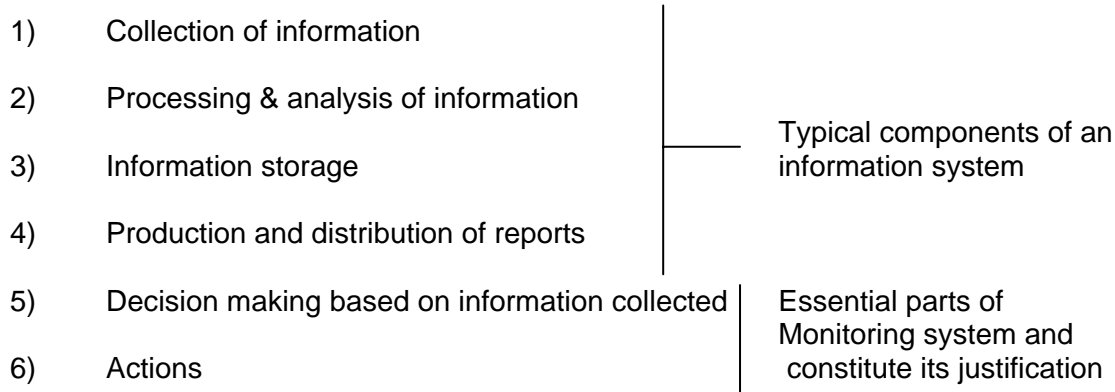
- ❖ Monitoring activities demand a considerable amount of time on the part of Researchers and intermediate level management.
- ❖ Monitoring activities are not conducted regularly and those that are conducted are considered bureaucratic because the information obtained is not reflected in decision making.
- ❖ Sometimes, monitoring activities generate large volumes of information and are therefore never used.
- ❖ Information generated from monitoring is generally found in respected access and consultation media such as internal reports but not in journals, scientific articles and other publications.

### **Conceptual Framework for monitoring agricultural research**

#### *Monitoring Concepts*

- ❖ Monitoring should be a part of an integral planning and evaluation system. ( PM & E)
- ❖ The process must be developed with the interaction among its components and its methodological and operational articulation in mind .
- ❖ The design of instruments must be consistent with planning and evaluation processes
- ❖ Sometimes it is not easy to distinguish monitoring from evaluation or from planning since monitoring also provides information for evaluating results and makes recommendations for reassigning resources and for redefining priorities
- ❖ Monitoring is a process of continuous observation, supervision, revision and documentation of research activities in relation to its context, objectives, expected results and resources allocated for its execution .
- ❖ The main end of monitoring is supporting decision making concerning an institution's ongoing activities and advising about problems and deviations from objectives and from expected results.
- ❖ Monitoring is necessary for quality control and also for identifying and taking advantage of opportunities not anticipated in the original research design .
- ❖ Monitoring systems also provide a record of information on research objectives, methodologies and designs used, resources used, the activities conducted and the results achieved.
- ❖ These records facilitate the preparation of reports for internal and external use.
- ❖ It is a Institutional memory of the organization and supplies information for evaluation and for planning future research.

*A good monitoring system includes:*



- ❖ Without decisions and actions the monitoring system becomes a mechanical and bureaucratic exercise.
- ❖ Attitudes and intentions are required which conceal monitoring **as an institutional process of permanent learning and international educational process involving all levels of organization.**
- ❖ **Monitoring is a participative and decentralized analysis process of research advances in relation to its context, objectives, expected results and resources allocated, to foresee deviations, problems and opportunities.**
- ❖ **Monitoring should support researchers, administrators, managers in providing them with elements for making adequate decisions at each level of the organization.**

### Uses of Monitoring

Monitoring has three main uses:

- i) Supporting decision making concerning ongoing research by detecting problems and opportunities and by controlling quality.
- ii) Documentation of research and its results packs up the preparation of reports and the evaluation and planning of future research.
- iii) Motivating and guiding researchers by promoting self-management and contributions from supervisors and colleagues to progress reports.

### Detection of Problems and Opportunities:

- ❖ Supervision of planned research activities is necessary for detecting and solving the problems that may arise. A problem can be solved at the level of execution viz., if inputs for an experiment do not arrive on time for planning it can be solved by a change in administrative procedures.
- ❖ Monitoring of a problem can indicate that plans are not realistic and that adjustments are required.

- ❖ During the execution of activities it is not only problems that may arise but unexpected opportunities can also occur.
- ❖ A monitoring system must be flexible and efficient in detecting problems and opportunities.
- ❖ Experience indicates that monitoring is more efficient in identifying problems and opportunities when Administrators and Scientists interact directly at the site where work is being executed .

#### **Quality Control:**

- ❖ Monitoring is essential to ensure good scientific quality control of research activities
- ❖ Reviews by peers of research proposals, visits to experimental fields and internal and external reviews of research projects and programs are useful mechanisms of quality control.

#### **Preparation of Reports:**

- ❖ Many organizations which do not have an organized monitoring system require much effort and time from Scientists and Administrators in preparing reports required by external agencies.
- ❖ On the other hand, organizations with a good monitoring system with brief but well structured reports can easily prepare reports on research activities and results.

#### **Evaluations:**

- ❖ Main problem in evaluating agricultural research is the lack of relevant and trustworthy information on research activities and its results .
- ❖ The type of information that is needed in evaluations must be anticipated and collected as a routine part of the monitoring system.

#### **Planning:**

- ❖ It is not only just evaluations but also plans which are commonly made with a great of relevant and trustworthy information.
- ❖ Priorities are frequently set without information on the current use of resources which results in wastage of the researcher's time.
- ❖ Good planning requires a good information base on the context of the research, its objectives, ongoing activities and the results achieved.
- ❖ A great part of this information must come from the monitoring system.

#### **Motivation and Guidelines:**

- ❖ Monitoring should also be an important source of motivation and for guiding researchers.

### **Users of Monitoring:**

- a) Researchers
- b) Program and Project Leaders
- c) Managers
- d) Funding Agencies

### *Relation to Decision making levels and information needs:*

- ❖ Monitoring in a research institution must have access to Administrative and Research Processes.
- ❖ Emphasis is placed on aspects related to the logistics and supply of services.
- ❖ Emphasis is also placed on the utilization of available resources.
- ❖ More number of people and the activities are involved in the lower than in the upper levels of organization.
- ❖ Monitoring must provide relevant information for decision making at all levels.
- ❖ Information required depends on the type of decisions made at each level.
- ❖ At the level of researchers and program leader detailed technical information is required on objectives, experimental design, task implementation and results.
- ❖ This information is essential for planning, supervising and evaluating the scientific quality of the work conducted.
- ❖ The upper levels require more aggregate and synthesize information on research needs, program objectives and components, the allocation and use of resources and the results and impact of the different research activities.
- ❖ This information is used for planning, supervision and the evaluation of research institutions.

### *Vertical flow of information:*

- ❖ Vertical flow of information must take place between the different decision making levels.
- ❖ Managers need to communicate organizational and program objectives to researchers (top to bottom flow).
- ❖ Researchers need to communicate managers, information on research proposals, ongoing activities and their results (bottom to top flow)
- ❖ Finally, managers must use the information provided by researchers to make decisions and must communicate these decisions to researchers (feedback).

- ❖ If decisions are not based on the information delivered and if there is not feedback, researchers soon lose interest in providing information to the monitoring system.
- ❖ Many organizations have more than one hierarchy of decision making levels.
- ❖ There may be an **administrative structure** with institutes, regional centres, and experimental stations and a **programmatic structure** with the program and the project levels.
- ❖ The amount of information is not as important as its relevance and quality.
- ❖ Delivery of an excessive amount of low quality or irrelevant information for decisions may highly counter productive.
- ❖ Many monitoring systems fail by delivering excessive amounts of semi-processed information to scientists or managers who do not have the time to analyse and interpret large amounts of information.
- ❖ Monitors need synthesized summaries of situations, critical problems and alternatives for action.

### **Horizontal flow of information**

- ❖ The horizontal flow of information in monitoring, planning and evaluation is very important.
- ❖ Monitoring must start by planning because indicators are defined during this phase for monitoring the use of resources, progress of activities and results obtained.
- ❖ Plans must have appropriate objectives and indicators at each level of decision to serve as monitoring parameters during implementation.
- ❖ Information recorded in the monitoring systems can also be used as the basis for subsequent evaluations.

### **Types of Information**

A comprehensive monitoring systems contains information on four large group of variables

- i) The research context including needs,
- ii) Inputs for research, including objectives, plans, designs, resources and foreseen activities.
- iii) Execution processes including the use of resources and the activities carried out
- iv) Research products including results and impact on production, economy, social welfare and environment.

The above variables are used in decision making for agricultural research administration especially in integrated PM & E processes.

**The Research Context** includes

- ❖ Social, economic, political, technical and environmental conditions
- ❖ Producers and consumers needs
- ❖ State of the Art of the Knowledge in the Scientific Field
- ❖ Priorities for Research

**Inputs for Research** includes

- ❖ Objectives
- ❖ Strategies
- ❖ Plans and designs for studying
- ❖ Sequence of activities to be conducted
- ❖ Required budget and resources

**Research processes** include

- ❖ Activities conducted
- ❖ Resources used (human, financial, physical)
- ❖ Administrative procedures used

**Research products** include

- ❖ Results obtained
- ❖ Information and Technologies generated
- ❖ Resulting impact (economic, social, environmental)

**Costs and Benefits of monitoring**

- ❖ Collecting, processing, analyzing, storing and disseminating information is extensive
- ❖ Due to costs, priorities should be set for monitoring
- ❖ Resources available must be used in the most efficient manner.
- ❖ Only relevant information should be recorded on the most important variables.
- ❖ Consize reports should be presented at the right moment for decision making.

- ❖ A monitoring systems must present scientists and administrators with the **minimum** amount of information required for them.
- ❖ In terms of priorities it is more feasible and less expensive to organize information on inputs and research processes.
- ❖ Finding and managing information on products is more complex and expensive
- ❖ Each organization has to evaluate its needs and possibilities and implement a monitoring system that is feasible and useful.
- ❖ A common strategy is to start by organizing information about ongoing activities (information on inputs and processes) and based on the experience acquired - broaden the system to include information on results (information on products).

### **Design and Implementation of a monitoring system**

- ❖ Monitoring system should not follow fixed models: instead it must adopt to the Institution's conditions, objectives, resources and needs.
- ❖ Decentralized implementation of a monitoring system allows different actors to participate at different institutional levels, contributing to the flexibility required to the efficient, supports constant feedback and increases the possibilities for clients and users to exert social control on the use of resources and the results obtained.
- ❖ Though planning, design and coordination of monitoring may be centralized, implementation should be decentralized.
- ❖ Seven aspects in the design and implementation of a monitoring system need to be analyzed:
  - a) Prerequisites of an effective system
  - b) Priorities for a system
  - c) System components
  - d) Instruments for monitoring
  - e) Organization of monitoring
  - f) System implementation
  - g) Indicators of monitoring effectiveness

### **Pre-requisites of an effective system**

- ❖ Top management must see the system as a priority tool for research administration, and decision making otherwise, the System will not be allocated the resources and support required for efficient operation.
- ❖ The System should generate clear objectives and measurable indicators to orient the collection and analysis of information during the monitoring process.
- ❖ Objectives and progress indicators are essential for conducting monitoring.

### **Priorities for monitoring:**

- ❖ Monitoring a large number of variables is possible but expensive

- ❖ Priorities should be established in the design of a monitoring system in terms of type of information to be collected, processed and distributed.
- ❖ Priorities should be established based on different user demands, on costs and on the feasibility of generating the information required.
- ❖ In establishing priorities for information to be collected the following questions should be answered:
  - Why is monitoring being conducted?
  - For whom is monitoring being done?
  - What information is required?
  - How should this information should circulate?
- ❖ The person incharge of designing the monitoring system needs together the internal groups in the Institution and also with external groups related to agricultural research to analyze their demands for monitoring information.
- ❖ Based on this analysis, the institutions directors, must determine priorities among the different types of information to be collected, processed and delivered to different users.
- ❖ In addition to a list of priorities on the type of information to be delivered the costs and feasibility of generating the information must be analyzed.

### **Components of the System:**

A monitoring system has six essential components:

- Collection of information
- Processing & analysis of information
- Information storage
- Production and distribution of reports
- Decision making
- Actions

In designing a monitoring system five questions should be answered for each of the above five components

- What is it done?
- What must be done?
- How it should be done?
- For whom it is done?
- Who must do it?

In designing a monitoring system, the first thing to be done is to decide what reports will be produced and their distribution.



## **Design of Reports**

- ❖ Preparation and distribution of reports must contribute to decision making, to documenting research and for motivating and guiding scientists.
- ❖ In designing a monitoring system the types of reports needed to contribute the achievement of these three objectives must be specified.

The monitoring system must generate two types of reports:

- Periodical and routine reports
- Special reports prepared on request

The report contents and format must satisfy reader's interest as well as complying with their criteria and feasibility of performing the tasks.

Administrative reports must be designed to satisfy the requirements of the different audiences ( Government Officers and local, national and foreign donors).

An institution can establish its own norms in terms of frequency, content, style and distribution of reports.

In terms of frequency in distributing information four types of reports are important:

- One at the end of each agricultural cycle
  - One at the end of each experiment or project
  - One for each internal review
  - One for each external review
- ❖ The report for the internal review cycle often coincides with that of agricultural cycle and the same report can meet both needs.
  - ❖ The first three types of reports are the basis for preparing external review reports.
  - ❖ Reports must be well structured and have a clear and short format
  - ❖ Many reports are of hardly any use because they are extremely long or poorly written: they include too many details and lack clear and relevant conclusions.

## **Collection of Information**

- ❖ The information collection, processing, analysis and storage systems can be designed once the design of reports is complete and the compatibility of the reports that the monitoring system must generate
- ❖ Monitoring systems have a tendency to collect more information than will be needed are used.
- ❖ Monitoring system can generally increase their efficiency by reducing the amount of information collected.
- ❖ Information required for monitoring context is normally available from secondary sources or institutional documents.

### **Information Analysis and Processing:**

- ❖ Verifying the information collected can be done by preparing lists and tables, summarizing the information and confirming it with other sources and by asking original reporters to review the lists and tables used.
- ❖ Another aim is to facilitate storage in clear formats ( on paper, or in electronic data bases).
- ❖ The third aim is to combining the information with information from several other sources in order to make analysis.
- ❖ The fourth aim of processing is conducting analysis and converting data and information originally collected into more synthesized information to facilitate arriving at conclusions and making decisions.
- ❖ The fifth aim of information processing is presenting results in different formats such as summary tables and graphs.
- ❖ Modern software, calculation programs and databases help enormously in presenting information graphically to facilitate comprehensive scientific analysis and for administrative decision making.
- ❖ Decision on what information, how to process it must be made on the basis of reports required and on the reader's needs.
- ❖ Information processing and analysis have a tendency to over crosses information, thus losing sight of the value of initial information and of user's priority needs.
- ❖ Team responsible for information processing must contact final users frequently to receive orientation on priority needs.

### **Information Storage:**

- ❖ Part of the information generated by the monitoring system must be stored for future use.
- ❖ Information storage must be tailored on the basis of future use.
- ❖ A common mistake is storing too much information that can neither be found or used when needed.
- ❖ Information storage must have priorities and be organized on the basis of future usage
- ❖ Generally scientists save information on their experiments and programs
- ❖ What is more worrying are the Institutional files: Often these files which contain valuable information are lost when the managers leave the institutions.
- ❖ Good scientific files must be kept
- ❖ The three most important relevant of a scientific file are:

- Project proposals
  - Progress reports and
  - Final reports
- ❖ The profile must include concise information on research context (justification, previous work needs) and on plans (objectives, materials and methods, experimental design, activities, required resources, expected results and monitoring and evaluation parameters).
  - ❖ Progress reports must specify activities and results for the period under analysis in relation to objectives.
  - ❖ Final reports must summarize all activities and results in relation to objectives and initial plans, and include a self evaluation of the experiment or project. Experimental data must be included in the final report to be useful to the future researchers.
  - ❖ Many institutions have had serious problems with information management systems and with information transfer from one computing system to another.

### **Decision Making**

- ❖ The monitoring process must end up in decision making either within or outside the institution.
- ❖ There are two types of decisions:
  - Implementation decisions related to conducting ongoing research and
  - Planning decisions addressed at establishing priorities and designing future research
- ❖ Decisions must be implemented and therefore in making decisions it is not only the things that need to be changed which must be specified but also who is responsible for the actions required.

### **Actions**

- ❖ One of the main ends of a monitoring system is executing actions that improve research implementation
- ❖ It is actions which responds to the information provided which makes the investment of time and other resources in the whole monitoring process worthwhile.
- ❖ If the people who provide the information for the monitoring system do not perceive its utilization and value it is doubtful whether they will continue to provide quality information of the system.

### **Internal Review:**

- ❖ One of the main advantages of an internal review is the possibility of direct communication among participants coming from different units and decision making levels of the organization.

- ❖ This face to face communication is usually more effective than written communications for identifying and solving problems.
- ❖ The disadvantages of such an internal review is that it does not generate the systematic documentation of the activities and results produced by an organization, the problems encountered and the recommendations made for future activities.
- ❖ For this reason internal reviews should be combined with the preparation of progress reports on projects and programs.
- ❖ A report of presentations, discussions, conclusions and recommendations made during the review as a whole should also be prepared.

### **Progress Report:**

- ❖ All Research Organization have to generate some kind of annual report on their activities and results.
- ❖ Inside the organization Scientists and Head of Projects, Programs and Centers prepare progress reports on their activities.
- ❖ The design of appropriate formats and training in technical writing are useful means for improving reports.

### **Management Information Systems:**

- ❖ MIS provides research administrators with condensed or summarized information to support decision making.
- ❖ Each Administrator has an informal system even though most of them are relatively informal.
- ❖ A MIS is designed and implemented with the purpose of providing relevant information to the Administrator when he/she needs it for making decisions.
- ❖ A very useful type of MIS in Agricultural Research is the data base project which has information on approved research plans, resources allocated or used, activities and results.

### **Organization of monitoring**

- ❖ A crucial aspect in the organization of monitoring is defining responsibilities.
- ❖ In terms of monitoring responsibilities there are several options: the one selected depends on each institution's conditions.
- ❖ The overall principle is that monitoring responsibilities must be associated with the person's responsible for decision making.
- ❖ Highly centralized institutions centralize monitoring responsibilities.
- ❖ Responsibilities need to be decentralized in decentralized institutions.

- ❖ Monitoring is frequently believed to be responsibility of a specialized unit such as PM & E.
- ❖ In large organizations a department or a specialized unit can play an important role in designing procedures and in supervising monitoring processes.
- ❖ In general, it is not advisable that a specialized unit be directly incharge of implementing monitoring.
- ❖ Rather, the responsibility of implementing monitoring should be in the hands of those that make decisions - those in charge of Research Projects, programs, centres and institutions.

### **Implementation of the System**

Four general rules for implementing a monitoring system are:

- Stock on a small scale, trying out and revising procedures
  - Implement procedures in a disciplined way
  - Generate useful information for different user groups
  - Revised system periodically
- ❖ A monitoring system is very complex and it is impossible to predict its functionality before trying it out.
  - ❖ A useful strategy is to try the system at the research program or centre level, revise it and then implement it at other centres.
  - ❖ Once the system is running disciplined implementation is important.
  - ❖ If scientists or administrators perceive that dead lines and other norms need not be met for the delivery of information, the system can become quickly outdated and useless for making decisions.
  - ❖ The best way to ensure institutionalization of a monitoring system is to deliver useful information to the different users including the Scientists themselves.
  - ❖ Once the system has been installed, it must be periodically reviewed (every three to five years) to evaluate its effectiveness and efficiency in relation to current circumstances and to make necessary adjustments.
  - ❖ On the other hand, it is not convenient to make continuous changes to procedures since this would show signs of insecurity and disorder.

### **Monitoring Effectiveness**

- ❖ The effectiveness of a monitoring system is defined in terms of the degree to which it fulfills its objectives.
- ❖ Since objectives vary from Institution to Institution, specific effectiveness criteria may vary among monitoring systems.

- ❖ However, as a general rule, a monitoring system must meet three basic criteria:
  - deliver useful information at the current moment to decision makers (internal and external)
  - generate adequate documentation on research (use of resources, activities and results) that is useful for preparing several types of reports, planning future research and making evaluations.
  - Motivate and guide scientists towards the Institutions priority objectives by means of feedback on decisions and actions taken.

### **The project as a PM & E Tool**

### **The project as a management unit in Agricultural Research**

#### *The Project Concept:*

- ❖ A project is set of inter-related activities, oriented towards solving a problem, with specific results expected at points in time by applying certain resources and methods.
- ❖ Various project components that can be monitoring:
  - The solution of a problem
  - Results obtained
  - Deadlines
  - Resources used
  - Methods used
- ❖ The project as the most common organizational and operational unit is frequently used in research management while both the private and public sector.
- ❖ Project Management principles have recently been introduced to agricultural research to improve its effectiveness and efficiency through planning, monitoring and evaluation.
- ❖ Project Management is particularly relevant when researchers compete for external resources and while research donors require clear information on research plans and results.

#### *The project cycle:*

A sixth-step cycle is suggested for agricultural research project management:

- Identification of priority research areas
- Preparation of proposals
- Revision of proposals
- Approval of proposals and allocation of resources
- Implementation of research and monitoring
- Evaluation of results and impacts
- ❖ Preparation of proposals include title, summary, individuals and units incharge, objectives, expected outputs, justification and initial solution, previous research and status of current knowledge, strategies and methods, schedule of activities, resources required, methods and indicators were for monitoring and evaluation.

- ❖ Research proposals must be reviewed in terms of their relevance, feasibility and scientific quality.
- ❖ Approval of proposals and allocation of resources is the responsibility of those who manage or direct the institution.
- ❖ Implementation and monitoring of research should answer the following questions:
  - do the objectives continue to be relevant and adequate
  - have objectives been met
  - till date what are the results of research
  - what have been the problems in implementing the project
  - do experimental designs need to be changed.

While evaluation results and impact the following needs to be analysed:

- relevance of objectives
  - achievement of objectives (project effectiveness)
  - appropriateness of designs and methods ( project efficiency)
  - products generated by the project (in relation to expectations)
  - contributions to overall knowledge
  - adoption and use of information and technologies generated
  - lessons from the project
  - recommendations for the future
- ❖ An impact evaluations objective is to determine the long term impact of research on production, the economy, social welfare and the environment.
  - ❖ A project should be a part of a broader institutional program and address national and regional priorities and specific user's needs.
  - ❖ The project should have a precise definition or otherwise monitoring losses its sense and utility.
    - between outputs and the purpose
  - ❖ The logical framework should establish a clear relationship among:
    - initial problem
    - expected results
    - activities and resources required
    - external factors to the project which condition its fulfilment
    - verifiable indicators of results and the place and procedure to find this information.

The logical framework enables preparation of well structured research proposals that are more readily approved, monitored and evaluated.

Three casual relations exist from input to the ultimate goal and these are:

- between inputs (resources and activities) and output
  - between the purpose and the goal
- ❖ Indicators and means of verification serve as a basis for monitoring and evaluating a project.

- ❖ Indicators are data that allow the objective verification of an objective's fulfillment and of the inputs.
- ❖ They are direct or indirect measures of achievement.

Indicators must meet various characteristics like:

- measure what is important in the objectives
  - must be valid
  - must be measurable
  - must be independent
- ❖ Indicators must measure what is relevant in an objective
  - ❖ Indicators selected must be related closely an eye with what needs to be measured.
  - ❖ Indicators must be specified in terms of quantity, quality and time (QQT)
  - ❖ The value of an indicator is limited by the means available to verify
  - ❖ If verification of indicators is expensive and time consuming, means of verification must be identified during the project's design state.
  - ❖ The vertical logic relates objectives to assumptions.
  - ❖ The horizontal logic relates objectives to indicators and verification means.
  - ❖ Participatory methods are recommended and the steps could be:
    - Characterize the initial situation.
    - Formulate objectives
    - Identify relevant assumptions
    - Verify the vertical logic
    - Select indicators
    - Specify means of verification
    - Verify the horizontal logic
    - Review the complete log frame

### **Instruments for monitoring: Progress Reports, Internal Reviews and Project Data Bases**

#### *Progress Reports:*

- ❖ Research results must be communicated in one way or another through written reports, oral or visual presentations
- ❖ The most common way of presenting information on a research project is the written report which can be supplemented with oral presentations and audio-visual aids.
- ❖ Reporting involves the collection and analysis of information related to agricultural research activities, resources, and results and its presentation so as to satisfy the needs of different groups of audiences.



- ❖ Research results may be recorded and presented to the Scientists, Managers, Producer Associations, Government Agencies or Donors.
- ❖ Reports can allow manager and others to compare research progress, to pre-establish the objectives and goals, to identify significant deviations and to take the necessary action.
- ❖ However, most often reports seem to be filed, unread and there seems to be little follow up.
- ❖ Since researchers seldom free that their reports are used, report preparation is generally seen as a tedious unproductive requirement.

### *Types of Progress Reports*

Several types of progress reports can be useful in a research organization:

- Technical - Administrative Reports
  - Progress reports on research projects, programs and institutions
  - Final project reports
  - Special reports
- ❖ Each type of progress report has its own style, contents and defusion channel according to the audience to which it is addressed.
  - ❖ Contents of final project report should include:
    - project on activity title
    - report summary
    - objectives and expected results
    - methodology used
    - main achievements and findings
    - problems and possible solutions
    - general conclusions
    - financial summary (for administrative reports)

Preparation of reports should consider five aspects:

- incentives for preparing good reports
  - formats and instructions
  - periodicity
  - audience and style
  - reports at different decision making levels
  - distribution and use of reports
- ❖ Formats have the advantage of orienting report preparation
  - ❖ Brief instructions can facilitate comprehension for preparing the report and allows for unification of the most important criteria.
  - ❖ Following are some of the audiences for which research reports are prepared:
    - Researchers
    - Extensionists
    - Planners
    - Professors

- Farmers
- Managers
- Donors

Some common problems of progress reports are:

- Standardized formats do not exist or are not used
- Reports are not presented at the right time
- Quality of reports is poor meaning little substance and analysis and poorly written
- Synthesis reports are not prepared at the program or institutional levels
- Reports are not used to make decisions and Scientists do not receive feedback information.

#### *Internal Reviews:*

Internal reviews can be used in atleast seven ways:

- Checking on activities and results
- Problem identification
- Identification and analysis of possible solutions
- Reevaluating priorities
- Annual planning
- Documentation
- Motivating and guiding scientists

- ❖ The usefulness of an internal review has a monitoring instrument basically depends on its organization and execution. These responsibilities must be assigned to a person or team.
- ❖ All internal review meetings should have clear objectives.
- ❖ An internal review meeting should cover a limited number of objectives and themes . This ensures discussions, analysis and recommendations sufficiently in depth to be useful for decision making.
- ❖ An internal review is an extensive exchange of information among members of a program or institution, so it also serves as a self-evalauting group. This process can be formulized by forming a review panel.
- ❖ Prior to the meeting all participants should receive appropriate documentation.
- ❖ Establishing and abiding by time limits for presentations is very important to allow sufficient time for discussions and analysis and preparing recommendations.
- ❖ As a rule, brief presentations (10-20 minutes) are more effective than long presentation (over 30 minutes). To be informative and effective, presentations must be well prepared and structured. Visual aids can be very helpful.
- ❖ During agricultural research reviews field visits are frequently advisable.
- ❖ The effectiveness of an internal review depends greatly on how it is managed.
- ❖ The optimum size of a review meeting depends on review objectives, the knowhow and ability of organizers, the facilities available and the meetings, organization and dynamics.

- ❖ Internal reviews need to be evaluated bearing in mind established criteria such as:
  - organization and coordination
  - confirmation of the evaluating group
  - conduction of the meeting
  - availability and timeliness of background information
  - quality of oral presentations
  - coverage of objectives
  - subjects proposed
  - conclusions drawn and decisions taken
  - utilization of results

### *Project Data Bases*

- ❖ A project data base facilitates organized storing of information to generate different types of reports with different combinations of variables.
- ❖ Usefulness of project data bases:
  - support decision making
  - filing of scientific information
  - production of reports

Designing a project data base requires decisions on the following points:

- Type of information to be generated
  - Degree of integration with accounting
  - Compatibility with other data bases
  - Degree of decentralization
  - Technical design
- ❖ Many project data bases are under utilized. This may be because researchers and managers, do not know how their information might be used.
  - ❖ In designing a project data base it is important to begin with the types of information which are more frequently requested over time and to leave special - request data for later.
  - ❖ Effectiveness involves producing the right information at the right time for decision making or other uses at each institutional level.
  - ❖ Efficiency involves delivering this information at the lowest cost possible.
  - ❖ An institution's project data base should be flexible enough to satisfy changing monitoring and decision making needs.

## Terms Used in the PM & E Manuals

- |  |                                       |
|--|---------------------------------------|
| - Accountability   | - Logical framework                   |
| - Assumption   | - Means of verification               |
| - Beneficiaries  | - Objective                           |
| - CIPP Evaluation model<br>(contest evaluation, input<br>evaluation, process<br>evaluation, product<br>evaluation) | - Objectively verifiable<br>indicator |
| - Clients  | - Ongoing evaluation                  |
| - Criteria   | - Operational planning                |
| - Decision making level  | - Organizational analysis             |
| - Effectiveness  | - Output                              |
| - Efficiency   | - Participatory management            |
| - Evaluation   | - Peer review                         |
| - Ex-ante evaluation   | - Planning                            |
| - Expert review (peer review)  | - Policies                            |
| - Ex-post evaluation   | - Products                            |
| - External analysis  | - Program                             |
| - External environment   | - Programming levels                  |
| - External review  | - Project                             |
| - External validation  | - Project cycle                       |
| - Formative evaluation   | - Project management                  |
| - Gap analysis   | - Purpose                             |
| - Goal   | - Quality control                     |
| - Impact   | - Relevance                           |
| - Input  | - Scenario                            |
| - Institutional sustainability   | - Stakeholders                        |
| - Institutionalization   | - Strategic planning                  |
| - Internal review  | - Strategy                            |
|  | - Summary evaluation                  |
|  | - Survey                              |
|  | - Tactical planning                   |

## Evaluation in Agricultural Management

- ❖ Evaluation is judging, appraising or determining the work, value, quality of research - whether it is proposed, ongoing or completed - in terms of its relevance, effectiveness, efficiency and impact.
- ❖ Relevance indicates how appropriate or important the goals and objectives are with respect to the established needs.
- ❖ Effectiveness measures the degree to which the goals have been reached.
- ❖ Efficiency refers to the cost effectiveness of an activity.
- ❖ The impact to the broad and long range effects of research
- ❖ Evaluation is also a part of the organizational process for improving ongoing activities and backing of future planning and decision-making activities.

- ❖ Evaluation should not be considered as a isolated activity but as a part of a cycle that begins with planning and monitoring followed by evaluation and ends with decision leading to the new management site.

Planning includes:

- Contest
- Problem
- Objectives
- Results
- Resources
- M & E indicators

Monitoring includes:

- Warn
- Adjust
- Continue
- Terminate

Evaluation includes:

- disseminate results
- decision making
- redesign
- policy negotiations
- fund raising
- public accountability

An evaluation begins with the design of an activity with clear objectives and verifiable indicators of the achievement of those objectives:

- an evaluation always involves a relative judgment

- ❖ Evaluations are more effective if adequate monitoring, recording information mechanisms are actively implemented during the course of the program.
- ❖ Research activities form part of a research and development system: therefore evaluation has to situate the activity in the institutional, political, social and economic contest in which it is carried out.
- ❖ Evaluation of research activity must clearly distinguish between the achievement of research objectives and the contributions of these results to broader developmental objectives.

Among main uses of evaluation:

- Uses related to public accountability
- Use of results to improve management and decision making
- Accountability is also a part of a good management of an organization
- Senior managers must ensure that their subordinates and those managing the projects can answer for the resources they use.
- Social groups in general are increasingly concern with how their tax money is being spent.

Many different things can be evaluated within the scope of agricultural research:

- Activities

- Projects and programs
- Research resources (scientists, funds and physical contributions)
- Research organizations (experimental stations, laboratories, institutions)
- National Research Systems made up of diverse organizations
- Research results (technologies in information)
- Impact

The level (institute, program, project etc.) and the components being evaluated at each level (inputs, processes, products, context) need to be defined and distinguished.

### **CIPP Evaluation**

- context evaluation identifies a target population and its needs, diagnosis current problems, identifies opportunities and judges whether the proposed objectives meet the needs.
- Input evaluation refers to all inputs to the research process itself - human, financial and physical resources
- Process evaluation identifies implementation processes and problems, providing information for improving implementation or redesigning procedures
- Product evaluation describes and appraises results in relation to objectives, goals, and client's needs
- Impact evaluation appraises the effects of results on the broader environment (impact of new technologies on yields, production or prices).

### **Types of Evaluation**

- ❖ *Ex - ante evaluation*: This is done before carrying out research and is used in the decision making process in order to choose the best option from among several options.
- ❖ Ex-ante evaluation is not practised widely but its value is recognized in supporting the research planning process, to identify low cost, priority alternatives for allocating resources.
- ❖ Ex-ante evaluations can also provide information on the social acceptance and also to establish which one has a greater chance to succeed.
- ❖ *On-going evaluation (or) supervision*: carried out during implementation can lead to timely decisions and actions leading to the achievement of previously established goals.
- ❖ Ex-post evaluation checks whether the new knowledge and technologies produced correspond to initially established goals or present needs.
- ❖ Ex-post evaluation is a process by which the things that have been proposed can be compared to what has really been achieved, taking into account how, why and with what it was done. It also identifies the reasons for satisfactory or unsatisfactory results.
- ❖ Ex-post evaluation also produces results and pertinent lessons for future or ongoing activities, and these should provide feedback for this system and become indicators for the ex-ante evaluation.
- ❖ Ex-post evaluation can be used mainly for:
  - operational ends to verify achievements

- as an analytical tool to improve the design and methodologies of new proposals or as feedback for ongoing research
- policy ends, to verify the validity of a strategy or approach.

### **Internal and External Evaluation**

- ❖ Internal evaluations are generally carried out at the level of the centre (experiment station or institute) program, project or technical area. This includes annual project reviews etc. Annual periodical project review.
- ❖ External evaluation are carried out to review a research centre, program or project with the participation of external evaluators - normally carried every three to five years.
- ❖ There are advantages and disadvantages in the internal evaluation and external evaluation but a right mix can be very useful.

### **Evaluation Methodology**

- ❖ There is much to be gained if complex activities such as evaluations are planned in advance
  - ❖ Planning or designing an evaluation is an element in the success of all subsequent evaluation activities and it can help avoid wasting resources and efforts.
  - ❖ It can help guarantee that the data gathered are appropriate for the objectives of the evaluation.
  - ❖ It can allow evaluation results to be interpreted more logically and systematically
  - ❖ One of the ways to plan and carry out an evaluation is to follow the methodology in the following
- 1) from objectives to concepts
    - identify the objectives and / are priorities of the evaluation
    - chose an appropriate model
    - relevant concepts
    - formulate casual hypothesis about their relationships using CIPP model of the guide
  - 2) from concepts to operational
    - identify the variables that represent the concepts chosen
    - define the variables operationally so they will be valid believable and feasible.
  - 3) From operational definitions to data collection
    - define the sources for each variable maximizing the validity and minimizing costs
    - choose the most appropraite instruments by collecting data at the highest measurement level and the lowest cost.
    - Plan the data collection
    - Trained data collectors

- Manage the collecting activity
  - Maximizing the validity as well as time and cost efficiency
  - Separate quantitative and qualitative data
  - Prepare the data analysis
  - Carry out analysis capable of revealing the meaning of the data
  - Prepare tables and graphs to present the data in a statistically correct form
  - Carry out the analysis to obtain the results needed for the original plan
- 4) From data to interpretation
- organize the qualitative data to describe the immediate context of evaluation as well as aspects that cannot be quantified appropriately
  - analyse the causal relations among variables critically using the causal hypothesis as a guide
  - broaden the analysis by adding the unquantifiable aspects
  - note interpretations, especially those which influence the more complex aspects of the situation.
  - Consider the results of the critical analysis from a strategic point of view, emphasizing important aspects, strong points and opportunities, without forgetting weak points and dangers.
- 5) From interpretation to presentation
- Finish with a specific presentation of findings and suggestions
  - Vigorously revise the form the logic, avoiding confusing or unreliable steps.
  - Write the Executive Report, omitting methodological details and emphasizing practical conclusions.
  - Write a popular version, communicating the most important opportunities and changes found
  - Plan the distribution of the information and its use, making the message appropriate for each type of audience.

The main steps for carrying out an evaluation are:

- Focus the evaluation
  - Decide what will be measured
  - Collect the information
  - Interpret the evidence
  - Write and present reports
- ❖ All the above steps can be applied with different degrees of complexity and magnitude, depending on the size of the institution, program or project and on the resource available.
- ❖ However, the logic of the method must be followed, always answering the questions:
- what must we evaluate
  - why?
  - How?
  - When?
  - With what?
  - What for?

A list of variables to represent the CIPP concept should include aspects such as:



- Context – potential users, interest groups, the program to which the project belongs, donor dependence, policies and government priorities
- Inputs – experimental designs, the number and level of qualification of researchers, funds, quality of experimental fields and the availability of information, science
- Processes – access to inputs, the level of researchers liberty for decision making, the organizational structure of the unit, consultation styles among researchers and communication processes.
- Products – research completed, scientific articles published, new technologies

Participatory identification of context, inputs, processes and products.

- participatory research with producers is a set of methods designed to allow a active contribution to decisions for planning and generating of agricultural technologies
- evaluation with producers are a sub-set of these participatory methods. Evaluation methods with producers can be used at different moments like at the time of diagnosis, planning and design experimentation and validation
- evaluation methods producers can be used during the planning stage to pre-select prototype technologies. This enables producers and scientists to decide together what technologies to validate.

Implementation of evaluation

- ❖ **Instruments and Procedures for collecting data - *questionnaire, summary sheets, interview schedules etc.***
- ❖ Evaluation methods are credible if the people for whom the evaluation is done accept them and believe in their usefulness.
- ❖ Evaluation methods are feasible if they can be implemented in the specific organizational context proposed for their use.
- ❖ Methods are valid if they measure what they claimed measure.
- ❖ Methods are credible if people accept them and believe in them.
- ❖ Methods are feasible if they can be implemented
- ❖ Analysis of quantitative variables is mainly done using statistical needs
- ❖ Qualitative variables can be treated as classifying variables
- ❖ Data collection instruments are means for registering information to the attain higher measurement methods.
- ❖ Primary data are those collected directly for the evaluation.
- ❖ Secondary data are those that are taken from other sources previously available.
- ❖ No matter how the data is collected and is treated, they must be synthesized to be interpreted and communicated easily.

## **Dissemination evaluation results**

Reports should be designed with the following in mind:

- who should receive the report?
- what type of information should the report contain?
- how should a report should be presented (written or verbal)?
- How can different stake holders be helped to interpret and use the report?
- When should the report occur ( beginning, middle or at the end of evaluation process )?
- Scientific reports, Executive Reports, Public Awareness Reports

❖ Donor agencies evaluate their projects mainly for reasons of accountability

❖ The most common criteria of a donor's evaluation are the timely and appropriate use of funds and the fulfillment of planned objectives.

Meta-Evaluation:

- if the evaluators are going to practice what they preach, evaluations should also be submitted for evaluation along with other activities of an agricultural research agency
- evaluators call this as meta-evaluation
- meta-evaluation should emphasize the practical aspects and the usefulness of results
- meta-evaluation can be done by people within or outside the organization

*Institutionalizing evaluation - Periodicity*

- interest in and support for evaluation on the part of management and staff
- clearly defined units of research (projects or programs)
- capacity to handle the information generated by the evaluation

## **Checklist for designing an evaluation**

- Define the subject - What needs to be evaluated
- Identify the client - who is the evaluation being done for
- Clarify the purpose - why is the evaluation being done
- Identify the issues - what questions need to be answered
- Assess the resources - what resources are needed are available
- Organize the evaluation - who, within the organization should be responsible for the evaluation
- Select the evaluators - should the work be done by the organization's staff or by outsiders (professional evaluators, subject matter specialists or clients)
- Select the methods - how should be information be collected and analysed
- Decide on reporting - when should reports be made and to what audience; what should be their content and style
- Determined follow up - what follow up should be made after the evaluation and who should monitor the follow up.

# TECHNOLOGY FORECASTING - AN OVERVIEW

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Technology Forecasting (TF) is a planning tool to be at use in dynamic environments which undergo rapid changes. The technological backwardness of developing countries is primarily due to lack of planned attention to the maintenance, development of technology capabilities and utilising resources efficiently. Rapid technology progress, and the increased rate of obsolescence of technologies necessitate technology forecasting for any planning process. Since technologies play a major role in planning of business, industry, government and society's growth, it becomes essential to determine its direction and magnitude by systematic analysis and study.

TF can be defined as a probabilistic prediction of technological changes in terms of future characteristics of useful machines, systems or procedures. In other words, technology forecasting attempts to predict rate of technology advance. Primarily TF attempts to bring potential future technology into focus. Decision-makers are concerned about the desirable and undesirable effects of fast growing technologies. Anticipation of such technologies serve as early warning signals before a particular technology is imported or manufactured indigenously.

## **Need for technology forecasting**

The need for technology forecasting are essential for the following reasons:

- \* Future oriented R & D
- \* Prevention of import of obsolete technologies
- \* Anticipating technical innovation
- \* Shift towards appropriate technology
- \* Effective technology transfer
- \* Development of exportable technologies
- \* Leap across generations
- \* Rapidity of innovations
- \* Trade restrictions
- \* Avoid surprises

## **Elements of technology forecasting**

There are four essential elements in a technology forecast, namely:

- \* Time
- \* Qualitative
- \* Quantitative
- \* Probability of occurrence depending on the purpose

The time element deals with resource-time relationship. The qualitative element attempts to identify the factors that are likely to change the activities or technology trends in areas of interest to the forecaster. The quantitative element attempts to measure and assess the level of performance of various technologies. The element of probability of occurrence attempts to predict different alternatives and its confidence level.

## Technology forecasting methods

The available technology forecasting techniques, both qualitative and quantitative methods, can be classified into two broad categories, viz. exploratory forecasting and normative forecasting. Various TF techniques are given in Table-1.

**Table-1: Technology forecasting techniques**

| <b>Exploratory forecasting</b> | <b>Normative forecasting</b> |
|--------------------------------|------------------------------|
| Delphi method                  | Operations research models   |
| Analytical methods             | Network techniques           |
| Multivariate analysis          | Cross-impact analysis        |
| Trend extrapolation            | Relevance trees              |
| Growth models                  | SEER                         |
| Brainstorming                  | Morphological analysis       |
| Scenario writing               | Dynamic modeling             |
| Substitution analysis          |                              |
| Input-output models            |                              |
| Monitoring                     |                              |

### i) Exploratory methods

Exploratory methods start with the present state of technology and quantitatively project future possibilities. In other words, it provides means for exploring the shape of tomorrow given the state, trends, and promises of today. These methods are applicable in systems which grow under a specific environment. Exploratory methods can be grouped into four categories, viz., intuitive, extrapolative, growth curves and technology monitoring.

#### a) Intuitive methods

Intuitive methods are based on the ability of one or more experts to assess the future. Some commonly used intuitive methods are:

**Individual forecasting:** Experts in specific fields often prepare forecasts in their field. This method lacks multidisciplinary interaction, and are often biased. Probability of failures is high.

**Opinion polls:** Opinions are obtained from several individuals and combined. The minimum sample size should be twenty. One of the disadvantages of this method is that the minority opinion will be drowned by majority opinion irrespective of its significance.

**Panels:** A group of experts interact across a table. This has the advantage of being multidisciplinary. The major disadvantages are:

- \* Extreme views get eliminated
- \* Vociferous or dominant personalities influence the forecast
- \* Some experts don't agree failure of their earlier stand
- \* Subordinates refrain from speaking against bosses' views.

**Brainstorming:** In situations where evaluation of unconventional alternatives are needed, the effects of bureaucracy and band wagon have to be reduced. Brainstorming is a frank and free unconventional alternative search technique.

**Scenario writing:** This is a creative method of deriving possible composite scenarios of future by considering alternate options.

**Delphi:** The delphi is a group process technique for eliciting, collating and generally directing expert judgment towards a consensus on a particular topic. This study is typically conducted by mail through several rounds of questionnaires for convergence of opinions. The detailed procedure is described later.

### **b) Extrapolative methods**

Trend extrapolation: The past trend is projected into the future using linear or semilogarithmic or double logarithmic extrapolation or curve fitting techniques. These are the most widely used techniques and are cheap in terms of fund requirements. Some extrapolation techniques are: Linear extrapolation, exponential extrapolation and trend correlation.

### **c) Growth curves**

Technology capabilities grow mainly in 'S' shaped fashion having a finite limit. In such cases, use of other techniques will lead to erratic end results. Some of the commonly used growth models are:

- \* Pearl curve
- \* Gompertz curve
- \* Fisher-pry curve

Substitution: In cases where technology substitutions occur substitution models can be used which are very simple for usage.

### **d) Technology monitoring**

Technology grows many times through breakthroughs, and prediction of future is possible by monitoring the early signals of the innovation. This is mainly achieved by a search of patents, radical alternatives and literature for the embryo of new technologies.

**Multivariate analysis:** In cases where the cause and effect relationship is not obvious, multivariate analysis between the dependent variable and the independent variables can give results which can be used in forecasting.

### **ii) Normative methods**

Normative methods begin with an objective/ goal and work backwards to the present to find out the best approach to realise the predetermined objective. This is need-based in which needed capabilities are identified for the achievement of the goals. Some of the available normative techniques for TF are:

**Network techniques:** These techniques are used for mission-oriented planning exercises mainly to analyse the road blocks to achieve the final target of objective. These are widely used and known mainly as SOON charts (Sequence of opportunities and negatives).

**System for Event Evaluation and Review (SEER):** This is a modified variance of Delphi ideal for corporate exercises not necessarily the ones aimed at consensus. This consists of a single round of event evaluation.

**Cross-impact analysis:** Different events interact with different strength towards other course of events, and forecasts are made using these interactions and random numbers so as to derive combine forecasts or for depicting the interaction of events.

**Morphological analysis:** This is a method for structured thinking identifying all possible system alternatives. The main idea behind using this method is not to miss any options.

**Relevance trees:** A number of steps may be available to achieve a given objective but each step may be different in its effectiveness in terms of cost or profit or probability of success. Evaluation of these multiple choices may be done through decision trees.

**Dynamic modeling:** These are computer aided structural modeling techniques in which time varying effects can be explicitly considered. Examples: Forvestor model, Mesarovic model, Meadows model (club of Rome), etc.

Some of the methods are simple variants of techniques used in other areas. These methods are mainly used to eliminate subjective errors associated with intuitive forecasting techniques.

### Criteria for application of TF

Few searching questions that are relevant for application of Technology Forecasting are:

1. Is the system prepared to absorb / contribute to arising technology needs of the society
2. Does the system has any mechanism to
  - anticipate changes?
  - assess needed technologies?
  - assign strategies to implement the technologies?

### Choice of techniques

The choice of selecting techniques for a particular situation is a complex problem, and depends on many factors such as:

- \* Purpose for which the forecast is being made
- \* Reliability needed
- \* Precision of the data
- \* Time period and resources available
- \* Ability to combine various interacting factors

The cost of using different forecasting methods vary considerably, dynamic modelling being more expensive. In general, the cost increases with the accuracy needed. It is preferable to use a combination of methods for improving the reliability of forecasts through mutual reinforcement.

The approaches to be selected for forecasting and elements to be assessed in forecasting will depend on the purpose for which technology forecasts are being prepared. Technology forecasting techniques are used based on purpose (Holroyd, 1979), and various methods used for each of the purpose are given in the Table - 2., and their applications are given in Table-3.

**Table-2: Choice of selection of techniques**

| The Technology Forecasting techniques which can be used in search of |                  |                      |                                |                         |     |
|--|------------------|----------------------|--------------------------------|-------------------------|-----|
| Problem identification   | Relevant factors | Trends or parameters | Relationships among parameters | Implications for action | for |

|                |  |               |   |                        |
|----------------|--|---------------|---|------------------------|
| Brainstorming  | Brainstorming                                    | Extrapolation | Dynamic modelling                       | Expert consultation    |
| Delphi         | Delphi   | Growth curves | Morphology                              | Scenario building      |
| Expert opinion | Expert opinion<br>Monitoring<br>Scenario writing | Substitution  | Cross-impact analysis<br>Relevance tree | Modelling & Simulation |

**Table-3: Application of technology forecasting**

| Technique              | Questions it tries to answer  | Applications  |
|------------------------|---|---|
| Trend extrapolation    | Past versus future<br>Is there a rate change?<br>Why rate is declining?<br>Future performance levels<br>Total market size                     | R&D Market planning<br>Corporate planning                                   |
| Growth curves          | Is there a limit?<br>Sales growth of new product<br>Setting up new plant capacity   | New product identification<br>Production                                    |
| Delphi                 | When can, will or should certain events occur<br>Setting up goals<br>What are the elements of future  | R&D<br>Market research<br>New product identification<br>Long range planning |
| Morphology             | Can we have a new way?<br>Did we consider all alternatives?<br>Listing diversification alternatives   | Value engineering design<br>R&D Marketing                                   |
| Cross-impact analysis  | Can interaction of events delay or accelerate the growth?   | LRP<br>R&D  |
| Relevance tree         | Target-orient planning<br>Problem solution convergence  | R&D   |
| Mathematical modelling | Thought provocation R&D<br>New products<br>How to assess alternative policies?<br>How to change course of action to achieve a desired result? | Policy analysis<br>R&D<br>Production marketing<br>LRP                       |
| Scenario writing       | Innovation stimulation<br>Consideration of all interactions<br>Organisational alternatives  | Policy planning<br>LRP<br>R&D New products                                  |
| Technology monitoring  | What are the new areas?<br>What are the likely new products?<br>Prediction of break through<br>Threats to the existing products               | R&D<br>Production   |

|              |   |  |
|--------------|---|--|
| Substitution | Production demand/replacement decisions | R&D<br>Marketing<br>New product demand |
|--------------|---|--|

### Case-1: Delphi study of future of Indian agriculture

The results of Delphi study conducted during 1976-77 to forecast the future of Indian Agriculture (Rohtagi et al, 1979) are given below. The expert panel for this study consisted of scientists and faculty from universities and R & D laboratories and administrators from government departments. The questionnaires were sent to 143 persons in the first round. But the actual respondents were 39 in the first round and 23 in the second round. The experts were asked to indicate the year of achievement of the events. Some of the forecasts and the actual achievements, wherever applicable and available, are given below:

| Event  | Forecast(achieving year) | Actual achievement |
|--|--------------------------|--------------------|
| Total irrigation to 50 m.ha.                       | 1992                     | Achieved           |
| Double crop to 50 m.ha.                            | 1993                     | Achieved           |
| Food grains to exceed 141 m.t.                     | 1982                     | Achieved 1983-84   |
| 75% bread fortification by soybean                 | 1991                     | Not achieved       |
| Fertilizer consumption of 50 kg/ha of cropped area | 1988                     | Achieved           |
| Fertiliser consumption of 75 kg/ha of cropped area | 2003                     | Likely to exceed   |
| Post harvest losses below 10%                      | 1986                     | Achieved           |
| Post harvest losses below 5%                       | 1998                     | Not possible       |
| Milk to exceed 40 m.t.                             | 1992                     | Achieved 1985      |

### Case-2: Delphi study of future of sorghum in India

A forecast of sorghum scenario in India was carried out using Delphi and trend methods (Rama Rao and Kiresur, 1992). The sorghum data for total cropped area and total production during 1950-1990 indicate great deal of fluctuation owing to various factors such as demand, prices, rain fall, seed quality and farmers priorities. The remarkable drop in area under Sorghum during late 1960s is noteworthy. This was a forced situation mainly due to near constant demand coupled with enhanced yield due to introduction of HYVs in this period i.e. green revolution. Given such an uncertain situation, forecast of sorghum was made in terms of its cropped area, production, productivity, demand for alternate uses and relative price structure.

**Scenario during 1992:** India is the largest producer of sorghum with about 11 per cent of the total area under food grains (128 m.ha) and 7 per cent of the total food grain production (172 m. tonnes) during 1990-91. Rabi sorghum is grown in an area of about 5.9 m.ha. and its productivity is 594 kg/ha. Because of its good quality it is preferred for human (traditional) consumption. About 71 per cent of the total sorghum production comes from kharif crop which is grown in a larger area (8.6 m.ha) and has improved productivity (974 kg/ha.). Though the production and productivity are high, its relatively poor quality has led to low demand. Thus, there is a gradual reduction in its area over the years. This situation may not change unless and until superior quality varieties/hybrids are evolved and/or alternate uses are made feasible.



**Forecast:** The forecasts made by Delphi are presented below:

| Forecasted Parameter/Event   | Actual for 1990-91 | Forecast for 2000 AD |
|--|--------------------|----------------------|
| Area (million ha.)   | 14.50              | 12.00                |
| Production (million tonnes)  | 11.88              | 12.09                |
| Yield (kg/ha)  | 819                | 949                  |
| Percentage area under HYVs   | 52.1               | 60.0                 |
| No. of years for sorghum to become attractive for alternate uses.....: | N.A.               | 10                   |

The forecast for area under HYVs is 67 per cent by trend method and 60 per cent by Delphi method; the latter appears logical since increased area under HYVs should reflect in decrease of cropped area as the rate of demand change is unlikely to increase by 2000 AD. With regard to the procurement prices of cereals, the forecast indicates continuation of government policies as in the past. To promote sorghum production, the experts strongly opined for a relatively higher support price than now. This refers to governmental policy on food grain procurement. As a corollary to present forecast, the total cropped area will decrease to about 10 m. ha. when the average yield increases to about 1500 Kg/ha. But the forecast does not indicate such a possibility by 2000 AD. However, this will be relevant as a long term forecast or alternatively should there be any breakthrough on the HYVs front. Another area of concern is the advancements in dry land crops. Any breakthrough in these crops will have severe impact on sorghum as such crops are likely to grow at the expense of sorghum.

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# ECONOMIC EVALUATION OF RESEARCH PROJECTS

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## INTRODUCTION

The basic economic problem facing all countries, but particularly the developing countries, is of allocating limited resources such as labour, capital, land, other natural resources and foreign exchange to many different uses such as current production of consumer goods and public service or investments in infrastructure, industry, agriculture, education, family planning and other sectors in such a way that net benefit to the society is as large as possible. Given the limitations of resources, choices should be among the competing uses and project analysis is one method of evaluating alternatives in a convenient and comprehensive manner

India being one of the largest agricultural research system in the world. A huge amount of funds are being spent on agricultural research. Among developing countries, India's research expenditure is exceeded only by Brazil. The Government of India through several agencies provides about 60 per cent of all funds, State Government about 20 per cent, private companies about 12 per cent and foreign agencies provide the rest (World Bank, 1990). India spending on public agricultural research averaged Rs 1228 lakhs per annum during 1965-68, and it increased to Rs 39,280 lakhs by 1989-92 registering a growth rate of 1.13 per cent per annum.

With accelerated growth of agriculture, new and multiple problems are emerging. The existing agricultural research system is under great strain as the future research is going to be more complex, more difficult and more costly. On the other hand, the funds allocated to agriculture research becoming scarce. The percentage plan outlays for agricultural research and education decreased from 0.535 percent in IV plan to 0.236 percent in VII plan. Therefore, economic evaluation of investment on agriculture research help to estimate economic viability of the research project and prioritization.

### Concept development

Agricultural research results into evolvement of new commodities/product; new package/process and correct information/ knowledge so that existing factors can produce higher output per unit of their use. In other words, research results led to increase the productivity of total factor or total factor productivity. Therefore, the change in productivity of total factor in agriculture is attributed to research.

The other point that is to be kept in mind is that research at a point of time does not bear fruits immediately. There exists a time lag between the research investments and returns to research. The time lag may vary from commodity to commodity and process package to process package. The time lag of research is more than the time lag of extension investments. The average time lag (T) found by various research studies in agricultural research is six to eight years. It is not like that the research investment will start yielding return only in the year T+6 but the contribution of investment in period T+1, T+2 goes on increasing.

The technological knowledge derived from agricultural research generates benefits not by itself. It depends on actual adoption of new technology in agriculture and spread of information (transfer of technology). Therefore, the rate of adoption of particular technology must be known to calculate benefits. Responsibility for bridging the gap between the research worker and the farmer rests primarily with the agricultural extension service. This

reduces the research time lag and results in higher returns to research investments. Similar concepts we use in economic evaluation of research projects.

#### Models for evaluation

The economic evaluation of the research investment could be done at two points of time: Ex-ante and Ex-post.

##### **A. Ex-ante evaluation models.**

1. Scoring models
2. Benefit cost approach
3. Simulation approach
4. Mathematical programming approach

##### **B. Ex-post evaluation models.**

1. Economic surplus approach
2. Production function approach
3. National income approach
4. Nutritional impact approach

There are some other statistical parameters, which give idea of agricultural research investment at a point of time rather than over a long period of time. These parameters are Agricultural Research Intensity (ARI), Research Investment per unit of land and per researcher, and agricultural GDP per rupee of research investment. The ARI is a ratio of Agricultural research investment to the agricultural Gross Domestic Product (GDP). The ARI has increased in India from 0.099 percent in 1966-69 to 0.267 percent in 1989-92. It is still considered to be low because FAO emphasized that ARI should be at least 1%. The research investment per unit of land is also known as Factor-Intensity Ratio (FIR). A problem with taking the FIR at face value is that it fails to take account of the inter-regional difference in input quality. To calculate research expenditure per researcher, the research personnel engaged in research are converted to Scientific Man Years (SMYs), and total research expenditure is divided by SMY unit. The expenditure per researcher increased from Rs 0.73 lakhs during 1965-68 to Rs 2.47 lakhs during 1986-89 at current prices registered a growth rate of 1.05 percent per annum. However, the 70 per cent of total expenditure per researcher goes towards salaries and very less operating funds are left with the scientists.

The agricultural GDP per rupee of research expenditure vary over time and across regions in response to the variety of factors. These include change in the level of composition of the output basket, changes in the quality and level of utilization of other inputs that are either substitutes or complements in production. In India, agriculture GDP per rupee of research expenditure decreased from Rs1041 in 1965-68 to Rs 385 in 1989-92. This parameter is at limited use because there are lags in the research process itself and further lags in the uptake of new technologies. Thus, interpretation of agricultural output relative to contemporaneous agricultural research expenditure as a partial research productivity measure has to be done with due caution.

## **STRUCTURE OF PROJECT EVALUATION**

### **Appraisal and evaluation**

The term appraisal means the process of identifying, defining and quantifying the likely or expected impacts of action (a practice) or closely related set of actions (a project). Some of these impacts are seen as benefits, while others as costs.

Economic appraisal and evaluation helps the decision-makers who are saddled with the responsibility to prioritize measures in a situation with enormous needs and quite limited resources. Government planners as well as donor agencies are all in need of enough data in order to make rational choice or decision in selection of investment alternatives. Most of the economists believe that economic analysis cannot give the final answers. There will always be lack of data, uncertainty about the future, disagreement on the methods, and similar issues. However, economic analysis, if properly done, can indeed be of much help to decision makers

### **Cost-benefit analysis:**

Cost-benefit analysis (CBA) is a highly structured method to organize information and quantify social advantages (benefits) and disadvantages (costs) in terms of a common monetary unit. Benefits and costs are primarily evaluated on the basis of individual's willingness to pay (WTP) for goods and services, whether they are actually marketed or not. Unquantified effects (intangible) are described and put against quantified values. CBA analysis is required for the following reasons:

- (i) Market deficiencies, lack of information, externalities, risk, monopolies, etc. may create a difference in the private *versus* the social perspectives. Thus, reliance on the market forces is insufficient.
- (ii) Government distortions, trade barriers, wage legislations, pricing policies, etc., affect land management and hence need to be analyzed. Thus, reliance on the market forces is insufficient.
- (iii) Resources are limited; somehow the allocation of resources between sectors (industry and agriculture) and within sectors (conservation here or there) has to be decided. CBA can be a guide.
- (iv) Attraction of external resources "the aid fatigue" among donor country and public opinion can only be fought by demonstrating the efficiency.

To apply CBA, some key concepts are given as under:

Willingness to pay (WTP) is considered to be the basis for CBA. This is the amount of other goods or services that an individual is prepared to give up to be able to acquire something. It may be noted that there may be a WTP for non-marketed goods (fresh air, etc.), hence it is a benefit relevant to CBA.

Another crucial concept of CBA is "opportunity cost". This is the benefit forgone by not using a resource (such as labour, land and capital) in its next best alternative (such as the job somebody would have without our project). In other words the opportunity cost is the WTP for a resource's alternative use.

### **Criteria for appraisal and evaluation**

Project analyst should determine the worth of a project under three situations:

- (i) Determining the project worth in the planning itself – appraisal or ex-ante evaluation.
- (ii) Evaluation of the on going projects – concurrent evaluation.
- (iii) Evaluation after completion of project – ex-post evaluation.

Ex-ante evaluation is carried out before actual implementation of the project to assess its economic feasibility in advance and to know whether the particular project is

capable of achieving the basic objectives of the plan i.e. whether the project is economically sound or not.

There may be one or many on-going evaluations in between ex-ante and ex-post evaluations so that one can know the way things are happening during the project implementation period i.e. whether the project implementation and its outcome is going on the stipulated path or not. Such method of evaluation of the project would help in putting the project implementation process on right direction and hence, help in reducing the gap between what was anticipated and what is actually to be realized from the project concerned.

Nevertheless, the ability to define failure is even more important than ability to document successes. It is possible only by knowing where things have gone wrong in the past that one can hope to achieve success in the future. Thus, ex-post evaluation of project is equally important. Ex-post evaluation is done after the completion of the project so as to know whether the project has actually achieved its objectives or not. If not, upto the desired extent then the evaluation will reflect the deficiencies in the present project that may be rectified in future ones.

### **Public versus private analysis**

If BCA is conducted from viewpoint of a private firm, who have a single minded profit maximising objectives, not only the direct and market, but both real and pecuniary benefits, it is known as financial analysis or private benefit-cost analysis. When it is possible to raise enough funds, it is said that the project is financially feasible.

If the analysis is done from the point of view of the public i.e. society as a whole, then the objective should not be mere profit maximization. Welfare of entire society is then the objective function. In such cases only real (including direct, indirect and non-marketed) benefits and costs are taken into account and the exercise is called *social benefit-cost analysis or economic analysis*. For example, taxes are costs and subsidies are benefits in the evaluation of a private project but not in the public project. If it is found that the present worth or net benefits of the project is positive, then it is said to be economically feasible. It is not necessary that every project that is financially feasible will also be economically feasible and vice-versa. However, a project must be both financially and economically feasible. In addition, a project must also be environmentally sound.

In a private analysis both the costs and benefits are those, which affect the financial status or balance sheet of the firm. In a public analysis, the benefits of a public project are defined in terms of the willingness of the consumers to pay for the goods and services generated by the project, and is measured in terms of change in 'consumer surplus'. Similarly the costs of a public project are measured by the 'opportunity costs' of resources to be used. Another major difference between these two types of analyses, public and private, is in the choice of the rate of discount. From the point of view of society, the appropriate discount rate to be used is the social discount rate. In the case of a financial analysis the rate used will be the firm's opportunity cost of capital.

Benefit-cost analysis in soil and water conservation and watershed management projects should be done from the point of view of society as a whole as far as possible because there are many benefits and costs that appear as non-marketed. External or public good effects can be easily incorporated in social analysis while it is difficult in private analysis.

## **Basic economic and evaluation principles**

The final phase in the project cycle is evaluation. It is intended to become the basis for investment decisions to know the elements of success in the project and learn how better to plan for future. The evaluation of project may be done either with or without project, or better and after the project.

### **With and without project**

Evaluation of soil and water conservation and development projects may be made with and without the plan. Costs and returns are measured at their exchange value, at the time to accrual. This approach becomes analytical device for determining the effects of various measures of formulation and evaluation phases. The anticipated need for land, water and other related goods, future land use as related to productivity should be projected both by time and productivity. Thus, with the technique of project evaluation one needs to make estimation for the likelihood output from the project area and also the surrounding agro-climatic region.

### **Before and after project**

Another method for evaluation of a project on soil water conservation and watershed management is before and after project. In this, input and output data are collected from the project area at two points of time, i.e. before start of the project and after completion of the project. This method is more accurate but it needs more time for evaluation. Secondly, this method cannot be applied in the appraisal of the project i.e. ex-ante evaluation. Secondly, this method cannot be applied in the appraisal of the project i.e. ex-ante evaluation. Thirdly, it fails account for changes in production that would accrue without the project and thus, it may over estimate the benefits of the project.

### **Technical data collection**

It is very important to collect and analyse the current information on input use, output produced and their prices. This represents the key components in the evaluation of conservation measures. The information is collected on cost paid for items such as, (a) equipment and power, (b) seeds and fertilizers, (c) labour, (d) irrigation, and (e) construction operation and maintenance of resource management systems. Such information should be maintained at district or state level so that it is easily available. The cost resources are estimated by systematic listing of physical resources used in the production and it provides value of each resource on hectare basis.

### **Identification of input and output of a project**

- (i) **Identification of inputs:** Programmes / projects involve a set of new or altered activities directed to obtain maximum possible production per unit of area on sustained basis. The inputs are costs and may occur either on-site and / or off site. The inputs involved in these programmes are, use of the factors of production (land labour and capital) over and above the level of their use without the project.

The first and foremost aspect is to enlist the inputs and their quantity required along with its time of requirements. These inputs may be categorised into five sub-heads as given

## Examples of inputs needed for a project

| Category of inputs | Description  |
|--------------------|--|
| Manpower           | <ul style="list-style-type: none"> <li>- Resource Managers – forest, range, watershed managers and planners.</li> <li>- Engineers and hydrologists – design of erosion control structures, flood plain analysis, water yield estimate, etc.</li> <li>- Subject matter specialists – experts from various fields: soil, agronomy, horticulture, Animal science, social science, etc.</li> <li>- Skilled labour – construction.</li> <li>- Unskilled labour.</li> <li>- Training / extension specialists to facilitate adoption of project.</li> </ul> |
| Equipments         | <ul style="list-style-type: none"> <li>- Detailed listing of equipments needed for construction, gauging and maintenance.</li> <li>- Schedule of needs, i.e. timing.</li> </ul>  |
| Land               | <ul style="list-style-type: none"> <li>- Land classified according to suitability for various uses.</li> <li>- Designate sensitive areas to be protected (Benefits foregone).</li> </ul>   |
| Raw materials      | <ul style="list-style-type: none"> <li>- Areas to receive treatments followed by management.</li> <li>- Utilities (energy, fuel, etc.)</li> <li>- Wood (construction, fence posts, etc.)</li> <li>- Other construction materials (concrete).</li> <li>- Water.</li> </ul>  |
| Structures and     | <ul style="list-style-type: none"> <li>- Housing, roads, other facilities needed for civil works project that are not part itself: if part of project, they are included in manpower, materials.</li> </ul>  |

(II) **Identification of output (benefits):** The benefits accrued from soil and water conservation programme are numerous / multiple. The first step in this is to identify those benefits, enlist them and group them in to following five broad categories.

➤ **Economic benefits:** Those benefits which can be measured in physical terms and valued at market price; these include:

- 1 Additional crop production from the catchment restoration / reclamation of land, development of new topsoil, introduction of new crop technology, etc.
- 2 Additional crop production from increased irrigation potential through soil and water conservation.
- 3 Additional production from trees, horticultural plants, grasses, etc.
- 4 Sustained yield.
- 5 Increase animal production.
- 6 Additional income from fish, etc, through developed water resources.
- 7 Increase in net income and reduction in income-inequality.

**Protective or ecological benefits:**



This group includes those benefits, which are mostly intangible and cannot be included, when the project is evaluated from private point of view. These are generally in one category called as externalities from the project.

- (i) Area directly protected against erosion, such as, gullying, stream bank erosion, etc.
- (ii) Protection of existing production from land liable to be lost as a result of erosion.
- (iii) Appreciation of the value of land restored to new production system.
- (iv) Proportionate investment on dam and its commands protected / proportionate loss due to flood hazards likely to be reduced.
- (v) Proportionate damage to crops, trees, grasses, etc., due to erosion, floods/drought prevented.
- (vi) Increase recreational value.
- (vii) Enrichment or maintenance of genetic diversity.

**Environmental benefits:** The environmental benefits are:

- (i) Preservation of ecological diversity and control of floods.
- (ii) Protection of soil, water and air-quality.
- (iii) Control of industrial pollution.
- (iv) Bio-diversity maintenance.
- (v) Better microclimate.
- (vi) Halting deforestation and desertification for the purpose of long-term national security.
- (vii) Landscape aesthetics.

**Secondary benefits to the community:**

Project can lead to benefits created outside the project itself. These are termed as secondary benefits or technological externalities. For the economic analysis of the project, these secondary benefits must be accounted for so that you can be properly attributed to the project investment. Due to non-availability of data and the techniques to convert them into money value it becomes difficult to consider all these benefits / costs aspects of soil and water conservation programmes for its evaluation.

**Valuing inputs and outputs**

Prices used in evaluation studies should reflect the exchange value or price relationship prevailing at the time of analysis.

The basic measure of value used is willingness to pay (w.t.p.). It measures the willingness of society or individual to pay for each marginal unit of goods and services. In a perfectly competitive market, market price or transaction price (the price at which market exchange occurs) adequately reflects the willingness to pay for goods and services in question. One should use market prices for goods and services until they are not distorted significantly.

**(a) Market price**

- (i) Market prices are often more readily accepted by decision-maker than artificial values derived by the analyst.

- (ii) They are generally easy to obtain both at single point of time and over time.
- (iii) They reflect the decision of a large group, the society, rather than decision of a single analyst or an administrator.
- (iv) Inflationary and deflationary affect (purchase power of money at a particular time) can easily be minimized.

The second common measure used in valuation of input and output in question is “opportunity cost” (O.C.). It is an extremely important concept; serves as a general guides in valuation of input and output. The opportunity cost represents the value of goods and services in the next best (second best) alternative foregone when the resource is used in best one alternative rather than the other. A farm family had certain amount of available work force, which he can use on his field (x) or on other wage earning jobs (y) at a particular time. Then the opportunity cost of using labour in activity X is the value of production foregone by removing / not using that labour in the next best use ‘Y’. In this situation the opportunity cost would be greater than zero. In the identification of price/cost as a medium benefit, which was sacrificed, one must be careful in defining the alternative opportunities realistically, bearing in mind the real feasibility and not merely technical feasibility. The same is true for benefit side and other resources too.

When the market is imperfect, existing market prices are considered as inadequate for direct measurement of economic value and adjusted to reflect the true scarcity of the resources in the economy. These adjusted prices are called ‘shadow prices’. Calculation of shadow prices, are required when government subsidises on prices of inputs to encourage investment on them. The second case where shadow prices are required pertains to those goods and services for whom market prices are not available e.g. environmental goods. The shadow prices may be obtained either using surrogated market prices or cost price approach.

### **(b) Surrogated market prices**

In this case, costs and benefits do not have market value but there exist clear substitutes for them for which market value exists. In this situation one can use the prices of substitute's adjusted market prices as a proxy value or surrogate prices for the resource or goods in question.

### **(c) Cost prices**

In some cases where it is not possible to derive acceptable price measure of value, it is possible to assign some value to them thorough personal judgement. Another method is to derive minimum values for some benefits through cost of producing it. It is often called cost-price analysis, e.g. travel cost approach. Cost-price analysis is generally used in ex-post analysis only.

### **Price base and indices**

Prices used in the evaluation studies should reflect the exchange value or price relationship prevailing at the time of analysis. Using constant prices or current prices for valuation may lead to analysis results that may not be readily acceptable to major section of the society. Under such circumstances, moving averages are calculated on the basis of commodities for a period of five years. It is a good estimate for establishing sound price relationship for resource management system and inflationary and deflationary effect is taken into account upto some extent.

Indices are devices for comparing values of construction / production items and prices for goods and services for one specified year with those for any other year. Base year (Index = 100) are established for each of these indices. The following example will illustrate the method of indexing:

**Problem:** Changing 1979 cost to a 1994 price level (replacement cost) where 1977 = 100)

|                    | Year | 1979 | 1994 |
|--------------------|------|------|------|
| Construction index |      |      |      |

Adjustment factor =  $198/144 = 1.74$

1979 cost x 1.74 = cost in 1994 (replacement cost)

### Interest rate

Money is the scarcest resource used in the soil and water conservation and watershed management programmes. The rate of interest is the payment for use of money i.e. the price for use of money. Factors that must be considered include market rate of interest, risk, price fluctuation, life of the project and source of finance. If funds are borrowed, the interest rate applicable must at least be equal to the time and length of time for which the loan is needed. If funds are not borrowed, the rate will depend on the desire for an opportunity of obtaining the returns from using that amount in other project opportunity i.e. opportunity cost of money.

### Discounting the present value of future

A future rupee is worthless today than a present rupee. If the price represents a benefit, the value of the benefit is less; if it represents a cost, the cost is less in the future than in the present. Of all the concepts of benefit-cost analysis, this is one of the most difficult to comprehend. Yet it is certainly one of the most indispensable concepts in the analysis. The discount rate is yet another name for the rate of interest society should charge itself for the opportunity cost of time. Time is the most irretrievable loss of all. As time goes on, investment opportunities are inevitably lost. Therefore, one wishes to use time as efficiently as one can. This is the ultimate objective of discounting. The appropriate rate of discount is that rate which represents the rate of return on alternative investments of equal degrees of risk. The discount charged against a particular project thus represents the opportunity cost of giving up the total, overtime, and return accruing to an alternative project. Discounting is not done for the purpose of real value of money or inflationary or deflationary trend of price adjustment.

After identification of input used, output produced and price tag to be attached to them, various concepts and terminologies used in costs and returns in the evaluation of projects are discussed below:

**Cost:** In a broad sense, a cost is any thing that reduces an objective. The concept of cost is amenable to various interpretations. It is useful to begin with clear understanding of what cost stands for in the context of benefit-cost analysis. In the broad sense the cost incurred in a project may be grouped into two, viz., direct costs and indirect costs.

**Direct costs:** Direct costs are those expenditures which are directly chargeable to each and every activity of the project, e.g. cost of manpower, equipment utilized, material consumed, etc. They are called direct costs because it is possible to apportion or allocate them directly to the activities of the projects. The various concepts under direct costs are:

- (i) **Installation costs:** These costs include initial construction for the resource improvement, viz., engineering services, land rights, project administration cost, legal fees, etc.
- (ii) **Associated costs:** These include values of goods and services needed over and above the installation costs to achieve expected benefits. These are amortized over economic life of the project at interest rate available from the banks/borrowing from the government.
- (iii) **Operation and maintenance costs:** These represent the value of materials, equipment and services needed for operation, repair and replacement value for sound operating conditions of the equipment during their economic life.
- (iv) **Annual equivalent costs:** These are the amortization of the installation costs over the expected economic life at the interest rate established for evaluation purposes.
- (v) **Average annual costs:** Such costs are the sum of the annual equivalent costs and the estimate of yearly operation, maintenance and replacement cost, etc.

**Indirect cost:** Indirect costs are those expenditures which cannot be allocated to any individual activity of the project or project as a whole as such but the persons within the project or outside the project have to bear these costs. A typical example is the pollution of air or water by industrial plants. The discharge is a by-product of the industrial process, which results in net disbenefits to the surrounding population. The people affected are not generally compensated for their discomforts by those responsible for it.

**Returns:** The ultimate output of any project is to be valued in monetary terms i.e. the return which is to be compared with costs involved in it. It is the product of output produced by a project and its prices, and is termed as returns. The most widely used term in the evaluation of projects is benefits / gross returns and net income.

**Gross returns/benefits:** It is a simple product of output produced and prices of output. In this no allowance is made for cost incurred in obtaining such returns. The gross returns / benefits are of limited use alone but have wide applicability in project analysis.

**Net income:** It is the product of gross return minus total involved in it. This term is sufficient to state the economic feasibility of the project in itself. If net income received from a project is positive it shows that the project is economically sound.

### **Period of analysis**

One of the important aspects in the economic analysis of the projects is the length of period to be included in the analysis. If the analysis of project is to be made from private point of view i.e. financial analysis, then the period of analysis should be same as the economic life of the project. However, when the analysis, the period of analysis should be as

long as the benefits and costs occurred. For example, an irrigation project in which construction of cement lined tank in hills has a useful physical life of 30 years in terms of providing irrigation water to the horticultural crops and thereby increase in output. But there are associated environmental benefit/costs that continue for next 10 years after physical life of the project. In such situation financial analysis will include only 30 years, while economic analysis should 40 years as project life.

If there are no major environmental effects that extend beyond physical life of project, two factors are then important in selecting appropriate time horizon: first the expected useful physical life of the project, and second the level of discount rate used in the economic analysis.

When project outputs diminishes or ceases altogether, the effective project life can be considered as completed. The discount rate has reciprocal relationship with period of analysis i.e. higher the discount rate factor; shorter will be the time horizon for analysis. This is because discount rate acts progressively to reduce the present value of future benefits (or costs). It is a common practice to select shorter time horizon for analysis by selecting higher discount rate to simplify the calculations

### **Organization of project evaluation**

The evaluation of any specific project must correspond to national goals and conditions within the total economy. Thus, it is necessary for individuals working in the field to have guidance on certain parameters from central agencies charged with defining these overall objectives and conditions. The social rate of discount is an obvious case. This parameter presumably reflects the state of capital shortages in the economy as a whole, together with the total menu of projects competing for public funds. Only a central agency is equipped together with this information and only such an agency can afford the high level of economic sophistication necessary to interpret the capital markets sufficiently to arrive at reasonable discount rates. In addition, it may be decided at political levels that projects serving certain kinds of groups and activities, or regions, should be implicitly subsidized by lower benefit-cost ratios than applied to other projects.

Another area in which some degree of centralization is desirable is in economic analysis itself. Project evaluation may require a high degree of technical skill and imagination. It is also desirable to have a core of people available for review and friendly criticism of the various evaluations that are performed and to aid in solving some of the more difficult problems, such as, mathematical programming or computer simulations.

### **Usefulness of project evaluation**

A 'project' differ from other planning type enterprises is that 'it has a specific beginning, a specific ending and a specific objective' (Gittinger).

First, it requires a great deal of hard work and thought in specifying the exact details and timing of all the constituent parts of a project. Secondly, when the beginning, end and objectives of project are specified in measurable terms, one is in a position to ascertain both success and failure of the project.

Following are the four sources of usefulness of project evaluation:

- (i) Ex-post evaluations of past projects is carried out to know where things have gone wrong in the past that one can hope to achieve success in the future.

- (ii) In course of formulating activities in project terms, many problems are encountered on paper that would otherwise be encountered on the ground. If these problems are anticipated in advance, the project can be designed to solve, avoid or at least minimise these problems.
- (iii) It serves as an important communication function. Engineers and physical scientists think in terms of calories, cosec's and the like, policy makers think in terms of rupees of costs and benefits. Thus, much of the communication problems of the two cultures of science and policy makers may be bridged up by the technique of project evaluation.
- (iv) It is desirable to have a few good projects rather than many bad projects; the CBA techniques help in discriminating the good and the bad.

Example – I: The cost and benefit streams of earth fill dam small-scale irrigation project is shown in the following table. Calculate Net Present Value at 12% discount rate.

**Table 1. Calculation of NPV.**

| (In 000 Rupees) |              |                         |                 |                 |                |              |                        |               |
|-----------------|--------------|-------------------------|-----------------|-----------------|----------------|--------------|------------------------|---------------|
| Year            | Capital Cost | Operation & maintenance | Production cost | Total costs     | Total benefits | Net benefits | Discount factor at 12% | NPV           |
| (1)             | (2)          | (3)                     | (4)             | (5)=(2)+(3)+(4) | (6)            | (7)=(6)-(5)  | farm table (8)         | (9) = (8)x(7) |
| 1.              | 7500         | -                       | 0               | 75000           | 0              | -7500        | .893                   | -6698         |
| 2.              | 6000         | -                       | 0               | 6000            | 0              | -6000        | .797                   | -4782         |
| 3.              | -            | 600                     | 700             | 1300            | 6000           | +4700        | .712                   | +3346         |
| 4.              | -            | 600                     | 700             | 1300            | 6000           | +4700        | .636                   | +2989         |
| 5.              | -            | 600                     | 700             | 1300            | 6000           | +4700        | .567                   | +2665         |
| 6.              | -            | 600                     | 700             | 1300            | 6000           | +4700        | .507                   | +2383         |
| 7.              | -            | 600                     | 700             | 1300            | 6000           | +4700        | .452                   | +2124         |
| Total           |              | 13500                   | 3000            | 3500            | 20000          | 30000        |                        | +2027         |

NPV at 12% = 2027

Since the NPV is positive at 12% discount rate, it is expected that the project will yield more than 12 per cent gain. The project may be accepted.

#### **Example-2: To calculate internal rate of return of the costs and benefits**

Internal rate of return (IRR) is the discount rate which makes the net present value come out to zero. The another way to find IRR is the discount rate which will equate discounted benefits with discounted costs.

There is no direct procedure to determine the IPR on 'first try'. The only way to go through the process of successive approximations. The method requires calculating the net

present value (NPV) with several trial rates, and when the net present value changes from positive to negative (or vice versa), interpreting to arrive at the estimated internal rate of return. It is suggested that while calculating the IRR, an interval of 5 percent of interest rate may be used. With experience, different increments can be used.

In the example of table 1, we calculated NPV at 12% discount rate which came +2027. Since the 12% discount rate yield positive value, the discount rate which will equate present net benefits with zero is higher than 12%. Raise the trial discount rate to 15% and see if the net present value is still positive (table 2)

Table 2. Calculation of IRR

(in 000 Rupees)

| Year  | Total Cost | Total bene- | Net bene- fits | Dis- count factor at 12% | NPV at 12%   | Dis- count factor at 15% | NPV at 15%   | Dis- count factor at 20% | NPV at 20%    |
|-------|------------|-------------|----------------|--------------------------|--------------|--------------------------|--------------|--------------------------|---------------|
| (1)   | (2)        | (3)         | (4)=(3) (-1)   | (5)                      | (6)=(4) x(5) | (7)                      | (8)=(4) x(7) | (9)                      | (10)=(4) x(9) |
| 1.    | 7500       | 0           | -7500          | .893                     | -6698        | .870                     | -6525        | .833                     | -6248         |
| 2.    | 6500       | 0           | -6000          | .797                     | -4782        | .756                     | -4536        | .694                     | -4164         |
| 3.    | 1300       | 6000        | +4700          | .712                     | -3346        | .658                     | 3092         | .579                     | 2721          |
| 4.    | 1300       | 6000        | +4700          | .636                     | +2989        | .572                     | 2688         | .482                     | 2266          |
| 5.    | 1300       | 6000        | +4700          | .567                     | +2665        | .497                     | 2336         | .402                     | 1889          |
| 6.    | 1300       | 6000        | +4700          | .507                     | +2383        | .432                     | 2031         | .335                     | 1575          |
| 7.    | 1300       | 6000        | +4700          | .452                     | +2124        | .376                     | 1767         | .279                     | 1311          |
| Total |            |             |                |                          | +2027        |                          | +854         |                          | -650          |

Total of all NPV at 15% discount rate if +854.

At 15% it is still positive, so try the exercise again, using a rate of 20 percent. This time the NPV comes out negative 650 (Table-2). Hence, the rate of return is between 15% and 20%.

(i) **An interpolation formula for calculation of IRR:** Substituting in the following formula, it will finally calculate the internal rate of return (IRR).

The present value for

Last discount  
between  
rate which  
yields a positive  
present value +  
IRR

the discount rate  
which gave the lowest  
  
positive total present  
value

Difference

the two discount  
rates mentioned  
in this formula =

The sum, without regard to sign, of the above number plus the present value for the discount rate which yielded the first negative present value

$$15 + \left[ \frac{854}{854 + 650} \times 20 - 15 \right] = \text{IPR}$$

$$15 + \left[ \frac{854}{1504} \times 5 \right] = \text{IRR or } 15 + 2.84 = \text{IRR}$$

$$17.84 = \text{IRR}$$

The IRR for the above project is 17.8%, which is greater than the social discount rate of 12%. Hence the project is acceptable.

**Ex- 3:** Calculation of benefit cost ratio at 12% discount rate of table-1 is given in table-2.

Table – 3. Calculation of benefit cost ratio

(In 000 Rupees)

| Year  | Total Costs | Total benefits | Discount factor | Discount cost at   | Discount at benefits |
|-------|-------------|----------------|-----------------|--------------------|----------------------|
| (1)   | (2)         | (3)            | 12%<br>(4)      | 12%<br>(5)=(2)x(4) | (6)=(3)x(4)          |
| 1     | 7500        | 0              | .893            | 6697               | 0                    |
| 2     | 6000        | 0              | .797            | 4782               | 0                    |
| 3     | 1300        | 6000           | .712            | 926                | 4272                 |
| 4     | 1300        | 6000           | .636            | 827                | 3816                 |
| 5     | 1300        | 6000           | .567            | 737                | 3402                 |
| 6     | 1300        | 6000           | .507            | 659                | 3042                 |
| 7     | 1300        | 6000           | .452            | 588                | 2712                 |
| Total |             |                |                 | 15216              | 17244                |



$$\begin{aligned} \text{B.C. ratio} &= \frac{\text{Total discounted benefits}}{\text{Total discounted costs}} \\ &= \frac{17244}{15216} = 1.13 \end{aligned}$$

Since project has a benefit cost ratio of 1.13 (greater than one) hence it is acceptable.

## Annexure

Discount factors of Present Value of Rs. 1.00 at Interest Rate from 5% to 35%

| Year | 5%   | 8%   | 10%  | 12%  | 15%  | 18%  | 20%  | 25%  | 30%  | 35%  |
|------|------|------|------|------|------|------|------|------|------|------|
| 1    | .952 | .926 | .909 | .893 | .870 | .847 | .833 | .800 | .769 | .741 |
| 2    | .907 | .857 | .826 | .797 | .756 | .718 | .694 | .640 | .592 | .549 |
| 3    | .864 | .794 | .751 | .712 | .658 | .609 | .579 | .512 | .455 | .406 |
| 4    | .823 | .735 | .683 | .636 | .572 | .516 | .482 | .410 | .350 | .301 |
| 5    | .784 | .681 | .621 | .567 | .497 | .437 | .402 | .328 | .269 | .223 |
| 6    | .746 | .630 | .564 | .507 | .432 | .370 | .335 | .262 | .207 | .165 |
| 7    | .711 | .583 | .513 | .452 | .376 | .314 | .279 | .210 | .159 | .122 |
| 8    | .677 | .540 | .467 | .404 | .327 | .266 | .233 | .168 | .123 | .091 |
| 9    | .645 | .500 | .424 | .361 | .284 | .225 | .194 | .134 | .094 | .067 |
| 10   | .614 | .463 | .386 | .322 | .247 | .191 | .162 | .107 | .073 | .050 |
| 11   | .585 | .429 | .350 | .287 | .215 | .162 | .135 | .086 | .056 | .037 |
| 12   | .557 | .397 | .319 | .257 | .187 | .137 | .112 | .069 | .043 | .027 |
| 13   | .530 | .368 | .290 | .229 | .163 | .116 | .093 | .055 | .033 | .020 |
| 14   | .505 | .340 | .263 | .205 | .141 | .099 | .078 | .044 | .025 | .015 |
| 15   | .481 | .315 | .239 | .183 | .123 | .084 | .065 | .035 | .020 | .011 |
| 16   | .458 | .292 | .218 | .163 | .107 | .071 | .054 | .028 | .015 | .008 |
| 17   | .436 | .270 | .198 | .146 | .093 | .060 | .045 | .023 | .012 | .006 |
| 18   | .416 | .250 | .180 | .130 | .081 | .051 | .038 | .018 | .009 | .005 |
| 19   | .396 | .232 | .164 | .116 | .070 | .043 | .031 | .014 | .007 | .003 |
| 20   | .377 | .215 | .149 | .104 | .061 | .037 | .026 | .012 | .005 | .002 |
| 21   | .359 | .199 | .135 | .093 | .053 | .031 | .022 | .009 | .004 | .002 |
| 22   | .342 | .184 | .123 | .083 | .046 | .026 | .018 | .007 | .003 | .001 |
| 23   | .326 | .170 | .112 | .074 | .040 | .022 | .015 | .006 | .002 | .001 |
| 24   | .310 | .158 | .102 | .066 | .035 | .019 | .013 | .005 | .002 | .001 |
| 25   | .295 | .146 | .092 | .059 | .030 | .016 | .010 | .004 | .001 | .001 |
| 26   | .281 | .135 | .084 | .053 | .026 | .014 | .009 | .003 | .001 | .000 |
| 28   | .255 | .116 | .069 | .042 | .020 | .010 | .011 | .002 | .001 | .000 |
| 29   | .243 | .107 | .063 | .037 | .017 | .008 | .005 | .002 | .000 | .000 |
| 30   | .231 | .099 | .057 | .033 | .015 | .007 | .004 | .001 | .000 | .000 |
| 35   | .181 | .068 | .036 | .019 | .018 | .003 | .002 | .000 | .000 | .000 |
| 40   | .142 | .046 | .022 | .011 | .004 | .001 | .001 | .000 | .000 | .000 |
| 45   | .111 | .031 | .014 | .006 | .002 | .000 | .000 | .000 | .000 | .000 |
| 50   | .087 | .021 | .009 | .003 | .001 | .000 | .000 | .000 | .000 | .000 |

# **SAFETY MANAGEMENT IN LABORATORY PRACTICE**

**R.V.S. Rao**

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The task of safeguarding the health of persons at work is a formidable one especially during periods of rapid technological and organizational change. Agricultural research is a multi-disciplinary subject with scientists and their associates working in varied subjects and agro-climatic conditions. Researchers have to take utmost caution in conducting their research so that no mishap occurs as a result of careless planning or conducting of experiments. To understand the subject of occupational hazard clearly, let us study the following terms and their meanings properly.

## **Accident**

“An accident is an unexpected, unplanned event in a sequence of events, that occurs through a combination of causes; it results in physical harm (injury or disease) to an individual, damage to property, a near-miss, a loss, or any combination of these effects”

## **Hazard**

The hazard presented by a substance is its potential to cause harm. Hazard is associated with degrees of danger and is quantifiable.

## **Potential hazard vs actual hazard**

Eg. Snake bite and actual deaths due to snake bites per year in the country

## **Invisible hazard vs visible hazard**

Eg. Deaths due to road accidents vs deaths due to radiation injury per year in the country.

## **Risk**

- The risk from a substance is the likelihood that it will cause harm in the actual circumstances of use. It should be thought in terms of ‘change-taking’.
- Poor control can create substantial risk even from a substance with low hazard. But with proper controls, the risk of being harmed by even the most hazardous substance is greatly reduced.

## **Costs associated with accidents**

- Safety administration and accident investigation
- Medical and treatment
- Cost of lost time of injured person
- Cost of lost time of other employees
- Cost of replacement labour
- Cost of payments to injured person
- Cost of repair to the damaged plant/equipment
- Cost of replacement of damaged materials
- Others costs – transport, fees etc.

## **Types of hazards in agricultural research**

- **Physical**
  - Noise, vibration, light, heat/fire, cold, UV light, infrared rays, Ionizing radiation, sharp/heavy objects, fall from heights, electricity, vibrations, work related upper limb disorders, ergonomics etc.
- **Chemical**
  - Corrosive chemicals (acids/alkalis), inflammable chemicals, explosive reactions, volatile solvents, hazardous gasses, carcinogen chemicals, pesticides etc.
- **Biological**
  - Viruses, bacteria, fungi, protozoa, nematodes, bovine spongiform encephalopathy (BSE), allergic chemicals from plants, animals etc.
- **Stress**
  - Person, work demand, environment, organization etc.

## **Degrees of hazard**

- **Immediate physical danger (Acute)**
  - **Chemical**

Acids, alkalis – corrosive burns
  - **Biological**

Contagious diseases, genetic manipulation (mutagenic/carcenogenic effects)
  - **Psychological**

Short-term trauma – disaster at home or at work, domestic illness-leads to loss of concentration, abruptness with work colleagues
- **Long-term physical danger (Chronic/cumulative)**
  - **Chemical**

Lead (Pb) poisoning, exposure to asbestos fibers, carcinogens and mutagens, chronic poisoning from pesticides and other agricultural chemicals
  - **Biological**

Noise induced occupational deafness

- **Psychological**

Fears connected with fear of failure, unemployment, job-security, lack of career direction and motivation

Oxygen requirement of humans at work

| Degree of work    | Oxygen requirement (l/min) |
|-------------------|----------------------------|
| Rest              | 0.3                        |
| <b>Light</b>      | <b>0.3-1</b>               |
| Moderate          | 1-1.5                      |
| <b>Heavy</b>      | <b>1.5-2</b>               |
| <b>Very heavy</b> | <b>2-6</b>                 |

**Noise level limits for humans**

| Limit of noise exposure | Time of exposure |
|-------------------------|------------------|
| <b>dBA</b>              | <b>Hours</b>     |
| 90                      | 8                |
| 93                      | 4                |
| 96                      | 2                |
| 99                      | 1                |
| 102                     | $\frac{1}{2}$    |
| 105                     | $\frac{1}{4}$    |

**Radiation dose limit for humans**

| Body part                     | Dose limit per calendar year<br>milli sievert (mSv) |
|-------------------------------|---|
| Whole body                    | 50.0  |
| Individual organs and tissues | 500.0   |
| Lens of eye                   | 150.0   |
| Women of child bearing age    | 13 per 3 months                                     |
| Pregnant woman                | 10 for period of pregnancy                          |

**Trainees under 18 years old**

|                               |     |
|-------------------------------|-----|
| Whole body                    | 1 5 |
| Individual organs and tissues | 150 |
| Lens of eye                   | 45  |

**Whole body external radiation effects in humans**

| Dose       | Effect              |
|------------|---------------------|
| <b>Rem</b> | <b>Sievert (Sv)</b> |

|          |            |   |
|----------|------------|---|
| Up to 25 | Up to 0.25 | Lymphocytes count                             |
| 25-100   | 0.25-1.0   | Falls, sperms, chromosomes damaged            |
| 100-200  | 1.0-2.0    | Drop in white cell count                      |
| 200-500  | 2.0-5.0    | Nausea, vomiting, diarrhoea                   |
| 500-1000 | 5.0-10.0   | Above effects plus increasing mortality       |
|          |            | Rapid onset of above symptoms, shock and coma |

### Diseases due to micro-organisms

| Organism  | Disease                                     |
|-----------|---|
| Viruses   | hepatitis A and B, AIDS                     |
| Bacteria  | Anthrax, Legionella, leptosporiasis         |
|           | TB, tetanus, ornithosis, Q fever, dysentery |
| Fungi     | Farmer's lung, ringworm, athlete's foot     |
| Protozoa  | Malaria, amoebiasis                         |
| Nematodes | Hookworm                                    |
| BSE       | New variant C-JD                            |

### Target organs of occupational hazards in agricultural research

| Body part  | Condition   | Cause   |
|------------|---|---|
| Hands/Arms | vibration white finger<br>Carpal tunnel syndrome<br>Tenosynovitis                                   | Use of vibratory tools<br>Use of vibratory tools<br>Forceful actions with hand (twisting/pulling)   |
| Lungs      | Dermatitis<br>Pneumoconiosis<br><br><b>Extr.Allergic-alveolitis</b><br><b>Asthma</b>                | Exposure to irritants<br>Minerals & organic dusts<br>Organic dusts<br><b>Proteins &amp; low molecular wt. Chemicals in toxic</b><br>Dose C1, H <sub>2</sub> S, SO <sub>2</sub> , NH <sub>3</sub> ,<br><b>Legionella, TB</b> |
|            | Irritation/Inflammation<br>Infection<br>Cancer  | Asbestos, Radon, Ni   |
| Skin       | Dermatitis<br><br><br>Cancer  | Solvents, acids, alkalies<br>Hg, Cr, Ni, As, mineral oils,<br>Wood, plants, resin, heat<br>Ar.PC.Hydrocarbons, As,<br>UV light, Ionising<br>Radiations  |
| Head       | Ears Deafness<br>Eyes Cataracts and corneal<br>Ulcers<br><br>Teeth Loosening<br>Erosion<br>Mottling | Noise<br>Ionising radiation, UV<br>light, heat, acids/alkalies<br>Arc flash<br>Hg<br>H <sub>2</sub> SO <sub>4</sub><br>Fluorides  |

|                   |  |   |
|-------------------|--|---|
| Brain             | Discolouration<br>Narcosis<br>Encephalopathy | Va, I, Br<br>Organic solvents<br>Hg, Pb, Mn, CS <sub>2</sub> , CO   |
| Peripheral nerves | Neuropathy                                   | Pb, Hg, CS <sub>2</sub> , CH <sub>3</sub> , CCl <sub>4</sub> ,<br>CHClCCl <sub>2</sub> , OP<br>Compounds, Vibration |
| Cardiovascular    | Anaemia<br>White cell count changes          | Pb, AsH <sub>3</sub><br>C <sub>6</sub> H <sub>6</sub> , CCl <sub>4</sub> , Ionising<br>Radiations                   |
| Liver             | Hepatitis                                    | Organic solvents,<br>Viruses A,B,C<br>Leptospirosis, As, Mn,<br>Be  |
|                   | Cancer                                       | Hepatitis B & C, Vinyl<br>Chloride monomer  |

### Target organs of occupational hazards

| Body part | Condition              | Cause   |
|-----------|------------------------|---|
| Kidney    | Toxicity               | Organic solvents<br>Pb, Hg, Cd  |
| Bladder   | Infection<br>Cancer    | Micro-organisms<br>2-naphthyl<br>Amine                                  |
| Bone      | Osteolysis<br>Necrosis | Vinyl chloride<br>Monomer,<br>Vibration<br>Work in<br>Pressurised areas |

### Psycho-social disorders in agricultural research

- **Stress**

- **The person**

Lack of physical and mental fitness to do the job; Inadequate training or skill for the particular job; Poor reward and prospects; Financial difficulties; Fear of redundancy; Lack of security in job; Home and family problems; Long commuting distances.

- **Work demand**

Long hours; Too fast or too slow a pace; Boring repetitive work; Isolation; No scope for initiative or responsibility

- **Environment**

Noise; Heat; Humidity; Fumes; Dust; poor Ventilation; Diminished oxygen; Confined space; Heights; Poor house keeping; Bad ergonomic design

- **Organization**

Poor welfare services and communications; Inconsiderate supervision; Remote management.

#### Types of safety

- Personal safety
- Personnel safety
- Experiment, structures and equipment safety
- Societal and Environmental safety

#### Principles of management of risk in agricultural research

- **Accident prevention**  
Precaution, safe handling of waste (radiation)
- **Freedom from accidents**  
Planning for safety in research
- **Safety in works**  
Safety handbooks, labeling, safety procedure charts, dosimeters, **first-aid box**
- **Known safety policy in each work place**  
Safe upkeep of dangerous chemicals, standardized procedures,
- **Organization of resources necessary for this policy**  
Budgeting for safety, fume cupboards, radiation chambers, procurement Of safety equipment,
- **Best available knowledge and methods**  
Approved standards and methods

#### References:

Ridley, J. and Channing, J. (1999) Safety at work. Butterworth and Heinmann . Oxford.

Angle, J.A. (1999) Occupational safety and health in the emergency services. Delmar publishers. Bonn.

Liu, D.H.F. and Lipták, B.G. (eds) (2000) Hazardous waste and solid waste. Lewis publishers. London.

Hafen, B.Q. and Karren, K.J. 1980. First aid and emergency care workbook. Morton publishing company. Colorado.

Hinkle, L.E. and Loring, W.C. (1979). The Effect of Man-Made Environment on Health and Behaviour. Castle house publications ltd. London.

### **Internet Resources of Interest to Safety and Health Managers in Agricultural Research.**

The following is by no means an exhaustive list of the volumes of safety and health-related information on the Internet. Many if not all of the sites listed have links available that will lead the user to other similar sites.

American Red Cross Home Page

<http://www.crossnet.org>

American National Standards Institute

<http://www.ansi.org>

American Society of Safety Engineers

<http://www.best.com/~assegsjc>

Centers for Disease Control and Prevention

<http://www.cdc.gov>

Chemical Emergency Preparedness and Prevention Office

<http://www.epa.gov/swercepp/>

Emergency Medicine and Primary Care Home Page by EMBBS

<http://www.njnet.com/~embbs/index.html>

Emergency Services Registry & Search Site

<http://www.district.north-van.bc.ca/admin/depart/fire/ffsearch/mainmenu.cfm>

Emergency Net

<http://www.emergency.com>

Fire Engineering

<http://www.fire-eng.com>

Federal Emergency Management Agency

<http://www.fema.gov>

FireNet Information Network

<http://online.anu.edu.au/Forestry/fire/firenet.html>

Fire Protection Engineering Home Page

<http://www.enfp.umd.edu/>

Fire Department Safety officers Association

<http://www.fdsoa.org>

Fire Marshals Association of North America

<http://www.nfpa.org/pfp-div/fmana.htma>

Hazardous and Medical Waste Program

<http://chppm-meis.apgea.army.mil>

Industrial Safety & Hygiene News Magazine

<http://www.SafetyOnline.net/ishn/ishn.htm>

Injury Control Resource Information Network

<http://www.injurycontrol.com/icrin>

International Association of Fire Chiefs

<http://www.iafc.org>

International Association of Fire Fighters



<http://www.iaff.org>  
IAFC Volunteer Chief Officers Section  
<http://www.vcos.org>  
National Advisory Committee for Acute Exposure Guideline Levels for  
Hazardous Substances  
[http://www.epa.gov/fedrgstr/EPSTOX/1997/October/  
Day-30/t28642.htm](http://www.epa.gov/fedrgstr/EPSTOX/1997/October/Day-30/t28642.htm)  
National Association of Emergency Vehicle Technicians  
<http://www.naevt.org>  
National Association of Emergency Vehicle Technicians  
<http://www.naevt.org>  
National Fire protection Association  
<http://www.nfpa.org>  
National Association of Fire Equipment Distributors  
<http://www.nafed.org>  
National Institute for Computer-Assisted Reporting Data Services: OSHA  
<http://www.nicar.org/data/osha>  
National Safety Council  
<http://www.cais.net/nsc>  
National Volunteer Fire Council  
<http://www.nvfc.org>  
National Institute for Occupational Safety and Health  
<http://www.cdc.gov/niosh/homepage.html>  
National Institute for Standards and Technology  
<http://www.nist.gov/>  
Oklahoma State University-Fire Protection Programs  
<http://www.fireprograms.okstate.edu/index.htm>  
Safety Link  
<http://www.safetylink.com>  
Safety List Internet Resource Guide  
<http://www.halcyon.com/ttrieve/carolla.html>

Safety Online  
<http://www.safetyonline.net>  
Safety Technology Institute  
<http://willow.sti.jrc.it>  
Safety, Occupational Health, Fire Prevention, and Emergency Services  
<http://www.acq.osd.mil/ens/sh>  
U.S. Fire Administration  
<http://www.usfa.fema.gov/>  
WPI Center for Firesafety Studies & Fire Protection Engineering  
<http://www.wpi.edu/Academics/Depts/Fire/fire-protection.html>  
WWW Emergency Sites  
<http://www.nw.com.au/%7Ebolin/emlist.html>

# **SCIENTIST – ADMINISTRATION – FINANCE INTERFACE**

**Jagannadham Challa**  
Principal Scientist

## **Introduction**

Agricultural Research is such an important operation it has its own specific features such as multi-disciplinary involvement, the location-specific, resource-dependent and overall with several risk factors and uncertainties. For successful management of agricultural research apart from the research idea and research project, the funding and the system of processing do play key roles as support functions. Over several decades, Indian Council of Agricultural Research has built impressive infrastructure, deployment of manpower in a variety of supportive and supplementary roles. The major source of funding has been mostly from the government with several collaboration projects attracting funding from international agencies and other donor organizations. In the recent past with the advent of Johl's Committee recommendations the scope of attracting sponsored projects has increased and the pressure on the institutes to generate resources is ever increasing. In other scientific organizations like CSIR, IITs, IIMs the majority of the research projects undertaken are generally sponsored from outside the organizations. This particular phenomenon is also likely to catch up with ICAR during the next decade.

ICAR with its vast network of institutes and manpower spread across the nation needs to integrate scientific, administration and finance wings into a proper harmony for achieving its mission by way of technology development. Our organization has remained in the shadow of government rules and procedures without effectively operating with autonomous character. In a large organization like ICAR where the mind set is by and large influenced by the government way of functioning it is the most common phenomenon wherein the mandate or the performance are ignored or set aside and systems, processes and procedures become predominant negating the research effort. Hence, this paper highlights the issues related to such an involvement of the three wings which are the major players in the output of agricultural research and open-up issues for a clear understanding and for reorienting our systems of management to achieve the organizational mandates involving huge investments of public fund. Scientist-administrator interface is not a new slogan. In fact such an idea was mooted by the Administrative Staff College of India, Hyderabad quite sometime ago considering the bureaucratic systems that have been entrenched in systems of management in R and D organizations. In the context of ICAR the structure is so designed that we have three distinctive wings starting from the headquarters namely: SMDs, Administration and Finance. Hitherto the experiences have been such that the finance wing has remained by and large independent without effectively integrating for the purpose of scientific research. This observation was even recorded by GVK Rao Committee of 1987. Hence, the interface of scientific, administration and finance wings with the focus on performance should be the new paradigm for effective implementation of perspective plans to meet the challenges of the 21<sup>st</sup> century.

## **Leadership and Decision Making**

The primary responsibility of bringing together the three wings that co-exist at every unit level lies with the management functionaries at various levels. As we all know the main functions of the management are logically to perceive a situation, analyze, explore the alternatives while making the appropriate decisions in the end. It is also essential to realize that there are several criteria for decision making such as:

- 1) Quality assurance
- 2) Acceptance by the concerned staff
- 3) Time frame within which decision is to be made
- 4) The extent of power invested
- 5) The importance attached to the issues concerned
- 6) Importance attached to the person concerned

While recognizing the fact that the most important function of management is to make decisions apart from other inputs it often gets less importance. It is often to be noted that decisions which require a high quality input often suffer from acceptance by the subordinates. This fact often gets side lined while decisions are made. Usually the slant while making decisions is for acceptance by the subordinates or changing the decisions as per the demands of the subordinates. On many occasions quality concern in decision making is either totally forgotten or totally imposed making it difficult for people to function. It is important to realize that the quality concern and acceptance factor should be judiciously matched which perhaps can be gained by training as well as experience. If the decisions are totally biased to the person concerned then the inconsistencies in the decision making will be prevalent which leads to unhealthy trends of management. On the other hand if the decisions are totally biased to the issues concerned then humanizing the management function is perhaps lost. This predicament is quite often staring into the management cadres of our system. In addition, the decision making process itself is prolonged with several procedures and protocols in-built as a matter of practices. The decision making style itself requires a little bit of mention. The simplest way of a decision style is to be either autocratic or democratic with the possibility of a middle-of-the road type, which can be termed as consultative. If the question is put to any scientist or any staff in an organization the most common preference would be for democratic style all the time. But the danger here is that most of the people in organizations do not realize that autocratic decision style is inherent even in the best of democratic functioning. On the other hand all the decisions in the governance of an institution can not be tackled by autocratic style of functioning. The management commonsense involves that the manager in position realizes the style of decision making for any given situation. It is common knowledge that in our organizations the character stills simmers with feudalistic overtones meaning that a master-servant relationship continues or sustained. Hence, majority of the decisions taken by the superiors is accepted, even if grudgingly, but the damage is quite likely if the decision style adopted is wrong or inappropriate. It is the decision style that comes under fire rather than the decision *per se*. Most of the organizational functioning and the output depend to a greater degree on the right decisions and the decisions in the right way. It is very necessary to understand the decision attributes in terms of the following diagnostic questions.

1. Is there need for quality importance
2. Is the information provided or available is sufficient
3. Is the structure of the issue or the problem clear and understood
4. Is the acceptance by the people critical to the implementation
5. Is the probability of success high or low
6. Is the motivation level of the people is high or low
7. Is a conflict or a controversy likely to arise

The present day experiences are that the easy way out that is adopted is not to take a decision at all or defer the decision or even delay the decision. It is all too well understood that an element risk is involved in every decision making but the fear of failure or criticism or consequences prevent the managers to take decisions. The reluctance in timely decision-

making leads to failure of leadership and chaos prevails. The most common feature in our entire system of management is to 'pass the buck'. There is a school of thought that there is not a great deal to learn about decision making since in government sector the decisions are to be taken as per rules. This is the misconception that is prevailing largely. If all the decisions are taken entirely as per rules and regulations only, there will be a lot of consistency in the function of administration and there shall be a sense of predictability. Problems arise when the decisions are not taken even if the rule- book permits. However, taking management decisions is entirely a different cup of tea. There are no set rules or guidelines for such decisions. A lot depends on the leadership qualities of the person-in-charge. Mere administrative decision making can not be considered as the sole function of management. Here it is worthwhile to try to understand the term of "competent authority" as it is used frequently in our organization. By far the best explanation that can be offered is that it rationally describes the position of power or the extent of power bestowed in the scheme of delegation in the organizational hierarchy. It does not in any way state or confirm that the decision taken is "competent". Problems in the organizations also arise when the competent authority does not take the logical decision as per the prevailing rules. It is justified as "superior's discretion". In addition there is another term "special powers" which is also quite frequently applied. It is the author's opinion that such decisions are commonly reflected as "management decisions" where there are no rules laid down. Sometimes such decisions defy the logical explanation of 'rule position' or many times go beyond even the rules or rules are interpreted as per convenience. This leads to an environment where the credibility of decisions is very poor which further leads to a host of other consequences. The decision making is more or less identified as a risk taking exercise.

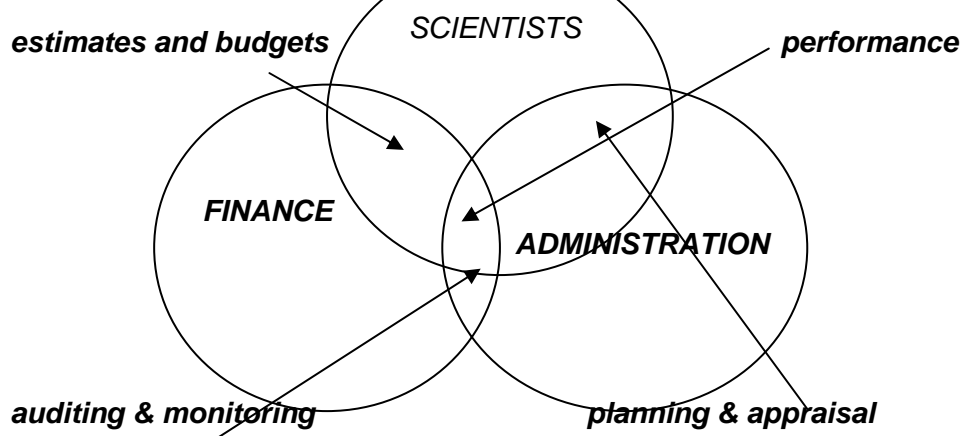
### **Group approach**

Another important observation is that there is tendency to call for meetings frequently to take decisions. This approach is considered as the Interface but it falls short of the expectations. It is the experience of the author that after a very prolonged meeting a committee is formed to submit a report on the details of the issue and suggest a feasible course of action. This leads to more meetings and a lot of waste of time. Decision making in-groups can be very slow and at times it is very difficult to arrive at a consensus unless the dynamics of groups are understood by all and sundry. For example, the group decision will suffer if all the members agree in the discussion on a course of action but subsequently change their mind when the file is sent to them. It is the tendency of some members to write and record their individual observations on an issue, which differs completely from the consensus arrived in the group meeting. It is also common knowledge that some key members keep silent in the group meeting but later record their observations, which may belie the whole exercise. Hence in this context the interfacing of the three wings in our organization becomes paramount and urgent if there has to be a professional way of managing the research out put. The urgent need is to nurture and develop a shared vision of all the concerned keeping aside the parochial or narrow focus of individuals and groups. The concept of team building in a matrix approach is the most imperative agenda.

### **Interface Model**

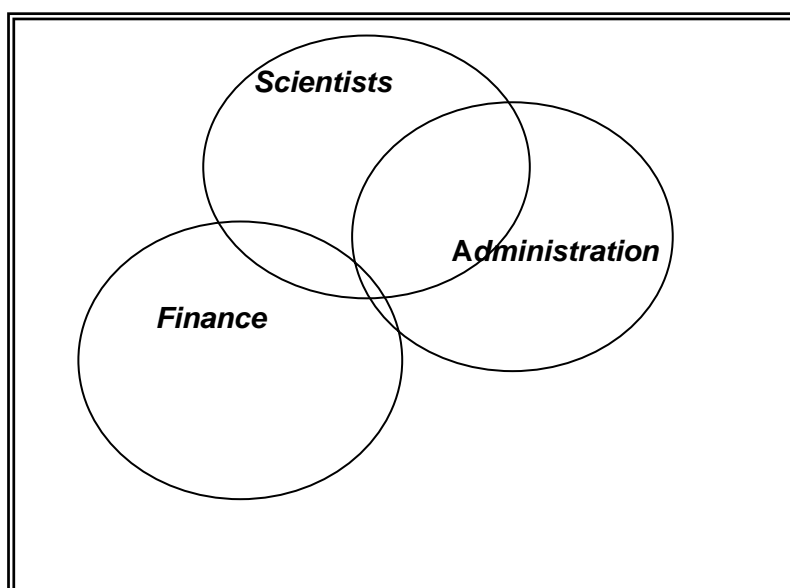
In this context it appropriate to depict a model of the three wings and look at the interaction between two wings and then collectively interface the three wings. I am adopting the model of John Adiar, which was used extensively in the armed forces.

**Fig.1. TRICHOTOMY**



This model logically explains that the central point of overlapping of the three wings indicates the merger of the three units leading to performance. If the overlapping is more it indicates more merging of the three wings meaning higher performance. This could be a good bench marking for assessing the successful interfacing of the scientific, administrative and finance units for the research out put. The Fig. 2 indicates what is more likely in the organization at present where in the finance remains detached and independent. This configuration may vary from institute to institute based on the culture of practices and local traditions and habits of the people.

**Fig.2** *Possible situation – where finance is less interactive*



An attempt was made to assess the possible reasons for such a situation occurring in the institutions, which are listed here.

1. Input obsession
2. Output obsession
3. Activity obsession
4. Audit obsession
5. Procedure obsession

## 6. Importance obsession

It is needless to point out that such obsessions are prevalent to varying degrees in different institutes. These obsessions are a direct consequence of over attachment to one's own importance in the hierarchy. Such obsessions lead to bureaucratic traps in the system which lead to administrative failures and ultimately to the scientific failures. Instead of an Interface we have an Impasse in the system. The attributes that have contributed to the impasse in the system of management are enumerated here.

1. Delayed actions or decisions
2. Justifying inaction
3. Power brokers and unethical power centers
4. Lack of discipline
5. Lack of accountability
6. Lack of leadership
7. Rule interpretation as per the case
8. Unfair or improper briefing to superiors
9. Mutual mistrust
10. "Refer to the Council" approach
11. Spoiled habits
12. Diversity in rule interpretation
13. "Pursue your own case"
14. "Adhocism" in management decisions
15. Aggressive individualism
16. Special cases and favouritism

The possible reasons for this present state of affairs where a professional integration of all the sections or wings has eluded the organization are listed here.

- Lack of understanding of the mandate and goals
- Failure of Leadership and decision making processes
- Lack of initiative for effective planning and anticipation
- Inadequate system of accountability
- Mismatch of perception of one's role in research management
- Lack of the concept of a learning organization
- Failure to avail the autonomy to match the requirements

In such a situation it is only expected that the leadership in agricultural research management is bound to suffer from a variety of dilemmas which is ultimately leading to a state of status-quo or a stalemate and a progressive development for change is missing. It is also common knowledge that some of the following symptoms contribute to the present state of affairs.

- Insecurity and victimization
- Fear of audit paras and vigilance
- Appeasement of certain sections
- Subjectivity vs objectivity
- Risk taking vs 'play safe' attitude

In the light of the above it is worthwhile to deliberate on issues that have become the bone of contention in the organization with a view for achieving the research mandates to the nation.

1. Conformity vs Creativity
2. Centralization of authority vs Decentralization of authority
3. Government functioning vs Autonomous functioning
4. Procedure vs Purpose
5. Rigidity vs flexibility
6. Static organization vs Learning organization
7. Individualism vs Team work
8. Auditing/controlling vs Supportive/advisory

## Role Perception

The mind set plays an important role in the way we wish to function and the perceptions about one's role and the mutual prejudices between scientists and administrators is also a matter of concern. Although no attempt was ever made to empirically survey such issues in ICAR system but an attempt was made by the Administrative Staff College of India which is being reproduced here for developing an insight into the possible clashes of attitudes among the three sectors of staff and officers. It is also planned to conduct a qualitative data collection on these issues.

| Scientists View of Administrators                     | Administrators View of Scientists                                   |
|---|---|
| Unimaginative and not helpful and negative            | Highly critical   |
| Emotionally stable                                    | Highly critical   |
| Goals of Organization not supported by Administration | Think that they only can deliver the goals                          |
| Bureaucratic  | Whimsocratic  |
| File pushers<br>Lovers of Red tape                    | Allergic to paper work and Red tape<br>Irresponsible, undisciplined |
| Shackled by Rules and Regulations Status quo minded   | Breakers of Rules and Procedures<br>Development Oriented            |
| Power-loving misuse of power, position/authority      | Loves power would like to have power without responsibility         |
| Hierarchical, always through proper channel           | Extra-constitutional power center                                   |
| Resist decentralization of authority                  | Believe in individuality and freedom                                |

The need for understanding one's role in the realm of research management is very much required for focussing on the performance of individual in teams in the organization.

**Role:** The concept of Role forms a prerequisite to understand the integration of the individual systems. If one considers the formal positions as 'offices' the behavior of any person in his or her office is his/her Role. The set of people-superiors, subordinates, peers and outsiders, with whom he has role-related relationships which constitute his 'Role set'. The role-related relationships between the people are called as a Role set. A Role defines the functions and activities to be performed and the behavior that is considered appropriate in a given position.

**What is a Role?** It is defined as a position, which an individual holds in a system as determined by the expectation from that position.

**Role Expectations:** Role expectation is defined, as how others believe an individual should behave in a given situation. The behavior of the individual is determined by Role Prescription in the situation, where the individual is behaving. When role expectations are concentrated in generalized categories, they give rise to 'Role stereotypes'. There may be some behavioral patterns corresponding to a role, which give rise to 'role Identity'.

**Role Perception:** An individual's view of how he or she is supposed to behave in a particular situation forms a 'Role Perception'. People learn roles from different media including the movies, books and television. Every life situation has a procedure indicating how it is to be played. Thus the group behavior can be perceived accurately through the concept of drama.

It is considered appropriate to deliberate on certain questions to clarify one's role and understand the perception of others.

1. As an Adm. Officer what is your role in the organization/Institute?
2. As a FAO what is your role in the organization/Institute?
3. As an AO what role do you expect from the FAO and Scientists?
4. As an FAO what role do you expect from the AO and Scientists?
5. As an officer how do you relate yourself to the function of Agricultural Research Management?

It is planned to put the above five questions to administrative and finance functionaries in the presence of scientists to deliberate on these issues in a spirit of harmony to overcome the existing lethargy and infuse a new form energy and spring into the system for professional performance and tap the full potential of the organizational human and physical resources and time. It is planned to develop a qualitative survey database on the responses given and analyze the causes for failure of the interface and suggest strategies to overcome the impasse.



# ON-FARM RESEARCH AND CONSTRAINT ANALYSIS IN TECHNOLOGY ADOPTION

**G. P. Reddy**  
Principal Scientist

## INTRODUCTION

In the field of agriculture, scientific research is moving with a fast pace. Despite the rapid development in knowledge much of the research findings are hardly put into practice. Several research programmes are in operation to transfer the technology. The time consuming and expensive efforts in generating improved agricultural technologies are of little value unless they are made available to farmers. These technologies are of little relevance if farmers do not adopt or use them. The ultimate decision to adopt a particular technology depends to a greater extent on the farmers' perceptions about the technology, socio-economic conditions and need for the technology.

Traditional wisdom and indigenous technical knowledge are learnt through experiences from one generation to another by means of testing and validation at farmer's fields. Experimental learning is the process of learning by doing. In this process, the farmers use new technologies in their fields and gain experience. When farmers are dedicated and sincere to adopt improved technology, they experience every activity for achieving productivity, sustainability and stability in crop production.

### **On-farm research:**

Concept, definition and target of on-farm research are important to know the significance and need of such experimentation at farmers' fields.

### **Concept of OFR:**

Research must begin and end with the farmer.

### **Definition**

It is an approach of adaptive research on farmers' field under their management, with their perception in view and active participation.

### **Target**

The target of on-farm research is small production systems agriculture and socio-economically disadvantaged farmers.

The objective of a farm research (OFR) is to develop technologies to solve problems of a group of farmers in a defined setting or area. This is a problem-solving research. There are three important components of OFR, viz. farmers' perspective, farmers' participation. The following essentials must be fulfilled in making this approach successful.

- A. The on-farm research must address problems that are important to farmers. It may be that the farmers themselves are not initially aware of a particular problem e.g. disease or any nutrient deficiency. If research does not lead to significant improvement in farm productivity, it will not attract interest of the farmers in technology assessment. The OFR demands a good understanding of the physical, biological, social, economic and cultural conditions prevailing in an area of programme activity.

- B. The OFR examines relatively few factors at a time. An on-farm experiment will be difficult to manage and may be inappropriate for the farmers.
- C. The farmers' practice should be included as one of the treatments in the experiment, if an alternative to existing practice is being tested so that the farmers can see themselves comparative performance of the two treatments.
- D. The non-experimental variables should reflect farmers' actual practices and management. Sometimes, the researchers are enthusiastic in using high levels of management for non-experimental variables to increase the chances of observable responses. The experimental on-farm research is, thus, a set of procedures for adaptive research whose purpose is to develop recommendations for representative groups of farmers. In on-farm research, farmers participate in identifying problems and priorities, managing experiments and evaluating results. On-farm research, therefore, is an adaptive research with farmers' perspective. The on-farm research is to identify existing inputs or practices that might help to overcome major problems of farmers in a defined area.

The farmers are usually selective in the choice of crops and production techniques in order to increase their income, bear risk and adopt in their complex farming system. This is called farmers rationality. Farmers usually adopt new technologies that increase their income without being too risky and have reasonability. They like to adopt new technology when it is in their best interest. The procedure of on-farm research has five steps viz. diagnosis, planning, experimentation, assessment and recommendation.

### **Characteristics of on-farm research (OFR)**

Integration of technology through complete understanding of farmers' situation and system of farming is supposed to be the best strategy for development. Extension programmes need to be farmer-centered based on their real micro-situation analysis. On – farm research is one of the ways to understand and plan of work for overcoming farmers' problems. The following are the characteristics of OFR: It is

- A holistic approach.
- Farmers participatory
- Problem solving.
- Gender sensitive
- Inter-disciplinary
- Complements on-station research.
- Interactive and iterative.
- Emphasizes extensively on-farm activities.
- Acknowledges the location specificity of technical solutions.
- Emphasizes on feedback.

### **Stages of on-farm research**

The five stages of on-farm research are described as under:-

## **STAGE I - Diagnosis**

It implies studying farmers' circumstances and practices in order to understand the farming system and system of interactions, identify possible productivity problems and begin to develop hypotheses on solutions of What, How and Why.

## **STAGE II – Planning**

After identification of problems, planning is done involving the following steps:

- Prioritization of problems
- Study 4 or 5 most important problems at one time.
- Develop problem-cause diagram.
- Identify intervention points.
- Decide the nature of intervention.
- Listing of possible solutions of the problem.
- Screening of possible solutions for system compatibility.

## **STAGE III – Experimentation**

It includes the following aspects for conducting experiment in on-farm research:

- Experimental sequence.
- Design of on-farm experiments.
- Selection of site and farmers.
- Choice of farmers' practice.
- Management of on-farm experiments.

## **STAGE IV – Assessment of results**

There are 4 types of assessment i.e. agronomic, statistical, economic and farmers' assessment. No single assessment is complete in itself and there are no common denominators across different assessments. The farmers' assessment is final because they are ultimate beneficiaries.

## **STAGE V – Recommendation**

In case the farmers approve the solution of the problem studied, the technology can be recommended to the farmers having similar conditions. Therefore, each recommendation should specify the conditions where it can be appropriately adopted. If the tested solution is not approved, the problem should be referred to research system for further investigation (feed back).

In small production systems, emphasis is on fine-tuning of technologies for different farming situations and environments through on-farm research. The foremost importance is on agro-ecosystem analysis including rain water harvesting. Based on indigenous technical knowledge of people, the area is categorised favourable and unfavourable ecosystems. In order to improve socio-economic condition, low-cost technologies are preferred. On-farm research is conducted in different situations with a view to increase productivity along with stability and minimization of risk.

## CONSTRAINT ANALYSIS

Defining the right problems for research to tackle is crucial. This can be done in a number of ways, but an obvious approach is to involve the technology users and government officials. They are the ones who come across these problems in the course of their daily work, and often have developed very good diagnostic insights. It is far better to build on the judgments of the users than to rely solely on the judgments of the researchers themselves. Nevertheless, even where users have concrete ideas about the problems they are facing, a formal constraint analysis may help to elucidate further problems, and may put problems in perspective.

The developments of new agricultural technologies do not yield benefits by itself. The new technologies are required to be transferred to the farmers' field, and depend on their effective adoption by the farmers. In the past, improved technologies were developed at a fast pace. But, the adoption of technologies occurred at desired pace only in case of some regions and crops. There have been some constraints in the adoption of technology in other regions and crops. Similarly, it has been observed that wide gap exists between the performance of the new technologies at the research station and at the farmers' field. Though some farmers are able to achieve high yields with the help of new technologies, they seldom reach the levels attained at experiment stations attributing to constraint factors.

A pressing need arises to probe into the factors responsible for lack of technology adoption and performance in one region, crop and farmer than the others. An inquire into these factors lead to constraint analysis research. Unless concerted efforts are made to ameliorate the constraints, and more uniformity is achieved in the adoption of improved technology, it will not be possible to reduce income inequalities across regions and groups of farmers.

***“Constraint analysis research pertains to identification and quantification of factors responsible for lack of technology adoption and performance and removal of these bottlenecks including reference to technology refinement”.*** The findings of such research have many implications for research to modify technology so as to reduce gaps.

There are wide range of factors influencing adoption and performance of new technologies at the farmers' field. These could be broadly categorized and discussed under following heads:

**1. Non-transferable component of technology:** Technology can be regarded as a combination of physical capital and technical knowledge/human capital. The simple purchase of physical capital or machine part of the technology is not a technology adoption or transfer. Equally important is to gain knowledge and expertise. And this is considered as non-transferable component of the technology. In agriculture, the expertise to identify disease or insect cannot be given until and unless the farmer works and gain experience under the supervision of the scientist. The other reason for yield gap could be use of modern machines and tools in the laboratory for accuracy.

**2. Environmental factors:** The environmental factors are mainly responsible for region-to-region performance of the technology. The agriculture being environment sensitive, the factors like heat, cold, frost, soil temperature, rainfall and sunshine play an important role in the growth and yield of the crops.

**3. Physical and biological constraints:** The physical constraints mean lack of infrastructural facilities and proper soil texture, etc. On the other hand, biological constraints include attack of insect pests and weed infestation. All these factors are location specific and

affect adversely on the adoption of certain technologies while the technology developed to remove these constraints will be accepted readily.

**4. Socio-organization constraints:** It has been observed that the farmers' social status also influence the adoption of technology including both physical and knowledge aspects. These factors could be age, education, infrastructure, and member of local organization, contact with extension agencies, media participation and extension participation.

**5. Techno-economic constraints:** These constraints are related with technical facilities and economic power of a farmer. A poor farmer always hesitates to adopt new technology unless no cost is involved. These constraints are size of the field, farm assets, finance/credit availability, expected yield and expected prices.

**6. Farmers' objective:** A farmer's objective in adopting a particular technology may not always be profit maximization. He may be interested to minimize losses and risk, save labor and improve quality. A technology giving the highest profit but evolve high risk will not be adopted by the farmer whose objective is to minimize risk.

**7. Extension gap:** Extension gap is another constraint in transfer and adoption of technology among farmers and crops. It may be due to lack of education among farmers or non-adoption of proper extension method like demonstration and farm trials.

**8. Technology deficiencies:** Sometimes technologies are developed for the sake of knowledge without giving much consideration to actual problems of the farmers and farmers' requirements in view.

It requires identifying specific factors among above-mentioned broad constraints effecting technology adoption and yield gap through analysis. The information on factors are collected and supplemented by on-farm trials and on-farm, on-station research and field surveys. A wide range of techniques has been employed to analyze constraints-such as simple tabular analysis, analysis of variance, whole farm budgeting, multivariate analysis, etc. These techniques are applied either separately or sometimes in combination under formal approaches. The formal approaches that might be distinguished in analyzing constraints are as given below:

**Diagnostic research:** It relies on several methodologies including base line survey, base data analysis and on-farm experimentation. A multi-disciplinary team visits an area and collects information on all possible constraints. Qualitative and quantitative information are gathered on the incidence and severity of each of the variables expected to limit yields in the crop for which the analysis is being carried out. In general, these constraints include biological, agro-climatic and management variables. Yield losses are estimated from a production function analysis in which observed yields are regressed on factors expected to influence yields. Each regression coefficient multiplied by mean value of the particular yield-limiting factor provides an estimate of the overall impact of this factor on sampled yields. The success of this approach requires observations on variable from a large sample size, variation in environment, biological and technological variables and a concerted multi-disciplinary team efforts. Depending on the cropping system studies, field observations need to be taken during critical periods such as planting, germination, flowering and harvesting. In order to increase management variability, some supplemental trials and demonstration plots at high levels of management may be included in the analysis.

**Whole-farm constraint analysis:** It takes whole farm management perspective and evaluates the impact of resource constraints, risk and farmers' objective on output and the allocation of resources. There exists a wide range of methods of whole-farm modeling, including mathematical programming approaches that can be used to carry out whole-farm constraint analysis. Mathematical programming approaches including linear programming and parametric programming which incorporate risk consideration along with resource

constraints. But they require reliable and suitable computer facilities. In the absence of such facilities, one has to rely on intimate knowledge of farm circumstances to carry out an intuitive assessment of constraints with a whole-farm budgeting approach. Partial budgeting can also be useful especially for analyzing the on-station experiments where farmers' technologies are simulated as 'control'.

**Yield gap analysis:** This is an ex-post technique of evaluation of technology adoption. The IRRI-type yield gap analysis designed for those situations of partial adoption and/or partial impact when technologies once adopted do not measure up to expectations in farmers' fields. The total yield gap is conceptually divided into two components: Gap I - between experiment station yield and potential yield at the farm level. Defining the right problems for research to tackle is crucial. This can be done in a number of ways, but an obvious approach is to involve the technology users and government officials. They are the ones who come across these problems in the course of their daily work, and often have developed very good diagnostic insights. It is far better to build on the judgments of the users than to rely solely on the judgments of the researchers themselves. Nevertheless, even where users have concrete ideas about the problems they are facing, a formal constraint analysis may help to elucidate further problems, and may put problems in perspective.

The developments of new agricultural technologies do not yield benefits by itself. The new technologies are required to be transferred to the farmers' field, and depend on their effective adoption by the farmers. In the past, improved technologies were developed at a fast pace. But, the adoption of technologies occurred at desired pace only in case of some regions and crops. There have been some constraints in the adoption of technology in other regions and crops. Similarly, it has been observed that wide gap exists between the performance of the new technologies at the research station and at the farmers' field. Though some farmers are able to achieve high yields with the help of new technologies, they seldom reach the levels attained at experiment stations attributing to constraint factors.

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I; Gap II - between and actual yield at the farm level. Gap 1 is conditioned by irreducible environmental factors, while Gap II is caused by the biological and socio-economic constraints. The amelioration of these factors will lead to the realization of the production potential. The data on influencing factors was collected and the analysis of variance technique was adopted to determine individual and joint contribution of various factors. Once the main factors conditioning the yield gap have been determined, action was taken to remove them.

Limitations of the formal approaches:

The three formal approaches discussed above are quantitative in nature. They can turn mechanistic if they are not completed with a proper appreciation of the practical problems. They often end up in recommendation to policy-makers and development workers. A separate approach is required for those who are actually interested to solve the problem by testing the constraint and apply in technology refinement.

Farming System Research: FSR is one approach of agricultural research and extension that attempts to deal more effectively with problems and constraints of complex, marginal, diverse risk-prone agriculture and disadvantages of farmers operating in harsh environment. The approach was developed in 1970's based on the observation that the groups of small-scale farmer were not benefited from mainstream agricultural research.

The steps of FSR/E activities:

Target and search area selection

- Problem diagnosis and development of relevant research agenda.
- Planning & designing of a farm research
- Farmer participation in on-farm research and its analysis.

### **Extension of research results.**

Similarly, there are policy researches where in policy-induced constraints are identified and taken into account in the research process. The research led information, in turn, are fed into the policy formulation process.

# HOW TO WRITE A REVIEW PAPER?

**R. Kalpana Sastry**

Principal Scientist

*Nature fits all her children with something to do,  
He who would write and can't write, can surely review.*

**- JAMES RUSSEL LOWELL.**

The word "review" means 'to go over again'. In scientific terms, it connotes both a compilation as well as a critical examination of documents. In other words, it is a narrative presentation or reformulation of existing information on a topic derived from various sources. It is an intermediary between a specialized scientific article and a textbook. Scientists, often become increasingly busy in their research activities and do not have sufficient time to devote to write a complete text-book. However, they are often willing to write a comprehensive review article/paper. A review paper is **not an original publication** and the main purpose is to review previously published literature and put it into some kind of perspective. One review paper could replace a number of primary articles and the reader would need to read only one article or would be directed to the primary sources or documents. A true effective review paper will be a pacesetter that stimulates further research efforts, and also plays a very significant role in shaping the nature of that research. Thus, review literature is secondary literature, mainly composed of primary publications in which information about a subject is compiled, evaluated, criticized and includes carefully compiled bibliography.

## **1. Motives for publishing reviews**

To keep up with literature relevant to the scientists' special subject area and that of the related areas, reviews are important information sources for scientists. In a survey conducted in some of the European countries on productivity of review articles on agriculture topics (Huisman and Koster, 1979), a large number of respondents were of the view that review articles are essential because:

- The impossibility of any person being able to read all primary publications relevant to his work
- Language barrier - reviewing primary literature published in different languages provide information that scientists might otherwise miss
- Decreasing accessibility of primary literature to scientists due to financial crunch
- Presence of reviews in journals increases the value of journals

## **2. Characteristics of a review**

In format, a review paper is not very different from a well-organized term paper or thesis. Review paper is usually long, typically ranging between 10 to 50 printed pages. The subject is fairly general, compared with that of research papers and provides an overview of the subject and a point of entry into the available literature. The review papers are much more than annotated bibliographies, and offer critical evaluation of the published literature and often provide important conclusions based on that literature, which will identify the strengths and weaknesses that characterize the current knowledge.



An effective review paper provides an element of synthesis and indicates the significance of the subject to other areas of scientific endeavor. It normally covers a number of highly specialized subjects which will be read by many peers and also by the many experts in the related fields. The style of writing can be more general than a research paper with a style which is little bit verbose rather than cryptic. The characteristics of this secondary form of scientific literature are:

1. No original research reported
2. Comprehensiveness of coverage
3. Subject should be of a broad appeal and controversial
4. Authoritative
5. Pinpointedness
6. Exhaustiveness
7. Timeliness of publication
8. Readable
9. Large number of references and pages
10. Indexed or flagged as reviews by secondary periodicals

### **3. Organization and outline**

Like a research paper, however, it is the organization of the review paper that is important. There is no prescribed organization for review papers and one has to develop his own style. When we visualize the review paper in terms of research paper we see an introduction part that is expanded, parts of materials and methods, result which are deleted (unless original data is being presented) and the discussion part which is extended). **A cardinal rule for writing a review paper is to prepare an outline which will help in organizing the paper systematically.** Obviously, this outline has to be prepared before writing, after assessing whether review journal would be interested in such a manuscript. Preparation of such an outline is desirable, since it often elicits constructive suggestions from editorial consultants.

A well-constructed outline would have:

- Introduction
- Sections of the theme indicated in the title in three to four parts
- Discussion
- Conclusions
- Literature cited

Introductory paragraphs are important and have to be well written as the readers are much influenced by this part of a review paper. The readers are likely to decide whether to read or not to read, based on what they find in the first few paragraphs. Some form of conclusion is an essential component of a review paper as it covers a subject in depth, and one should write the conclusion in a systematic and analytical manner. It is essential to summarize a difficult subject to the satisfaction of both the expert and a casual reader.

### **4. Functions of reviews**

Review paper as a secondary publication has three important major functions to perform.

#### **4.1. Current awareness**

Reviews enable scientists and scholars to maintain current awareness of present activity in their own field of research/interest. This is necessary to avoid unintended duplication of research and identify areas for further research.

#### **4.2. Tutorial function**

Reviews are useful to students in understanding new subjects and to specialists and researchers in continuing education or in obtaining an overview of a subject outside their field of specialization before commencing a new project.

#### **4.3. Bibliographic function**

Reviews are almost invariably accompanied by comprehensive bibliographies of primary documents reviewed, and are, therefore, useful as bibliographic tools in making retrospective literature searches.

### **5. Types of reviews**

Before writing a review, it is good to determine the critical requirements of the journal to which the manuscript is planned to submit, as some journals demand critical evaluation of the literature, whereas others are more concerned with bibliographic completeness. Often, the old review journals prefer and some demand authoritative and critical evaluation of the published literature. But some of the annual reviews, advances, year book series publish reviews designed to compile and to annotate, but not necessarily to evaluate the papers published on a particular subject during a defined time period.

In the earlier days, the review papers tended to present historical analysis, where the reviews were often organized in chronological order. This type of review is now in less practice. Today, most review media prefer either "state of the art" or review that provides a new understanding of a rapidly moving field, where the recent literature on the subject is catalogued or evaluated. If you are reviewing a subject that has not been previously reviewed, or one in which polemics or misunderstandings have developed, more coverage of the historical foundations would be more appropriate. If the subject has been effectively reviewed earlier, then the starting point for review would be the actual date upto which the literature has been reviewed.

Broadly, we can sum up the review into five types:

1. Critical evaluative, interpretive, speculative (e.g. annual reviews; monographs and review of reviews)
2. State of the art or trend report
3. Historical; bibliographical (Bare documentation list. Annotated documentation list)
4. Tutorial or explanatory (Review periodicals, Encyclopedias)
5. Technical application

### **6. Usefulness of reviews**

The impact of reviews on a piece of research in progress is similar to that of any type of information. The reviews may aid in:

1. Attaining a proper perspective of a field of knowledge, be it known or unknown field.
2. Alerting service
3. Reference and fact finding devices

4. Source of inspiration for continued interest or for stimulation or work in unfamiliar fields
5. Selection of specific subject for research
6. Guidance in work and clarification of ideas
7. Supporting the type of approach adopted
8. Avoiding unintended and unnecessary duplication
9. Modification of work

## **7. Index to scientific reviews**

Since publication of Theodore Besterman's *World Bibliography of Bibliographies* (4th ed., Societal Bibliographic, Lausanne, 1965-1966), there has been no comprehensive multidisciplinary index or bibliographic control mechanism for the scientific review literature. Although some of the review literature has been indexed and identified by various specialized abstracting and indexing services, these services are limited by their own subject coverage constraints, has identified relatively little material. The reporting of the literature time lag many times is six months to three years such sources include the *Bibliography of Medical Reviews* begun in 1955, to cover the field of clinical medicine, the subject index to *Biological Abstracts*, which codes review literature in its various indexes and abstracts with the designation "R". The *Science Citation Index (SCI)* also, in the *Citation Index* and *Source Index* sections, identifies with an "R" code narrative, categorical, and critical reviews appearing in the most important review journals, monographic review series and primary journals. Over 10,000 such articles are so identified each year in the *Science Citation Index*.

On seeing the deficiencies of the existing bibliographic control methods for covering, indexing and locating reviews, the Institute for Scientific Information designed and published a *Index to Scientific Reviews (IRS)* the first issue appeared in 1975 as a half-yearly publication. The goal of "complete" bibliographic control of all *Scientific Reviews* and review-type articles. *Index to Scientific Reviews* covers the entire spectrum of over 100 subject disciplines in the sciences, medicine and technology. Searches performed in the *Index to Scientific Reviews* will identify in a matter of minutes, review and "review type" materials which have been selected from over 3000 principal scientific journals and review publications from the world's literature. It is observed that about 26,000 review articles are being covered in *Index to Scientific Reviews*.

### **7.1. Sections of Index to Scientific Reviews (IRS)**

Reviews contained in index to scientific reviews are indexed in the following four separate reference sections, each employing a different method than the others but cross referenced for ease of searching. In addition to the four sections mentioned below, the index to scientific reviews also provides a list of source publications arranged alphabetically.

#### **7.1.1. Source index**

The source index provides a complete cross-referenced author index to the current review literature appearing in each current *Index to scientific reviews* issue, and contains the main entry, a complete bibliographic description of each source item, as well as a list, by research front specially number, of all the research front specialties to which that source item belongs. Main entries are arranged alphabetically by first author. Each main entry includes all co-authors (to a maximum of nine). All article co-authors are also listed as cross-referenced entries to the first author, even if there are more than nine. Anonymous articles, alphabetized by journal title, are listed at the beginning of the source index.

### **7.1.2. Permuterm Subject Index (PSI)**

Permuterm Subject Index is an alphabetic list of significant words from the titles and sub-titles of all the current review articles listed in the source index. Significant words from the names of all research front specialties listed in the Index to scientific reviews. Each significant word, or in some cases word-phrase, is listed alphabetically as a main entry or primary term, and is paired with all other significant words in a title (secondary or co-terms) with which the primary term has co-occurred. Each such permuted word pair from a review primary title is linked to the name of a first author who has used the word pair in the title of a published review article covered in the source index. Words from the names of research front specialties listed in the research front speciality index are linked to a research front speciality number instead of an author name. This number provides access to the complete research front speciality name and bibliography in the research front speciality index.

### **7.1.3. Corporate index**

This Index consists of two sections, geographic and organization. In the geographic section, source items are arranged alphabetically by the location of the author's organization. The organization section of the Corporate Index is an alphabetical list of source author's organizational affiliations giving the geographic location for each organization. For further information on any review article, the searcher can use the author name to enter the source Index. The Corporate Index can be used to locate review articles emanating from some known center of excellence of specialized research institution with expertise in the desired research area.

### **7.1.4. Research front speciality index**

The research front speciality index makes use of the documented citation patterns of publishing scientists to provide searchers with bibliographies of current reviews, all related to the same area of intense research activity, or "research front speciality". Each issue lists over 2000 most active research fronts. The Index is arranged by speciality number each entry in this index provides the full name of the speciality, and a list of current review articles which cited into the core literature of the speciality. To use the research front speciality index, one has to start with an author's name in the source index or with a little word in the permuterm subject index. Entries in the source index and the permuterm subject index include speciality Index are retrieve a bibliography of current reviews on the speciality subject. Full bibliographic information for each review article can then be obtained in the Source Index.

### **7.1.5. Index to scientific reviews and library reference work**

The importance of good review articles for a researcher, educator, and student lies in the consolidating and integrating character of the review, which in convenient place brings together makes order of and emphasizes the significance of widely scattered research articles in particular subject areas. Providing bibliographic access to the reviews and review type literature through research front speciality indexing and subject word indexing, scientists may determine the critical assessment of their own and others work. Scientists who are to review the significant literature of a new branch or in mission-oriented research will find the review literature the fastest and most efficient informational tool for brushing up.

Following are the answers that an Index to scientific reviews can offer:

1. Is there a review on this subject?
2. What is the current view of the validity of this theory?
3. Has this work been extended?
4. Does this work show promise?
5. Has this method been supplemented, improved, extended?

6. What alternative routes to synthesis exist for this compound?
7. Has this drug been clinically evaluated and discussed in a review article?
8. Have there been reviews of the validity of these data?
9. Has this technical report been published in a journal?
10. Has this field advanced enough to warrant updating teaching materials, text book chapters
11. Who else is working in this field?
12. What published reviews have originated from this center of specialized research activity?
13. Has this theory or concept found application?
14. What reviews have been written by this expert?
15. Which authors have had experience writing reviews in this field?

## **Conclusion**

A review paper in short, is a comprehensive summary of all that is known on any particular subject, presented in an organized manner. It presents all the views on the subject, however divergent they may be, critically evaluated and placed in their proper perspective. It usually indicates the state of the art and suggests the future trends in the field. For a busy student of the subject, who may not have access to the information explosion that is happening in the world of science, a good review provides an opportunity to have an authentic summary of the subject at hand. Although it is not meant to be a compendium of all the controversies obtaining in the subject, it is expected to provide important conclusions based on the available literature. A good review also stimulates further research in the subject by throwing open the unsolved problems.

## **Suggested reading**

Chen, C.C. 1976. Biomedical, Scientific and technical book, reviewing, New Jersey, Scarecrow Press. 186 p.

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Index to Scientific Reviews Annual, Cumulative Index 1986, Philadelphia, ISI Press

Paper, L. 1971, Approaches to establishing dimensions and criteria for evaluation of review publications Proc. Iaslic Int. Conference on Information Sciences, pp 213-231.

# TECHNIQUES FOR RESEARCH PRIORITIZATION IN AGRICULTURE

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## INTRODUCTION

One of the major problem facing not for profit agricultural research in this decade is the lack of funds .The prevailing poverty conditions add urgency to the optimum allocation of scarce resource among competing enterprises. Hence the *resources* allocated to agricultural research are getting less and the expectations from research are at a higher scale. Hence, is an imperative need to analyze and prioritize the allocation of research resources among the competing research programs and projects? In the past, priority setting in agricultural research was a centralized activity with a lot of subjectivity. With a view to make research prioritization an objective and transparent activity, several methods were developed and are recommended for adoption by the National and international research organization and institutions. These procedures and methods are discussed below

Methods of Research Prioritization

### 1. Congruence Method:

This method is applied for prioritization of commodities or production environments situations where time and data are binding constraints There are several variations of congruence method .In the simplest form of this method, research funds are to be allocated to commodities in the same proportion as their existing contribution to Gross Domestic Product (GDP) from the Agricultural Sector. This method ensures certain minimum allocation of research resources for each agricultural commodity. It implicitly assumes that opportunities for research are equal across commodities, and that the value of new knowledge generated by research is proportional to the value of output. It also assumes constancy of relative shares of different commodities as it is based on present values. These restrictive assumptions imply that results of this exercise provide only starting point in rationalization research resource allocation. However, this disadvantage that it is not useful for non-commodity research and that it favours the already well-established commodities and ignores the new ones. The CGIAR (1992) and Indian agricultural research Institute (Jha .et al) also opted for this approach because of its simplicity, transparency and flexibility.

In the modified form of the congruence method, value of production parameter (indicating economic gains) is used in combination with other parameters such as expected impacts on equity and sustainability of production environments .In the modified congruence model prioritization of commodities and regions involves in calculation of an initial baseline matrix consisting of value of output from different commodities in different regions. A composite baseline is then developed using efficiency, equity and sustainability indicators using equal weights for these parameters, which will capture extensity dimensions

*Applicability*

- ***Suitable for the initial fund allocation at the national level***
- ***Applicable to the commodity related research only***

## 2. Domestic Resources Cost Ratio Method:

This method ranks the commodity programs on the basis of comparative advantage of domestic production.

$$\text{DRCR} = \frac{A}{B - C}$$

Where 'A' is the unit cost of producing a commodity domestic

'B' is the unit cost of importing a commodity from other countries

'C' is the cost of imported inputs used in domestic production (per unit out output)

When this ratio is less than one, relatively a high priority must be accorded to that commodity. If the ratio is more than one, there is a case of low priority as it will be cheaper to import it from outside rather than produce locally. So for countries prepared to trade in agricultural commodities with other countries this is more useful

## 3. Checklist Method:

This method basically consists of a set of criteria requiring answers to set priorities for research programs and project. Depending on the degree of satisfaction of the set criteria, the programs and projects are ranked. Because of its *simplicity and non-mathematical approach*, it is most *liked by the biological scientists*. But its limitation is that it does not indicate the relative significance of one criteria against the other. The other disadvantage is that the expression of answers is cumbersome and does not facilitate comparisons.

### **Applicability**

- Applicable to commodity related research only
- Can not be used for individual lines of work with in the commodity programmes
- Applicable to both commodity as well as non-commodity research
- Used for arriving at priorities even for individual lines of research

## 4. Scoring or Weighted Criteria Method:

This method is sophisticated version of the checklist method, in which numerical values are assigned. Relative weights are assigned to the criteria chose to arrive at the set of priorities. Information on the commodities or research area may be collected on each criterion from primary and secondary sources. Finally, weights are assigned to criteria to obtain priority ranking by commodity or research area. Thus, it can be used to rank commodities or research area according to their overall contribution to research objectives. Scoring models have the advantage that they can be administered in a relatively short period of time and are transparent, which facilitates their understanding particularly by administrators. They can be used to rank a long list of commodities as well as research area, including non-production oriented research qualitative as well as quantitative information can be used and perhaps most importantly, they facilitate the weighting of multiple goals and objectives. However, these models are often criticized because of their subjective weighting of objectives. They are also criticized for the lack of discounting of future benefits and costs.

## 5. Economic Surplus Approach:

The concept of economic surplus derives ex-ante measures of the relative economic benefits of alternative commodities and regional research portfolios and distribution of benefits, producers, importers and exporters. This model provides a relatively simple, flexible

approach to specifying the value of research, by comparing the situations with and without it .It computes gains in production efficiency through reduction in per unit cost. It is useful to estimate the benefits or economic surplus, as well as its distribution among producers and consumers .The improved research techniques either increase in yields or reduce costs .As a new technique is introduced, it starts showing its impact after adoption lag, Which may differ across commodity sector or regions .The adoption level reaches to its maximum and then starts declining. After a certain time span the technology becomes obsolete and new technological innovations are required to attain further increase in yields. Economic surplus uses this information on research-extension-adoption continuum to generate series of costs and benefits.

#### ***Applicability***

- This method can be difficult to apply on a large number of commodities or research areas because types of data necessary for the analysis often do not exist for all commodities. It is also not well suited to rank non-commodity research areas.

### **6. Programming Models:**

These rely on mathematical optimization to choose a research portfolio through maximizing a multiple goal objective function given the resource constraints of the system. Zero-one programming model is well suited for selecting the research projects or programs that would maximize the objective function. Programming models have the advantage of explicitly incorporating the budget, human resources and other constraints in the system. Like scoring models, they facilitate the inclusion of multiple objectives. If constructed in a multi-period format, they can identify how the research portfolio should change over time. However, they require a great deal of analytical ability, data and time.

#### ***Applicability***

- This method has major advantage of incorporating several criteria related to economic efficiency and distribution in to one or two measures
- Used to examine the general equilibrium effects of the research, to assess the spillover of the research benefits among the different technologies, commodities, regions or countries and to estimate the effects of agricultural policies on benefits arising from the research

### **7. Simulation Models:**

In simulation models, mathematical relationships among variables are exposed to different scenarios to assess the best possible outcome. They can incorporate many factors that affect research priorities, such as multiple goals, research constraints, socio-economic variables, risk and uncertainty. The advantage of simulation models is their flexibility. They can be constructed as relatively simple or complex tools, can incorporate optimizing or ranking procedures and can readily include probabilities information. Their major disadvantage is that, to be useful they must be relatively complex and typically require extensive amounts of both data and time of skilled analysis.

### **8. Econometric Methods:**

The results of ex post analysis can also provide useful guidance for ex ante resource allocation decisions if appropriately incorporated into systematic ex ante procedure. The most common ex post approach is the econometric estimation or production or supply functions incorporating research variables. These econometric models address the



contribution of research to changes in production of different agricultural commodities to be useful in ex ante analysis, econometric approaches must be applied with a high degree of disaggregation and good historical data on production, farm inputs and research expenditures. Numerous studies have estimated these models (production functions supply functions, profit functions etc.) for ex post evaluation of agricultural research. While the results of these studies have been used to justify additional research funds for particular commodity; no research system has systematically used the results of a comprehensive econometric analysis for all its major commodities to help in setting research priorities.

Studies on prioritization have generally five methods, singly or in combination, no single method is suited for every situation. Choice of the method is influenced by the of priority setting (Macro-Micro) and availability of data, analytical skills and resources. More complex one's like mathematical programming, simulation model and econometric model are quite data intensive and therefore are applied in very few cases .The scoring model which is simple often used for micro-level-prioritization of research projects

# BASICS OF COMPUTERS

In the present day world computers became the integral part of day-to-day activities of mankind and in future we can visualize that they will be inseparable from human life. It is therefore felt useful to know the historical developments and the basic terminologies and jorgans of this important machine.

## Types of Computers:

Computers are broadly classified into two types:

(I) Analog (ii) Digital

- (I) Analog Computers : Computers using signals as input is known as Analog Computers. Their use is limited to Scientific and Engineering Applications
- (ii) Digital Computers : Computers which accepts digital and alphabets as input is known as digital computers

The computers commonly called as PC's, come under 'digital computers'. Functionally computers can be represent as:



## Digital Computers

In 1937 Howard A. Aiken of Harvard University began work on the design of a fully automatic calculating machine in collaboration with the International Business Machines Corporation (IBM). His aim was to develop a machine which would help in solving complex differential equation, which would have been impractical manually. In May 1944, the design became a reality and in August the machine under the name "Harvard Mark - 1" and also known as "Automatic Sequence Controlled Calculator" was donated to Harvard University in Cambridge. The disadvantage with this machine was University in Cambridge. The disadvantage with this machine was its complexity in design and large in size. Physically the machine was of 51 feet length and 8 feet in height. Also this machine was extremely slow in calculation. The Mark-1 was really an electro-mechanical machine in that the Central Processing Unit (CPU) depends on both mechanical and electronic devices for its operation.

The innovation of very high-speed vacuum tube switching devices led to the first all-electronic computer called "Electronic Numerical Integration and Calculation (ENIAC) in February, 1946. This was constructed at the Moore School of Engineering of the University of Pennsylvania by a design team led by Prof. Eckert and Mauchly. The machine was small in terms of storage capacity and it was designed for a specific purpose (ballistics) and therefore its use was limited.

Before the completion of ENIAC Dr John Von Neumann brought revolution in the field of computers, which was influenced highly for the development of modern digital computers. His most significant concept was that of the "Stored programme". The idea behind was that a sequence of instructions might be stored in computer for the purpose of directing the flow of

operation and then instructions themselves might be altered and manipulated the data. This was named as “Electronic Discrete Variable Automatic Computer” (EDVAC). This machine was not however popular due to difficulties during the development stage. Later in early 1947, the work “Electronic Delay Storage Automatic Calculation” (EDSAC) was started in the mathematical laboratory of Cambridge University under the leadership of Prof. Maurice Wilkes. The machine executed its first program in May 1949. This was the first electronic, stored-program and digital computer, as we know it today.

## Computer Generations

The custom of referring to the computer era in terms of generation comes into wide use after 1964. Originally the term “generation” was used to distinguish between varying hardware technologies. Since 1968 it has been extended to include both the hardware and the software, which together make up an entire system.

The features of the computers of different generation, their advantages and disadvantages are shown in the following table.

| Generation                           | Electronic Component Used      | Advantages   | Disadvantages   |
|--------------------------------------|--------------------------------|--|---|
| 1 <sup>st</sup> generation (1940-52) | Vacuum tubes                   | vacuum tubes were the only electronic components available   | Large size A/c required unreliable constant maintenance |
| 2 <sup>nd</sup> generation (1952-64) | Transistors                    | Smaller size less heat generated more reliable and faster  | A/c required maintenance costs                          |
| 3 <sup>rd</sup> generation (1964-71) | Integrated circuits            | Even smaller size. Even lower heat generation. Less power requires. Even more reliable fastens still | Initial problems with manufacture                       |
| 4 <sup>th</sup> generation (1971- )  | Large size integrated circuits | No A/c minimum maintenance cheapest  | Less powerful than mainframe computers.                 |

The 5<sup>th</sup> generation computers are in progress wherein “artificial intelligence is going to play a key role in development. Already Computer systems display in some degree of artificial intelligence in some fields such as medical diagnosis, mineral and oil exploration. Incorporation of artificial intelligence would further enhance the capabilities of computers. USA and Japan are leading in research and development and Japan in particular is investing vast sum of money.

## Advantages and Limitations

The use of computers, particularly personal computers (PC) have expanded so rapidly that their utilities can no longer be ignored. In a modern society their presence made more advantageous and comfortable. Some of the advantages and limitations are given below.

## Advantages

- Computers are useful for getting the job fast with accuracy
- Computers brought a revolutionary change in data processing which include (a) Inputting the raw data (b) manipulation of data by classification, calculation and summarization (c) storing, retrieving, communication and reproducing.
- Computers can be used as substitutes in the areas where man could not do physically.
- Computers in the area of research helps in handling huge quantum of data, for sophistication and rigorous analysis to draw meaningful conclusions.
- Advancement of computers brought revolutionary changes in communication, defense, space, remote sensing research.

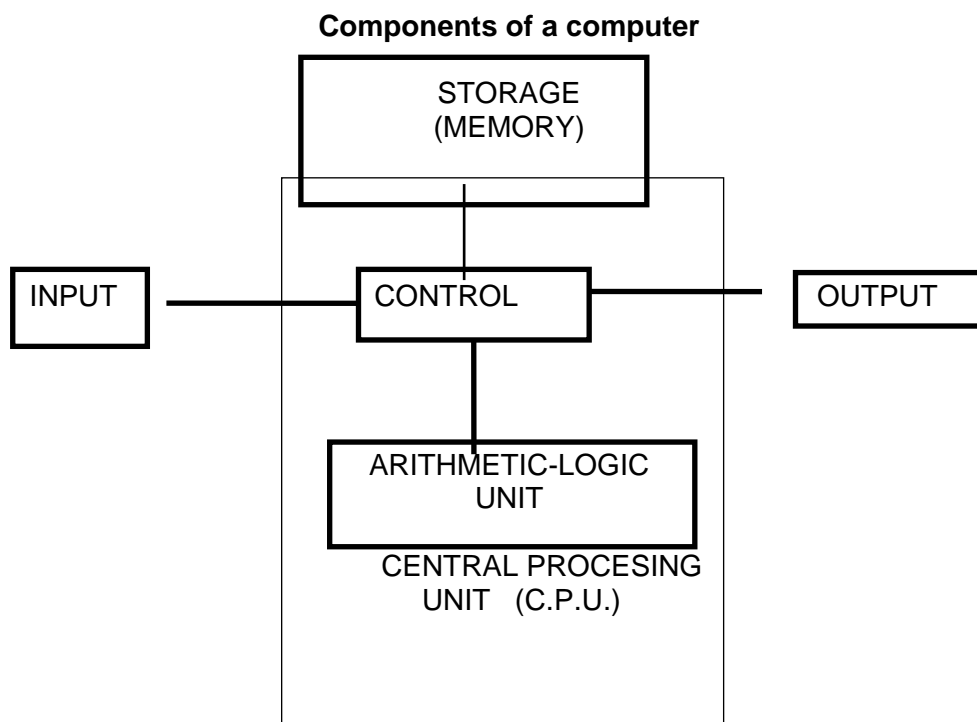
## Limitations

Compared to the advantages and usefulness, the limitation of computers is not so serious. However, one should be aware of some of the limitations while using the computers.

The first and foremost one is that computer is only a supporting tool to the man. Since it is a sincere servant to a master (man), its functions and usage depends upon the master's instructions. Therefore one should be very careful in designing the instructions (in computer language it is called programming). The misuse of programming technique like virus is another great limitation in computers. Once virus is attacked the information stored in the computer will be lost permanently. Computers will help only in processing the data or information but it may not be helpful to people in areas where subjective evaluations are important and decision-making is involved.

## Computer Hardware

The computer receives the data from the input device and processes the information according to the set of instructions and provides in output form. Computer system mainly the following components as shown below diagrammatically.



## Central Processing Unit (CPU)

The Central Processing Unit is further divided into three namely storage unit, Arithmetic Logic Unit (ALU) and Control Unit. The central processing unit (CPU) can be comparable to the human brain. Before it can carry out any processing operation, two kinds of information have to be fed into namely the programme and the data. The programme is a set of instructions which the computer has to carry out the assigned job. The data is the information of which these instructions are to operate. The functions of the Units of the Central Processing Unit (CPU) are given below:

### (i) Arithmetic Logic Unit (ALU)

This unit takes care of the calculation addition, subtraction and logic functions like true and false. Once data is fed into the main memory from input devices they are held and transferred as needed to ALU where processing takes place. Intermediate results generated in ALU are temporarily placed in the main memory and back again to ALU if needed. This process continues so many times before the process is finished.

### (ii) Memory

Memory stores programme instructions, user's programmes, data, internal results and final output. The memory of a computer can be thought of as cells. Each of these cells is further broke down into BITS. These bits are represented by 0 and 1 and are used to store instructions and data by their combinations. The following are the units to measure the storage capacity of the Computer.

|                |   |                 |
|----------------|---|-----------------|
| 8 bits         | - | 1 Bytes         |
| 1024 Bytes     | - | 1 Kilobyte (KB) |
| 1024 Kilobytes | - | 1 Megabyte (MB) |
| 1024 Megabytes | - | 1 Gigabyte (GB) |

To store one character (alphanumeric or numeric) computer requires 8 bits or one byte. Computer memory is of two types. These are Random Access Memory (RAM) also known as Prime Memory and Read Only Memory (ROM).

## RAM

The information stored in RAM will be lost when the computer is switched off. The other one is the secondary memory (secondary storage media) which will be used for mass storage and the devices are floppy disk, hard disk, tapes etc. The following table shows the distinction between these two memories.

| Primary Memory       | Secondary Memory          |
|----------------------|---------------------------|
| 1. Costlier          | Cheaper                   |
| 2. Temporary storage | Permanent storage         |
| 3. Chip technology   | Magnetic/Laser technology |

## ROM

Other important memory in computer is Read only Memory (ROM). The program required for running the computer stores in ROM. The data or program instructions stored in this memory does not erase even when the power is switched off. Usually ROM contains BiOs (Basic input-output system). Boot strap loader, which loads the operating systems (OS) into the memory. Since this program is stored in ROM, it starts as soon as the computer is switched on and makes the system ready to load OS program in the memory.

## Control Unit

The control unit ensures that the information is stored correctly and the programme instructions are followed in proper sequence and the data is selected from memory as necessary. This is similarly to central nervous system of human body which controls all the input devices, output devices, memory and arithmetic logic unit. It activates the necessary units depending upon the command from the user.

Further the CPU will have a Mother Board which will have several chips mounted on a circuit board. The major components which are mounted are Micro Processors, RAM chip, ROM chips and other supporting circuits.

## Micro Processor

Micro Processor chip is a brain which contains circuits and registers (storage locations). There will be address bus which are built into these chips to determine the storage locations (of RAM) of the data and instructions. Over the years, different microprocessors have been developed and the first one is INTEL 8088 (INTEL is a Computer Chip manufacturing Company in U.S.A.). In this chip, it retrieves from RAM 8 bits (1 byte) at a time but the data are processed 16 bits at a time internally in the 8086. Thus 8086 is a 8/16 bit chip. The following table gives brief idea on different Microprocessors along with technical details.

| S.No. | Micro Processor | Relative Power | Type of PC and No. of Observations   |
|-------|-----------------|----------------|--|
| 01.   | 8088            | 8/16           | Early Pcs, the PCXT. This was a veritable  |
| 02.   | 8086            | 16/16          | The first COMPAQ. The 8086 was faster than the 8088 but more expensive   |
| 03.   | 80286           | 16/16          | At types of Pcs and compatibles and some laptops. Much faster than the 8088/8086, this microprocessor first appeared in the IBM PC AT. |
| 04.   | 80386           | 32/32          | The father of the 386 family of computers. This is also called the 80386DX or just a 386.  |
| 05.   | 80386SX         | 16/32          | Laptops and inexpensive systems. These are slightly slower than the full 80386DX but cheaper.  |
| 06.   | 80486           | 32/32          | Expensive. This type is also called the I486 or the 486DX.   |
| 07.   | 80486SX         | 32/32          | Not quite as expensive as the preceding one. In this, there is no need of Math Coprocessor.  |

In the above table, Item 1 and 2 are of PC and PCXT range and from Item 3 onwards belongs to PCAT range. Intel later developed 486C and 386L chips for use in Note Book and LAPTOP Computers.

## Pentium

It is a very powerful chip developed by Intel during 1993. It do 900 lakhs instruction per second and is nearly 5 times more than 80486 chip.

Intel's main aim in developing the Pentium chip is to make use it as a highly advanced complex instruction set computing processor. Because of Pentium, the advanced features like complicated graphics, multi-media are developed in Computer field.

Pentium Pro (1995) is an advanced chip over Pentium. It consists of 55 lakh transistors and do 3000 lakhs instruction/sec. with a speed of 200 Mhz. It works 2 times more speed than Pentium. It needs 512 MB memory and 32 GB of Hard Disc space.

### **Clock Speed**

The speed with which the instruction is executed or number of pulses it loses per each second is called Clock Speed. The clock speed will be measured in terms of million pulses per second (Mhzs). The earlier PC/PCXT used to have a maximum Clock speed of 8 Mhz. Clock speed for PCAT ranges, starts from 16 Mhz and the newest chip operate at a speed of 90 Mhz.

### **Operating System**

The Operation System (OS) is collection of software or set of instructions that controls the over all operation of the Computer. The user communicate with the OS, supplies application programmes, and input data that are in a format acceptable to Operating System and produces output results. So the user is not too concerned with the Hardware or how the OS directs the Hardware to handle certain tasks. In Personal Computer System, the OS is called as DOS (Disk Operating System) and are commonly stored on a floppy disk which is called as system disk or boot disk.

### **Peripherals**

The input, output and secondary storage units are called as peripheral devices or simply peripherals. The name peripheral is because of the location of these units nearer to processor. Compared to PC and PCXT, and PCAT range of Computers can support more number of peripherals and work at faster rate.

**Input devices:** The computer processes the data which are entered/fed through the input devices. The output from the computer depends upon the data entered through these input devices. The principle "Garbage in and Garbage out (GIGO) is very much applicable. The input devices available are listed:

1. Keyboard 2. Floppy disks 3. Hard disk 4. Tapes 5. Magnetic Ink Character Recognition (MICR) 6. Scanner 7. Mouse 8. Voice Input System and 9. CD-ROM

**1. Keyboard:** The keyboards are similar to the conventional typewriter. Presently there are 101 keys on the board. There will also be separate functional keys, numeric key pad. The functional keys numbered from F1 to F10. There are special keys like HOME, END, PAGEUP, PAGEDOWN and four directional arrow keys. Both upper and lower letters can be entered by using the Caps lock key and the Shift Key.

**2. Floppy disk:** The floppies act as both input and output devices. The floppy disks are famously called as "Diskettes" is made of iron oxide recording substance. The data is recorded as thinly visible magnetic spots on this coating. Almost all floppy disks come in two sizes 5.1/4" and 3.1/2". Each size of the floppy disk can be either high capacity or low capacity. So leaving the user with four main varieties to choose from. These varieties will have a small hole on one side and the floppy called Right Protect Notch which protects the accidental writing/deleting the information from the disk. It is to be remembered that one cannot use 5.1/4" disk into a 3.1/2" drive and vice-versa.

All these floppy disks will run through the disk drives. These disk drives contains the motor that spins the disks around atleast 300 times each second. The head inside the drive hovers over the spinning disk, reading or writing information from or to the disk. The following tables give the storage capacity of the disk of different diskettes.

| <u>Storage capacity</u> | <u>Disk Size</u> |
|-------------------------|------------------|
| Low density (360 KB)    | 5.1/4"           |
| High density (1.2 MB)   | 5.1/4"           |
| Low density (720 KB)    | 3.1/2"           |
| High density (1.4 MB)   | 3.1/2"           |
| Extended (2.8 MB)       | 3.1/2"           |

**3. Hard Disk:** The hard disk acts as both input and output devices. The hard disk can hold more information compared to a floppy disk and retrieval of information from hard disk is faster compared to floppies and tapes. Usually the hard disk is fixed inside the computer. The capacity of the hard disk ranges onwards from 20 Megabyte.

**4. Tapes:** The tapes act as both input and output devices. The magnetic tapes are similar to audiotapes consisting of magnetic material that comes in one side of the plastic tape. The tape will be divided into number of tracks. Commonly 9 tracks are used to record data on standard 1/2" wide reels of tape. The retrieval from the tape is slower compared to diskettes because of lack of direct access to the information. But the advantage is that it is cheaper in cost and ease of handling. The magnetic tapes will be of two varieties. The first one is magnetic reels which are commonly used in Mainframe Computers and the second one is magnetic tape cartridges which are used in micro computers.

**5. Magnetic Ink Character Recognition:** The MICR is widely used by banks to process the volume of cheques. In this month, the data will be precoded in numbers and symbols. They are presented with a special ink that contains iron oxide. There will be a reader, sorter unit which has these codes and translates into data directly to the computer. The process is speedy and ink characters are readable but there are only 10 digits and limited special characters and no alphabetical characters are visible.

**6. Scanners:** The scanners are of recent technology and can be used as one of the input devices. These scanners directly reads any printed document and produces a computer file which can read by any word processing package for further manipulation of the data.

**7. Mouse:** The mouse looks like a bar of soap with a large rolling ball embedded in its another side. On top of it, there will be two push buttons and the card runs from the mouse into the back of the computer. When the mouse moves, small arrow will move parallelly on the screen. The selection on the screen will be done by using this arrow and the two buttons on the mouse. The mouse cannot be used for entering data. It is only useful to select the option on the screen. So it is not a replacement of the keyboard.

**8. Voice Input System:** This is one of the input devices of recent origin and the computer recognizes the oral commands from the user. But there are lot of limitations and is not a proven technology still. This technology may be coming in a big way in the future. Presently, it is being limited to the blind users.

**9. CD-ROM:** CD-ROMs are of high storage capacity floppies. These are very durable and cost of production is relatively cheap and access time is faster. The capacity of these floppies will be about 600 MB. Usually, the CD-ROMs are used only as input devices for information retrieval from large databases.



**Output Devices:** The output devices store the processed data for later use or for printing purpose. Some of output devices are 1. Terminal/Monitor 2. Printer 3. Floppies, Hard Disks and Tapes.

**1. Terminal / Monitor:** The monitor is physically a television like thing. The computer displays information on the screen of the monitor either text or graphics either in monochrome or colour. The display may be of monochrome or colour. The monochrome mode displays information in only two colours like black and white TV set and the colour displays information in several colours. These modes will depend upon the adopter used inside the computer. Some of them are Colour Graphics Adopter (CGA), Enhanced Graphics Adopter (EGA), Video Graphics Adopter (VGA) and Super Video Graphics Adopter (SVGA).

**2. Printer:** The information generated by the computer can be printed by using these printers. There are a variety of printers available in the market. Some of them are listed.

a) Dot-Matrix Printer b) Ink-Jet Printer c) Laser Printer d) Line Printer and e) Plotter

**Dot-Matrix Printer:** The Dot-Matrix printer prints the character in dotted pattern by using 24 pin or 9 pin. Usually the speed of the printers will be in characters per second (CPS) ranges from 200/300 to 700 CPS> The dot-matrix printers can enhance the quality of printing by using Near Letter Quality (NLQ) mode, but at the cost of the speed. The NLQ provision is an optional.

**Ink-Jet Printer:** The output from the inkjet printer is better than the dot-matrix printer. It uses the ink rather than a ribbon and the character is formed by designs of tiny ink dots. The speed is slower compared to dot-matrix printers. The speed is measured in characters per second (CPS).

**Laser Printer:** The output from the laser printer is the best compared to any other devices. This uses the laser light to produce the dots needed to form pages of characters. The laser printer writes the desired output on a copier track with a light beam that operates under computer control. These printers are quite and produce high quality output. The speed of these printers is measured in terms of pages per minute (PPM) which ranges from 6 PPM to 12 PPM.

**Line Printer:** In contrast to dot-matrix printers, the line printers produces line at a time printed output by using chains or bands of print characters. The speed is measure din lines per minute (LPM) and the range is from 300 to 600 LPM. These printers usually will be used where print requirement is very high.

**Plotters:** The plotters are used to produce drawings or graphs. This plotter uses the pens and each pen is filled with different ink colors. The computer selects the required pen to produce the colour output.

## **Software**

Software can be defined as sequence of instructions which when fed into the Computer Hardware enable a Computer to perform various desired tasks. Software can be categorized into: 1. Systems Software 2. Application Software

## 1. Systems Software

This is a software to run the computer. It consists of operating system (OS), translators, compilers, etc.

(I) Translators: Computer accepts only digits and alphabets as inputs. However, this input is not directly understood by the Computers. It is translated into the machine language so as to make computers understand it. There are three types of translators: (a) Compilers (b) Interpreters (c) Assembler

(a) Compilers: A compiler will accept complete set of programme instructions (code) as input and then converts it to machine code. Ex: COBOL, FORTRAN

(b) Interpreter: An interpreter will accept programme codes line by line and converts it to machine code. Ex: BASICS

(c) Assembler: Accepts programmes in assembly language as input and produces machine code as output.

In operation a compiler is more efficient than interpreter.

## Application Software

For developing programmes to serve a particular application like financial account, pay bills, examination evaluation etc. is called application software.

## Disk Operating Systems (DOS) Commands

### ATTRIB

Displays or changes file attributes. This command displays, sets, or removes the Read-Only (R), Archive (A), System (S), and Hidden (H) attributes assigned to files or directories.

**Syntax:** **ATTRIB** [+R|-R] [+A|-A] [+S|-S] [+H|-H][[drive:][path]filename] [/S]

To display all attributes of all files in the current directory, use the following syntax:

Examples:

To display the attributes of a file named NEWS86 located on the current drive, type the following command: `attrib news86`

To assign the Read-Only attribute to the file REPORT.TXT, type the following command:

`attrib +r report.txt`

To remove the Read-Only attribute from files in the \PUBLIC\JONES directory on a disk in drive B and from files in any subdirectories of \PUBLIC\JONES, type the following command:

`attrib -r b:\public\jones\*. * /s`

### CHDIR (CD)

Displays the name of the current directory or changes the current directory.

**Syntax:** **CHDIR** [drive:][path]

`CHDIR[.]`

`CD [drive:][path]`

`CD[.]`

To display the current drive letter and directory name, use either of the following syntax lines:

`CHDIR`

`CD`

Examples:

Either of the following commands changes your current directory to the directory named PRIMETIM:

```
chdir \primetim  
cd \primetim
```

To change from a subdirectory back to the parent directory, type the following command: `cd..`.

### CHKDSK

Checks the status of a disk and displays a status report. Can also fix disk errors. The status report shows errors found in the MS-DOS filing system, which consists of the file allocation table and directories. CHKDSK also displays a summary of disk usage. (CHKDSK does not verify that the information in your files can be accurately read.) If errors exist on the disk, CHKDSK alerts you with a message.

**Syntax:** CHKDSK [drive:][[path]filename] [/F] [/V]

/F : Fixes errors on the disk. Do not use this option when running CHKDSK from other programs; for more information, see "Using CHKDSK With Open Files" in <CHKDSK--Notes>. In general, when fixing disk errors, use <ScanDisk> instead of CHKDSK.

/V :Displays the name of each file in every directory as the disk is checked.

#### Examples

To find out how much data is stored on drive C and how much space is still free, and to check the disk for errors, type the following command:

```
chkdsk c:/f
```

CLS: Clears the screen. The cleared screen shows only the command prompt and cursor.

**Syntax :** CLS

### COPY

Copies one or more files to the location you specify. This command can also be used to combine files. When more than one file is copied, MS-DOS displays each filename as the file is copied.

**Syntax:** COPY [/Y|/-Y] [/A|/B] source [/A|/B] [+ source [/A|/B] [+ ...]][destination [/A|/B]] [/V]

/Y : Indicates that you want COPY to replace existing file(s) without prompting you for confirmation.

/A : Indicates an ASCII text file.

/B :Indicates a binary file.

/V :Verifies that new files are written correctly.

#### Examples

The following command copies a file and ensures that an end-of-file character is at the end of the copied file:

```
copy memo.doc letter.doc /a
```

### DATE

Displays the date and prompts you to change the date if necessary.

MS-DOS records the current date for each file you create or change; this date is listed next to the filename in the directory.

**Syntax:** DATE [mm-dd-yy]

### DISKCOMP

Compares the contents of two floppy disks. This command performs a track-by-track comparison. DISKCOMP determines the number of sides and sectors per track to compare based on the format of the first disk you specify.

**Syntax:** DISKCOMP [drive1: [drive2:]] [/1] [/8]

Parameters

drive1: Specifies the drive containing one of the floppy disks.

drive2: Specifies the drive containing the other floppy disk.

/1 Compares only the first sides of the disks,

/8 Compares only the first 8 sectors per track

Example: If your system has only one floppy disk drive, drive A, and you want to compare two disks, type the following command:

diskcomp a: a:

DISKCOMP prompts you to insert each disk, as required.

## DISKCOPY

Copies the entire contents of one floppy disk to another floppy disk. DISKCOPY writes over the existing contents of the destination disk as it copies the new information to it.

This command determines the number of sides to copy based on the source drive and disk.

**Syntax:** DISKCOPY [drive1: [drive2:]] [/1] [/V] [/M]

Parameters

drive1: Specifies the drive containing the source disk.

drive2: Specifies the drive containing the destination disk.

/1 Copies only the first side of a disk.

/V Verifies that the information is copied correctly. Use of this switch slows the copying process.

/M Forces DISKCOPY to use only conventional memory for interim storage. By default, DISKCOPY uses your hard disk as an interim storage area so you don't have to swap floppy disks.

## DEL (Erase)

Deletes the files you specify.

**Syntax:** DEL [drive:][path]filename [/P]

ERASE [drive:][path]filename [/P]

Parameter

[drive:][path]filename

Specifies the location and name of the file or set of files you want to delete.

/P Prompts you for confirmation before deleting the specified file.

## Examples

To delete the CAT.TMP file from the TEST directory on drive C, you can use either of the following commands:

```
del c:\test\cat.tmp
```

```
erase c:\test\cat.tmp
```

## DELTREE

Deletes a directory and all the files and subdirectories that are in it.

**Syntax:** DELTREE [/Y] [drive:]path [[drive:]path[...]]

Parameter

drive:path

Specifies the name of the directory you want to delete.

/Y Carries out the DELTREE command without first prompting you to confirm the deletion.

### Example

To delete the TEMP directory on drive C, including all files and subdirectories of the TEMP directory, type the following at the command prompt:

```
deltree c:\temp
```

### DIR

Displays a list of the files and subdirectories that are in the directory you specify.

**Syntax:** DIR [drive:][path][filename] [/P] [/W] [/A[:attributes]] [/O[:sortorder]] [/S] [/B] [/L] [/C]

/P Displays one screen of the listing at a time.

/W Displays the listing in wide format, with as many as five filenames or directory names on each line.

/A[:] attributes]

Displays only the names of those directories and files with the attributes you specify.

H Hidden files

-H Files that are not hidden

S System files

-S Files other than system files

D Directories

-D Files only (not directories)

A Files ready for archiving (backup)

-A Files that have not changed since the last backup

R Read-only files

-R Files that are not read-only

/O[:] sortorder]

Controls the order in which DIR sorts and displays directory names and filenames.

/S Lists every occurrence, in the specified directory and all subdirectories, of the specified filename.

/B Lists each directory name or filename, one per line (including the filename extension).

/L Displays unsorted directory names and filenames in lowercase.

### Examples

To delete the CAT.TMP file from the TEST directory on drive C, you can use either of the following commands:

```
del c:\test\cat.tmp
```

```
erase c:\test\cat.tmp
```

To delete all the files in a directory named TEST on drive C, you can use either of the following commands:

```
del c:\test
```

```
del c:\test\*. *
```

### EDIT

Starts MS-DOS Editor, a text editor you can use to create and edit ASCII text files.

**Syntax:** EDIT [[drive:][path]filename]

### EXIT

Quits the MS-DOS command interpreter (COMMAND.COM) and returns to the program that started the command interpreter, if one exists.

**Syntax :** EXIT

### FORMAT

Formats a disk for use with MS-DOS. The FORMAT command creates a new root directory and file allocation table for the disk. It can also check for bad areas on the disk, and it can delete all data on the disk. In order for MS-DOS to be able to use a new disk, you must first use this command to format the disk.

### **Syntax**

```
FORMAT drive: [/V[:label]] [/Q] [/U] [/F:size][/B/S] [/C]
FORMAT drive: [/V[:label]] [/Q] [/U] [/T:tracks /N:sectors][/B/S]
[/C]
FORMAT drive: [/V[:label]] [/Q] [/U] [/1] [/4] [/B/S] [/C]
FORMAT drive: [/Q] [/U] [/1] [/4] [/8] [/B/S] [/C]
```

/V:label Specifies the volume label.  
/Q Specifies a quick format of a disk.  
/U Specifies an unconditional format of a disk.  
/F:size Specifies the size of the floppy disk to format.  
/B Reserves space for the system files IO.SYS and MSDOS.SYS (as hidden files) on a newly formatted disk.  
/S Copies the operating system files IO.SYS, MSDOS.SYS, and COMMAND.COM from your system's startup drive to a newly formatted disk that you can use as a system disk.  
/T:tracks Specifies the number of tracks on the disk.  
/N:sectors Specifies the number of sectors per track.  
/1 Formats a single side of a floppy disk.  
/4 Formats a 5.25-inch, 360K, double-sided, double-density floppy disk on a 1.2-MB disk drive.  
/8 Formats a 5.25-inch disk with 8 sectors per track.

/C Retests bad clusters.

### **Examples**

To format a 360K floppy disk in drive A and copy the operating system files to the disk to make it a system disk, type the following command:

```
format a: /f:360 /s
```

## **LABEL**

Creates, changes, or deletes the volume label (name) of a disk.

MS-DOS displays the volume label as part of the directory listing. If a volume serial number exists, MS-DOS displays this number as well.

**Syntax:** LABEL [drive:][label]

To specify that MS-DOS is to display the current volume label and serial number, if they exist, and that MS-DOS is to prompt you to enter a label or delete the existing one, use the following syntax:

### **LABEL Parameters**

drive: Specifies the location of the disk you want to name.

label Specifies the new volume label. You must include a colon (:) between drive and label.

### **Example**

To label a disk in drive A that contains sales information for 1991, you might type the following:

```
label a:sales1991
```

## **MKDIR (MD)**

Creates a directory. You can use the MKDIR or MD command to create a multilevel directory structure.

**Syntax:** MKDIR [drive:]path

MD [drive:]path

## MORE

Displays one screen of output at a time. The MORE command reads standard input from a pipe or redirected file and displays one screen of information at a time. This command is commonly used to view long files.

**Syntax:** command-name | MORE  
command-name

Specifies the command that supplies data you want to display.

Examples

Suppose you have a long file named CLIENTS.NEW that you want to view on your screen.  
type clients.new | more

## MOVE

Moves one or more files to the location you specify. The MOVE command can also be used to rename directories.

**Syntax:** MOVE [/Y|/-Y]  
[drive:][path]filename[, [drive:][path]filename[...]]  
destination

Examples:

Suppose C:\LETTERS is a directory. To move the files ED.TXT and SIGRID.TXT from the current directory to the LETTERS directory on drive C, type the following at the command prompt:

move ed.txt,sigrid.txt c:\letters

## MSAV

Scans your computer for known viruses.

**Syntax:** MSAV [drive:] [/S | /C] [/R] [/A | /L]  
[/N] [/P] [/F] [/VIDEO]

/S Scans the specified drive, but does not remove viruses that MSAV finds.

/C Scans the specified drive, and removes viruses that MSAV finds.

/R Creates a Report File MSAV.RPT

/A Scans all drives except drive A and drive B.

/L Scans all local drives except network drives.

/N Displays the contents of an MSAV.TXT file, if it exists and it is located in the directory that contains the MSAV.EXE file.

/P Displays a command-line interface instead of the graphical interface.

/F Turns off the display of filenames that have been scanned. Use this switch only with the /N or /P switch.

Examples

To start MSAV using a black and white color scheme, and to specify that MSAV check all drives except drives A and B, type the following command:

msav /bw /a

## MSBACKUP

Runs Microsoft Backup for MS-DOS, which backs up or restores one or more files from one disk onto another.

You can back up all files on a disk or files that have changed since your last backup, schedule backups so they are done automatically on a regular basis, and restore files that you have backed up.

**Syntax:** MSBACKUP [setup\_file] [/BW | /LCD | /MDA]

setup\_file

Specifies the setup file that defines files to back up and the type of backup you want to perform.

Example: Suppose you created a setup file named WEEKLY.SET that defines a weekly full backup procedure on specified files. To use this setup file, type the following at the command line:

msbackup weekly

## PATH

Indicates which directories MS-DOS should search for executable files.

MS-DOS uses the PATH command to search for executable files in the directories you specify. By default, the search path is the current directory only.

**Syntax:** PATH [[drive:]path[;...]]

Example

The following command specifies that MS-DOS is to search three directories to find commands (the three paths for these directories are C:\USER\TAXES, B:\USER\INVEST, and B:\BIN):

path c:\user\taxes;b:\user\invest;b:\bin

## PROMPT

Changes the appearance of the command prompt. You can customize the command prompt to display any text you want.

**Syntax:** PROMPT [text]

text

Specifies any text and information you want included in your system prompt.

The following list shows the character combinations you can include instead of, or in addition to, any character string(s) in the text parameter.

\$P Current drive and path

\$G > (greater-than sign)

Examples

The following example sets the command prompt to display the current drive and path followed by the greater-than sign (>):

prompt \$p\$g

## PRINT

Prints a text file while you are using other MS-DOS commands.

**Syntax:** PRINT [/D:device] [/B:size] [/U:ticks1] [/M:ticks2] [/S:ticks3]  
[/Q:qsize] [/T] [[drive:][path]filename[ ...]] [/C] [/P]

Examples

To view the status of the print queue, type the following at the command prompt:

print

MS-DOS displays the name of the file being printed (if any), the names of files in the queue, and an error message, if an error condition exists.

The following command removes the PENCIL.TST file from the print queue:

print a:pencil.tst /c

## RMDIR (RD)



Deletes (removes) a directory. The directory must be empty except for the "." and ".." symbols.

**Syntax:** RMDIR [drive:]path

RD [drive:]path

Example: To delete a directory named \USER\SMITH, first ensure that the directory is empty, as in the following example:

dir \user\smith /a

## RENAME (REN)

Changes the name of the file or files you specify. You can rename all files matching the specified filename.

**Syntax:** RENAME [drive:][path]filename1 filename2

REN [drive:][path]filename1 filename2

Example: To delete a directory named \USER\SMITH, first ensure that the directory is empty, as in the following example:

dir \user\smith /a

## RESTORE

Restores files that were backed up by using any version of BACKUP from MS-DOS versions 2.0 through 5.0. If you are restoring files that were backed up using the MSBACKUP program in MS-DOS 6 or later, use that version of the <MSBACKUP> program to restore those files.

You can restore files from similar or dissimilar disk types.

### Syntax

RESTORE drive1: drive2:[path[filename]] [/S] [/P] [/B:date] [/A:date] [/E:time] [/L:time] [/M] [/N] [/D]

### Examples

To restore the file INVEST.MNT from the backup disk in drive A to the IRS directory on drive C, type the following command:

restore a: c:\irs\invest.mnt

## SCANDISK

Starts Microsoft ScanDisk, a disk analysis and repair tool that checks a drive for errors and corrects any problems that it finds.

**Syntax** to check the current drive for disk errors, use the following syntax:

SCANDISK

Examples: To check and fix the current drive, type the following:

scandisk

## TIME

Displays the system time or sets your computer's internal clock.

MS-DOS uses time information to update the directory whenever you create or change a file.

**Syntax:** TIME [hours:[minutes[:seconds[:hundredths]]][A|P]]

Example: To set your computer's clock to 1:36 P.M., use either of the following commands:

TIME 13:36

TIME 1:36p

## TREE

Graphically displays the structure of a directory.

**Syntax:** TREE [drive:][path] [/F] [/A]

/F Displays the names of the files in each directory.

/A Specifies that TREE is to use text characters instead of graphic characters to show the lines linking subdirectories.

Examples

To display the names of all the subdirectories on the disk in your current drive, type the following command:

```
tree \
```

## TYPE

Displays the contents of a text file. Use the TYPE command to view a text file without modifying it.

### Syntax

```
TYPE [drive:][path]filename
```

Examples

If you want to display the contents of a file named HOLIDAY.MAR, type the following command:

```
type holiday.mar
```

## UNDELETE

Restores files that were previously deleted by using the <DEL> command.

UNDELETE offers three levels of protecting files against accidental deletion-- Delete Sentry, Delete Tracker, and standard.

### Syntax

```
UNDELETE [[drive:][path]filename] [/DT]/DS/DOS]
```

```
UNDELETE [/LIST]/ALL/PURGE[drive]/STATUS/LOAD/UNLOAD /S[drive]/Tdrive[-  
entries]]
```

/LIST

Lists the deleted files that are available to be recovered, but does not recover any files.

/ALL

Recovers deleted files without prompting for confirmation on each file.

/DOS

Recovers only those files that are internally listed as deleted by MS-DOS, prompting for confirmation on each file.

/DT

Recovers only those files listed in the deletion-tracking file, prompting for confirmation on each file.

/DS

Recovers only those files listed in the SENTRY directory, prompting for confirmation on each file.

/STATUS

Displays the type of delete protection in effect for each drive.

Examples

The following command specifies that UNDELETE is to recover all deleted files in the current directory one at a time, to prompt for confirmation on each file, and to use the highest available level of delete tracking:

```
undelete
```

## UNFORMAT

Restores a disk that was erased by using the FORMAT command.

UNFORMAT restores only local hard disk drives and floppy disk drives; it cannot be used on network drives. The UNFORMAT command can also rebuild a corrupted disk partition table on a hard disk drive.

**Syntax:** UNFORMAT drive: [/L] [/TEST] [/P]

/L

Lists every file and subdirectory found by UNFORMAT.

/TEST

Shows how UNFORMAT would recreate the information on the disk, but does not actually unformat the disk.

/P

Sends output messages to the printer connected to LPT1.

Examples: To determine whether UNFORMAT can restore a formatted disk in drive A, type the following command:

unformat a: /test

## VER

Displays the MS-DOS version number.

**Syntax:** VER

## VOL

Displays the disk volume label and serial number, if the disk has them. Syntax

VOL [drive:]

## VSAFE

Continuously monitors your computer for viruses and displays a warning when it finds one. VSAFE is a memory-resident program that uses 22K of memory. Do not use the VSAFE command when Windows is running.

**Syntax:** VSAFE [/option[+ | -] ...] [/NE] [/NX] [/Ax | /Cx] [/N] [/D] [/U]

Example:

To specify that VSAFE not check for formatting that could erase all data on the hard disk, that VSAFE warn of attempts to write to the boot sector of a floppy disk, and that ALT+T be assigned as the hot key to display the VSAFE screen, type the following command:

vsafe /1- /7+ /At

## XCOPY

Copies directories, their subdirectories, and files (except hidden and system files). With this command, you can copy all the files in a directory, including the files in the subdirectories of that directory.

**Syntax:** XCOPY source [destination] [/Y|/-Y] [/A|/M] [/D:date] [/P] [/S] [/E] [/V] [/W]

source

Specifies the location and names of the files you want to copy. Source must include either a drive or a path.

destination

Specifies the destination of the files you want to copy. Destination can include a drive letter and colon, a directory name, a filename, or a combination.

Examples

The following example copies all the files and subdirectories (including any empty subdirectories) from the disk in drive A to the disk in drive B:

xcopy a: b: /s /e

# **ECONOMIC POLICIES AND AGRICULTURAL DEVELOPMENT**

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## **CONCEPT OF GROWTH AND DEVELOPMENT**

In recent literature, the term economic growth refers to sustained increase in a country's output of goods and services, or more precisely product per capita. Output is generally measured in terms of gross national product (GNP) or net national product (NNP) though other measures could also be fruitfully employed for this purpose. The term economic development as stated above is of more comprehensive. It implies progressive changes in the socio-economic structure of a country. Viewed in this way, economic development involves a steady decline in agriculture's share in GNP and a continuous increase in the shares of industries, trade, banking, construction and services. This change in production structure is inevitably accompanied by a change in occupational structure of the working population and improvement in the skill and productivity of labour. Further, where economic growth merely refers to a rise in output, development implies change in technological and institutional organization of production as well as in distributive pattern of income. Hence, compared to the objective of development, economic growth is easy to realize. By a larger mobilization of resources and raising their productivity, output level can be raised.

The process of development is far more extensive. Apart from a rise in output, it involves changes in the composition of output, shift in the allocation of productive resources, and elimination or reduction of poverty, inequalities and unemployment. In some of the third world countries the process of economic growth has been accompanied by economic development. In some of the third world countries the process of economic growth has been accompanied by economic development. This, however, is not necessary. It is quite probable that the country merely manages to raise the output of the same type of goods and services to keep up with a growing population, while the basic structure of the economy remains intact. This is not a hypothetical situation.

The experiences of a number of underdeveloped countries clearly prove the point that unless the state directly strives for eliminating poverty, inequalities and unemployment, growth has an in-built tendency to bypass those very people in the society who deserve to benefit most by it. In a well-known book on Liberia, Robert Clower and others have pointed out that various concessions given by the state in this country to the foreign firms had induced its exports resulting in a considerable increase in GNP. This, however, did not result in complementary developments in other sectors of the economy.

The institutional set up of the country remained almost intact and the benefit of growth did not trickle down to the poor. Thus in spite of economic progress in terms of GNP per capita the vast majority of the population lived in destitution. Clower thus call it " growth without development." However, it is difficult to conceive of development without growth in most of the African and Asian countries, where GNP per capita is already high, development can take place even if the out put level does not rise for some years. For example, countries like Brazil, Mexico, Argentina, Chile and Venezuela can wipe out poverty completely at their existing levels of national income. They can ensure employment and a reasonably high living standard to all, in case they choose to pursue egalitarian policies. This is also possible in other newly industrializing and OPEC countries.

Most of the Third World countries have a colonial past and their growth pattern is quite similar in many respects. The essence of this pattern of growth is dualism. Dualism refers to the coexistence of developed and underdeveloped sectors in a country's economy side by side. In such an economy one sector or a sub-sector experiences perceptible growth, while the rest of the economy does not. Income generated by this growth in the past was shared between the representatives of the colonial powers and a small segment of the native population. Dualistic growth in the colonial period generally bypassed those areas and people who were completely outside the export sector. Having no connections with the growing sector of the economy the self-sufficient subsistence societies suffered a long period of stagnation. Colonialism that is rightly blamed for total stagnation or enclave growth in the countries of Africa and Asia has now disappeared. However, its imprints on the economies of these countries are still visible. It is distressing that in a number of Third World countries neo-colonialism has been able to take its roots. In all these countries growth process leaves large segments of the population completely untouched. Even in other countries following capitalist path of development growth has not benefited everyone.

## **GROWTH AND DEVELOPMENT OF AN ECONOMY**

### **Concepts of Growth and Development**

In Schumpeter's treatment of the dynamic evolution of an economy it is notable that he clearly distinguishes between two types of influences upon the economy. In the first category Schumpeter includes the influences of changes in the availabilities of the factors of production. He refers to them as the "growth" component. Influences included in the second category are those of the technological and social changes. He characterized them as the "development" component. While defining the term growth Schumpeter wrote, "we shall designate by the term growth changes in population...and in the sum total of savings plus accumulations corrected for the variation in the purchasing power" of the monetary unit. The changes in these two variables, in his opinion, are both continuous and slow. Distinguishing development from growth Schumpeter has asserted, "Development...is a distinct phenomenon, entirely foreign to what may be observed in the circular flow or in the tendency towards equilibrium. It is spontaneous and discontinuous change in the channels of the flow, disturbance of equilibrium, which forever alters and displaces the equilibrium state previously existing." For Schumpeter economic development is a phenomenon that cannot be explained economically. The "explanation of the development must be sought outside the group of facts which are described by economic theory."

### **Economic policies and Agricultural Development in India**

The process of economic policies and planning started in a systematic way in India after the establishment of Planning Commission in 1950. Agriculture being an important sector of the Indian economy, its development was considered inevitable for economic growth of India, Five Year economic planning process is an attempt towards this. The objectives of the Planning Commission were to assess the resources and requirements, and formulate policies to implement through five-year plans. Now, almost at the end of the eighth Five Year plan, there are numerous experiences with us to analyze the impact of these economic policies in agriculture development, which guide us to revise our objects and targets to meet future challenges. These policies went on changing with the Five Year plans. The highly centralized, public sector dominated, and close economy of 1950s has now changed to comparatively decentralized, private-owned and open economy. Before coming to any conclusion, it becomes imperative to retrospect into the agriculture situation at the time of Independence, and then analyse the economic policies in relation with agricultural development during the last eight Five Year plans.

### **Agricultural situation at the time of Independence and partition**

The Indian agriculture was characterized by regular famines and insufficient supply of foodgrains before Independence. The disastrous Bengal famine in 1943 rudely awakened India to the dire necessity to rapidly augment food production and streamline the distribution system. To add the woes, the partition of the country at the time of Independence resulted in a more than proportionate reduction in growth due to substantial transfer of irrigated land to Pakistan. About 32 per cent of irrigated land in undivided India went to Pakistan, reducing the percentage of irrigated land to the cultivated land from 21.6 per cent before partition to 17.6 per cent post partition.

By the year 1950-51, the country was experiencing severe food shortage, and consequent upsurge in food prices. The total foodgrain production was only 50.82 million tonnes at an average productivity of 522 kg/ha., and India was importing 4.8 million tonnes of food grains. Even after importing, the per capita net availability of foodgrains was only about 395 gms per day. The major portion of foreign exchange was lost towards import of foodgrains and other items of consumption.

### **Pride of place in the first Five Year plan (1951-56)**

The unfavorable conditions prevailing during fifties, the First Plan gave high priority to agriculture and augmenting food production. In the public sector outlay of Rs 2356 crores, the combined allocation to agricultural programmes, community development, cooperation, irrigated and flood control worked out to 37 per cent. Aided by favourable weather, the foodgrain production reached upto 68 million tonnes by the end of the plan period. The dependence on imports declined from 4.8 million tonnes in 1951 to less than a million tonnes by the end of the plan period. The pressure on prices eased and the fall in agricultural prices did cause a fall in the wholesale price index.

### **Shift of emphasis in the second plan (1956-61)**

The success achieved in the agricultural front during the first plan period has brought in a sense of complacency. The combined allocation to agriculture, irrigation and community development, etc., got reduced from 37 per cent in first plan to 22 per cent in second plan. The second Five Year Plan followed the Mahalanobis growth model with emphasis on building up the basic infrastructure for industrial development. It was also argued that the development of agriculture required investment in the production of a large number of modern inputs such as fertilizers, pump sets, tractors, etc., in non-agricultural sectors and on infrastructure consisting of transport, storage and energy. Nature was also not as kind as it was during the first plan period. Production during the second plan did not increase at the same rate as in the first plan and imports were again stepped up to maintain the per capita availability at the level of the closing years of the first plan.

### **New strategies in the third plan (1961-66)**

The agricultural sector attracted the same level of budget allocation in percentage terms during the third plan period as in the second plan. However, following the Ford Foundation Team's recommendations, it was decided to concentrate development effort on crops and areas, which have the greatest potentialities for increasing food production. The Intensive Agricultural Districts Programme (IADP) and the Intensive Agricultural Area Programme (IAAP) followed package approaches. By 1966-67 these programmes covered

about 15 per cent of the cultivated area in the country. While good progress was achieved in these areas, there was no let up in the difficulties faced by the country on the food front. Food grain imports reached an all time high of 10.4 million tonnes in 1966 following the disastrous drought. This period also witnessed the emergence of a number of Institutions like Food Corporation of India, Agricultural Prices Commission, etc., to extend support to the agricultural sector.

### **Turbulent years of annual plans (1966-69)**

The continued difficulties necessitated the postponement of fourth Five Year plan and plans were formulated on annual basis for three years. Agricultural sector received a marginal step up in budgetary allocations during this period. It is sheer coincidence that, by this time, after years of international research and experimentation, the new high yielding short duration short stem, fertilizer responsive, photo-insensitive varieties (HYVs) of wheat (Mexico) and rice (Philippine) proved their potential, and become available for commercial cultivation. India promptly took full advantage of this discovery and put all its administrative and technical resources to the adoption and spread of the HYV seeds. This has laid the foundation for some kind of take-off in the agricultural sector.

### **Green Revolution in the fourth plan (1969-74)**

The accent has shifted to modern agriculture, and to the use of non-farm purchased inputs - fertilizers, pesticides, electric and diesel pump sets, tractors and combine harvesters. The adoption of the HYV Technology yielded such spectacular results that the phenomenon was hailed as "Green Revolution". Average production of foodgrains in the five years (1967-68 to 1971-72) averaged 100 million tonnes compared to the average of 83 million tonnes of the pre-green revolution (1960-61 to 1964-65), leaving aside the two drought years of 1965-66 and 1966-67. But viewed in the total context of Indian agriculture, the terms "Green Revolution" looks like a hyperbole in the growth, was confined to cereal crops and to regions with good irrigation potential. More importantly, since the HYV technology necessitated capital investment and larger availability of credit, the relatively big farmers mainly adopted it. These two features of the new technology did result in some accentuation in inter-regional and inter-class disparity. This has been sought to be rectified by setting up of All India Coordinated Research Project on Dryland Agriculture and ICRIASAT on one hand, and Small Farmers Development Agency (SFDA) and Marginal Farmers and Agricultural Labourers Development Agency (MFAL) on the other.

### **Counter-vailing strategies in the fifth plan (1974-79)**

While continuing with the strategy for growth, Government intensified countervailing schemes to achieve equity for regions and classes which have not been benefited by the new technology and high growth rates. For this purpose, it has launched a series of special programmes for the weaker sections and backward regions. Drought Prone Areas Programme (DPAP), Hill Areas Development Programme (HADP), Small Farmers Development Agency (SFDA) and National Rural Employment Programme (NREP) were pursued doggedly, but their overall impact on poverty and unemployment was only marginal. The International Oil crisis pushed up the prices of fertilizers, diesel oil and machinery and farmers started articulating their demand for higher prices to their products. But the performance of agricultural sector during the plan period was quite satisfactory with the foodgrains production touching 132 million tonnes and productivity of food grains crossing the 1000 kg mark (1022 kg/ha.) for the first time in 1978-79.

### **Steady growth in the sixth plan (1980-85)**

The drought year of 1979-80 was disowned by the plan process due to the change of Government. The sixth plan period marked a steady progress on the agricultural front, with the foodgrain production reaching a record level of 152.4 million tonnes in its penultimate year. However, uneven distribution of benefits, flowing from the new agricultural strategy and from other institutional changes, has contributed to an increase in inter-regional disparities, besides accentuating inequalities between rich and poor peasants. According to the seventh plan, "There is a serious regional imbalance in the impact of green revolution in that less than 15 per cent of the area under foodgrains accounts for 50 per cent of the increase in foodgrain production in the post green revolution period". Another dominant and somewhat intractable problems of agriculture is the stupendous marginalisation of holdings under the pressure of population. The average size of holding quickly dropped from 2.3 ha. in 1970-71 to 2.0 ha. in 1976-77 and to 1.81 ha. in 1980-81 and subsequently to 1.57 ha. in 1990-91.

### **Setbacks in the seventh plan (1985-90)**

The seventh plan aimed at achieving 5 per cent growth rate in the economy and set a target of 4 per cent growth rate in agricultural production. Special emphasis was laid on increasing production from eastern Uttar Pradesh, Bihar and other states where potential existed. Special programmes were taken up for stepping up oilseeds production, and to develop dry lands on a watershed basis through the National Watershed Development Programme (NAWAPROG). The first three years of the plan period were marred by bad weather, culminating in an unprecedented drought in 1987-88. However, favourable weather conditions helped the country to achieve a record foodgrain production of 172 million tonnes in 1989-90.

### **Economic liberalization in the eighth plan (1992 -97)**

The eighth Five Year plan which could not commence in 1990-91 on account of political instability at the centre, actually started on April 1, 1992. It was the time when Indian economy was burdened with external debt, budgetary deficit and highly unfavourable balance of payment. At World Trade Forum, GATT was emphasizing for the acceptance of Dunkel Draft text. The Government of India announced a policy of economic liberalization to encourage direct private and foreign investment. The efforts were made to link Indian market with the world market thinking that agriculture sector will also be benefited and situation of *status quo* could be broken for faster development. The overall economic growth was fixed at still higher level of 5.6 per cent per annum.

An allocation of 22.2 per cent of the total plan outlay has been made for agriculture, irrigation and other related programmes. During the first three years of the plan, the foodgrain production touched all time the highest 191.1 million tonnes in 1993-94 and 1995-96. The actual foodgrain production remained much below the target of 210 million tonnes. The emphasis for the priorities and thrust areas in agriculture has been stressed for further development.

### **Top priority to agriculture in ninth plan**

In the ninth plan, top priority has been given to agriculture and allied sectors. The targets will be realized through a regionally differentiated strategy based on agronomic climatic and environment-friendly conditions. The diversification and high value crops will be



promoted in north-western high productivity regions along with strong linkages with the agro-processing industry and exports. More infrastructural facilities will be created for the later in this region. The second line of strategy will be to increase productivity in the eastern region having abundant water availability. At the same time major thrust in the region will be on flood control, drainage management and improvement of irrigation facilities. The emphasis will be on development of efficient water harvesting and conservation methods and technologies in water scarce region and peninsular India. In agricultural research, efforts will be made through biotechnology and genetic improvement. In agricultural education, thrust will be a human resource development.

### **Phases of agricultural development strategies**

The total agricultural development strategies adopted in past Five Year plans can be divided into four phases. The first phase of agricultural development strategies lasted with the third Five Year plan. During this phase, emphasis was led to increase agricultural production through potential area cultivation, capacity generation through industrialization and institutional support. The second phase which was more specifically limited to the fourth Five Year plan, was characterized by adoption of modern technology of seed, fertilizer and irrigation. This phase of agricultural development created lot of disparities in terms of land, crop and farmer. In order to remove these disparities, the third phase of equity distribution started from the fifth Five Year plan and continued upto the seventh Five Year plan. In this phase, programmes like DAAD, HADP, NREP and watershed development were implemented. A new phase of agricultural development started in the beginning of 90's with the adoption of economic reforms. In this phase, major emphasis are being given to growth, efficiency, food security, sustainability, remove disparities and equity in terms of income, employment and assess for food. Though these policies, sometimes, counter productive to our agricultural situation but we have to find a trade off between production and sustainability, subsistence/food security and commercialization.

### **Impact on agricultural development**

- Over the last four decades, the food grain production has commensurated with population growth and attained a level of self-sufficiency but the food grain productivity has become static, fluctuating between 1552 kg/ha. in 1997-98 to 1739 kg/ha. in 2001-02
- The share of agriculture in the gross domestic product steadily declined from about 60 per cent in 1950-51 to about 31 per cent in 1990-91 and 24.1 per cent in 2001-02 at current prices. But there is marginal decrease in proportion of labour force dependent on agriculture. Consequently the productivity of an agricultural worker is steadily declining over time in relation to that of non-agricultural worker.
- The inter regional disparities in yield has widened after the Green Revolution. The northern region made progress in wheat yield and southern region in rice yield but the eastern and central region showed negligible improvement. It led to increase in the variability of productivity among regions.
- The increases in average production have also been accompanied by increased production unstability. The coefficient of variation of total cereal production increased after the 1966-67, and led to various adverse effects on industry and export.
- The cost of production of agricultural commodities in the country is much higher than the international levels. Therefore, Indian agricultural commodities are unable to compete in the world market.
- The intensity of fertilizer use has gradually increased from about 1 kg/ha. in the first plan to 90.1 kg/ha. in the ninth plan. It is relatively higher in irrigated area, which leads to skewed consumption of fertilizers in the country in favour of irrigated areas. Irrigated

area which accounted for about 30 per cent of total crop area used 60 per cent of fertilizers consumed in the country.

### **Future challenges/targets of agricultural development**

- The present self-sufficiency in food grain production is being termed fragile self-sufficiency. In the year 2000, when India's population is expected to be one billion, there will be a demand of 215 million tonnes of food grains. According to IFPRI - IARI projections, the demand of cereals alone will be 293.4 million tonnes in 2020.
- It has been observed in the recent past that the growth rate of demand for foodgrains has declined despite rises in per capita income. There is a need for diversification and to increase the production of horticulture crops, animals and fisheries. Their demand is bound to increase in future due to increase in income and education regarding balanced diet. It requires development of low cost technologies, and their transfer to the farmer's field especially in rainfed, dryland and watershed areas.
- The present irrigated area is only about half the ultimate irrigation potential (139.89 million ha.) of the country indicating that country has a long way to go on irrigation. Even in irrigated area there is potential to increase productivity through improvement of technology and effective water management to reduce the problem of soil salinity.
- The sustainable agricultural development has an important place in changing climate and environment conditions. Therefore, there is a need in future to efficiently use chemical fertilizers, recycling of organic wastes and use of bio-fertilizers. The Integrated Pest Management (IPM) has been given major emphasis in the eighth plan to reduce the problem of residue of pesticides.
- There is a need to increase reliability in agriculture production in India through assured irrigation, development of suitable technology for rainfed areas and infrastructural development in marketing of products and input.
- An IFPRI-ICAR study of 14 out of the 15 agro-climatic regions delineated by the Planning Commission shows that after the introduction of the Green Revolution, technology, yield growth rate did not exceed the population growth rate of 2.2 per cent in 10 agro-climatic regions. So it is required to abridge the gap in productivity of these regions through refinement of the technology, streamline distribution of modern inputs at reasonable prices in backward areas and involvement of NGOs in agriculture extension work.
- Recent changes in the industrial policy have thrown open opportunities for rapid expansion of agro-based industries. The emphases are required on research side to develop industry linked agriculture system, post-harvest technologies and efficient marketing structure to meet the increasing demand of international and domestic markets for the processed food.
- Fisheries sector occupies a very important place in the socio-economic development of the country. It has been recognized as a powerful income and employment generator. In fisheries, against the estimated total potential of about 4.5 lakh tonnes of inland and brackish water fish, it is proposed to reach a production level of 2.7 lakhs tonnes by the end of eighth plan. Thus water areas to be covered under freshwater aquaculture would reach more than 4 lakh ha. As against the total area of 15 lakhs ha of ponds and tanks.
- The profitability of rice-wheat system is to be maintained in the Indo-gangetic plains in order to increase supply of food grain according to population.

**Table 1 : Performance of agricultural sector in Five Year plans**

| Plan         | Average rate of (years) | Average production (million of funds) | Average % plan | plan Growth | Growth period annual productivity allocation | rate of production |
|--------------|-------------------------|---------------------------------------|----------------|-------------|--|--------------------|
| Base level   | 50.82                   | 522                                   | -              | -           | -  | (1950-51)          |
| First Plan   | 63.18                   | 598                                   | 37.0           | 7.26        | 3.6  | (1951-56)          |
| Second Plan  | 74.00                   | 652                                   | 20.9           | 5.06        | 4.0  | (1956-61)          |
| Third Plan   | 77.35                   | 692                                   | 20.5           | 1.58        | 2.3  | (1961-66)          |
| Annual Plan  | 87.76                   | 736                                   | 23.8           | -           | -  | (1966-69)          |
| Fourth Plan  | 102.96                  | 835                                   | 23.3           | -0.10       | 3.3  | (1969-74)          |
| Fifth Plan   | 118.07                  | 935                                   | 22.1           | 6.19        | 4.8  | (1974-79)          |
| 1979-80      | 109.70                  | 876                                   | N.A.           | -           | -  |                    |
| Sixth Plan   | 138.06                  | 1080                                  | 23.7           | 3.73        | 5.6  | (1980-85)          |
| Seventh Plan | 151.28                  | 1232 **                               | 22.0           | 4.31        | 5.6  | (1985-90)          |
| Annual Plan  | 171.70                  | 1381                                  | 20.0           | -           | 4.5**  | (1990-92)          |
| Eighth Plan  | 210.00 *                | 1510 **                               | 22.2           | -           | -  | (1992-97)          |
| 1999-2000    | 215.00 *                |                                       |                |             |  |                    |

\*Target \*\*Provisional

**Table 2: Progress made in use of modern agricultural inputs in Five year plans**

| Item                       | Plan |      |      |      |      |       |       |        |
|----------------------------|------|------|------|------|------|-------|-------|--------|
|                            | I    | II   | III  | IV   | V    | VI    | VII   | VIII   |
| Area under HYV million ha. | -    | -    | -    | 25.3 | 38.  | 1 46. | 4 63. | 1 78   |
| Fertilizer kg per ha.      | 0.9  | 1.6  | 5.1  | 16.7 | 29.5 | 47.5  | 64.5  | 101.60 |
| Consumption                |      |      |      |      |      |       |       |        |
| Irrigated area of per cent | 17.4 | 18.3 | 19.9 | 23.7 | 28.0 | 30.9  | 32.9  | 35.7   |
| total cropped area         |      |      |      |      |      |       |       |        |
| Pesticide 000'tonnes       | -    | -    | -    | -    | -    | -     | 72.47 | 97.8   |

**Table 3 : Production of other agricultural and livestock products**

| Sl. Products Units                       | Years   |         |         |         |         |          |
|--|---------|---------|---------|---------|---------|----------|
| No.                                      | 1950-51 | 1960-61 | 1970-71 | 1980-81 | 1990-91 | 2001-02* |
| A. Agricultural Products                 |         |         |         |         |         |          |
| i) Oilseeds Million tonnes               | 5.2     | 7.0     | 9.6     | 9.4     | 16.9    | 18.6     |
| ii) Sugarcane -do-                       | 57.1    | 110.0   | 126.4   | 154.2   | 225.6   | 300.1    |
| B. Livestock products and fish           |         |         |         |         |         |          |
| i) Milk Million tonnes                   | 17.0    | 20.0    | 22.     | 31.6    | 53.9    | 85.4     |
| ii) Eggs Million no.                     | 1832    | 2881    | 6172    | 10060   | 21101   | 34034    |
| ii) Wool Million Kg.                     | 5.6     | N.A.    | N.A.    | 32.0    | N.A.    | NA       |
| iv) Fish Million tonnes                  | 752     | 1160    | 1756    | 2442    | 3836    | 5986     |
| *Target                                  |         |         |         |         |         |          |
| <b>Source: Economic Survey 2002-2003</b> |         |         |         |         |         |          |

# GUIDELINES FOR DESIGNING SELECTED A.V. AIDS

**N. Sandhya Shenoy**

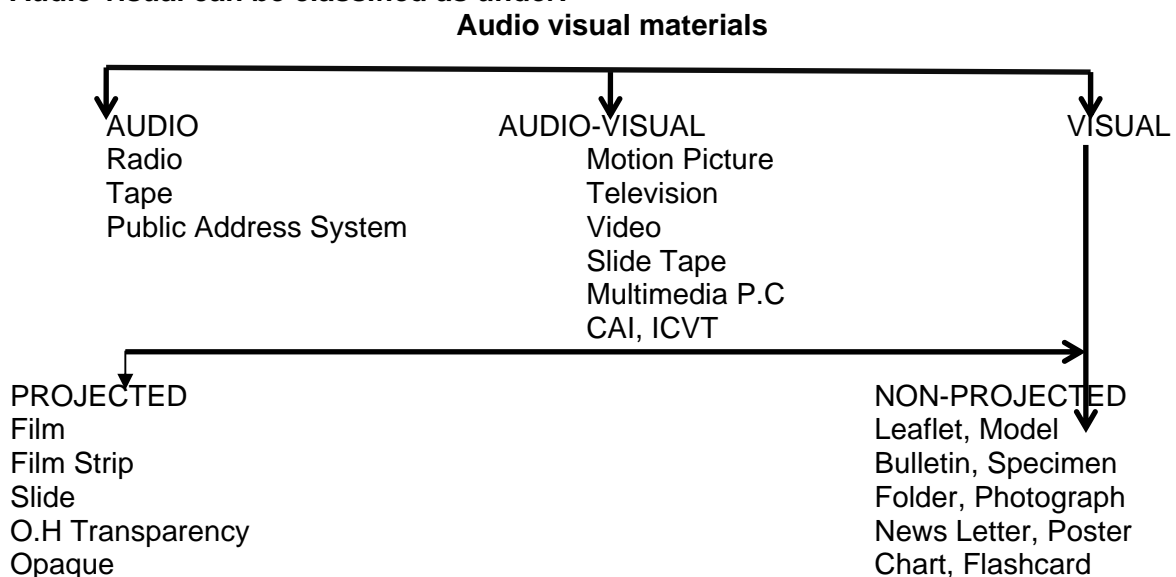
Principal Scientist

Learning is defined as change of behaviour in response to well defined instructions. Instruction is a process of series of learning steps involving communication and interaction setup for a learner to move from lower level of competencies to higher level of competencies. Successful instruction is one by which a learner begins and directs self-learning.

The role of audio-visual aids is crucial in facilitating successful teaching-learning process. They make the learning experiences more concrete, realistic and dynamic. Use of A.V.aids contributes to quicker and more effective communication, and forms an integral part of classroom and extension teaching. Any material (or) method used to reinforce the spoken work in teaching which contributes to better presentation and learning can be termed as audio-visuals. Audio-visuals are those devices that affect our sense of audibility and vision.

Audiovisuals contribute to one (or) more of the following. They help to give correct initial concept, speedup learning process, contact verbalism, intensify impressions, attract attention, draw and sustain interest, motivate, develop and change attitudes, help reach more people, vitalize instruction and provide variety in teaching, save time and promotes organized presentation, supplements learning and serve as reminders.

**Audio visual can be classified as under:**



The ABC's in preparation of A.V Aids are attractiveness, brevity and clarity. There are several steps to be considered while preparing the A.V aids such as:

- deciding an actual information to be given to the learners/participants,
- choosing code for communicating message/information (written form, pictures, diagrams, symbols, etc)
- selecting the most suitable design after initial trials.

- listing necessary items or materials for preparing aids, and
- observing proper sequence when more than one audio (or) visual aids are being used.

While using A.V aids, the following principle is to be followed - use right aid, in right way, at right time, to the right audience/receiver with tight message by right source (teacher/trainer). Criteria for a.v. media selection include the objective of the teacher/trainer, audience and teaching pattern. Apart from these, consider whether the materials are commercially available, development and preparation costs, reproduction costs, time to prepare, skills and services needed, equipment facilities for viewing, handling and storage, viewer's preference and presenter's preference.

It has to be kept in mind that all visuals should follow the 'Rule of Thirds' for placing important information on the "hot spots", and all projected visual media should follow 'Rule of Seven' i.e., 7 lines per visual, 7 words per line, Using upper and lower cases when the title has more than 7 words, determining the correct font size for the art material from which projected aids are prepared (ex: slides, OH Transparencies etc.) by measuring the length of the longest sentence (say 6 inches) and multiplying with 7 (42 inches or 3' 6") and testing its visibility at that distance to determine its readability on the screen. In the following sections, guidelines for usage of different non-projected and projected visual aids and audio-visual aids are discussed.

## Charts, graphs

Deals with relationships - comparisons, developments, processes, trends variations from normal can be explained effectively.

**Charts:** These are combinations of graphic and pictorial media designed for visualising relationships between key facts and ideas.

**Graphs:** These are visual representations of numerical data.

There are different types of charts and graphs, which can be appropriately used for increasing the comprehensibility.

## Types of graphs

**1. Tabular:** Compact form of related data in rows and columns

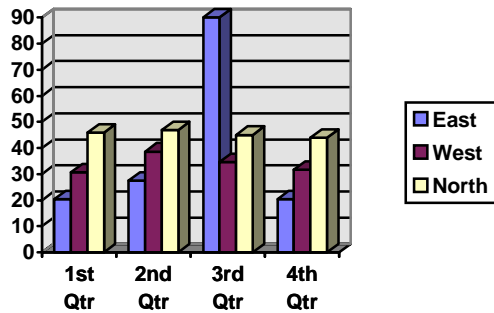
Example: Month-wise labour employment in paddy per acre (Kharif 1997)

|        | June | July | August | September |
|--------|------|------|--------|-----------|
| Male   | 7    | 5    | 4      | 15        |
| Female | 5    | 10   | 8      | 10        |

**2. Bar:** A series of bars along a measured scale.

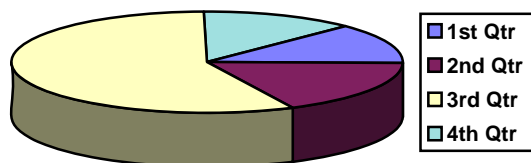
- \* length of the bar implies amount of data
- \* Used to compare quantities at different times or under different conditions

Example:

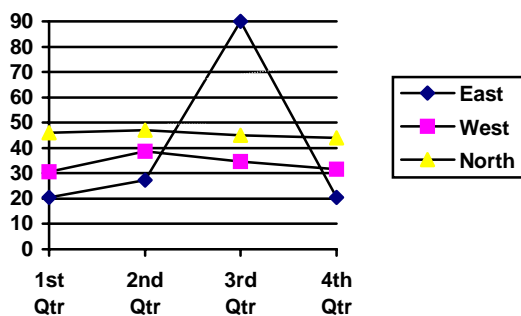


**3. Pie:** It is a circle graph. Sectors represent component part of a whole. Preferred when there are less than 8 observations.

Example: Labour employment at Directorate of Rice Research



**4. Line:** It is the most accurate graph. Useful when more number of observations are to be shown. Shows trend between two series of data.

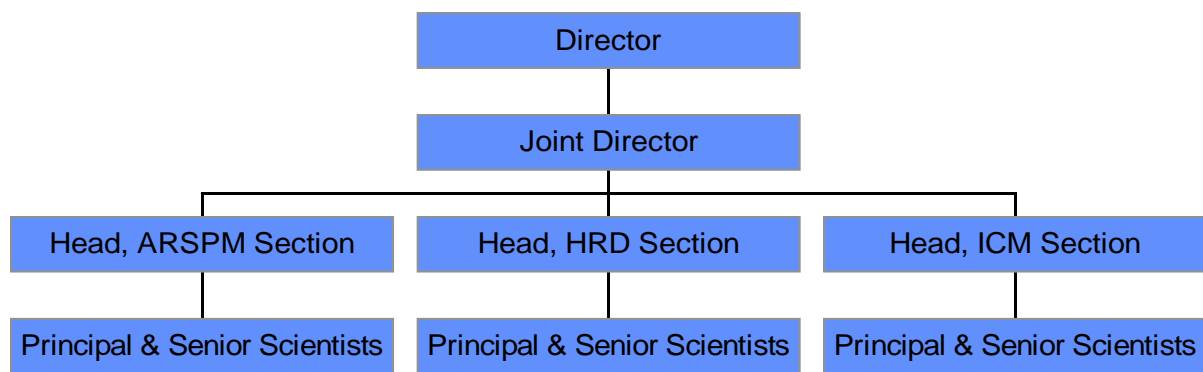


## Types of charts

### 1. Flow chart

- \* It is a simple chart for an orderly and logical presentation.
- \* Materials can be presented symbolically to summarise information in a visual form.
- \* It is shown by rectangles and joined by arrows.
- \* Shows organization or structure of departments
- \* Tells a story step by step.
- \* Easier to understand, easier to follow.
- \* Designed to visualise relationship between key facts.

Example: Organizational Structure of NAARM



## 2. Flip chart

It is a series of visuals drawn into large sheets of paper fastened together at the top. Sheets are turned over or flipped one at a time, as the presentation is made.

### Used for:

- \* Presentations involving sequential steps.
- \* Maintaining organized presentation.
- \* Supplementing / or substituting Overhead Projector, Slide Projector, etc.

### Steps in designing flip chart

- \* Start with an idea.  
(Sequential exposition / pictorial represen.)
- \* Identify salient points of idea, divide them into sequence.
- \* Prepare miniature flipchart. (Use cards / sheets of paper)
- \* Visualize each sequence (Determine letter type, style, size, illus., colour)
- \* Finalize miniature flipchart (Add cover, use illus. tech. to enlarge)

### Making flip chart effective

- \* Keep presentation simple, few strong points.
- \* Lettering & visuals large and simple.
- \* Placement in adequate light, seen by all.
- \* Materials in proper sequence.
- \* Face audience, avoid blocking view.
- \* Information to be revealed only when it is discussed.
- \* Summary points on separate sheet.

### Factors in designing flipchart

Size: Not too big to handle, but, large enough to see.

24" X 34" for a 23' X 20' sq.ft. room or 25-35 out door audience.

Letter Size, style: Caps for Headlines, Combine caps & small letters for captions and labels.

Letter height: At least 1 - 2 inches

Letter style: Simple - Gothic or Block

Language, Illustration type: Simple, brief concise statements, Use analogy for unfamiliar terms. Local dialect. Illustration big, bold, minimum details.

Layout: Arrange headlines, illustration text or caption in sequential order.  
Aim for simplicity.

Provide enough space in each page.

Consider eye movement and 'Rule of thirds' to place 'visuals.'

Colour : Use colour for contrast / emphasis. Vivid, bold colours. 2-3 enough.



### **Relative advantages of flip chart**

- \* Relatively inexpensive. Use locally available materials.
- \* Used both in classroom & outdoors.
- \* Portable, No proj. equipment or facilities.
- \* Uses many types of visuals (pictures, charts, diagrams, posters, etc.) for display.
- \* Presentation is organized and in sequence.
- \* Revision to update part(s) easier.

### **Limitations of flip chart**

- \* Requires ingenuity or `design prod. skills
- \* Poor legibility due to limited size.
- \* Limited audience coverage compared to project aids.
- \* Flip chart material can be damaged easily.

### **Steps in designing flip chart**

- \* Start with an idea.  
(Sequential exposition / pictorial representation)
- \* Identify salient points of idea, divide them into sequence.
- \* Prepare miniature flipchart. (use cards / sheets of paper)
- \* Visualize each sequence  
(Determine letter type, style, size, illustration, colour)
- \* Finalize miniature flipchart  
(Add cover, use illustration techniques to enlarge)

### **Tips for making charts**

- Have a brief and catchy title. Mention source and date to increase credibility wherever necessary.
- Logical, clear and orderly layout is essential.
- Keep charts simple and not crowded.
- Empty space is not necessarily wasted space.
- 24" x 34" size charts are good for all purposes.
- Letters should be simple and easily legible.
- Size of letters in Title, Sub-title and Text in the ratio of 3 : 2 : 1.
- One idea per chart to be presented.
- Use 2-3 contrast colours to increase readability.

### **Overhead projector (OHP)**

- \* OHP is used for better group attention and participation.
- \* For better meeting control, immediate group reaction.
- \* It reveals material point by point.
- \* Easy to operate.
- \* It can be made quickly and inexpensively.

### **Model transparency**

- \* Title: Letter size should be 36 points or 9mm for fixed stand projection system or 24 points or 6mm for projection using trolley.
- \* Matter: Letter size should be 24 points or 6mm for fixed stand projection system or 14 - 18 points or approx. 3.5 to 4.5 mm for projection using trolley.
- \* Line spacing: Minimum 20 mm
- \* Number of lines: Ideally about 7, maximum upto 10 sentences.

- \* Material in bullets not in paragraphs.
- \* Transparency to support the talk, not to replace speaker.
- \* Colours not more than 2 - 3.
- \* Leave one and half inches space on all the four sides.

### **Overhead projector (projection)**

- \* It is based on principle of vertical projection.
- \* Lamp is arranged along axis of projection.
- \* Parabolic reflector reflects light towards condenser lens.
- \* Condenser lens refracts divergent light to parallel rays on mirror.
- \* Objective lens inverts, enlarges, and defines image off front surface mirror to screen.
- \* Mirror set  $45^{\circ}$  angle to axis of objective lens reflects image to screen.

### **Tips in using OHP**

- \* Position transparency before turning light.
- \* Project information towards top of screen.
- \* Use uncovers technique when there are more points.
- \* Projection should be simple. 6 - 7 words per line.
- \* No hand should be placed on light stage. No 'light on' when nothing is projected.
- \* No ordinary typing in OHP transparency.
- \* No moving projector / transparency while 'light on'.
- \* Put 'fan on' after switching light off to cool bulb in models where light and fan switches are separate.

### **Ink jet transparency film**

The "Ink jet transparency" film has smooth surface on one side and a patterned surface on the other. The patterned surface enables to print colours from any Ink jet model printers.

Example: 3-M "Ink jet transparency" film CG 3460 sized 210 mm x 297 mm (A4 size)

### **Tips to use**

- ⇒ Before printing, the programme is to be set to Transparency, Bold, High quality mode.
- ⇒ When loading the transparency manually, insert the striped edge first with stripe facing up. After printing the stripe can be removed by peeling off.
- ⇒ Hold the transparency by the paper stripe when handling manually.
- ⇒ For printers with front feeding tray, load the textured side down, while for the printers with feeding tray on the rear, load the transparency with textured side up.
- ⇒ Before use, fan the product to reduce the static for more reliable feeding.
- ⇒ To assist feeding, it is advised to load 5 sheets of paper in the bottom of feeding tray.
- ⇒ Allow the film to dry at least 15 minutes in normal office conditions.
- ⇒ Place the printed transparency in the protector.

The other important visual aids that are most commonly used are the Photographs and Slides. It is essential to have the knowledge of photography for quality photographs or for slide making. The next section deals on salient features in photography.

### **Photography**

J.F.W. Herschel coins the term Photography.

“Photography is any system for converting to a more or less permanent and visible form images produced on supports by the action of ultra-violet, visible or infra-red radiation”

Photography is a complete process by which pictures are made by the chemical action of light on a sensitive plate or film.

### **Its role**

In development of visual aids such as Photographs, Slides, Filmstrips, Motion pictures, etc.

### **Basic elements in photography**

1.Subject, 2.Photographer, 3.Camera, 4.Film, 5.Light.

### **Types of camera**

1. Box Type: No camera settings, exposure table. Load, aim and shoot the film. Camera should be held steady.

2.Twin Lens Reflex (Tlr): Ground glass focussing. Square format. Subject view same size as negative. Lenses 13.5 or better. Brief shutter speed (1/500) or better.

3.Single Lens Reflex (Slr): Exact viewing. Ideal for close-ups. Subject seen with any lens at any distance will come on the film.

4.Picture-In-Minute: Single exposure setting. Prints in 60 seconds. Film contains all ingredients necessary for finished photo. Common models by Polaroid.

5.Stereo Camera: Takes three-dimensional pictures. Have two lenses. Each lens makes separate picture. When viewed at same time, they appear to have depth.

### **Lens types**

1.Normal Lens: Approximates eye view. Focal length 45 - 55 mm.

2.Wide - Angle Lens: Greater depth of field. Shorter focal length (28mm). Includes broad scenic, larger groups of people within frame.

3.Tele-Photo Lens: Narrower field of view than normal lens. Longer focal length (85-200mm). Subject appears larger on film than normal lens. Ideal for birds, mountains, boats and distant objects.

4. Zoom Lens: Focal length adjustable over wide range. Good starter Zoom lenses focal length 28-85 mm. Shoots wide-angle, normal or tele-photo pictures.

### **Filters**

Filter is a disc of coloured glass or coloured dyed gelatin cemented between two discs of glass. Used over lens for black and white rendition of certain colours. Filters always lighten the objects of same colour.

### **Categories**

A) Contrast Filters: To obtain extra contrast of the colours.

B) Correction Filters: Corrects film's inability to see the subject as our eyes view it.

C) Gradation Filters: Half with colour and half plain. To selectively increase or decrease colour.

### **Types of filters (for black & white film)**

- 1.Sky Light: Protects lens from dirt, fingerprints, bumps, etc. Saves film from U.V. radiation.
- 2.Polarizer (Grey): Eliminates reflection from non-metallic surfaces. Used for good scenics (colour enhancement for sky, clouds, trees).
- 3.Medium Yellow Correction filter: Subjects appear just as eye views them.
- 4.Green: Improve flesh tones. Good for shooting portraits outdoors. Natural rendering of trees, flowers and marine subjects.
5. Orange & Red: Eliminates haze in distant landscapes and arial pictures. Require more exposure. Used with Panchromatic film.

### **View finder**

The main purpose of the view finder is to look at the subject through it and compose the picture area before shooting it.

### **Types**

- 1.Waist Level Reflecting Finder: Fitted in box cameras.
- 2.Ground Glass Screen Finder: Fitted in both twin lens reflex (TLR) and single lens reflex (SLR) cameras.
- 3.Prism And Ground Glass Finder: Fitted in most of the SLR cameras.

### **Picture Composition**

Refers to arrangement or position of subjects within a photograph, so that relationship of subjects /elements effectively express a point of view.

#### **Points to note:**

- ⇒ Only one centre of interest. Place it following the “rule of thirds”
- ⇒ Sufficient fore ground to create illusion of depth. Background simple.
- ⇒ Long shots for answering ‘where’. Make good opening slides. Relates whole and parts.
- ⇒ Close-up shots for answering ‘who’ & ‘what’. One element dominates scene.
- ⇒ Extreme close-up magnifies small and important details.
- ⇒ Low angle shots to emphasize ‘who’ or ‘height’.
- ⇒ High angle shots (arial view, birds-eye view) for emphasizing ‘how many’ of the subjects.
- ⇒ Vertical shots for tall things. Horizontal shots for wide or long things.
- ⇒ Horizons and vertical lines should not cut the picture in centre.
- ⇒ Horizon below centre accentuates spaciousness, in upper third increases depth and closeness.
- ⇒ Diagonal lines give illusion of depth and of better picture interest. Horizontal lines indicate rest.
- ⇒ Framing fills empty spaces. Foreground objects can be used to frame centre of interest.
- ⇒ Picture is to be taken normally 6-10 feet away.

- ⇒ Candid shots with expression, actions are better.
- ⇒ Avoid tone mergers. Colours, brightness should emphasize subject from fading into background.

### Settings

| Aperture<br>f                            | Shutter Speed<br>B                                | Film Speed<br>ISO(ASA)   |
|--|---|--|
| 1.4, 2, 2.8,<br>4, 5.6, 8,<br>11, 16, 22 | 1, 2, 4, 8,<br>15, 30, 60, 125,<br>250, 500, 1000 | Slow speed<br>(25-32)<br>Medium speed<br>(64-125)<br>High speed<br>(160-400) |

Bright sunny day      f / 16, B 1/125 second, Medium 100 ISO(ASA)

Dark scene              f / 2, B 1/30 second, High speed 400 ISO(ASA)

Night / Indoors        f / 2.8 or <, B 1/30 or >, High speed 160-400 ISO (ASA)

Use Smaller aperture (f / 16) for greater depth and bigger aperture (f / 4) to make fore and backgrounds out of focus.

Slow speed films are good for close-ups with slow shutter speed and larger aperture opening. Medium films are good for sunny outdoors, but with Flash indoors.

High-speed films rate suited for action shots and dim light conditions.

### Common mistakes

| Mistake           | Cause                                   | Correction  |
|-------------------|---|---|
| Double exposure   | Film not advanced                       | Advance film after taking snap  |
| Out-of-focus      | Too close to subject                    | Take shot beyond 6 feet   |
| Moved camera      | Improper holding or shutter adjustment. | Hold camera against body. Faster shutter speed.   |
| Moved subject     | Improper Shutter adjustment             | Adjust shutter speed for speed /angle of subject.   |
| Missing part      | Improper distance From subject          | Total picture in view finder.   |
| Black circle      | Shutter left open                       | Set shutter just before Taking picture  |
| Fuzzy fore ground | Wrong depth of focus                    | Focus object in front of subject by increasing aperture Where, both subject & fore ground are in focus. |
| Tilted camera     | Camera not in level                     | Check horizon lines in view finder.   |
| Under exposure    | No sufficient light                     | Set exposure to   |

|               |                |  |
|---------------|----------------|--|
| Over exposure | Too much light | shadows with<br>larger aperture.<br>Reduce aperture opening. |
|---------------|----------------|--|

## **Slide - Making**

### **Camera**

Use 35mm Single Lens Reflex (SLR) camera with normal (50-58m.m) and magnifying lens (+1,+2,+3) power. Also use cable shutter release for photocopying.

### **Light Source**

Photo floods bulbs 800-1000 watts.

### **Slide Films**

1. Kodachrome II (ASA 25) - For outdoor photography. In bright sunlight without flash.
2. Kodachrome Daylight (ASA 64) - Slightly warm skin tones. For Out door pictures and indoors with flash.
3. Ektachrome Daylight (ASA 64) - Colder skin tones. Bright greens and lighter sky. Late afternoons produce slides with heavy warming effects.
4. High speed Ektachrome Daylight (ASA 160) - Not to be used in bright sunny days. Flash causes dark backgrounds.
5. Kodachrome II professional type A tungston - Used with photoflood lights. Gives slightly cool effect. Comes in 36 exposure rolls.
6. High speed Ektachrome Tungston (ASA 160) - Used with photo flood lights. Normal to warm balanced tones. Good for copy stand work.

## **Lettering for Slides**

- Use letter styles Helvetica Medium, Folio Bold, Futura Bold Italic, or plain Gothic.
- Letter height-width ratio should be maintained as 3:5.
- Letter spacing should be equal between letters.
- Letter Size should be 1" at 3 ft. distance when photocopying object size is 16"/24" or 19"/19". When using SLR camera with close-up lens focussing upto 12" to 14" distance from the photocopying object, the letter size can be 36 points (9m.m) for title and 24 points (6m.m) for text.

Slide Size: Normally 2 1/2"

### **Points to note**

- Limit one idea per slide.
- Use slide series for progressive disclosure.
- One slide per one minute speed.
- Duplicate slides which are seen more than once.
- Take long shots for location, medium to identify subject, close-up for details.
- Thumb spot slides.

## Advantages

- ◆ Stimulate interest, holds attention.
- ◆ More number of people can see.
- ◆ Low cost.
- ◆ One can make their own slides.
- ◆ Easy to show actual situations.
- ◆ Easy to refer back.

## Disadvantages

- ◇ Lack motion.
- ◇ Not three-dimensional.

### Guidelines for preparation of the slide-tape module

1. Collect all the matter required on a given topic.
2. Arrange the matter in a logical sequence.
3. Divide the matter into parts/sections based on different aspects to be covered in the module.
4. The matter in each section is to be sub-divided into a) 'Most essential' b)'Desirable' and c) 'Nice to know' parts based on the importance.
5. Select 'Most essential' and 'desirable' parts in an aspect to be covered in the module.
6. The Slide-Tape module has two parts - the Visual (Slide) and the Audio parts. The Slide material is to be prepared for taking a Slide, and the Audio script is to be prepared for recording the Audio portion.
7. The Slide-tape module should not be lengthy, as the interest would be lost after 30 minutes. Thus, an effective slide-tape module should contain 15-30 slides along with relevant audio portion.

### Slide-material preparation

- There should be minimum text in the Slide-material.
- The Illustration should appear very prominently in the Slide-material.
- The minimum font size for the title in the Slide-material should be 36 points (9mm) and the text 24 points (6mm).
- About one inch margin should be left on all sides. But, the borderline need not be drawn in the Slide-material, as the 35-mm frame itself provides border.
- The alignment of the text and the illustration should be in a 'rectangular' format and not in a 'square' format.
- One idea per slide. So one aspect is to be covered in a slide-material.
- Slide-material should not be cluttered. Enough empty space to be provided.
- Slide-material should contain maximum 5-6 lines. Each line containing maximum 5-6 key words. Approximately, 10 mm to be maintained between the lines.
- If more number of points are to be covered in a Slide-material, use key words only and arrange in two columns.
- Appropriate title is to be given for each slide-material based on the aspect covered.
- Avoid 'Continued...' slides. Matter should be divided such that one aspect can be covered in one Slide-material.
- For a coloured slide, use 2-3 deep and contrasting colours only in the slide material.
- If the Slide-material is to be prepared manually, care should be taken that the ratio of height and width of the letters should be 3: 2 and, each letter is to be printed separately.

- All capital letters are to be used only for title and sub-titles. The text portion with all capital letters should be avoided, as the comprehension would be adversely affected.

### **Audio-script preparation**

- Audio- script should be matched with the slide-material (the audio that is heard should be about the slide, which is projected).
- Audio-script is to be written in a conversational or narrative style and not in 'Bookish' style.
- Avoid difficult and technical words. Simple style is to be followed for better comprehension.
- The Audio-script should contain 10 simple sentences or less about each Slide-material. When read at a medium pace, the duration of audio portion for each slide should not exceed one minute. If a slide is shown for more than a minute in a Slide-tape module, it creates 'fixation' effect.
- Only simple sentences are to be written in the Audio-script. Compound and complex sentences are to be re-written as simple sentences.
- Each Audio-script for a Slide-material should be connected with the preceding and succeeding Audio-scripts. This should give an effect of smooth transition from one aspect to the other.

### **Posters**

Poster should provide enough information at the first glance to invoke curiosity to allow further reading by the viewers. It is intended, as substitute for 'talk' therefore should project only significant results and not reviews previously published work. Posters can be further utilized to supplement other extension methods such as field days, group discussions, conferences, Short courses, etc.

#### **Advantages**

- Provides excellent opportunity for interaction and discussion.
- Poster format encourages more expansive presentation than oral sessions.
- Provides flexibility in organization of seminars and symposia.

#### **Disadvantages**

- Takes more time to prepare and costs involved are higher than oral presentation.
- Presenter must effectively communicate both in written and oral modes.
- Not all research results lend themselves to poster format. Results from complex multi factorial experiments are difficult to clearly present as a poster.
- More difficult to transport compared to other visuals like slides computer floppies, etc.



# MARKETING NETWORKS FOR AGRICULTURAL COMMODITIES

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Principal Scientist

## INTRODUCTION

Agricultural marketing has assumed greater importance, especially in the context of economic liberalization and globalization. The thrust right from the 'grow more food campaign' through the green revolution period has been to increase agricultural production, posing the first generation problems of marketing. Commercial production, shifting cropping patterns, increasing domestic trade and international trade and growing market intervention have led to increased marketed surplus, resulting in the second generation problems. The increased surpluses, together with higher demand for non-conventional commercial inputs have put greater pressure on the existing marketing systems and have exposed the inadequacies. Today, marketing has become a serious constraint both in the sale of agricultural products and supply of crucial inputs. Despite major market interventions and support by the government, efficiency of the marketing system continued to be a matter of concern. Governments of developing countries are realizing the importance of the marketing institutions as a stimulating and dynamic force in agriculture. In India, through a series of marketing reforms, a number of institutions have been established from time to time to keep pace with expanding and changing needs of farming sector.

## Marketing Channels

Marketing channels are routes through which agricultural products move from producers to consumers. The length of the channel varies from commodity to commodity, depending on the quantity to be moved, the form of consumer demand and degree of regional specialization in production.

## Definition

A marketing channel may be defined in different ways. According to Moore *et.al.* the chain of intermediaries through whom the various food grains pass from producers to consumers constitutes their marketing channels. Kohls and Uhl have defined marketing channel as alternative routes of product flows from producers to consumers.

## FACTORS AFFECTING LENGTH OF MARKETING CHANNELS

Marketing channels for agricultural products vary from product to product, country to country, lot to lot and time to time. For example, the marketing channels for fruits are different from those for food grains. Packagers play a crucial role in the marketing of fruits. The final form in which consumers demand the product. For example, consumer in developed countries demand more processed foods in a packed form. Wheat has to be supplied in the form of bread. Most eatables have to be cooked and packed properly before they reach the consumers. Processors play a dominant role in such societies. In developing countries like India consumers buy commodities in the raw form and processing is done at the consumers level. Again, the lots originating at small farms follow different route or channels from the one originating in large farms. For example, small farms usually sell their produce to village traders; it may or may not enter the main market. But large farms usually sell their produce in the main market, where it goes in to the hands of whole sellers. The produce sold immediately after the harvest usually follows longer channel than the one sold in later months. With the expansion in transportation and communication network, changes in

the structure of demand and development of markets, marketing channels for farm products in India have undergone a considerable change, both in terms of length quality.

### **MARKETING CHANNELS FOR FOOD GRAINS**

Marketing channels for various cereals in India are more or less similar, except the channel for paddy (or rice), where rice millers came in to the picture. For pulse crops, *dal* mills appear prominently in the channel. The following flow chart enables us to know the marketing channels for general food grains in India.

**Some common marketing channels for wheat have been identified as follows:**

Farmer to consumer;

- (i) Farmer to retailer or village trader to consumer;
- (ii) Farmer to wholesaler to retailer to consumer;
- (iii) Farmer to village trader to wholesaler to retailer to consumer;
- (iv) Farmer to co-operative marketing society to retailer to consumer;
- (v) Farmer to a government agency (FCI, etc) to fair price shop owner to consumer;
- (vi) Farmer to wholesaler to flour miller to retailer to consumer.

The channels for paddy-rice and pulses are broadly the same, except that the rice millers or *dal* millers come in to the picture before the produce reaches retailers or consumers.

### **MARKETING CHANNELS FOR OILSEEDS**

Marketing channels for oilseeds are different from those for food grains, mainly because the extraction of oil from oilseeds is an important marketing function of oilseeds. The following flow reveals the movement of oilseeds from producers to consumers in India.

**The most common marketing channel for oil seeds in India are;**

- (i) Producer to consumer (Who either directly consumes the oilseeds or gets it processed on custom basis);
- (ii) Producer to village trader to oil retailer to consumer;
- (iii) Producer to oilseed wholesaler to processor to oil consumer;
- (iv) Producer to government agency to processor to oil wholesaler to oil retailer to oil consumer.

### **MARKETING CHANNELS FOR FRUITS AND VEGETABLES**

Marketing channels for fruits and vegetables vary from commodity to commodity and from producers to producer. In rural area and small towns, many producers perform the functions of retail sellers. Large producers directly sell their produce to the processing firms.

**Some of the common marketing channels for vegetables and fruits are:**

- (i) Producer to consumer;
- (ii) Producer to primary wholesalers to retailers or hawkers to consumer;
- (iii) Producers to processors (for conversion in to juices, preserves, etc);
- (iv) Producers to primary wholesalers to processors;
- (v) Producers to primary wholesalers to secondary wholesalers to retailers or hawkers to consumers;
- (vi) Producers to local assemble to primary wholesalers to retailers or hawkers to consumers.

### **MARKETING CHANNEL FOR EGGS**

The prevalent marketing channels for eggs are;

- (i) Producer to consumer;
- (ii) Producer to retailer to consumer;

- (iii) Producer to wholesaler to retailer to consumer;
  - (iv) Producer to co-operative marketing society to wholesalers to retailers to consumers;
  - (v) Producers to egg powder factory.
- Some times, the wholesaling and retailing functions are performed by a single firm in a channel.

### **MARKETING CHANNELS FOR LIVE POULTRY**

A study conducted in the Punjab has identified the following movement path for live poultry. Most of the studies on the identification of marketing channels for agricultural commodities have concentrated on a concept of marketing channel, which defines the flow of the produce from the producer (farmer) to the consumer. But as the commercialization (market orientation) of agriculture, is increasing and as the farmers and consumers are located in different states or different countries, the marketing channels that are emerging go across state or even national boundaries. This apart, unless quantities flows in to various channels are estimated, the relative importance of alternative channels cannot be assessed. Acharya did such an analysis for gram grains in Rajasthan According to this study there are three points of entry of gram grain in the marketing channel viz; farmer level, wholesaler level (from outside the state). There are 28 marketing channels, village traders appear in 8 channels, grain wholesalers appear in 18 channels, processors appear in 15 channels, dal (split) wholesalers appear in 5 channels and retailers appear in 15 channels. Assuming the farmers' surplus entering the marketing channel as 100 units, the entry from outside the state at wholesaler and processor level was 4.24 per cent of the farmer's surplus.

### **Marketing Costs, Margins and Price Spread**

Market functionaries or institutions move the commodities from the producers to consumers. Every function or service involves cost. The intermediaries or middlemen make some profit to remain in the trade after meeting the cost of the function performed.

In the marketing of agricultural commodities, the difference between the price paid by consumer and the price received by the producer for an equivalent quantity of farm produce is often known as *farm-retail spread* or *price spread*. Sometimes, this is termed as *marketing margin*.

#### **The total margin includes:**

- (i) The cost involved in moving the product from the point of production to the point of consumption, i.e., the cost of performing the various marketing functions and of operating various agencies; and
- (ii) Profits of the various market functionaries involved in moving the produce from the initial point of production till it reaches the ultimate consumer. The absolute value of the marketing margin varies from channel to channel, market to market and time to time.

### **CONCEPTS OF MARKETING MARGINS**

These are two concepts of marketing margins.

#### **(i) Concurrent Margins**

These refer to the difference between the prices prevailing at successive stages of marketing at a given point of time. For example, the difference between the farmer's selling price and retail price on a specific date is the total concurrent margin. Concurrent margins do not take into account the time that elapses between the purchase and sale of the produce.

#### **(ii) Lagged Margins**

A lagged margin is the difference between the price received by a seller at a particular stage of marketing and the price paid by him at the proceeding stage of marketing during an earlier period. The length of time between the two points denotes the period for which the seller has held the product. The lagged margin concept is a better concept because it takes in to account the time that elapses between the purchase and sale by a party and between the sale by the farmer and the purchase by the consumer.

The method of calculating lagged margins is based on the same principal as that involved in the *first in-first out* method of accounting. However, it is difficult to obtain data on time lags between purchase and sale with a view to maintaining continuous series of marketing margins.

### **Producer's price**

This is the net received by the farmer at the time of the first sale. This is equal to the wholesale price at the primary assembling center, minus the charges borne by the farmer in selling his produce. If  $PA$  is the wholesale price in the primary assembling market and  $CF$  is the marketing cost incurred by the farmer, the producer's price ( $PF$ ) may be worked out as follows:

$$PF = PA - CF$$

### **Producer's Share in the Consumer's Rupee**

It is the price received by the farmer expressed as a percentage of the retail price (i.e., the price paid by the consumer). If  $Pr$  is the retail price, the producer's share in the consumer's rupee ( $PS$ ) may be expressed as follows:

$$PS = \frac{PF}{Pr} \times 100$$

## **CLASSIFICATION OF MARKETS**

**Markets may be classified on the basis of each of the ten dimensions already listed.**

1. **On the basis of location:** On the basis of the place of location or operation, markets are of the following types:
  - (a) **Village Markets:** A market, which is located in a village, where major transactions take place among the buyers and sellers of a village, is called a village market.
  - (b) **Primary wholesale Markets:** These markets are located in big towns near the centers of production of agricultural commodities. In these markets, the producer farmers themselves bring a major part of the production for sale. Transactions in these markets usually take place between the farmers and traders.
  - (c) **Secondary Wholesale Markets:** These markets are located generally in district headquarters or important trade centers or near railway junctions. The major transactions in commodities take place between village traders and wholesalers. The bulk of the arrivals in these markets is from other markets. The produce in these markets is handled in large quantities. There are, therefore, specialized marketing agencies performing different marketing functions, such as those of commission agents, brokers, weighmen, etc.
  - (d) **Terminal Markets:** A terminal market is one where the produce is either finally disposed of to the consumers or processors, or assembled for export. Merchants are well organized and use modern methods of marketing. Commodity exchanges exist in these markets, which provide facilities for forward trading in specific commodities. Such markets are located either in metropolitan cities or in sea-ports-in Bombay, Madras, Calcutta and Delhi.
  - (e) **Seaboard Markets:** Markets, which are located near the seashore and are meant mainly for the import and/or export of goods are known as seaboard

markets. Examples of these markets in India are Bombay, Madras and Calcutta.

### **Agriculture Marketing reforms**

Government of India in the Ministry of Agriculture appointed an Expert committee on 19<sup>th</sup> December, 2000 to review the present system of agricultural marketing in the country and to recommend measures to make the system more efficient and competitive. The committee in its Report has suggested various reforms as well as the reorientation of the policies and programmes for development and strengthening of agricultural marketing in the country.

With a view to examine the findings and recommendations of the Expert committee and to suggest measures to implement them, the Ministry of Agriculture constituted a Task Force on 4<sup>th</sup> July, 2001 under the chairmanship of Agriculture & Cooperation. The Task Force thereupon identified some priority areas to work out a road map for strengthening the agricultural marketing system in the country, The Important among the Identified are

- Direct marketing
- Forward and future markets
- Price support policy
- IT in agricultural marketing and
- Marketing extension, Training and Research

In the liberalized era, the paradigm of agricultural marketing is changing and emphasis should be on the performance of all marketing functions. The competitiveness of the agricultural markets can be sharpened by providing required infrastructure, price transmission and policy support. Considering the persistent financial crunch faced by the government, one cannot foresee an increase in public investment for the development of market infrastructure. Therefore, the government should come out with a comprehensive policy framework to encourage private investment under the system of build own and operate (BOO) and build, own, operate and transfer (BOOT) for the development of marketing infrastructure.

# VIDEO IN AGRICULTURAL RESEARCH AND EDUCATION

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Use of mass media technologies for dissemination of agricultural information has long been recognized. Television, being the most effective among the mass media technologies, started disseminating information on agriculture and allied sectors in India right from its introduction in 1975 when SITE (Satellite Instructional Television Experiment) was started.

## 1. Introduction to Television and video:

Many times the terms 'video programmes' and 'television programmes' are being used interchangeably. Video, from technological perspective, is defined as the method of recording images and sounds (converting the moving images on to electrical signals) on to a medium (magnetic tape). This may be viewed against the cinema (celluloid film) on which moving images as well as sounds are recorded and projected for screening.

Television, meaning 'seen from far', from technological perspective, is defined as the method of sending (broadcasting) video programmes from a centralized distribution point (television station/transmission tower) to a number of recipients at their home television sets simultaneously. This may again be viewed against the cinema (celluloid film) where the film is screened to a group of audiences that are physically placed in front of the projection screen. Therefore, all the television programmes that you are watching at home TV set are nothing but video programmes. If you still like to distinguish between video programmes and television programmes, you must view it from dissemination perspective. All the programmes, that are disseminated on telecast/broadcast mode from a centralized distribution point (television station/transmission tower) to a number of recipients at their home television sets for individual and simultaneous viewing are called television programmes. On the other hand, those programmes that are screened on a play back mode (through video cassette player) to individuals or groups (non telecast) are video programmes.

However, some professionals call the video programmes as 'television programmes' since they are made exclusively for the purpose of television broadcasting. Here the term is viewed from the context of dissemination (broadcasting mode). It is important to note that video programmes meant for broadcasting must technically adhere to certain video quality standards set by broadcasting/telecasting companies.

## 2. Advantages of Video

Agricultural scientists involved in development of innovative technologies and practices need to disseminate the information to the farmers whereas agricultural faculty can improve teaching effectiveness by using video as an audio visual aid.

- Video is most suitable medium for reaching out to the non-literates. Being agrarian country, more than 70 per cent of Indian population is dependant on agriculture, and the rate of illiteracy among farmers is high. Therefore, video is the best media option to disseminate the agricultural innovations to farmers.
- Video is most suitable for reaching large cross-section of the audiences with simultaneous presentations. The videotapes can be recycled. The ability of tapes to record video several times has made video more economical and convenient. After initial investment on infrastructure is made, video can be used with minimum running costs.

- Video can be effectively used to improve teaching and presentational skills of agricultural scientists, teachers etc. Presentation can be recorded with simple video camera to provide video feed back for self-assessment and further improvement.
- Video can be effectively used for scientific observation of research processes. This involves high precision video equipment and accessories like micro-photographic equipment, video equipment compatible to microscopes, time-lapse recording equipment etc. Conventional video equipment can be used for field observations for monitoring and documenting different stages of crop growth, pest activities and life cycles, Video is very useful in recording and documenting of field operations such as spraying of fertilizers, weeding, harvesting etc.
- It has the advantages of immediacy. In the sense that the video along with audio can be played back immediately after recording. It does not involve any processing after recording is done.
- Video gives the flexibility of revising the video programmes, changing from one format to another easily, and dubbing into several languages.
- With technological advancements in video resulting in reducing the size and weight of video equipment, reducing costs of equipment and arrival of digital technologies in video production, video has become a highly effective communication tool for agricultural scientists, teachers and technologists.

### **3. Use of video by agricultural scientists and teachers:**

You may speak on to television at TV studio in the form of one-to-one interview, where an interviewer keeps asking you several questions on the subject you are well versed, and you disseminate the knowledge you possess in the form of answers. Interviews may take place outside the studios also on location. You may even take up the role of interviewer while interviewing another subject expert. You will be a successful disseminator of information if you possess the skills to speak on to camera. You may also need to show/demonstrate the things while explaining.

You may also participate in the panel discussions in the television studios, where three to four subject experts debate on various issues chaired by another expert. In-depth knowledge on the subject of discussion, presentational skills, crispness in presentation, dialogue delivery, body gestures, facial expressions, are the aspects that you need to concentrate for best results.

You may provide subject expertise to various television channels on a particular programme that they intend to make. Doordarshan regularly makes programmes on agricultural topics to address the farmers. Similarly, some private channels are also concentrating on tapping the farmers by broadcasting the video programmes on farmers' issues. For example, A Telugu TV channel, Teja TV, is producing programmes for farmers where they are addressing the questions of the farmers on line, on interactive mode by the subject experts. The subject expert, sitting in the television studio, offers solutions to farmers who ask questions over telephone.

Similarly, there are several EMRCs (Educational Media Research Centre), AVRCs (Audio Visual Research Centre) set up by UGC all over the country to produce video programmes in the name of 'county wide classroom', broadcast by Doordarshan. They produce programmes on various subjects including agriculture and address undergraduate and postgraduate students. They may also approach you to provide subject expertise for video programmes on agricultural subjects.

The government of India has recently started an exclusively agricultural channel called 'Kisan Channel' for which ICAR Research Institutes and SAUs are expected to feed

local based agricultural programmes. ICAR, under support from NATP, has already allocated funds to some ICAR Research Institutes and SAUs to produce videos on selected topics. Equipping yourself not only in subject knowledge but also in presentation as well as production skills will enable you to handle the situations with ease. Apart from, many of the research institutes/agricultural universities are coming up with infrastructures to produce video programmes.

As a Agricultural teaching faculty, you may make full-length video programmes or video clippings for your self on different agricultural topics in support of your lectures. Class room lectures, supported by video clippings of various demonstrations, practices etc., proved very interesting. But, make sure that there is perfect correlation between what you tell and what you show.

As a researcher, you may video record various research processes and activities for scientific observation, documentation and archival purpose. You may use video as a tool for agricultural extension, dissemination of innovative agricultural technologies and practices. With the help of intensive production facilities, you may produce agricultural video programmes to communicate with farmers for adoption of innovative technologies and practices. Local languages, local dialects, literacy levels of the farmers, are some of the aspects you need to consider for best outcome. You may make video clippings to use in multimedia programmes. Effective use of video clippings makes multimedia programmes self-explanatory and interesting.

#### **4. Video Technology:**

Continuous developments are taking place in Video/Television technology. A basic understanding of the video scanning systems, formats, etc. are useful in effective use of the video equipment as well as establishment of video infrastructure.

##### **4.1. Video scanning systems**

Many countries are using three basic television-scanning systems. They are:**NTSC** (National Television Standards Committee) system is being used in Japan, USA, and parts of South America. The video scanning takes place at the rate of 525 scanning lines per frame (262.5 scanning lines per field) and 30 frames per second, with 2 fields per frame i.e. 60 fields per second.

**SECAM** (Sequential Colour And Memory) system is being used in France, Russia, East Europe and parts of Africa. The video scanning takes place at the rate of 625 scanning lines per frame (312.5 scanning lines per field) and 25 frames per second, with 2 fields per frame i.e. 50 fields per second.

**PAL** (Phase Alternating Line) system is being used in India, UK, Germany, China, Australia, Malaysia, New Zealand, Middle East, parts of Africa, most of Europe and Commonwealth. The video scanning takes place at the rate of 625 scanning lines per frame (312.5 scanning lines per field) and 25 frames per second, with 2 fields per frame i.e. 50 fields per second. With the help of scan converters, video programmes can be manipulated from one system to other.

##### **4.2. Video formats**

Several video formats came into being as a result of continuous research as well as competition among the industries manufacturing video equipment. These formats are;

**C format.** This high quality broadcasting video format consists of one inch tape, used at television studios. It was compatible only for studio recordings as it was huge in size and housed in a spool. Entry of lightweight and small size formats like U-Matic has pushed it to back seat.



**U-Matic.** This 3/4<sup>th</sup> inch tape format, has revolutionized the television production. With reduction in tape size and housed in cassette without compromising on broadcast quality, this format lead to manufacture of portable videocassette recorders (VCR). With introduction of U-Matic format, it became possible to take out the video equipment to outside the studios for electronic field production (EFP). Continuous research to improve the video quality has resulted in bringing out **U-Matic High Band** as well as **U-Matic SP** (Superior Performance) formats, both with 3/4<sup>th</sup> of inch tape.

**Betacam.** This 1/2 inch format has further increased portability for the field shooting. Replacement of picture tube by CCD (charge coupled device) in camera has drastically reduced weight and size of the camera paving way for introduction of camcorders (camera with built-in cassette recorder). Video quality was considerably increased though tape size was reduced to 1/2 inch. Continuous efforts to improve video quality have resulted in introduction of **Betacam High Band**, **Betacam SP**, **Betacam SX** and **Digi Beta** formats. Digi Beta records video on digital recording mode.

**VHS format.** Video Housing System (VHS) with 250 lines resolution was developed exclusively to meet domestic and amateur needs. Though it consists of 1/2 inch tape, video quality is far lesser than Betacam format. This format is widely used for mass copying professionally made video films for individual and small group screenings. Super Video Home System (SVHS) is an improved format over VHS with 400 lines resolution. SVHS is considered as semi professional format.

**Video 8.** It is a 8 mm format that gives quality more or less equivalent to that of U-Matic format. It is also called semi professional format.

**Digital video.** Digital video (DV) format records the video and audio in digital form. Small cassette format called 'Mini DV' has become very popular in amateur as well as professional market. Though the tape size is very small its quality very good. Many private TV channels are using Mini DV format for field recordings and ENG (electronic news gathering) work. Some DVC Pro and DV Cam cameras and recorders give provision to record on Mini DV tapes also. Mini DV is very economical for making semi professional video films. Many corporate, educational, research institutes are using this format.

**DVCAM.** It is also a digital format where video is recorded at 50 MBPS (mega bites per second) and therefore it is definitely better than DV format.

**DVCPRO.** Panasonic introduced this format. Many private TV channels have adopted this as their standard format. Prices of DVCPRO equipment are cheaper as compared to the prices of DVCAM equipment.

There are other digital high quality broadcasting formats called **D1**, **D2**, **D3**, **D4** and **D5**. These are used at the television studios for high quality video recording.

Introduction of digital technology for video recording as well as development of computer technology together lead to introduction of computerized non-linear editing (NLE) systems. Video footage, after shooting, is uploaded into computer and edited. It is easy to generate titles, graphics, animation etc. Sequences can be manipulated, voice over can be inserted improving audio and video quality becomes easy. After video is finalized, it can be downloaded into videocassette of any format.

## **5. Video Production Skills:**

It is worth learning the craft of video production whatever way you associate yourself with video,. It is simple and easy to do. The advent of digital technology with non-linear editing capabilities has further simplified video production. Video production involves three stages.

Planning  
Production  
Postproduction

### **5.1. Planning**

Planning plays a major role in bringing out quality in video production. Good planning leads to smooth and uninterrupted production. Pre production planning time could be as short as couple of hours to as long as couple of years. During this stage the concept is developed. The objectives of video programme and production approach are set. Script for the video is developed. Video format (whether it should be made in documentary format, drama, interview, etc.) is decided. During this stage, producer/director of video works with subject experts, scriptwriter, and technical crew. Locations to be shot and equipment to be used are decided and arranged during this stage. Sets, wherever required, are erected. All the materials needed for shooting are procured and brought to shooting place. Seasons of various crops, their stages, occurrences of diseases, life cycles of pests etc. have to be kept in mind. The director/producer has to be very clear as to what he wants to tell to the audiences. The target audience must also be properly defined, since the format, treatment, and approach of the video must be accordingly decided. Any flaw in planning could lead to delay, compromise or interruption in shooting.

### **5.2. Production**

This is the stage where actual shooting of the video programme takes place. The director has to coordinate various activities like cameras, lighting, locations, performers, recording etc. A well-planned producer/director handles the shooting with ease, without any tensions. Shooting need not be done in the exact order in which they appear on the video programme. They may be recorded as per the convenience of the shooting. However, sequences are kept in order during editing stage. The producer has to ensure that all the required scenes were shot before the shooting crew leaves the location.

### **5.3. Postproduction**

During postproduction stage, all the sequences are assembled in logical order to create the flow of the content. All this is done at the editing table. Commentary, if needed, is recorded and inserted. 3D or 2D graphics are generated and incorporated into the video. Subtitling is done wherever needed. Background music is added to the video programme to break the silence and monotony. Programmes' titles and credit titles are inserted. Dubbing of the video into different languages is done. Any minor mistake occurred during shooting can be corrected and manipulated to possible extent.

Video is increasingly getting recognition as effective tool for communication in agriculture. Several ICAR research institutes, agricultural extension agencies and SAUs began establishing video units of different levels depending on their objectives, requirements, budgets, vision etc. The success of a video programme depends on proper planning and execution to achieve the set objectives of the video. Effective use of video with subject knowledge, combined with technical skills and creativity makes video as most effective communication tool in agriculture.

# DATABASE MANAGEMENT WITH MS ACCESS 97

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Database management systems store, retrieve, update and analyze data quickly and efficiently to provide useful information for specific purposes and situations.

## What is a database?

A database is any systematic collection of information (eg: Telephone directory, library catalogue, weather database). Information can be stored in books, data registers, files or computers. In a computer, information about a system is stored in **data files** (Examples are, personal data file and payroll data file which store information about employees in an organization, weather data file which contains information about daily weather at a location, field experimental data file which has periodic data of experimental observations, and so on). The data may be text, numbers, dates, documents, etc.

In a given data file, data are stored in **fields** and **records**.

A data field is the basic unit of representing information in a data file. Fields refer to attributes of data (eg. 'name' is an attribute in a personal data file of an organization, 'age' is another such attribute in the same data file, temperature and rainfall are attributes in weather data file, plot no., dates and plant height are attributes in a field experimental data file, and so on).

Records are actual attribute data (text, numbers, dates, etc.) for each entity in the data file. Each record is one set of attribute data, that is, the data of all fields for one entity (eg. text, numbers, dates, etc. representing say name, age, date of birth, etc. for any one employee in the personal data file, or soil type, texture, available water capacity etc., in soils data file).

If we visualize the data file as data table comprising columns and rows of data, then *each record is one row of data, and fields are the column headings*:

| Fields ►   | IDNo. | Name | Age  | Address                     |
|------------|-------|------|------|-----------------------------|
| Record 1 ► | 1     | A.BC | 45   | Xxxx<br>Yyyyyyyy, New Delhi |
| Record 2 ► | 2     | XYZ  | 54   | ---<br>-----<br>-----       |
|            | --    | --   | --   | --                          |
| Record N ► | N     | ZZZ  | ---- | ---                         |

It is possible to build a database such that all the available information is in one data file or in one data sheet, that is, all the data are organized in only one table. But as the variety of information increases, or if there are multiple entries for any one type of data and information needs to be duplicated for some fields, the data sheet may grow to too large a

size to facilitate easy retrieval and updating of information. It also becomes cumbersome to update the database frequently. **The preferred way is to store data about a system thematically in different tables or data files, one table representing each theme.** Relationships can then be developed between the themes to extract relevant information or update the database. For example if you were developing a database for watershed management, it would be preferable to store weather data, and land use data in separate data files. If there were many weather stations in the area, one data file can provide information about the weather station properties (location, latitude, etc.) and separate data files would be required for the daily weather data at each location. If the relationships between the thematic data files can be specified, then relevant data from each file can be taken to create a new data file. The information in this data file can be processed either directly or with models to develop watershed management plans and presented in reports.

A **database** is a collection of *related* data files (like the one above).

All the data files in a database are accessible from one computer (or interconnected computers for a distributed database).

In a **relational database** the different data files can be linked by specified procedures to both enter and extract necessary information.

### **What is a database management system (DBMS)?**

The database files, and the software that facilitates their creation, storage, retrieval and linkages, together constitute a database management system. A DBMS may also be called a database management programme. MS access 97 is one such database management programme, that is powerful, efficient and flexible enough for developing information systems for a range of purposes. In addition to storing and arranging information Access helps to run reports that lead to conclusions. Using Access, we can type data directly into a database or import from another programme, sort index and organize the data whichever way we want, and quickly create reports using all or part of the data. It is possible to customize data entry into simple filling the blanks on a form and also run queries that extract subsets of the data that meet specified conditions.

### **Developing DBMS with MS Access 97** **Terminology**

The first step in developing a DBMS using Access is the creation of a database file. This file contains all the data in the form of several tables. It also contains files for customized data entry forms, reports and queries. Thus a database file in Access contains files which can be: Tables, Forms, Queries or Reports

**Tables** are the core primary building blocks of a database. A Table is very much like a data table or spreadsheet containing rows (records) arranged in different columns (fields). At the intersection of field and a row is the individual bit of data for a particular record, called a *cell*. Each database file can have many tables. Each Table is collection of similar data. All the data entered into a database end up in a Table for storage. Information can be entered directly into each Table, but this may prove cumbersome. The specific Tables into which the data will be organized needs to be planned carefully and frequent changes in their form and structure should be avoided.

**Forms** are a more convenient means of data entry and viewing. In Access, a fill-in-the-blanks kind a form (similar to an application form) can be created to simplify data entry.

Data entered in a Form gets stored in a specified Table, as Access automatically links them. One convenient feature is that separate forms need not be created for filling each Table. A single form can be used to enter data into several Tables at the same time. It can therefore serve as link between Tables. Forms are designed to be used on screen for data entry based on the needs and some flexibility in their changes is possible, but it is better to plan them in advance.

**Queries** are questions that you ask of the data stored in the Tables. They facilitate seeing data from several Tables simultaneously. They also facilitate seeing only that part of the data in the Tables that is desired at a particular time by filtering out the data that may not be needed.

**Reports** are designed for printing. They are specially formatted collections of data, organized in a specified way to summarize the data. A report can extract data from many Tables, perform simple calculations on the data, and present results in a neat format. Reports can be created at any time. They need not always be planned beforehand.

Tables, forms, reports and queries are created in separate steps, but they are related. Tables are the core of the DBMS, with the others having to do with entering, extracting or presenting the data in the Tables.

Access is an **object-oriented programme**; that is everything in Access is an object, including the database application itself. Each object has properties that define how it looks and performs. Thus Tables, Forms, Queries and Reports are objects. So are fields in a Table. In Access all objects of database are stored in a single data file, and the filename has a .MDB extension. The objects are managed through a Database window.

Multiple Tables can be created in Access to reduce redundancy in a database. By creating Forms, Queries and Reports, we can pull information from more than one Table easily. This can be done best when there is a well-defined relationship between the Tables. When two Tables have a common field they can be related.

**Relationships** are created between Tables by defining a primary key field in each Table. The record entered in the primary key field is unique and distinct for all records in the Table. Thus, the primary key field uniquely identifies a record in a Table. A relationship works by matching data in a primary key field of one Table with that of a normal field (usually a field with the same name as the primary key field) in the second Table. The key with the same name in the second Table is called the Foreign Key. Thus, in most cases, the matching fields are the primary key from one table, which provides a unique identifier for each record, and a foreign key in the other table.

The following types of relationships are commonly possible between Tables:

1. One-to-one
2. One-to-many
3. Many-to-many

In a one-to-one relationship, each record in Table A can have only one matching record in Table B. And each record in Table B can have only one matching record in Table A. **This type of relationship is not common.** Because most information related in this way can be accommodated in one table. A one-to-one relationship can be used sometimes to divide a table with many fields, to isolate part of a table for security reasons, or to store information that applies only to a subset of the main table.

A one-to-many relationship is the **most common** type of relationship. In a one-to-many relationship, a record in Table A can have many matching records in Table B, but a record in Table B has only one matching record in Table A.

In a many-to-many relationship, a record in Table A can have many matching records in Table B, and a record in Table B can have many matching records in Table A. A many-to-many relationship is really two one-to-many relationships with a third table.

### Defining relationships

A relationship is defined by adding the tables to be related to the Relationships window, and then dragging the key field from one table and dropping it on the key field in the other table. The kind of relationship that Microsoft Access creates depends on how the related fields are defined:

- A one-to-one relationship is created if the related fields are both primary keys.
- **A one-to-many relationship is created if the related fields are a primary key and a foreign key.**

An important feature of Access is that it comes with several **database wizards**. These are mini programmes that interact with the user about his needs for creating each object, and then create the database structures that match them. The user only needs to choose among a range of database structures (for Tables, Forms, Queries and Reports) and enter the actual data. Because of such user-friendly tools for designing each object and for defining relationships between Tables, Access is an appropriate database management tool for both novices and professionals.

### Designing a Database

Before Microsoft Access is used to actually build the tables, forms, and other objects that make up the database, it is important to take time to design the database. A good database design is the key to creating an effective, accurate and efficient database. The following stages are involved in designing a database:

1. Determine the purpose of the database (identify the purpose and information required from the database)
2. Determine the tables required in the database (determine what subjects or themes under which data can be stored )
3. Determine the fields needed in the tables (each table contains information about the same subject, and each field in a table contains individual facts about the table's subject).
4. Determine the relationships between tables.
5. Add data and create other database objects.

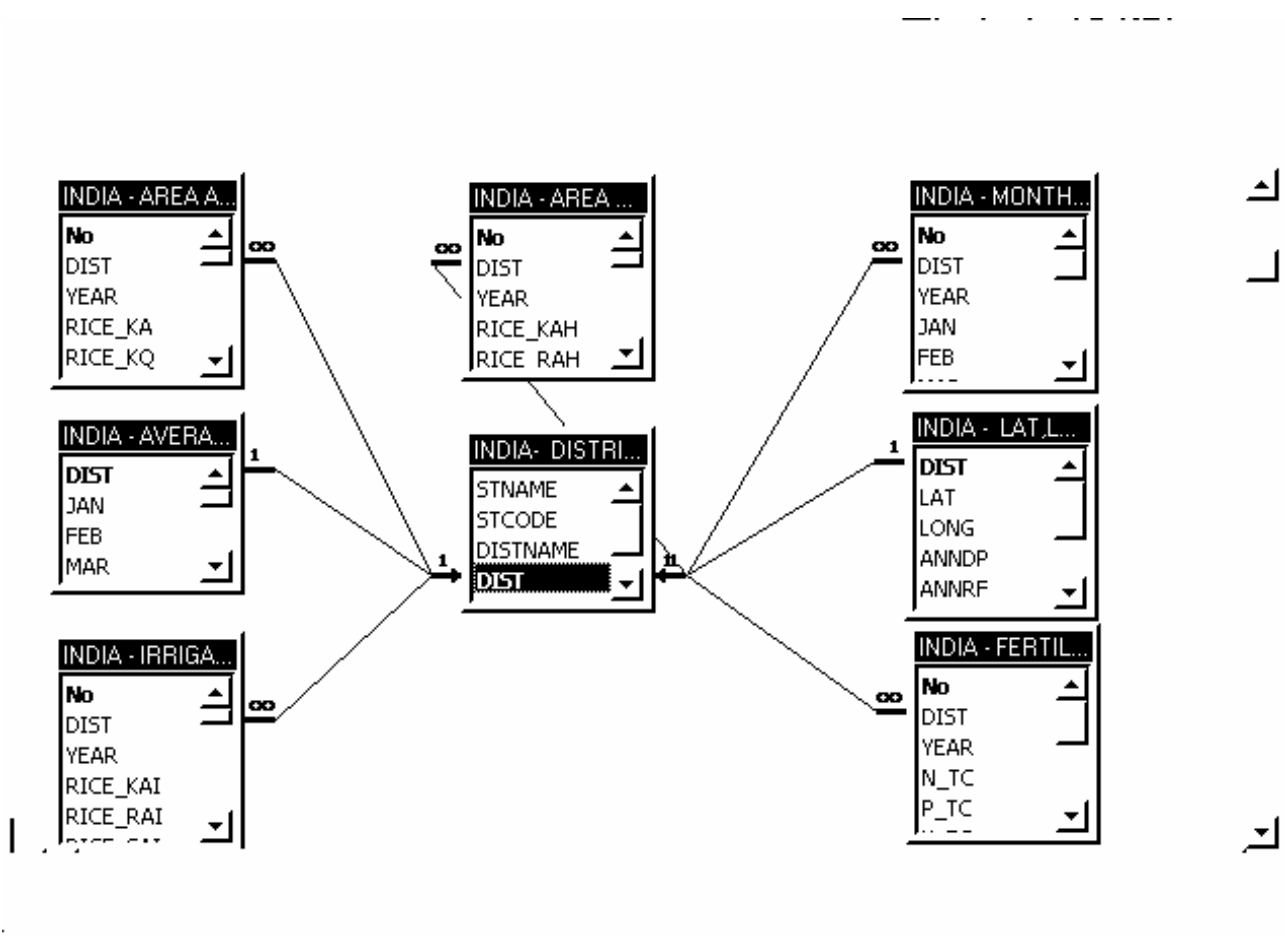
The following may be kept in mind while designing Tables and Fields in Tables:

- A table should not contain duplicate information, and information should not be Duplicated between tables. This facilitates efficient updating of database.
- Each table should contain information about only one subject. This facilitates maintaining information about each subject independently from other subjects.

- Each field should be related directly to the subject of the table.
- Derived or calculated data should not be included in Tables (calculations are best done in queries)
- Information must be stored in its smallest logical parts (First Name and Last Name, not Name.)
- Identify fields with unique values (primary key fields - to connect information stored in separate tables )

### Example

The accompanying chart shows the type of relationships that can be established in an national level district-wise agricultural resources database. Notice the 1 and infinity sign next to the primary key and foreign key (DIST). This implies a one-to-many relationship between the two tables. The signs appear in relationships whenever 'referential integrity' (another feature of MS Access) is enforced in relationships. Enforcing referential integrity prevents data entry mistakes and ensures that information in the two field's matches.



**Fig1. Tables and their linkages in a district database**

Using the above Tables, forms (Fig 2) reports can be generated from queries for specific information about say the average irrigated area under rice in past five years in each district of a State (Fig 3) or the rice yield variations during kharif and rabi and the corresponding variations in rainfall and fertilizer use during the past five years (Fig 4).

Microsoft Access - [RICE]

File Edit View Insert Format Records Tools Window Help

DIST 89

DISTNAME Tanjavur

INDIAID 1916

STNAME Tamil Nadu

STCODE 11

rice data

|   | YEAR | RICE_KA | RICE_KQ | RICE_RA | RICE_RQ | RICE_SA | RI |
|---|------|---------|---------|---------|---------|---------|----|
| ▶ | 1990 | 402.79  | 1221.48 | 28.1    | 76.75   | 28.53   |    |
|   | 1991 | 424     | 1411.22 | 13.59   | 42.35   | 34.03   |    |
|   | 1992 | 181.73  | 582.77  | 5.03    | 10.37   | 35.46   |    |
|   | 1993 | -1      | -1      | -1      | -1      | -1      |    |
|   | 1994 | 164.29  | 506.97  | 2.4     | 5.73    | 43.67   | ▼  |

Fig 2: Form for entering data of rice



## Irrigated area under crops

| DISTRICT                                   | RICE     | CEREALS  | PULSES | OILSEEDS | SUGARCANE | COTTON  |
|--|----------|----------|--------|----------|-----------|---------|
| <b>Chengalpattu</b>                        |          |          |        |          |           |         |
| Summary for 'DIST' = 83 (4 detail records) |          |          |        |          |           |         |
| <b>Avg.</b>                                | 229.0475 | 234.3175 |        | 5.87     | 60.12     | 13.715  |
|  |          |          |        |          |           | 0.09    |
| <b>South Arcot</b>                         |          |          |        |          |           |         |
| Summary for 'DIST' = 84 (4 detail records) |          |          |        |          |           |         |
| <b>Avg.</b>                                | 187.54   | 192.9575 |        | 0.7425   | 52.95     | 48.6175 |
|  |          |          |        |          |           | 8.0225  |
| <b>North Arcot</b>                         |          |          |        |          |           |         |
| Summary for 'DIST' = 85 (4 detail records) |          |          |        |          |           |         |
| <b>Avg.</b>                                | 78.935   | 59.9025  |        | 1.4275   | 27.84     | 21.5425 |
|  |          |          |        |          |           | 0.99    |
| <b>Salem</b>                               |          |          |        |          |           |         |
| Summary for 'DIST' = 86 (4 detail records) |          |          |        |          |           |         |
| <b>Avg.</b>                                | 55.4475  | 82.475   |        | 12.075   | 41.7      | 16.0675 |
|  |          |          |        |          |           | 8.095   |
| <b>Coimbatore</b>                          |          |          |        |          |           |         |
| Summary for 'DIST' = 87 (4 detail records) |          |          |        |          |           |         |
| <b>Avg.</b>                                | 21.455   | 39.625   |        | 2.2625   | 69.2275   | 11.93   |
|  |          |          |        |          |           | 10.9875 |
| <b>Tiruchirapalli</b>                      |          |          |        |          |           |         |
| Summary for 'DIST' = 88 (4 detail records) |          |          |        |          |           |         |
| <b>Avg.</b>                                | 109.915  | 114.5825 |        | 2.875    | 26.625    | 22.0125 |
|  |          |          |        |          |           | 2.23    |
| <b>Tanjavur</b>                            |          |          |        |          |           |         |
| Summary for 'DIST' = 89 (4 detail records) |          |          |        |          |           |         |
| <b>Avg.</b>                                | 333.0625 | 333.535  |        | 3.97     | 14.13     | 16.9275 |
|  |          |          |        |          |           | 3.815   |
| <b>Madurai</b>                             |          |          |        |          |           |         |
| Summary for 'DIST' = 90 (4 detail records) |          |          |        |          |           |         |
| <b>Avg.</b>                                | 113.185  | 120.0975 |        | 3.7675   | 68.3175   | 14.7675 |
|  |          |          |        |          |           | 12.05   |
| <b>Ramanthapura</b>                        |          |          |        |          |           |         |
| Summary for 'DIST' = 91 (4 detail records) |          |          |        |          |           |         |
| <b>Avg.</b>                                | 59.6575  | 60.5025  |        | 0.0725   | 4.535     | 0.0975  |
|  |          |          |        |          |           | 0.4525  |
| <b>Tirunelveli</b>                         |          |          |        |          |           |         |
| Summary for 'DIST' = 92 (4 detail records) |          |          |        |          |           |         |
| <b>Avg.</b>                                | 101.5875 | 105.815  |        | 2.375    | 14.3725   | 4.1675  |
|  |          |          |        |          |           | 9.3225  |
| <b>The Nilgiris</b>                        |          |          |        |          |           |         |
| Summary for 'DIST' = 93 (4 detail records) |          |          |        |          |           |         |
| <b>Avg.</b>                                | 0.14     | 0.1425   |        | 0        | 0.135     | 0.0025  |
|  |          |          |        |          |           | 0.0025  |
| <b>Kanyakumari</b>                         |          |          |        |          |           |         |

Fig.3 Part of sample report for irrigated areas in districts of Tamilnadu.

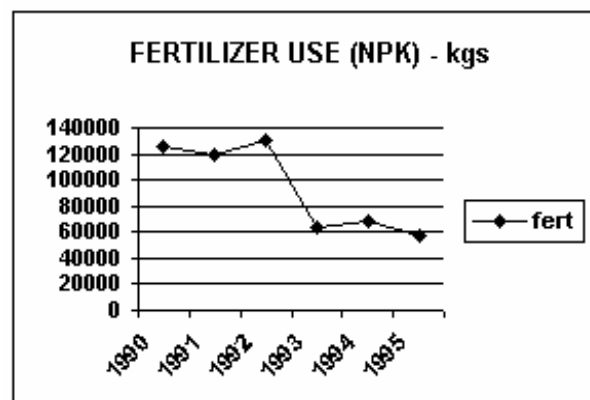
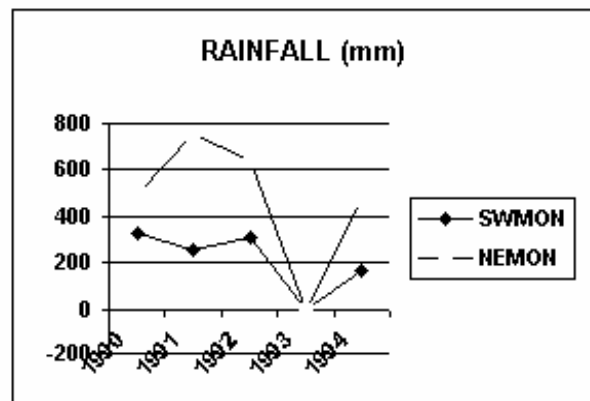
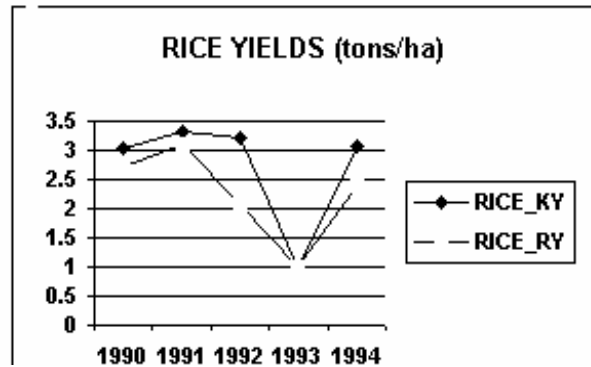


Fig 4. Rice yields, rainfall and fertilizer use in Tanjavur district of Tamil Nadu

# GENERAL FEATURES OF MS EXCEL 97 WITH EXERCISES

M.N. Reddy & K.V. Kumar

Microsoft excel is an Electronic spreadsheet Program. These spreadsheet programs have evolved dramatically over the past decade, and now comprise one of the most widely used categories of software products. Among these Excel is versatile as it has more user interface features in common with other Microsoft Office applications such as MS Word, MS Power point MS Access etc.

Spreadsheet is software, which is a substitute to all types of applications using paper worksheets. Spreadsheet displays data in the form of rows and columns. An intersection of rows and columns is known as cell. Data and formulae are entered in the cell. Spreadsheet allows to perform the following.

- All types of arithmetic calculations
- Allows to perform many types of Statistical Analysis from simple to advanced.
- Allows to represents data in various graphical forms and hold graphical objects like pictures and images

## Some Important features of Excel

Excel like all other applications has tool bars, short cut Menus, templates, Wizards and online help.

- **Windows Environment:** Excel like all other all other applications has tools bars, Shortcut Menus, Templates, Wizards and online help.
- **Workbooks:** An Excel document is referred to as workbook. There are 256 worksheets in each workbook. Each worksheet contains 65,536 (256X256) rows and 256 (AA, BB,...BA,BB, ....IV) columns. Each single cell in and worksheet can accommodate about 32,000 characters.
- **Formula bar:** Below the tool bar (i.e. Standard and Formatting), there is a Formula Bar.
- **Cell Address:** On the left hand side of Formula Bar is the address Box. The address of the cell which is active is shown in the box. Ex. A1 refers the cell in first column and first row.

**EXERCISE 1.** Create a workbook by name 'Foodgrains-Years' in worksheet1.

| Year | Area(M Ha) | Production (Mt) | % Coverage Under Irrigation |
|------|------------|-----------------|-----------------------------|
| 1971 | 124.32     | 108.42          | 24.1                        |
| 1972 | 122.62     | 105.17          | 24.5                        |
| 1973 | 119.28     | 97.03           | 25.4                        |
| 1974 | 126.54     | 104.67          | 24.5                        |
| 1975 | 121.08     | 99.83           | 26.5                        |
| 1976 | 128.18     | 121.03          | 26.5                        |
| 1977 | 124.36     | 111.17          | 27.4                        |
| 1978 | 127.52     | 126.41          | 27.7                        |
| 1979 | 129.01     | 131.9           | 28.8                        |
| 1980 | 125.21     | 109.7           | 30.1                        |
| 1981 | 126.67     | 129.59          | 29.4                        |
| 1982 | 129.14     | 133.3           | 29.4                        |
| 1983 | 125.1      | 129.52          | 30.6                        |

|      |        |        |      |
|------|--------|--------|------|
| 1984 | 131.16 | 152.37 | 30.5 |
| 1985 | 126.67 | 145.54 | 31.5 |
| 1986 | 128.02 | 150.44 | 31.1 |
| 1987 | 127.2  | 143.42 | 32.7 |
| 1988 | 119.69 | 140.35 | 33.2 |
| 1989 | 127.67 | 169.92 | 33.8 |
| 1990 | 126.77 | 171.04 | 34.2 |
| 1991 | 127.84 | 176.39 | 34.7 |
| 1992 | 121.87 | 168.38 | 37.1 |
| 1993 | 123.15 | 179.48 | 37.4 |
| 1994 | 122.75 | 184.26 | 38.7 |
| 1995 | 123.86 | 191.5  | 39.6 |

- Copy worksheet1 to worksheet2
- Calculate productivity in kg/ha(worksheet2)
- Calculate actual irrigated Area in M ha(Worksheet2)
- Copy worksheet2 to worksheet3
- Calculate average area, production ,productivity and irrigated area for each decade (use **Sum** Function and **AutoSum** Icon in worksheet3)
- Represent trends in area, production and productivity and irrigated area graphically
  - for all the years (1971-95) (worksheet2)
  - For different decades (worksheet3)

#### HINTS:

- Start entering data from the cell **A1 to D25** (in four columns)
  - Insert row by **Click right Mouse Button > Insert > Entire Row**
  - Name column 'A' as 'Years' column B as 'Area(M ha)' column C as ' Production (Mt)' Column 'C' as 'Area irrigated(%)'
  - Adjust the column width of 'D' by **Click on D > Format > Column > Auto Fit Selection**
  - Insert row as in second step write the title from the cell A1 as "Trends in Foodgrains Production in India"
  - Center the title by **Mark Title > click on Merge Center Icon**
  - Copy worksheet1 to worksheet2 by **Click on the top corner cell > click on copy Icon > Click on Sheet2 of the Bottom tool Bar > Place the cursor in A1 cell > Click on Paste Icon**
- Insert column by **Click on column 'D' > Insert > Columns**
  - Write the name 'Productivity (kg/ha)' in D2 cell
  - Place the cursor in D3 and type in the formula bar "**= (C3/B3)\*1000 > enter**
  - Copy the formulae up to D7 by **Click on D3 > Drag the right lower corner of the cell box by pressing left mouse button to D27**
  - Convert Formulae as values in column D by **click on D column > click copy Icon > Edit > Paste special >Values**
  - Format the valued of productivity to one decimal by **Click on D > Format > Cells > number > 1( in the box of Decimal places)**
- Place the curser in F3 and type in the formulae bar "**=(B3\*E3)/100**"
  - Copy the formula to E27 , convet to values and Format to Two Decimal Places as mentioned in b)
  - Enter the name "Irrigated Area (M ha)" and format the column by
  - Click on E > Format > Column > Autofit selection**

d)

- Copy Worksheet2 to Worksheet3 as described in a)

e)

- Delete Column E by **Click Column E > Edit > Delete**
- Place the cursor in **A13 > Insert > row**
- Place the cursor in **A24 > Insert > row**
- Place the cursor in **B13 > Type in the formula bar "=Average (B3:B`12)"**
- Copy the formula in B13 to C13,D13,E13.
- Place the cursor in B24 > type in the formula bar **"=Average(B14:B23)"**
- Similar way calculate averages for half decade 91-95 or use Auto sum Icon
- Convert the formula into values
- Type in the blank places of column A as 1971-80, 1981-90, 1991-95.
- Delete all the values except decadal averages by **Mark using left Mouse Button > Edit > delete**
- Format all the values to two decimal places by **Mark A2:E5 > Format > Cells > Number >2**

f)

- Select **Chart Wizard Icon > Select Chart type as Line > select any Chart sub-type > > next > Series in Columns**
- **Click on series > select Range of Y-axis > Select range of X-axis > Next**
- Enter the Title as ' **Trends in Area under Foodgrains in India** ', Y -Axis title as ' **Area (M ha)** ' X-axis title as "Year" > Next
- Save the Chart in Separate Sheet by **Clicking on New Chart sheet**
- Repeat the above steps for Production, Yield and Irrigated Area
- Go to Sheet 3 and Represent the Data on Average Area, Production, and Productivity through Histograms.

# STATISTICAL ANALYSIS USING MS-EXCEL

M.N. Reddy and K.V. Kumar

Microsoft excel is an Electronic spreadsheet Program. These spreadsheet programs have evolved dramatically over the past decade, and now comprise one of the most widely used categories of software products. Among these Excel is versatile as it has more user interface features in common with other Microsoft Office applications such as MS Word, MS Power point MS Access etc.

Spreadsheet is software, which is a substitute to all types of applications using paper worksheets. Spreadsheet displays data in the form of rows and columns. An intersection of rows and columns is known as cell. Data and formulae are entered in the cell. Spreadsheet allows performing the following.

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## EXERCISES ON ANALYSIS OF VARIANCE (ANOVA)

### **Single Factor: Completely Randomized Design (CRD):**

The simplest of all Designs having a random arrangement is the "Completely Randomized Design". It assumes the complete homogeneity of the experimental material.

Examples: Laboratory studies, Green house and Pot culture experiments, animal feeding experiments, Soil moisture and related studies etc.

Exercise: The percentage moisture content is determined for ten samples for each of four different soils. Calculate the analysis of variance to obtain an estimate of the sampling variation within a soil and hence calculate the standard error of the mean moisture content of a soil and the standard error of a difference between two such means. Test the hypothesis that there is no variation of soil moisture content between different soils and summarize briefly the conclusions to be drawn from this data (Table value  $t_{hi}$  of  $t$  for 36 df at 5% level of significance = 2.034, 1% level of significance = 3.599.)

| Soil A | Soil B | Soil C | Soil D |
|--------|--------|--------|--------|
| 12.8   | 8.1    | 9.8    | 16.4   |
| 13.4   | 10.3   | 10.6   | 8.2    |
| 11.2   | 4.2    | 9.1    | 15.1   |
| 11.6   | 7.8    | 4.3    | 10.4   |
| 9.4    | 5.6    | 11.2   | 7.8    |
| 10.3   | 8.1    | 11.6   | 9.2    |
| 14.1   | 12.7   | 8.3    | 12.6   |
| 11.9   | 6.8    | 8.9    | 11.00  |
| 10.5   | 6.9    | 9.2    | 8.0    |
| 10.4   | 6.4    | 6.4    | 9.8    |

Hints:

- a) Analysis of Variance
  - Enter the data from A1 cell to D11 Cell (The first row contains headings on Soil types)
  - Click left mouse button on Tools > Data Analysis > Anova Single Factor > click on OK
  - Type in the input range box A1:D11 & Click in the Labels in First Row Box

The Dialog Box Looks like as follows:

**Anova: Single Factor**

Input

Input Range:

Grouped By: ☒ Columns ☐ Rows

☒ Labels in First Row

Alpha:

Output options

☐ Output Range:

☒ New Worksheet Ply:

☐ New Workbook

OK Cancel Help

- Click on OK button

To see the contents of the first column clearly

- Select Column A by clicking > Format >Column >Autofit selection

The hypotheses that "there is no variation of soil moisture content between different soils" can be tested by comparing F-Value with F-Critical Value

$$\text{Standard error of mean} = \sqrt{s / r} = s / 10$$

$$\text{The estimate of standard error of a difference} = \sqrt{2s / r} = \sqrt{2s} / 10$$

$$\text{Coefficient of Variation \%} = (\text{standard deviation}(s) / \text{mean}) * 100$$

$$\text{CD}(55\%) = (t (.05) \text{ at } 36 \text{ df}) (SEd)$$

## Randomized Block Design

The following data represent the yield of soyabean plants for five treatments grown in six randomized complete blocks. The experiment was conducted in the greenhouse. The five treatments are 20,40,60,80,100 ppm of nitrogen.

Yield of soybean in grams per plot

| Treatment | Replications |      |      |      |      |      |
|-----------|--------------|------|------|------|------|------|
|           | R1           | R2   | R3   | R4   | R5   | R6   |
| T1        | 8.8          | 12.9 | 11.7 | 31.2 | 22.0 | 9.9  |
| T2        | 23.5         | 26.5 | 21.6 | 15.6 | 24.4 | 23.3 |
| T3        | 41.2         | 22.5 | 21.8 | 46.3 | 15.6 | 22.6 |
| T4        | 28.4         | 48.4 | 16.4 | 44.5 | 38.8 | 43.6 |
| T5        | 67.4         | 33.2 | 59.5 | 49.8 | 57.1 | 36.6 |

Analyze the data and summarize the results.

### Hints

- Enter data from A1 cell to G6 cell
- Click on Tools > Data Analysis > Anova Two-Factor without replication >Ok
- Click in labels Box
- OK

## Descriptive Statistics Analysis

Generates a report of univariate statistics for data in the input range, providing information about the central tendency and variability of your data.

### Example

The following are the data on total height(cm) of 100 plants of sorghum.  
Calculate the following statistics.

1. Mean
2. Standard Error
3. Median
4. Mode
5. Standard Deviation
6. Variance
7. Range
8. Skewness
9. Kurtosis
10. Maximum
11. Minimum
12. Sum
13. Count
14. Largest(1)
15. Smallest
16. Confidence Limits
17. Frequency Distribution with Class Interval Ten
18. Histogram

|    |     |     |     |     |    |    |    |     |     |
|----|-----|-----|-----|-----|----|----|----|-----|-----|
| 90 | 109 | 69  | 100 | 115 | 68 | 70 | 72 | 73  | 70  |
| 76 | 82  | 80  | 68  | 69  | 79 | 72 | 69 | 80  | 79  |
| 79 | 84  | 84  | 108 | 83  | 84 | 99 | 98 | 102 | 101 |
| 45 | 59  | 60  | 63  | 79  | 87 | 94 | 91 | 88  | 90  |
| 72 | 68  | 80  | 81  | 84  | 77 | 79 | 81 | 84  | 76  |
| 70 | 67  | 100 | 103 | 69  | 72 | 74 | 66 | 67  | 72  |
| 79 | 78  | 83  | 92  | 93  | 81 | 82 | 86 | 89  | 93  |
| 77 | 76  | 88  | 89  | 94  | 82 | 84 | 87 | 77  | 80  |
| 92 | 91  | 76  | 79  | 73  | 84 | 79 | 84 | 79  | 84  |
| 89 | 85  | 93  | 90  | 79  | 83 | 91 | 87 | 89  | 94  |



## Analysing the Data

- Enter the above data in a separate worksheet of the same workbook as did earlier. Since this is a uni variate data, the user has to enter this data in a single column, that is in Column A
- On the Main Menu Click the Tool menu to get various options in the Tool menu.
- Click the Data Analysis Option to get the different options of Analysis Tool Pack as shown in the previous exercise.
- Click the Descriptive Statistics option from the displayed Analysis Tool Pack Options.
- Click OK to get the Descriptive Statistics Analysis Tool Window as shown below

**Descriptive Statistics**

Input

Input Range:

Grouped By: ☒ Columns ☐ Rows

☒ Labels in First Row

☒ Confidence Level for Mean:  %

☒ Kth Largest:

☒ Kth Smallest:

Output options

☒ Output Range:

☐ New Worksheet Ply:

☐ New Workbook

☒ Summary statistics

From the above screen,

- Input Range is A1 : A101
- Click on the Grouped by Columns check box
- Click on the Labels in the First Row check box
- Confidence Level For Mean : Select if user want to include a row in the output table for the confidence level of the mean. In the box, enter the desired value for confidence level. For example, a value of 95% calculates the confidence level of the mean at a significance of 5%.
- K<sup>th</sup> Largest : Select if user want to include a row in the output table for the kth largest value for each range of data. In the box, enter the number to use for k. If k is 1, this row contains the maximum of the data set.
- K<sup>th</sup> Smallest : Select if user want to include a row in the output table for the kth smallest value for each range of data. In the box, enter the number to use for k. If k is 1, this row contains the minimum of the data set
- Summary Statistics : Select if user want Microsoft Excel to produce one field for each of the following statistics in the output table: Mean, Standard Error (of the mean), Median, Mode, Standard Deviation, Variance, Kurtosis, Skewness, Range, Minimum, Maximum, Sum, Count, Largest, Smallest and Confidence Level.
- Output Range is from C1
- Click OK to get the output on the screen

## Regression Analysis

Performs linear regression analysis by using the "least squares" method to fit a line through a set of observations. By using this tool to analyze how a single dependent variable is affected by the values of one or more independent variables.

### Example

The following table gives for 25 progenies of cotton the data for mean fiber length of each progeny, the corresponding parent plant value and the mean value of the plot in which the parent was grown. It is found that both the parental value as well as the plot mean bear some relationship with the progeny mean. Express this relation in the form of a partial regression equation with progeny mean as the dependent variate.

| Number of Progenies | Progeny Mean (mm)<br>Y | Parental Plant Value<br>$X_1$ | Parental Plot Mean<br>$X_2$ |
|---------------------|------------------------|-------------------------------|-----------------------------|
| 1                   | 24.3                   | 26                            | 25.5                        |
| 2                   | 24.48                  | 28.8                          | 25.5                        |
| 3                   | 23.41                  | 25.2                          | 25.5                        |
| 4                   | 21.6                   | 23.4                          | 25                          |
| 5                   | 22.49                  | 26.6                          | 25                          |
| 6                   | 23.62                  | 25.4                          | 24.6                        |
| 7                   | 22.75                  | 23.4                          | 24.6                        |
| 8                   | 24.4                   | 27.6                          | 23.6                        |
| 9                   | 22.6                   | 24.4                          | 23.6                        |
| 10                  | 25.36                  | 24                            | 24.42                       |
| 11                  | 23.21                  | 24.2                          | 24.42                       |
| 12                  | 24.76                  | 26                            | 24.42                       |
| 13                  | 21.53                  | 22.8                          | 22.56                       |
| 14                  | 21.32                  | 20.8                          | 22.56                       |
| 15                  | 22.81                  | 24.8                          | 22.56                       |
| 16                  | 25.41                  | 26.2                          | 24.9                        |
| 17                  | 24.3                   | 27.2                          | 24.9                        |
| 18                  | 23.65                  | 26.6                          | 24.91                       |
| 19                  | 24.31                  | 25                            | 24.91                       |
| 20                  | 21.88                  | 23.4                          | 24.05                       |
| 21                  | 24.1                   | 25.6                          | 24.05                       |
| 22                  | 21.91                  | 23                            | 24.05                       |
| 23                  | 22.24                  | 25.4                          | 24.57                       |
| 24                  | 23.45                  | 23.4                          | 24.57                       |
| 25                  | 22.1                   | 24.2                          | 24.57                       |

### Analysing the Data

- Enter the above data in a separate worksheet of the same workbook as did earlier.
- On the Main Menu Click the Tool menu to get various options in the Tool menu.
- Click the Data Analysis Option to get the different options of Analysis Tool Pack as shown in the previous exercise.
- Click the Regression option from the displayed Analysis Tool Pack Options.
- Click OK to get the Regression Analysis Tool Window as shown below:

- Input Y Range : Enter the range of dependent variable's data, that is, B2 :B26 The range must consist of a single column.
- Input X Range : Enter the range of independent variables data, that is, C2:D26 The maximum number of input ranges is upto 16 variables.
- Click in the Labels check box to select the first row or column of input range contains labels.
- Click in the Confidence Level check box to include an additional level in the summary output table. In the box, enter the desired confidence level in addition to the default 95% level.
- Output Range : Enter the range of cells or a cell that is A30 to keep the output on the worksheet. Allow at least seven columns for the summary output table, which includes an anova table, coefficients, standard error of y estimate, r2 values, number of observations, and standard error of coefficients.
- Click in the Residuals check box to include residuals in the residuals output table.
- Click in the Standardised Residuals check box to include standardised residuals in the residuals output table.
- Click in the Residual Plots to generate a chart for each independent variable versus the residual.
- Click in the Line Fit Plot to generate a chart for predicted values versus the observed values.
- Click in the Normal Probability Plot to generate a chart plotting normal probability. .

## t-TEST

### Paired Two Samples

Performs a paired two-sample student's t-test to determine whether a sample's means are distinct. This t-test form does not assume that the variances of both populations are equal. Use this paired test when there is a natural pairing of observations in the samples, such as when a sample group is tested twice — before and after an experiment.

Example:

A paired feeding experiment was conducted with pigs on the relative value of limestone and bonemeal for bone development. The results are given in the following table.

| Pair | Ash Content (%) |            |
|------|-----------------|------------|
|      | Lime Stone      | Bone Stone |
| 1    | 49.2            | 51.5       |
| 2    | 53.3            | 54.9       |
| 3    | 51.4            | 53.2       |
| 4    | 50.6            | 49.9       |
| 5    | 52.0            | 51.6       |
| 6    | 46.8            | 49.3       |
| 7    | 50.5            | 52.4       |
| 8    | 52.1            | 44.6       |
| 9    | 53.0            | 52.8       |
| 10   | 48.5            | 49.7       |

### Test the significance of the difference between the means

#### Analyzing the data

For analysing the above data, first enter the data in a separate worksheet of the same workbook and enter the data as did in the earlier exercise.

|    | A    | B          | C         |
|----|------|------------|-----------|
| 1  | Pair | Lime Stone | Bone Meal |
| 2  | 1    | 49.2       | 51.5      |
| 3  | 2    | 53.3       | 54.9      |
| 4  | 3    | 51.4       | 53.2      |
| 5  | 4    | 50.6       | 49.9      |
| 6  | 5    | 52.0       | 51.6      |
| 7  | 6    | 46.8       | 49.3      |
| 8  | 7    | 50.5       | 52.4      |
| 9  | 8    | 52.1       | 44.6      |
| 10 | 9    | 53.0       | 52.8      |
| 11 | 10   | 48.5       | 49.7      |

- On the main menu Click Tools option
- Click Data Analysis option from the displayed window
- From the displayed Analysis Tool Pack window, Click t-Test :Paired Two Samples for Means to get the following screen

**t-Test: Two-Sample Assuming Equal Variances**

Input

Variable 1 Range:

Variable 2 Range:

Hypothesized Mean Difference:

☒ Labels

Alpha:

Output options

☒ Output Range:

☐ New Worksheet Ply:

☐ New Workbook

OK  
Cancel  
Help

- Enter the cell reference, that is B1 : B11, As Variable 1 Range for the first range of data to be analyze. The range must consist of a single column or row. And similarly enter the Variable 2 Range is C1:C11 .
- Hypothesized Mean Difference: Enter value of 0 (zero) indicates that the sample means are hypothesized to be equal.
- Click on the Labels check box to consider the column label as the variable names.
- Alpha: Enter the confidence level for the test. This value must be in the range 0...1.
- Output Range: Enter the reference Cell as A13 to keep the results on the worksheet. The out will be displayed.

# INTRODUCTION TO MICROSOFT FRONTPAGE 98

**M.N. Reddy**

Principal Scientist

Microsoft FrontPage 98 helps to the web creation and management tool that requires no programming knowledge but is robust enough for experienced Web site developers. FrontPage 98 has everything you need to design and build a great looking, easy to navigate World Wide Web site.

FrontPage 98 includes the FrontPage Explorer, where you create, design, and manage your entire Web site, and the FrontPage Editor, where you create and edit Web pages without needing to know HyperText Markup Language (HTML). FrontPage includes many features that make Web-site creation easy for any user, such as a gallery of professionally designed graphical themes, a full set of wizards and templates for creating pages and FrontPage webs, active page elements for providing complex functionality without programming, and a Tasks list for tracking tasks as you create your FrontPage web.

You use the FrontPage Explorer to create the structure or layout of your Web site, apply graphical themes to its pages, organize its files and folders, import and export files, test and repair hyperlinks, administer access privileges, track tasks, and launch the FrontPage Editor to design and edit the contents of your Web pages. When your FrontPage web is completed, you use the FrontPage Explorer to publish it on your computer, your organization's intranet, or the World Wide Web.

You use the FrontPage Editor to create, design, and edit World Wide Web pages. As you add text, images, tables, form fields, and other elements to your page, the FrontPage Editor displays them as they would appear in a Web browser. Although it is a powerful tool, the FrontPage Editor is easy to use because of its familiar, word-processor interface. You do not need to learn hypertext markup language (HTML) to use the FrontPage Editor because it creates all the HTML code for you.

If you want to edit HTML code directly, you can use the FrontPage Editor's HTML view. In this view, you can enter text, edit HTML tags or script code, and use standard word-processing commands such as cutting, pasting, finding, and replacing.

FrontPage is a member of the Microsoft Office family of products, and shares many of the features of Microsoft Word and Microsoft Excel, such as the Microsoft Clip Gallery, global spell checking and thesaurus, and easy table-editing. FrontPage 98 also manages hyperlinks created in Microsoft Office 97 documents.

## **The FrontPage Explorer**

The Microsoft FrontPage Explorer is a tool for creating, organizing, administering, and publishing FrontPage webs. Using the FrontPage Explorer, you create the structure or layout of your Web site, arrange its files and folders, import and export pages and files, test and repair hyperlinks, administer access privileges, and launch the FrontPage Editor to design and edit the contents of your Web pages. You also use the FrontPage Explorer to publish completed FrontPage webs on your computer, your organization's intranet, or the World Wide Web.

A FrontPage web is a collection of HTML pages, images, documents, and other files and folders that make up a Web site. Authors can create, delete, open, edit, and close FrontPage webs using the FrontPage Explorer and FrontPage Editor on a client computer. FrontPage webs can be stored on a remote Web server, a Web server running on the same computer as the client programme, or in the client computer's file system.

A FrontPage web also contains a number of support files that provide added functionality with sophisticated features such as navigation bars, hyperlink recalculation and repair, full text index generation, consistent design elements from themes, automatic table of contents generation, and built-in forms handling.

Here are some of the key features of the FrontPage Explorer:

- You can quickly create professional-looking Web sites using the built-in web templates and wizards. For example, you can create a corporate presence on the World Wide Web with the Corporate Presence Wizard; launch a Customer Support site with the Customer Support Web template; host a discussion group with the Discussion Web Wizard; or publish a project management web with the Project Web template.
- If you have an existing Web site, you can easily convert it to a full-featured FrontPage web with the FrontPage Explorer's Import Web Wizard. In a few steps, this wizard imports your pages, images, and files, while preserving the web's structure as well as its hyperlinks.
- You can import files to your FrontPage web by specifying a folder in your file system to import its contents. You can also export files from your FrontPage web to your file system.
- You can display and maintain the files, folders, hyperlinks, and layout of a FrontPage web by selecting any of the FrontPage Explorer's seven views. Each view gives you a different perspective of a FrontPage web, designed to assist you in maintaining FrontPage webs from their creation until their publication to a Web server.
- In the FrontPage Explorer, you can apply one or more shared borders — page regions that are reserved for content that you want to appear consistently throughout your pages. Shared borders usually contain navigation bars — hyperlinks to the other pages in the current FrontPage web. When you create a FrontPage web in the FrontPage Explorer's Navigation view, FrontPage can create shared borders and navigation bars that are automatically updated whenever you add, move, or delete pages from the web's structure.
- FrontPage includes a gallery of professionally designed graphics and color schemes — called themes — that can be applied to any FrontPage web. Themes enhance the appearance of list bullets, fonts, navigation bars, table borders, horizontal lines, and page backgrounds, and they lend an attractive and consistent appearance to any FrontPage web.
- You can double-click any HTML page in the FrontPage Explorer and it will open for editing in the FrontPage Editor. In the FrontPage Explorer, you can also associate other editors for other file types in your FrontPage web. When you double-click a file that has been associated with an editor, it will open in that editor.
- When your FrontPage web is ready to be published on the World Wide Web — or on your organization's intranet — the FrontPage Explorer's Publish command transfers the

pages and files to the World Wide Web or a Web server while automatically verifying the addresses of pages and the paths to your files.

- If you use the FrontPage Explorer to rename or move a file in your FrontPage web, all hyperlink references to that file are automatically updated within the FrontPage web, including hyperlinks from Microsoft Office 97 documents. You can also verify and repair broken hyperlinks, including hyperlinks to external World Wide Web sites. In a multi-authoring environment, you can refresh hyperlinks to incorporate and view recent changes made to the FrontPage web by other authors.
- Using the Tasks view in the FrontPage Explorer, you can track and complete any unfinished FrontPage web tasks (such as spell-checking corrections) on all pages. Clicking a task can take you right to the page that needs work. Some tasks are generated automatically as you create and maintain a FrontPage web; you can add other tasks and assign them to other FrontPage authors.
- In multi-user environments, you can protect a FrontPage web from unauthorized access by requiring a logon username and password for browsing or authoring access.

## **The FrontPage Editor**

The Microsoft FrontPage Editor is a tool for creating, designing, and editing World Wide Web pages. As you add text, images, tables, form fields, and other elements to your page, the FrontPage Editor displays them as they would appear in a Web browser.

You do not need to learn HTML to use the FrontPage Editor because it creates all the HTML code for you. The FrontPage Editor generates all the popular HTML tags, including extensions such as cascading style sheets, frames, and ActiveX Controls.

If you want to edit the HTML code directly, you can use the FrontPage Editor's HTML view. In this view, you can enter text, edit HTML tags, and use standard word-processing commands such as cutting, pasting, and find and replace.

Although it is a powerful tool, the FrontPage Editor is easy to use because of its familiar, word-processor interface.

Here are some of the key features of the FrontPage Editor:

- You can create new HTML pages based on page wizards and templates. The FrontPage Editor offers many choices of page formats, and you can create your own templates.
- You can apply one of the many FrontPage themes, created by professional designers, to give your pages a dynamic, colorful appearance. You can also add and design borders for your pages and insert navigation bars, which guide your users around your Web site.
- You can open any HTML file in the FrontPage Editor and all the HTML tags on the page are preserved. You can also open files of many popular types, and the FrontPage Editor converts them to HTML. Some of the file types you can open are Microsoft Word 2.0 and 6.0, Microsoft Word 6.0 for MS-DOS, Microsoft Word 95 and 97, Microsoft Excel 4.0 and 5.0, Microsoft Excel 95 and 97, and WordPerfect 6.x. The FrontPage Editor preserves hyperlinks from Microsoft Office 97 documents.



- You can insert text in all HTML styles, create multilevel lists, change text size and color, and apply formatting such as centering a heading or making text italic. Using cascading style sheet support, you can control margins, line spacing, colors, fonts faces and sizes.
- Using a point-and-click interface, you can create hyperlinks to pages and files in your FrontPage web or to pages and files on the World Wide Web. Point to a page and FrontPage creates the correct hyperlink syntax for you automatically.
- You can insert an image of almost any type, and the FrontPage Editor converts it into GIF or JPEG format. Double-click an image and it opens for editing in your favorite image-editing programme. Create an image map by adding hotspots, areas in an image containing hyperlinks. Using FrontPage image-editing commands, you can crop, rotate, and resize an image, make it black and white, give it beveled edges, and change its brightness and contrast. FrontPage includes the Microsoft Clip Gallery, a large library of clip art, stock photos, and video clips.
- You can create forms containing text fields, check boxes, radio buttons, drop-down lists, and push buttons. When you create a form, the default FrontPage form handler automatically saves form information to a file or sends it to an e-mail address. You can select from a set of FrontPage form handlers or add you own custom form handler to a form.
- Using the FrontPage table-editing commands, you can create a table, insert rows and columns, align them, and create background colors, using a point-and-click interface.
- You can add powerful functionality to your page by inserting FrontPage components. They add interactive features such as navigation bars, threaded discussion groups, full-text searches, and form handlers that would otherwise require complex programming. For example, the Table of Contents component automatically creates an HTML outline of your FrontPage web with hyperlinks to each page, and the Banner Ad Manager replays a sequence of images using effects similar to a rotating billboard.
- You can create new frames pages, edit the appearance of your frames, and assign initial pages to each frame, all using a point-and click interface. FrontPage displays your frames pages in WYSIWYG style and generates the HTML.
- You can insert ActiveX Controls, plug-ins, and Java applets in the FrontPage Editor. You can launch a script-editing session and create and insert JavaScript scripts and Microsoft Visual Basic Scripting Edition scripts.

### **About the FrontPage Workplace**

The FrontPage workplace includes what you see on the screens of the two components of FrontPage, the FrontPage Explorer and the FrontPage Editor. On both screens you see menu bars, toolbars, status bars, menus, title bars and dialog boxes.

The FrontPage Explorer shows you seven different views of the current FrontPage web:

- Folders View
- All Files View
- Navigation View
- Hyperlinks View
- Hyperlink Status View
- Themes View
- Tasks View

## **Folders View**

In the FrontPage Explorer, the view of a FrontPage web that shows how the content of the FrontPage web is organized. You can create, delete, copy, and move folders in the Folders view. Views in the FrontPage Explorer provide different ways of looking at the information in your FrontPage web, so that you can effectively manage your site.

## **All Files View**

The FrontPage Explorer view that displays all the files in a FrontPage web in a single list, along with information about each file, such as name, size, and file type. Views in the FrontPage Explorer provide different ways of looking at the information in your FrontPage web, so that you can effectively manage your site.

## **Navigation View**

The FrontPage Explorer view that is used to create, display, print, and change the navigation structure of a FrontPage web. The Navigation view includes a folder-like view, from which you can drag-and-drop pages into your site structure. Views in the FrontPage Explorer provide different ways of looking at the information in your FrontPage web, so that you can effectively manage your site.

## **Hyperlinks View**

A view in the FrontPage Explorer that graphically shows the hyperlinks among pages and other files in your FrontPage web along with the hyperlinks from your FrontPage web to other World Wide Web sites. Views in the FrontPage Explorer provide different ways of looking at the information in your FrontPage web, so that you can effectively manage your site.

## **Hyperlink Status View**

A view in the FrontPage Explorer that graphically shows the status of the hyperlinks in your FrontPage web. The list includes both internal and external hyperlinks, and graphically indicates whether the hyperlinks have been verified or whether they are broken. Views in the FrontPage Explorer provide different ways of looking at the information in your FrontPage web, so that you can effectively manage your site.

## **Themes View**

The FrontPage Explorer view that lets you add graphic page elements, such as bullets and backgrounds, to your FrontPage web. You can choose from a gallery of available FrontPage themes and apply them to all pages in the current FrontPage web to give your site a consistent, professional appearance and navigation structure. You can also enable, disable, or override theme formatting for individual pages in the FrontPage Editor.

## **Tasks View**

The FrontPage Explorer view that maintains a list of the tasks required to complete a FrontPage web. Views in the FrontPage Explorer provide different ways of looking at the information in your FrontPage web, so that you can effectively manage your site.

You switch between these views by clicking buttons on the Views bar. You use the FrontPage Explorer to create and open FrontPage webs, set permissions, create a navigation structure, manage folders and files, view and repair hyperlinks, use themes, and create and manage tasks.

The FrontPage Editor has a text area where you create the pages of your FrontPage web. In the FrontPage Explorer and FrontPage Editor you can display or hide some screen elements, such as the status bar.

Microsoft Office documents can be opened and edited while in FrontPage. FrontPage uses the power of the text import converters from Microsoft Word to import a wide variety of file formats into FrontPage, increasing your ability to use existing content for your web site. This feature is integrated into the File command options on the Insert menu, and any new converters are automatically shared with other Microsoft Office applications.

## **About Pages**

Pages are the basic documents of the World Wide Web. They are written in an evolving language called HTML (HyperText Markup Language). An HTML page contains text and HTML tags — embedded commands that supply information about the page's structure, appearance, and contents.

Some HTML tags build a description of the structure of the elements on a page, such as tables and forms, which are made up of many elements. Web browsers (programmes that display pages) use this information to determine how to display the page elements in relation to each other. For example, the HTML tags that describe a table specify the number of rows it has, the number of cells in a row, and so forth.

In addition to describing the structure of page elements, some HTML tags also contain attributes. Attributes provide details about a particular tag. For instance, the tag that inserts an image on a page has an attribute that supplies the name of the image to insert. Some attributes supply preferences about the layout of the page element. For example, a table has attributes that describe its border width and the padding between its cells.

The FrontPage Editor is the FrontPage tool for creating, editing, and testing World Wide Web pages. As you add text, images, tables, form fields, and other elements to your page, the FrontPage Editor displays them as they would appear in a Web browser.

You do not need to know HTML to use FrontPage. The FrontPage Editor creates the HTML in the background, adding tags and filling in attributes based on your choices. You create and edit pages using a familiar, word-processor interface. In the FrontPage Editor, you can add text, images, tables, form fields, hover buttons, marquees and many other elements to a page. You can add HTML by hand using the FrontPage Editor's HTML view, but only if you want to.

Because a page can combine many elements, designing pages so that all the elements have a consistent, professional look can be time consuming. To help you create well-designed pages quickly, FrontPage has over 50 professionally-designed themes that use coordinated designs for bullets, fonts, images, navigation bars, and other page elements.

To see how the pages you are working on look in a Web browser, you can select the Preview tab in the bottom-left corner of the FrontPage Editor window. To view or edit the HTML that FrontPage generates, click the HTML tab.

## **About Tables**

Tables are made up of rows and columns of cells that can contain anything you might put on a page, such as text, images, forms, ActiveX controls, or FrontPage components. You can use tables to arrange data systematically or to organize the layout of a page. A table allows you to display text in side-by-side paragraphs or arrange text next to graphics. Use a table to simulate columns of text, or use a fixed-pixel-width column to provide a margin for text on a page.

You can create a table quickly with the Draw Table command, which lets you define a table just by drawing the borders of the table, columns, and rows. After you create a table, you can customize it by adding rows and columns, changing the size of cells, and adding a caption. You can also convert existing text to a table and vice-versa.

When you type text in a cell or insert text, images, forms and so on, the cell expands horizontally and vertically to accommodate the elements that are typed or inserted. You can edit, format, and specify properties for the text or inserted element, as well as for the table cell, row, column, or table itself. You can easily resize cells, columns, rows, or the entire table by dragging borders.

## **About Themes**

A FrontPage theme consists of unified design elements and color schemes for bullets, fonts, images, navigation bars, and other page elements. When applied, a theme gives the pages and navigation bars in your FrontPage web an attractive and consistent appearance.

You apply a theme to all pages in the current FrontPage web in the FrontPage Explorer's Themes View. Once a theme has been applied, you can change to a different theme, or remove the theme.

You also apply, change, or remove themes page-by-page in the FrontPage Editor using the Theme command on the Format menu.

In both the FrontPage Explorer and the FrontPage Editor, the Theme Preview pane lets you preview sample page elements as they will appear on your Web pages. You can preview a theme before applying it by selecting it from the list of available themes. FrontPage includes over 50 themes.

Before applying a theme, you can select options that change the appearance of the theme's components. For example, selecting Vivid Colors will apply brighter colors to text and graphics, selecting Active Graphics will animate certain theme components, and selecting Textured Background will apply a textured background image to the pages in your FrontPage web.

## About Frames and Frames Pages

Frames divide a Web browser's window into separate regions, each of which can display a separate, scrollable page. A group of frames is called a frames page. A frames page is a special Web page that defines the size and location of each frame it contains.

In the simplest frames page there are two frames: one frame displays a page listing a set of hyperlinks, and the other frame displays the pages to which the hyperlinks point. Each time a user clicks a hyperlink in the first frame, the page pointed to by that hyperlink is displayed in the second frame. The frames page itself does not actually contain any content or pages; it contains only hyperlinks to existing pages that are displayed in the frames.

You create a new frames page by selecting a frames page template from the Frames tab of the New dialog box. FrontPage creates the frames page in a new window in the FrontPage Editor. You then set the initial page you want displayed in each frame on the frames page.

When a user clicks a hyperlink to the frames page, the Web browser will load the frames page and then load the initial page specified for each frame. Typically, each page displayed in a frame is a Web page. However, a frame can also display another frames page, in which case that frame is the parent frame of all the frames in the new "nested" frames page.

When a user clicks a hyperlink on the initial page in a frame, the page to which the hyperlink points will be displayed in the designated target frame based on the frames page template you selected.

## About Hyperlinks

A hyperlink is a connection from a World Wide Web page to another location on the World Wide Web. The destination of the hyperlink is most often another Web page, but it can also be an image, an e-mail address, a multimedia file, or even a programme.

Hyperlinks are embedded directly in text or images on a page, and they give textual or graphical cues about where they lead. For example, a text hyperlink from the phrase "Microsoft FrontPage" and an image hyperlink from the Microsoft FrontPage logo both would indicate that the hyperlink goes to a page describing Microsoft FrontPage.

Web browsers usually underline text hyperlinks and display them in a specific color. Hyperlinks in images are invisible. However, users can tell when the pointer is over a hyperlink because it changes appearance, usually to a pointing hand.

When a user clicks on a hyperlink to a page, the Web browser gets the page from the correct server and displays it. When a user clicks a hyperlink to another type of file, the Web browser gets the file from the server and opens it in an associated programme. For example, most browsers open WAV files in a sound-playback application.

When a hyperlink is inserted on a page, the destination of the hyperlink is encoded as a Uniform Resource Locator (URL). A URL gives the address of a file on the World Wide Web and also identifies the Internet service, such as FTP or the World Wide Web that will handle the file.

Any URL can be absolute or relative. An absolute URL is the full Internet address of a page or file, including the protocol, network location, and optional path and file name. For example, [http:// www.microsoft.com/news.htm](http://www.microsoft.com/news.htm) is an absolute URL.

A relative URL is a URL with one or more of its parts missing. Browsers take the missing information from the page containing the URL. For example, if the protocol is missing, the browser uses the protocol of the current page, and if the network location is missing, the browser uses the current page's network location.

The most common type of relative URL has only a partial path and a file name, but no network location. If a page uses this type of relative URL to hyperlink to another page and both pages are moved to another server, the hyperlink will still work if the relative positions of the pages remains the same on the new server. For example, the relative URL [products.htm](#) points to a page in the same folder as the page containing the hyperlink. If both pages are moved to the same folder on a different server, the URL will still be correct.

FrontPage makes it easy to create, edit, and verify hyperlinks. In the FrontPage Editor, you create a hyperlink to a target page or file in your current FrontPage web by selecting the target from a list of your web's contents. You create hyperlinks to any page on the World Wide Web by typing in the target page's URL or by browsing the World Wide Web for the page.

You can also create hyperlinks to e-mail addresses. When a user visiting your Web site clicks an e-mail hyperlink, the Web browser will prompt the user for a message and will send the message to the specified e-mail address.

Using FrontPage, you can create hyperlinks without needing to know the URL of the target page or file. You can just browse the current FrontPage web or the World Wide Web, point to the page or file, and the FrontPage Editor fills in the correct URL.

FrontPage generates relative URLs when you create hyperlinks between pages in your FrontPage web. If you rename or move a page, FrontPage updates all the relative URLs in your FrontPage web that point to that page. By generating all relative URLs, FrontPage saves you time and ensures that your Web site will be portable.

## **About Images**

Authors use images on their World Wide Web pages to provide information or decoration, to communicate their personal style or that of their organization, to display graphic artwork or pictures of products, and to create image maps, which are images containing one or more hyperlink areas called hotspots.

In general, images on Web pages must be in either Graphics Interchange Format (GIF) or in Joint Photographic Expert Group format (JPEG). FrontPage lets you import images in the following formats: GIF, JPEG (standard and progressive), BMP (Windows and OS/2), TIFF, TGA, RAS, EPS, PCX, and WMF. FrontPage then converts these imported images to GIF format (for images containing up to 256 colors) or JPEG format (for images containing over 256 colors) when the page is saved to the current FrontPage web.

FrontPage has a complete interface for using images in FrontPage webs. In FrontPage, you can easily import images to your FrontPage web and insert them on pages, align them with text, create and edit image maps, create thumbnails, and use images in

page design. You can also scan images from TWAIN-compatible scanners, cameras, and other devices directly onto a page.

Along with its comprehensive set of image commands, FrontPage includes a full library of clip art from the Microsoft Clip Gallery: commonly used buttons, icons, background patterns, video clips, and other images that you can use in your FrontPage Web pages.

Image maps are images containing hyperlinks. A well designed image map gives users visual cues about where each hyperlink will take them. For example, an image map for a tourism bureau could be an actual map of a geographical region. By clicking a place of interest on the map, a user could follow a hyperlink to a topic describing the hotels and tourist attractions in that place. A business could use an image map to display pictures of its products. By clicking a product, a potential customer could follow a hyperlink to a topic describing the product.

In the FrontPage Editor, you can easily create image maps. Just insert the image on the page, and then use the commands on the Image Toolbar to create your hotspots.

### **About FrontPage Webs**

A FrontPage web is a collection of HTML pages, images, documents, and other files and folders that make up a Web site. Authors can create, delete, open, edit, and close FrontPage webs using the FrontPage Explorer and FrontPage Editor on a client computer. FrontPage webs can be stored on a remote Web server, a Web server running on the same computer as the client programme, or in the client computer's file system.

A FrontPage web also contains a number of support files that provide added functionality with sophisticated features such as navigation bars, hyperlink recalculation and repair, full text index generation, consistent design elements from themes, automatic table of contents generation, and built-in forms handling. In order to fully benefit from certain FrontPage components, you should create and maintain FrontPage webs on a Web server that has the FrontPage Server Extensions installed. These are a set of programmes and scripts that support FrontPage authoring and extend the functionality of your Web server.

When your FrontPage web is ready to be published on the World Wide Web — or on your organization's intranet — the FrontPage Explorer's Publish command will publish the pages and files to the Web server you specify, while verifying the addresses of your pages and the paths to your files. If the Web server to which you are publishing your FrontPage web has the FrontPage Server Extensions installed, then your FrontPage web will have full FrontPage functionality when it is published. If FrontPage detects that you are publishing to a Web server that does not have the FrontPage Server Extensions installed, some FrontPage Components, such as the FrontPage Search Form, will not work.

If the FrontPage Server Extensions are not present on the target Web server, FrontPage launches the Microsoft Web Publishing Wizard, which will publish your FrontPage web using FTP, a file transfer protocol. All hyperlinks to pages and files will be retained.

### **Adding Security on Your Web**

If you create and edit FrontPage webs directly on a World Wide Web or intranet server, FrontPage offers a set of useful administrative tools for setting web permissions and limiting access to FrontPage webs from specified computers. FrontPage security is based on

the security mechanism used by the Web server and on the operating system on which the Web server is running.

For each FrontPage web on your Web server, you can set the following types of permissions:

- Browsing permission gives a user, a group of users, or specific computers permission to view the FrontPage web after it has been published on the World Wide Web or your organization's intranet.
- Authoring permission gives a user, a group of users, or specific computers permission to open the FrontPage web in the FrontPage Explorer and create and edit pages and files in the FrontPage Editor.
- Administering permission gives a user, group of users, or specific computers permission to administer the current FrontPage web. An administrator of the root web can create new FrontPage webs and set permissions for other users and computers.

The root web is the top-level web on your Web server. All other FrontPage webs on the Web server inherit their permissions from the root web by default. In the FrontPage Explorer, you can assign unique permissions for any FrontPage web in the Settings tab of the Permissions dialog box.

FrontPage web permissions are hierarchical. This means that a user with administrative permissions also has authoring and browsing permissions; a user with authoring permissions also has browsing permissions. When you set permissions for administering, authoring, or browsing a FrontPage web, the Web server requests a name and password for any task that requires permissions; however you may not see the prompt because, with some Web servers, FrontPage will send the name and password you are currently logged in with.

On some Web servers, you can also set permissions for computers, based on their IP addresses. You can set permissions for a group of computers using the asterisk character (\*) to create an IP address mask. For example, the IP address mask 127.\*.\* applies to all computers with IP addresses beginning with 127. In this scenario, a user, author, or administrator must not only have sufficient permissions to access the FrontPage web, but must also be working on a computer that has the appropriate level of permissions. By default, all computers have permissions to browse to a FrontPage web.

Note: You should not use IP address restrictions on computer networks that do not support fixed IP addresses.

When using Microsoft Internet Information Server or Microsoft Personal Web Server 1.0 (in configurations that support security), you can only set permissions for users or groups of users that are known to the Web server. With these Web servers, you cannot use FrontPage to add new users or groups, or to set passwords. You must use the operating system's features to create and manage users and groups. With Microsoft Personal Web Server 4.0, you cannot set permissions for your webs. All users on the network can browse to your FrontPage webs, and authoring and administering webs is permitted only from the computer on which the Web server itself is installed.

If you use other Web servers, you can create users, assign names and passwords, and give these users administrative, authoring, or browsing permissions.



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to your FrontPage webs, and authoring and administering webs is permitted only from the computer on which the Web server itself is installed.

If you use other Web servers, you can create users, assign names and passwords, and give these users administrative, authoring, or browsing permissions.

## **FrontPage Database Integration**

Using the FrontPage Database Region Wizard, you can submit SQL queries to an ODBC-compliant database accessible from the Web server computer. When a user visits your Web site and submits search criteria, the query runs based on the values of SQL parameter fields. The results are then combined with an Active Server Page, which acts as a custom form handler, and returned to the Web browser for display.

An Active Server Page is an HTML document that contains embedded server-side scripting. Web servers compatible with ASP can execute these server-side scripts. On the client side, an ASP is a standard HTML document, viewable on any platform using any Web browser.

Before you can integrate a database into a FrontPage web, you must follow a series of steps that take place outside of FrontPage. These include configuring your Web server and workstation, and building (and modifying) Structured Query Language (SQL) queries in a database management tool such as Microsoft Access. You can use any database with an available Open Data Base Connectivity (ODBC) compliant driver to publish data on a Web site.

Please see the Getting Started with Microsoft FrontPage 98 book for more information on FrontPage 98 Database Integration.

## **FrontPage Advanced Components**

By using the advanced components that are built into the FrontPage Editor, you can take advantage of the latest developments in Web browser technology. In the FrontPage Editor, the following advanced components are available on the Insert menu: ActiveX control, Java applet, plug-in, script, and Design-Time control.

ActiveX controls are software components that provide dynamic features on your pages. For example, a stock ticker control could be used to add a live stock ticker to a page, or an animation control could be used to add animation features. To insert a control, you must first have it installed on your machine. For more detailed information about ActiveX controls, and to see a gallery of free controls that are available on the World Wide Web, visit <http://activex.microsoft.com/>

When an author is using the FrontPage Editor, Design Time controls are a set of interfaces for ActiveX controls that allow design-time editing and manipulation of a control.

Java applets are similar to ActiveX controls. They are software components written in the Java programming language called Java that provide dynamic features on your Web page. A software vendor might choose to create a product as a Java applet because its interpreted nature lets it run on several different hardware platforms. Inserting a Java applet is similar to inserting an ActiveX control.

Plug-ins are platform-specific components for pages. Originally designed for Netscape Navigator 2.0, they are supported in Microsoft Internet Explorer 3.0 and higher versions as well.

Scripting is a method for writing that you can use to write custom code for your Web page. This is an advanced FrontPage feature that requires knowledge of programming. Scripting is useful for custom Web-based solutions development. It provides a full object model for the Web browser and the objects on the current page. This makes it easy to write code that manipulates elements on the page without knowing the details of the HTML or how the objects are implemented. You can also use the Script Wizard included in FrontPage 98 to create script code that is specifically designed to handle events that occur on objects (such as ActiveX controls) on your page. The Script Wizard includes its own online Help system.

## **CREATING INTERACTIVE LESSONS USING MICROSOFT FRONTPAGE PART – I : BASICS, INSERT DOCUMENTS, HYPER LINKS AND BOOKMARKS**

### **Exercise – I**

#### Converting MS Word Documents into HTML Documents

In this exercise all word documents are available in C:\SUSAGRI folder

#### Activate MS Word

1. Click on START button
2. Choose PROGRAMS folder
3. Select MICROSOFT WORD

#### Open MS Word Document

4. Click on FILE MENU
5. Click on OPEN and
6. Select folder name : C:\SUSAGRI from look in dialogue box
7. Choose the file OBJECTIVES from the displayed list of files
8. Click on OPEN button

#### Convert Word document into HTML document

9. Select SAVE AS option from the file menu
10. Keep the same file in FILE NAME dialogue box
11. Choose HTML Document option from SAVE AS TYPE dialogue box
12. Click on SAVE button
13. Select CLOSE option from the FILE menu

Similarly convert the following other word documents into HTML documents

Introduction.doc  
Land\_degradation\_index.doc  
Sustainable\_Development.doc  
Sustainable\_Agriculture.doc  
Indicators\_of\_in\_sustainable\_Agr.doc

## Exercise – II

### Activate Front Page

1. Click on Start button
2. Choose Programs folder
3. Select Microsoft Frontpage

### Create a New Front Page

1. Select option Create a NEW FRONT PAGE WEB from the Displayed GETTING STARTED WINDOW
2. Click on OK to get NEW FRONT PAGE WEB SCREEN
3. Select EMPTY WEB from the displayed WIZARD OR TEMPLATE dialogue box
4. Type **SUSTAINABLE AGRICULTURE** as the Title for your FRONT PAGE WEB
5. Click on CHANGE Button to specify the new location of the NEW FRONT PAGE WEB
6. Type the path as **C:\sustain** to specify the location of the New Front Page Web
7. Click on OK
8. Click on YES button to create a NEW FOLDER as given above.
9. Click on OK button
10. Click on YES button

Then it will displayed the Front page Explorer Window you can observe the different views of Front Page Explorer on the left side of the displayed Window : Folders, All Files, Navigations, Hyperlinks, Hyper Links Status, Themes and Tasks.

### Creating TITLE PAGE

1. Click on FILE MENU
2. Select PAGE option from NEW sub menu
3. Double Click on HOME PAGE icon  
Then it will be displayed the Front Page Editor Screen
4. Position the MOUSE Pointer Middle of the SCREEN by pressing ENTER KEY
5. Select INSERT TABLE option from the TABLE menu
6. Select Rows 1 & Columns 3 as the size of the table &
7. Click on OK button
8. Position the Mouse Pointer in the 1<sup>st</sup> Column of the TABLE
9. Select IMAGE option from the INSERT MENU
10. Click on SELECT A FILE ON YOUR COMPUTER Icon at the URL Dialogue BOX
11. Choose **C:\SUSAGRI** folder
12. Select the File Name : **na01441\_.gif**
13. Click OK button
14. Position the Mouse Pointer in the 2<sup>nd</sup> Column of the TABLE
15. Type the Text : **SUSTAINABLE AGRICULTURE**
16. Block the above Text and choose the Appropriate FONT, SIZE, BOLD & CENTRE ALIGNMENT, etc.,
17. Position the Mouse Pointer in the 3rd Column of the TABLE
18. Select IMAGE option from the INSERT MENU
19. Click on SELECT A FILE ON YOUR COMPUTER Icon at the URL Dialogue BOX
20. Choose **C:\SUSAGRI** folder

21. Select the File Name : **na01441\_.gif**
22. Click OK button
23. At the Bottom of the Table type Text as : **CONTENTS**
24. Position the Mouse Pointer at the Bottom of the Screen &
25. Select IMAGE option from the INSERT MENU
26. Click on SELECT A FILE ON YOUR COMPUTER Icon at the URL Dialogue BOX
27. Choose **C:\SUSAGRI** folder
28. Select the File Name : **FRONTPAGELOGO.gif**
29. Click OK button
30. Select SAVE option from the FILE MENU and
31. Type the File Name that is URL as : **INDEX.HTM**
32. Type the Tile Name that is : **Sustainable Agriculture**
33. Click on OK button
34. Again Click on OK button
35. Select CLOSE Option from the FILE Menu

### **Exercise –III** Creating Framed Pages

#### **Objectives**

1. Activate Front Page Editor
2. Select NEW option from the FILE menu
3. Click on FRAMES and
4. Select CONTENTS option from the NEW Displayed Window
5. Click on OK button
6. Position the Mouse pointer on the NEW PAGE Option of the Left Side FRAME &
7. Click the Left Mouse Pointer
8. Type the following CONTENTS :
  - OBJECTIVES
  - INTRODUCTION
  - GLOBAL CRISIS
  - SUSTAINABLE DEVELOPMENT
  - SUSTAINABLE AGRICULTURE
  - INDICATORS OF UNSUSTAINBLE AGRICULTURE
  - STRATEGIES FOR SUSTAINABLE AGRICULTURE
  - QUIZ
  - EMAIL
  - HOME
1. Click on SET INITIAL PAGE option from the Right Side Displayed Frame
2. Select file : **Index.htm**
3. Click on OK button
4. Click on SAVE Option from FILE MENU
5. Type the File name as : **Content\_Frame** at URL Dialogue Box for the contents page of the Left side FRAME
6. Type the Title as : **Contents**
7. Click on OK button
8. Again the Type the FILE NAME as : **WELCOME\_PAGE** at URL Dialogue Box on the Displayed SAVE AS Screen
9. Type the Title as : **WECOME**

## Exercise - IV

- Create a Hyperlink to **Objectives**

1. Block the OBJECTIVES in the Contents Frame Page
2. Select HYPERLINK Option from the INSERT MENU
3. Click on MAKE HYPERLINK TO A FILE ON YOUR COMPUTER at the URL Dialogue Box
4. Choose **C:\SUSAGRI** folder
5. Select the File Name : **Objectives.htm** from the displayed list in the URL Dialogue Box
6. Click OK button

- Create a Hyperlink to **Introduction**

7. Block the INTRODUCTION in the Contents Frame Page
8. Select HYPERLINK Option from the INSERT MENU
9. Click on MAKE HYPERLINK TO A FILE ON YOUR COMPUTER at the URL Dialogue Box
10. Choose **C:\SUSAGRI** folder
11. Select the File Name : **Introduction.htm** from the displayed list in the URL Dialogue Box
12. Click OK button

- Create a Hyperlink to **Sustainable Development**

13. Block the SUSTAINABLE DEVELOPMENT in the Contents Frame Page
14. Select HYPERLINK Option from the INSERT MENU
15. Click on MAKE HYPERLINK TO A FILE ON YOUR COMPUTER at the URL Dialogue Box
16. Choose **C:\SUSAGRI** folder
17. Select the File Name : **SUSTAINABLE\_DEVELOPMENT.htm** from the displayed list in the URL Dialogue Box
18. Click OK button

- Create a Hyperlink to **Indicators of Unsustainable Agriculture**

19. Block the INDICATORS OF UNSUSTAINABLE AGRICULTURE in the Contents Frame Page
20. Select HYPERLINK Option from the INSERT MENU
21. Click on MAKE HYPERLINK TO A FILE ON YOUR COMPUTER at the URL Dialogue Box
22. Choose **C:\SUSAGRI** folder
23. Select the File Name : **Indicators\_of\_un\_sustainable\_agr.htm** from the displayed list in the URL Dialogue Box
24. Click OK button

- Create a Hyperlink to **Strategies for Sustainable Agriculture**

25. Block the INDICATORS OF UNSUSTAINABLE AGRICULTURE in the Contents Frame Page
26. Select HYPERLINK Option from the INSERT MENU
27. Click on MAKE HYPERLINK TO A FILE ON YOUR COMPUTER at the URL Dialogue Box
28. Choose **C:\SUSAGRI** folder

29. Select the File Name : **Strategies\_for\_sustainable\_agric.htm** from the displayed list in the URL Dialogue Box
30. Click OK button

- Create a Hyperlink to **Email**

31. Block the word Email
32. Select HYPERLINK Option from the INSERT MENU
33. Click on MAKE HYPERLINK TO THAT SENDS E-MAIL at the URL Dialogue Box
34. Type AN E-Mail Address : mnreddy@naarm.ernet.in
35. Click on OK button
36. Click on OK button

- Create a Hyperlink to **HOME**

37. Block the HOME in the Contents Frame Page
38. Select HYPERLINK Option from the INSERT MENU
39. Select File name as : WELCOME\_PAGE.htm
40. Click on OK button

### Exercise - V

#### Create Book Marks and Hyperlinks

- Create a Book Marks to : **Global Crisis**

1. Active Front Page Editor
2. Select OPEN Option from the FILE MENU
3. Click on FILE ON YOUR COMPUTER at the URL Dialogue Box
4. Choose **C:\SUSAGRI** folder
5. Select the File Name : **Land\_degradation\_index.htm** from the displayed list in the URL Dialogue Box
6. Click on OK button
7. Block the word GLOBAL CRISIS
8. Select BOOK MARK Option from the EDIT MENU
9. Keep the BOOK MARK name as : GLOBAL CRISIS
10. Click on OK button
11. Position the Mouse Pointer on the side heading of the : Land Degradation Paragraph
12. Block the word LAND DEGRADATION
13. Select BOOK MARK OPTION from the EDIT MENU
14. Keep the BOOK MARK name as : LAND DEGRDATION
15. Click on OK button
16. Position the Mouse Pointer on the side heading of the : Depletion of Ground Water Resources Paragraph
17. Block the word : Depletion of Ground Water Resources
18. Select BOOK MARK OPTION from the EDIT MENU
19. Type the BOOK MARK name as : Depletion
20. Click on OK button
21. Position the Mouse Pointer on the side heading of the : Deforestation Paragraph
22. Block the word : Depletion of Ground Water Resources
23. Select BOOK MARK OPTION from the EDIT MENU
24. Keep the BOOK MARK name as : Deforestation
25. Click on OK button

In Similar way, Create book marks for the following paragraphs ;

- Loss of Biodiversity
- Climate Change
- Excessive use of Pesticides
- Population Growth

Create a Hyper Links to : **Global Crisis**

1. Block the Word Land Degradation
2. Select HYPERLINK Option from the INSERT Menu
3. Select LAND DEGRADATION as the Book Mark option
4. Click on OK button
5. Block the Word Depletion of Ground Water Resources
6. Select HYPERLINK Option from the INSERT Menu
7. Select DEPLETION as the Book Mark option
8. Click on OK button
9. Block the Word Deforestation
10. Select HYPERLINK Option from the INSERT Menu
11. Select Deforestation as the Book Mark option
12. Click on OK button

In Similarly way create Hyperlinks for the following bookmarks

- Loss of Biodiversity
- Climate Change
- Excessive use of Pesticides
- Population Growth

13. SELECT SAVE AS Option from the FILE MENU
14. Click on OK button

**At the Each end of the Paragraph Insert Image Name : UP\_HAND.jpg and give Hyperlink to Top of the Page that is GLOBAL CRISIS.**

1. Position the Cursor End of the **Land Degradation** of the Paragraph
2. Select IMAGE option from the INSERT MENU
3. Click on SELECT A FILE ON YOUR COMPUTER Icon at the URL Dialogue BOX
4. Choose **C:\SUSAGRI** folder
5. Select the File Name : **UP\_Hand.jpg**
6. Click OK button to Insert the Image
7. Click on UPHAND Image
8. Select HYPERLINK Option from EDIT Menu
9. Select GLOBAL CRISIS as the Book Mark option
10. Click on OK button

In similar way Create navigational link (UPHAND IMAGE) at the end of all other remaining Paragraphs

11. SELECT SAVE AS Option from the FILE MENU
12. Click on OK button
13. Select CLOSE Option from the FILE menu

1. Select OPEN Option from the FILE menu
2. Select WELCOME\_PAGE.htm in the URL dialogue box
3. Click OK button

- Create a Hyperlink to **Global Crisis**



1. Block the word GLOBAL CRISIS in the Contents Frame Page
2. Select HYPERLINK Option from the INSERT MENU
3. Click on MAKE HYPERLINK TO A FILE ON YOUR COMPUTER at the URL Dialogue Box
4. Select the File Name : **Land\_Degradation\_Index.htm** from the displayed list in the URL Dialogue Box
5. Click OK button
6. SELECT SAVE AS Option from the FILE MENU
7. Click on OK button

### Exercise - VI

#### Self Learning Practice for Book Marks and Hyper Links

1. Open the File : **Sustainable Agriculture.htm** from the folder **C:\SUSAGRI**
2. Create a BOOK MARKS for the following :
  - Successful
  - Management
  - Resources
  - Changing Human Needs
  - Maintaining the quality of environment
3. Create Hyper links to the above BOOK MARKS
4. Create a Hyperlink to **SUSTAINABLE AGRICULTURE** in the Main Page

## IMAGES USING FRONT PAGE

### N. Sandhya Shenoy

Faculty member

One reason for the popularity of the World Wide Web is that it quickly and easily enables to include graphic images in the web pages.

In Front page you can import images to web, insert images in pages, and create image maps.

Image maps are the images that contain hyperlinks (hotspots)

Front page also uses clip art, pictures, icons, buttons, and background patterns

### Image Types

Images that are used in the web pages are of two types.

1. GIF ( Graphics Interchange Format) - The files with .gif extension
2. JPEG ( Joint Photographic Expert Group) format - the files with .jpg extension

## **Re-sizing Image**

Resizing of images according to the need is possible. Frontpage software provides option for automatically generating the image Thumb nail. For this, Select the image, click thumbnail option button on the image toolbar.

The images also can be re-sized (increased or reduced) according to the specific needs. This custom resizing is possible by selecting the image, picking the 'image sizing handles' that are activated from any corner and drag the image to the desired size.

The 'image sizing handles' need to be operated only from the corners to avoid distortion of the image.

## **Alignment Options**

Centre - Aligns image to the centre of the text

Left - Places the image against the left margin and wraps the adjacent text down the image right side.

Right - Places the image against the right margin and wraps the adjacent text down the image left side.

Text top - Aligns the top of the image with the top of the tallest text in the current line of text

Base line - Aligns the image with the base line of the current line of text

Abs bottom - Aligns the bottom of the text with the bottom of the image

Abs middle - Aligns the bottom of the text with the middle of the image

For these options, select the image, right click on the image to get the 'image properties' dialogue box, select Appearance tab and select the option.

## **Spacing the Image**

The vertical and horizontal spacing can be changed by entering an amount in pixels (eg 30, 40) in the horizontal or vertical spacing boxes.

Horizontal Spacing - Entering an amount of pixels in the horizontal spacing box sets the horizontal spacing between the image and the nearest text or image on the current line.

Vertical Spacing - Entering an amount of pixels in the vertical spacing box sets the vertical spacing between the image and the nearest text or image on the current line.

For this, Select the image, right click on the image to get the 'image properties' dialogue box, select Appearance tab and enter the values in the horizontal and vertical text boxes.

## **Alternative Representation**

Provide alternate text for every image you use.

'Alternate Text' appears in the place of image, if the user's browser cannot display the images.

This is very useful when the browser's image viewing capabilities are turned off or when the browsers that users use don't support images or when there is a very slow connection to the internet.

For this, Select the image, right click on the image to get the 'image properties' dialogue box, select 'General' tab and under the "Alternate representations" type the description of the image in the text box. When the image doesn't appear on the screen, the text would indicate about the image.

### Altering Images

Washed out Option - This option enables to display light coloured image. You can make such image as a backdrop to the text. For this effect, select image, click on the image toolbar on the wash out button to get the effect.

Black and White Option - This enables to change a colour image to the black and white image. For this effect, select image, click on the image toolbar on the Black and white option button to get the effect.

Bevel option - It displays the image as though they were raised on the page. This is useful for the images you want to use as links( Image maps). For this effect, select image, click on the image toolbar on the bevel option button to get the effect.

### Making Images Transparent

Transparency enables to blend images into background colour of the web page.

If a single colour of an image is denoted as transparent, that colour doesn't appear and the background colour of the web page is displayed in its place.

It is useful to blend the image into the web page.

### Image Maps

Image maps are those images that have embedded hyperlinks. The specific area or location in which the hyperlink is embedded on the image is called the "Hot spot". Any image can be hot spotted. When a hotspot is clicked on , it takes to the target page or image or audio file according to the hyperlink. To hotspot an image, select the image, click on the hotspot button options (rectangle, circle, polygon), select the location in the image to be hot spotted, place the mouse on the location and drag or mark the hotspot area. Then automatically the 'Create hyperlink' dialogue box appears. Browse the file for the internal links, and select the target file and click OK. For the external links type the URL in the 'Create hyperlink' dialogue box.

To create hyperlink to the image, Select the image, right click on the image to get the 'image properties' dialogue box, enter the URL in the location text box. Images used as links don't display colour or underline as in the text. A well-designed image hyperlink gives the user clues about where each hyperlink will take them.

After selecting all the options and making the links, Click the preview in the browser, choose view, options, check show picture and click OK. Click the refresher button and test the image based links.

## CREATING IMAGES USING FRONT PAGE

### **Exercise - 1**

Convert all the files with the extension **.jpg** in **rice pests** folder as **.htm** files

#### **Steps :**

##### **Activate Front Page Editor**

open **New Page**

Insert Image

Browse in **rice pests folder** and select a .jpg file

Click OK

Click the mouse pointer below the image

Type **BACK** on the page (justify to right)

Save the file keeping the same title.

**Repeat the process** for all the .jpg files in the **rice pests** folder

### **Exercise – 2**

#### **Gall midge**

Open **gall midge diagnosis.htm**

**Insert Image ( gallmidge adult.jpg here and align right)** Gall Midge ([Orseolia oryzae](#)) is also a major pest of rice. Adults are like mosquitoes. The female gallmidge has orange coloured abdomen. Adults are active at night. Late planted rice gets severely infested with this pest. If the infestation occurs in nursery, the midge may complete several life cycles before panicle initiation. When the infestation is severe, the plant becomes stunted and bushy. The vegetative phase is prolonged and flowering is delayed.

The characteristic damage symptom of the Gall midge is the **Silver Shoot**

**(Select the words Silver shoot and hyperlink to gallmidge silvershoot symptom.htm)**

The silver shoot resembles an onion leaf or a tubular gall. Tillers with galls don't produce panicles. The larva feeding the primordium( growing point) causes irritation and the tiller develops as gall.

#### **Home**

(Select the word Home and hyperlink to Diagnosis of rice pests.htm)

### **Exercise - 3**

#### **Green leaf hopper**

Open **green leaf hopper diagnosis .htm**

**(Insert Image green leaf hopper adult.jpg here, bevel the image and align left)**

The Green Leaf Hoppers (Nephotettix spp) suck the plant juice and cause damage. Adults are bright green in colour with variable black markings on their wings. They cause extensive damage as vectors for the viral diseases such as 'Rice Tungro Virus'.

**Type the words "Click to see the Rice Tungro Virus damage" on the adult Green Leaf Hopper**

**(Select the Image, select rectangular or circular Hotspot drag over one Green Leaf Hopper, and hyperlink to Rice Tungro Virus.htm)**

**Home**

**( Hyperlink the word Home with Diagnosis of Rice diseases.htm)**

### **Exercise – 4**

#### **Stem borer dead heart Symptom**

Insert **stem borer dead heart.jpg** here.

(Type "**Click here to see stem borer larva**" on the Image and give appropriate colour to be visible on the Image

(Select the Image, Hotspot Dead heart and link to **stem borer larva.htm**)

**Back**

Hyperlink the word Back to stemborer diagnosis.htm

### **Exercise - 5**

#### **White Backed Plant Hopper**

**(Insert Image white backed plant hopper adult.jpg here and align left)**

White Backed Plant Hopper ( Sogatella furcifera) occurs along with Brown plant hopper. Only females are short winged. Nymphs are white in colour to strongly mottled dark grey or black or white. Adults have a white stripe on their back.

It rarely causes the 'Hopper burn' as their populations usually decline by flowering.

White Backed Plant Hopper (Sogatella furcifera) occurs along with Brown plant hopper. Only females are short winged. Nymphs are white in colour to strongly mottled dark grey or black or white. Adults have a white stripe on their back.

It spreads Grassy stunt Virus as a vector.( **Select the words Grassy stunt virus and hyperlink to Grassy stunt virus.htm Hyperlink the word Back to White backed plant hopper diagnosis.htm, save it and close it. )**

### **Exercise - 6**

#### **Exercise for the HOME page - Diagnosis of Rice Pests.htm**

Insert Table with 2 columns and 8 rows. Merge cells in first row for Title. Select the rightside column and merge all cells.

Type **Diagnosis of Rice Pests** title and make appropriate size and centre the title. Merge the two cells of the table for the title.

Insert insects images (.jpg files) and type the pests name in all rows. Hyperlink each pest name to its respective .htm page

Stem borer

Gall midge

Merge all cells in the right side

Insert week.jpg here

Type on the image, click to hear me. Hyperlink these words to sandhya video mail .exe file

Below the image, type

*For further details on rice production see*

*Rice Web (Hyperlink the words Rice Web to the URL <http://www.riceweb.org>)*

## CREATING INTERACTIVE LESSONS USING FRONT PAGE

### Images – Exercises - Part – II

#### Exercise - 1

Convert all the files with the extension .jpg in **rice pests** folder as .htm files

**Steps :**

**Activate Front Page Editor**

open **New Page**

Insert Image

Browse in **rice pests folder** and select a .jpg file

Click OK

Click the mouse pointer below the Image

Type **BACK** on the page ( justify to right )

Save the file keeping the same title.

**Repeat the process** for all the .jpg files in the **rice pests** folder

#### Exercise - 2

**Gall midge**

Open **gall midge diagnosis.htm**

**Insert Image ( gallmidge adult.jpg here and align right)** Gall Midge ([Orseolia oryzae](#)) is also a major pest of rice. Adults are like mosquitoes. The female gallmidge has orange coloured abdomen. Adults are active at night. Late planted rice gets severely infested with this pest. If the infestation occurs in nursery, the midge may complete several life cycles

before panicle initiation. When the infestation is severe, the plant becomes stunted and bushy. The vegetative phase is prolonged and flowering is delayed.

The characteristic damage symptom of the Gall midge is the **Silver Shoot**

**(Select the words Silver shoot and hyperlink to gallmidge silvershoot symptom.htm)**

The silver shoot resembles an onion leaf or a tubular gall. Tillers with galls don't produce panicles. The larva feeding the primordium( growing point) causes irritation and the tiller develops as gall.

**Home**

(Select the word Home and hyperlink to Diagnosis of rice pests.htm)

### **Exercise - 3**

#### **Green leaf hopper**

Open **green leaf hopper diagnosis .htm**

**(Insert Image green leaf hopper adult.jpg here, bevel the image and align left)**

The Green Leaf Hoppers (Nephotettix spp) suck the plant juice and cause damage. Adults are bright green in colour with variable black markings on their wings.They cause extensive damage as vectors for the viral diseases such as 'Rice Tungro Virus'.

**Type the words "Click to see the Rice Tungro Virus damage" on the adult Green Leaf Hopper**

**(Select the Image, select rectangular or circular Hotspot drag over one Green Leaf Hopper, and hyperlink to Rice Tungro Virus.htm)**

**Home**

**( Hyperlink the word Home with Diagnosis of Rice diseases.htm)**

### **Exercise - 4**

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Insert **stem borer dead heart.jpg** here.

(Type "**Click here to see stem borer larva**" on the Image and give appropriate colour to be visible on the Image

(Select the Image, Hotspot Dead heart and link to **stem borer larva.htm**)

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Gall midge

**Merge all cells in the right side**

**Insert week.jpg here**

**Type on the image, click to hear me.** Hyperlink these words to **sandhya video mail .exe file**

**Below the image, type**

***For further details on rice production see***

***Rice Web (Hyperlink the words Rice Web to the URL <http://www.riceweb.org>)***



# **MULTIMEDIA**

**K.M. Reddy**  
Principal Scientist

During the last decade, there have been dramatic technological changes in information technology especially in computing & communications. We have witnessed the advent of personal computers, worldwide packet networks, optical disks and other mass storage media, interactive video technology, imaging technology, digitizing and scanning technology, computer graphic technology, and the growth in massive public and private databases. This situation will continue at an even faster pace in future and there is no turning back.

## **BACKGROUND AND HISTORY**

The concept of mixed media or multimedia existed well before the advent of the computer. Though many people even today think of the computer mainly as a number-cruncher, early visionaries like Vannevar Bush already saw its future role as an information and media processing powerhouse in the 1940s. In his famous 'As we May Think', published in the July, 1945 issue of Atlantic Monthly, he advocated mechanizing scientific literature by a device called 'memex'.

Bush's idea inspired two people about twenty years later – Douglas C. Englebart of the Stanford Research Institute who developed a system for knowledge workers, called NLS (online System) in 1963, which embodied many original ideas and concepts of hypertext, including windows, the mouse, electronic mail, and a hypertext-like ability to link and annotate documents, and Ted Nelson of Xanadu who coined the word 'hypertext' in the 1960s, which he described as non-sequential reading and writing that links different nodes of the text.

## **HYPERTEXT AND HYPERMEDIA / MULTIMEDIA**

Hypertext mimics the brain's ability to access information quickly and intuitively by reference. At the basic level, a hypertext system is a database management system which permits one to connect screens of information using associative links. At the more sophisticated level, a hypertext system has a software environment which supports collaborative work, communication and knowledge acquisition.

Hypertext is the forerunner of multimedia / hypermedia. The concept of hypertext was brought down to the 'household' level only after the introduction of Apple's HyperCard in 1987. Using HyperCard, one can create links in a given work – an electronic book, multimedia presentation etc. which can be explored in a non-linear way. Then, when users are reading or exploring, they can click on icons to zoom to related topics which may be in the same file or in another one.

Hypermedia extend the hypertext concept to link textual material to all other forms of material – graphics, image, video, animation and sound – that may be digitally encoded for storage and retrieval through computer – based systems. As early as 1988, Casa Bianca (1988), in his attempt to publish a hypertext like journal, Hyper – Media, graphically presented a typological framework of hypermedia in what he called HyperMedia Map. He used graphic icons, to illustrate how the world's communications media – audio,

audiovisual, film, music, video – have been incorporated with computers, communication networks, publishing and information resources, 3 – D graphics, design and system management to enable us to provide multimedia / hypermedia information in a new, global, 'wired society'.

'Multimedia technologies' are not one single technology, and there is no single product, or definable market. The term refers to technology integration through the use of multimedia tools. A simple working definition of multimedia is as follows.

Multimedia extends the hypertext concept of non-linear and non-sequential links of textual material to all forms of material that may be digitally encoded for storage and retrieval through computer-based systems, including images, sound, graphics and animation ... Thus, multimedia refers to a synthesis of text, data, graphics, animation, optical storage, image processing and sound.

## **MULTIMEDIA TOOLS AND TECHNOLOGY**

*Input and output technologies : hardware and software for digital data, sound, image, video and films*

Librarians and libraries everywhere who are still handling largely printed materials will want to supplement the printed information with more dynamic sound, music, graphics, animation, photography and video, all of which can now be fed into an ordinary computer where they can be cut, changed, shaped, combined, manipulated, enhanced and reconstructed into all kinds of exciting information products. In order to benefit from the current multimedia environment, one needs to know the multimedia tools available in the market – place so that they can be used to bring multimedia to the desktop.

*Hardware and Software for users of Multimedia*

Currently the market – place is full of multimedia products, as shown by the thousands of titles on different subject topics in the form of multimedia CD-ROM titles. Because more and more products have incorporated rather large number of images, sound and digital videos, much more powerful hardware than the *bare minimum* requirement for a PC system will be required :

- κ 80386 CPU
- κ EGA / VGA or VGA A Plus Graphics
- κ 2 MB RAM
- κ Double – speed CD – ROM Drive
- κ Microsoft Windows 3.1

The general rule is that whenever possible, one must try to acquire a system with as much speed, hard disk space and RAM as possible. For example, some products will run properly only with a 486 or Pentium processor with at least 16 MB of RAM and a four speed CD – ROM drive. The unfortunate fact is that most multimedia application products are developed for users with the higher – end systems, and few have kept the low – end systems users in mind.

## ***Multimedia Productions Tools***

Till couple of years ago, producing multimedia applications was generally difficult, since most multimedia production tools were either not readily available or simply too expensive for general use. But fast technological development has made it possible for many to consider producing their own multimedia applications now. To facilitate librarians' use of these tools for production purposes, those for both Macintosh and PC systems are included below. Although Macintosh tools are often preferred for the development of multimedia applications, they might not be readily available in developing and less developed countries.

There are simply too many multimedia production tools to cover all adequately. The following are selective tools in some distinctive categories.

### ***Animation***

The best known animation tool is Macromedia's Director 4.0 which is available for both Mac and Windows. Macromedia's Director is a powerful animation and authoring tool. Users can create, combine and synchronize graphics text and animation with audio and video; add full interactivity with buttons and scripts; export and import QuickTime movies, etc. Other notable software includes Adobe's Premier 4.1 , Avid's VideoShop 3.0 for Mac, and Gold Disk's Animation Works Interactive 2.0 for PC.

### ***Clip Art and Photography***

In this category, Photo – CD technology has been utilized fully by most producers to store about 100 images of clip art and photographs on almost every subject for both Mac and PC platforms. Of international interest, Educorp's International Graphics Library is a CD with 32 – bit QuickDraw images . These clip art images can be copied and pasted on multimedia applications. More clip art CDs can be found in various software catalogues.

### ***Development Tools***

There are over fifty development tools for multimedia authoring and digital publishing. For Macintosh, the most noteworthy is HyperCard (current version is 2.3). Other popular ones include Macromedia's Authorware 3.0 for both Mac and Windows, the Voyager Co.'s Expanded Book Toolkit and SuperCard 3.0 . Other PC systems include Aim Tech's IconAuthor and Motion Works' MediaShop and TookBook .

### ***Drawing and Painting***

Most noteworthy in this category are Adobe's SuperPaint 3.5 . This is a powerful illustration and design tool that simplify the creation, manipulation and refinement of artwork with advanced features for editing, text handling, colour support and more.

### ***Image Processing***

Adobe's Photoshop for both platforms (Photoshop 3.03 for Mac) is the most powerful image processing tool. It lets users design artwork with a wealth of powerful painting and

selection tools, or retouch and correct true colour or black and white scanned images with image editing tools and filters. Aldus PhotoStyler 2.0 for Windows is also a popular tool for PCs.

### ***Media Catalogues***

A number of tools are available for organizing and quickly retrieving digital photos in categories. Adobe's Fetch 1.2 , Inspace System's Kudo Image Browser and Kodak's Showbox fall into this category for Mac, while Electronic Imagery's Image Manager and Lenel Systems' Media Organizer are for PC users.

### ***Modelling and Rendering***

Many powerful tools are available in the market-place for creating photo-realistic computer images and animation at an affordable price (under US \$1,000) for the type of sophisticated work that was possible only with mainframe and minicomputers a few years ago. Some powerful tools are Specular International's Infini-D 3.0 , Strata Inc's Strata Virtual for real – time renderer, Macromedia's Swivel 3D Professional 2.0.4 (Fig.6) and Virtus Corp.'s Virtus VR . Tools from Strata and Virtus are for both Mac and PC Systems.

### ***Music Software***

Music is an important element of a multimedia production. Various tools are available as a MIDI (Musical Interface for Digital Instruments) sequencer, editor and performance tool that provides multitrack recording, precise editing of all musical events, etc. These include Unicorn's Performer 5.02 and Opcode Systems' Vision 2.0 for Mac, Midisoft's Studio for Windows and Turtle Breach Systems' Wave for Windows for PCs. Digi-Design's Sound Tool consists of a sound accelerator card and Sound Designer II (software) which allow hours of CD – quality sound to be recorded on to a hard drive and edited with unparalleled precision.

### ***Optical Character Recognition***

For multimedia applications, it is important to have effective tools to turn hard-copy printed texts into digital word-processing files. Optical Character Recognition (OCR) software is very useful for this process. An outstanding example is Caere's OmniPage Professional which is an advanced OCR solution available for both Mac and PC. Another competitive OCR software for Windows is Xerox's TextBridge Pro 96 .

### ***Presentation and Video – Editing Software***

Many high – powered software tools are available for on-screen animation presentations with motion, sound and QuickTime, and flexible non-linear editing systems for Mac. For presentation purposes, Gold Disk's Astound and Adobe's Persuasion 3.0 are powerful graphic and digital video software that will produce or deliver data-intensive multimedia presentations. Macromedia's Director 4.0 , Adobe's Premier 4.1 , and Avid's VideoShop 3.0 are powerful tools providing an economic means of professional video editing. Director and Premier are available for both Mac and PC systems. Other PC desktop presentations include Motion Works CameraMan , Eduquest's Linkway 2.01 and Linkway Live ! , Lenel Systems' MultiMedia Works , and IBM's Storyboard Live ! 2.0 .

## ***Special Effects***

Like clip art and photographs for fast and easy use of still images, there are many clip media products available for immediate use of ready digital videos, such as Macromedia's ClipMedia with professional animation, sounds and videos arranged on CD-ROMs in various subject categories. Many products, like Olduvai Corp's Sound Clips 1.0 , feature an average of 100 sounds per volume.

In addition, software tools are available for producing special effects for multimedia production. One of the most used is Gryphon's Morph 2.5 for Mac, which smoothly transforms one image into another with dynamic morphing. Gallery Effect 1.51 is another tool that transforms scanned photographs and other bit-mapped images into works of art. The counterpart of Griffin's Morph for PC is North Coast Software's PhotoMorph 2 , which allows users to combine and apply sophisticated special effects to bit-map images and AVI video clips, with features for desktop video, including motion morphing.

## ***Multimedia Peripherals***

Multimedia requires hardware and software power and speed as well as special capabilities to capture sound, image and video. Thus, peripheral devices which can accelerate any process as well as performing any of the capturing functions are essential. In addition, because all multimedia elements will consume a large quantity of memory and storage space, there will be a need to look into those peripherals that can double memory as well as compress and decompress multimedia files. The following are samples of peripherals which are worthy of consideration.

## ***Accelerators***

Many accelerators and chargers, such as DayStar Digital's Image 040 , can accelerate imaging functions up to 600%. Unfortunately these boards are generally quite expensive (over US \$ 1,000) and are intended for high-end operation.

## ***Audio / Video Controllers***

IBM's M-Motion Video Adapter / A for PS/2 can receive and process analogue signals from multiple external video and audio sources, and then send them to a monitor and external speakers for immediate viewing / listening in multimedia application settings. In this way, a PC can be connected directly to an analogue videodisk device and grab the analogue videos directly to integrate into multimedia applications. The Creative Lab's Sound Blaster 16 boards for PCs provide rich CD – quality stereo sound for multimedia, education, business, home and entertainment applications at affordable prices.

## ***Digital Cameras***

In the last couple of years, several reasonably priced high performance digital cameras have been introduced. Apple, Canon, Kodak and others have produced such digital image capture devices at a cost ranging from \$350 to over \$1,000. One should acquire cameras only after studying carefully their need for digital images. These digital cameras can be connected to hardware systems using any platform. Most digital cameras function like regular cameras and therefore are mainly for capturing individual images. Other type of digital cameras which can capture both colour pictures and videos becoming quite popular

include VideoLab's FlexCam and Connectrix's QuickCam . These are compatible with all leading video digitizing boards. Each is an integrated colour camera and microphone and can produce video output in both NTSC and PAL.

### ***Digitizers and Frame Grabbers***

In addition to software, built-in hardware capabilities or addition digitizers and frame grabbers are required for real-time digitizing of sound, images and video. For example, Macromedia's MacRecorder Sound System includes both the digital sound recorder hardware and SoundEdit software for users to record, edit and play back live or pre-recorded sounds on a Macintosh. Digital frame and video grabbers are abundant in the market-place. For example, Radius' SpigotPower AV provides full-screen, full-motion capture and playback of interlaced and non-interlaced JPEG video. It is able to capture and save full 24-bit colour data. Creative Labs' Video Blaster boards of different models can bring full-motion video sequences at up to thirty frames per second. Generally one connects the television video recorder, and / or video camera to these boards.

### ***Scanners***

Scanners are essential for turning hard-copy texts, pictures in both positive and negative forms and films into digital files. Different types of scanners available include :

- + Flat-bed scanners, such as Microtek's ScanMaker II and III models, that convert printed and artwork to digital files. For example, the ScanMaker III is a 36 – bit colour high – resolution flat-bed scanner up to 1,200 dpi. Generally, a scanner with at least 300 dpi can be quite effective for multimedia application development. Higher resolution drum scanners are generally too expensive (some are over \$35,000) for general – purpose use.
- + Slide Scanners that will do the same with photographs, such as Microtek's ScanMaker 1850S .
- + Film scanners, such as Microtek's ScanMaker 35t , that can scan any 35 mm slide in 24-bit colour mode in upto 16.7million colours or in 8-bit grey-scale mode to capture up to 256 shades of grey.
- + Hand-held scanners that generally provide a low-cost alternative for producing digital images for multimedia applications. However, the resolution of these scanned images is low and the images can easily be distorted.

### **NEED FOR MASS STORAGE IN INFORMATION WORK (ARCHIVES, LIBRARY AND INFORMATION SERVICES)**

Library information and archival work generally deals with very large quantities of information. Regardless of whether information sources are in printed or electronic formats, space is always a key issue. Mass storage is required to meet :

- The need for a large – volume digital storage system for archival management.
- The need to provide users with immediate access to the rapidly growing volume of data and information that is stored in digital information systems and is likely to be distributed on optical media in the future.
- The need to provide users with access to multimedia information quickly and interactively through the integration of technologies.
- The need to transfer a large volume of data and / or files from one system to another.

### ***Various Technologies available for Mass Storage***

Traditionally libraries have used conventional media like film, microfilm and microfiche to store information which are bulky and expensive. With the advent of computer and optical technologies, mass storage has shifted mostly to electronic media. There are several technologies available for mass storage on magnetic tapes, high-density floppy disks, portable hard disks with a capacity of over 2 GB, and optical disks. But it is optical media that are the primary ones for mass storage.

### ***Storage Media : Optical Disks, CD-ROM, etc.***

Various types of optical media offer different storage densities, media formats, transfer rates, capabilities and compatibility among commercial vendors' products. In the last decade alone, a flood of new media and applications – CD-ROM, laser videodisks, write-once and read-many devices, erasable disks – have been introduced, promoted and utilized. There is a wide range of optical alternatives available to provide the highest application flexibility to end-users.

### ***Optical media can be grouped into 3 major categories :***

- 2 Read-only media.
- 2 Write-once and read-many.
- 2 Erasable.

**Under each of these major categories, number of optical storage media can be found [Chen, 1989]. All of them are useful for multimedia application developments.**

### ***Drive and Interface***

Each different kind of optical media requires an appropriate drive to be connected to a microcomputer system.

### ***Videodisk Players***

Multimedia CD-ROMs have become popular products in recent years. Earlier, interactive videodisks were the popular means of presenting multimedia applications. Even today, some applications still choose videodisks as end products if quantities of still and moving images are large. For example, one side of a videodisk can store 58,000 still images and thirty minutes of video in dual sound tracks. These are huge in comparison to what can be stored digitally on a multimedia CD-ROM even with high-ratio compression. Major manufacturers of videodisk players are Philips, Pioneer and Sony. Each has produced several different models with different playing speeds, and some with the capability of playing both NTSC and PAL disks.

### ***CD-ROM Drives***

The CD – ROM drive is currently the most popular device used to play regular CD-ROMs and Photo-CDs as well as multimedia CD-ROMs. Speed is one of the most significant considerations when acquiring such a drive. In order to run a multimedia CD-ROM, the

minimum requirement is a double-speed (2X) drive. However, 24 – speed and even 32 – speed are available in the market.

### ***CD Recorders***

WORM and erasable drives are essential for mass storage, publishing and back-up of multimedia development materials. Earlier WORM drives played discs generally holding 100 MB to 200 MB of data. The latest WORM CD medium is CD – R (CD – Recordable) which can stores 600 MB of data and requires a CD recorded with appropriate software to record information on the disc according to the appropriate CD standard. For example, JVC's Personal RomMaker, Kodak's PCD Writer and Philips' CDD 522 Compact Disc Recorder are only a few samples of such CD recording devices with hardware and software solutions that allows users to premaster and master their own CD – ROMs inhouse on the desktop for both PC and Mac platforms. Optical Media's TOPiX is a CD publishing system used to record information on CD. Once the information is recorded, the disc will be used in the same manner as any other CD – ROM by using a regular CD – ROM drive.

### ***Erasable Drives***

For multimedia work, no matter how big the size of the hard drive, one will quickly run out of storage space. An erasable medium is very attractive for this purpose as it can be modified and / or re-used. However, erasable optical disk technology is still not very stable, and both the medium and the drive are quite expensive. An erasable drive can cost over US \$ 2,000. Thus, one of the more popular products has been the SyQuest drive; each SyQuest cartridge can store from 44 MB to about 200 MB of data / information.

Two of the hottest products in this line now are Lomega's Zip and Zap drives, which are both easy to use and affordable. The Zip drive, which runs with its Zip disk (100 MB per disk) costs only \$199 per drive and the disk is less than \$20. The Zap drive, with a disk capacity as big as 1 GB, costs only around \$599. Many PC manufacturers are including a Zip drive as part of the regular system configuration.

### ***Multimedia Operating And File System***

#### **Multimedia Hardware and Peripherals:**

To enter the interactive multimedia world, a minimum equipment configuration should be more than the bare minimum described earlier. It should consist of the following components :

- φ A computer system with a minimum of 4 MB of RAM.
- φ A 350 MB hard disk drive.
- φ A 14.4 kbps modem (fax modem would be preferable).
- φ A double-speed CD – ROM drive.
- φ A portable videotape recorder capable of being connected to a computer output either directly or through an appropriate AV card inserted into one of the bus slots in the computer.
- φ A television monitor for use during taping and playback.
- φ A scanner.



Additional hardware in the form of an LCD display panel or LCD projection system is highly recommended.

### ***Multimedia Software***

The minimum software configuration for using multimedia products is rather low, since most products have plug-and-play capabilities with very few requirements other than the installation processes. However, the following are varying levels of software requirements for producing simple multimedia applications :

- A basic editing software package, such as those available from Adobe, Avid, Radius and others.
- An intermediate-level software system that would include all of the above plus a free standing audio editing software package, a two-dimensional modelling or rendering software package and a graphic / titling package such as Adobe Photoshop.
- An advanced – level software system that would include all the above plus an advanced – level three – dimensional modelling or rendering software package, and an authorware package for output to hard, floppy disk or to read / write compact disc.

### ***Costs and Equipment / Software***

The equipment cost varies greatly from one model to another, and from one configuration to another. Thus it is best to check with the vendors for current price information. However, it is safe to estimate that a PC Pentium multimedia system can be acquired from US \$1,500 to \$4,000, and a Macintosh Power Mac from US \$2,000 to \$5,500, depending on the system model, RAM size, hard disk size, and connected peripherals. Whenever possible, efforts should be made to acquire a system with as large a RAM and hard disk storage capacity as possible.

The cost of software also varies greatly, ranging from less than \$100 to over \$1,000. However, powerful software like Adobe Photoshop costs about \$600 and Macromedia's Director about \$900.

## **CREATING MULTIMEDIA APPLICATIONS**

The abundant multimedia tools are to be used for creating multimedia applications. Yet how one goes about developing multimedia depends on the nature of the applications and how it will be viewed and used. Although there is no multimedia development formula, the process does follow a series of basic steps which include :

- Concept.
- Content and Interface.
- Product.

### ***Planning and Design (including data preparation and processing)***

Planning and design is always the most important component of any development, regardless of whether it is technology – related or not. Usually at least half to two-thirds of project effort is devoted to this phase. In other words, the better a project is planned and

designed, the more likely it is that it will be *successful, effective, efficient and useful*. For a multimedia application, after the idea is conceived and a conceptual framework developed, the planning process will have to go into the more minute details of plans and design, so that these will lead to the successful implementation of the application development. Many questions will have to be addressed :

- └ What are the goals and objectives of the application ?
- └ Who is it intended for ?
- └ What is it going to deliver which is either not available or not sufficiently available now ?
- └ What is the deliver platform ?
- └ What multimedia elements will the application include ?
- └ What are the existing information sources and which and how will these be used for the application ?
- └ Where can help and / or contribution be found ?
- └ What is the budget for the application, and how will it be budgeted ?
- └ What are the environmental limitations ?
- └ What existing multimedia tools – both hardware and software—are required ?
- └ Who is going to do what ?
- └ How will it be published ?
- └ What is the target completion date ?

Once these questions have been addressed, the multimedia developer can deal with all the problems and issues surfacing during both the pre-production and production periods. It is important to stress the importance of project design. This includes both the application design and interface design. An application can deal with ‘gold-mine’ source materials which are rich, relevant and essential, but if the presentation is not well through out and the interactive feature of multimedia technology is not fully utilized, then the richness of the available knowledge base will not be fully exploited. On the other hand, even if the presentation of the multimedia application is well designed conceptually, it can still fail if the interface design is either poor or uninviting / confusing to the user.

### **Design Criteria for Effective Integration of Different Media**

In designing multimedia applications, it is essential to realize that the process of linking multimedia information in a hyperweb environment can be both confusing and disorienting. Multimedia functions can be classified as under.

| <i>Essential</i> | <i>Expected</i> | <i>Desirable</i> |
|------------------|-----------------|------------------|
| Integration      | Diversity       | Programmability  |
| Freedom          | Extensibility   | Orientability    |
| Flexibility      | Sociality       | Guidability      |
| Usability        | Spatiality      | Recreatibility   |
|                  |                 | Attributability  |
|                  |                 | Communicability  |

Besides many demanding technical elements that are required to put multimedia together, there is a sense of transcendentalness that occurs during the production process. While combining massive amounts of information, one commonly observes coincidences and encounters baffling developments. Great care must be taken to separate the intelligent realities from the illusions. Integrating the complex threads of interactive electronic communication requires an emphasis on the relationship between the designer / producers and their reader / listener / user / viewer. New access paths to source material and new

procedures for protection and licensing must be developed. Industry standards must emerge to facilitate diversity and universal connectivity.

### ***Preparation of Multimedia Documents***

After the planning, one has to determine what kind of information is to be included and published, and then prepare and process this information. Information sources can include all formats – textual, still images and motion videos, sounds and animation. This step involves information – gathering and preparation, and electronic management. The former determines the format to be chosen for inclusion, and the latter considers how to turn all the desired information to electronic forms and also how to manage them.

### ***Data Preparation and Processing***

#### **Data Conversion**

*Text* : The existing text information can be available in both printed and electronic forms. For the printed information, all three popular ways of conversion to an electronic format – keyboarding, imaging (scanning), and optical character recognition – will be used. For the electronic files, once the deliver platform is decided, electronic text files will have to be converted for the chosen platform.

*Images* : Hard-copy images will have to be scanned and stored in acceptable format for multimedia applications. The most popular format is JPEG, but PICT and TIFF are also popular with multimedia application software. When multimedia is moving closely with Internet and World Wide Web applications, GIF and JPEG with a very high rate of compression are preferred. Scanned images often need to be processed and enhanced by the use of software like Adobe Photoshop.

*Video*. Using the video-capturing software via a video-capturing board, one can convert video sources from television, video recorder and video camera to digital video and save them in popular format such as QuickTime movies (in both platforms), or AVI for PC applications. The standard for digital video is MPEG. Again, like the scanned images, captured digital videos will have to be edited by the use of software tools like Macromedia's Director, Adobe's Premier or Avid's VideoShop.

*Sound*. Through the use of sound recording software and sound recorder, sound sources from tapes, cassettes and video can be converted to digital sound files, which can also be manipulated and enhanced by means of existing tools. Some of them were described earlier.

### ***Data Compression for Degitized Data, Sound and Fixed and Moving Images***

Non-text files consume a large amount of storage space and this fact forces us to necessarily think about compression and decompression.

Compression is a widely employed technique to reduce the size of large files without appreciably changing the way a viewer sees the images or digital videos or hears the sounds. Once compressed, the file must be decompressed before it can be used. Compression and decompression can be accomplished by software alone or through the use of a combination of software and hardware. Compression software analyses an image and finds ways to store the same amount of information using less storage space. Compression hardware usually consists of a ROM chip with built-in compression routines for

faster operation, or a co-processor chip that shares the computing load with the computer's main processor.

There are different levels of software compression :

- σ Lossless compression : no information lost through the compression process. In this way, the file size is generally not reduced much.
- σ Lossy compressions : through the compression, some information is lost. This will reduce the file size more dramatically than the lossless one.

The most common method for compressing image is called JPEG, which is a standard way of reducing image file size that discards information which could not be detected easily by the human eye. In compressing the digital video, the standard is MPEG. MPEG is an industry standard for moving images that uses interframe compression (or frame differencing) as well as compression within frames. There are different MPEG standards, such as MPEG I, which optimizes for data rates in the 1 to 1.5 MB / sec range (the common transfer rate of CD-ROM drives and T-1 communications links), and MPEG II, which optimizes for data rates above the 5 MB / sec rate (specifically for broadcast video applications).

### **Interactivity in Multimedia Technologies**

There are many compelling reasons for using multimedia for education, training, information delivery, business, entertainment etc. First of all, the *power of pictures* is enormous. With the advent of multimedia technologies, have we been able to tap the undeniable power of visual images and other non-textual information sources. Then comes the *power of interactivity* – a concept extended from hypertext as discussed in the introductory section. Through the ages, information has been presented and absorbed in a linear fashion. Interactive multimedia brings the incredible freedom to explore a subject area with fast links to related topics.

### **DISTRIBUTION, STORAGE AND USE OF DIGITAL DATA AND DOCUMENTS**

#### **Portability**

Currently, most digital data have been stored on optical media such as CD-ROMs, CD-Rs, and Photo-CDs, and most interactive multimedia products are produced and distributed as multimedia CD-ROMs, or interactive laser disks. The portability of these products, specifically those on CD-ROMs, is great.

When multimedia applications are stored or published on an optical medium such as CD-ROM, they can be distributed easily for intra-organizational use. For a few copies, in-house CD-R technology can be used to produce the CD-ROMs. When published formally, whether commercially or not, the CD-ROMs or laser disks are mastered by companies like 3M, DMI, Philips, etc. The cost of production generally is around US\$1,000 to \$1,500, with an additional cost for each unit ranging from \$1.50 to over \$10 depending on the quantity of the order.

Commercially produced CD-ROMs are generally published and distributed much like books, and they will be properly packaged with an attractive graphically designed cover, and publicized for sale either directly from the publisher or via distributors, or both. Currently over 10,000 multimedia products have been published.

## **Use and re-use of Stored Documents**

When information source materials are in digital form and stored electronically on a *digital* medium, they can be used and re-used for any suitable purpose. They can be retrieved easily to answer an information inquiry, used to create multimedia applications, or used for resource-sharing in either a network environment or for electronic publishing on the Internet or the World Wide Web.

## **Long-Term Conservation of Electronic Data**

One must be aware of the need to back up electronic data with additional copies of floppy disks, backup tapes, Zip or Zap disks, or CD-Rs. It is important to know that though optical media, specially something like CD-ROM, tend to give an impression that they are the ultimate conservation medium with no possibility of data loss, in reality it is not the case. All electronic media have the possibility of wearing out, and thus it is important to make duplicate copies in order to avoid data loss due to wear and tear. Optical media such as CD-ROMs and laser disks should be used carefully to prevent possible scratches on the surface. Non-optical electronic media, such as magnetic tape and floppy disks, should be stored under proper temperature and humidity control.

It is important to preserve and conserve the source materials regardless of whether they are electronic or not. Most images and videos originally came from film or microfilm sources. These should be kept using the best conservation methods, since electronic image – capturing – still or moving – cannot currently produce images of as high a resolution as those on films and microfilms. Though the technologies advance, there will be need still to re-use the source materials in order to produce new images of higher resolution.

## **EMERGING TECHNOLOGIES AND FUTURE TRENDS**

As the use of multimedia will continue to expand, it is fair to expect that more tools will be introduced with more functions and at lower cost. Thus, creating multimedia applications will be easier as time goes on.

With the explosive development and use of the Internet and the World Wide Web, and the exponential growth in use of Web browsers like Netscape, we are witnessing the exciting marriage of multimedia and the Internet / World Wide Web in a way never possible before. Instead of Web publishing with mainly still images, graphics and text, now virtual reality and Web publishing with avatars are being introduced by all major companies like Netscape and Microsoft. The forthcoming versions of Web browsers, like the 3.0 version of Netscape, are filled with all kinds of features and capabilities to present digital videos, sound, animations, etc.

In addition to the increasing capability to include all types of multimedia publishing on the Web, emerging technologies will enable exciting live multimedia Internet publishing as well as real-time fast deliver of multimedia broadcasting onto the desktop. A good example of live multimedia Internet publishing is the '24 Hours in Cyberspace' event on 8 February 1996 (Arnold, 1996). On that day, Rick Smolan, producer of award-winning multimedia products such as *From Alice to Ocean* and *Passage to Vietnam*, pulled off the most ambitious Internet event ever undertaken by deploying hundred of photographers and journalists around the world to electronically transmit stories, images, videos and audio annotations onto a live, one-day Web site. In total, sixty-three photo-illustrated articles from every part of the world were electronically published for global access within twenty-four

hours. The event demonstrated the immense power of a new medium that goes far beyond the scope of television news, magazines, radio or newspapers.

Clearly this big-time project involved hundred of millions of dollars and offers us a glimpse of where the future of multimedia and Internet / World Wide Web are heading. The prospective future for libraries is equally exciting. It is clear that more than ever, libraries around the world will be able to share information resources in a way that was never possible before. It is possible now for us to have such a digital global library. Global communication makes it possible to connect national libraries from different part of the world. These national libraries become regional 'knowledge centres' which can access information from the entire global ' network of networks'. High-density optical storage in juke-boxes makes a vast increase in global collection size possible. Cutting-edge technologies such as multimedia and digital imaging are available in this high speed global network so that texts, images and even voices can be transmitted from one part of the world to another. The use of multimedia and Knowledge Navigator permit the deliver of national information, as well as information from other countries, to citizens' homes, schools and offices. In this kind of environment, printed information sources, such as books, journals and archival materials, meet a highly competitive technology. Digital information sources become essential.

As long as the resources are in digital format regardless of whether they are still images, video or sound – and are on a Web server, one can obtain this information almost instantly from anywhere in the world. A graphic directory of over thirty national library homepages around the world is available.

# **A BRIEF NOTE ON GIS AND ITS USE IN AGRICULTURE**

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GIS stands for Geographical Information System. The development GIS is considered to be a technological advancement in the area of computer modeling. During the recent years GIS proved to be an efficient tool in Agricultural Research Management and Development. Some of its well-known applications are:

- Precision farming
- Land use planning
- Watershed modeling and management
- Pest and disease modeling and management
- Irrigation modeling and management
- Resource inventory, mapping and modeling
- Characterization studies related to resources and also socio-economic aspects
- Yield forecasting
- Spatial Database management etc.

An information system can be defined as the chain of operations that takes us from planning the observation and collection of data to the use of the derived information in some decision making process. Better information helps in making better decisions. Map is also a kind of information system. For example maps showing the distribution of soil series or land use, which are made for more limited purposes are often called as thematic maps. In the late twentieth century, demands for data on the topography and specific themes of the earth's surface, such as natural resources, have accelerated greatly. The growing demands for more spatial data and for better means to analyze them can only be met by using computer software such as GIS. GIS stores the spatial information without losing its geographical reference. GIS is designed to accept large volumes of spatial data that are derived from different sources and to efficiently store, manipulate, retrieve, analyze and display these data according to some specifications.

A map is a kind of spatial information system and it is a collection of stored, analyzed data and information to be used in making decisions. If the source of information is an existing paper map then that is considered being the weakest part of the information system. The map (spatial) information should be available in computer readable digital form. GIS is a computer software which reads and stores digital maps and helps in integrating, analyzing with other tabular (numerical) data. This opens powerful new ways of looking at and analyzing data in which one can access information in the tabular database through the spatial database (map).

There are three levels at which GIS approach can be used for resource management (Harrison and Sharma 1992). The first level provides a simple inventory of current resources and their characteristics in a region. The second level deals with data management from a wide variety of sources housed within a single framework. At this level integration of different types of data such as these maps of a region showing soils, ratio of actual to potential evapo - transpiration, and topography, might be used to examine potential production of a crop in that region. The third and more advanced level involve a combination of spatial analysis and simulation models.

## **Uses of GIS**

- Different layers of spatial information such as, soils, land use, weather, hydrology, socio-economic etc., can be stored with its spatial identity;

- Thematic maps of various resources can be prepared for specific purpose quickly;
- It allows experimentation with different ways of representing the same data on maps for easy understanding and interpretation;
- It facilitates analysis of data that demand interaction between statistical analysis and mapping;
- It is a powerful spatial data-base system and allows to link various types of crop, hydrological and statistical models;
- Maps that are difficult to make by hand can be created and updated easily.

GIS is not simply a computer system for making maps, it is a powerful analytical tool for analyzing spatial data.

For any GIS application, there are five general questions that a GIS can answer.

- Where is the location?
- What is at that location?
- What are the trends and what has changed since at the given location?
- What spatial pattern exists?
- What if...? (modeling)

The first question seeks to find out the identification of the location. For example a location can be described in terms of latitude and longitude. The second questions require spatial analysis to answer. For example, soil type, type of land use, means annual precipitation etc. The third question seeks to find the changes on a specified area over time. The fourth question is more sophisticated. For example why the productivity of a particular crop yield is higher at one place compared to another? What spatial patterns are affecting the yield? To answer the fifth question the GIS has to be linked to other modeling software. For example, how the productivity at different locations varies when different land use treatments are mapped. This information will be useful to the administrators in arriving at decision in optimizing the use of resources in the point of sustainability and economic viability.

**Various activities involved in executing a GIS project is as follows:**

- Getting spatial data into GIS
- Making spatial data usable
- Getting attribute data into GIS
- Managing the data-base
- Performing geographic analysis
- Presenting the results of the analysis

**Steps involved in executing a GIS project can be summarized as follows:**

**Determine the objectives of the project:** The important issues to consider are: a) what is the problem to solve? b) How is it solved now? c) What are the final products of the project? d) How frequently might these products be generated? e) Who is the intended audience for the final products? f) Are there any other uses for this same data? These issues determine the scope and implementation of the project.

**Building the database:** This is the most critical and often most time consuming part of the project. The completeness and accuracy of the spatial database determines the quality of the analysis and final products.

**Analysis of the data:** Analysis is where the true value of GIS becomes important. A GIS efficiently performs analytical tasks that are extremely time-consuming, an even impossible to do manually. With GIS, one can test alternative scenarios simply by making minor changes in the input values. The analytical capability of GIS can be increased by linking with various computer simulation and analytical models.



**Present the Result of the Analysis:** A GIS offers many options for creating maps and reports. It is the individuals skills at summarizing and presenting spatial (map and graphic) and tabular results of analysis which effects the decision making process.

**Some examples describing the use of GIS are discussed below:**

GIS and Crop Simulation Models for Regional Productivity Management:

Regional Productivity analysis involves evaluating spatial soil and weather variability, identifying optimum crop management practices, and predicting productivity of the region under different climatic and management scenarios. This analysis can help regional planners and policy makers in delineating acreage and distribution of areas with high productivity and developing management recommendations for different crops. Lal et al., (1993) extended the scope of applicability of site-specific crop simulation models such as DSSAT to regional planning productivity and policy analysis by combining their capabilities with ARC/INFO (AEGIS). In this combined system, simulation models predicts information on yield and other crop related outputs for different homogeneous soil and weather combinations, and GIS aggregates information from individual units, displays maps, and also presents results in tabular format for the study region.

They used this system of analysis for three sites having considerable soil and weather variability. To generate yield databases for AEGIS several thousands simulations are to be made using DSSAT for a variety of management combinations for different soil and weather conditions in the study regions. The input for this type of study includes soil maps, soil survey reports, daily, precipitation, daily maximum and minimum temperatures, and solar radiation values. The results of the study by Lal et al., indicates considerable variation in optimum planting dates and yield levels under rainfed conditions. Their study successfully demonstrates the scope of applicability of site-specific models to regional planning and productivity analysis by combining their capabilities with GIS. Singh et al., (1993) demonstrated the use of GIS to investigate nitrogen fertilizer efficiency in Maharashtra state, using sorghum crop simulation model coupled with a GIS. The spatial databases of the GIS contain information on soils, weather and other inputs needed by the sorghum model. The system allows regional analyses and the output can be in terms of maps. Hence these combined tools can be used for characterizing the region, locating high yielding and problematic areas and estimating their productivity under different management strategies.

### **Management of District-wise Databases Using GIS**

Measuring agricultural growth has been one of the most extensively researched areas. Time series data at national level, state level or at district levels is being considered for this purpose. Creating this database in vector GIS such as ARC/INFO has got many advantages in understanding not only temporal trends in agricultural growth but also spatial pattern of growth. Further the tool GIS will be useful in mapping these trends on the background indicating resource characterization. For example Katyal et al (1996b) and Katyal and Narayana Reddy (1997) studied the changes in area and productivity of rainfed crops Sorghum, Pearl millet, Pigeon pea, Chickpea etc. by linking the time series district-wise data to district map of India. Further Agro-eco regions were (Siegal *et al*, 1992) overlayed.

These maps reveal the spatial trends in area and productivity of rainfed crops in different Agro-eco regions apart from temporal trends. For example from the study of Katyal and Narayana Reddy (1997) Sorghum is grown in agro-eco region (AER) numbers 2,5,6,7,8,9 and 10. The concentration is more in AER 6 followed by that of 5 and 7. Their study brings out the need for the revitalize the efforts on stabilizing and accelerating the productivity levels even in AER 6, which is the major sorghum area.

Now, more than ever, decision makers at all levels need an increasing amount of information to help them understand the possible outcomes of their decisions by integrating the data from different sources and types. Satellite Remote Sensing digital data is an useful source of resources for characterizing different productivity regions accurately at grass-root level. By importing this data to GIS and integrating other socio-economic attribute data homogeneous regions can be characterized and mapped. This helps in research planning, targeting the products of research, and assessing the impact of research and development and to support strategic research.

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# **HUMAN RESOURCES MANAGEMENT IN INDIAN NATIONAL AGRICULTURAL RESEARCH SYSTEMS - AN OVERVIEW**

India has one of the largest national agricultural research systems in the world. It consists of about 30,000 scientists, 30,000 technical staff, 60,000 administration support staff, and auxiliary staff. Among the scientists, about 7,000 are employed by the constituent institutions of the Indian Council of Agricultural Research and the rest are employed in the 28 state agricultural universities spread throughout the country. Such a large number of research and other personnel are required because India is blessed with a variety of agro-climatic conditions ranging from the frigid to the torrid, the arid to the humid, and agricultural activity at sea level upto the foot hills of Himalayas. India, thus, conducts research on all aspects of agriculture to suit this diversified agro climates in the areas of plant sciences, animal sciences, fisheries, soil sciences, engineering, social sciences, home sciences, agro-forestry, etc.

## **Components of human resources management**

The issues of human resources management can be considered under three sub heads. They are Human Resources Development (HRD), Human Resources Administration (HRA) and Human Resources Facilitation (HRF). A brief survey under all these three sub headings of the Indian agricultural research system is presented, highlighting the managerial issues such as the organization, problems and prospects.

### **1. Human Resources Development (HRD)**

The HRD is the process of helping people to acquire competencies. People need competencies (knowledge, skills, values and attitudes) to perform tasks in organizations. Higher degree of performance needs higher level of skills, and continuous development of competencies in people is necessary for organizations to achieve goals. Organizations, over a period of time, may achieve a saturation point in terms of growth. Even to maintain such levels, organizations need to sharpen the competencies of their employees to face new challenges in changing environments to maintain their survival, new growth and excellence.

The HRD activities of the Indian NARS can be categorized into three parts. These are education, training and development. The educational activity focuses on the future job and its benefits can be realized in the near future, and it can be considered as a short-term investment in terms of financial resources utilization with a medium risk level regarding its successful utilization. Training is mostly an on-the-job process and focuses on the present job whose results are for immediate utilization. In terms of financial accounting, it can be listed as an expense having very low risk regarding the benefits that will accrue from it. Development has a focus on the entire organization (as against the person focus for training and education), and its time of benefit utilization may be sometime in the distant future. Financially, it is considered as a long-term investment with a high level of risk in that, its benefits may or may not accrue to the organization.

Categorizing the HRD activities on another criteria we get two areas. One consisting of the improvement in the **technical** area and the other in the **management** area, which includes the improvement in organizational behaviour. India has mostly set in place institutions for all these three different activities of training, education and development in both the technical and managerial areas.

### 1.1. Education

The educational activities of national agricultural research system are undertaken by the 28 agricultural universities, one Central University and four deemed to be Universities of the ICAR. The deemed to be Universities are federal educational institutions. These are Indian Agricultural Research Institute (IARI), Indian Veterinary Research Institute (IVRI), National Dairy Research Institute (NDRI) and the Central Institute of Fisheries Education (CIFE). The State Agricultural Universities have established 31 polytechnical agriculture schools which award bachelors, masters and Ph. D degrees in 65 disciplines of agriculture. The total output of the country is about 11,000 graduates in agriculture, veterinary, fishery sciences, horticulture, home science and agricultural engineering. In the area of managerial education, the agricultural universities are in the process of setting up a research and education management-cum-training cell for research and education. **NAARM is the only institution in the country that awards diplomas in agricultural education technology management and shortly proposes to start another diploma programme in research management.** These two diplomas are offered in the outreach education programmes of the Academy.

### 1.2. Training

The NARS in India is fairly well equipped to organize training in all technical aspects of all the disciplines of agriculture, and also to organize training in management of agricultural research, extension education and training. However, the country does not have a well-defined training policy, wherein the training needs of the people are regularly assessed and the procedure laid down for training at regular intervals. Nominations to training programmes (technical or managerial) are generally made on an adhoc basis. Sponsoring for a training programme requires the sponsoring institutions to meet the traveling expenses and also the expenses of an allowance for board and lodging. No training fee is generally charged by the Institutions of the NARS. Any shortfall in the traveling funds in the sponsoring institutions, invariably result in axing the training nominations, as training is usually accorded the last priority for spending traveling funds. Training in technical areas is usually organized in the shape of summer institutions and special programmes, and training in the management areas is organized by NAARM. Some agricultural institutions also sponsor candidates for training in general management areas in institutions such as Administrative Staff College of India, Hyderabad, and the Indian Institute of Management, Ahmedabad, etc.

### 1.3. Development

At the macro level, the developmental activity in NARS has taken shape of the study of the organization by different commissions and committees, and also by employing consultancies for the purpose of HRD. The first commission appointed was the Royal Commission on Agriculture in 1928. Subsequently, the National Commission on agriculture was appointed by the Government of India in 1974-75. This was followed by the ICAR Review Committee in 1988. All these commissions and committees have submitted reports, which had far reaching effects. In addition to these major milestones, there have been a number of similar consultancies done by the NAARM, Administrative Staff College of India and the Indian Institute of Management on various HRD issues from time to time.

In the micro level, there are many methods or instruments available for organizations to develop themselves and their employee competencies. Some of these are: establishment of a HRD department, developing a training policy, doing role analysis, providing for mentoring, review discussions, feedback counseling, job rotation, job enrichment, career development and undertaking performance appraisal, potential development, organizational development exercises, improving communication and providing adequate rewards in the system. These HRD instruments will generate HRD processes like role clarity, performance planning, risk taking, openness, authenticity, etc., in the employees leading to more competent, satisfied and committed people. These will influence the organizational effectiveness in terms of higher productivity, lower costs and better organizational image.

## **2. Human Resources Administration (HRA)**

This area considers the issues of recruitment, placement, appraisal, compensation, and manpower planning. These are the traditional functions of the personnel department. They are very important to human resources management and without attention to these activities few organizations can continue to function effectively with satisfied manpower.

### **2.1. Recruitment**

The recruitment procedures in the Indian NARS are considerably vary at present, and there had been a number of changes in these procedures over a period of time. Taking the example of recruitment of research workers in the federal system, an insight may be obtained of the differences and changes. Recruitment was first done to the higher posts by the Union Public Service Commission (UPSC) at national level, and for the lower posts by the committees constituted at the institute level. This procedure continued up to 1965. From 1966 onwards, the recruitment was removed from the purview of the Union Public Service Commission, and was done by Committees constituted at the ICAR Headquarters in New Delhi for the senior posts and the incumbents to the junior posts continued to be recruited at the institution level by the Director of the respective institutions.

In 1975, there was a complete reorganization of the service rules and conditions and the Agricultural Research Service (ARS) of the ICAR was formed concurrently. An Agricultural Scientists Recruitment Board (ASRB) was established for the purpose of recruiting the scientists at the all India level for placement in different ICAR Institutes all over the country. Initially, the Board functioned with only a single chief executive officer who was the chairman. Later, two other members were also appointed to the ASRB to take up the recruitment responsibilities. For recruitment at the lowest level of the scientific service, the ASRB conducts an All India Competitive written examination in sixty-five disciplines at 30-35 centres all over the country. The candidates who successfully pass this examination are further interviewed by a selection committee constituted separately for each of the sixty-five disciplines. The Board then recommends a list of candidates to the ICAR for recruitment to the 'scientist' cadre, which is the starting grade of the agricultural research service. In the recent past, the association of agricultural universities has taken a decision that they will utilize the good offices of the ASRB and the ARS examination will also be used as a National Eligibility Test (NET) for the purpose of recruitment to the State Agricultural Universities. Only those candidates who successfully pass the NET will be called for an interview for recruitment to the post of Assistant Professor in the SAUs.

The recruitment at lateral entry into the ICAR system is also conducted by the ASRB, which advertises the position giving the essential and desirable qualification and other details. The lateral entry is provided for the recruitment of the scientists at the 'Senior Scientist' level, 'Principal Scientist' level and also for the 'Research Management Positions' (RMP) such as the Head of the department, Joint Directors and Directors of research institutions and for other research management positions of the headquarters such as the Assistant Director General, Deputy Director General, etc. These research management positions are mostly in the same grade as that of the Principal Scientist except for a few senior positions such as the Deputy Director General of ICAR and Directors of five national institutes. The position of the Director General of ICAR is the highest post in the hierarchy of the Indian NARS. The ASRB constitutes a recruitment committee for the purpose of conducting an interview and selecting the candidates. The Committee consists of experts in the technical area. It, however, does not have any management specialists or psychologists, and no psychometric instruments are used to screen applicants for recruitment interview so as to select only those with genuine interest and aptitude to make a career of agricultural research. The recruitment procedures, thus, test the technical capabilities and but not the evaluation of managerial capabilities.

## 2.2. Placement

The placement of the scientists, after recruitment, is done by the Director (Personnel) for the ICAR Scientists and by the Vice Chancellor's Office for the SAUs. The placement is generally done keeping in view the specialization of the candidates, and the requirement of such candidates at different locations. Wherever possible, care is also taken to accommodate the candidate's preference for the place of posting. The issue of posting is sometimes a very contentious one and a lot of organizational politics come into play while taking this decision. The service rules require that a person must serve for at least two years in a backward area. However, in practice, this is not always ensured. At times it happens that people posted in backward areas continue to remain there after serving for two years while those who are placed at choice locations try to firmly entrench themselves there. It is always desirable that the newly recruited scientists at the beginning of their service should be placed at centres of excellence under apprenticeship to eminent scientists. However, this does not happen as a policy, and sometimes we see newly recruited scientists being made in-charge of a small one-man research station in a remote outpost of the system.

## 2.3. Appraisal

The appraisal of the scientists is a two-stage process. There is a provision for annual assessment of the scientists, which consists of a five-part form. Part I of the form gives personal details of the scientist. Part II is self-assessment to be filled in by the scientists reported upon, and it has the following columns:

1. Brief description of duties
2. Listing of targets and achievements
3. Statement of shortfalls and constraints in target achievement and/or significantly higher achievement.
4. (a) Technical achievements during year
  - (i) Research papers
  - (ii) Popular articles
  - (iii) Books
  - (iv) Technical bulletins
  - (v) Others
- (b) Additional qualifications acquired
- (c) Training programmes attended
- (d) Participation in deputation/delegation abroad

This is followed by Part III and Part IV to be filled in by the reporting authority who, is the immediate supervisor of the scientist. Part III has space for comments on the following:

### A) Nature and quality of work

- 1) Comment on Part II as filled by the scientist.
- 2) Quality of output
- 3) Knowledge of sphere of work

### B) Quality of scientific/technical achievements

### C) Attributes

- 1) Attitude to work
- 2) Decision making ability
- 3) Initiative
- 4) Ability to inspire and motivate
- 5) Communication skill (written and oral)
- 6) Interpersonal relations and team-work

- 7) Relations with the public
- 8) Attitude towards SC/ST

D) Additional attributes

- 1) Planning ability
- 2) Supervisory ability
  - i) Assignment of tasks
  - ii) Identification of proper personnel for performing the tasks.
  - iii) Guidance in the performance of the tasks
  - iv) Review of performance.
- 3) Coordination ability
- 4) Aptitude and potential (choose 3)
  - i) Research management,
  - ii) Research and development,
  - iii) Training,
  - iv) Planning,
  - v) General administration,
  - vi) Industrial administration,
  - vii) Any other field.
- 5) Training for further advancement.

Part IV consists of comments on health integrity, scientific integrity, general assessment and provides for a grading on a five point scale. The part V to be completed by the Reviewing Officer. The Reviewing Officer is the CEO of the Institution where the concerned scientists are working.

The second part of the appraisal is coupled with the promotion. The agricultural research service consists of three grades for the scientists. These are scientists, senior scientists and principal scientists. The scientist grade has three scales. These are scientists, scientist-senior scale, and scientist-selection grade. A person, after completing eight years in the scale of scientist, fills out an assessment form regarding eight years of work and appear for an interview before a committee, which appraises his work. The committee consists of members from ASRB, the Institute where the scientist is working from another ICAR institute. After appraising the work of the candidate, the committee may either recommend the person for promotion to the next scale of Scientist Senior Scale (SSS) or award some increments in the previous scale itself. A similar procedure is followed for scientist to move from Scientist Senior Scale to either Scientist Selection Grade (SSG) or Senior Scientist (SS). Both these positions i.e., SSG and SS enjoy the same scale of pay, however, those incumbent who do not hold a doctoral degree are placed in the Scientist Selection Grade while those holding Ph.D. degree are placed in the post of Senior Scientist. The scientist in the Scientist - Selection Grade position may be placed in the Senior Scientist position after they acquire a Ph.D degree, and receive a positive recommendation from the departmental promotion committee. A person can move from the position of senior scientist to principal scientist only by applying for, and being recruited to this higher post. These positions of principal scientists are nationally advertised. The position of scientist in ICAR is equivalent to the post of an assistant professor in the SAU, and the posts of senior scientist and principal scientist correspond to the posts of associate professor and professor respectively. The rules currently do not provide for promotion by performance evaluation or appraisal from the post of senior scientist to the post of principal scientist.

## 2.4. Compensation - Service structure and career advancement

There have been **two landmarks** in the organization and compensation package for the agricultural scientist in the country in the recent past. The **first** was the formation of the **agricultural research service** in 1975 and the **second** was the implementation of the **University Grants Commission (UGC) package** for the compensation to the scientist. The earlier service structure adopted in 1975 was essentially a **dual ladder** system in which a scientist could move to the highest grade and receive the same compensation that was paid to a person occupying the highest research management position in the system. The basic philosophy of this system was that a research scientist can move up the technical ladder to the highest position without requiring to change to the research management position ladder to move up, in terms of occupying higher positions and drawing better compensation.

The service had then provided 8 scales of pay with the S-1 scale being the lowest and the S-8 scale being the highest. A person working in the laboratory in active research could aspire to move to the S-8 scale in the technical ladder without moving to the managerial ladder to attain the same scale. This system provided for adequate compensation for those not willing to go into research management positions but wanting to stay in active research in the area of their interest for the entire period of their service without sacrificing career advancement. The movement from one scale into another was done by a five yearly assessment system and a person if found suitable was promoted to the next scale. The system was thus, **person centred** and not **post centred**. A person who was not successful in moving to the higher grade in the five yearly assessment could appear for an assessment for promotion in each successive year till he was promoted to the next higher grade, following which he went for a five yearly assessment. In the **UGC package**, which was adopted by the ICAR, **some features of the dual ladder** system have been retained. However, the **top positions are not available** for promotion by assessment and do not exist in the technical ladder, but are present only in the management ladder. The highest that a person can presently aspire is to become a Senior Scientist by periodic evaluation and assessment of his work. After this, one has to only compete for the existing number of posts to move to higher positions. This policy at the higher level is, thus, post centred and not people centred.

## 2.5. Manpower Planning

The manpower planning in the NARS is done separately in two channels. The first is the federal channel of the ICAR, and the second is the channel of the State Agricultural Universities. All these organizations have a manpower planning cell which engages itself in projecting the requirements for manpower under the Directions of the technical committees that may formed from time to time.

## 3. Human Resources Facilitation (HRF)

The Human Resources Facilitation can be said to happen at three different levels. The individual level, the group level and the organizational level. The improvement in HRF can take place mainly through the process of training, consultancy and major organizational development intervention, such as change in organizational structure, organizational policies and policies of human resources administration. The systems concerning the human resources administration have already been dealt. The issues of training and development for improving of Human Resources Facilitation in the NARS are addressed by the interventions of NAARM to a greater extent and the intervention of other management training institutions to a limited extent. The NAARM training programmes offer instruction in all aspects of management for different levels of personnel working in the NARS. The training that is offered includes instruction in **operations management** (Programme, materials and machine/equipment management, **research project management**), **financial management**, **human resources management**, Marketing Management (extension and transfer of technology, **information management**), etc.



The programmes are also offered in specialized and upcoming areas of interest in the management such as agricultural management, Management Information System for agricultural research, computer applications in agricultural research, training of trainers/teachers and advances in educational technology. The course on human resources management is structured around three levels - **the individual**, the **group** and the **organization** system. At the first level of the individual, topics such as values and attitudes, personality formation, perception, motivation and learning are discussed. At the group level, topics that are included are foundation of group behaviour, group dynamics, communication, leadership, power, politics and conflict. At the organizational system level the issues that find a place are organization structure, job design, performance evaluation and rewards, organizational culture and human resources policies and practices.

The environment around an organization also has an impact on its functioning. Organizational development techniques may also be used to change and develop organizations. The area of organizational development discusses the major techniques available for initiating and facilitating changes both in structural and human processes in organizations and the resultant impact these methods have on changing behaviour. **These techniques may include sensitivity training, survey feedback, process consultation, team building, OB modification and transactional analysis.** They also include all those issues discussed in the development segment of HRD. The course is, then, rounded off with a discussion on organizational change and interaction with the environment in which organizations exist. The impact of personnel policies, procedures of financial and material management is also discussed on the human resources environment. The other managerial topics such as delegation, teamwork, interpersonal relationships, and administrator - scientist interface also find place in the programme.

The Academy also offers **consultancy** in the area of the Human Resources Facilitation. Such consultancy can be in the shape of studying the organization and making recommendations, assessing the training needs of the organization, trouble shooting in the area of problems pertaining to management, etc. The training programs of the Academy are based on the available literature on general management, and they also draw heavily from the research results of the projects investigated by the Academy. Some of the other issues that have an impact on the human resources environment are sabbatical leave, national and international exchange of scientists, opportunities for intense personal communication through seminars, symposia and workshops, adequate technical and labour support, proper administrative service, (and not unimaginative administration!) sufficient funds for research contingency, and proper system for credit sharing.

## **Conclusion**

The experiences in human resources management in the Indian NARS have been very rich and rewarding, and there have been problems, failures and successes. All of them are provided lessons for improving the human resources management for the future, not only for this country but also for other countries around the globe.

# LEADERSHIP STYLES

Dynamic and effective leadership is one of the most important attributes for the success of any organization. It is defined as 'the activity of influencing people to strive willingly for group objectives', or as 'interpersonal influence exercised in a situation and directed, through the communication process, towards the attainment of a specialized goal'. Most of the management writers agree that leadership is a 'process of influencing the activities of an individual or group in efforts towards accomplishing goals in a given situation.

While it is easy to understand what leadership is, it has been difficult to understand how successful leadership is to be exercised. In an effort to improve leader behaviour, and train in effective leadership, a large number of studies have been conducted. These may be grouped into three categories. 1. The early approaches to leadership 2. Behavioural theories of leadership 3. Situational theories of leadership.

## 1. The early approaches to leadership

These theories explain leadership effectiveness in terms of the leader. They attempted to study the person of the leader and draw conclusions on leadership.

### 1.1. Great man approach

This is the earliest theory of leadership, and suggested that great leaders were born and not made. They had some inborn qualities, and this made them great. However, there was no agreement of the qualities these leaders shared or how such people could be identified.

### 1.2. Trait approach

In this approach, the researchers attempted to identify specific traits and characteristics of leaders. In more than a hundred studies from 1930 to 1950, attempts were made to correlate certain traits and the rise of leadership. A review of these studies grouped twenty-six traits identified in three or more studies. However, the application of the traits theory for development of leadership posed some problems. Often leaders (successful as well as unsuccessful!) and non-leaders possessed the same traits. This only shows that a given trait cannot cause an individual to become an effective leader. It is not possible to measure the extent of a trait a particular person has, and another situation. Although one can identify certain traits good leaders appear to have, research indicates that no distinctive set of good leader traits exists.

## 2. Behavioural theories of leadership

These theories focus on the effectiveness of leader styles and behaviours.

### 2.1. Iowa studies

In the University of Iowa, Lewin, Lippitt and White studied the impact of three leadership styles - autocratic, democratic, and laissez-faire. This relates to the behaviour of the leaders in relation to their group. The results indicated that 1) group members preferred democratic over autocratic leaders 2) incidents of intra-group hostility was higher in autocratic and laissez-faire groups. Incidentally, productivity was also higher in democratic group. This study was the turning point where research began to be focussed on leadership behaviour rather than traits.

### 2.2. Ohio State studies

The Ohio studies identified two dimensions of leader behaviour while directing the activities of the group towards achievement of the goal. These are initiating structure and consideration. Initiating structure refers to the leader's behaviour in delineating the relationship between himself and the members of the work group, and in establishing a well-defined pattern of organization, communication and methods of procedure. That is, the leader specified the task to be performed

by each member of his group, set down deadlines, gave directions and put pressures for completion of the task. Consideration refers to behaviour of friendship, mutual trust, respect and warmth in the relationship between the leader and members of his group. The Ohio studies were the first to describe that the initiating structure, and consideration were separate and distinct dimension. They were not a part of the same continuum, and can be plotted on two separate axis. A high score on one dimension does not necessitate a low score on the other. Any mix of both dimensions could describe leader behaviour as illustrated in the following figure. This results in four leadership styles.

|  |   |
|--|---|
| High<br>consideration<br>and<br>low<br>structure   | High<br>structure<br>and<br>high<br>consideration |
| Low<br>structure<br>and<br>low<br>consideration<br><br>(Low) → Initiating structure → (High) | High<br>structure<br>and<br>low<br>consideration  |
| <b>The Ohio State leadership quadrants</b>   |   |

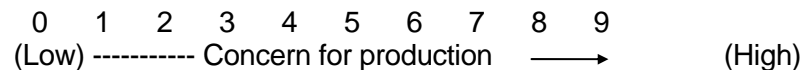
### 2.3. Michigan studies

These studies attempted to compare the employee-centred and production-centred styles to determine which results in improved performance. No conclusive evidence was found to support either style. Higher productivity was observed in both the styles, by different studies. At first, the two styles were thought to be at the opposite ends of a continuums, however they were recognized as independent dimensions of leadership.

### 2.4. Managerial grid

Extending the Ohio and the Michigan studies, Blake and Mouton developed the concept of the managerial grid illustrated below:

|   |                       |               |
|---|-----------------------|---------------|
| 9 | 1-9<br>(Country club) | 9-9<br>(Team) |
| 8 |                       |               |
| 7 |                       |               |
| 6 |                       |               |
| 5 |                       |               |
| 4 |                       |               |
| 3 |                       |               |
| 2 |                       |               |
| 1 | (Impoverished)<br>1-1 | (Task)<br>9-1 |



### **The managerial grid leadership styles**

The five leadership styles illustrated are described below:

**Impoverished (1-1):** Such managers have little concern for either people or production. Their involvement in jobs is the minimum. They exert only that little which is necessary to retain their positions. Their main function is to communicate information from superiors to subordinates and vice versa. They may be just marking time to retire or quit.

**Country club (1-9):** This type of managers have little concern for production. Their only concern is for people. They turn thoughtful attention to satisfy their needs so that a happy and friendly organizational atmosphere and good work tempo are created and maintained.

**Task (9-1):** These managers sometimes referred to as autocratic taskmasters, have little or no concern for people. Their only concern is with production, for which they arrange the conditions of work in such a way that human elements are kept at the minimum, and productive operations attain maximum efficiency.

**Middle of the road (5-5):** These managers occupy a via media position. Their concern for both production and people is moderate. They strike a balance between the two. They neither set targets of production too high nor aim at building outstanding employee morale. The levels of both production and morale are on the whole satisfactory. The approach of these managers is generally one of benevolent autocracy.

**Team (9-9):** These managers have the highest possible concern for both production and people. They gear the system of work to maximum efficiency and also inspire the subordinates to do the utmost. Individually they are committed to the work and together they feel a common stake in the organization. They develop a relationship of trust and respect. Team style is the best possible style, which integrates the needs of the individual, and those of the organization.

According to behavioural theories of leadership, certain types of behaviour determine the success of leaders. These studies prescribe the types of behaviour to be effective leaders.

### **3. Situational theories of leadership**

Studies concentrating on identification of qualities or behaviour of effective leaders could not completely understand the process of successful leadership that could be applied to various situations by different people. In fact, leadership effectiveness was now increasingly thought to be highly dependent on situations the leaders found themselves in. Thus new studies began to consider the influence of the leader, the followers, and the situation in an attempt to better understand the true nature of leadership.

#### **3.1. Contingency theory**

The contingency model of leadership effectiveness developed by Fiedler postulated that leadership effectiveness is determined by the interaction of employee orientation (leadership style - relationship oriented or task oriented) with the three situational variables - leader - member relations, task structure and leader position power. Leader - member relations are determined by the manner in which the leader is accepted by the group. Task structure reflects the clarity or

ambiguity of the task. Clear task is said to have high structure. Position power refers to the authority vested in the leader because of his position in the organization. These three components combine in various ways to form eight situations as shown below:

| Type of situation               | I                | II       | III        | IV       | V          | VI       | VII        | VIII     |
|---------------------------------|------------------|----------|------------|----------|------------|----------|------------|----------|
| <b>Favourableness</b>           | High <-----> Low |          |            |          |            |          |            |          |
| <b>Leader- Member relations</b> | Good             |          |            |          | Poor       |          |            |          |
| <b>Task Structure</b>           | High             |          | Low        |          | High       |          | Low        |          |
| <b>Leader Position Power</b>    | Stro<br>ng       | Wea<br>k | Stro<br>ng | Wea<br>k | Stro<br>ng | Wea<br>k | Stro<br>ng | Wea<br>k |

Situation I is a high control situation, while situation VIII is a low control situation. The relationship-oriented (i.e., the considerate, employee-oriented) leader is most successful in situations that have intermediate favourableness to the leader, while the task-oriented leader is most successful in conditions that are either favorable or quite unfavorable to him.

Fiedler states that it is quite difficult to change the style of a leader, say from structured to considerate, and it would be better to change the job assignment rather than trying to change the leader. A job can also be engineered to fit the leader by adjusting the situational variables. Leadership style should and will vary among departments in a single organization, contingent upon different situations. Thus, the contingency model is not a solution to all matters of leadership style.

### 3.2. Path-goal theory

This theory focuses on the leader behaviour necessary to motivate to work more effectively. It derives from the expectancy theory, which assumes that motivation is a result of valence and expectancy. It becomes the leaders job to build both valence (amount of desire for a goal) and expectancy (strength of belief that particular act will be followed by a particular outcome) for the employee. Leaders encourage development of valence and expectancy by structuring the path towards goal attainment so that employees will see that their acts lead to their goals. Leaders can increase the rewards to subordinates, and also make the path easier by training and direction and by removing the barriers that stand in the way of goal attainment. Four leadership styles are used based on the contingent subordinate characteristics and environmental factors. The leadership styles are directive, supportive, participative and achievement-oriented.

### 3.3. Vroom-Yetton model

This model explores the extent of participation of followers in the decision-making process. It selects a particular leadership style most appropriate for the situation based on the quality and acceptance of the ultimate solution.

- AI : The leader solves the problem or makes the decision personally, using the information available at the present time.
- AI1 : The leader obtains necessary information from subordinates, then personally decide a solution to the problem. The leader may or may not tell subordinates the purpose of the questions. Their input is limited to the leader's request for information.
- CI : The leader shares the problem with relevant subordinates on an individual basis. After getting their ideas, the leader makes the decision. The decision may or may not reflect subordinates views.

- CII : The leader shares the problem with the subordinates in a group meeting which he obtains their ideas and suggestions. The leader then makes the decision personally. The final decision may or may not reflect subordinate influence.
- CIII : The leader shares the problem with subordinates as a group. Together, all parties generate and evaluate alternatives, and attempt to reach consensus on a solution. The leader facilitates the meeting, attempting to keep attention on the problem and moving the group towards a mutually acceptable solution. However, the leader does not try to influence the group to arrive at any particular solution. The appropriate style is selected answering a set of questions and using the decision tree proposed in the model.

### **3.4. Situational leadership theory**

This theory formulated by Hersey and Blanchard also identifies two dimensions of the leadership as in the Ohio State studies. These are 'relationship behaviour' and 'task behaviour'. However, unlike the managerial grid, which was also based on the Ohio State studies, this theory does not prescribe one best leadership style. The model states that the effectiveness of leader behaviour is situational. A manager should choose the style most appropriate for each situation. The appropriateness of the situation is judged by the maturity of the followers.

The model is illustrated below:

The four leadership styles are described below :

Telling (S1) : Provide specific instruction to subordinates and closely supervise performance.

Selling (S2) : Explain decision to subordinates and provide opportunity for clarification

Participating (S3) : Share ideas with subordinates and facilitate the decision-making process.

Delegating (S4) : Turn over responsibility for decisions and implementation to subordinates.

The four follower maturity levels is described below.

M1 Person is unable and unwilling to perform the job.

M2 Person is unable but willing to perform the job.

M3 Person is able but unwilling to perform the job.

M4 Person is able and willing to perform the job.

The style S1 suits a person with maturity M1 and so on. It is the responsibility of the manager to improve the maturity of his followers and move from style S1 to S4 gradually along the curve.

## **4. Leadership styles in perspective**

All the existing models can guide in choosing an effective style. The theories are not contradictory, but are alternative approaches to leadership questions. A person may choose one approach in seeking to become a better leader, however, knowing each model can also be valuable.

### **Leadership style suitable to Indian conditions**

Singh (1982) studies the profile of leadership styles in India and found that Indian managers do not have a dominant preference for a particular style and suffered from a style flux and normlessness. Leadership is viewed in terms of functions and roles the managers are supposed to perform by the managerial community overlooking the two important elements, the leadership dominance and consistency. The ambiguity about the concept of leadership style and the lack of proper emphasis on leadership dominance and consistency may be responsible for the style flux according to Singh (1982). Style normlessness can be explained in terms of too much emphasis on situational factors. Leadership and supervision are not the same. Leadership involves guiding, helping, planning and developing people from one phase of growth to a higher one while supervision entails policing i.e. keeping close watch on the organizational activities. In India some of the researchers have recommended authoritarian style linking leadership to the

profile of working class and with the assumptions that the workers are dependence-prone, cannot take decisions on their own, need to be goaded, controlled and guided which are not based on realities. The works of Singh and Dass (1977) and Sharma (1971, 1976) clearly demonstrate that the working class also desire autonomy, freedom, responsibility and challenges for motivation. The effectiveness of the leadership style is judged against the leader's ability to influence others' action and behaviour, which depends upon his position on the power continuum. The place and position on the power continuum helps one to prescribe a functional and effective style suitable for Indian conditions. Basically the following six factors determine a leader's position on the power continuum:

#### **4.1. Leader's own strengths, weaknesses and charisma**

Family background, educational background, technical expertise, nearness to power centre and charismatic personality contribute to the personal strengths. Few leaders have the charisma capable of evoking reverence and the ability of a leader to operate on charisma becomes high if the profile of subordinates is that of non-questioning. Historically, the caste system in India where authority was blindly accepted was contributory to charismatic authority. This is fast disappearing due to political, social and economic policies followed by the Government.

#### **4.2. Profile of subordinates**

The relevance of the subordinate's profile in determining the managerial style can be viewed mainly from two angles: (1) Subordinates' respect for the superior's authority and decisional judgment (2) The subordinate's motivational profile. The respect for superior's authority has, of late, eroded considerably, both in the industrial and social institutions due to the credo for permissive values and the stronger desire for participative decision-making. Emergence of trade unions, associations and government's regulatory measures, etc., have led to a virtual revolt against autocratic and authoritarian managerial style. A study of the motivational profile at top, middle and lower management levels by Singh (1982) have shown the preponderance of freedom, autonomy, responsibility, and challenges and varieties over other motivational factors at all the levels of management. This shows that except democratic style other styles are ineffective in motivating subordinates.

#### **4.3. Socio-political environment**

Political democracy has taken deep roots in Indian life and for such environment the best-suited leadership style would be participative and democratic.

#### **4.4. Organizational power position**

If the power to punish or reward, and if autonomy and operational flexibility given to a manager by the organization is high, it helps him to get overtly an unquestioned obedience from his subordinates. Now a day this power of the managers has been considerably reduced due to trade union activities and governmental controls. In such situations the managers (leaders) have to be more democratic and rely less on organizational authority.

#### **4.5. Knowledge and expert power**

Managers with superior job knowledge or expertise are capable of exerting greater influence on their subordinates. Today the knowledge differentiation between the leaders and followers is getting fast reduced and in fact, an opposite trend can be seen i.e. the younger generation of subordinates has better exposure and academic qualifications. The young subordinates are more informative and better trained. The knowledge obsolescence is more common among the senior managers. The younger generations of today have a strong desire to question the unilateral decision making process of the superiors, thereby putting enormous limitations on autocratic style i.e. centralized decision-making system.

#### 4.6. Nature of task

If the job technology is highly programmed and structured making performance qualification easier, the superior exercises greater control over his subordinates. In case of unstructured and interdependent job technology, work quantification is difficult which greatly reduces the control of manager over the behaviour of his subordinates.

The style of leadership which fits in well keeping in view the demands and challenges of the contemporary Indian society is that of participative management, oriented towards democratization of work.

According to Sinha (1982), for understanding leadership behaviour it is necessary to know the cultural context in which the leader and group operate. For Indian culture consultative type of leadership is more suitable. Indian culture seems to reject extreme autocratic leadership behaviour because it generates too much dependency and authoritarianism. Consensus leadership is too demanding and requires skill to deal with conflict, with differences in values and view points and arrive at an integrated solution. It also requires a climate of self-control, understanding and trust. Most organizational leaders in India are comfortable with consultative style, which involves others, but helps keep the decision-making role to themselves.

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# **PERFORMANCE APPRAISAL AND ASSESSMENT OF AGRICULTURAL RESEARCHERS**

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A critical factor related to an organization's long-term success is its ability to measure how well employees perform, and then use that information to ensure that performance meets present standards and improves over time. This process is referred to as performance appraisal or performance evaluation. It is a complex task that is difficult to do, and it is not done well by most organizations. Proper utilization of human resources in research is a matter of paramount importance. In order to check how well a scientist is performing his role as a member of a research team, it is necessary that his efforts be periodically evaluated.

## **I. Definition of Performance Appraisal**

"Appraisals regularly record an assessment of an employee's performance, potential and development needs. The appraisal is an opportunity to take an overall view of work content, loads and volume, to look back on what has been achieved during the reporting period and agree objectives for the next." (Advisory Conciliation and Arbitration Service, U.K. 1994)

"It is the process through which an individual employee's behavior and accomplishments for a fixed time period are measured and evaluated".

## **Requisites of a performance appraisal system**

The organization believes in the development and optimization of its human resources. It also believes that such a development is in its own interest of improving productivity and effectiveness and that all employees have the potential for development.

The organization will create and provide reasonable opportunities to every one of its employees for improving his performance and development. The organization believes in developing a climate of openness, trust, mutuality and collaboration through appropriate training and other strategies.

Performance appraisal system needs to have the active support and involvement of the management. They should besides articulating the organizational goals and values demonstrate their belief in and efforts for management development, as managerial example influences behaviour down the line in the organization.

At managerial level, there should be willingness to understand human behaviour and get along with people. Genuine concern for efforts towards development of subordinates, ability and willingness to communicate clear-eyed, honest observations and judgments about individual competence and performance, a spirit of dynamism, and sense of personal involvement in the affairs of the organization and effective leadership are the other managerial inputs in a performance appraisal system.

There must be employee willingness to develop and continually improve performance through realistic and challenging goal setting. They should commit themselves to the furtherance and achievement of his objectives of the organization. Organizational goals are to be perceived as personally relevant. He should perceive and accept the superior as one genuinely interested in his development and not as one "playing God".

A performance appraisal system presupposes role clarity.

## **II. Objectives of Performance Appraisal**

1. Part of planning and control functions of management.
2. Monitor performance of individual employees.
3. Motivate improvement in current work
4. Employee's involvement in own job development increases, through the agreements of targets.
5. Assess training and development needs.
6. Employee's view of their contribution to overall objectives clearer.
7. Encourage communication between manager and subordinate.
8. Standardize feedback to subordinates and ensure some praise of them by the managers.

### **Advantages of Appraisal schemes**

1. To disseminate organizational objectives by relating these directly to individual objectives
2. To incorporate individual objectives where necessary or appropriate in to organizational objectives.
3. Improvement of individual performance where necessary.
4. Improvement of organizational efficiency by enabling identification of weakness within the organization and efficient deployment or redeployment of skills
5. Systematic and ongoing analysis of training and development needs for all staff covered by the scheme
6. Promotion and encouragement of good management practice.
7. Improvement in morale with greater identification with the organization.
8. Improved training and development opportunities

### **Disadvantages of Appraisal schemes (as often perceived)**

1. Managers feel that appraisal schemes are a waste of time and that there is no immediate pay-off. They may also be anxious.
2. Day to day management is enough
3. Low morale if there is no follow-up because of falsely raised expectations to which there are no "rewards" offered
4. There is a loss of time away from "proper" work
5. There is often resentment about possible bias and staff who can't or don't want to improve may feel that are not appreciated.
6. The end of term report style is unhelpful and usually treated defensively.

### **Major Components of Appraisal System**

1. Identifying job responsibilities and duties and performance dimensions, standards and goals
2. Prioritizing and weighting performance dimensions and performance goals.
3. Determining appropriate methods for appraising performance
4. Developing suitable appraisal instruments and scoring devices
5. Establishing procedures that enhance fair and just appraisals of all employees.
6. Providing performance feedback to all employees
7. Relating observed and identified performance to the rewards provided by the organization
8. Designing monitoring and auditing processes to ensure proper operation of the system and to identify areas of weakness
9. Granting employees opportunities for appeal whenever and where ever such action is appropriate
10. Training involved employees in all phases of the appraisal system.

In order to achieve the above-mentioned objectives the appraisal format should have the following components:

- Identification of key performance areas (KPAs) and target setting through periodic discussions between each employee and his/her boss.
- Identification of qualities required for the present and future jobs (higher level) in the company.
- Self-appraisal by the appraisee.
- Performance analyses to identify factors that have facilitated and factors that have hindered performance.
- Identification of training needs.
- Action planning and goal-setting for future.
- Final assessment by the supervising officer for administrative purposes

Each employee now plays an important part in his or her organization through involvement in (a) Creative planning (b) Development of new process and product knowledge (c) understanding criteria for effectiveness.

## **Effect of Performance Appraisal process on the employee morale**

### **Impact on individual**

When appraisals are used for discipline, pay increases, promotions, discharges, or layoffs, they are likely to be regarded with apprehension by those employees who tend to underestimate themselves, or by the less productive members of the organization, or by those who feel appraisal will be arbitrary or unjust. Similar feelings result when employees don't know or understand the criteria being used to assess them, or when they see the appraisal as overly critical rather than helpful.

### **Performance Appraisal and Potential Appraisal**

**Performance Appraisal** involves assessing someone's performance against some specified criteria.

**Potential Appraisal** involves assessing how an individual is likely to behave in the future. In practice this means assessing probable performance against as yet undetermined criteria.

### **Ethical perspective**

When organizations make decisions about people, such as whom to hire or promote, what appraisal ratings or merit raise to give, or how to discipline a particular infraction, it is very important that the decisions are seen as fair and just. Research has shown that at least two aspects of justice influence employee's job satisfaction and organizational commitment and both must be considered in organizational decisions.

#### **1. Distributive justice**

Distributive justice would exist if employees agreed that the best person had been chosen for a promotion, that the punishment fit the crime in discipline case, or that the size of merit raises accurately reflected true differences in performance across the people involved.

#### **2. Procedural justice**

A just policy or procedure should help assure equitable outcomes every time. The six rules for procedural justices are:

1. Consistency rule
2. Bias suppression rule
3. Accuracy rule
4. Correctability rule
- 5 Representative rules
6. Ethicality rule: Performance Appraisal Methods

### **The criteria and methodology of evaluation**

There could be three basic approaches to the construction of an evaluation proforma.

1. **Performance-centered:** emphasis is given to the measurement of performance over a predetermined period of time. Obviously the objectives here would be performance accountability and control and/or performance improvement.

2. **Human-centered:** emphasis is given to the assessment of human potential for development in professional/organizational spheres.
3. **Ritualistic:** purposeless evaluation administered as a bureaucratic necessity.

The third approach must be avoided. A composite proforma must contain items emanating from the first two approaches. Other basic requirements are:

**Clarity:** Items must be easily understood and answerable by the assessee and the assessor.

**Specificity:** AS much as possible, items must seek information and evaluate on specifics

**Generality:** For large organizations with wide diversity of functions, evolving generalized categories of performance may be more desirable than the requirement of specificity.

**Eliminating bias:** The proforma must represent the entire range of activities and potential which assessment is to be based. It must allocate correct weighting to these activities according to institutional requirements. It must have built-in facility for multiple assessments. Like any other measuring instrument, an evaluation form must try to achieve a high degree of validity and reliability.

### **Subjective measures**

Because they rely on human judgement, subjective measures are prone to the rating errors. The subjective measures can be classified as either comparative procedure (ranking) or assessment against absolute standards (ratings).

#### **1. Ranking/Comparative**

Evaluate performance of employees relative to each other

- a. Paired comparisons; b. Ranking; c. Forced distributions; d. Man-to-man rating; e. Personality trait rating

#### **2. Blind Ratings**

- a. Forced Choice Scales (FCS) / Mixed Standard Scales (MSS); b. Check list – weighted check list

#### **3. Judgement Rating / Absolute methods**

- a. Essay; b. Global rating scales; c. Graphic rating scales (GRS); d. Behaviourally Anchored Rating Scales (BARS)/ Behavioural rating scales; e. Behavioural Observation Scales (BOS); f. Critical incident technique.

### **Objective measures**

They assess performance in terms of numbers, such as the number of times an employee is absent or late to work or some other numerical index of how well or quickly an employee can perform certain tasks. The major types of objective measures are

1. Production measures; 2. Personal data; 3. Money value sales; 4. Performance tests; 5. Business unit performance measures; 6. Management By Objectives (MBO)

### **Feedback of results / The performance appraisal**

An appraisal system has three integral sets of activities to be implemented in order to complete the process viz., Pre-appraisal, Appraisal and Post-Appraisal activities.

#### **Pre-Appraisal steps**

##### **Frequency of Appraisal:**

Frequency of appraisal is yearly in most organizations. Frequent appraisals like biannual will reduce “halo effect” and errors like “recency effects”

##### **Format determination:**

This step is very crucial in the whole appraisal process, because the subsequent results would depend on this format. Format is the real instrument and has therefore, to be very carefully designed. A format will be based again on the objectives to be achieved through appraisal and, hence, clarity would facilitate the process.

Formats structure can be divided in to 5 parts

1. Self appraisal by the ratee; 2. Current performance; 3. Potential for growth; 4. Training and Development needs; 5. Concluding information

In most organizations, subjective ratings of employee performance are provided by supervisors.

However, there are several other potential sources for performance ratings like

1. Self-evaluation;
2. Peer evaluation;
3. Subordinate evaluation;
4. Customer /client evaluation;
5. Computers in Performance evaluation;
6. 360-degree appraisal;
7. Group or Committee Appraisals/ Multiple rater performance appraisal

### **Post-Appraisal activities**

#### **Follow up - Coaching:**

Is a process in which the manager, through direct discussion, helps a colleague to learn using a problem- solving approach?

### **Process**

#### **Counselling**

A counselling interview is one in which the interviewer helps an individual to come to terms with a situation about which that individual is not happy.

#### **Impression management in the feedback process**

The impression management tactics include

1. Taking sole credit even when credit should be shared
2. Making the supervisor aware of your accomplishments
3. Arriving early or staying late to give the impression of being a hard worker
4. Taking an interest in the supervisor's personal life and perhaps doing personal favours.

### **Rating errors in Performance appraisal**

#### **Halo/Horns**

Failure to discriminate in rating on several logically unrelated dimensions, due to an overall impression that influences all of the dimensions

#### **Central tendency**

Failure to use extreme ends of rating scales when such ratings are appropriate, due to a constant psychological bias of the rater against using extremes. This results in an inappropriately narrow range of ratings.

#### **Harshness (severity)/Leniency**

Rating everyone too poorly or too favorably with respect to his or her actual performance. This results in a skewed distribution and makes the rater's group inaccurately look worse or better than the other groups. For a large number of employees, one would expect the true distribution of performance ratings to approximate a bell-shaped curve. When harshness/leniency error occurs, the curve shifts to either end.

#### **Similarity/Dissimilarity**

Rating particular individuals or all people of some specific characteristic, such as age, race, sex, or education, inappropriately because of the similarity or lack of similarity to the rater. Similarity and dissimilarity may lead to either higher or lower ratings, but the cause is the degree of likeness between the rater and ratee rather than the ratee's performance.

#### **Contrast**

Rating a person inappropriately high (or low) in contrast and due to an extremely low (or high) deserved rating given to the previous ratee. The person looks better (or worse) when contrasted with a person who was just previously rated extremely bad (or good).

#### **First impression/Recency**

Basing a general judgment about a ratee on some appearance factor during the appraisal interview rather than on job performance. The ratee may look slovenly, appear nervous, etc., resulting in a poor first impression and negative ratings, or the ratee may speak smoothly, dress well, etc., and receive an inappropriately favorable rating. Recency refers to the same type of error due to a recent action outside the interview situation, which is giving a high (or low) rating because of an obvious recent success

(or failure). Intentional errors: Sometimes supervisors intentionally rate employees inaccurately for political or other reasons.

### **Critical elements and performance standards**

A critical element is any component of an employee's job that is of sufficient importance that performance below the minimum standard established by management requires remedial action and denial of a within-grade pay increase and may be the basis for removing the employee or reducing his or her grade level.

**Performance evaluation of researchers:** five questions to be answered

1) Who is to be evaluated? 2) For what purpose? 3) On what criteria? 4) How? 5) by Whom?

### **What sort of people are we trying to evaluate?**

Our frame of reference is knowledge worker who is identified by not only by the nature of his or her vocation but also by virtue of certain special traits and attributes as well as by the value system of the profession to which he or she subscribes.

### **Four important hypothetical traits of a knowledge worker:**

1. Knowledge workers are highly sensitive
2. Knowledge workers are highly egotistical
3. Knowledge workers are basically exhibitionists (and consequently),
4. Knowledge workers actualize themselves through the recognition of colleagues, peers and others.

### **Scientists and academics consider the following values as most important aspects of their profession.**

1. The value of autonomy of research / academic institutions,
2. The value of freedom in research / academic work,
3. The value of creativity, originality, priority, intellectual honesty, etc. in scholarship (i.e. scientific / academic excellence)
4. The value of (peer) recognition for excellence.

As human beings knowledge workers would be as much or as little sensitive to things in general as anybody else. But in the professional world they are extremely sensitive to anything that might be considered a violation of their academic freedom, a denial of academic excellence, or of recognition by peers. Similarly, what has been called egotism and exhibitionism is a response to the heavy emphasis on expectation of being creative and original in one's thinking and be recognized for that by peers (Ahmad, 1977).

### **The why of evaluation:**

First and foremost is the need to discriminate between mediocrity and excellence, distribute rewards accordingly, and thereby reinforce excellence and discourage mediocrity.

Two other related purposes of an evaluation system are 1) To provide a measure of institutional accountability of professionals and 2) To ensure a certain degree of organizational control on their professional behaviour.

Indian scientists, particularly in junior positions, have often complained that evaluations have generally been used as punitive measures of coercion and organizational control without any regard to the developmental aspects. Such a situation would be counterproductive in that it would lead to resentment, nihilism, and even false reporting, thus defeating the very purpose of evaluation. Managers must ensure that they use evaluation with a positive attitude leading toward betterment of the individual, the organization and the profession.

## Performance appraisal in ICAR system

Present System of Performance Appraisal for scientists in ICAR is through submission of self-appraisals in the form of Annual Assessment Reports (AARs) by the appraisee and further processing of this report by the Reporting authority followed by reviewing authority. The self appraisal form includes duties performed and self appraisal on the same, targets set and achievements, and constraints in achieving the same, significantly higher achievements in targets, publications for the period under report, additional qualifications acquired, scientific / technical / management training programmes attended and participation in deputation /delegations abroad. Duration of service in difficult areas like hilly, tribal, neglected, backward, rural etc.

### The reporting authority in turn appraises the appraisee using the following criteria:

#### A. Nature and quality of work done

1. Comments on the part filled by the appraisee with respect to targets, objectives, achievements and shortfalls, and also specifying constraints in achieving the objectives.
2. Quality of out put: Regarding standard of work and programme objectives and constraints.
3. Knowledge of sphere of work: Scientist's level of knowledge of (a) functions (b) related instructions and their application.

#### B. Quality of scientific/technical achievements

Attributes like

1. **Attitude to work:** This includes dedication, motivation, willingness and initiative to learn and systematize his/her work.
2. **Decision making ability:** This includes analysis of decision-making and ability to weigh pros and cons of alternatives.
3. **Initiative:** This includes capacity and resourcefulness of the scientists in handling unforeseen situations on his or her own and willingness to take additional responsibility and new areas of work.
4. **Ability to inspire and motivate:** Motivate, to obtain willing support by own conduct and to inspire confidence.
5. **Communication skill:** Written and oral – ability to communicate and present arguments.
6. **Interpersonal relations and team- work:** Quality of relationship with superiors, colleagues and subordinates, and on the ability to appreciate other point of view and take advice in the proper spirit, also capacity to work as a member of a team and to promote team spirit and optimize the output of the team.
7. **Relations with the public:** Accessibility to the public and responsiveness to their needs.
8. **Attitude towards scheduled casts / scheduled tribes and weaker sections of society:** His/her understanding of the problems of scheduled casts / scheduled tribes and weaker sections of society and willingness to deal with them.

#### C. Additional attributes:

1. **Planning ability:** Anticipation of problems work-needs and plan accordingly and is able to provide for contingencies.

#### 2. Supervisory ability:

- a). Assignment of tasks; b) Identification of proper personnel for performing the tasks
- c) Guidance in the performance of tasks; d) Review of performance

**3. Coordination ability:** Extent to which the scientist is able to achieve coordination in formulation and implementation of tasks and programmes by different functionaries involved.

**Aptitude and potential:** Selection of the first, second, third position among any three items given below.

- I) Research management II) Research and development III) Training IV) Planning V) General administration VI) Industrial administration VII) Any other field (specify)

**4. Training for further advancement:** Recommendation for training with a view to further improving the effectiveness and capabilities of the scientists.

**D. General**

**1. Statement of health:** Physical and mental

**2. a. Integrity:**

**b. Scientific integrity:**

**3. General assessment:** Overall assessment with reference to strength and shortcomings and also by drawing attention to the qualities if any not covered by entries above.

**4. Grading:** (Outstanding / Very good / Good and Average / Below Average) For outstanding – exceptional qualities and performance noticed, grounds for giving such grading should be clearly brought out.

**E. Reviewing Authority**

1. Length of service under the reviewing authority
2. Is the reviewing authority satisfied that the reporting authority has made his/her report with due care and attention and after taking in to account all the relevant material
3. Do you agree with the assessment of scientist given by the reporting authority? In case of disagreement, please specify the reasons. Is there anything you wish to modify or add?
4. General remarks with specific comments about the remarks given by the reporting authority and remarks about meritorious work of scientist including the grading.
5. Has the scientist any special characteristics and / or any ability or aptitude, which would justify his/her selection for special assignment or out of turn promotion? If so specify.

The above mentioned performance appraisal is a confidential report. The objective is to develop an officer so that he/she realizes his/her true potential. It is not meant to be faultfinding process but a developmental one. The reporting officer and reviewing officer should not shy away from reporting shortcomings in performance, attitudes or overall personality of the officer reported upon.

Reporting officer shall in the beginning of the year, assign targets, to each of the officer with respect to whom he is required to report upon for completion during the year. The tasks set should clearly be known and understood by both the officers concerned.

Although the performance appraisal is a year-end exercise, in order that it may be a tool for human resource development, the reporting officer should at regular intervals review the performance and take necessary corrective steps by way of advice etc.

Some posts of the same rank may be more exacting than others. The degree of stress and strain in any post may also vary from time to time. These should be commented upon appropriately.

**Proposed new proforma of AAR by NAARM**

A document from NAARM on “**Project based budgeting, RPF and AAR – Guidelines and Proformae**” proposed the following new proforma for annual assessment report.

Part I- General particulars about the scientist and posting/work in difficult areas if any.

Part II - A self assessment for which includes activities planned and accomplished and time in weeks spent with respect to planning under different activities like Research, Teaching/training, Transfer of Technology, Scientific support, Project management/administration, General activities, Consultancy, etc. Targets/Milestones planned and achieved Justification for over-achievement/shortfall. A detailed report (200words) on the progress made during the year as annexure. A separate annexure about activities that were not planned at the beginning of the year but were taken up because of opportunities, which came up later. A list of number of



publications in international journals, national journals, technical reports, popular articles, books and others.

Part III – Assessment Report, which includes the comments on the achievements vis-à-vis targets by the team leader on various aspects like research, education/training, transfer of technology and other activities. Review of the significant contributions by the Head of the Division/Director in different columns like 1) Contribution to science/profession/technology 2) Quality of performance in terms of work planned and achievements 3) Resource Generation (Project funding; contracts, consultancy, patent/process charges...) 4) Funds allotted and spent and 5) Team working and team building/ Team leadership. Reporting officers' assessment of the scientist in a 1-9 scale where 9 is excellent, 8 is very good, 7 is good, 5-6 is average and below 5 is below average. The scientist is assessed in the following attributes in the 1-9 scale.

1. Professional knowledge and skills and analytical rigour
2. Scientific communication ability
3. Scientific contribution
4. General behaviour (Cooperation, team work)
5. Any other (specify)

The assessment also carries columns for the remarks by the reviewing officer.

Specific shortcoming, because of which the rating is below five in any of the above and if the scientist is rated below 5 has it been informed to the concerned scientist along with suggestions for improvement. The Reviewing officer also gives an overall rating of the scientists' performance in the scale of 1-9.

This proforma has an additional item in part IV in the form of work plan for next year which is an improvement over the existing proforma.

Construction of a performance index would be delicate and challenging. The first thing will be to divide performance in to (1) scientific/academic or professional performance; and (2) extra-professional or organizational performance.

### **Implementation**

Constructing an evaluation proforma is only half of the job. Implementing and processing it is the other half. Even the best proforma would not give good results if improperly implemented.

A bad appraisal system is worse than no system at all but by building on the positive achievements and seeking to eradicate some of the worst faults of existing schemes, we should be able to ensure that appraisal survives not as a moribund ritual but as a vital and essential part of good management.

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# INDIVIDUAL AND ORGANIZATION - AN INTERACTIVE PROCESS

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## Individual

It has been found that the behaviour of people in their organizations is very variable and all attempts to understand why people behave as they do in organizations must necessarily involve certain basic assumptions about the nature of human beings. But the first issue in trying to understand the work behaviour is to assess the mind-set of the people working in the organizations. For example, it is appropriate to know the attitude of the people whether they are happy with the profession they have chosen to pursue. In our agricultural context it is all the more relevant to know whether the scientists who are joining the National Agricultural Research System (NARS) have chosen Agricultural Sciences as their first choice in spite of other attractive, lucrative and prestigious sciences being available to them. Secondly, it is imperative to know whether the young post graduates of agricultural sciences have opted for a research career in ICAR or for an academic career in SAUs out of interest and commitment or merely as a means for their livelihood. Looking for a job with an assured income and comfort is different in its outlook compared to another person who is looking forward to an enjoyable research or academic career in NARS. Quite often the aptitude of the persons is either totally ignored or not understood at all at the time of recruitment for the vacant positions. Hence, we face a kind of scenario that quite a significant number of young post graduates join the Agricultural Research Service with least knowledge of what is expected of them in a research organization like ICAR. Assumption that securing selection in ARS is like any other government job is perhaps more damaging to the beginning of a research career. Commensurate with this assumption, the actual experience of the individual in the organization subsequently over the years and the perceptual trade off can lead to more strengthening of the assumptions about the organization, and can remain as a perpetual cycle with no scope for improvement. Hence, it is important to realize certain issues that an individual faces during the course of serving the organization for a long period.

## Assumptions and attitudes

Assumptions are typically made about what people seek and what they avoid; how people make choices about what they will do; what they are capable and incapable of accomplishing and so on. From an organizational point of view, the theme of management is having responsibility for the achievement of some intended organizational ends or outcomes - i.e., for getting results, which meet or exceed performance expectations. Achieving results is of particular importance to the organization. An assumption about the organization in which one has chosen to join is very crucial for the individual and its influence on the work behaviour is utmost. For example, the assumption that ARS is a good profession of research and a positive opinion about ICAR/SAUs is highly essential if one wishes to start the career on a right footing. However, in this regard the prestige one attaches to the profession of ARS and the pride one enjoys while working either in ICAR or SAUs play an important role. If such questions are put to the young scientists at the entry level in a non-threatening and informal setting a variety of responses emerge which give a fair hint as to the quality of interactive process between the individual and the organization. The typical questions that one needs to introspectively seek answers are as follows:

1. Why have you chosen agricultural science as your area of professional study?
2. Why have you chosen ARS as a means for your professional career?
3. What is your honest opinion about ICAR as a research organization?
4. Do you personally identify yourself with the designation "Scientist"?

## 5. How do you rate your position in the society as a scientist in ARS?

Quite often while we are socializing outside the organizational spheres we come across many piquant situations, which has a bearing on the way, we look at ourselves. For example, when you introduce yourself to a stranger in public places do you confidently introduce yourself as a scientist or do you avoid the designation of scientist. A lot of scientists have confessed that they feel embarrassed or uncomfortable to own the designation of scientist. On the other hand an academician is quite comfortable with his designation. An IAS officer exhibits a certain degree of pride with regard to his status and designation. Similarly, a doctor, an army officer or an administrative officer and a host of other cadres in a variety of functions and jobs do feel the importance of their position and designation. Contrary to all walks of life, a scientist does exhibit a low self-esteem and a low profile attitude in life. Peer approval in the society and family circle has a lot of influence on the scientist to make him feel comfortable and happy with himself and the organization in which he is employed. It is obvious that people attach a lot of prestige and image to the designations in the organizations. Hence, one important question comes up for a thorough perceptual analysis and understanding.

1. How does a common man view a scientist?
2. How does an educated man view a scientist?
3. How does your family view a scientist?

After having constructed an image as to how the world perceives a scientist, it is quite appropriate to address the above question to yourself i.e., how do you (already a scientist) perceive a scientist to be?

The next question obviously will be - Do you have the requisite qualities and characteristics that the world likes to see in a scientist? (Qualification alone does not make a scientist). Such a perceptual analysis about yourself and the social responsibilities at the entry level at a young age shall foster a spirit of conscientiousness, which shall carry you happily along with the profession and the organization.

Basically there are certain major assumptions about the characteristics of man, which influence his/her behaviour at work. Although people work to earn a living and survive, one should look at man as a system and examine the variables that affect the quantity and quality of his/her work performance and also allow prediction of his/her behaviour in a variety of situations. Several views are expressed and discussed in the following paragraphs.

### **Rational Vs emotional**

Man is seen as systematically collecting information relevant to whatever task is at hand, analyzing that information carefully and logically, weighing and evaluating alternative courses of action and eventually deciding on a line of action in the form of a research project.

On the other hand, man is also “emotional”. Very often interpersonal relationships are governed by emotions (many of which may not be under the voluntary control of the individual). Because of these dialectic behavioural opposites of being rational and emotional, the behavioural responses between a scientist and his/her project team mates/leader may not happen along the expected lines.

### **Behaviouristic Vs phenomenological**

Similarly, a scientist's behaviour can also be controlled by environmental forces meaning any human being can be trained to become any type of specialist that the organization might select regardless of one's talent, abilities, interests, background, etc. However, he can also behave phenomenological as an individual creator/explorer trying to create

information/knowledge. It is suggested to strike a balance between behaviorist and phenomenological responses of the scientist working in an organizational context.

### **Economic Vs self-actualizing**

Another peculiar characteristic of a human being is that his actions are governed by economic considerations. Economic man is basically self-interested. He strives hard to outwit others and does not like to help others. His sole concern is with his very own survival. However, he may work very effectively when his work functions are highly specialized and standardized and he is sufficiently well compensated.

On the other hand, one can also claim that man's behaviour is not always governed by economic considerations. The self-actualizing man is motivated by the opportunity to increase his competence and to grow and develop in the profession and the organization. The individual is not satisfied unless he is doing what he is fitted for. What a man can be, he must be. This refers to his desire for self-fulfillment, and tendency to actualize his potential. It is the desire to become more and more of what one is to become and everything that one is capable of.

### **Man is proactive**

The behaviour of scientists at work is often discussed in terms of the way the individuals react to the organizational policies and practices. Thus, individuals are often seen resisting organizational plans for change or policies or a new pay package or promotional policy, etc. Similarly, taking initiative to work more because of the motivational climate generated by the new leadership or becoming more skilled in their work because of an organizational training scheme and so on.

It is quite true and normal that individuals react and respond to the events, incidents, decisions and opportunities that occur at work places in the organizations and also to similar things in their lives outside the organization. These things often influence their goals and the behaviour they exhibit to obtain the goals. Apart from these, individuals demonstrate a great deal of personal initiative in seeking means to satisfy their personal goals and aspirations.

### **Man is social**

Since people spend substantial part of their lives in organizational settings of one kind or another, hence, membership in organizations is central and a highly important part of their lives. Moreover, some involvement with other people either individually or in groups seems to be inevitable and very necessary to maintain their identity and well being. Social need is the fundamental need for human beings and the sense of belonging to the organization is very strong under conditions of psychological and physical stress.

Thus an individual's mind set towards the organization and the job and his/her own psychological make-up play a significant role in influencing the behaviour at work and performance.

### **Man has various needs**

The most basic need for which people work is to earn a living and survive. When this need is met he/she exhibits several needs in a hierarchical order as per Maslow's classical theory of needs induced motivational theory.

1. Needs for existence include hunger, thirst, air, sex, etc.
2. Security and safety needs
3. Social needs
4. Need for esteem and reputation

5. Need for power and independence
6. Need for competence achievement and self-actualization

In any organizational setting, a scientist may exhibit behaviour to satisfy all the above needs. As the lower order needs are satisfied, higher order needs become more important. A person will be concerned with self-actualization only if the existence needs, security needs, social needs and so on are satisfied. If however, satisfaction of lower order need is threatened, that need will become prepotent and the person will reduce the efforts to satisfy the higher order needs. For instance, if a person's sense of security is endangered, higher order needs such as esteem and self-actualization shall be ignored. It is not always true that every scientist shall follow the same work behaviour pattern as governed by the hierarchy of needs to its logical end. There may be many who may not show any desire for higher order needs even after complete satisfaction of lower order needs. Generally quite a significant number of scientists remain static at the satisfaction of social needs. All those people who are looking for a comfortable job may not make efforts for higher order needs. Since in many organizations some of the higher order needs are governed by seniority and time, hence extra efforts and zeal to fulfill the higher order needs may not be required at a relatively younger age in the true spirit of career building. It is also largely dependent on the individual's aspirations, ambitions and definite chief aim in life. For many scientists social need may be the predominant need and for such people a comfortable job with routine duties is more preferable. Any effort for satisfying higher order needs is an unwanted stress and hence motivational profile for higher performance is practically non-existent. Those who have higher order needs in greater magnitude shall be fiercely determined to achieve their goals and ambitions and their work performance in the organizations shall be of the highest order. In many ways the need-based motivation does play another significant role in the interactive process between an individual and the organization.

### **Individual variables**

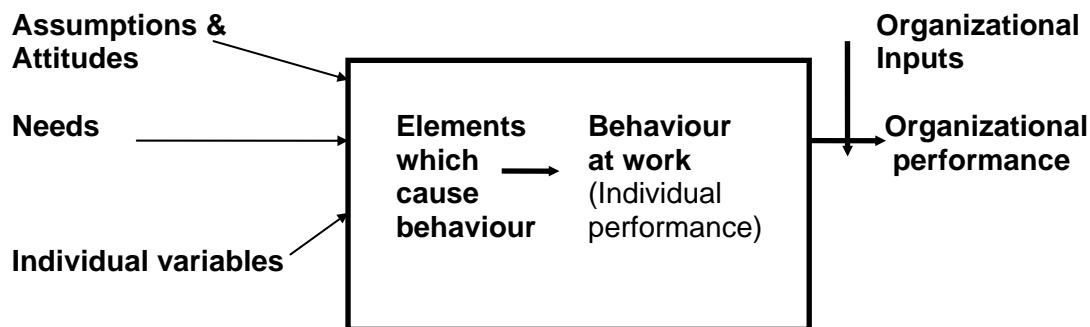
In spite of the major role of the above two factors on the quality and quantity of work performance, there are certain other variables that affect the individuals, which have direct bearing on the work behaviour. These variables are different from person to person in their magnitude and output.

1. Intelligence
2. Ability
3. Health
4. Past experience in life
5. Task/job experience
6. Motivation

The above variables need no special elaboration. The intellectual output of a scientist is very much dependent on the intelligence and the ability. Although scientists in ARS are all selected through the same system of evaluation and scoring but in the final analysis of their output there can be large variations from scientist to scientist. Similarly, two scientists from the same laboratory given the same environment may perform quite differently, two students from the same guide/supervisor during their research degree need not perform exactly alike and quite often exhibit two different personalities. These individual variables are difficult to measure on a given common factor but need to be assessed carefully to understand the individual. Health as an individual variable is quite important as it indicates the enthusiasm and energy one has for the work and it does play a very crucial role. Any person frequently afflicted with health problems may lack the desire and drive for work. One's upbringing and experiences in his/her personal life certainly influences one's approach to work and the dignity he or she derives out of it. It is difficult to conclude based on several theories that the motivational profiles of all the scientists shall be similar. Such an assessment can lead to a lot of disappointment failures to inspire people to work. Especially while dealing with people of high

intellect it should be noted that what can motivate one scientist need not necessarily motivate another. For example, if a reprimand is issued to one scientist it might improve his performance but on the other hand it might prove to be counter productive in another case. Judging people that all are alike when it comes to motivation, perhaps, shall be a mistake if one wants to effectively harness the talent and potential of individual scientists. Thus it is important to notice and understand the individual oddities that occur in a certain set of traits/qualities and realize as to how they influence the work behaviour of individuals.

A simplified overview model of an organizational performance from the behavioural attributes of individual members can be as follows:



Thus it indicates that the organizational performance is a direct consequence of human qualities and behaviour to a great extent than one can visualize. Any organization basically consists of people and hence the quality and quantity of performance and the decisions made by people are all an integral part of behaviour of people at work. The organizational influence by way of policies and systems and other infrastructure facilities are no doubt crucial but so long as the work behaviour of people is not forthcoming positively the organizations can become expensive failures. Hence, it is obvious that an individual scientist is contributing to the organizational performance through his/her work behaviour leading to his or her performance which constitutes to nearly about 75 - 80 per cent of the responsibility. Consider an example for an organizational setting in which two scientists are observed on the same job, under the same supervision. One scientist is turning out high quality research output. He is happy and enjoying the work and seems to be prospering in his job. On the other hand the other scientist is turning out neither high quality nor quantity of research and is always observed to be muttering to himself, unhappy with the work, complaining bitterly about every thing and finding excuse after excuse for not doing any work.

### Individual - Organization interaction

There are four basic features to any organization:

1. WHO: composed of individuals and groups
2. WHY: in order to certain goals and objectives
3. HOW: by means of differentiated functions that are intended to be rationally  
Coordinated and directed
4. WHEN: through time on continuous basis

Individuals as units form an organization and individuals bring several unseen things to the organizations apart from several physical attributes such as aptitudes, abilities, attitudes, personality dispositions, feelings, emotions and the like. One important way that organizations contribute to the interaction is by providing the 'stimuli' to which the individuals in the organization are exposed. These stimuli differ depending on the particular organization and the position of the individual within that organization. But individuals react differently to identical stimuli just as different organizations provide different sets of stimuli to their members. The stimuli may be partitioned into two classes.

1. Expectations/demands
2. Resources

It is particularly suggested that both organizations and individuals bring identifiable demands to the interaction, and each contributes its particular kind of resource as well. The dynamics of individual-organization interaction then have to do with the ways these demands are exchanged and combined.

The overall perspective on the individual-organization interaction is of particular importance for the well-being of both and is called "Psychological Contract". This is relatively permanent at least for many scientists who are with the organization for a long time, and it affects their perception and interpretation of specific events and decisions, which come up during the interactive process. There are strictly two sides to the Psychological Contract i.e. the individual and the organization. It is a set of expectations by the individual towards the organization and what is expected of the individual by the organization and what each party perceives as the fair interchange of demands and expectations.

| <b>What the individual may expect to receive and the organization may expect to give</b>  | <b>What the individual may expect to give and the organization may expect to receive</b>   |
|---|--|
| <ol style="list-style-type: none"> <li>1. Salary</li> <li>2. Personal development opportunities</li> <li>3. Recognition and approval for good work</li> <li>4. Security and fringe benefits</li> <li>5. Friendly and supportive environment</li> <li>6. Fair treatment</li> <li>7. Meaningful or purposeful job with reasonable facilities</li> </ol> | <ol style="list-style-type: none"> <li>1. Sincere and hard work</li> <li>2. Loyalty to organization</li> <li>3. Initiative and creativity</li> <li>4. Identity to organizational goals and norms</li> <li>5. Job efficiency and effectiveness</li> <li>6. Flexibility and willingness to learn and develop</li> <li>7. Willingness to cooperate with fellow researchers</li> </ol> |

The psychological contract in an individual's perspective is an important thing for management to assess and articulate, particularly when an organizational change is being contemplated which could alter the terms of contract.

## **Recognition needs**

Generally the term 'motivation refers to the strength of an individual's propensity to behave in order to gain recognition and rewards. It can be defined as "the conditions responsible for variation in the intensity, quality and direction of on-going behaviour". The conditions are both extrinsic and intrinsic to the individual. Behaviour is also caused by the individual's desire to meet the needs for recognition. Such needs of scientific staff can be satisfied by:

1. Granting reward, promotion or simple pat on the back in public
2. Fulfillment or feeling of mastery over work, process of working and encouraging results.

Scientists' satisfaction can be gauged by the degree to which the scientists feel their personal goals or needs are met as a result of their participation as members of an organization. It has to be recognized that an individual's activities are a function of inputs, the perceived tasks and perceived rewards. He or she then evaluates these inputs according to his current motivation and need strength, which results in attitudes and steering mechanism. This attitude determines his behaviour at work and the quantity and quality of his performance. How to motivate those people who seem to have lost interest and initiative on the job? There is no



ready prescription for this question. Motivation results from interaction of the individual with the organization through his role.

### **Individual - Organization conflicts**

People need organizations and organizations need people. Individuals need organizations as instruments to achieve their goals just as much as organizations use people to achieve objectives. There is a mutual social transaction in which each benefits the other. The interactive process between the individual and the organization may attain a kind of predictable pattern if the individual is in the organization for a very long time. In spite of such a stable relationship certain differences may crop up over issues which may turn out to be conflicts between the two parties. Such conflicts are not totally undesirable. Such conflicts may not totally alter the nature of relationship between the individual and the organization but can prove to be irritants in the progress of the interaction. For example, scientists want independence while bureaucratic organizations want dependence. The result of this conflict is frustration, sense of failure and loss of self-esteem. The existence of such conflicts does not mean that organizations should abolish some of its systems overnight. The conflict should be viewed as an important challenge that requires better resolution for better results. The idea is to have organizations that serve people rather the other way round. Some areas of possible conflict are conformity, slow decision making, victimization, and legitimacy of organizational influence, privacy and disciplinary action.

Every organization develops some conformity through its policies, systems and rules for achieving its objectives. The important point to be considered in connection with conformity is how legitimate these requirements are perceived to be by other people. Influence originated by organizations may be coordinative or substantive. Substantive conformity may be either of action or thought. If of action, it may be on the job or off the job. Organizations cannot generally use its disciplinary power to regulate employee conduct off the job.

There is reasonable amount of agreement concerning areas where organizational influence is considered legitimate. High-legitimacy items related to work behaviour or attitude to work and organization. Items of low-legitimacy primarily are non-job oriented such as family relationships, place of residence, religious and political views. Areas of least-legitimacy are private thoughts, opinions, motives, religious, political and social beliefs. These are part of inner self, and should not be interfered with unless these adversely affect the job performance. Questions of infringements on individual privacy are complex and difficult viz., secret observations, and release of confidential information and spread of rumors. Habits such as alcoholism and drug abuse do have possible influence on the performance of the individual but the organization should deal with such cases without endangering the rights of privacy of the employee.

The employment relationship is two-way. Just as the organization has responsibilities to the individual, similarly the individual has responsibilities to the organization. Each individual invests his life into the organization; works for it expects profitable returns. Similarly the organization also invests in the individual and it too expects profitable returns. Hence, there is a mutual obligation between the employee and the organization to support each other's activities. This obligation does not extend to support illegal activities or those, which violate social standards or the individual's private conscience.

# **GROUPS IN ORGANIZATION**

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Principal Scientist

## **Definition of a group**

It is generally difficult to define a group independent of some specific purpose or frame of reference. Since we are dealing with behavioural problems in organizations, it would appear appropriate to define the group in psychological terms. A psychological group is any number of people who: 1) interact with one another 2) are psychologically aware of one another and 3) perceive themselves to be group. Mere aggregates of people do not fit this definition because they do not interact and do not perceive themselves to be a group e.g., a crowd in a street watching some event, a total department, a union or a whole organization.

While the existence of groups in organizations probably does not alter individual's motivations or needs, the group does influence the behaviour of individuals in an organization. Organizational behaviour is not the sum or product of individual's behaviour but rather a much more complex phenomenon. The division of labour basically breaks an organization into groups.

## **Types of groups in organizations**

Formal groups are created in order to achieve specific mandate or specific goal and carry on specific task, which are related to the total institutional mission. Based on their duration two types of formal groups exist: (a) Permanent or command groups comprising of the subordinates who report directly to a given supervisor specified or designated by the organizational chart e.g., the authority relationship between a departmental head and the subordinates of the department. (b) Temporary or Task groups comprising of employees or scientists who work together to complete a particular task or project. For example the various functional committees in an institute or a task force of scientists to attend to specific projects within a time frame which contribute directly to the institutional responsibilities. These temporary formal groups cease to exist after the task is completed.

Informal groups are natural groupings of people in the work situation in response to social needs. Because man has needs beyond the minimum ones of doing his job, he will seek fulfillment of some of these needs through developing a variety of relationships with other members of the organizations.

The following informal groups may be found in organizations:

(a) Horizontal Clique: Informal association of workers, scientists or other employees who are more or less of the same rank and work more or less in the same area. E.g. grouping of all newly recruited scientists of an institute.

(b) Vertical clique: A group composed of members from different levels within a given department or a campus viz. Grouping of people of the same language or of the same State or University. Such grouping of people comes into being because of affinities due to language, caste, region or earlier acquaintance of the members or they need each other to accomplish their social needs or any other goals.

(c) Mixed (random) cliques: These groups consist of members of different ranks from different departments, and from different physical locations. Such groups may arise to serve common interests or to fulfill functional needs which are not taken care of by the organization. For

example, ARS Forum of ICAR or Professional scientific bodies like Society of Biological Chemists, Indian Science Congress, Animal Nutrition Research Workers Conference of India, All Indian Veterinary Association, etc. Recognition of these outside associations by the organizations is optional and the membership is voluntary. Although these groups are informal in nature but they do tend to get formalised in due course as these groups grow in size and develop a hierarchical structure and sponsorship from the organization.

### **Why people form groups?**

Formal and informal groups form because of various reasons some of the reasons concerned are needs, proximity, attraction and goals.

**Satisfaction of needs:** (Psychological functions) (a) As an outlet for affiliation needs friendship, support and love (b) As a means of developing, enhancing or confirming a sense of identity and self-esteem. A certain group may be viewed by employees as being a high-prestige group for technical competence or outside activities, and so on. Membership in such a group can provide needs satisfaction for employees with high esteem needs. (c) As a means of increasing security and a sense of power in coping with a common and powerful enemy or threat. (d) As a means of getting some jobs done which members need to have done such as gathering information or helping out when some fall sick or bringing new members of the organization quickly into the informal structure, etc.

**Proximity and attraction :** Interpersonal interaction can result in-group formation. Proximity means physical distance between employees performing a job. Attraction to each other may be due to perceptual, attitudinal, performance or motivational similarity.

**Economic reasons :** In many cases groups form because individuals believe that they can derive greater economic benefits from their jobs if they form groups.

**Group goals :** The goals of a group can attract the individuals to a group. Most groups turn out to have both formal and informal functions; they serve the needs of both the organization and the individual members. Psychological groups, therefore, may well be the key unit for facilitating the integration of organizational goals and personal needs. An informal group can be used as a channel of communication to obtain information about the various parts of the organization.

The problem here is to discover the conditions which will make such groups use their informal resources for the fulfillment of organizational goals instead of defeating the same or competing with one another thereby undermining organizational integration.

### **Variables affecting the integration in groups of organizational goals and personal needs**

#### **Environmental factors:**

The cultural social and technological climate in which the group exists has an impact. The organization of work, the physical location of workers and the time schedule will determine who will interact with whom and which people are likely to form groups. The work environment should encourage the emergence of 'logical' groups to fulfill organizational tasks. In many cases the nature of location of a job requires effective group action e.g. The degree to which such locally designed groups come to serve psychological needs will depend upon the managerial climate i.e., prevailing assumptions about the nature of man. In a climate built on assumptions of rational-economic man, defensive anti-management informal groups are most likely to develop. One of the primary psychological functions is to enable members to feel more secure and to gain power for use against management. A secondary function is to obtain status and self esteem which the formal organization denies the worker through the demeaning nature of work itself.

An organization with the "Social man" philosophy maintains job design and job allocation on the assumptions of rational-economic man but meets the man's affiliate needs by creating various social groups external to the work organization e.g., picnics, games and social activities. In exchange for fulfillment of his social needs, a man should work harder on his individually designed job. This logic does not permit the integration of formal and informal group forces.

An organization built on the assumptions and values of self-actualising man is conducive for the emergence of psychologically meaningful groups but research organizations or university departments give much emphasis to individual and very little to collective effort. They fail to see the importance of groups as a means for individual self-actualisation.

The effective integration of organizational goals and personal needs require an environment based on the values of a complex man. Some of the following factors affect the environment.

1. Nature of research
2. Behaviour of past project groups
3. Standard of scientists available
4. Ability of scientists to form groups
5. Team leadership
6. Assumptions and values

#### **Membership factors:**

a) The effective functioning of a group on an organizational task and at the same time serve the needs of the members, depends in part on the group composition. There must be a certain amount **of consensus on basic values and on medium of communication**. The relative status of the members should be carefully assessed because a lower-ranking member may be afraid of giving accurate information to a higher-ranking member for fear or other reasons. Such a group is ineffective for problem solving.

b) Another difficult group is a committee composed of representatives of various departments of the organization where each person is more concerned about the group he comes from rather than identify with the new committee.

c) An inadequate distribution of relevant abilities and skills may be another membership problem. It is important to consider the characteristics of the members and to assess the likelihood of their being able to work with one another and serve one another's needs.

d) Norms and procedures that are followed by the members collectively shall have great influence on the integration of the group

e) The groups develop and function well if there are less status differences among the members or if the status differences are given least importance. Such an effort leads to more cohesiveness among the members.

f) It is also necessary for the members to subordinate their individual needs to the group goals.

#### **I. Dynamics factors:**

Dynamic factors are those events and processes which occur during the life of the group or which lead up to the formation of the group, viz., the manner in which members are oriented to and brought into the group, the structure emerging out of the actual interaction of the members (as contrasted with the imposed structure). Groups are not static, rigid or unchangeable. In fact, groups should be helped to change, grow and become more effective.

Some of the dynamic factors which influence the group integration need special attention from time to time. There are as follows:

- 1) Leadership styles
- 2) Training of scientists
- 3) Progress of group (periodically)
- 4) Equipment and facilities for research
- 5) Openers in communication
- 6) Conflict resolution
- 7) Events that occur while working together

### **Group development :**

Groups develop at different rates and with unique patterns depending on the task, the setting, the membership's individual characteristics and behavioural patterns and the manager's style of managing. The performance of a group depends on both individual learning and how well the members learn to work with each other.

A research project group or a problem solving group passes through four stages of development : 1. Mutual acceptance. 2. Communication and decision-making. 3. Motivation and productivity. 4. Control and organization. A training group engaged in formal organization training has the following sequence of group development : 1. Testing and dependence 2. Intra-group conflict 3. Development of group cohesion 4. Functional role-relatedness.

### **Characteristics of groups**

1. **Structure** : The group members are differentiated on the basis of such factors as expertise, aggressiveness, power and status. Each member occupies a position in the group. The pattern of relationships among the positions constitutes a group structure.

2. **Status and hierarchy** : Status differences exert a powerful influence upon the pattern and content of communications in a group.

3. **Role** : Each position in the group structure has an associated role which consists of the expected behaviours of the occupant of that position. The expected behaviours are generally agreed upon both by the occupant and other members of the group. There are 3 types of roles : expected role, perceived role and enacted role. There is a possibility of conflict and frustration resulting from differences in these three role types. Individuals, because of membership in different groups, perform multiple roles. These multiple roles result in a number of expected role behaviours. When there is no compatibility in the behaviours specified by different roles, the individual experience role conflict.

4. **Norms** : are the standards that are shared by members of the group. Norms may be accepted in various degrees by group members and they may apply to every member or to only some group members.

5. **Norm conformity** : Why do employees conform to group norms? This is very important in case of a person performing below their capacity. Conformity is a requirement of sustained membership and the member who does not conform to important norms is often punished by a group (e.g. Isolation, ignoring etc.) One potential positive consequence of conformity is that a manager can predict the group behaviour.

6. **Leadership role in groups** is an extremely crucial group characteristic. The leader of a formal group exercises legitimate power. The person who becomes a leader in an informal group is generally viewed as a respected and prestigious member who aids the group in achieving its goals, enables members to satisfy needs, embodies the values of the group, facilitates group conflict, initiates group actions and maintains the group as a functioning unit.

7. **Cohesiveness** : Groups possess a closeness or commonness of attitude, behaviour and performance. A cohesive group consists of individuals attracted to each other. This attraction may be due to the goals of the group, its charismatic leader, and its reputation, freedom for members for expressing their opinions and mutual support and personal growth. In a cohesive group we may expect effective group performance but sometimes this may not be correct, particularly if group norms are inconsistent with those of the organization. Pressure to conform to group norms is more intensive in a cohesive group.

8. **Inter-group conflict** : Sometimes there are conflicts between groups, the consequences of which may be sometimes good and sometimes bad to the organization.

The above characteristics of a group provide a degree of predictability for the membership behaviour patterns that are important to the group and to others (management, other groups). A group that is unstable or unpredictable is a problem to members and others who interact with it.

### **The concept of role :**

The term role refers to the expected behaviour patterns attributed to a particular position. An individual performs multiple roles and for each position there may be different role relationships. For example, a Director of Research Institute may be besides directing research, a teacher, administrator, or member of a social service organization. Each group may expect different things. This is termed role set. In organizations there may be as many as three perceptions of the same role : the organization's, the group's and the individual's. When an individual faces a situation of the simultaneous occurrence of two or more role requirements, the individual experiences role conflict. Three different types of role conflict are :

a) Person-role conflict occurs when role requirements violate the basic values, attitudes and needs of the individual occupying the position, viz., a person may resign a job if it involves some unethical activities.

b) Intra-role conflict occurs when different individuals define a role according to different sets of expectations, making it impossible for the person occupying the role to satisfy all.

c) Inter-role conflict occurs because individuals simultaneously perform many roles, some of which have conflict expectations. viz., a scientist who is a member of the administrative group may experience a role conflict of this type. Inter-role conflict is often the cause of conflict between groups in many organizations. Each of the above conflicts is important since research has shown that the consequences of the individual are increased psychological stress and other emotional reactions. Management can minimize certain types and should be continually aware that the consequences of role conflict to the organization are ineffective performance of individuals and groups.

### **The nature of highly effective groups**

Groups have great potential power to build effective organizations. They can have constructive or destructive goals and can achieve these goals fully or partially. There is nothing inherently good or bad about groups. According to Likert, an organization which makes the greatest use of human capacity consists of highly effective work groups linked together in an overlapping pattern by other similarly effective groups. Some business executives are highly critical of groups or committees and the inability of committees to accomplish a great deal. It is desirable to keep the groups as small as possible for effective functioning.

The properties and performance characteristics of the ideal highly effective group according to Likert, are as follows:

1. The group is conceived as part of a larger organization
2. The members are skilled in all the various leadership and membership roles and functions.
3. There is a well established, relaxed working relationship among all its members
4. The members are attracted to the group and loyal to its members.
5. The members and leaders have high degree of confidence and trust in each other.
6. The values and goals of the group are a satisfactory integration and expression of the relevant values and needs of its members.
7. The members of the group performing linking functions endeavour to have values and goals of the groups which they link in harmony, one with the other.
8. The more important a value seems to the group, the greater the likelihood that the individual member will accept it.
9. The members of the group are highly motivated to abide by the major values and to achieve the important goals of the group.
10. The entire interaction, problem-solving, decision-making activities of the group occur in a supportive atmosphere. Respect is shown for the point of view of others. Ego forces directed towards a sense of personal worth and importance are not allowed to disrupt important group tasks. Members are able to accept any criticism and make constructive use of it.
11. The leader adheres to those principles of leadership which create a supportive atmosphere.
12. The group is eager to help each member develop to his full potential.
13. Each member accepts willingly and without resentment the goals and expectations that he and his group establish for themselves.
14. The leader and the members believe that nothing is impossible and set high goals.
15. Mutual help among the members
16. The supportive atmosphere of the highly effective group stimulates creativity.
17. The group knows the value of "constructive" conformity and knows when to use it and for what purpose. It does not permit conformity to affect adversely the creative efforts of its members.
18. There is a strong motivation on the part of each member to communicate fully and frankly to the group all the information which is relevant and of value to the group's activity.
19. There is a high motivation in the group to use the communication process so that it best serves the interest and goals of the group.
20. There is a strong motivation in the group to receive communications.
21. There are strong motivations to try to influence other members as well as to be receptive to influence by them.
22. The group processes enable the member to exert more influence on the leader and to communicate far more information to him.
23. The ability of the members of a group to influence each other contributes to the flexibility and adaptability of the group.
24. Individual members feel secure in making decisions which seem appropriate to them.
25. The leader of a highly effective group is selected carefully. His leadership ability is so evident that he would probably emerge as a leader in any unstructured situation.

### **Role of membership and leadership:**

In the highly effective groups, many functions are performed either by the leader or by the members depending upon the situation. The leader and members, as part of their roles in the group establish and maintain an atmosphere and relationships which enable the communication, influence, decision-making and similar processes of the group to be performed effectively. According to Benne and Sheats (1948) group roles can be classified into two categories.

#### **1. Group task roles :**

These roles are related to the task which the group is deciding to undertake or has undertaken. They are directly concerned with the group effort in the selection, definition and solution of a common problem.

These roles deal with the intellectual aspects of the group's work and performed by the members during the problem-solving process. These roles may be: initiating-contributing,

information/opinion seeking and giving, elaborating, co-ordinating, orienting, evaluating, energising, assisting and recording, etc.

## **2. Group building and maintenance roles:**

These roles are concerned with the emotional life of the group. They deal with the group's efforts to strengthen, regulate and perpetuate the group as a group viz. group's attractiveness to its members, its warmth and supportiveness, its motivation and capacity to handle problems. These roles may be: encouraging, harmonising compromising, gate keeping (keeping communication channels open), setting standards, observing and following:

### **Increasing effectiveness of a group:**

One major determinant of group effectiveness is the sensitivity and skill of group members and formal leaders in diagnosing and working on the problems which the groups generate : for example, failing to pay attention to each other; lack of respect for one another; members being preoccupied with their own problems of status, security, influence, comfort, failure to listen to others; leaders failing to sense either of the above problems; leaders or members being insensitive to status differentials within the group, which unless resolved block communication; leaders or members failing to note and evaluate group norms and pressures towards conformity. Such sensitivity and skill can be best obtained by the laboratory method of training where the participant learns from an analysis of his own experiences and feelings in group situations.

Group history and tradition has to be taken into consideration for its effective functioning. When there is a change of leadership, the new leader cannot impose his particular conception of how the group should operate unless he adapts to the major norms and traditions of the group. If he persists, he may either reduce the effectiveness of the group or undermine its existence.

### **Leadership :**

According to Fielder one characteristic of an effective group is that the accepted leader perceives greater differences among his members. Groups have to accomplish tasks as well as fulfill emotional needs and leadership consists of behaviour which helps the group to achieve one or the other. These are called as "task" and "Socio-emotional" leaders. The task leader is not necessarily an socio-emotional leader. In fact, the two roles tend to be taken by different persons.

### **Groups vs. individual performance :**

A great deal of research has been done on the question of whether the group or isolated individuals whose work can be pooled is the more effective problem solving instrument. No definitive answer has yet been reached but some key variables have been identified and some myths have been exploded. It is believed that groups are very slow and inefficient but there is case evidence to show that a group can work more quickly and efficiently than any single member alone, if there is mutual trust and confidence among the members. A group can be more creative than individuals because of mutual stimulation under certain circumstances. It is easier to identify errors of judgement by a group than by an individual. One of the most important criteria for determining whether to use a group in making a decision involves an assessment of why and how the decision is to be implemented. People are most likely to carry out a decision that they have had a hand in making than the one that has been imposed.

### **Inter-groups problems in organizations**

The main problem of any group in an organization is fulfilling both organizational goals and the a needs of the members, and the second problem is to maintain cordial (relations) conditions between groups which will increase the productivity of the group without destroying the inter-group relations and coordination. As groups become committed to their own goals and norms, they compete with each other undermining their rival's activities and in due course become a problem for the organization as a whole. Some of the consequences of inter-group competition are :



(A) **Within the group:** (1) each group becomes more closely knit and expects greater loyalty from its members (2) group climate changes from informal to task oriented (3) Leadership tends to change from democratic to autocratic (4) each group becomes highly structured and organised (5) each group demands more conformity from its members.

(B) **Between the competing groups:** (1) each group begins to see the other groups as the enemy, (2) each group begins to experience distortions of perception i.e. tends to see the best parts of itself and the worst parts of the other group (3) there is a decrease in the interaction with the other groups and an increase in hostility towards them (4) Members of a group tend to listen only that which supports their own position. In inter-group competition the same factors which improve intra-group effectiveness may have negative consequences for inter-group effectiveness.

When intra-organizational situations become win or lose affairs the following consequences can be observed :

(A) **Winner:** 1. The group becomes more cohesive 2. Winner tends to release tension and becomes relaxed. 3. There will be high intra-group cooperation and concern for members' needs. 4. Winner becomes complacent and does not evaluate its performance and learn how to improve them.

(B) **Loser:** 1. Tends to find out excuses or scapegoats for failure. 2. The group tends to break and unresolved conflicts come to the surface in an effort to find a cause for the loss. 3. Becomes more tense and desperate trying to throw the blame on somebody e.g. Leader, judges, 4. Tends towards low intra-group cooperation with low concern for members and high concern for recouping by working harder 5. Tends to learn about itself and tries to have a realistic revaluation of itself and in doing so may become more cohesive and effective. The inter-group tension increases after the competition.

Sometimes inter-group competition is advantageous for example, when groups compete for increasing production and sometimes disadvantageous, forcing the management to take steps to reduce the inter-group tension. The fundamental problem of inter-group competition is the conflict of goals and breakdown of interaction and communication between the groups leading to perceptual distortion and mutual negative stereotyping. The basic strategy of reducing conflict, therefore, is to find goals upon which groups can agree and re-establish valid communication between the groups. The following tactics (or any combination of them) will help in reducing the conflict: 1. Locating a common enemy 2. Locating a superordinate goal 3. Through laboratory training methods, 4. Preventing the inter-group conflict by establishing from the outset organizational climate, which stimulates collaboration rather than competition. This preventive strategy does not imply absence of disagreement or conflict within or between groups. Conflict and disagreement at the level of group or organizational task is not only desirable but also essential for achieving best solutions to the problems, what is harmful is interpersonal or inter-group conflict in which task is not as important as gaining advantage over the other person or group.

# MOTIVATION IN WORK ENVIRONMENT

## Introduction

The main needs and expectations to be taken into account in considering the motivation of people at work are described below:

Most of the working people have their physiological, security and belongingness needs satisfied. Their behaviour is mostly directed towards satisfying the fourth order needs of power, prestige and status. These are also called 'ego needs' or 'esteem needs' or 'social motives'. These needs have been found to influence work behaviour of people in different work settings. These needs are described below:

A) The need for activity is a desire for constantly doing things. This kind of person is a hard worker. The opposite of this is passivity, which is also a need to be relax and not to be disturbed.

B) The need for extension is a desire to be helpful to others, and to provide one's services to the organization or nation. People dominated by this need will be good social workers and maintain good interpersonal relations.

C) The need for dependence is the need to consult others before making any decision. Such people feel insecure and want to be protected. They lack initiative, and always look for direction from others.

D) The need for independence is a desire to do things individually and to be one's own self. They prefer freedom, like to make decisions. They dislike interference. They may consult others but do not seek approval.

E) The need for power is a desire to influence others and gain control over them. Such people like to lead and enjoy giving directions to others. They are argumentative and seek leadership positions.

F) They need for aggression creates a desire to dominate others and to demonstrate one's own strength at times, even physically. These people talk loud, are argumentative and may get into physical fights.

G) The need for status and prestige is a desire to be respected and treated with deference specially by others in the social situations. These people are status conscious, they may run for offices and show authoritarian tendencies when working with others.

H) The need for recognition demands recognition for one's accomplishments. These people may be completely demotivated if their work is not immediately recognized.

I) The need for achievement is a concern for excellence. People dominated by this need are generally active, work hard, set high goals, take challenging tasks, desire pleasure from doing difficult things and look for quality.

In addition to the nine important needs mentioned above, there are two others that fall into second and third order needs that are important in the work place. These are the need for security and the need for affiliation.

J) The need for security is the need to be secure about one's own livelihood and to be sure to continue to have it. The domination by this need calls for economic security and causes frustration at lack of job. If people grumble about the job or save money for future, they are expressing a deficiency in this area, and the organizational policies are worth looking at.

K) The need for affiliation is a concern for establishing or maintaining warm and affectionate relations with others. To fulfill this need, people join groups, invite people and develop attachment.

The satisfaction of these eleven needs mentioned above are important in the work place. The organization must provide opportunities to satisfy these needs to ensure a motivating environment in the work place. Understanding these needs and behaviour indicators of these motives help us to understand the people. Each person is different and unique, and has a different mix of these needs in different degree in him/her. This must be appreciated and the working environment must be so structured that it provides opportunities for satisfying these needs. If these are considered carefully then there can be high motivation of people at work.

It is important to create conditions where scientists and other workers' energies are not expended totally in meeting their basic needs, but where opportunities exist to satisfy higher order needs. Create a climate for inter-dependent work rather than dependency. In the work place, create a competitive climate through recognition of good work and a productive climate through personal example. The emphasis should be on problem-solving rather than avoidance and attempt should be to motivate individually through guidance and counselling.

Various studies have been conducted for the management of motivation in the work situation. It is worthwhile to examine the results of some of these studies. The first of these studies is the Hawthorne experiment. In 1924, efficiency experts at the Hawthorne, Illinois, plant of the Western Electric Company designed a research programme to study the effects of illumination on productivity.

### **Hawthorne Studies - Elton Mayo**

In the initial study of Hawthorne, efficiency experts assumed that increases in illumination would result in higher output. Two groups of employees were selected: an experimental or test group, which worked under varying degrees of light, and a control group, which worked under normal illumination conditions in the plant. As lighting power was increased, the output of the test group went up as anticipated. Unexpectedly, however, the output of the control group went up also - without any increase in light. Mayo and his associates discovered that the answer to this phenomenon was not in the production conditions aspect of the experiment, but in the human aspect. As a result of the attention lavished upon them by experimenters, the employees were made to feel they were an important part of the company. They no longer viewed themselves as isolated individuals but had become members of a congenial, cohesive work group. The relationships that developed elicited feelings of affiliation, competence and achievement. This led to the conclusion that the most significant factor affecting organizational productivity is the interpersonal relationships that develop on the job, not just pay and working conditions. The work of Mayo paved the way for the development of the now classic "Theory X - Theory Y" by Douglas Mc Gregor.

### **Theory X and Theory Y (Douglas Mc Gregor)**

According to the Mc Gregor, traditional organization with its centralized decision making, superior - subordinate pyramid, and external control of work, is based upon certain assumptions about human nature and human motivation. These assumptions which he describes as Theory X, are, that most people prefer to be directed, are not interested in assuming responsibility, and want safety above all. Accompanying this philosophy is the belief

that people are motivated by money, fringe benefits, and the threat of punishment. Mc Gregor found this a questionable method for motivating people whose physiological and safety needs are reasonably satisfied and whose social, esteem and self-actualization needs are becoming predominant. He felt that management needed practices based on a more accurate understanding of human nature and motivation. As a result of these feelings he developed an alternate theory of human behaviour called Theory Y. This theory assumes that people are not, by nature, lazy and unreliable. It postulates that people can be basically self-directed and creative at work if properly motivated. Therefore, it should be the essential task of management to unleash this potential in individuals. The properly motivated people can achieve their own goals best by directing their own efforts towards accomplishing organizational goals.

The impression that one might get from the discussion of Theory - X and Theory - Y is that managers who accept Theory X usually direct, control, and closely supervise people, while Theory Y managers are supportive and facilitating. This kind of conclusion could lead to the trap of thinking that Theory X is 'bad' and Theory Y is 'good'. Although the best assumptions for a manager to have may be Theory Y, it may not be appropriate to behave consistent with those assumptions all the time. Managers may have Theory Y assumptions about human nature, but they may find it necessary to behave in a very directive, controlling manner (as if they had Theory X assumptions) with some people in the short run to help them "grow up" in a developmental sense, until they are truly Theory Y people.

**Table 1: List of assumptions about human nature that underline Mc Gregor's Theory X and Theory Y**

| <b>Theory X</b>   | <b>Theory Y</b>  |
|---|--|
| Work is inherently distasteful to most people.  | Work is as natural as play, if the conditions are favourable.  |
| Most people are not ambitious, have little desire for responsibility, and prefers to be directed. | Self-control is often indispensable in achieving organizational goals.   |
| Most people have little capacity for creativity in solving organizational problems.               | The capacity for creativity in solving organizational problems is widely disturbed in the population.                |
| Motivation occurs only at the physiological and safety levels.                                    | Motivation occurs at the social, esteem and self-actualization levels, as well as physiological and security levels. |
| Most people must be closely controlled and often coerced to achieve organizational objectives.    | People can be self-directed and creative at work if properly motivated.  |

### **Motivation - Hygiene theory (Frederick Herzberg)**

Herzberg found that people have two different categories of needs in the work situation, and these are essentially independent of each other and affect behaviour in different ways. He found that when people felt dissatisfied with their jobs, they were concerned about the environment in which they were working. On the other hand, when people felt good about their jobs, this had to do with the work itself. Herzberg called the first category of needs hygiene or maintenance factors: Hygiene because they describe people's environment and serve their primary function of preventing job dissatisfaction; maintenance because they are never

completely satisfied - they have to continue to be maintained. He called the second category of needs, motivators since they seemed to be effective in motivating people to superior performance.

**Table 2 : Motivation and hygiene factors**

| Hygiene Factors             | Motivators                     |
|-----------------------------|--------------------------------|
| Environment                 | The job itself                 |
| Policies and administration | Achievement                    |
| Supervision                 | Recognition for accomplishment |
| Working conditions          | Challenging work               |
| Interpersonal relations     | Increased responsibility       |
| Money, status, security     | Growth and Development         |

The hygiene factors, if absent, will cause dissatisfaction but their presence does not create positive motivation. In the presence of satisfactory hygiene factors, motivators are necessary to stimulate positive motivation. Hygiene factors, when satisfied, tend to eliminate dissatisfaction and work restriction, but they do little to motivate an individual to superior performance or increased capacity. Satisfaction of the motivators, however, will permit an individual to grow and develop in a mature way, often implementing an increase in ability. Thus, hygiene factors affect an individual's willingness or motivation, and motivators impact an individual's ability.

### **Needs theory (David Mc Clelland):**

Another model for work related motivation is that of MC Clelland. He studied the basic needs and concerns that people frequently express, and divided them into three groups : People with a high need for achievement, those with high need for power and the third with a high need for affiliation. Every one has each of these needs to some degree, but seldom in the same strength. A person may be high in the need for power, low in the need for achievement, and moderate in the need for power. Such people would tend to think more about friendship than about doing a good job or controlling others. Their motivation to work will be of different order than that of an employee who is high in achievement motivation and low in affiliation and power motivation.

Competitive behaviour results from high need for power and collaborative behaviour results from a high need for affiliation while competitive and/or collaborative behaviour may result from high need for achievement. We often define a situation as being a 'Zero-sum' power game (If you win, I must lose). Our definition causes us to behave in a certain way - i.e. to compete instead of collaborative in order to achieve our goals. But this does not mean that competitive behaviour is always bad and collaborative behaviour is always good. The salient issues are :

1. Under what conditions are the two forms of behaviour appropriate?
2. What kinds of factors cause us to misread a given situation and what are the consequences?

Unfortunately, in most of the social situations we find ourselves neither purely competitive nor purely collaborative. One complication is that we frequently have to play the competitive and the collaborative games simultaneously, such as when we are trying to problem-solve with the same persons with whom we are competing for promotion. However, it is fortunate that in the ICAR personnel policy, at least at the lower level it is laid out that promotion is person-oriented and not post-oriented. One does not compete with one's colleagues but with one's own past and with one's own potential, a case for arousing the need for self-actualization and situation for self-motivation. Unfortunately, at the higher level, there is no career advancement by assessment and promotions irrespective of the number of posts. Thus the promotion is post oriented where all people compete to fill a limited number of higher research management posts.

A second complication arises from the fact that we frequently cannot accurately diagnose a situation as competitive or collaborative until we know how the other participants are viewing it and how they will behave. People do not collaborate in what is logically a collaborative situation, because they cannot trust others to do the same. What is required, is influencing the behaviour of the others through communication and trust building.

Some people may approach every situation as if it were a competitive game, e.g. they will transport every discussion into a debate. Others will approach every situation as if it were a collaborative game. Another will tend to see the objective reality of the situation, and choose approaches that are appropriate. The first type can be called cynical, the second naive, and the third realistic.

In which category do you and your colleagues fall?

The common problem we generally face today is cynicism - we characteristically approach situations as if they are competitive even when they are not. The conflicts between the senior and junior scientists, and the problems of sharing the facilities result from these attitude. It is now time to wonder if the game might have some collaborative aspects. Attitude changes plays a key role in permitting collaborative behaviour to substitute competitive behaviour. The important thing is that the parties begin to know each other, and have some trust in each other (if not positive feelings). They can begin to re-examine the situation to find the collaborative aspects that will facilitate the goal achievement of both parties.

### **Relationship between different models:**

The needs identified in Mc Clelland's framework are similar to Maslow's higher-order needs and Herzberg's motivational factors. The relationship is presented in the following table:

### **Motivation and work**

The question asked is "How can I increase motivation to work at our task?" We have to aim allowing employees to work on higher order needs (achievement, self-esteem, self-actualization) while working towards organizational goals. Assuming that lower order needs are met, a motivating climate would have these factors :

1. The work itself must allow opportunities for employees to satisfy their higher-order needs.
2. The employees must be involved in determining what needs are important and what will be done to satisfy those needs.
3. The immediate work context must be supportive of these efforts at improvement.

**Table 3 : Relationship between different models**

| Maslow's Need<br>Priority Model       | Herzberg's Motivation<br>- Hygiene Model                                 | Mc Clelland's<br>Needs Model |
|---------------------------------------|--|------------------------------|
| <b>Motivators</b>                     |  |                              |
| Self-actualization<br>and fulfillment | Work itself<br>achievement<br>Possibility of<br>growth<br>responsibility | Need for<br>achievement      |
| Esteem and Status                     | Advancement<br>Recognition   |                              |
| <b>Hygiene Factors</b>                |  |                              |
| Belonging and<br>Social needs         | Interpersonal rela-<br>tions, supervision,<br>peers & subordinates       | Need for<br>affiliation      |
| Safety and<br>security needs          | Company policy and<br>Administration<br>Job security                     |                              |
|                                       | Working<br>Conditions  |                              |
| Physiological needs                   | Salary<br>Personal life  |                              |

Given these factors, three major types of interventions may be applied to work situations in an attempt to make them more motivating.

1. Data feed-back methods, in which information about the state of the organization is collected from employees, organized and fed back to them as a basis for collaborative problem solving.
2. Job enrichment methods, which attempt to change the nature of job by broadening responsibilities, giving more autonomy for decision making and generally enlarging the scope of the job.

3. Socio-technical system interventions, which attempt to match the necessary technology of the job with the social needs of the employees.

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# SCIENTIFIC VALUES AND PROFESSIONAL ETHICS IN AGRICULTURAL RESEARCH

**Jagannadham Challa**

Principal Scientist

## 1. Introduction

The focus of attention in science has shifted from physical to life sciences during this century, especially so during the last twenty years. The unraveling of DNA and the subsequent discoveries have opened up enormous possibilities in biology, more so, in agriculture. For a common man, the high profile biological research of the present is a new frontier of hope. He perceives science through technology for his betterment. Science and technology have become household topics. Twentieth Century has witnessed tremendous leaps and advances in science and technology both in physical and biological sciences. However, 21st Century holds a lot of promise for biology scientists, and there are greater challenges ahead.

Science, as we all know, is a study of nature or facts of the world around us. It is universal, and results of scientific research are considered to be the property of mankind. However, technology is not universal and need not be so. Developers of technology claim ownership and that makes the differences between a rich nation and a poor nation. There is no technology without science but there is a lot of science which does not lead to technology. For a common man, it is the technology that matters. Science is of academic interest but technology is of topical interest. Text books of science are freely available but manuals of technology are available at a premium. Hence, there is a great deal of social responsibility on part of scientists, and have a very special role to play for the sake of their nation. It is expected of the scientists to play that special role to solve the pressing problems of mankind in the 21st century which are, to name a few, population control, food production, malnutrition, health, AIDS, environment, energy resources. Social responsibility, scientific values and professional ethics of scientists are the great attributes that draw the line of difference between a research organization and any other organization.

A scientist is more like a composer or an artist since his intuition and personality play a significant role in opening up of pathways of research. Many great scientists of the past were great personalities with a strong sense of imagination. Qualities such as deep interest, persistence, have often been identified with successful scientists. One can go on listing several qualities for scientists. But all the great scientists have shown respect for scientific values and professional ethics. It is the aim of this paper to discuss a few issues wherein scientific values and professional ethics are compromised so as to check the trend of value-unlearning among young scientists.

## II. Polycentric approach

Scientific research is truly international in character. It is neither a personal domain nor a personal hobby. Scientific research is a national subject. Public at large are indirectly involved in financing for research work. Research is financed from different sources. Gone are the days where an individual saves his money and finances himself to carry out research as an obsession. Research is institutionalized and establishment oriented. Finance, infrastructure policies, systems, priorities, manpower, training are some of the visible and invisible inputs that we talk of for a research organization. One qualifies as a scientist at the expense of the state and continues to work and live at the expense of the state. The element of trust reposed on a scientist is perhaps unmatched and yet there are no stringent accountability measures on scientists.

Polycentric approach is also reflected in different possibilities of publishing the results obtained by scientific research. Similar to the fact that research finance comes from different sources, the research results are also published in different forums. Research journals have all

along enjoyed the status of autonomy and independence in decision-making. No censorship has ever been imposed by any nation either by law or by statutes. No matter what the form of government a nation is having there has been neither prejudice nor administrative pressure on scientific journals.

This relative freedom, to express one's opinions and conclusions through results, has been the greatest character of scientific journals. Every publication of research results and ideas should include some elements of novelty. Several questions need to be addressed.

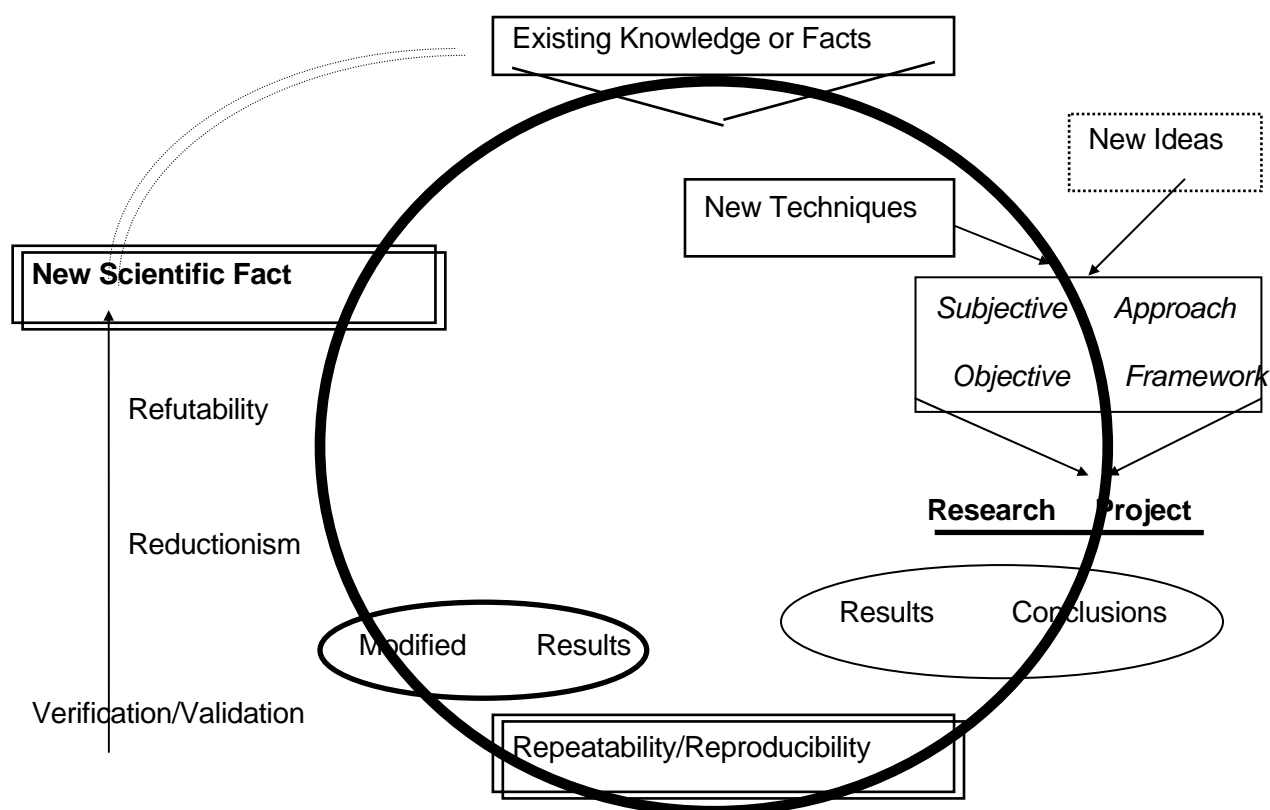
1. Are the objectives for which the project is set out worth the expenditure?
2. Have all the results obtained been documented, analyzed and published?
3. Is there an element of novelty either in the experimentation or in the results and ideas that are being published?
4. Has every result of students' research projects been published for scientific scrutiny?
5. Is every research paper presented in a scientific conference published in a research journal?
6. Is every published research paper going through a rigorous scrutiny through secret refereeing and independent decision-making?
7. Should scientist justify the research or should research justify the scientist?

### III. Cyclical development

**Research begins when scientific facts and conclusions from them give neither the solution to an existing problem nor pathway to it.** Intuition and subjective approach form the basis of research. They are both the driving power and the main value for research. Subjective approach through an objective scientific framework is the rationale behind any research initiative. Thus, an existing scientific fact which does not lead to a solution to a problem or to a technology forms the starting point for research. New ideas coupled with a subjective approach and an objective scientific framework begin the cycle. The results obtained, thus, may be different from the existing established fact. However, such results cannot be taken for granted unless they go through three stages of **repeatability, reductionism and refutability**. Experimental results should be independently reproducible, redefined, amended and verified before they are accepted as scientific FACT. Results published in journals cannot be accepted as FACTS unless they go through the cycle. At the end of the cycle the new modified FACT is established. If it does not lead to a solution to the problem or a viable technology, the cycle begins again.

IV.

**Fig. 1 Research Cycle**



This particular philosophy is more important in the context of agricultural research considering the location-specificity based on the agro-climatic zones. If we draw inferences from the above cyclical nature of research, parallel research becomes absolutely essential. The experimental data generated by a certain research effort needs to be tested to withstand repeatability and refutability irrespective of the status, cadre and reputation of the individual, or a group or the institution. During the course of this process, several mistakes committed may come to light. Here comes the most important issue of researcher's right to commit mistakes and even failure. No doubt every scientist has a right to commit mistakes or even failure but there has to be a limit as to how far one can stretch this right to commit mistakes. It is not to be used as a security cover. Science accepts only the positive elements of work. The inbuilt cyclical character and approach is meant to overcome such limitations and experiences in research work. Science and scientific results have always enjoyed immunity from 'commissions of inquiry' but that is not to be taken as an advantage. Here again several questions come to mind in search of scientific values and professional ethics.

- Are we carrying out the principles of repeatability, refutability and reductionism in our research approach?
- Are we encouraging parallel research?
- Have we understood the cyclical nature of research?
- Have we given thought to the right to commit mistakes?
- Have subjective approach and objective scientific framework been thoroughly understood in our research planning?

## **Stimulation of quality**

The efficiency in research is based on a good idea, which attracts many scientists and the financial support from competent authorities. These two attributes not only stimulate quality in research but also demand. Professional ethics play a major role in stimulating quality. A good idea may suffer due to lack of quality efforts and substantial financial back up may be wasted if professional ethics are flouted. There are two types of problems linked to professional ethics.

### **Individual scientist**

Any scientist has a major role and responsibility in the stimulation of quality in research results. The most important aspect in this direction is the professionalism at work by the individual scientist. The experimental inputs and the subsequent sampling are of prime importance for an agricultural scientist. There should be no scope for compromising these two values in carrying out research work. The accuracy of data is predominantly dependent on these activities. Professionalism is absolutely essential through attention to detail, accurate observation, correct procedures for sampling and subsequent analysis. The accuracy of data is the single most important attribute for publication of results and their subsequent transfer.

Irresponsible and careless approach to the research methodology, analytical techniques and to the data leads to worst consequences for the entire project as well as the individual scientist. Right to mistake is a fundamental right of the scientist but it should not be misused. Ignorance and carelessness can never be forgiven. We assume that published results are correct but if they turn out to be bogus, it can lead to the scientific death or isolation.

In approaching a research problem a scientist is expected to study the previous results published, follow new publications, refer to all publications regardless of personal feelings towards other authors, should exercise his/her right to express opinions freely and not to ignore others results. Professional ethics also come into picture while publishing the results. Respect for professional ethics and norms play an important role in activities such as 1) evaluating the work of other scientists 2) decision making on research priorities 3) refereeing of research papers and 4) evaluation of students' thesis for research degrees. These are some of the hidden responsibilities of scientists.

### **Organization of science**

Ethical problems arise while establishing research positions in a group, a department or in a project. It should be ideally based on actual contribution in idea generation and carrying out research. Quite often the problem that arises is the establishing research position based on administrative power or clout. Many scientists show personal interest to seek positions of administrative power, or membership in a council, or a committee, etc. There is a tendency to spend substantial time in administrative work in a bureaucratized research organization. There is also another tendency for a scientist who reaches a middle level in the hierarchy to feel that he has done enough and that he should now 'sit, guide and administer' rather than actively involve in research activity and offer leadership.

Scientific tolerance to one another is another important character, which has great implications to the general organization of science. A scientist of high reputation and seniority is usually fanatically convinced of his/her correctness. A junior who questions the results and conclusions of seniors is considered as 'irrelevant', 'undisciplined' 'talks too much' and so on. A junior stands the risk of being ridiculed, harassed, rebuked and even threatened. Such situations can not only ruin the self-confidence of upcoming bright youngsters, the general organization of

science in terms of culture and temper suffers. A kind of negative traditions may set in where in a doctrine rules that "Professors is right whether you like it or not".

Scientists have to overcome personal feelings and sometimes may have to act contrary to his personal interests for the sake of science and research in particular. Subjective phenomenon is normal in research while objectivity and tolerances are an obligation for any scientist. While we talk of promoting scientific tolerance, intolerance towards ignorance, carelessness, irrationality and non-professional approach is permitted and justified as well.

If a scientist fulfills the expectations of his organization, he or she feels certain about oneself, independent with inner freedom and equilibrium. Such feelings support his ethical behaviour and he or she will be sound in professional knowledge and skill. A scientist with no professional knowledge can be called a "man-in-the-wrong position". Such a person has no confidence, no stability of his opinions, can never be independent. His/her position defines their behavior, and can never follow principles. Such persons always choose coworkers who are ready to toe their line for his/her image.

## **V. Finally...**

If we are talking of lack of scientific culture in our organization, we all are, individually and collectively, responsible for the state of affairs. It is worthwhile to make a beginning in the right earnest. One last word of advice - avoid fashion in research and avoid unfair competition for position, privileges and honours.

# UNDERSTANDING GROUP DYNAMICS

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What is groupwork?

The term groupwork in agricultural research refers to research approaches, which are based around scientists of different disciplines or otherwise working together collaboratively and paying as much attention to the process of tackling a task as they pay to the task itself. When a Head of a Research Division subdivides the scientists in his division into small groups of units as a strategy for administration and management, this provides scope and opportunity for employing the groupwork approach in problem solving. However, in reality the heads tend to choose to address each group formally or set individual assignments within each group. This approach makes groups so formal and fluid that their composition loses significance. The head of the division has to give more importance to the group outcome or product and more emphasis on group reflection or how the product was produced.

A group does not simply mean individuals possessing some identical features. For instance, a collection of students does not form a group. This collection of students may be better designated as a class. The term **group** refers to two or more individuals with established definite psychological relationship to one another, which provides cohesiveness to the group. For each group member the other group members stand in a somewhat immediate psychological form so as to influence their behaviour and their features on him. As such, there will be a lot of interaction among its members, encouraging one another (a) to reflect, (b) articulate on, what is happening in the group and (c) how they feel about it. Even when the group is tackling a routine practical task they will exhibit these group traits. As the group operates on a common task, common attitudes develop and members are aware that they are part of it.

It is possible to promote groupwork with no other impetus than the interactions of group members to complement one another through sharing their feelings about themselves, or their interpretations of their experiences over a cup of tea, or social evenings, informal meetings in laboratories, etc. They then help to increase awareness as to their own social behaviour, and learn to deal with other's feelings, and use their own feelings and social skills to help others. Such groups help reveal to group member's interpersonal processes which are normally obscure. Interpersonal processes among individuals in a group are very powerful and need careful preparation and debriefing. The feedback about feelings may also be encouraged.

It should be said that participation in-groups should be voluntary; the element of compulsion to join a particular group totally alters the dynamics of groups, and is inappropriate, as their trust levels will be affected. However, it is quite common in our agricultural research setting that an individual is asked or forced to join a group of research workers or a group is forced to accept a new member and other similar things. The basic strength of a group is the way it handles its personal interactions, the roles of members, their animosities, etc., and how a process of acceptance, trust and mutual complementation sets in. Because of the complexity of the interaction, a group of 30 or more is beyond the scope of this kind of reflection. Groupwork normally involves small numbers of people working together. For groupwork purposes even 12 is a large number. Ideally a group size of five is optimum. It is always better to keep the group size small so that the group leader is more a facilitator than a decision-maker. There shall be more involvement of individuals and more opportunities arise for members to learn effectively. The individual identity in small groups is very high, and there is full scope for expression of rational thinking than feelings and emotions. The climate in the group shall be more informal, and it obviously enhances motivation and problem-solving skills are exhibited.

However, in larger groups there is tendency for individuals to lesser identity and the group leader dominates making the interaction more formal. There is also another tendency to give full expression to one's own feelings and emotions leading to distortion and projection of unwanted qualities.

It is also possible that one individual who behaves perfectly rationally in a small group may exhibit qualities to the contrary in a large group setting. This kind of transformation can be termed as "Psychological Shrinking of Brain". This phenomenon is rapid when shifted from small group setting to a large group setting but may not be so rapid vice a versa.

### **Why use a groupwork approach?**

The groupwork approach to scientific research needs to be appreciated. However, each scientist will have to decide when and where it makes sense to try the approach. The benefits of groupwork approach can be, in general terms, as listed here.

- 1) Groupwork **distributes the responsibility** for a given task among scientists. The senior scientist or Head is no longer controlling or orchestrating the responses of a large number of scientists. Scientists may look to him as a group to seek help and support or information and guidance but they are also able to seek help and information from each other. This helps the senior scientist or Head to concentrate his/her energy where it will be most effective.
- 2) In groupwork, **communication** through talking is paramount. This is true of task-oriented as well as discussion oriented groups. Task demands and physical location of members also determines the amount of communication in a group. The manner in which individuals are expected to work together in terms of an organizational chart affects their communication. More communication occurs in-groups which are collaborating than those which are coordinating or operating independently. Individuals tend to communicate with those individuals whom they like, and they come to like those individuals with whom they communicate.
- 3) A free **exchange of ideas** is possible in groupwork, scientists, especially those who have certain communication disability or social inhibitions, can freely express thoughts, feelings, attitudes and information in smaller groups. They can witness the way other people are tackling or clarifying problems and learn from this. This not only helps to present alternative approaches to the task but also is itself a process of social interaction which can be highly educative.
- 4) In order to proceed, groups have to **regulate their interactions**. Individuals have to learn to adopt helpful roles. They have to learn to listen, to express ideas clearly, to settle disputes and reach consensus. They learn how to give and receive support. They may learn to play some formal roles. They learn to proceed by agreement in the face of differing personalities, values and abilities.
- 5) Groupwork provides for a **trustful environment**. Scientists can take a chance to express ideas and true feelings without fear or favour of the organisation or superiors. Those scientists who have certain disabilities and drawbacks with regard to professional knowledge, research aptitude, laboratory skills, communication and presentation, preparation of research documents, etc., can feel safe in a groupwork rather than loose confidence and self esteem. It gives an opportunity for such individuals to develop professionally and socially.
- 6) Through groupwork scientists can learn to distinguish between their real and imagined selves. We all have myths about who we are and what we are capable of doing. Some of these may depend on upbringing, training and social background. Some of these myths are

sustaining and others are undermining. Groupwork can progressively put these myths to the test without totally undermining the individual's identity.

7) In group work the individuals are less likely to be dominated by the targets and the expectations of the organization.

### **Understanding group dynamics**

The term '**dynamics**' connotes adjustive changes taking place in the group structure as a whole, as caused by changes in any part of the group, either due to change of task, or additional responsibilities or addition/deletion of a member. Thus, group dynamics refers to changes, which may take place within groups, and is concerned with the interaction and forces obtained between group members in a social setting. It is a study of forces operating within a group. According to one viewpoint, group dynamics reveals how a group should be organized and conducted. Attempts are made to emphasize democratic leadership, member participation and overall cooperation. The other viewpoint considers group dynamics as a set of techniques, and equates it with a role-playing, brainstorming, etc. A recent viewpoint visualises group dynamics from the standpoint of the internal nature of groups, how they develop their structure and processes and how they influence individual members, other groups and the organization.

In all groupwork situations, it is essential that group leaders are skillful in making sure that the working process is positive. It must be borne in mind that not all groupwork produces sincere, self-confident, competent and accepting individuals. If groupwork is not carefully monitored and skillfully guided, it can lead to such things as over-conformity, dependence on the group and people getting stuck in their roles.

All of us have participated in groups of various sorts, family, team, workgroup, committees and the like but rarely have we taken time to observe what was going on in the group or why the members were behaving in the way they were. In any group, there are at least two classes of issues operating at any given point. One is the reason for the group's existence in the first place, for e.g., research project or problem-solving group. These are called Task-issues. A second, and equally important, set of issues concerns elements of how the group is going about achieving its formal task. These are called Process-issues.

The best way to start developing groupwork skills is to ignore theory and observe what actually happens when people interact in-groups. In our research institutes it is often noticed that a few individuals may join to work together and formulate a research project and perceive themselves as a group. Now compare your observations of such spontaneously formed group with your observations of a group that has been set up by the Head of the Institute or department for a particular project or a purpose. Here are a few tips for group observation.

1. Why does the group exist?
2. Who is in the group?
3. Is membership static or fluid?
4. Was the structure of the group imposed or did it arise spontaneously?
5. Is participation equal in the group, or do some members contribute more frequently or more effectively than others?
6. How does one gain access to the group?
7. How does group behaviour alter in relation to different environments, the inclusion of new members, the taking of new tasks?
8. Are there any sub-groups?
9. Is there hierarchy of prestige in the group?
10. How does the group interact with other groups?
11. What roles do people play in the group?



One of the important features of group process is communication and how the group is handling its communication. The content of conversation is often a good clue as to what group processes that are taking place in the group. It often seems that groups spend considerable time talking about things that have nothing to do with the task at hand. One of the easiest aspects of group process to observe is the pattern of communication.

1. Who talks? For how long? How often?
2. Who do people look at when they talk?
  - a. Individuals, possibly potential supporters
  - b. The group
  - c. No body
3. Who talks after whom? or who interrupts whom?
4. What style of communication is used?  
(assertions, questions, tone of voice, gestures, etc.)

In any group situation attending to a task consensus building is paramount, and it depends to a great extent the way the members participate in the group process. For example, some of the factors, which hinder consensus building, are as follows:

1. Domination by a few
2. Withdrawal by one or several members
3. Tendency to make quick decisions
4. Testing strength
5. Avoiding confrontation on issues
6. Trading or compromising

On the other hand, factors, which facilitate consensus, are as follows:

1. Concern for fellow members
2. Listening to other members
3. Discussing assumptions and logic
4. Testing consensus and disagreements
5. Process orientation with a view to develop shared decision
6. Identifying constraints and collective diagnosis on issues

## **Roles**

People play different roles in group work. These may depend on various situations and many times people interchange their roles. Primarily roles arise from:

1. the way one behaves as an individual
2. the way one tends to respond in groups
3. the nature of the purpose, or task
4. the capabilities and skills one possesses and
5. the way one is handled

It is possible, indeed quite likely that individual members will play several of these roles listed here.

**Task Roles:** Initiating, idea seeking, briefing, coordinating, interpreting, proposing, synthesizing, summarizing and liaoning.

**Maintenance Roles:** Encouraging, harmonizing, umpiring, compromising, assessing legislating and recognizing.

While the above two sets of roles help in task and process objectives of the group certain other roles played by members based on their behavioural oddities and predominant personal needs can hinder the group performance. These are called as self-serving roles which are listed here. Competing, dominating, blocking, yarning, attention seeking, dramatizing, horse-playing and criticizing.

In the early stage of a group the dominant roles are those, which are concerned with establishing roles or norms, sorting out power, and clarifying tasks. Once the group has sorted out these matters it can concentrate on exploring the task at greater depth, brainstorm ideas and generate creative interactions. Interaction with other groups may happen at any stage but it will be most orderly once the group is confident in its own structure and sense of purpose and belief.

Don't take anyone's word for anything about groups until you have done some investigation of your own. Gradually you will build up your own view of what groups are about, and to this you can add findings of others. Armed with this understanding you can plan how you can usefully exploit group dynamics for multi-disciplinary research endeavors.

# TRANSACTIONAL ANALYSIS

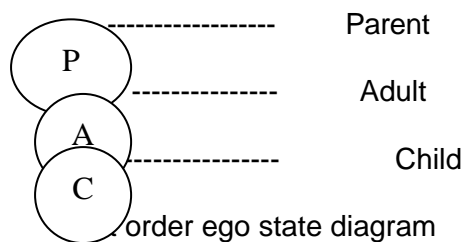
Managing people is perhaps the most important part of successful management. Human beings are very complex, have different personalities, and different interests. Before one can manage people it is important to be able to analyse and understand human behaviour. Transactional Analysis method uses popular terminology taken from everyday language to explain human personality and behaviour. Transaction Analysis (TA) was developed by Eric Berne and has been developed by Eric Berne and has been popularized in recent years by the writings of Thomas Harris, Muriel James and Dorothy Jongeward. Berne developed TA in the 1950's by watching people interact. He observed that as you watch and listen to people you can see them change before your eyes. There are changes in vocabulary, facial expressions, gestures and postures. Sometimes people act like children, at other times like adults, and yet at other times like parents. Berne noticed that sometimes people play communication games with each other and don't come off straight. He also observed transactions in which people engaged in smooth communication through complementary behaviour. At other times they crossed the communication by working against each other.

The subject matter of T.A. can be conveniently divided into the following segments for study.

1. Structural Analysis – study of ego states
2. Transactions – Interactions between people
3. Life positions – Self confidence and confidence in others
4. Strokes – recognition of another's presence
5. Stamps – the study of collection of feelings
6. Time structuring – ways of spending time
7. Script analysis – study of life plan.

## STRUCTURAL ANALYSIS

When we analyse the structure of our personality we find that there are, "Selves within ourselves and others". According to T.A. theory there are three persons within all the people. These are – Parent, Adult and child. These are technically known as ego states. An ego state denotes the habitual way of thinking, feeling and reacting. Although we cannot directly observe these ego states, we can observe the behaviour and conclude the ego state from which it is arising. The three ego states are usually diagrammed as shown below.



## VI. The Parent Ego State

The parent ego state is developed by all the people childhood up to the age of 6 years, when they absorb certain attitudes, values, beliefs and ways of behaving from parental figures – father, mother or significant others who raised them. When you feel think or act as you saw your parental figures act when you were little, you are in your Parent egostate. Parent egostate reflects the life as it is *taught*. Functionally, it sets limits, gives advice, discipline, protects and nurtures, teaches how-to, keeps traditions and makes rules and regulations about how life should be : (the do's, don'ts, always, nevers, shoulds, shouldn'ts musts, ought to's, have to's, can'ts, good, bad etc.)

The critical parent (C.P) is that part of us which sets limits makes judgement about ourselves and others. Critical Parent ego state is expressed in statements such as :

- “ Nobody can leave until this report is finished ”
- “ You should exercise every morning ”
- “ You don’t fight with your boss” etc.

*The Nurturing parent* (NP) is the other part of the parent ego state. It gives guidance, supports, protects, nurtures and teaches how-to. It is characterized by statements such as

- “ I am sorry you are not feeling well today, I’ll take care of your work “
- “ Is there any way I can help you ?”
- “ Let me show you how deal with that “

With their genuine concern for their co-workers and the organizations, nurturing, parent employees help foster a climate of cooperation and dedication where team work can flourish.

## **VII. The Adult Ego State**

The adult ego state behaviour is rational, problem-solving and decision-making. It is the non feeling part of the personality. It is the computer which analyses the information before generating and selecting alternatives. Functionally it gathers the data from the parent adult and child, eg. How the child feels and what he wants; what the parent says, feels and how he reacts; what the adult has to say based on the past decisions; and what one external situation is, after gathering the data it analyses and elevates it, generates alternatives and takes a decision. It is the alert and analytical part of the personality. The adult ego state reflects life as it is *thought*. It is expressed through statements such as :

- “ Has all the information been gathered ? ”
- “ The breeding criteria have to be set based on consumer preference ”
- “ What is the total rainfall in the area ”

The basic vocabulary of the Adult consists of why, what, where, when and how.

## **VIII. The Child Ego State**

The child in you is what you were when you were very young. There are many children inside us from the past. They are known collectively as the child. These children have the same feeling and ways of behaving you had when you were little. The child ego state is associated with behaviours that are evoked when a person is coming from an emotional base. The child ego state reflects life as it is *felt*. The child ego state is the center of feelings and energy, the source of our creativity, curiosity and intuition and site of our early experiences including those ways we have chosen to get attention from and get along with authority figures.

The child ego state is divided into three parts; the Natural Child (NC), the Adopted Child (AC) and Little Professor (LP).

*The Natural Child* (NC) is spontaneous, energetic, curious, loving and uninhibited. It is what comes naturally and knows no rules and consequently operate without regard for others and is unconcerned about others reactions. It is characterized by behaviour such as the joy of solving a problem, the happiness of getting the better of someone enjoying the feeling of comfort etc. The natural child is not entirely without fault. It can be self centered, impatient and greedy.

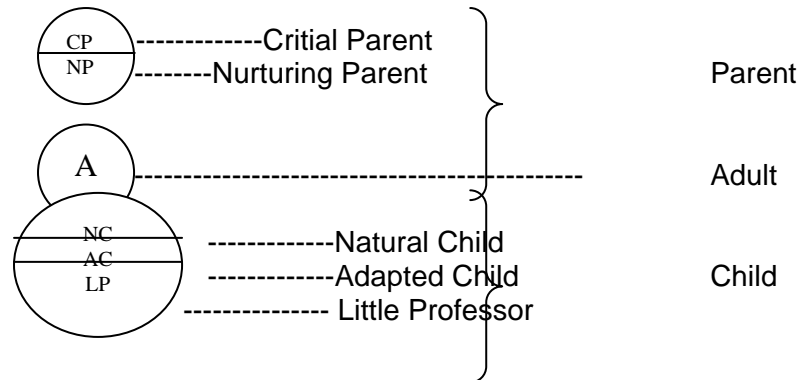
*The Adopted Child* (AC) acts in patterns learned from the environment. It developed when you learned to change (adapt) your feelings and behaviour in response to the world around you. Learned feelings of guilt, fear, anxiety, depression and envy are characterized in the AC. The pride you feel when somebody praised you for your good performance often comes from the AC.

*Compliance and Rebellion* are two sub-parts of the AC. Early in life some people learn that the best way to get along is always to say ‘yes’ (compliance). Their problem in adulthood is saying ‘yes’ when their better judgement, experience and knowledge suggests that arguing the point and asserting themselves would be more appropriate. Many children only get attention

when they are naughty (Rebellious). Such individuals in adulthood may continue this behaviour by seeking bosses and/or institutions (eg. Banks, the police) to constantly fight and rebel against.

The *Little Professor* (LP) is the intuitive part of the child which thinks without knowledge all the facts believed to be needed. LP “thinking” can be free of rigid boundaries and seems to have an in-born ability to dream up new ideas and intuitively sense what to do (or how to solve a problem) as if by the magic. The LP part of us gets those brilliant, non-logical insights that give us solutions to problems which can result in major breakthroughs.

The three ego states with their sub-parts are diagrammed as shown below:



## IX. Implications of Ego States

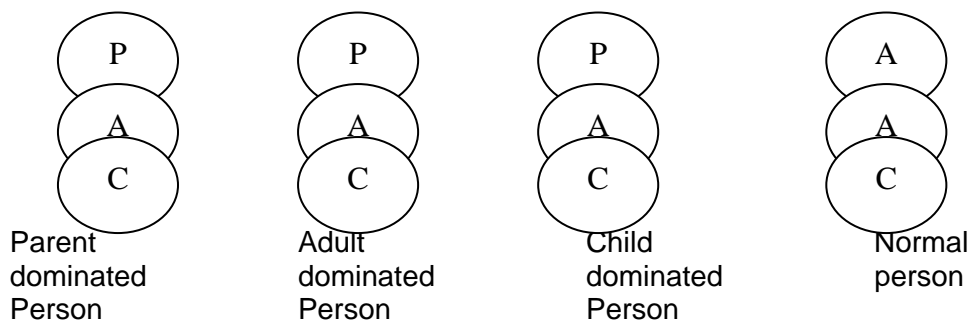
All of us evoke behaviour from one of the three ego states at different times. A healthy individual maintains a balance between all the three ego states. Each ego state has an appropriate time and place. To realize one's potential in life, it is important to be able to move flexibly from one ego state to another as different situations arise. For example adult ego state should dominate a literature search, the little professor ego state should operate to come up with creative alternatives and the parent ego state may exercise caution while writing up the research proposal. People who lack ego state flexibility tend to operate rigidity and fail to use their whole personality, and hence their potential.

In certain sense, organizations also have personalities just like individuals. For example, an organization that encourages employees at all levels to be creative and spontaneous would have a high Natural Child and Little Professor. An organization in which employees have little freedom to think of better ways of doing things might be thought of as having a high controlling parent low adult and a high adaptive child.

## X. How Do We Differ?

While all the people are structurally alike, in that they all have a PAC, they differ in two ways : content differences and functional differences.

*Content of Parent, Adult and Child* : Differing people will be dominated by one ego state or the other. A normal person will have a proper balance between the three ego states.



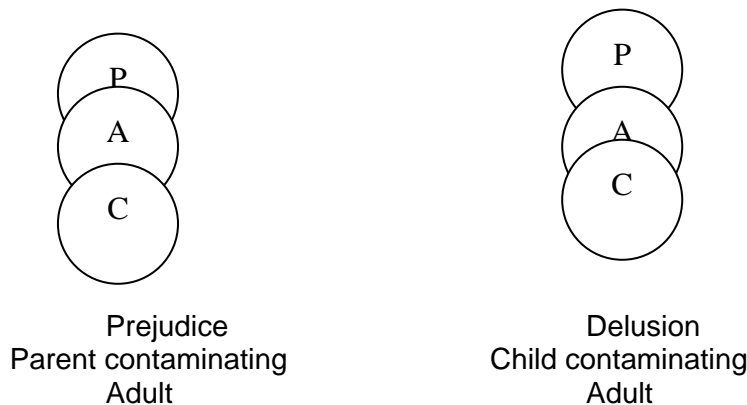
*The Parent dominated people* do not engage in rational problem solving because they already know what is right and what is wrong. They seem to have an answer for everything. *The Adult dominated people* can be troublesome because they will be very boring to work with. They are often “Workaholics”. They are never able to “let their hair down” and have fun. *The*

*child dominated people*, like parent dominated people, do not engage in rational problem solving. They learned in their formative years that they can get things by screaming and being emotional. These people are very hard to reason with in many situations.

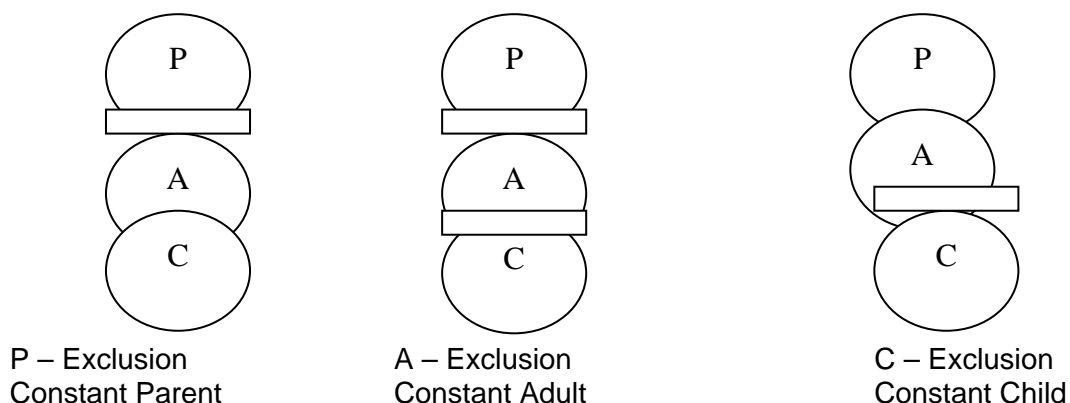
A proper balance between ego states and flexibility to move from one to another depending on the situation is essential for a healthy personality.

*Functional differences* : In the functioning of P, A & C two types of differences may occur. These are called 'contamination' and 'exclusion'.

*Contamination* : Ideally the P-A-C are separate circles. In many people the P or C tend to overlap and contaminate the A. When the unexamined Parent-data contaminate the Adult it results in *Prejudice*. Thus beliefs such as "right-handedness is better than left handedness" or "Administrative people are always out to trouble scientists" are based on prejudgement, before the reality of Adult data is applied to them. When the contamination of the Adult is by the child in the form of feelings which are inappropriately applied, it results in *Delusion*. These are usually grounded in fear. For example "Those who are admitted in a hospital are destined to die...." "Telegrams always bring bad news". "Cops always beat up people in police station," are all delusions.



*Exclusion* is manifested by a stereotyped, predictable attitude which is steadfastly maintained as long as possible in the face of any threatening situations. The constant parent, Adult, the constant Child all result primarily from defensive exclusion of the other two complementary ego states. Some exclude parent some exclude Adult, and still some others exclude the child. The individual behaves from the excluded ego state in such case.



People acting with the exclusion of only one ego state are likely to create problems for themselves and others. The constant parent could be too critical or over-indulgent, the constant Adult could be humour less and boring and the constant child could be either care free or too self centred.

## ANALYSING TRANSACTIONS

The transaction consists of a stimulus by one person and a response by another, which in turn may become a new stimulus for the other person to respond to. It is a unit of social interaction. The purpose of analysis is to discover which part of each person – PAC is originating each stimulus and response. The clues to identify these are not only in words but also in tone of voice, body gestures and facial expressions. The transactions may be verbal for non verbal. The transactions may be (1) open or complimentary or parallel (2) Blocked or uncomplimentary or crossed (3) Ulterior or hidden or disguised transaction.

### XI. Open or complementary or Parallel transactions

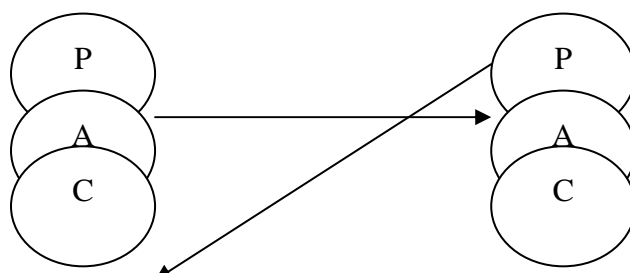
When the stimulus and response on the PAC diagram make parallel lines the transaction is complementary and can go on indefinitely. It does not matter which way the vectors go (Parent-Parent, Adult-Adult, Child-Child, Parent-child, Child-Adult) as long as they are parallel. In this case the response to the stimulus is expected or predictable one. Given below are some examples.

1. Scientist 1 : The bus is never on time.  
2. Scientist 2 : It is always like this.  
P → P  
←
2. Scientist 1 : You can never trust the labourers.  
Scientist 2 : Yes, they are lazy.  
P → P  
←
3. Scientist 1 : What time is the SRC meeting?  
Scientist 2 : At 10 AM.  
P → P  
←
4. Scientist 1 : Did the attendant clean the lab yesterday.  
Scientist 2 : Yes, he did it before he left.  
A → A  
←
5. Trainee 1 : Lets bunk the class.  
Trainee 2 : Yes ! it will be fun.  
C → C  
←
6. Scientist 1 : Tomorrow is a holiday, we can have fun.  
Scientist 2 : Yes, we can enjoy ourselves.  
C → C  
←
7. .Sr. Scientist : You should have started your statistical analysis last week.
8. Jr. Scientist : I am sorry, I'll do it right away.  
P → C  
←
9. Sr. Scientist : When we were your age we worked very hard.  
You must also do so.  
Jr. Scientist : Yes sir.  
P → C  
←

### Blocked or Uncomplimentary or Crossed Transactions:

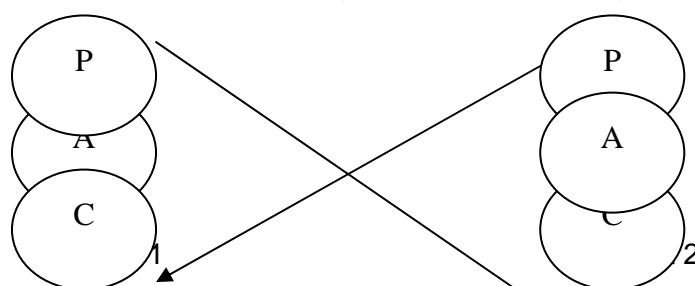
When the stimulus and response cross on the PAC diagram this is called the crossed transaction and communication stops. Here the response to the stimulus is either unexpected or inappropriate. It is out of context with what the sender of the stimulus had originally intended. For example if a scientist asks his colleague what is the time? The expected response is telling the time of the day. But if the colleague says 'Why don't you wear a watch?' then a crossed

transaction has occurred. The stimulus calls for a adult to adult response, but instead a critical parent response is made, as shown in the following illustration.

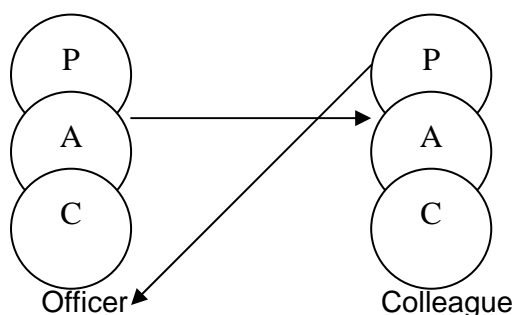


Additional illustrations of crossed transaction are shown below.

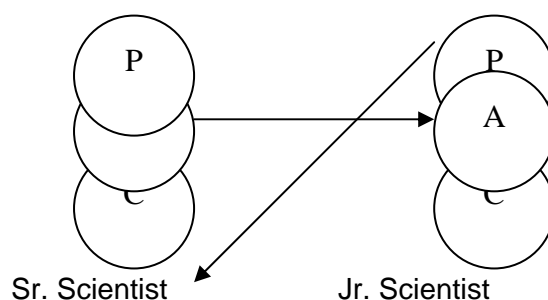
- 1) Scientist 1: You must clean up the lab ( $P \rightarrow C$ )  
 Scientist 2: You can't tell me what to do. You are not the boss  
 The Head of the Department is the boss ( $P \rightarrow C$ )



- 2) Officer: What is the principal trouble in this office ( $A \rightarrow A$ )  
 Colleague: Red tape, red tape (banging on the table) damn it,  
 Red tape! ( $C \rightarrow P$ )



- 3) Sr. Scientist: Give me your report on dry farming.  
 Jr. Scientist: You have your own copy. Why don't you look for it.

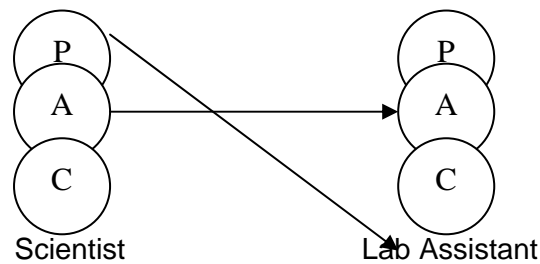


The crossed transactions often terminate communications and thus are disruptive. However, they can be beneficial in certain cases. For example, if a subordinate avoids taking decisions and always seeks advice, the boss can cross his transactions seeking guidance and force him to take decision for himself.



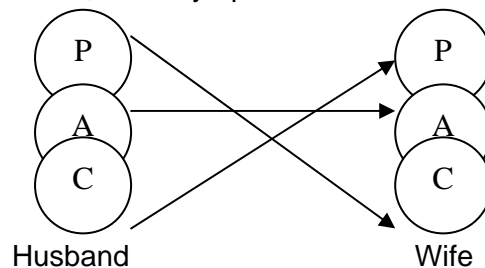
## XII. Ulterior or Hidden or Disguised Transaction

In this type of transaction there is one overt stimulus and simultaneously there is another covert stimulus. For example consider the following transaction. Scientist to lab assistant : Where did you hide the pipettes ?

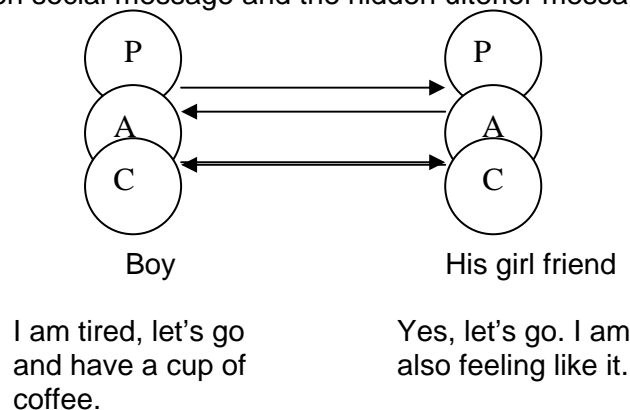


The main stimulus is the adult seeking the information, but there is a secondary communication in the word hide. This is 'You never keep anything in the proper place' or 'you keep reorganizing the lab arrangement too often.'

Some transactions of this nature can involve stimulus and response at all levels. For example if a man writes 'I love you' in the dust collected on the coffee table at home, the adult is in command. However both his parent and child are involved. The parent says 'Why don't you ever clean this place up?'. The child says, 'please don't get angry if I criticize you'. But the adult takes charge and write, 'I love you' because loving is important to marriage and thus parent or child are not activated, but they operate in a hidden manner.



Some times a duplex transaction also takes place where an ulterior message is sent along with a social one. This involves four ego states. The initiator and the responder both understand the spoken social message and the hidden ulterior message in this transaction.



The expressed social message in the above example is from Adult – Adult, but the ulterior message is from child – child. Both the initiator (boy) and the responder (girl) understand the real purpose; to exchange some pleasantries over a cup of coffee.

## EXISTENTIAL OR BASIC LIFE POSITIONS

In the process of 'growing up', people make assumptions about themselves and other significant people in their environment. These assumptions may or may not be generalized to other persons later in life. These are basic assumptions that individuals make about themselves and about others. The combination of an assumption of oneself and another is called a life

position. The life positions tend to be more permanent and a conscious effort is to be made to if shift to position four of I am OK – you are OK.

The four possible life positions are

- |    |            |   |               |
|----|------------|---|---------------|
| 1) | I'm not OK | - | you're OK     |
| 2) | I'm not OK | - | you're not OK |
| 3) | I'm OK     | - | you're not OK |
| 4) | I'm OK     | - | you're OK     |

By the end of three years of age a person has decided on one of the first three positions. The I'm not OK – you're OK is the first tentative decision based on the experiences of the first year of life. By the end of the second year it is either confirmed and settled or it gives way to position 2 or 3. I'm not OK – You're not OK or I'm OK – you're not OK. Once finalized, the child stays in his chosen position and it governs everything he does. It stays with him the rest of his life, unless he later consciously changes to the fourth position.

### **XIII. I am not OK – you are OK**

This is the universal position of early childhood, being the logical conclusion of the infant. Some people get stuck in this position because their parents unwittingly put them down with negative strokes like : Those nasty shoe string. Let me tie them for you'. 'Do not worry about that if you can not do it'. 'Let your brother make your sandwich'. 'Do not worry about your grades. We do not expect you to do as well as your sister. After all, she is a gifted child'. Grown ups who assumed this position as children feel inadequate and often compare themselves unfavourably to others. They tend to seek approval from others unnecessarily and admire them from an envious position. This position indicates an acceptance of others and not of oneself. This is typified by feelings of sadness, inadequacy, stupidity and a sense of being incompetent. People with this life position experience themselves to be inferior, powerless and lack in skills when compared to others. They tend to undervalue their skills and expertise and avoid facing difficult situations and problems. Statements which typify this position are : I will never be able to understand maths, I wish I could write a paper as good as yours; and so on.

### **XIV. I am not OK – You are not OK**

In the process of growth this is the second position that may develop when the parents stop stroking the child and tend to put him down, while the child also might be making a mess and getting into trouble. This position develops when the parents ignore the children and show them little respect and give them rude negative comments like, 'Hurry up, you are always too slow'. 'You will never learn, will you ?'

These people tend to feel bad about themselves and see the whole world as miserable. Their attitude is, why bother, what is the point ? Management by chaos would be their style. At work, they can't make their own decisions and can't thrust their subordinates. They often lose interest in life, tend to give up, and in extreme cases commit suicide or homicide. This is the perfect wrong position, and one should get rid of it at the earliest after being made aware of it.

### **XV. I am OK – You are not OK**

Some children develop this position when their parents treat them as if they are always right. Such parents are continuously blaming themselves, putting themselves down. For example, Nina often heard her mother say things like, 'Oh how stupid of me. Look what I have done. I have bought you the wrong size shoes again'. Children of these parents understandably develop a false sense of power and superiority over their parents and other people. They usually do not accept responsibility for their problems, and may not even realize they have any problems. They project the blame on others. Their relationships with others at work will be characterized by victimization, abuse and disregard. Statements like : you don't know how to draft even a simple letter, that is a stupid proposal etc. indicate that a person is operating from this life position. These people put down others, inflate their own achievements and attain power and stats at other's expense.

## XVI. I am OK – You are OK

This is an ideal, healthy, constructive position in which people feel good about themselves and others. This fourth position is reached as a result of a conscious decision based on thought and faith. People with this position tend to have a positive outlook on life and are happy, productive, energetic and at peace with themselves and the world. This life position indicates an acceptance of one's own self-worth and the worth of others. A person holding this life position will employ management by self direction, because he is sure of his competence as well as the capabilities of his subordinates. The dominant style of these people is collaboration, mutual trust, sharing authority and responsibility with others. They listen to, and offer constructive criticism and are good problem solvers. They are likely to succeed in life, finding satisfaction with work and relations with others and lead a happy life.

## STROKES

A stroke is defined as any act implying recognition of another's presence. A stroke can be verbal or non verbal or both. A hello, waving the hand, a smile, 'I like you' are examples of stroking. Every one needs some kind of stroking; whether pleasant or unpleasant. A stroke that evokes the feelings of 'I am OK, You are OK', is a positive stroke. Expressed loving, caring, respecting and responding to a need are *positive stroking*. Example: a spontaneous hug. A stroke that brings forth a feeling of I am not OK is a *negative stroke*. Expressed hating is such a stroke. Example: 'Get away from me, I don't like you'. A *conditional stroke* is given to you for what you do. Example 'Ali, if you take off your school uniform I will like you'. An *unconditional stroke* is one that is given for just being you. Example: 'I like to look at You'. The strokes can appear in combinations as shown below.

|          | Strokes for being                                  | Strokes for doing  |
|----------|--|--|
| Positive | I like you.<br>Positive, unconditional<br>Loving   | I like what you have done.<br>Positive, conditional.<br>Reward.      |
| Negative | I dislike you<br>Negative, unconditional<br>Hating | I dislike what you have done<br>Negative conditional.<br>Punishment. |

Good strokes humanize and improve the quality of work life. Strokes are necessary for physical and mental health. People need strokes for their sense of survival and well being on the job. In fact strokes are a basic unit of motivation. Throughout your life you need stroking. As you grow up, symbolic or word stroking becomes substitute for physical stroking.

In a work situation the strokes serve as (1) negative or positive motivators, (2) source of job satisfaction and (3) intrinsic motivators where the activity of work itself gives strokes.

## XVII. Guidelines for stroking performance

When some organizations are relatively small, strokes can come easily. People are able to talk over their problems with their bosses. As organizations grow larger, people become farther removed from one another and begin to feel smaller. Remarks such as 'Nobody listens, nobody cares' are often heard. This is because strokes become fewer and more remote. Moreover, when things are running smoothly the strokes dry up and life become boring. To get some excitement and the strokes people need, they unwittingly perform poorly so that a crisis results. It is then that people are able to give and get enough strokes. To avoid this pitfall it is appropriate to set up a system where employees are able to get a lot of positive strokes when things are going well. Some guidelines are given below.

*Avoid stroking and undesirable behaviour* : People who come to work on time and do a good job may never hear about it for years. Those who arrive late and go off early get a lot of attention. This situation tends to perpetuate 'mediocrity'. What you stroke is what you get.

Following this principle, avoid stroking a person for undesirable behaviour. Instead, think of the positive behaviour you want and stroke it.

*Time your stroke* : To be most effective in motivating a person, a stroke should come as soon as possible after the desired performance. A late stroke loses its effectiveness.

*Stroke approximation* : Stroke with every small improvement in performance without waiting for complete perfection before stroking. If you wait until people perform at the mastery level, you may never stroke them and they may never know they are moving in the desired directions. Stroke should be commensurate to the level of performance.

*Raise the criteria of stroking*: A criterion is a rule or guidance for deciding whether something is acceptable. It is not enough just to apply stroke approximations. Eventually we want to be stroking masterly performance, so you must gradually raise your criteria for stroking.

*Place your strokes* : Give consistent conditional positive strokes initially and conditional positive random strokes during the later phases. Never completely stop stroking.

*Ear shooting* : is a useful technique for stroking and is also called third hand stroking. When we give a third hand stroke, we do not talk directly to the person we are stroking, but instead talk to a third party within ear shot. Negative ear shooting gives negative result and positive ear shooting is very effective.

*Reminders for stroking* : A display of record of high performance is an effective way of stroking people. It reminds the supervisor to stroke the people, who also stroke themselves when they see the display.

## **XVIII. Ways of stroking**

*Stereo typed stroking* : when stroking performance, it is important to be aware of our pattern of stroking the ego states of others. Sometimes we do not distribute strokes equally – one ego state may get all the strokes and others none. People get strokes for being intelligent, decisive, controlling, self-reliant, dependent, nurturing, decorative or aggressive. Traditionally women have commonly got strokes for such things as appearance, niceness, neatness, quietness i.e. strokes for their adapted child. In contrast men have got strokes for such things as performance, leadership, decision making, achievement i.e. strokes for their Adult ego state. These cultural patterns for stroking continue in many organizations even today, although the roles of men and women have changed. Since everyone uses all their ego state, it is a good idea to become aware of stereotyped stroking and to move towards more balanced stroking of ego states. It is complained that female employees are not as self-reliant, decisive or logical as they should be or that men are insensitive and without feeling, little realizing that stereo typed stroking had made them so.

*Nonverbal Stroking* : Stroking is not always verbal (i.e. the spoken word). It can also be done in non verbal ways (including the written words) as follows.

*Physical touch* : This is the most direct and often the most powerful stroke and involves physical touch – a pat on the arm, shoulder, or back, a hearty handshake or a warm hug.

*Body Language* : The look in our eyes, the position of our arms, gestures, postures and facial expressions, all speak a powerful language. Often our body speaks without our being fully aware of it. It is important that our body language strokes fit with and compliment our verbal strokes.

*Written messages* : If you find it hard to say anything warm or complementary, it might be easy to express your appreciation through the written word. On job, a memo or a note that shares information with employees can be an effective written stroke.

*Gifts* : Another non verbal way to stroke a person is to give a gift. This is not about buttering up or bribing someone, but is either a spontaneous act of thoughtfulness or a planned honour for service of an outstanding performance.

#### **XIX. Strokes for Being**

In addition to stroking people for performance, it is also important to stroke them simply because they are there because they exist. Such stroking is not only reassuring but it also feels especially good. It tells others that you know they are there and that you care about them as people. People need both kinds of strokes positive conditional and positive unconditional.

#### **STAMPS**

In TA terminology, stamps are feeling that are collected at the end of a transaction. One can collect stamps from oneself or from others. When sufficient number of stamps are collected, they can be encashed for a 'prize'. There are two types of stamps – Gold stamps and Brown or grey stamps.

XX. **Gold Stamps** : These refer to collections of good or positive feelings. Collecting gold stamps is a constructive activity. Gold stamps are collected when one does a job well, succeeds in a competitive examination, and so on. These gold stamps can be encashed for good times. Seeking relaxation after a productive job is one such example.

**Brown or Grey Stamps** : These refer to collection of bad or negative feelings. It is a non constructive activity. In this case, a person collects hurts, insults and resentments until he feels ready to encash them for a drink, a day off reporting sick, or by rebelling. When enough stamps are collected, a person feels justified in indulging in a dramatic emotional out-burst, feeling depressed or feeling sorry for oneself. It may also result in activities in the organisation such as slowing down production, sabotaging some equipment or spreading rumours against a colleague, supervisor, workers or the organisation and so on.

Everyone collects grey stamps at one time or the other. It is therefore, essential to learn of the procedure of giving up grey stamps. The first step is to learn to identify the bad feelings and their source. Is it someone else, or is it you yourself who are originating the bad feeling. If the feeling is self given, then you have to deal with it by analyzing it and giving it up by getting away from the situation by constructive action. If the bad feelings are given by someone else, it is best to clarify the message, if it still persists, then the grey stamp can be given up by a) sharing the feeling with someone else, b) by physical exertion, c) by nurturing self-talk, and d) by giving unexpected gold stamp to the grey stamp giver.

#### **TIME STRUCTURING**

Every one needs strokes. One can get the desired strokes by structuring one's time properly. Time structuring helps to relieve boredom and is a basic hunger in human beings. There are six basic ways in which we structure our time.

|   |            |   |   |
|---|------------|---|---|
| * | Rituals    | : | Socially acceptable ways of greeting  |
| * | Pastimes   | : | Superficial exchanges about non-threatening subjects like sports, gossip etc. |
| * | Activities | : | Goal directed behaviour like work, hobbies etc.                               |
| * | Games      | : | Recurring transactions with concealed motivation                              |
| * | Withdrawal | : | Non contact with others   |
| * | Intimacy   | : | Honest, open, loving and trusting relationship.                               |

**Rituals** : A ritual is a fixed and socially approved way of behaving towards other people. Strokes such as 'Hello', 'Good Morning', 'How are you,' 'Good bye,' 'Take care', are called rituals. Rituals offer a safe, reassuring and often enjoyable method of structuring time. They give us an early starting point and enable us to move to more meaningful ways of relating to each other.

**Pastimes** : This is a comfortable way of passing time. Gossiping is a popular example of pastime. When you give a person pastime strokes, you fill the time with common place topics like weather, sports, politics, bosses, etc. In the work place pastimes take the shape of discussions such as 'why don't we do it this way?' Did you hear – the latest gossip, 'Now a days it is not what it used to be' etc.

A certain amount of pastime is beneficial in the work place as it helps people to get to know another better. It gives an opportunity to relax. However, if it is carried to an excess, pastimes take up a lot of productive time as they are not goal oriented and produce no goods or services.

**Activities** : These are behaviours directed towards external goals such as work, hobbies, sports, household activities and social activities. The work is the most important way of structuring time. Activities can be very satisfying in themselves through creativity and productivity. They are very rewarding because of strokes gained from the activity itself and also from others. Excessive indulgence in activities can cause its own problem such as boredom and isolation from others.

**Games** : A game is an ongoing series of ulterior transaction progressing to a well defined, predictable outcome. Games give us strokes which are negative pay offs resulting from ulterior transactions. These are strokes which are very powerful and intense and we continue to feel them for a long time. Game transactions conclude with an emotional pay off – a hurtful stroke – which reinforces a person's previous decision that some one is 'Not OK', either I am OK' or 'You are not OK'. Game players assume one of the three basis roles – Prosecutor, Victim or Rescuer all of which are phony roles.

Prosecutors are people who

- make unrealistic rules
- enforce rules in cruel ways
- pick on 'little guys' rather than people of their own size

Victims are people who

- provoke others to put them down, use them and hurt them
- send 'helplessness' messages
- forget conveniently
- act confused

Rescuers are people who

- offer a false helpfulness to keep others dependent on them
- do not really help others and may actually dislike helping
- work to maintain the victim role so that they can continue to play rescuers.

The players of a game form a triangle in which they often switch back and forth in their roles. This way pointed out by Karpman and is called the Karpman triangle.

People play games

- to get strokes
- to strengthen one's life positions
- to avoid or control intimacy
- to structure time in a predictable way
- to keep re-experiencing a favourite bad feeling
- to avoid responsibility for the problems they have

## **XXI. Some common Games**

*Games that put other down include :*

*Blemish* Players are the office nit pickers. They pick on small, inconsequential details when more important matters need attention.

*If it were not for you (IWFY)* People who play this game unconsciously often feel incapable, unhandy or inadequate. Rather than admit these feelings, they blame others for their plight.

*Now I have Got you, You Son of a Bitch (NIGYSOB)* : These players lay traps. They set impossible goals, give ambiguous directions, fail to provide subordinates with needed job aids, or give hazy standards. When a subordinate fails to measure up, these players bounce on the victim and indulge in angry explosions.

*Rapo* : Women who play rapo have learned to distrust or dislike men and have taken the position that “Men are not OK”. Men who take up the position that “Women are Not OK” also play a variation of rapo. Sexually oriented games are disruptive and especially inappropriate on the job. In addition, they tend to reconfirm role stereotypes. This is particularly defeating to women seeking higher position in an organization and to men who are adjusting to the new roles of men and women.

*Psychiatry* : A psychiatry player hurts other people with special psychological language. Guard against playing this game. To make sure that you are not playing “psychiatry”, be sure that whenever you use a TA term, everyone within earshot not only understands it but also agrees to its use. If they do not, do not use it.

#### **Games that we use to put down ourselves include**

*Wooden leg* : A person who plays this game wants to be excused from work and responsibility. These players often have a burden of some kind such as a physical or social handicap. Wooden leg players are often heard to say such things as, “What can you expect from a person with my background?” or “How can you expect me to operate that machine? You know :

- I am too short
- I am too tall
- I wear glasses
- My ears are too sensitive to loud noises
- I came from a poor home
- I have always had a bad memory

To play this self-defeating game, players must put themselves down or see themselves unnecessarily as fragile or dependent. These players also often get themselves put down by others who will eventually get fed up and strike back.

*Kick Me* : These people provoke other people to put them down. They do this in a variety of ways – for example by :

- drinking excessively;
- violating company policies or procedure
- taking drugs;
- failing to carry out important tasks;
- consistently missing deadlines

Kick me players like being kicked; it is what they have learned to expect and accept. A hard game of Kick Me on the job often results in the player being fired. We can also play Kick Me all by ourselves. In such games players kick themselves by how they talk to themselves in their own heads – hence this is called a “skull game”! These players often say things like “How could I have done such a terrible thing ? I could kick myself” “Why did I say that?” How could I have been so mean to .....?”

*Stupid* : This is a type of Kick Me game in which players make special arrangements for putting their brains down. They seem to compulsively make mistakes so that they can make a

fuss and proclaim, “How could I have done such a stupid thing ? Where was I when the good Lord passed our brains?”

*Schlemiel* : Although Kick Me players want kicks, Schlemiel players do many of the same things but seek a different kind of ending to their game – forgiveness. These players want to be reassured that they are OK, that they are accepted no matter what they do. To get reassured these players compulsively makes clumsy mistakes like :

- spilling coffee on the final draft of a manuscript;
- dropping a delicate piece of equipment
- spilling, typing correction fluid on a new rug;
- burning a desk with a cigarette

Each time, they play, they become highly upset and plead for forgiveness until someone reassures them by saying, “That is OK, Do not worry about it. Everybody makes mistakes”.

*Lunch Bag* : Executives who compulsively collect self-righteous feelings about themselves like to play this game. They try to make others feel too guilty or too fearful to come to them with their proposals and requests. The object of playing lunch bag is to feel self-righteous and to encourage others to think “How can I come to this humble person with a request for a new facility when he/she does not even eat a good hot lunch”? The lunch bag game also allows players to avoid contact with co-workers who do not get a chance to talk over lunch about their needs and interests.

*Harried* : It is a dangerous game that can structure a whole lifetime. These players play the role of superman or wonderwoman to hide an underlying psychological position of “I am Not – OK”. Often they are the first ones to arrive at work and the last ones to leave. As Harried persons advance in an organization, they take on more responsibilities and do more work under excessive pressure to maintain their superperson front. Stress takes its toll, and eventually Harried players may collapse from nervous tension. Common pay offs are depression, vices, colitis and even heart attacks.

*Effect of Game Playing on organizations* : Because of their destructive quality, games in organizations waste energy, time and money. Problems remain unsolved, decisions remain unmade and important tasks beg for attention. Games waste productive time in organizations and affect psychological health of the employees. We have to thus, stop playing games in the organizations.

#### **Ways to stop playing games**

- Give an unexpected response
- Stop putting down people
- Build self confidence
- Stop playing phoney roles
- Give and receive more warm fuzzies
- Risk authenticity
- Keep your sense of humour
- Exchange genuine positive strokes
- Spend more time in activity and intimacy

**Withdrawal** : is the removal of oneself from a situation either physically or mentally / psychologically. Physical withdrawal involves actually walking out and removing yourself from other people. Psychological withdrawal occurs when you turn off awareness of your surroundings and start day dreaming. There can be many reasons for withdrawal; fear of getting hurt, mentally leaving a lecture to think about an idea that struck you, talking to yourself if you are angry in order to cool off. Both kinds of withdrawal can be positive or negative. Withdrawal is not helpful when it results in continued avoidance of responsibility. Withdrawal



can be positive. We can withdraw to go for a walk, read a book, listen to music, or to check out how we feel. If we can relax or engage in productive mental activity we can give ourselves positive strokes while we are alone. Sometimes we simply need time to sort things out, to integrate what is happening to us. When you engage in withdrawals, you give strokes only to yourself.

**Intimacy** : It occurs when we are having a heart-to-heart talk and sharing feelings. When we are coming on straight and being honest. When we drop pretense and are not afraid to be ourselves. Intimacy is a 'Union of personalities', the mentality of two persons in a shared identity', of the word 'sex' and 'intimate' are considered interchangeable. They are not. At best, sex does involve the depth of intimacy, but sex can certainly occur without intimacy. For example, sex can be a Saturday night ritual, a pasting for an otherwise boring evening, an activity for making babies, or a game to hurt or to be hurt. It's important to recognize that the real basis for intimacy is not sex, but rather an authentic encounter with another person which is open, honest and game free.

The different facets of Intimacy are listed below :

- Aesthetic : Sharing experiences of beauty
- Commitment : Mutual self-investment
- Conflict : Facing and struggling with difference
- Creative : Sharing experiences of creating
- Crisis : Closeness in coping with problems
- Emotional : Sharing of significant feelings and meanings
- Intellectual : Closeness in the world of ideas
- Sexual: Expression of caring and enjoyment of each other
- Spiritual : The we-ness in sharing ultimate concerns
- Work : Sharing of common tasks.

## **SCRIPT ANALYSIS**

A person's psychological script is a life plan, decided by him before the age of six or seven – a drama the person writes and then feels compelled to live out. These plans may be positive, negative or circular – endless repetition headed nowhere. Everyone has a script. You have developed yours based on experiences as a child. One potent influence was your various transactions with your parents (or other authority figures). These in turn led you to make certain decisions, formulate life positions, play psychological games, and start the drama of your script. Without being aware of it, we tend to arrange our environment so that our script is perpetuated. Once we begin to be more aware of ourselves we can write a new script, choosing even more successful pathways.

## **USING T.A. FOR SUCCESS**

1. As a Scientist, arrange your ego states in such a way that your Adult dominates followed by Little Professor, Natural child, Nurturing Parent, Adapted child and Critical parent in that order.
2. Get rid of negative Parent tapes
3. Have more open transactions with others
4. Move into I'm OK – You're OK life position.
5. Give and receive more unconditional as well as conditional positive strokes.
6. Avoid collecting grey stamps and collect gold stamps
7. Structure your time in the following decreasing order Activity – Intimacy – Rituals – Pastimes – Withdrawal – games.
8. Never play or encourage Psychological games.

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# INTERPERSONAL BEHAVIOUR AND RELATIONSHIPS

## Introduction

Human beings are social animals. Among the various needs of human beings, the one to interact with fellow being is perhaps the most important. It establishes their relations with their associates, family and friends. Interpersonal contact is a source of both pleasure and pain. The situations of comradeship, healthy relationship with colleagues, love, affection, group activities, or conflict, disagreement are all manifestations of interpersonal behaviour.

Interpersonal behaviour is obviously very complex. In any interpersonal encounter, the behaviour is determined by the participants' conceptions of what are appropriate, since they have been taught that some behaviours are correct and others are not. But their behaviour is also determined by what other people pressurize them to do, how much they enjoy or dislike this behaviour, what consequences they see connected with the behaviour, and how much they value these consequences. In addition, what persons do in an encounter feeds on the behaviour that has just taken place. These previous behaviours are interpreted according to what are assumed to be the causes of these behaviours. The total social setting and some aspect of the personality of the actors may also modify the course of interpersonal relations.

One of the theories of interpersonal behaviour, Fundamental Inter-personal Relations Orientation (FIRO) was propounded by Schutz (1958). We have selected this theory because its instrument FIRO-B, which we shall administer, provides valuable insight into one's interpersonal relation orientation and behaviour. The basic assumption of this approach is that people need people. Every human being, because he/she lives in a society, must establish an equilibrium between himself/herself and the physical world. This social nature of human beings give rise to certain interpersonal needs, which they must satisfy to some degree while avoiding threat to themselves. These interpersonal needs may be divided into three categories: issues surrounding inclusion, issues surrounding control, and issues surrounding affection. Although each individual has different intensities of need, and different mechanisms for handling people, the three basic interpersonal needs are common, and are explained in the following narration.

## The need for inclusion

This is the need to maintain a satisfactory relation between the self and other people with respect to interaction or belongingness. Some people like to be with other people all the time; they want to belong to organizations, to interact, to mingle. Other people seek much less contact; they prefer to be alone, to interact minimally, to stay out of groups; to maintain privacy. If a continuum were to be drawn between these two extremes, every personal could be placed at a point (or region) at which he/she feels most comfortable. Thus, to a certain degree, each individual is trying to belong to a group, but he/she is also trying to maintain a certain amount of privacy. That is, he/she wishes, to some degree, to have people initiate interaction towards him/her through invitations and the like, and also wishes, to some degree, that people would leave him/her alone. For this dimension, the following two aspects may be distinguished. 1. The behaviour a person initiates towards others, i.e. his/her expressed behaviour 2. The behaviour a person prefers others to express towards him/her, his/her wanted behaviour. This distinction will help in considering the compatibility between people.

## The need for control

This is the need to maintain a satisfactory relation between oneself and other people with regard to power and influence. It will spell out the extent an individual feels should have control over others, and the extent he/she will allow others to control him/her. It is the people that create the environment, and by controlling them a person wants to control the situation and make the

environment predictable for him/her. This need varies from those who want to control no one in any situation, no matter how appropriate controlling them would be, to those who wish to control their entire environment and all the people they come in contact with. People also vary with respect to the degree they want to be controlled by others. On one side are those totally dependent and want to be completely controlled by others, and on the other extreme are those who want to make all their decisions accepted, and are not willing to be controlled by others. These two aspects illustrate the expressed behaviour and the wanted behaviour respectively.

### The need for affection

This is the need to maintain a satisfactory relation between the self and other people with regard to love and affection. In the scientific setting, this need is seldom made overt, as it is done in family situation. It takes the shape of friendship or close cooperation between two associates. Affection is a relationship between two people. The intensity of the relationship varies on a continuum, where at one end an individual may like his/her personal relation to impersonal and distant, perhaps friendly but not close and intimate. At the other end, an individual may like to maintain close and personal relations with others. In between these two extremes, everyone has a level of intimacy which is most comfortable for him/her. This category also has an expressed and wanted dimension depending on the fact that a person is making the overture or is needing the other personal to make the moves.

### Scheme of interpersonal behaviour

The following table presents these three categories in their two dimensions of expressed behaviour and wanted behaviour, and shows the extreme positions that can be taken. Every personal will fit some where between the extremes, most in the middle.

**Scheme of Interpersonal behaviour**

|                           |              | Inclusion        | Control    | Affection          |
|---------------------------|--------------|------------------|------------|--------------------|
| Expressed Behaviour (E.B) | Extreme high | Over social      | Autocrat   | Over personal      |
|                           | Extreme low  | Under social     | Abdicrat   | Under Personal     |
| Ideal Behaviour           |              | Social           | Democrat   | Personal           |
| Wanted Behaviour (W.B)    | Extreme high | Social compliant | Submissive | Personal compliant |
|                           | Extreme low  | Counter social   | Rebellious | Counter personal   |

Given below are the brief descriptions of three types of behaviours: (1) excess - indicating that the individual is constantly trying to satisfy the need (2) deficient - indicating that the individual is not trying directly to satisfy the need (3) ideal - indicating satisfaction of the need.

## Inclusion types

**The over social and social compliant:** The over social and social compliant person tends towards extroversion in his/her interpersonal behaviour. Characteristically, this type of person seeks people incessantly and wants them to seek him/her out. This type person is also afraid they will ignore him/her. This person's interpersonal dynamics are the same as those of the withdrawn person, but his/her overt behaviour is the opposite. This person's unconscious attitude is summarized by "Although no one is interested in me, I will make people pay attention to me in any way I can". His/her inclination is always to seek companionship. This person is the type who "can't stand being alone". All of his/her activities will be designed to be done "together".

**The under social and counter social:** The interpersonal behaviour of the under social and counter social person tends to be introverted and withdrawn. Characteristically, he/she avoids associating with others and does not like to accept invitations to join others. Consciously this person wants to maintain this distance between himself/herself and others, and insists that he/she does not want to get enmeshed with people and lose his/her privacy. This person's biggest fears are that people will ignore him/her and generally have no interest in him/her - their attitude is "No one is interested in me, so I am not going to risk being ignored. I will stay away from people and get along by myself."

**The social:** To this person, interaction with people does not present any problem. He/she is comfortable with people and comfortable being alone. He/she can be active or passive in a group, or can equally play a moderate role, without anxiety. This type of person is capable of strong commitment and involvement to certain groups and can also withhold commitment if he/she feels. This type of people feel that they are worth while, significant people and that life is worth living. They are fully capable of being genuinely interested in others and feels that others will include them in their activities and that others are interested in them. These people have an "identity" and an "individuality".

## Control types

**The autocrat and rebellious:** The autocrat and rebellious is a person whose interpersonal behaviour often tends towards dominating and non-acceptance of the authority of others. Characteristically this person tries to dominate people and strongly desires a power hierarchy with himself/herself at the top. This type of person is the power seeker, and is afraid people will not be influenced or controlled by him/her - that they will, in fact dominate him/her. Commonly, this need to control people is displaced into other areas. Intellectual or athletic or scientific superiority allows for considerable control, as does the more direct method of attaining political power. Basically, the person feels he/she is not responsible or capable of discharging obligation and that this fact is known to others. This type of person attempts to use every opportunity to disprove this feeling to others and to himself/herself. This person's unconscious attitude is "No one thinks I can make decisions for myself, but I will show them. I am going to make all the decisions for everyone, always".

**The abdicat and submissive:** This is a person who tends towards submission and abdication of power and responsibility in his/her interpersonal behaviour. Characteristically this person gravitates towards subordinate position where he/she will not have to take responsibility for making decision, and where some one else takes charge. Consciously, these people want others to relieve them of their obligations. This type of person does not control others even when he/she should, and never take a decision that can be referred to some one else. This kind of person is usually a follower, or at most a loyal lieutenant, but rarely the person who takes the responsibility for taking the final decision. Unconsciously, this type of person has the feeling that he/she is incapable of responsible adult behaviour and others know it. Behind this feeling are anxiety, hostility and lack of trust towards others. This hostility is usually expressed as passive resistance, since actual overt rebellion is too threatening.

**The democrat:** This individual successfully resolves his/her relations with others in the control area. Power and control present no problem to him/her. This type of person feels comfortable giving or not giving orders, and taking or not taking orders, as is appropriate to the situation. Unconsciously, this type of person feels that he is a capable and responsible person and therefore he/she does not shirk from responsibility or to try constantly to prove how competent he/she really is. Unlike the abdicrat and autocrat, he/she is not preoccupied with fears of his/her own helplessness, stupidity and incompetence. He/she feels other people respect his/her competence and will be realistic with respect to trusting him/her with decision making.

### **Affection types**

**The over personal and personal compliant:** This type attempts to become extremely close to others. This person definitely wants others to treat him/her in a very close, personal way. They will be striving in their interpersonal relations primarily to be liked. Being liked is extremely important to them in their attempt to relieve their anxiety about being always rejected and being unlovable. There are two behavioural techniques for this types, the direct and the subtle. The direct technique is an overt attempt to gain approval, be extremely personal, intimate and confiding. The subtle technique is more manipulative, to devour friend and subtly punish any attempt by them to establish other friendships, to be possessive.

**The under personal and counter personal:** This type tends to avoid extremely close personal ties with others. They characteristically maintain their dyadic relations on a superficial, distant level and are most comfortable when others do the same to them. Consciously, this person wishes to maintain this emotional distance, and frequently expresses a desire not to get "emotionally involved"; unconsciously he/she seeks a satisfactory affectionate relation. This person's fear is that no one loves him/her. In a group situation this person is afraid he/she won't be liked, and has a great difficulty genuinely liking people, and distrusts their feeling towards him/her. This type of person believes that if people get to know him/her well, they would discover the traits that make him/her unlovable.

**The personal:** For the individual who successfully resolved his/her affectional relations with others in childhood, close emotional relations with one other person present no problem. This person is comfortable in such a personal relation, and he/she can also relate comfortably in a situation requiring emotional distance. It is important for this person to be liked, but if individual is not liked, he/she can accept the fact that the dislike is the result of the relation between himself/herself and one other person. Unconsciously, this person feels that he/she is a lovable person who is lovable even to people who do not know him/her well. This type of individual is capable of giving genuine affection.

**Causes of extreme positions:** The inclusion anxiety of over social under social, social compliant and counter social behaviour is due to the feeling that the self has no value is worthless and empty. The control anxiety of being autocratic, abdicratic, rebellious or submissive is due to the feeling that the self is stupid and irresponsible. The affection anxiety is that the self is nasty and bad leads to overpersonal, underpersonal, personal compliant or counter personal behaviour.

**Compatibility:** This refers to the successful operation of an interpersonal relation. The less compatible the relation, the more time must be spent in finding ways of dealing with the difficulties. Thus, there is less energy available to devote to the task, and there is more internal dissatisfaction. It is more important to mention here, that compatibility does not necessarily imply linking. It has mainly to do with an ability to work together successfully.

### **FIRO-B**

This theory of interpersonal relations and the data collected by FIRO-B can be very useful to a research manager or a scientist in determining the compatibility of the members of a group

FIRO-B produces six scores; three on behaviour expressed towards others and three on behaviour wanted from others, in the areas of inclusion, control and affection. The six FIRO-B scores can be summarized as in the following table:

It is useful in a number of situations, to look at the score patterns of two individuals for insight into their relationship (supervisor, subordinate, collegial, associates). In organisational development, it may help to compare basic interpersonal relations orientations of two parties.

|   | Scientist A - Susheel |   |   |
|---|-----------------------|---|---|
|   | I                     | C | A |
| e | High                  | - | - |
| w | High                  | - | - |

Susheel: "Jaweed, why don't we form a tea club in our unit?"

In work situation, the control area is often the seat of difficulty, as the following example illustrates.

Boss: "Well, you know the situation, do whatever you think is best".  
The subordinate want strong leadership while the boss is unable to give it.

|   | I | C | A |
|---|---|---|---|
| e |   | H |   |
| w |   | L |   |

500

Subordinate: "Let us do this research project our way and we will give the country a green revolution?"

Boss: "You will do things the way I say to do".

Here, we have a group of scientists who do not want directive leadership (as is most often the case in scientific culture) but who are under a directive boss who does not want to be told what to do. The result is usually loss of energy and spirit that the subordinates could provide.

Thus, a study of interpersonal relationship orientation is valuable to a research manager to understand the human interactions and effect appropriate interventions for effective cooperation and collaboration, while it is important to a research worker to gain valuable insights into his/her own interpersonal orientation and behaviour, and the activities of others to allow for a better team work in research projects.

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## **TEAM WORK IN RESEARCH**

Most human endeavour takes the shape of teamwork. Ever since the dawn of civilization, we have recognised that most activities are better done in a group than done alone. There are, however, certain activities that are the result of individual excellence and effort. Examples of such activities are the works of artists, sculptors and musicians who work solo. Even in these branches of work, we do have group performances which vie with the individual efforts. Research work in the past was usually an individual effort where personal resources were employed by highly committed researchers. Most results were inventions which were flashes of the genius and these were slow to come by and highly unpredictable. In contrast to this, modern research is a group exercise and uses public funds. Researchers generally need to be motivated and research is planned and organised resulting in accelerated tempo of investigation. Thus, we have moved from private labs to organisational labs. In modern research, there is hardly any project that is investigated by a single person unaided by others. Some kind of interaction with other people is always necessary in the course of the work. It is, thus, important to search ways and means of making such interactions as effective as possible. This search for effective interaction or good team work is more important where the scientific content of the task needs input from different disciplines for solving a research problem, and number of experts need to come together and conduct what has come to be known as interdisciplinary research.

### **Definition of Team Work**

A team is a group of two or more individuals which is very cohesive, works unitedly, and its members perfectly understand each others' contribution and their own contribution for successful completion of the team's goals.

Thus, in a good team each person shoulders a different part of the whole job, with each having 100 per cent responsibility for the success of the whole, and work is done by a number of associates, all subordinating their personal prominence to the success of the whole team.

Team work is a collective activity of a group of two or more individuals who are totally committed to the team's goals, and who collaborate with each other resulting in coordinated and united effort which is essential for the successful completion of a given task.

The three most important characteristics of good team work are :

1. Unity of direction : Resulting thorough understanding of the total task, one's own role and others role in it.
2. Cooperation : Resulting from common point of view about, and commitment to the total task.
3. Subordination of personal prominence : Resulting from commitment to the success of the total task.

Team work can best be understood by watching a sports team in action. In watching a game of football, it is immediately clear that the entire team has a single goal, a definite position is assigned to each player, and the players work in great cooperation and collaboration in order to win the game. The activities of the players are sequential and the ball passes from one to the other and then to a third or back to the first while definitely moving towards the opponents' goal. This clearly shows that more than one person is required to score a goal. It is thus evident that this team is not just a collection of eleven best players but also a unit where individuals support and work with each other while playing in a given match. The observation to detect good team work in research organisation is more difficult but it follows a similar pattern. In research

organisations too, good scientists must be recruited and should be built into teams which can function effectively.

### **Pre-requisites of team work**

1. Group must have a charter or reason to work together
2. Members of the group must be inter-dependent.
3. Group members must be committed to the idea that working together leads to better performance than working alone.
4. Group as a whole must be accountable, not individual members.

### **Desirable climate for team work**

A desirable climate for team work will have the following requirements :

1. The atmosphere in which the team work is relaxed, comfortable and informal. The people involved can easily laugh and joke together, and there is a lot of back slapping and bonhomie.
2. The task is well understood by all the members, and their role in it is accepted by one and all.
3. The members communicate a lot and listen well to each other.
4. A lot of task relevant discussion takes place.
5. In a team, the members express both their ideas and their feelings.
6. Conflicts and disagreements centre around ideas and methods, and not around people.
7. Decisions are usually based on consensus.
8. When actions are decided upon, clear assignments are made and accepted by the members.

### **Causes of poor team work or the lack of it:**

Some of the causes for poor team work are :

1. Lack of understanding of the total task by the members of the team.
2. Lack of concern for others problems.
3. Lack of proper plan for the completion of the task.
4. Lack of trust and openness between the members of the team.
5. Lack of confidence by some of the team members in the capability of others.
6. Fear in the minds of the members that others may misuse the resources.
7. A high degree of possessiveness by some of the members of the team.
8. The bloated ego of some of the members which causes problems.
9. Misunderstandings arises between the members of the team.
10. People fearing the loss of control over resources when shared with others.
11. Genuine difficulty and inconvenience faced by people.
12. Operational problems in catering to the needs of all.
13. Inadequacy of the resources available in the organisation.
14. Poor leadership which is unable to keep the team together.

### **Symptoms of poor vs good team work in organisations**

The following is a description of characteristics observed in organisations that are having bad or ineffective team work vs organisations that exhibit good team work.

1. In organisations where bad team work flourishes, the symptoms of grumbling and retaliation are easily seen. Openness and trust are the primary victims. Because people cannot express

themselves through the system, they do it in private discussions in corridors, in lunch-time meetings, etc. In these organisations, mistakes are not seen as opportunities for increased learning and improvement but in excuses for punishing those who made the mistakes, and they do this in many ways. On the other hand, organisations with effective team work people can and do express themselves honestly and openly. Conversations about the work is same both inside and outside the organisation. Mistakes are faced openly and used as vehicles for further learning.

2. Unhealthy competition is another indicator of poor team work. Competition is the life-blood of research organisations but there is a great difference between the kind of healthy competition where people enjoy the just rewards for their deserved success, and the kind of organisation where backbiting, dirty tricks, and politics are everyday pastimes of individuals. Similarly, significant differences in rivalry between departments may be found. Many organisations owe much of their success to the natural competitive spirit which exists between departments and to the pride of team membership, but many others have departments which are at constant war with each other, each jockeying for superior organizational position, power, perks and funds. Such departmental rivalry especially hurts and demoralizes the junior researchers.

3. Meetings are another key indicator of team work. The main reason for having meetings is to utilise the collective skills of a group of people while working on common problems or projects. Too often, however, we experience meetings which in no way use these skills; meetings where one or few individuals contribute, and meetings where many research managers use the occasion as an opportunity to lay down the rules rather than utilise the resources of the team. In organizations where effective team work exists, meetings are regularly held, they are productive and stimulating with all members participating and contributing. New ideas abound, and their use enables the team to explore new frontiers of research.

4. Where relationship between research leaders and their scientists is poor, effective team work rarely evolves. Under such conditions, people cannot confide in or trust their leader. Their conversations will be on a superficial or trivial level, resulting in the leader becoming increasingly isolated from his team. The effective team leader needs to be very much a part of his team.

5. People just not developing is another sure sign of ineffective team work. If a team is to be effective, it needs to be continually developing itself and this in part means constantly facilitating individual member to improve his/her competence and expertise.

6. The ineffective team will either usually reject offers of external help because it fears the consequences of outsiders finding out what the team is really like, or will seize all offers of help as it lacks coherent view of how to proceed, and is content to hand over its problems to someone else. The effective team will welcome and use external help where it is appropriate.

7. The degree to which people help and use each other is another indicator of team work. When effective team work doesn't exist, people tend to work in isolation and neither offer nor receive the help of their colleagues. Where effective team work exists, personal relationships are characterized by support and trust, with people helping each other wherever possible.

8. Poor team work often results in jobs getting done twice or not done at all because no clear understanding of roles within and between teams exist. Where effective team work exists, clear agreement about objectives of the team is reached, and all the team members understand their roles and the way in which the team and its individual members will act in achieving their objectives.

The characteristics just described will give an idea about the prevalence of effective or ineffective team work in an organisation. But simply knowing the nature of team work operating

in an organisation is not sufficient. We must be able to identify the areas which are contributing to the ineffective team work in an organisation. This can be achieved by developing statements like - prevalence of :

1. Grievances or complaints within the division/work unit,
2. Conflicts or hostility between division/work unit members,
3. Confusion about assignments or unclear relationships between people,
4. Lack of clear goals, or lack of commitment to goals,
5. Apathy or general lack of interest or involvement of unit members,
6. Lack of innovation, risk taking, or proactiveness,
7. Ineffective staff meetings,
8. Problems in working with the boss,
9. Lack of trust between boss and member, or between members,
10. People are not encouraged to work together in better team efforts,
11. People feel that good work is not recognised or rewarded,
12. Low productivity of the division/work unit, and so on.

If the responses of the unit members to one or more of the above statements are strongly positive, then there is a strong need for team building effort in that unit.

As the causes for ineffective team work are varied, the team building efforts are also of many types. One such team building activity is described here which will be useful especially when there is confusion about assignments, relationships among people are unclear, lack of clarity of goals, existence of general apathy and lack of innovativeness. This technique is called "Role analysis technique" (Dayal and Thomas, 1968) or "Role clarification model" (Dyer, 1977).

### **Role clarification model**

Once the need for a team building effort has been identified, the next step is to develop an action plan.

**1. Time commitment :** The maximum time required for conducting team building activities is approximately one hour for each person. This can be done during week ends using a solid block of time, or by taking out one afternoon a week over a period of 3 to 4 weeks. However, Dyer (1977) indicates that time spent in one block allows for more input to occur. Each time a group meets, a certain amount of "settling-in" time occurs, which is minimized if the sessions are held at one time.

**2. Location :** Off-site conferences are often preferred, since it reduces possibility of interruptions. On-site programmes are also effective, provided the problem of interruptions due to phone calls, people going back to the office, etc., are controlled.

**3. Resource personnel :** If the ground rules, procedures, over-all goals and design elements are clear, this type of team building activity can be conducted by internal experts. If the internal expertise is inadequate, an outside resource person could be associated with the activity.

Whether or not an outside resource person is used, the whole team building activity should be conducted and managed by the head of the division or head of the organisation. Team building is management's business; it is a boss building his or her team.

**4. Goals :** The goal of a role relationship team building programme is to arrive at that condition in the work unit where all unit members can publicly agree that they :

- a) have a clear understanding of the major requirements of their own job;

- b) feel that others at the team building meeting also clearly understood everyone's position and duties;
- c) know what others expect of them in their working relationships; and
- d) feel that others know what is expected of them in their working relationships.

All agreements in working relationships are met in a spirit of collaboration and a willingness to implement the understandings. Procedures are established which permit future misunderstandings to be handled in a more effective way.

**5. Pework :** This part of the team-building activity can be done prior to coming to the session, or should be done first by each member of the group in private as the team session begins. Each person should write answers to the following questions.

- a) What do you feel the organisation expects you to do in your job? (This is the formal job description)
- b) What do you actually do in your job? (Describe your actual work activities and point out any discrepancies between the formal job description and your actual job activities).
- c) Identify specific difficulties or concerns you have in working with other staff members.
- d) What do you need to know about other people's jobs that would help you to do your work more effectively?
- e) What do you feel others should know about your job that would help them to do their work more effectively?
- f) What do you need from others in order to do your job the way you would like?
- g) what changes in organisation structure, assignments, or activities would improve the functioning of the whole unit?

**6. Meeting design :** All meetings of the team-building programme should be conducted by the research manager. If a consultant is present, he or she should be a resource person, but should not conduct the sessions.

The goals of the team-building meeting should be presented, clarified and discussed. Everyone should agree on the goals or hoped-for outcomes of the sessions.

Ground rules for functioning should be developed from the group, written on a sheet of paper, and posted for all to see. Some suggested ground rules are :

- \* Each person should be as candid and open as possible in a spirit of wanting to help improve the team.
- \* If a person wants to know how another person feels or what that person thinks on an issue, he or she should ask that person directly. The person asked should give an honest response, even if it is to say, "I don't feel like responding right now".
- \* Each person should have an opportunity to speak on every issue.
- \* Decisions made should be agreeable to all persons effected by the decision.

**7. Job understanding :** Each person should have a chance to read his or her answers to prework, questions A, B and E. After the person reads an answer, all other teams members should have a chance to respond in terms of how they have seen that person's job. It is important for each person to hear how other's see his or her job, and also what they would like the person to do on the job that would be of benefit to them. Each person should be given ample time to explore personal job responsibilities with others. This could be from thirty minutes

to more than an hour for each person. Each person should next read his or her answers to question D and attempt to get answers from the person(s) identified in the question in the total group. An alternative design is to have group members read their answers to question D and then divide into sub-groups, so that people can talk with those individuals they mentioned in their responses.

**8. Concerns :** Each person should read his or her answer to question C. Many of these concerns may have already been covered in the earlier discussions, but any unresolved concerns should be aired at this time.

As much as possible, try to solve the problem and not place blame. It is not as important to fix blame on a person as it is to recognise that a problem exists and to work out a solution.

**9. Conclusion :** At the end of the sessions, the whole team building programme should be critiqued. People should respond to the following questions :

- a) How have you felt about the team-building meetings ?
- b) What were the best parts for you ?
- c) What needed to be changed or improved ?
- d) Do we need another session like this ? If so, what should we discuss ? When should we meet again ?

This type of team-development meeting is one of the easiest to manage and one of the most productive of all design possibilities for improving team effectiveness. Most groups of people slip into areas of ambiguity in their working relationships. Expectations get formed about performances which people do not understand or even know about. The periodic clarification of roles is a useful process for any working group.

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# TECHNOLOGY ASSESSMENT

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## **What is technology assessment?**

Technology assessment is an exercise/tool for technology forecasting. It is used to predict or generate scenarios of new technology required by the client, and to identify technology refinement points in existing technology. Assessment of technology is, therefore, setting a value to technology, scientists, farmers and any one can do it, but the results of technology assessment in the agricultural context can be used for technology development, technology refinement, and technology transfer. The nature of technology assessment depends on who assesses, why the assessment is performed, and the nature of the technology itself.

Technology assessment has been defined as the systematic, purposeful application of knowledge, skill and expertise towards a function or service useful to man. Strasser (1972) defines technology assessment a systematic planning and forecasting process that delineates options and costs, encompassing economic as well as environmental and social considerations, that are both external and internal to the product in question, with special focus on technology related bad as well as good effects.

Therefore, all organizations and units developing, refining and transferring agricultural technologies may have interest in technology assessment.

## **Objectives of technology assessment:**

1. To make better use of present and future technologies
2. To cope up with emerging challenges
3. To guide technology policy making-GATT and WTO
4. To develop guidelines and policies in terms of more useful and less harmful technologies
5. To develop, refine and transfer technologies which solves public and social problems of farmers

Technology assessment is considered as the thorough and balanced analysis of all significant primary, secondary, indirect and delayed consequences or impacts, present or foreseen of a technological innovation, on society, environment or economy. Technology assessment is a step to humanize science and technology, it is to evaluate and select alternate technologies for the client to bring about transformation in the standard of living from better to best. Technology assessment has gained importance because technological change does not imply technological progress and better quality of life.

## **How is the technology assessed?**

Technology assessment started first in the US Navy as a measure to assess arms, ammunition and their utility to the general operational requirement by the sailors in the warfront. Based on this, the technology forecasting was developed as a management tool to predict the future requirements of the force and developing technological capabilities for future warfare (Cetron, 1971). Technology is assessed using criteria, indicators, parameters as the case may be, and the criteria must be relevant and important to the context in which the technology is assessed. For example if it is export onion it may be size, flavour, yield and colour, if it is flowers it may be spike length, color, fragrance, and so on., if it is a processed product, it may be value addition and consumers preference. Like this technology assessment becomes contextual and

dependent on the technology and the person who assesses it keeping in view the environment he is targeting for technology development/transfer.

So for every criteria shall have a relative importance among the various criteriae, and each criteria will be scored on a ten point scale for its consequences on the user when the technology is used. So the product of the relative importance of each criteria and the consequences of the technology scored for positive to negative consequences on each criteria/indicator gives the value of the technology on that indicator, and the sum total of all consequences on all indicators gives the total value of the technology on many indicators to the target client in question.

### **Why is technology assessment gaining importance?**

Technological base for improving productivity and income of the rural population in the field of agriculture has broadened with the success of green revolution that the country witnessed during mid sixties. Some of the agricultural research stations and institutes have celebrated their centenary of their existence, contributing to the scientific knowledge in agriculture. Various technological innovations have been released claiming spectacular yield potentials at research stations. As a result of this research and transfer of technology programmes, the national production has increased over times in the decades, thus, balancing the population growth and food production of our country. However, the benefits of the new production technology have accrued mostly to a section of farmers and the majority of the rest have become by-passed in development process.

During the same period one billion people economically active in agriculture, will have less than one hectare of land. Liberalised trading from GATT agreement forces global agriculture to be specialised and competitive. Diversification is the solution where land is limited and rural labour is excess, high value commodities need intensification of farming systems. This can be achieved by use of precision technologies, and precision technologies can only be developed after technology assessment.

Privatisation of agriculture technology systems in the coming decades for reducing public expenditure on agricultural research and extension, benefits those with higher purchasing power and hence the large, and medium sized commercial farmers would be benefited because they have clear advantage in their management of skills, technical expertise, and financial resources, they also can purchase these technical inputs and gain from these technologies, and the marginal and resource poor farmers will be left behind by private efforts. Therefore, there is need to assess the technologies suited to each and every micro situation and then recommend a basket of alternate technologies to the user.

During 1960s, the National agricultural extension programmes were built on the faulty premise that the western technologies were suited to our situations. They were neither assessed nor refined to our micro-situations, and to gain self-sufficiency in food production. We have imported rice and hybrid wheat varieties from IRRI and CIMMYT, but the cost of this hybrid seed replacement has slowed down the distribution and use of hybrid seed (Dalrymple and Srivastava,1994).

Then, on-farm adaptive research, location specific technical recommendation suited to the 126 NARP zones was done, after technology assessment for the micro situation, this was done by experts and not farmers? The recommendations became specific to the agro-climatic zones after this.

The enormous challenge to public funded research for the present is development of productive and sustainable technologies to nearly one billion resource poor farmers who face the immediate threat to their resource base and they are categorised as **CDR** farmers (Complex,



Diverse, and Risk prone agriculture). Hence, there is a need to develop precision technologies for them who aggregate to 66 per cent of the farmers in our country.

According to Singh (1996), appropriateness of technology is a prerequisite for technology transfer and adoption. a good measure of appropriateness is cost benefit ratio of the technology at a given space and time, the speculations are based on price and cost of physical and biological resources, environmental cost, risk factor, socio-economic, and natural factors.

A technology is a product, process or a method applied in a manner to produce the required output. A critical technology is a technology, which is aimed at problem solving of a current problem faced by the users in their context. And a technology assessment is the relative worth of a technology in terms of the capabilities, resources, opportunities, social and economic considerations that are both internal and external to the technology with emphasis on positive and negative consequences for the users context (Cetron, 1971).

Indicators of technology assessment vary from region, target categories, resources and context to be used. The Brundtland commission, identified three types of target categories for India, The farmers engaged in industrial agriculture, green revolution agriculture, be it partially or fully irrigated and the resource poor agriculture (Misra, 1993).

### **Can the farmer do technology assessment?**

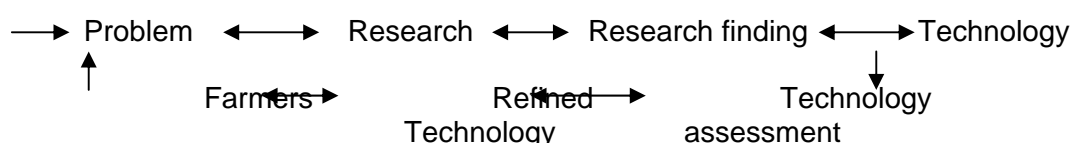
Farmers with the participatory rural appraisal and other participatory techniques can do technology assessment. Studies have shown that informal surveys and farmer led technology assessments are feasible and practical. In the IVLP, the technologies have been assessed by the farmers with the help of the multidisciplinary team, and need based technology interventions have been carried out based on rural peoples' knowledge called as RPK's, and categorising them into favourable and unfavourable eco-systems and then technology recommendation for specific users and region will be prepared.

### **Implications of technology assessment on technology transfer**

Today's self sufficiency and marketable surplus are the results of green revolution, where in the emphasis was on technology transfer on a package, area, basis with production potential being the important consideration. However, with programmes like IADP, IAAP, HYVP, the production targets were achieved but with lesser participation of the small and marginal farmers. Therefore, the SFDA and MFAL, IRDP programmes were launched with the aim of development through social justice, and ensuring the participation of all sections of the people.

In agriculture, technology assessment and refinement was institutionalised by the ICAR (1995) through the IVLP (Institute Village Linkage Programme) with the emphasis on technology assessment leading to technology refinement. It started from rabbi season of 1995-96 in 42 centers of the country, covering 42,000 farm families. The same is proposed to be expanded under the NATP project covering two lakh farm families, this has an outlay of 700 million.

The future transfer of technology models should have the research extension continuum of technology assessment and technology refinement as under:



The objective No. 7 of the IVLP is relevant to this topic is to identify extrapolation domains for new technology/technology modules based on environmental characterization at

meso and mega levels. These extrapolation domains of a technology can be found out by technology assessment on identified indicators, diagnosing deficiencies in present technologies and improving them to suit user situations, or developing new appropriate technologies, would help farmers effectively take part in development.

Maize varieties in Mali were assessed on the basis of their acceptance, rejection, and modification of the technologies done by farmers and why? Through informal surveys, and secondary data.

Technology assessment must be in the technological context and not in the biological performance, which is already done in the research stations and appropriate methods, variables to be assessed by the project must be selected according to availability of the resources and the context.

In a study on technology assessment in mango in Philippines used the criteria of technical feasibility, economic viability, social/cultural acceptability, environmental safety, sustainability, ease of application, understandability and resource efficiency, some of the positive impact of the technology of spraying chemicals to induce flowering in off season has broken the supply of mango which is highly seasonal and has alternate bearing, but the negative impact of the technology was that the flower inducers use has led to the decline of yield in mango over the years (Granola, Jr. *et al.*, 1988). When qualitative and quantitative and multiple indicators are used for technology assessment the scoring model, checklist and logistic framework have been used (Mc Clean, 1988; Nestel, 1989).

### **Issues/questions for technology assessment**

The following research questions need to be answered before doing a technology assessment:

1. What are the indicators on which farmers assess the various technologies for they're worth, relevance, and could there be rationality in adopting, rejecting, or modifying a technology?
2. Are there differences among the indicators chosen for technology assessment by big, small and marginal farmers?
3. If the differences in indicators on which technology assessment is made exists among big, small and marginal farmers, how to bridge the gap?

Technology assessment helps to identify research gap based on whether there are any recommendations available for the district from any source for the problems identified under each Agro Ecological Situation, while the extension gap would be identified based on the differences in the recommendations and adoption gaps to solve the problems faced by farmers identified based on participatory methodology. **The SWOT analysis carried out to identify strengths and weaknesses of existing farming systems, opportunities for optimal exploitation of resources, new markets and technologies and threats to existing natural resource base and markets is the real focus of SREP( Strategic Research Extension Plan).** The success stories of innovative farmers would be documented for multiplier effects on other farmers and faster diffusion of technology to problems faced by farmers.

### **Steps to conduct technology assessment**

In the IVLP programme (ICAR, 1995), the following steps are taken for technology assessment: i) Identification of constraints in the farming system by RRA/PRA; ii) Selecting the innovations or solutions which aim at a selected constraint (It is also called as the critical technology/input); iii) Identification of the criteria/indicators, which characterise the farming system on which the technologies have to be assessed, for its relative worth in solving the constraint/problem on which it is aimed as a technological solution; iv) Comparison of all the innovations on the selected criteria and v) Validation of the exercise by circulating it to experts for their comments.

## Sampling farmers to do technology assessment

Using a participatory rural appraisal you may select a few *key informants* who will be able to give you a realistic set of indicators to do the technology assessment.

## Item pool for developing technology assessment indicators

With the help of experts, topical survey, discussion with growers, an item pool consisting of around 150 items related to technology assessment in the relevance field of production, where technology is to be used may be collected, edited and scored with the help of farmers on a ten point scale of least important to most important.

### Working out scale values:

Relative weights are to be computed by the normalized rank order method. The summated ratings of indicators are to be converted to rank and rank-to-rank values, and centiles (p) may be computed by the equation:

$$p = \frac{(R_i - 0.5) \times 100}{n}$$

$R_i$  = Rank of the  $i$ th indicator  
 $n$  = Number of things ranked

The centiles (**p**) may be z normalized and (**C**) scale value may be computed by linear transformation of z scores, normally distributed with a mean of 5.00 and a standard deviation of 2.00 :

$$z = \frac{C - 5.00}{2.00}$$

## Building technology assessment index

While building the index two methods generally followed are un weighted and weighted composites, while in former the indicators are considered equivalent, in the latter they are considered differential. They are weighted using scale values:

$$X_c = a_1 I_1 + a_2 I_2 + \dots + a_n I_n \quad \text{where:}$$

$X_c$  = The composite score on the index

$a_1 \dots a_n$  = differential weights obtained by scale values /factor loading.

$I_1 \dots I_n$  = The score obtained on the individual indicators from respondents from  $I_1$  through  $I_n$  which has been included, our raw scores ranged from +1 to +5 for positive and -1 to -5 for negatively expressed  $j^{\text{th}}$  indicator by the  $i^{\text{th}}$  respondent.

## Computing technology assessment index score

Index construction for big, small, and marginal farmers and obtaining their relative differential weights by scale values to build the technology assessment index score, we use weighted averages using the following steps:

### Step 1.

Raw scores obtained by  $i^{th}$  respondent on the  $j^{th}$  indicator are multiplied by the scale values

**Step 2.**

The product obtained are converted to unit scores. It is done as below:

$U_{ij}$  = Unit score of the  $i^{th}$  respondent on the  $j^{th}$  component was calculated as under:

$$U_{ij} = \frac{y_{ij} - \text{Min } y_j(\text{possible})}{\text{Max } y_j(\text{possible}) - \text{Min } y_j(\text{possible})} \dots (1)$$

$y_{ij}$  = score of the  $i^{th}$  respondent on the  $j^{th}$  indicator

$\text{Min } y_j$  = Minimum score distributed on  $j^{th}$  indicator

$\text{Max } y_j$  = Maximum score distributed on  $j^{th}$  indicator

$U_{ij}$  = Unit value of  $i^{th}$  respondent on  $j^{th}$  indicator

These unit values ranged from 0 to 1, when  $y_{ij}$  is minimum, unit value is 0, and when  $y_{ij}$  is maximum unit value is 1.

**Step 3.**

The sum of weights are computed as:

$\sum a_1 \dots a_n$  = sum of the weights obtained by scale values of the indicators used for technology assessment by the  $i^{th}$  respondent

... (2)

**Step 4.**

The Technology assessment index score was computed by the equation:

$$TAI = \frac{\sum U_{ij}^{(1)}}{\sum a_1 \dots a_n^{(2)}} \times 100$$

**TAI** = Technology assessment index score of the  $i^{th}$  respondent. The maximum and minimum scores ranged from 0 to 100.

$\sum U_{ij}$  = Sum of unit scores obtained by  $i^{th}$  respondent on indicators.

$\sum a_1 \dots a_n$  = Sum of weights obtained by scale values

As negative effects have been scored from -1 to -5 and positive effects from +1 to +5 in the scoring scheme, after multiplying by respective scale values, the raw scores have been further converted to unit standard scores, subsequently summed and weighted averaged, and expressed as percentage, so that the score ranges from 0 to 100, hence technology assessment index score of less than 50 is understood to have given a net negative effect. As the classification of high, medium, and low based on mean and standard deviation is not meaningful, due to different technologies and different groups of farmers have different means and standard deviations, and classification on this criterion would invariably group majority of the respondents in medium category, therefore net effect negative and positive, is one scheme of classification of the scores based on above 50 and below 50, further below 25 and above 75 as highly negative and highly positive was decided. The scheme of classification used is as under:

**Interpretation of the technology assessment index score**

The technology assessment score arrived after the final calculation can be interpreted as follows. If the score is above 75 the technology has given a highly positive effect for the client in question, if it above 50 and below 75 it has given a positive effect, below 50 upto 25 it has given a negative effect and below 25 it has given a highly negative effect. These interpretations are highly specific to a particular client and the average of these scores for a

category of farmer may indicate the trend of effect the technology has given for a group of target users who may be categorised according to their homogeneity for the purpose of technology targeting.

| <b>Category of index score</b> | <b>Technology effect</b> |
|--------------------------------|--------------------------|
| > 75                           | Highly positive          |
| > 50 up to 75                  | Positive                 |
| < 50 up to 25                  | Negative                 |
| < 25                           | Highly negative          |

\*Technology assessment indicators to be used by participants as per their situation extra indicators may be added, this is only a guideline and a checklist for a specific example.

| <b>INDICATOR</b>                            |                  |                     |
|---|------------------|---------------------|
| Name of the technology                      |                  |                     |
| Category of user/farmer: Small/marginal/big |                  |                     |
| <b>Indicators</b>                           | <b>Weightage</b> | <b>Effect score</b> |
|   | (0-10)           | (-5 TO + 5)         |
| 1. High yield                               |                  |                     |
| 2. Late maturity                            |                  |                     |
| 3. Early maturity                           |                  |                     |
| 4. Better market price                      |                  |                     |
| 5. Easy to harvest                          |                  |                     |
| 6. Better shelf life                        |                  |                     |
| 7. Pest tolerance                           |                  |                     |
| 8. Disease tolerance                        |                  |                     |
| 9. Area covered is more                     |                  |                     |
| 10. Local Seed availability                 |                  |                     |
| 11. Uses less input                         |                  |                     |
| 12. Gives more income                       |                  |                     |
| 13. Short duration results                  |                  |                     |
| 14. Long duration results                   |                  |                     |
| 15. Reduced need of irrigation              |                  |                     |
| 16. Processing facility                     |                  |                     |
| 17. Drought tolerance                       |                  |                     |
| 18. Assured income                          |                  |                     |
| 19. Stability of yield                      |                  |                     |
| 20. More net profit                         |                  |                     |
| 21. Increases employment opportunities      |                  |                     |
| 22. Uses less fertilizer                    |                  |                     |
| 23. Needs staking                           |                  |                     |
| 24. Does not need staking                   |                  |                     |
| 25. Less cost                               |                  |                     |
| 26. Thick pulp                              |                  |                     |
| 27. Juicy pulp                              |                  |                     |
| 28. Longer duration                         |                  |                     |
| 29. Shorter duration                        |                  |                     |
| 30. Bears in off season                     |                  |                     |
| 31. Bears in regular season                 |                  |                     |
| 32. High Storage capacity                   |                  |                     |

|                            |  |  |
|----------------------------|--|--|
| 33. Low Storage capacity   |  |  |
| 34. Geographical isolation |  |  |

| <b>INDICATOR</b>                                     |                             |                                     |
|--|-----------------------------|-------------------------------------|
| Name of the technology                               |                             |                                     |
| Category of user/farmer: Small/marginal/big          |                             |                                     |
| <b>Indicators</b>                                    | <b>Weightage<br/>(0-10)</b> | <b>Effect score<br/>(-5 TO + 5)</b> |
| 35. Suitable to poor land                            |                             |                                     |
| 36. Value addition of products                       |                             |                                     |
| 37. Good Infrastructure                              |                             |                                     |
| 38. Nutritional security                             |                             |                                     |
| 39. Equity   |                             |                                     |
| 40. Access of technology                             |                             |                                     |
| 41. Helps in poverty reduction                       |                             |                                     |
| 42. Optimal resource utilization                     |                             |                                     |
| 43. Productivity                                     |                             |                                     |
| 44. Efficiency in production                         |                             |                                     |
| 45. Low Risk   |                             |                                     |
| 46. Low Drudgery                                     |                             |                                     |
| 47. Displacement of women labor is less              |                             |                                     |
| 48. No additional labor - required                   |                             |                                     |
| 49. Compatibility with existing practice/implements- |                             |                                     |
| 50. Synthesis with ITK                               |                             |                                     |
| 51. Low external inputs needed -                     |                             |                                     |
| 52. Timeliness of operation                          |                             |                                     |
| 53. Pollution  |                             |                                     |
| 54. Health hazard                                    |                             |                                     |
| 55. No Pest resurgence                               |                             |                                     |
| 56. No Destruction of Useful insects                 |                             |                                     |
| 57. Low Linkage required                             |                             |                                     |
| 58. Buyback arrangement (Vertical integration)       |                             |                                     |
| 59. Availability of Credit                           |                             |                                     |
| <b>60. Availability of Technical Know-how</b>        | <b>II.</b>                  | <b>III.</b>                         |
| 61. Reaching the Potential yield of the area         |                             |                                     |
| 62. Solves local food problem                        |                             |                                     |
| 63. Less fluctuating Price of the commodity          |                             |                                     |
| 64. Less competition from Fellow farmers             |                             |                                     |
| 65. Export Orientation                               |                             |                                     |
| 66. Immediate gains are visible                      |                             |                                     |
| 67. Highly flexible technology                       |                             |                                     |
| 68. Compatibility with internal household resources  |                             |                                     |
| 69. Probability of success under                     |                             |                                     |

|  |  |  |
|--|--|--|
| farmers condition                                  |  |  |
| 70. Compatibility with existing farm situation     |  |  |
| 71. Divisibility of technology.                    |  |  |
| 72. Simple to practice.                            |  |  |
| 73. Low dependence on external inputs.             |  |  |
| 74. Locally available inputs.                      |  |  |
| 75. Savings not needed                             |  |  |
| 76. Extent of women involvement is less            |  |  |
| 77. Not tedious technology                         |  |  |
| 78. Suited to Marginal farmer                      |  |  |
| 79. Suited to -Small farmer                        |  |  |
| 80. Suited to --Big farmer                         |  |  |
| 81. Compatible with existing enterprises           |  |  |
| 82. Suits their Occupation                         |  |  |
| 83. Suits the soil type                            |  |  |
| 84. Suits the existing soil fertility              |  |  |
| 85. Suits existing crop rotations                  |  |  |
| 86. Effective in Kharif                            |  |  |
| 87. Effective in Rabi                              |  |  |
| 88. Effective in Summer.                           |  |  |
| 89. Not dependent on Rainfall                      |  |  |
| 90. Does not increase seasonal workload            |  |  |
| 91. Distributes seasonal workload                  |  |  |
| 92. Contributes to majority of farmers problem     |  |  |
| 93. Community participation required               |  |  |
| 94. Policy and government intervention not needed. |  |  |
| 95. Low mechanization                              |  |  |
| 96. Vertical and horizontal linkages not needed    |  |  |
| 97. Extension of ITK                               |  |  |
| 98. More net profit                                |  |  |
| 99. Solves the most critical/Serious problems      |  |  |
| 100. No need of good quality water for irrigation- |  |  |
| 101. Plant population per hectare                  |  |  |
| 102. Balanced use of nutrients                     |  |  |
| 103. Organic manure-and resource recycling-.       |  |  |
| 104. Low weed infestation.                         |  |  |
| 105. Does not require subsidy for promotion        |  |  |
| 106. Absence of glut                               |  |  |
| 107. Determinate or                                |  |  |

|   |  |  |
|---|--|--|
| indeterminate plant type                            |  |  |
| 108. Cooking quality                                |  |  |
| 109. Uniformity of fruit                            |  |  |
| 110. Elongated picking life                         |  |  |
| 111. Prolific bearing habit                         |  |  |
| 112. Suitability to year round planting             |  |  |
| 113. Crispiness of the fruit texture                |  |  |
| 114. Flavor of the fruit                            |  |  |
| 115. Firmness of the vegetable                      |  |  |
| 116. Tenderness of the vegetable                    |  |  |
| 117. Domestic market suitability                    |  |  |
| 118. Service support availability                   |  |  |
| 119. Absence of middle men                          |  |  |
| 120. Information support availability               |  |  |
| 121. Consumer preferences                           |  |  |
| 122. Retailers preferences                          |  |  |
| 123. Credibility of technology source               |  |  |
| 124. Liberalism(Positive attitude towards research) |  |  |
| 125. Suitability for Non refrigerated storage       |  |  |
| 126. Waiting period of pesticides                   |  |  |
| 127. Suitability to hedging                         |  |  |
| 128. Micronutrient sensitivity                      |  |  |
| 129. Salt tolerance                                 |  |  |
| 130. Suitability to cropping systems/sequence       |  |  |
| 131. Suitability to stickers/synthetic pyrethroids  |  |  |
| 132. Transplanting time suitability                 |  |  |
| 133. Suitability to staggering                      |  |  |
| 134. Availability of Subsidy                        |  |  |
| 135. Suitable to Micronutrient deficiency           |  |  |
| 136. Suitability to Bio-fertilizer use              |  |  |
| 137. Response to Growth regulators                  |  |  |

Example of a case with four indicators on a varietal technology on marginal farmers

Marginal farmers in vegetables may have the following indicators as important to them.

1. High yield
2. Uses less input
3. Local seed availability
4. Must not increase seasonal workload

Using these four indicators and five key informants in the village (marginal farmers) the 'c' scale values are calculated as below:



| SI No | Indicators                          | KI-1 | KI-2      | KI-3 | KI-4 | KI-5 | sum | rank | rank value | centiles | z values | c values |
|-------|-------------------------------------|------|-----------|------|------|------|-----|------|------------|----------|----------|----------|
| 1     | High yield                          | 9    | 8         | 7    | 6    | 8    | 38  | 1    | 4          | 87.5     | 1.161895 | 7.3      |
| 2     | Uses less input                     | 7    | 6         | 5    | 6    | 7    | 31  | 3    | 2          | 37.5     | -0.3873  | 4.2      |
| 3     | Local seed availability             | 8    | 8         | 4    | 7    | 6    | 33  | 2    | 3          | 62.5     | 0.387298 | 5.8      |
| 4     | Must not increase seasonal workload | 3    | 4         | 5    | 6    | 7    | 25  | 4    | 1          | 12.5     | -1.1619  | 2.7      |
|       |                                     |      |           |      |      |      |     |      | Average    | 50       |          |          |
|       |                                     |      | (+ and -) |      |      |      |     |      | Std devn   | 32.27486 |          |          |

The scores on the varietal technology is given by the marginal farmer in vegetable production totally the scores of 5 marginal farmers are computed for illustration as below:

| Indicators                          | c values | score(f-1) | score(f-2) | score(f-4) | score(f-5) |
|-------------------------------------|----------|------------|------------|------------|------------|
| High yield                          | 7.3      | 5          | 4          | 5          | 3          |
| Uses less input                     | 4.2      | -5         | -3         | -4         | -1         |
| Local seed availability             | 5.8      | -3         | -1         | -3         | 0          |
| Must not increase seasonal workload | 2.7      | 4          | 2          | 5          | 4          |
| Sum of scale values                 | 20.0     |            |            |            |            |

The Unit normal score as per the formula above is calculated for the five farmers as below:

| Indicators                          | U1  | U2  | U3  | U4  | U5   |
|-------------------------------------|-----|-----|-----|-----|------|
| High yield                          | 1   | 0.9 | 1   | 0.8 | 0.6  |
| Uses less input                     | 0   | 0.2 | 0.1 | 0.4 | 0.5  |
| Local seed availability             | 0.2 | 0.4 | 0.2 | 0.5 | 0.52 |
| Must not increase seasonal workload | 0.9 | 0.7 | 1   | 0.9 | 0.59 |

| Indicators                             | P1   | P2   | P3   | P4   | P5   |
|--|------|------|------|------|------|
| High yield                             | 7.3  | 6.6  | 7.3  | 5.9  | 4.4  |
| Uses less input                        | 0.0  | 0.8  | 0.4  | 1.7  | 2.1  |
| Local seed availability                | 1.2  | 2.3  | 1.2  | 2.9  | 3.0  |
| Must not increase seasonal workload    | 2.4  | 1.9  | 2.7  | 2.4  | 1.6  |
| Sum of product of unit score and scale | 10.9 | 11.6 | 11.6 | 12.8 | 11.1 |

**The Technology assessment score is calculated for the 5 farmers as below:**

| Indicators                             | TAI 1 | TAI 2 | TAI 3 | TAI 4 | TAI 5 |
|--|-------|-------|-------|-------|-------|
|  | P1    | P2    | P3    | P4    | P5    |
| High yield                             | 7.3   | 6.6   | 7.3   | 5.9   | 4.4   |
| Uses less input                        | 0.0   | 0.8   | 0.4   | 1.7   | 2.1   |
| Local seed availability                | 1.2   | 2.3   | 1.2   | 2.9   | 3.0   |
| Must not increase seasonal workload    | 2.4   | 1.9   | 2.7   | 2.4   | 1.6   |
| Sum of product of unit score and scale | 10.9  | 11.6  | 11.6  | 12.8  | 11.1  |
| Sum of product divided by total scale  | 54.4  | 58.1  | 57.9  | 64.2  | 55.4  |
| Value multiplied by 100=TAI            |       |       |       |       |       |

Therefore, the total technology assessment index score for the five farmers on the 4 indicators is as indicated in the bold, as per the classification all the marginal farmers have got a positive effect for the varietal technology so assessed and this score varies as farmers and indicators vary from agro-eco-region to region and when the constraints and indicators of farmers change spatially and temporally.

### Conclusion

1. The early technology assessment efforts were made by experts and institutions and not by farmers.
2. Technologies with high visibility sell themselves without an extension agency involved in its transfer.
3. Agricultural technologies succeed only in a few pockets due to region, season, agro-eco-system specific nature.
4. Technologies tried without proper assessment tend to have poor adoption rates.
5. Technology assessment is to produce and transfer appropriate technologies based on needs and aspirations of farmers.
6. *Human face* of the technology whether, it meets basic needs and aspirations, and participatory technology development backed by technology assessment is yet to be realised on a large scale.
7. Agricultural development process by technology assessment would be direct, diagnostic, and problem solving compared to other indirect and educational efforts without it.

# PARTICIPATORY TECHNOLOGY DEVELOPMENT

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## Prologue

In the coming years, agricultural research in India has to address a host of new challenges like global competitiveness, sustainability, environmental conservation, social equity, etc. The focus then will be on market driven research with significant emphasis on stakeholder interests. This calls for a gradual shift in our approaches to agricultural research in general and agricultural technology development and diffusion in particular. We have to gradually shift our approach from the conventional subject specific research to multidisciplinary, collaborative and PTD. It is, therefore, necessary to understand and appreciate the issues related to participation of all the stakeholders of agricultural research to develop and diffuse need based and appropriate technologies.

## Stakeholders in agricultural research

The primary stakeholders of agricultural research are the farmers. Besides, a host of other interest groups have their own stakes in agricultural research. The following figure illustrates the possible stakeholder groups in agricultural research process.

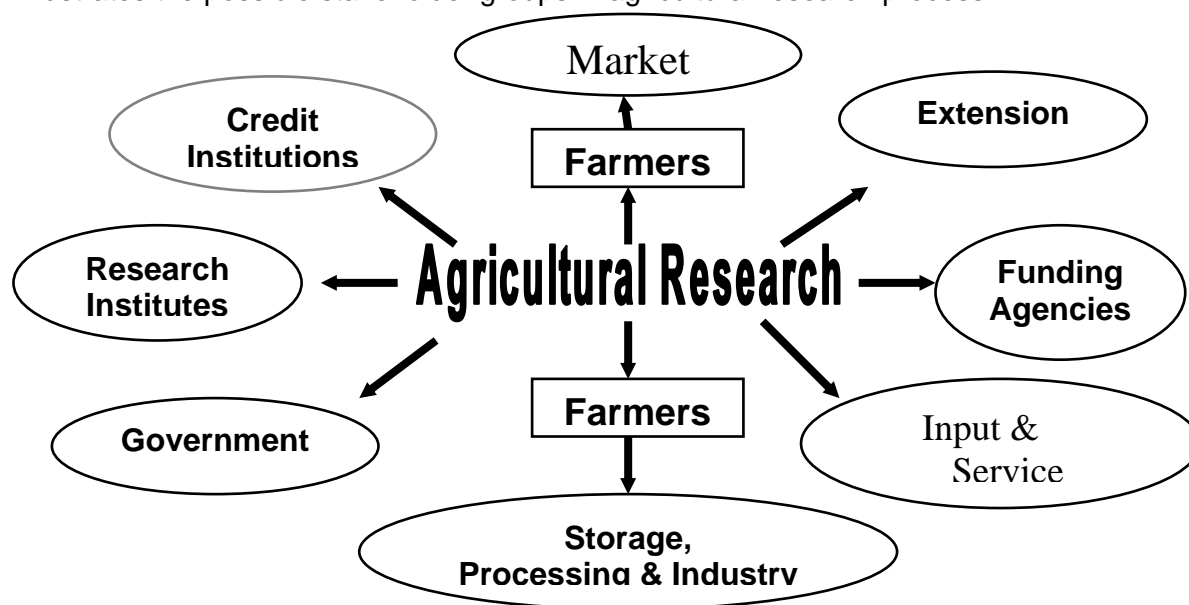


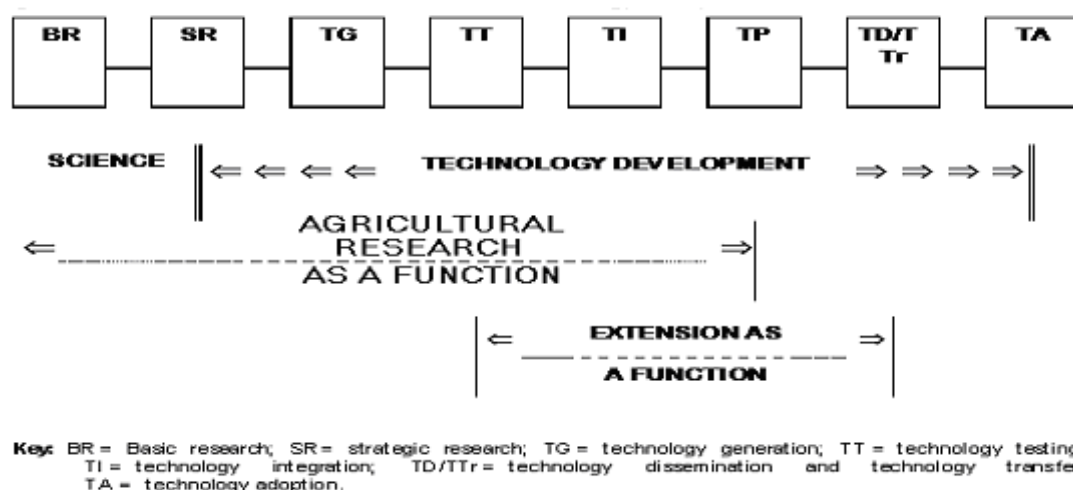
Figure 1. Stakeholders of agricultural research

## Weaknesses in the present approaches to agricultural research and extension

The conventional approach to agricultural research and extension has often been criticized for its top-down nature. This approach has led to the technology recommendations that are too general ignoring the multiple farming situations within a farming situation. Participatory approaches offer readymade solutions to this problem. Hence, of late there is growing awareness globally on the use of participatory approaches in agricultural research and development.

## Research, technology development and transfer

The main objective of agricultural research is to solve the farm and farming related problems of farmers by developing appropriate technologies. Research management primarily involves perception/identification and articulation of the research problem, project prioritization, selection and resource allocation, planning of research activities, monitoring and review of the project, and utilization of research results. The technology development and transfer processes form a continuum on which our research and extension activities are carried out (figure 2).



**Figure 2. Continuum of agricultural research – technology development, transfer and adoption**

## Participatory approaches in agricultural research and extension

This approach combines the advantages of several established methodologies that ensure involvement of farmers in the definition of a research agenda, conduct of research, evaluation of results and the dissemination of findings (Farrington as cited by Mettrick, 1993).

Ensuring the participation of users in the agricultural technology development process is a strategic research issue. It is also of vital importance to achieve impact that benefits poor people. User participation in agricultural research, technology development and transfer processes enables development of appropriate and demand driven technologies that readily fit into the agro-climatic and socioeconomic conditions of farmers.

In brief, stakeholder participation in technology development and transfer is the key to meet the future challenges of Indian agriculture. As a corollary, the research projects developed in participatory mode, incorporating the interests of various stakeholders, would be more appropriate in the days to come.

## Evolution of participatory approaches

Over the past couple of decades or so, substantial work has been done to introduce a user perspective in to the formal agricultural research in general and adaptive research in particular. A broad representation of specific documented efforts in this direction is listed in Table 1.

**Table 1. Evolution of participatory approaches in agricultural research**

|       |  |
|-------|--|
| FSR   | Farming System Research (Mellor, 1966; Collison, 1972; Norman, 1974) |
| ITK   | Indigenous Technical Knowledge (IDS, 1979; Brokesha et al. 1980)     |
| OFT   | On-farm Trials (Tripp, 1982)   |
| FBTF  | Farmer Back to Farmer (Rhodes and Booth, 1982)                       |
| FFL   | Farmer First and Last (Chambers and Gildyal, 1985)                   |
| FPR   | Farmers PTD (Farrington and Martin, 1988)                            |
| OFCOR | On Farm Client Oriented Research (Merill-Sands and Kaimowitz, 1990)  |
| IBA   | Interactive Bottom-up Approach (Bunders et al. 1990)                 |
| RRA   | Rapid Rural Appraisal (IIED, 1991)                                   |
| PRA   | Participatory Rural Appraisal (IIED, 1991)                           |
| PTD   | Participatory Technology Development (Reintjes et al. 1992)          |

The above are a few documented and published approaches in PTD. In addition, a wide diversity of undocumented efforts in the field practices also exists in developing countries. The list is growing as a result of increasing farmer involvement in problem identification and technology testing and, ultimately, the support of farmers in agricultural research. **Four distinct approaches to PTD** could be identified based on the above documented efforts. They are:

- The first approach (e.g. FSR, ITK, and FFL) evolves around *understanding farming systems*. This is a move away from looking only at commodity crops to a more holistic perspective. This approach shows that farming systems are not static but dynamic.
- The second approach (e.g. OFT, FBTF, and FFL) *emulates the physical conditions of farmers* in on-farm research. This approach addresses the fact that conditions in laboratories and research stations are vastly different from actual field conditions.
- The third approach (e.g. IBA, and OFCOR) revolves around the *emulation of the personal and physical conditions of farmers*. This is based on farmers' rationality; i.e. farmers' decisions and practices are not only in response to physical factors but are also due to socio-economic factors.
- The fourth approach *combines analytical tools geared toward action*. FPR, PRA, and PTD involve methodologies that not only combine the understanding of farmers' physical and personal conditions but also provide the tools necessary for farmers to participate in the research process.

A perusal of the above approaches reveals that the differences among farmers have to be recognized and all the groups need to be integrated including a gender perspective in agricultural research to make it truly participatory.

Participatory approaches are constantly evolving. The three main reasons for ever growing awareness of and appreciation for participatory methodologies are:

- The concept and practice of participation in agricultural research is relatively new and certainly complex involving a wide diversity of farming systems. There is also a considerable gap between theory and practice. Many lessons have been learned and even more need to be learned.
- The diversity of context and corresponding institutional policy environments requires constant analysis and application.
- A prescribed methodology does not exist. There is no fixed recipe or a model for PTD. This may be seen as a complication of participation but, more appropriately, it is the essence and strength of participation. Hence a “tool box approach” to research is essential, wherein different approaches should not be looked at as competitive to one another but as sources of a rich array of research tools and procedures (Mettrick, 1993).

### **Participatory Technology Development (PTD)**

PTD is a strategic action and a purposeful process by which scientists sponsored technology is tested, suitably modified and refined by the farmers in their fields leading to its, viability and acceptability by them in their farming situations.

### **Goals of participatory approach in agricultural research**

One goal of encouraging stakeholder participation in research and technology development and transfer is to improve the functional efficiency of formal research (better technologies, more widely adopted, more quickly adopted). Another objective is to empower the stakeholders, especially the marginalized ones, on their own decision making so that their research capacity to make effective demands on research and extension organizations is strengthened. These goals are not mutually exclusive; functional participation can be empowering and empowering participation may lead to functional efficiency gains in technology development. However, the two may imply different financial priorities and time horizons; the quest for empowerment generally demands more intensive participation over a longer time period than the quest for functional efficiency gains in a particular research area. They may also imply that different indicators for project monitoring should be adopted; cost effectiveness is a key indicator for functional participation while indicators of capacity are central for empowering participation (Farrington and Nelson, 1997).

### **Key features of PTD**

- **Client-based:** The knowledge, needs, criteria, and references of farmers are given importance in decisions regarding research agenda, prioritization of problems for research, choice of methodologies, and verification, validation, dissemination and adoption of research results.
- **Decentralized research/technology development**
- **Devolution of more responsibility to farmers for adaptive testing**
- **Accountability sharing**
- **Focuses on farmer-led experimentation**
- **Tests the relevance of farmers' problem solving measures**
- **Takes in to account the local resources**
- **Is often based on indigenous technical knowledge and native wisdom of farmers**
- **Emphasizes use of low cost and locally available resources**

## Steps in PTD Process

To have a more meaningful and effective PTD process for suitable and appropriate technology development so as to enable farmers to use and implement the technologies in their fields, following steps are suggested.

| Step                                     | Activity  |
|--|---|
| 1. Getting started in field              | <ul style="list-style-type: none"><li>➤ Building relationship/rapport</li><li>➤ Preliminary situation analysis</li><li>➤ Awareness mobilization</li></ul>   |
| 2. Understanding Problems and Potentials | <ul style="list-style-type: none"><li>➤ Analyzing driving/restraining forces</li><li>➤ Identifying scientific and local knowledge of farmers</li></ul>  |
| 3. Looking for thinking to try           | <ul style="list-style-type: none"><li>➤ Identifying priorities</li><li>➤ Screening options, choosing selection criteria</li><li>➤ Developing 'agreed' research agenda</li></ul>   |
| 4. Designing Experiments                 | <ul style="list-style-type: none"><li>➤ Review existing practice</li><li>➤ Planning and designing experiments</li><li>➤ Designing evaluations</li><li>➤ Protocols</li></ul>   |
| 5. Trying out                            | <ul style="list-style-type: none"><li>➤ Implementation of farmer experiments</li><li>➤ Measurement/observation of research</li><li>➤ Developing structure of dissemination of experiences</li></ul>   |
| 6. Evaluation of the experiments         | <ul style="list-style-type: none"><li>➤ Analyzing the results</li></ul>   |
| 7. Sharing results with others           | <ul style="list-style-type: none"><li>➤ Farmers extension-conduct of field</li><li>➤ Field days/exchange</li><li>➤ Communication of principles and results of PTD Process</li><li>➤ Training in skills and use of experimental methods.</li></ul> |
| 8. Sustaining the PTD Process            | <ul style="list-style-type: none"><li>➤ Creation of favourable conditions for continuing experiments</li><li>➤ Developing self management capacity of farmers</li></ul>   |
| 9. Scaling up/Phasing out                | <ul style="list-style-type: none"><li>➤ Farmer consolidation</li><li>➤ Gradual withdrawal of the organization</li><li>➤ Dissemination to more farmers</li></ul>   |

Hence it may be said that PTD is the significant strategic action to make agricultural technology viable and pro-farmers. The advantages accrued to farmers from PTD can be told in more specific words as follows.

### Advantages to Farmers from PTD

- Farmers produce their own technologies
  - Appropriate to farm situations
  - Based on problems experienced by farmers

- Encourage community participation
- Use local materials and local expertise
- Technologies are cheap and flexible
- These are culturally supportive
- Reduce time lag in large scale adoption
- More sustainable and productive
- Within the resources and capability of farmers
- These have options rather than fixed packages for production.

### **Comparison of PTD with other similar concepts**

Here, comparison of PTD with other known concepts – Extension, Demonstration and Farmers Managed Trials is also important. They are:

#### **Extension**

- Farmers opinion is not considered important
- Targets are fixed for technology dissemination
- No attempt is made to empower the farmers to develop and use technologies on their own

#### **Demonstration**

- Only proved technologies are offered to farmers
- Implementation alone is the activity left to farmers

#### **Farmers Managed Trials**

- Technologies may succeed or fail
- Only implementation of trials is left to farmers
- All other factors are controlled by researchers

Similarly, comparison between Research Stations Vs. Farm Holdings and Scientists' Research Vs. Farmers' Research provide a vivid picture how PTD is different and important than other systems, as mentioned below:

|                    | <b>Research Stations</b>         | <b>Farm Holdings</b>                     |
|--------------------|----------------------------------|--|
| * Resources        | Abundant<br>Assured availability | Limited<br>Availability not assured      |
| * Seed             | High quality                     | Quality not certain                      |
| * Capital          | Not a constraint                 | Limited factor                           |
| * Irrigation       | Under own control                | Mostly under control of others           |
| * Labour           | No limit                         | Very much limited                        |
| * Price            | Not a critical factor            | High input cost<br>Low price for produce |
| * Technical Skills | Always available                 | Limited availability                     |



| Scientists' Research  | Farmers' Research                               |
|---|---|
| * Use more capital – intensive equipment                                  | * Limited equipment, use local resources        |
| * Long term perspective   | * Short term perspective                        |
| * Complicated design and analysis   | * Simple farmer-decided design                  |
| * Standard procedures   | * Changing procedures, according to adhoc needs |
| * Focus on single crop  | * Integrated system                             |
| * Oriented to general consumer preferences and market                     | * Local preferences and markets                 |
| * Controlled variables (introduces practices which farmers do not follow) | * Follow farmers' management practices          |
| * Artificial situation  | * Real life situation                           |

### Participation typology

In his summary of the findings of the ISNAR study, Biggs (1989) identifies the following four distinct types of farmer participation in agricultural research:

- **Contractual participation:** Scientists contract with farmers to provide land or services. In this approach the farmer's role is passive and participation is not explicit. Scientists manage research themselves so as to maintain tight control over the variables. Multi-location testing of technology is a good example of contract participation. Although this mode cannot by itself be considered as client-oriented research, it can form an important component of such efforts. E.g. On-farm Trials.
- **Consultative participation:** Scientists consult farmers about their problems and then develop solutions. This type of participation is akin to 'doctor-patient' relationship. Researchers use formal and informal surveys to define farming systems and diagnose priority problems. Then they design experiments to test various solutions or to better understand identified problems. The emphasis is on adapting technology to the socioeconomic as well as the agroecological conditions facing farmers. Researchers involve farmers mostly in the problem identification and diagnosis and then later in the evaluation of proposed solutions. This mode was dominant in more than half of the programmes reviewed by the ISNAR study. E.g. FSR.
- **Collaborative participation:** Scientists and farmers collaborate as partners in the research process. This approach, noticed in about a third of the programmes reviewed, involves more intense and continuous interaction. Researchers actively draw on farmers' knowledge and experimentation in seeking solutions to identified constraints. Regular meetings are held between farmers and researchers to understand the current farming practices, set priorities among research problems, develop potential solutions, monitor progress, and jointly review the results. E.g. PRA.
- **Collegiate participation:** Scientists work to strengthen farmers' informal research and development systems in rural areas. Here the emphasis is on increasing the ability of farmers to carry out research on their own, as well as to request information and services from the formal research system. This mode is often used with large-scale commercial producers, but is uncommon with resource poor farmers. E.g. PTD.

## The choice of degree of participation:

The institutions involved should choose and develop for themselves the type of participation they wish to pursue. This will depend on the type of research, risk involved, suitability for farmers' circumstances and preferences, etc. Participatory approach is one of the many approaches possible in agricultural research. The relevance of any approach depends on specific material conditions and desired objectives. For example, the nature of client-based agendas is likely to differ from that of basic, long-term research. In the case of resource poor farmers, their subsistence conditions imply short-term goals. The illustrations in Figure 3 highlight the need for and likelihood of participation (Loevinsohn, 1996).

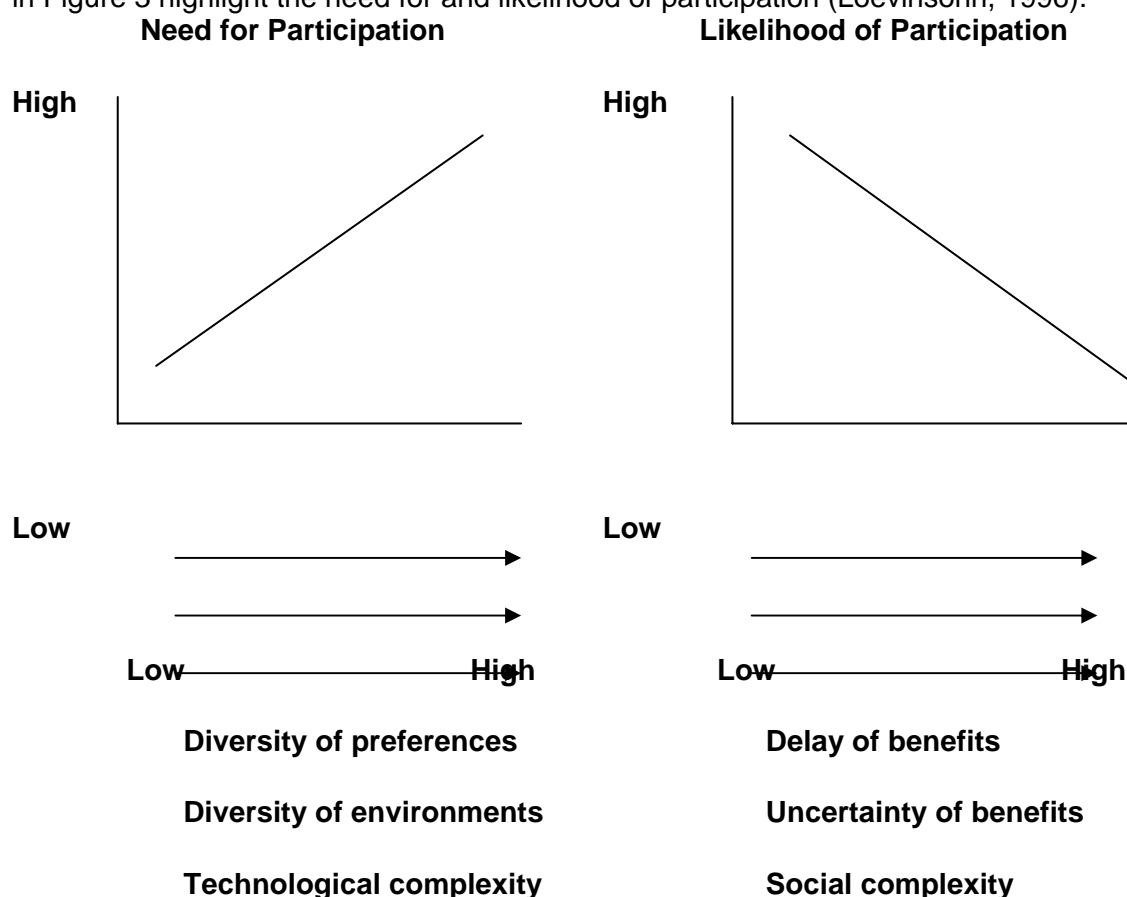


Figure 3. Need for and likelihood for participation

## Benefits of PTD

PTD originates from the recent evidence that user participation can be critical in pre-adaptive (or upstream) stages of certain types of research. In contrast to earlier approaches to on-farm research, pre-adaptive PTD and development brings users directly into early stages of technology development, as researchers and decision makers who help set priorities, define criteria for success and determine when an innovation is ready for release to farmers. The benefits of this approach are:

- ❖ The technologies are more rigorously tested under users' conditions.

- ❖ Farmers' participation in defining research agendas, conducting trials, and evaluating results could increase the chance that technologies developed will be more suitable to their circumstances in diverse agro-ecological and socio-economic situations.
- ❖ Farmers are motivated when their views are respected.
- ❖ The indigenous technical knowledge of farmers can be gainfully tapped.
- ❖ Enhances the capacity of farmers to adapt technologies by encouraging farmer experimentation.
- ❖ Technology is more likely to be adopted.
- ❖ Technologies are in users hands more rapidly.
- ❖ Farmers' knowledge and creativity are harnessed to develop appropriate technology.
- ❖ Participatory approaches complement station-based research by systematizing feedback in orienting the research focus and accordingly guide the development of technological alternatives.

### **Obstacles in PTD**

Although convinced of the importance of PTD, **scientists generally may be hesitant to involve farmers because:**

- ❖ They are concerned that results could be spoiled by mismanagement of factors outside the researchers' control.
- ❖ The failure of technologies in farmers' fields may be construed as demonstration of inadequacies of scientists. Therefore, scientists prefer 'finished' and well-tested technologies.
- ❖ Scientists are afraid of exposing farmers to too many uncertainties, in terms of economic, health and environmental damages.
- ❖ Lack of participatory theory in the practice of analytical research; therefore,
- ❖ Lack of skills and experience in PTD.
- ❖ Scientists may lack time, motivation, and the communication skills to approach farmers.

On the other side, **farmers may be unwilling to participate because:**

- ❖ They are concerned that research would take too much time and would be too great a risk in their production system.
- ❖ The fear that they may be punished if the technology fails.
- ❖ They may have no intention to experiment an option, which they consider risky, insignificant, or having delayed benefits.
- ❖ They may lack communication link with scientists. In many cases, farmers feel that their problems are unimportant to scientists.

### **Institutionalizing PTD**

The effectiveness of PTD depends on the recognition of the farmer-driven agenda as a policy, strategy and priority. This needs to be formalized and institutionalized through the following:

- Institution policy
- Methodologies in the research project cycle
  - Farmer representation and participant selection
  - Clear links between problem identification and corresponding project activity
  - Well-defined activity follow-up
  - Continued and integrated feedback

- Improved awareness, knowledge and skills through training, constant practice, and analysis
- Strong and committed leadership and staff support
- Inter-disciplinary team work
- Better systems of monitoring, evaluation and accountability sharing.
- Changes in the reward system of agricultural research, which measures strong performance, based on farmers' adoption of technologies, instead of number of technologies and publications.
- Decentralized decision-making on administrative and financial matters.

## Conclusion

In conclusion it may be stressed that PTD has to make way in all possible manner to develop technologies that readily fit into the agro-climatic and socioeconomic domains of farmers. The tremendous potential of the PTD can be realized by institutionalizing this approach. PTD should not be thought of as a substitute to conventional station-based agricultural research. It can at best supplement and complement the more formal research carried out by agricultural scientists, to derive a kind of synergy to develop and disseminate need-based and appropriate agricultural technologies. Adequate care, however, has to be exercised in doing so, as it calls for a series of changes in our approach to agricultural R&D, the research management process and the organizational frameworks.

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### **Further Readings**

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Kannaiyan, S. 2001. Modernization of Indian Agriculture in the 21<sup>st</sup> Century: Reforms in Technology Development and Technology Dissemination. In: Hansra, B. S., G. Perumal and K. Chandrakandan (Eds.) *Modernizing Indian Agriculture in 21<sup>st</sup> Century: Challenges, Opportunities and Strategies*. Concept Publishing Company, New Delhi. 37 – 55 pp.

Arya, H. P. S. and Shagufta Jamal. 1998. Participatory research for technology assessment and refinement. *Indian Journal of Extension Education*. 34 (1&2): 21 – 26.

Chandre Gowda, M. J., P. S. Prabhkumar, and P. P. Ramachander. 1998. Participatory problem diagnosis: First step in technology assessment and refinement. *Indian Journal of Extension Education*. 34 (1&2): 27 – 30.

### **Useful Internet Readings**

[http://www.fao.org/sd/pe2\\_en.htm](http://www.fao.org/sd/pe2_en.htm)

<http://www.odi.org.uk/agren/index.html>

# **PRA TECHNIQUES**

**(Social Map, Mobility Map, Venn Diagram, Time Line and Time Trend)**

**Bharat S. Sontakki**

Principal Scientist

## **Social Map**

**Description:** It is a visual PRA method involving direct participation in which simple maps/drawings are drawn without scales by the residents and which shows the social structures and institutions found in an area. It enables to understand and simplify locations/structure of houses and other social facilities in a given area like a village or a hamlet.

### **Objectives:**

- ❖ To learn about the social structures in the Village and the differences among the households by ethnicity, religion and wealth
- ❖ To learn about who is living where
- ❖ To learn about the social institutions and the different views local people might have regarding those institutions.

### **Issues covered in social map:**

- Social issues like caste/dowry/liquor abuse/bonded labor/etc.
- Ownership of dwellings and buildings
- Location of poor and non poor households
- Heads of households (male/female)
- Dependency ratio
- Ownership of assets and cattle
- Beneficiaries under government and other programmes
- Health characteristics
- Literacy levels
- Social stratification
- Pattern of influence: who dominates for what
- Institutions
- Value systems
- Leadership pattern
- Social norms
- Social interaction
- Cooperation/competition /conflict
- What are the approximate boundaries of the village with regard to social interaction and social services?
- How many households are found in the village and where are they located?
- Is the number of households growing or shrinking?
- What are the social structures and institutions found in the Village?
- What religious groups are found in the village?
- Where in the village are the different religious groups living?
- What ethnic groups are found in the village?
- Where in the village are the different ethnic groups living?
- Which are the female headed households and where are they located?

## Key Questions:

1. What are the approximate boundaries of the village with regard to social interaction and social services?
2. How many households are found in the Village and where are they located?
3. Is the number of households growing or shrinking?
4. What are the social structures and institutions found in the Village?
5. What religious groups are found in the village? Where in the Village are the different religious groups living?
6. What ethnic groups are found in the village? Where in the Village are the different ethnic groups living?
7. Which are the female Headed Households and where are they located?

## How to facilitate:

- Ask the participants to draw a map of the village, showing all households. For orientation it will be helpful to draw roads and significant spots of the village into the map.
- Discuss whether the total number of households has increased or shrunk during recent years. If there were any changes ask why the number has changed and whether this has caused any problem for certain families or for the community at large.
- Ask the group to also show institutions, buildings and places that offer some kind of social service or which are popular spots to meet and discuss. (Example: schools, churches, health service, traditional healers, community administration, community leaders, local shop, kindergarten, places where people frequently meet, water point, etc.)
- Encourage the group to discuss and show on the map which different ethnic groups are living in their village. Using a common symbol, mark those households in which the minority ethnic groups live.
- Ask the group to indicate with a symbol on the map different categories of households like rich, average and poor.
- Encourage the group to discuss and show on the map which different religious groups are living in their village.
- Similarly encourage the groups to explore the other social issues and indicate the same using a suitable key or legend.
- Make sure that your copy of the map has a key explaining the different items and symbols used on the map.

## Material needed:

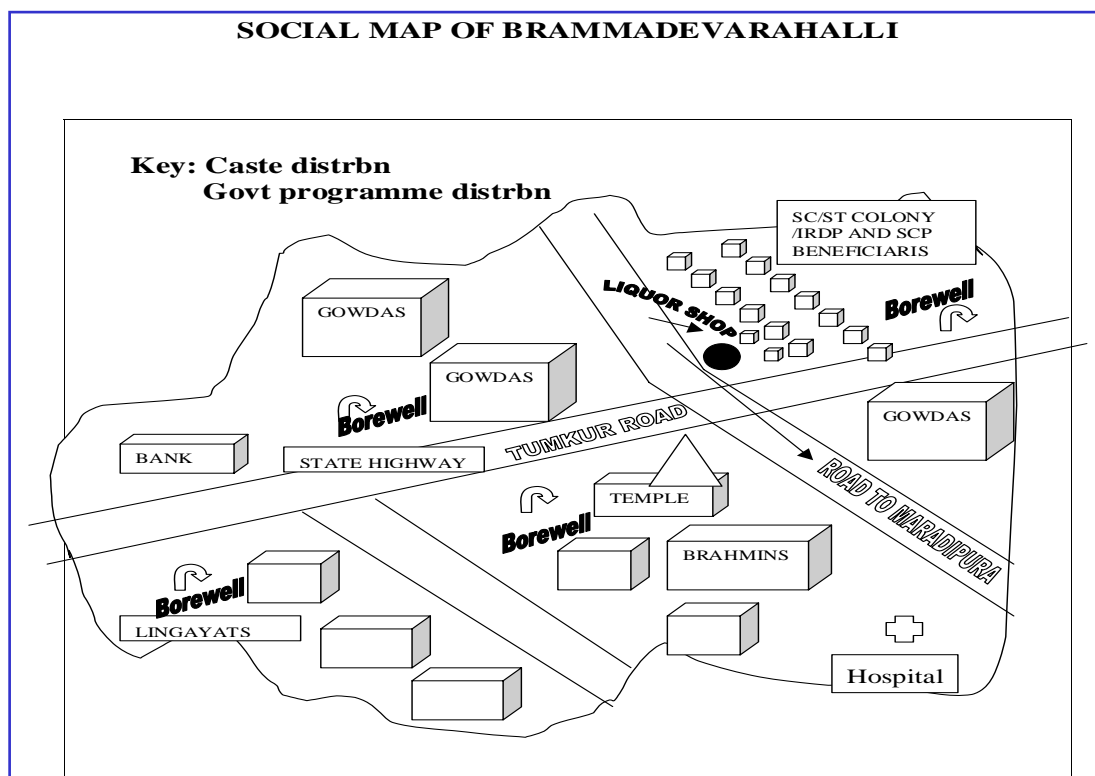
- Documentation sheet of this tool, white paper for copying the map
- If drawing on the ground: soft ground, sticks and local material for symbols, or
- If drawing on a paper: BIG sheet of paper, pencils and markers.

**Time:** 1.5 - 2 hours

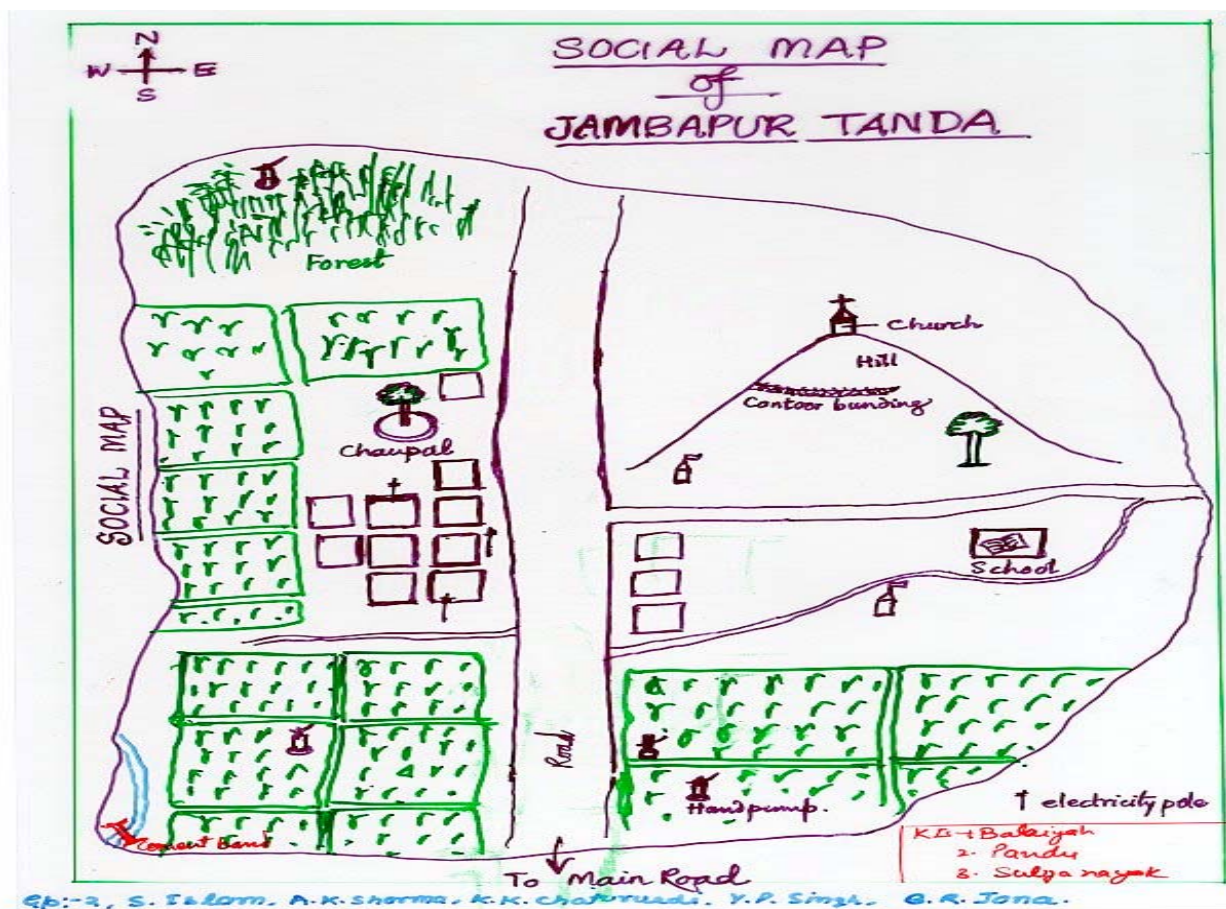
## Practical tips for effective social mapping:

- If people find it difficult to understand this tool, it will be helpful to draw a simple example for them.

- During the whole process, take care that once somebody has given a statement, you ask the others whether they agree, disagree or want to add something.
- The note-taker must ensure that all the important points of the discussion and also other information is documented.
- The purpose of the social map must be very clear to all participants, make sure that the participants do not have wrong expectations. For example they might think that the poor households would get food donations, which is completely wrong.
- Unlike resource mapping, social maps need good and well-prepared facilitation. Be aware that some of the issues that might be discussed could be sensitive issues for the group.
- Make sure that the objective of having all households shown on the map will be achieved.







## Venn Diagram

**Description:** The Venn diagramme shows institutions, organizations, groups and important individuals found in the village as well as the villagers view of their importance in the community. Additionally it explains who participates in these groups in terms of gender and wealth. Venn diagramme also indicates how close the contact and cooperation between those organizations and groups is.

### Objectives:

- ❖ To identify external and internal organizations/groups/important persons active in the community
- ❖ To identify who participates in local organizations/institutions by gender and wealth
- ❖ To find out how the different organizations and groups relate to each other in terms of contact, co-operation, and flow of information and provision of services

### Key Questions:

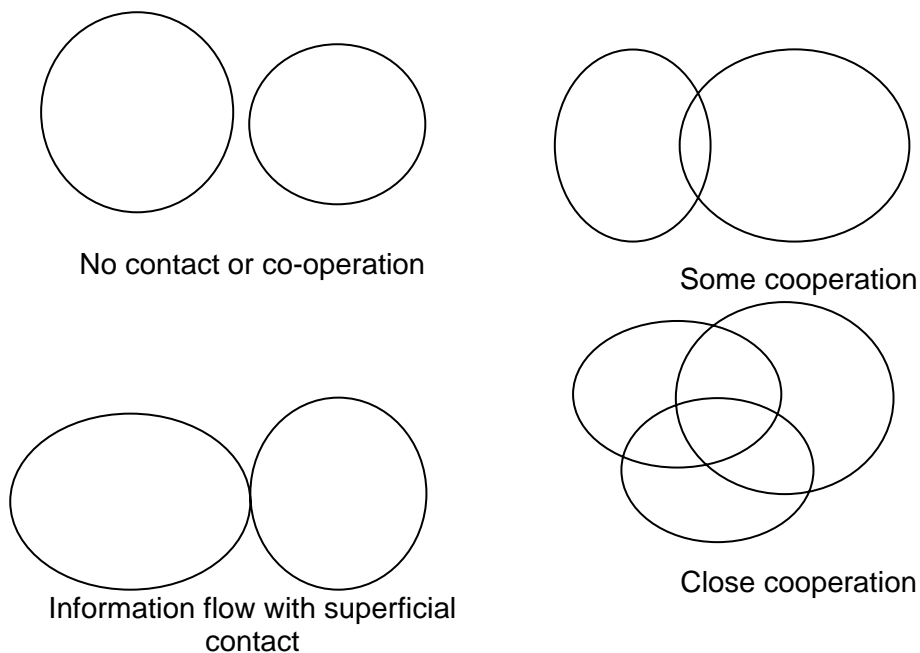
- ❖ Which organizations/institutions/groups are working in or with the community?
- ❖ Which institutions/groups do the villagers regard as most important, and why?
- ❖ Which groups are addressing household food security and nutrition issues?
- ❖ Which organizations work together?
- ❖ Are there groups, which are meant for women or men only?
- ❖ Are some particular groups or kind of people excluded from being members of or receiving services from certain institutions?

### How to facilitate the process?

- i. If time allows it will be good to form separate focus groups for women and men. Make sure that also the poorest and most disadvantaged join the group.
- ii. Make sure that you have all material that is needed. You can a) either draw and write with a stick on a soft ground or b) you might use a BIG sheet of paper, pencil and markers. If you decide to use paper, people should first use a pencil to be able to still change the size of the circles that the participants will draw.
- iii. Explain to the participants the three objectives (see above) of the Venn Diagram on institutions.
- iv. Ask the participants which organizations/institutions/groups are found in the village (Village) and which other ones from elsewhere are working with them. Make sure that they also think of the small not formal groups like e.g. neighbourhood committees. These questions will be useful to ask:
- v. What kinds of ways of assisting each other do exist among people? Which local groups are organized along environmental issues (water, grazing, arable land), economic issues (saving, credit, agriculture, livestock), social issues (health, literacy, religion, tradition, education, sport). Are their political groups? Who makes important decisions in the Village?
- vi. Ask one of the villagers to write down all the institutions that are mentioned and to give each organization a symbol which everybody can understand.
- vii. Ask the participants to draw a big circle in the centre of the paper or on the ground that represents themselves.
- viii. Ask them to discuss for each organization how important it is for them. The most important ones are then drawn as a big circle and the less important ones as smaller circles. Ask the participants to compare the sizes of the circles and to adjust them so that the sizes of the circles represent the importance of the institution, organization or group.
- ix. Every organization/group should be marked with the name or symbol.
- x. Ask them to discuss in which way they benefit from the different organizations.

- xi. The facilitator and note-taker have to listen very carefully and the note-taker writes down, why the different organizations are considered important or less important!
- xii. Ask them to show the degree of contact/co-operation between themselves and those institutions by distance between the circles. Institutions that they do not have much contact with should be far away from their own big circle. Institutions that are in close contact with the participants and which whom they co-operate most, should be inside their own circle.

The contact between all other institutions should also be shown by the distance between the circles on the map:

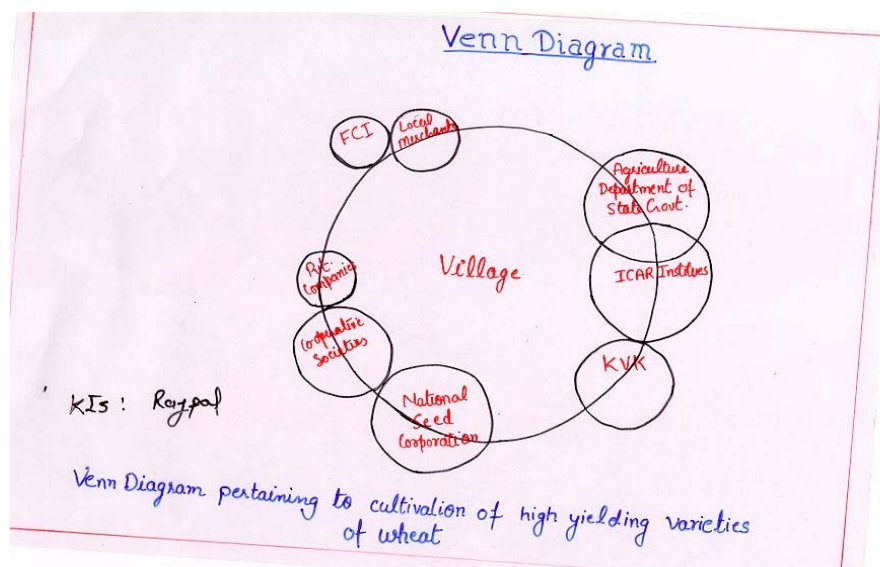


- xiii. Ask them which institutions are only accepting women or men as members. Are there any institutions or groups that do provide services either only for men or only for women? Show the answers by marking the circles with a common symbol for men or women.
- xiv. Ask them to discuss in which organizations poor people do not participate and why. Ask if there are any services of certain organizations from which the poorer people are usually excluded. Mark these institutions on the map by using a symbol for poor. You might also ask if there are other groups of people that usually are excluded from some of these institutions or services.
- xv. Ask the participants which institutions/groups are addressing household food security and nutrition issues. Ask them to discuss in which way they address these issues? Mark the mentioned institutions with a common symbol.
- xvi. Only if time and the motivation of the participants allows, ask the group to discuss and document the strength and weaknesses of those institutions which were reported as most important.

**Material needed:** The note-taker will need the Documentation Sheet for the Venn Diagram, this tool sheet, white paper for copying the map

- ❖ If drawing on the ground: soft ground, sticks and local material for symbols, or
- ❖ If drawing on a paper: BIG sheet of paper, pencils, markers

Time: 1.5 - 2 hours



## Mobility Map

**Description:** It is visual, participatory data collection & analytical tool used for exploring spatial mobility/outside contacts with reasons thereof. It highlights activity-wise importance of places. Mobility is influenced by socio-economic conditions, gender, age, nature of work, resourcefulness, transportation facilities & access.

### Objectives:

- To identify the places visited by rural people together with reasons thereof.
- To highlight the activity-wise importance of various places around a given area.

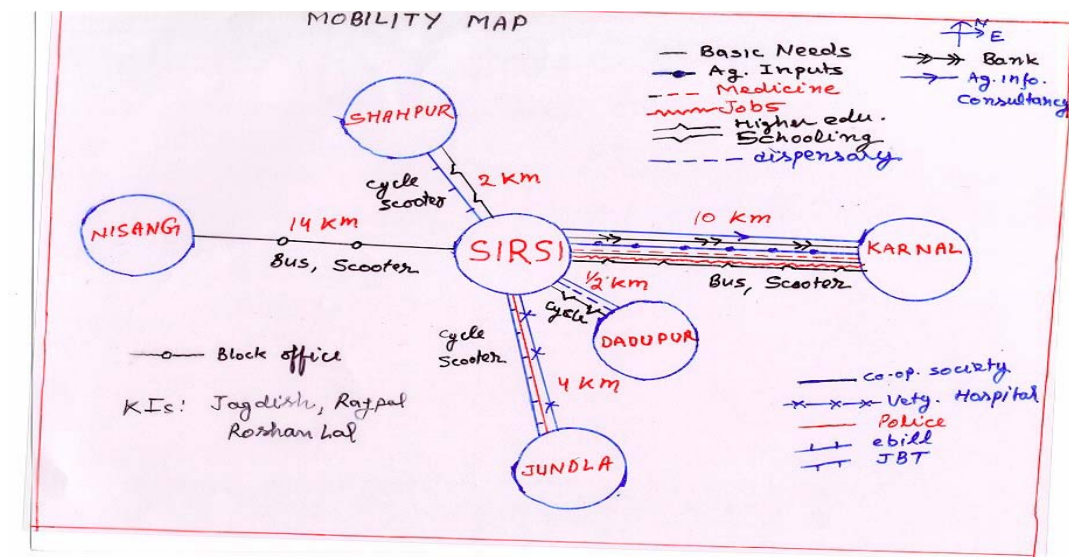
### Purpose:

- To identify & analyze patterns of spatial mobility
- To locate a persons contacts with & knowledge of outside society
- To identify extent of cosmopolitaness

### Procedure:

- **Identify appropriate place and persons**
- **Use appropriate material**
- Encourage the participants to draw mobility map by placing village at the centre and indicating places visited by villagers at the periphery.
- For each place of mobility indicate the, purpose, distance, time taken, mode of transport & cost.
- Draw the maps using appropriate legend of activities as shown below:

| ACTIVITY         | LEGEND     |
|------------------|------------|
| Job/Farming      | 👤👤👤👤👤👤👤👤   |
| Health/Medical   | 🏥🏥🏥🏥🏥🏥🏥🏥   |
| Market/Marketing | 💰💰💰💰💰💰💰💰💰💰 |
| Education        | 🎒🎒🎒🎒🎒🎒🎒🎒   |
| Entertainment    | 🎵🎵🎵🎵🎵🎵🎵🎵   |



## Agriculture/Farm Time Line

**Description:** It is a method of knowing history of major remembered events in a community. It indicates a causal link between past and present. It is also known as historical profile. A historical account is given by the key informants of how different aspects of village life have changed and made impact on the social, economic and agro-ecological bases in the village. It indicates the major remembered events in the history of a village life that have direct or indirect bearing on the rural life.

### Objectives:

- To obtain developmental historical profile of a village.
- To know the qualitative changes that have occurred in the village over a period of time.
- To know the coping behaviour of villagers during adverse years.

### Purpose:

- Useful for sensitizing the R&D agents to the importance of past for understanding the present and planning for the future, and
- To obtain historical accounts of changes in demography, socio-economics, communication & social relationships & interactions, technology diffusion & adoption, farm production, etc.

### Procedure:

- Identify key informants – relatively old people in the village who hold key positions like Sarpanch, Chairman of village cooperative society, School Teacher, Village Leader, etc.
- **Ask them to present a historical development of their village vis-à-vis facilities, production changes, technologies, etc.**

| <u>Time line</u>                     |                                    |  |
|--------------------------------------|------------------------------------|--|
| Vill: Jambapurthanda                 |                                    |  |
| Year                                 | Services / facilities              |  |
| 1969                                 | Draught                            |  |
| 1977                                 | Bi-cycle                           |  |
| 1980                                 | Vegetables                         |  |
| 1983                                 | Oil-Engine                         |  |
| 1990                                 | Fertilizers                        |  |
| 1990                                 | Road - kaccha                      |  |
| 1992                                 | Electricity                        |  |
| 1992                                 | Water shed (Reeds)                 |  |
| 1994                                 | Pesticides                         |  |
| 1996                                 | DPAP - Draught Pone Area programme |  |
| 1996                                 | Sprayers                           |  |
| 1997                                 | Family- Planning                   |  |
| 1998                                 | Primary School                     |  |
| 2000                                 | Television                         |  |
| 1986                                 | Radio                              |  |
| Date: 19.08.2001                     |                                    |  |
| K1. Krishnaih, Narasimulu, Veekataih |                                    |  |



## Time Trend

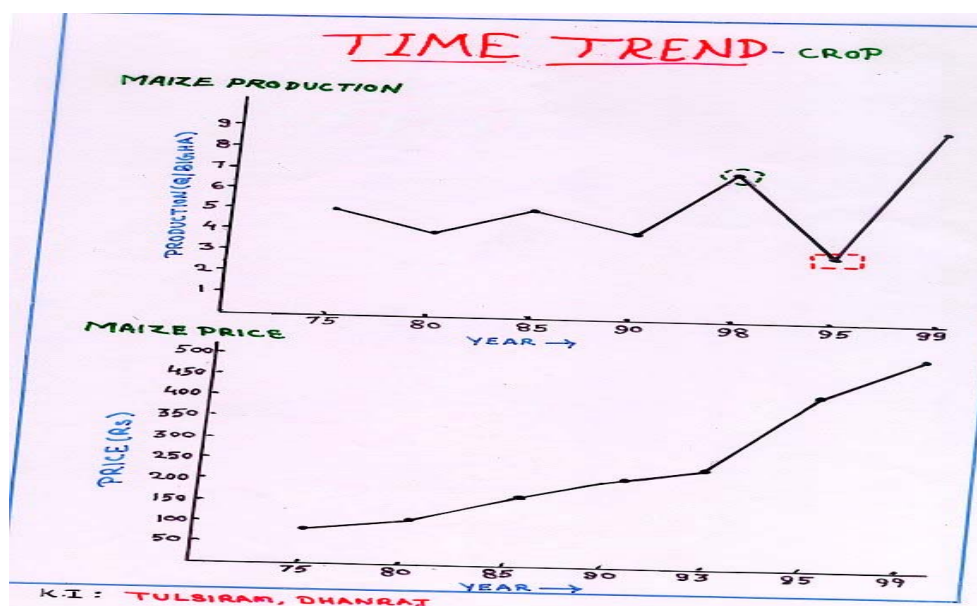
**Description:** It is a participatory visual method of analyzing the trends and fluctuations in the variables that influence the village life. Sometimes, it is combined with time-line.

### Objectives:

- To identify the changes / fluctuations that have occurred over a period of time in the variables influencing village life.
- To explore the coping behaviour of villagers during adversities.

### Procedure:

- Time trends are usually depicted in the form of graphs (bar/line graphs) to show the trend of crop/animal production, commodity prices, human/cattle population, etc.
- Two separate time trend analyses have to be carried out.
- One analysis will focus on crop production, while the other on animal production
- Generate one graphic to show the trend of production of commodity (e.g., trend in paddy production/milk production during last 25 years)
- Another graphic will focus on trend of price/net returns/cost of production of the commodity
- Identify the Key Informants
- Focus the interview on the trend of crop production, animal production, trend in prices/cost of production/net returns, etc. of the farm commodities
- Usually ask for information of past 10 - 25 years
- Try to locate the fluctuations like the 'unusual highs' and 'unusual lows' and explore the reasons for the same
- Encourage KIs to narrate the coping mechanisms during fluctuations.



# **INDIGENOUS TECHNICAL KNOWLEDGE AND ITS RELEVANCE FOR SUSTAINABILITY**

**N. Sandhya Shenoy**  
Principal Scientist

## **Introduction**

The Indigenous Technical Knowledge (ITK) is regarded as the information gained over a period of time passed on from generation to generation by the word of mouth. Wang (1988) defined ITK as “the sum total knowledge and practices which are based on people’s accumulated experiences in dealing with situations and problems in various aspects of life and such knowledge and practices are special to a particular culture.” Indigenous technical knowledge (ITK) refers to the unique, traditional, local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area (Grenier, 1998). ITK is stored in people’s memories and activities, and is expressed in the form of stories, songs, folklore, proverbs, dances, myths, cultural values, beliefs, rituals, community laws, local language and taxonomy, agricultural practices, equipment, materials, plant species and animal breeds. ITK is shared and communicated orally, by specific examples and through culture. An African proverb says “When an old knowledgeable person dies, a whole library dies” indicating the importance of ITKs.

Of late, the policy makers, the scientific community and the extension workers started recognizing the value and importance of ITKs in agriculture. The inherent nature of ITKs prevent from over-exploiting natural resources, thus paving the way for sustainable agriculture. Sustainable agriculture can be defined as “an exploitation of renewable natural resources and conservation measures for long-term maintenance of resources”.

The basic characteristics of the ITKs provide for conservation and efficient utilization of resources by being eco-friendly, less capital intensive, cost-effective, and efficient bi-product and waste recycling and use. Most of the ITKs are location – specific, using locally available materials and are products of informal research. ITKs are found to be socially desirable, economically affordable, sustainable, and involves minimum risk to users and widely believed to conserve resources. Thus, ITK provides basis for problem solving strategies for local communities. In addition, the use of ITK assures that the end user of specific development projects are involved in developing technologies appropriate to their needs (Warren, 1991).

When the use of ITKs in agriculture was studied, it was found that most of them are in use in complex diverse and risk prone areas, practiced mostly by small and marginal farmer in developing countries. These ITKs have scientific parametres, and, the latest approach in the technology generation of scientific agriculture include ITKs integration into the research process by testing their scientific validity for providing comprehensive and effective location-specific solutions in agriculture. Moreover, whenever group action is planned to support developmental programmes, and to generate favourable environment for quick information exchange and technology transfer, interventions of farmers’ participation at the highest levels is envisaged. The ITKs and the farmers’ local experience provide for higher farmer participation in strengthening group action. It is also noted that preserving ITKs is vital for the survival of the aboriginal communities and farmers as they are ingrained or deep rooted in their culture and traditions. Thus, it is regarded that recognition of ITKs bring pride to the farming community, and, there is an urgent need to integrate them into the Agricultural Knowledge and Information System (AKIS). In the present context of the Intellectual Property Rights (IPR), it is necessary to document the ITKs and direct the flow of



benefits to the farming community who are the rightful owners and architects of indigenous knowledge.

### **Role of ITKs in the traditional non-chemical agriculture**

Successes in agricultural front with high production levels, especially in food grains have indeed been achieved. But more energy in the form of mineral fertilizers, chemical pesticides and farm machinery are required every year to produce the same quantity of farm products (Swaminathan, M.S. 1991). The yield plateau of crops in Punjab, Haryana, Western Uttar Pradesh and other states strongly indicate that there is a disturbance in our natural resources management and the present practices are not conducive to sustainable agriculture (Deb, 1994). Area covered by soil degradation has increased by almost 800 lakh hectares. Soil degradation has already consumed 57 per cent of the country's area. Apart from soil erosion, in-situ degradation like water logging, salination and nutrient depletion is responsible for a loss of up to 26 per cent of the annual agricultural output. Another major cause of concern, particularly in the core Green Revolution belt, has been the decrease in genetic diversity of major HYV crops, which has increased the potential danger for sudden widespread loss of crops from unknown / uncontrollable diseases (Maji and Bhattacharya, 1994).

Depletion of natural resource base due to deforestation, over grazing, desertification, excessive agricultural intensification, over fishing and agriculture on marginal lands leads to decline in agricultural production potential leading to decrease in the sustaining / carrying capacity of agriculture. Natural resources (soil, water, nutrients) have boundaries and improved management is needed to reverse the degradation of this resource base and develop agricultural production systems that sustain our ecosystem. It is estimated that without conservation measures on the rain-fed lands for soil erosion by wind or water, salinisation or alkalinisation, depletion of plant nutrients and organic matter, deterioration of soil structure and pollution total productivity loss will amount to 29%, and loss of 544 million hectares of cropland all over the world (FAO, 1984a). Thus, sustainable agriculture involving sustenance of our agricultural systems should be the major emphasis for all technological innovations involving land and water use so that there is no adverse effect on the biological productivity of the resource base in the long run (Deb, 1994). Sustainable agriculture is the sustainable exploitation of renewable natural resources including annual and perennial cropping, agro-forestry and livestock as well as the conservation measures needed for long-term maintenance of resources.

The intensive agriculture resulted in depletion of nutritional status of soils, erosion of biodiversity, natural habitats, forests and water resources. Indiscriminate use of chemical pesticides and fertilizers affected the agro-ecosystems, caused pollution of soil and water resulting in human and animal health hazards and contributed significantly to destabilize the traditional systems of agriculture. When the farmers practiced integrated crop management, integrated nutrient management and non-pesticidal management which are the major components of sustainable agriculture, the cost of cultivation reduced by 6.7 percent, and net income increased by 57 percent in Pigeon pea; in Paddy due to adoption of sustainable agriculture practices, the cost of cultivation reduced by 15.2 percent and net income increased by 98 percent; in vegetables, the cost of cultivation reduced by 27.5 percent and the net income increased by 36.3 percent (CWS, 2003). The traditional practices especially regarding water management, nutrient management and pest management have been classical examples of non-exploitative and non-polluting methods of natural resources leading to sustainable agriculture as presented below.

## Water management

In Sri Lanka, as perhaps in other countries, methods for forecasting rain and managing water are typical examples of knowledge that is passed down orally from generation to generation (Herath T. N., 2001). The agro-ecological dry zone of Sri Lanka is characterized by mean annual rainfall of less than 1750 mm, with a pronounced dry season. To the farmers, it has always been of vital importance to have methods for conserving water and to possess knowledge about rain and the patterns, times and quantities in which it falls. When farmers could forecast the amount of rainfall to expect in the coming season, they could decide which crops and crop varieties to plant. In the dry zone, there had been a system of tanks constructed in a sort of cascade, with one tank below the next. The excess water from one tank automatically flowed to the tank just below it. Only water from seasonal rains was collected in these small tanks. At the level just below each tank, land was prepared and always grown with paddy. Vegetables and cash crops were also grown on this land. Since tanks were constructed in a cascade, the areas fed by the tanks were also arranged in a sort of cascade. Bunds and hedges separated the areas fed by the various tanks. Normally there were several canals running parallel to each other from the tank's water sluice. The first canal provided water for the first section of land. The farmers who worked this first section were not entitled to take water from the second and third canals. If they did so, they were punished. The second canal went to the end of the second section of the field and so on. Thus, each farmer was ensured of water. In fields fed by tanks, paddy was normally grown in two seasons: the rainier one from September to January, and the drier one from March to July. The documented methods for conserving water include the selection of drought-resistant seed varieties, and the careful timing of ploughing. The normal system is to sow paddy after a second ploughing has made the field muddy. But, the farmers of Selveheragama, Thimbiriwewa and Mawathawewa followed a remarkable technique by strewing paddy seeds during the second ploughing that enabled them to make efficient use of rainwater. By the time they needed to draw water from a tank, the paddy plants had been thriving for 15 days or more.

Farmers engaged in cultivation activities had discovered several ways of forecasting the amount of rain that would fall in the coming season. These methods were based on observations of environmental factors such as flora, fauna over the years. These predictions were useful for making decisions about the crops or the varieties to be sown. It was observed that if at the beginning of the season wood-apple trees (*Feronia alephantum*), karamba (*Carissa carandas*), and meegon karapincha (*Clausena indica*) bear more fruit than usual, there would be more rain than usual. Farmers observed that if the wasps make their nests larger and the spiders make their webs larger after the first two or three showers of the season, the year would not bring sufficient rain. The same will be true if the crabs build their hollows closer to the source of water (tank, lake, etc.). On the other hand, if the crabs built their hollows on high ground farther away from water reservoirs and wet places it is predicted that heavy rains would fall during that year.

Many farmers in India traditionally adopted water harvesting measures such as farm ponds, check dams, shallow wells dug in depressions to collect rain water, diversion channels (khuls), brick lined tank, channels constructed through hilly rivers (pynes), tank cascades, Bandhara, Khadin, Nalla check, Pat system, Phad system, Chauka system and Haveli system etc. The age old well-maintained water supply system of Sindhu Valley civilization, Grand Anicut system in 2nd century A.D. by Chola kings, huge tanks that were developed in Deccan during medieval times are serving people even today for their needs of irrigation, drinking water and aquaculture.

## Soil conservation and Nutrient Management

Traditional farmers have found ways of improving soil structure , water holding capacity, nutrient and water availability without the use of artificial inputs. Their systems are sophisticated forms of ecological agriculture fine-tuned to the specific environmental conditions.

The farmers in Gundlupet taluk of Mysore district in Karnataka have been using Khus (Vetiver grass) as vegetative barrier for soil conservation in the dry lands and vulnerable areas where rills would have formed otherwise and to protect waste-weirs and stabilize drop structures. When the waste-weirs and drop structures are to be treated, clumps of Khus are placed at appropriate locations. Even in plain fields farmers grew khus to mark boundary lines. As a perennial fodder it was able to give 3-4 cuts at 45 day interval. Farmers of Tumkur district observed that growing Khus prevented the occurrence of Striga - a root parasite Khus is planted across the slope on small section bunds formed on sloped land or in plough furrow in the plain land 2-3 slips per rill at 20-30 cms interval. The inflorescence axles are avoided at planting by chopping the tops. Khus established well when planted after first monsoon shower, and, even without irrigation hedges in about an year. Slips for further planting are collected from 3 year old hedges (Subramanya, S.& Sastry, K.N.R., 1990).. On establishment, Vetiver completely stopped sheet erosion of soil, slowed runoff, let water seep through the entire length of the hedge, trapped silt behind grass barrier to form natural terrace over the years. Vetiver exhibits wide adaptability, from over 2000 meters in Himalayas to deserts of Rajasthan, swamps near Delhi and waste lands of Andhra Pradesh. It costs less than 1/10<sup>th</sup> of the engineered soil conservation systems, and, unlike the other systems, with this system of contour ploughing and planting between stabilized hedges, food crops can be produced safely on 100% slopes (45°) and vast areas of unstable lands can be brought under cultivation (Grimshaw, R.G., Vetiver Information Network, World Bank).

## Bio- pesticides for Pest Management

For generations, using neem leaves in storage bags as a means of preventing damage by pests has been employed by farmers in India. It is observed that farmers of West Bengal, Bihar, Andhra Pradesh and Tamil Nadu used it to protect paddy, and those in Madhya Pradesh, Uttar Pradesh, Haryana, Punjab and Maharashtra to protect wheat ( Samanta, R.K., Prasad, M.V., 1995)

The bins, baskets or cans used for storing the grains are generally made of thatch bamboo, wood or thin sheets of aluminium. Grain is also stored in large earthenware pots, and many of the farmers in the low- income group make use of bamboo baskets, or gunnysacks (bags made of jute fibres). The quantity of grains stored in a bag or basket generally varies from 50-100 kg. For every 50 kg of grains, about 200 grams of *neem* leaves, together with a few of the more tender branches, are added. The amount of leaves is increased with the quantity of grains. It has been reported that in the first 2 to 3 months, the grains stored together with *neem* leaves are not affected by pests of any kind. If the baskets are kept completely airtight, the occurrence of pests in the grains is reduced virtually to nil. It is also reported that after three months various pests are to be found in the bamboo baskets and in gunnysacks where grains are stored. In all cases, the occurrence of pests in grain storage baskets is reported to be negligible due to the use of *neem* leaves. It has been suggested that when used in appropriate quantities and kept in almost airtight storage bins, *neem* leaves prevent damage to grains by pests. The *neem* leaves in the storage bins should be replaced every six to eight weeks. This technique can also be used for other types of grain elsewhere in the country and in other parts of the world.

In the southern part of Satpura plateau, of Madhya Pradesh, seven most effective indigenous practices for dealing with soybean insect pests are identified (Singh, R.K., 2001).

- Dry mahua flowers (Madhuka india J.F. Emel.) are applied to the field at the rate of 10-15 kg/hectare without any other mixture to control Gaygwalan (Scalopendra spp) pest that causes economic losses to crop amounting to 20 percent by sucking sap from both leaves and buds of soyabean. The insect, after feeding on the flower, becomes unconscious for 20-25 days, which is enough to save the crop.
- 6-8 kg of freshly collected green neem leaves (Azardirachta indica) are boiled in 10 liters of water until the liquid turns dark brown. After 10-12 hours, this is mixed with 80-100 liters of clean water and sprayed on the fields for controlling the girdle beetle (Oberia brevis), Bihar hairy caterpillar (Dicrisia oblique) and other pests in soya bean.
- 1.5 - 2 kg of dry tobacco leaves are placed in 5-6 litres of water and boiled until the liquid is reduced to 1-1.5 liters and has turned dark black. After 10-12 hours the solution is filtered and mixed with 80-90 liters of fresh water to spray one hectare, early in the morning to control the larvae of Heliothis armigera.
- Farmers collect 1000-1200 fresh leaves with buds from ipomea bushes. The leaves are placed in 30-35 liters of water and boiled until the liquid turns milky white. Ipomea leaf extract is a bit difficult to process because it is poisonous. The solution has to be sprayed within four days of its preparation to control the larvae of Heliothis armigera, spotted bollworm and armyworm. It was found that the ipomose and anthacin glucoside it contains help in controlling pests.
- 100-150 grams of asafoetida is placed in one litre of fresh water and boiled for 10-15 minutes. After 2-3 hours, this is mixed with 40-50 liters of water and sprayed over crop in a hectare. Asafoetida is used to help control the larvae of Heliothis armigera and other small insects, but slightly expensive.
- In Ayurvedic medicine, Dinkamali (gardenia: Gardinia gummiifera L.F.) is used to treat stomach ailments in humans. It is also used by farmers to combat Heliothis armigera on soybean and other small insects on vegetable crops such as cauliflower, tomatoes and cabbage. The process of preparation is the same as for asafoetida, except that the mixture is boiled for 25-30 minutes.
- Both rich and poor farmers in the area collect the larvae of major insects, especially the girdle beetle (Oberia brevis) and Heliothis armigera. 2 to 2.5 kg of larvae are placed in 2 liters of clean water and boiled for 45-60 minutes until the water turns dark brown. After 5 to 6 hours, the solution is mixed with 25-30 liters of fresh water and sprayed over the crop in one hectare. The odor acts as a repellent to larvae of the same species, which quickly flee the field, leaving it entirely free of that particular species.

Similarly, there are several traditional practices subscribing to non-chemical agriculture and efficient utilization of natural resources followed in various parts of the country as given below:

#### Other Uses of ITKs:

##### In fisheries

- Salting followed by sun drying is effective method of fish preservation
- Immediately after dressing and cutting fish into pieces, mustard oil, salt and turmeric powder are rubbed to prevent spoilage.
- Banana stems are put in the ponds after harvest, to make water alkaline, to increase fish growth.
- To catch more fish, thorny bushes are used as aggregating devices – especially in summer to enable fish to take shelter and then catch with net.

- Glue made from tamarind bark is used for strengthening fishing nets.
- Cow dung slurry is used to control the 'Euglena' bloom.
- Supernatant of the cow dung slurry is used as disinfectant for the preparation of dry fish.
- Ray fish' oil is used for painting boats for leak proofing.
- Cashew shell oil, coal tar and sardine oil are used for preservation of boats and nets.
- Saw dust and ice are used for fish preservation and live transport
- Boiled extract of Tamarind seed powder and the bark of "Kalasha' are used to treat fishing nets for improving their strength.
- Lime spray is used to rectify water pollution signified by green water coloration

### **In crop husbandry**

- Stubbles are burned in the field for controlling pests.
- Neem leaves are buried in soil for termite control
- Ash is applied in seedbeds and in the field of Onion before sowing and planting for development and improvement of quality of bulbs.
- Residues of Tobacco are incorporated into soil to control termites.
- Deep ploughing is taken up in summer in drylands for avoiding hard pan in soil, improving water holding capacity and pest control
- Seeds of Coriander are mixed with Sorghum seed before sowing to completely control Striga (parasitic weed).
- To prevent storage pests in Paddy, neem leaves and 'Kanjnam-korai' plants which emanates pungent smell are kept along with grains.
- The filtered extract of half Kg. of well crushed cloves of garlic mixed in kerosene and left for overnight, filtered solution of 50 grams crushed chillies in one litre of water and 100 grams of detergent powder dissolved in sufficient quantity of water is mixed. The mixture of these three solutions is used at the rate of 25 ml in 16 litres of water and sprayed on the Pigeon pea crop for controlling pod borer. (It is found scientifically that garlic has volatile sulphur containing oil which is vaporized with raising temperature, Chillies contain capsaisin which irritates skin, detergent helps in spread of solution and adherence to crop.)
- One Kg jaggery is mixed with 10-12 litres of water, and, 5-6 litres of this solution is sprayed on one acre of Cotton crop to control whitefly up to 40-50 percent.
- Cotton seeds are dipped in cow dung slurry and shade dried before sowing to facilitate better germination.
- Pulse seeds are treated with red earth slurry and shade dried for prevention of storage pests and better germination.
- Sheep and Goat are penned in fields prior to ploughing, to enrich fertility status of the soil.
- Intercropping Sesbania with Tomato during summer is found to enhance the yield of Tomato crop.
- Intercropping castor, Bhendi and Cluster beans with Cotton reduced pest and disease incidence in Cotton.
- Using Neem and Pungam leaves in storage bins controlled damage by storage pests in cereals.
- Green manuring is practiced by planting trees like Karanj (pongamia glabra) and using their leaf, or by sowing sesbania, crotalaria, green gram or Pillipesara in field and ploughing back into field to improve soil fertility.
- Dung and crop wastes are used as organic manure and cow's urine spray for the pest control.

## In animal husbandry

- Spices of mango pickles (afara) and neem leaves are fed to animals to cure bloat
- A bandage with jowar, kerosene and yellow soil is applied for Foot and Mouth disease in cattle
- Leaves of 'Dikkamani' (Gardenia resinifera) and seeds of 'Bendval' (Dendrophthoe falcata) plant are pounded and the mixture is fed to animal to cure the constipation within a day.
- To cure swelling of udder caused due to Mastitis, bites of poisonous insects or mechanical injury or improper milking, 200 grams of soil from the termite mounds is collected and boiled in water, and the boiled suspension is given to animal give relief within a day. This is very effective in summer, not so effective in monsoon season.
- Flatulence caused due to excessive grazing or feeding of green fodder which is common during the monsoon, can be cured by giving whey milk, onion and leaves of custard apple to the animal.
- For the animal suffering from gastric trouble, 10 grams of Hing (asaphoetida) is dissolved in 500 grams of edible oil and given to have a carminative and soothing action.
- For de-worming the young calves, a small quantity of curd or buttermilk is kept overnight in a copper container overnight to get a blue-green colour, diluted and given. The effect is seen from the next day.
- To treat FMD affected animals, the hooves and mouth are washed with warm salt solution, and the mixture of leather ash and Sesame oil or groundnut oil is applied to affected area.
- Neem leaves and turmeric powder is used as a paste on external injuries to cure the wounds and other skin disorders.
- Hot fomentation with bags containing salt and boiled Tamarind leaves is used to relieve sprains and inflammations in cattle.
- Oral administration of castor oil mixed with neem leaf or bark extract is used to cure constipation in cattle.

Traditional or indigenous knowledge of agricultural operations is of help to agricultural scientists, as they develop and disseminate cultivation and management practices for various crops and types of vegetation. This process deepens our understanding of nature and agriculture by combining the generations of experience of local farmers with the latest scientific knowledge.

## Strategies for integration of ITKs into scientific research process

Today it is widely accepted among agricultural scientists throughout the world that the re-assessment of indigenous technical knowledge is an indispensable part of the introduction of new agricultural technology. It is recognized that the knowledge of farmers must be taken into account before any new technology is developed and disseminated. This view is based on the assumption that

- farmers have a wealth of knowledge pertaining to their own environment;
- farmers have developed specific skills designed to make the best use of that environment.

The four important steps in inclusion of the ITKs in technology generation, reassessment and adaptation process are, **Documentation, Validation, Refinement** and **Integration**.

| S.No. | Steps   | Methods   |
|-------|---|---|
| 1.    | Document the ITKs   | Surveys / RRA / PRA/ Observations/ Documentary evidences                                    |
| 2.    | Validate the ITKs / Assess the ITKs for Scientific Logic        | Survey/ Laboratory Analysis/ On-farm testing  |
| 3.    | Refine the ITKs for increasing its applicability on wider scale | Input to Research/ On Farm Research / Farmer Participatory Research / Laboratory Studies    |
| 4.    | Patent the Valid and Refined ITKs                               | <b>Guard and legalize the ITKs, ensure ownership to local communities</b>                   |
| 5.    | Promote the Use of validated and refined ITKs                   | Involve local communities, use media mix, integrate indigenous networks, publicize & reward |

### Criteria for Validating ITK:

The following criteria are to be considered while validating the ITK:

- Efficacy
- **Cost-effectiveness**
- Availability
- Complexity
- Cultural appropriateness
- Effect on different groups in communities, and
- Environmental soundness
- Constraints

Once the ITKs were found valid and refined through On Farm Research / Farmer Participatory Research / Laboratory Studies the ITKs need to be guarded and legalized to ensure the ownership to local communities and flow of benefits to the rightful owners. Therefore, it is essential to understand the relevance of the Intellectual Property Rights (IPR), in the context of ITKs.

### IPR and ITKs

The potentials of indigenous technical knowledge (ITK), both for expanding scientific technical knowledge and for empowering its owners, are overwhelming. Within farming systems, ITK embraces people's knowledge of tools and techniques for the assessment, acquisition, transformation, and utilization of resources that are specific to a particular location. ITK can encompass:

- Vernacular: technical knowledge held by all or most individuals in a specific locality, e.g., knowledge of crop rotation, or pest and weed control;
- Specialized: the technical knowledge of certain skilled 'resource persons', e.g., medicine, charcoal-making, black smithery and varietal testing;
- Controlled: knowledge held by dominant groups in society, such as the specialized knowledge referred to above, or skills in animal breeding, hunting or water divining;
- Social: knowledge belonging to the group (clan, caste or tribe) or community, e.g., grazing rights, fishing controls and tenure regulations.

The categories often overlap, but in all cases local knowledge is the main resource which is controlled by at least part of the 'rural people', whilst lands, natural resources and labor have been appropriated by outside powers (McCall, M.K., 1995)

To improve the role of IPR in the benefit sharing of traditional knowledge, current Intellectual Property debates need to study systematically the 'tradition of Invention' instead of 'inventing a tradition' (Gupta, 1993). 80 per cent of modern plant-based medicines are used for the same purpose for which native people discovered their use (Farnsworth, 1981). The correlation between claims of local communities and the evidence from modern pharmacological science was more than 85 per cent in the studies pursued in a part of Nigeria (Iwu, 1996). Chinese right holders held about 45 per cent of all herbal-based patents in 1996, followed by the Japanese and Russia with 22 per cent and 16.5 per cent respectively (Gupta, 1999). Therefore, the indigenous practices need be systematically documented, validated and integrated in the scientific process as a part of strategic programme planning for sustainable agriculture and for initiating patenting process.

## **Conclusion**

The Indigenous Technical Knowledge (ITK) is socially desirable, economically affordable, sustainable, involves minimum risk and focus on efficient utilization of eco-friendly resources. The context of local knowledge systems combining traditional skills, culture and artifacts with modern skills, perspectives and tools is not something that has happened only in the recent past. From time immemorial, new crops were introduced from one part of the world to another and cultural and ecological knowledge systems evolved while adapting these crops, animals, trees, tools, etc., into their new contexts. This is an ongoing process. What may set the traditional ways of dealing with local resources and external knowledge and inputs apart, may be a slower trial and error approach which may not necessarily be unscientific. But, it may not be fully compatible with modern methods of experimentation, validation, and drawing inferences. In some cases, the correspondence is close but in many case it may not be. However, it is possible that through flexibility, modification and mutual respect and trust, traditional knowledge experts can and may work with the experts from modern scientific institutions to generate more effective solutions for contemporary problems (Gupta, 2003). Therefore, The need of the day is to establish a foundation at the national level that helps in building national register of innovations, file applications for patents, provides micro-venture capital support for enterprises based on indigenous knowledge and non-material incentives such as recognising or honoring innovators and community holding indigenous knowledge. Policy reforms need to be aimed at building local ecological knowledge in educational curriculum, development of markets for the indigenous and organic products and supporting collective resource management institutions reinforcing conservation ethics. It is only through multi-pronged comprehensive approach that the sustainable agriculture can be accomplished on a long term.



# DECISION SUPPORT SYSTEM

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The information explosion coupled with technological revolutions set the agriculture development on a faster pace during this decade in our country. The systems effectiveness and impact depend on the appropriate decisions taken by its personnel. Quality decision making is a prerequisite for efficient and effective management. The timely and effective decisions always show its new face on the development front. Indian agriculture is no exception to this. The agriculture scientists and faculty members play key role in bringing spectacular change in the productivity of the system through timely decisions in their R&D endeavors. Under this context, there is a felt need by the agricultural research scientists to learn the methods of decision support systems (DSS) in agriculture. This course is intended to fulfill this desired need.

This course is in continuation of the Academy's training programmes in related areas like management information system (MIS), planning and forecasting. DSS is an emerging area and considering its importance, need and utility to NARS, the Academy's faculty has developed this programme. The personnel trained in this area will be able to act as resource persons in their respective agricultural universities / ICAR Institutes, and implement the use of DSS tools in enhancing futuristic vision in academic and research activities.

## **Decision support system - Overview**

Decision support system (DSS) is an interactive, flexible computer based information system, which help decision makers utilise data and models to solve unstructured problems. DSS couples intellectual resources of individuals with the capabilities of computer to improve the quality and effectiveness of decisions. Implicit in the definition is that, DSS is computer-based and serves as an extension of the users problem-solving capabilities.

To be successful a DSS must be

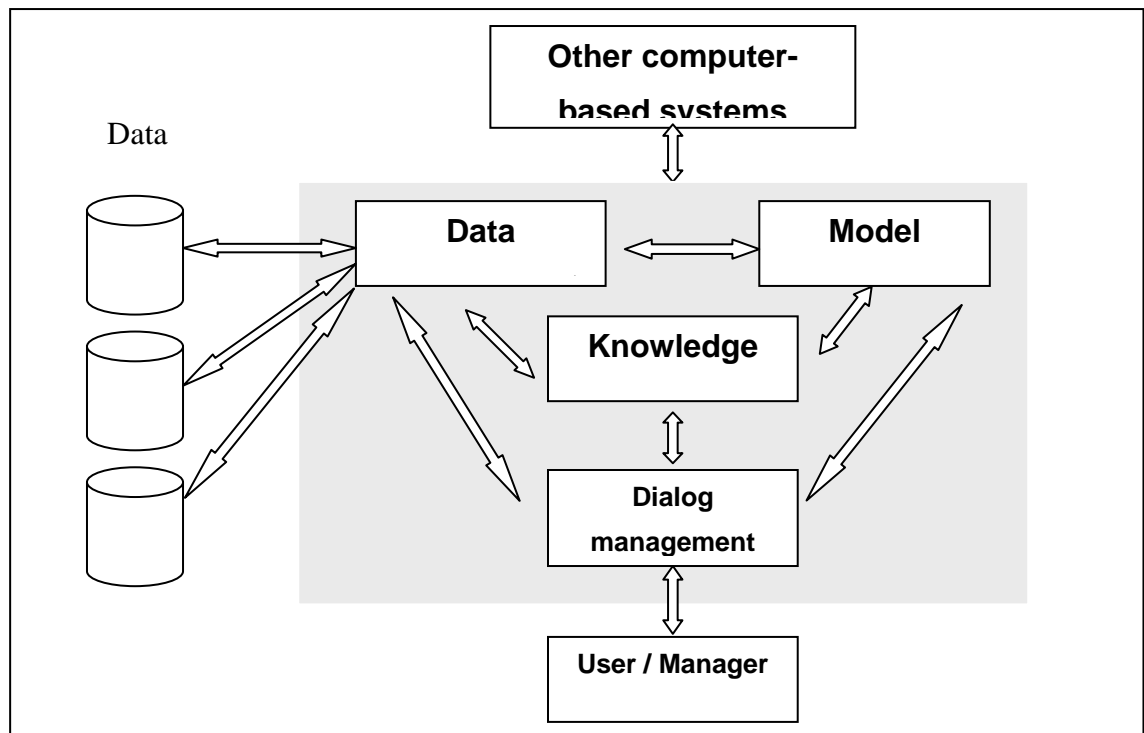
1. Simple
2. Easy to control
3. Robust
4. Adaptive
5. Complete on important issues
6. Easy to communicate with

## **Components of DSS**

A conceptual model of DSS is shown below:

DSS is composed of following sub-systems:

1. Data management sub-system
2. Model management sub-system
3. Communication (dialog) management sub-system
4. Knowledge management sub-system



The above four sub-systems constitute software part of the DSS and they are housed in a computer. Finally the researcher/user is also considered to be part of the system as shown in the conceptual model of DSS.

#### The data management subsystem

The data management subsystem is composed of the following elements:

- **DSS database**
- Database management system
- Data directory
- Query facility

The Data management subsystem is an essential component of DSS. It contains a database and software to use the database. Database is collection and retrieval of interrelated data in the forms of tables. In a computer data is stored in data files.

The database performs the function of data warehousing. The data ware housing is collection of relevant data from different sources and store it for generation of information. The data base can be further classified according to manner in which they store the information

- The relational database
- The object oriented database
- the relational object oriented database

A good data base design is the key to creating an effective, accurate and efficient database.

#### The model management subsystem

The model management subsystem of the DSS is composed of the following elements:

- **Model base**
- Model base management system
- Modeling language

Model management subsystem is another essential component of DSS. It composed of elements described above. A model base is an analytical base of DSS. Varieties of models are used in DSS. The main types of models are regression analysis models, financial model optimization models, simulation models and strategic planning models. Models are build according to the requirement of the problem to be solved. A model in DSS can be static or dynamic. In static model, the analysis is done for a single duration of time and it is assumed that there is stability during that particular duration in which analysis is being done. In dynamic model, scenario is evaluated that changes over time. Dynamic models are time dependent and they show trends and patterns over time.

### **The knowledge subsystem**

The knowledge management subsystem of the DSS is composed of expert system, which provides human-like solutions to unstructured or semi-structured complex problems. A DSS that includes such a component is referred to as an intelligent DSS or a knowledge based DSS.

### **The user interface subsystem**

The user interface is a surface through which data and information is communicated between user and computer. The user interface is an another essential component of DSS which enables managers to use DSS in user friendly environment. The interface mode determines how information is displayed and entered in to computer. Graphical user interface (GUI) is one such most widely used mode in which the users have direct control of visible objects (such as icon), and actions replace complex command syntax.

### **Decision-making process**

**Decision-making is a process of choosing among alternative course of action for the purpose of attaining goal. Decision-making is done on three levels in any organization i.e. operational level, managerial level and strategic level.**

Decision -making is being done in four phases:

The first phase is **intelligence phase**. In this phase the organizational goals are set and objectives are identified. In this phase we also collect the relevant data and prepare the problem statement selected. To evaluate and compare alternatives it is necessary to predict the future outcome.

The next phase of decision-making is **design phase**. In the design phase a model is formulated and criteria for chose is set. In this phase we search for alternatives and try to predict out comes.

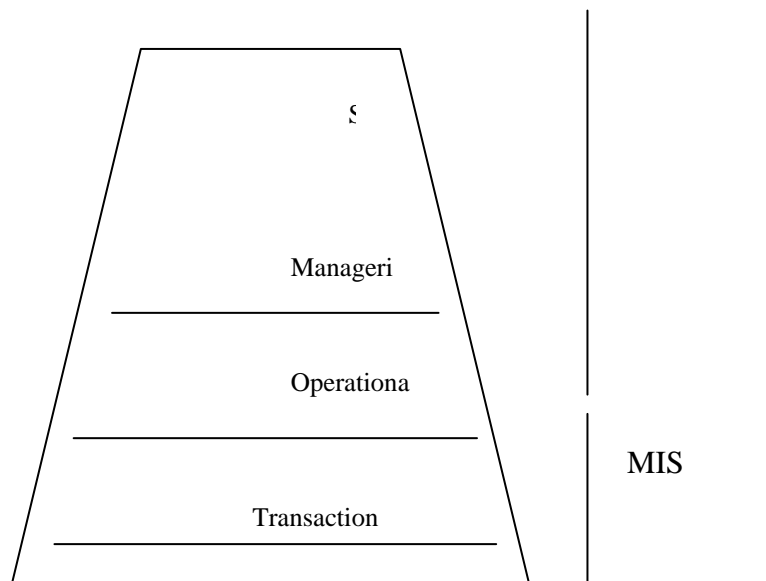
The next phase of decision-making is **choice phase**. In this phase first solutions to model is worked out after that sensitivity analysis is being done with given set of alternatives. Then best alternative is set for each proposed alternative. The last phase is **implementation phase** in which we try to implement the solution.

## Differences between MIS and DSS

In most management information systems (MIS), decision support is by structured information flows. MIS provides detailed and summarised information from operational databases which are created by various functional transaction processes activities such as accounts, marketing, personnel, etc. But conventional MIS packages are not designed to combine data from different sources. Thus most MIS applications and systems are developed by data processing professionals. The main focus of MIS is to improve efficiency by reducing costs, time, and so on.

On the other hand, a DSS can provide a valid representation of a complex real-world problem. The models are build to represent the real life situations and validated. A DSS is often developed by non-data processing professionals. A DSS evolves as the decision maker learns more about the problem. This requirement helps decision making in semistructured and unstructured situations. Thus the strength of DSS is that it can be used to address ad-hoc, unexpected problems. Thus DSS is designed very differently from MIS.

Executive information system (EIS) in theory was to serve higher managerial activities. As such, DSS can be considered a subset of EIS. But DSS is more suited to the higher levels of decision-making involving managerial control and strategic planning. Thus in a functional sense MIS and DSS are two different, although complementary applications. The differences are simple but profound. MIS and DSS are integrated to develop an intelligent EIS. MIS delivers information needed in day-to-day job responsibilities as opposed to unique adhoc analysis of DSS. DSS helps in understanding why things are happening the way they are or to investigate alternative solutions to a problem. Therefore, more sophisticated EIS systems include feedback from the DSS.



**Fig: Relation among MIS, DSS and EIS**

## **PURCHASE PROCEDURE AS PER MODIFIED GENERAL FINANCIAL RULES 2005**

### **Procurement of Goods**

**Rule 135.** This chapter contains the general rules applicable to all Ministries or Departments, regarding procurement of goods required for use in the public service. Detailed instructions relating to procurement of goods may be issued by the procuring departments broadly in conformity with the general rules contained in this Chapter.

**Rule 136. Definition of Goods:** The term 'goods' used in this chapter includes all articles, material, commodities, livestock, furniture, fixtures, raw material, spares, instruments, machinery, equipment, industrial plant etc. purchased or otherwise acquired for the use of Government but excludes books, publications, periodicals, etc. for a library.

**Rule 137. Fundamental principles of public buying:** Every authority delegated with the financial powers of procuring goods in public interest shall have the responsibility and accountability to bring efficiency, economy, transparency in matters relating to public procurement and for fair and equitable treatment of suppliers and promotion of competition in public procurement.

The procedure to be followed in making public procurement must conform to the following yardsticks:-

- (i) the specifications in terms of quality, type etc., as also quantity of goods to be procured, should be clearly spelt out keeping in view the specific needs of the procuring organizations. The specifications so worked out should meet the basic needs of the organization without including superfluous and non-essential features, which may result in unwarranted expenditure. Care should also be taken to avoid purchasing quantities in excess of requirement to avoid inventory carrying costs;
- (ii) offers should be invited following a fair, transparent and reasonable procedure;
- (iii) the procuring authority should be satisfied that the selected offer adequately meets the requirement in all respects;
- (iv) the procuring authority should satisfy itself that the price of the selected offer is reasonable and consistent with the quality required;
- (v) at each stage of procurement the concerned procuring authority must place on record, in precise terms, the considerations which weighed with it while taking the procurement decision.

**Rule 138. Authorities competent to purchase goods:** An authority which is competent to incur contingent expenditure may sanction the purchase of goods required for use in public service in accordance with Schedule V of the Delegation of Financial Powers Rules, 1978, following the general procedure contained in the following rules.

**Rule 139. Procurement of goods required on mobilisation:** Procurement of goods required on mobilisation and/or during the continuance of Military operations shall be regulated by special rules and orders issued by the Government on this behalf from time to time.

**Rule 140. Powers for procurement of goods:** The Ministries or Departments have been delegated full powers to make their own arrangements for procurement of goods. In case

however, a Ministry or Department does not have the required expertise, it may project its indent to the Central Purchase Organisation (e.g. DGS&D) with the approval of competent authority. The indent form to be utilised for this purpose will be as per the standard form evolved by the Central Purchase Organisation.

**Rule 141. Rate Contract:** The Central Purchase Organisation (e.g. DGS&D) shall conclude rate contracts with the registered suppliers, for goods and items of standard types, which are identified as common user items and are needed on recurring basis by various Central Government Ministries or Departments.

Definition of Registered suppliers is given in **Rule 142 below**.

The Central Purchase Organization will furnish and update all the relevant details of the rate contracts in its web site. The Ministries or Departments shall follow those rate contracts to the maximum extent possible.

**Rule 142. Registration of Suppliers:**

(i) With a view to establishing reliable sources for procurement of goods commonly required for Government use, the Central Purchase Organisation (e.g. DGS&D) will prepare and maintain item-wise lists of eligible and capable suppliers. Such approved suppliers will be known as "Registered Suppliers". All Ministries or Departments may utilize these lists as and when necessary. Such registered suppliers are prima facie eligible for consideration for procurement of goods through Limited Tender Enquiry. They are also ordinarily exempted from furnishing bid security along with their bids. A Head of Department may also register suppliers of goods which are specifically required by that Department or Office.

(ii) Credentials, manufacturing capability, quality control systems, past performance, after-sales service, financial background etc. of the supplier(s) should be carefully verified before registration.

(iii) The supplier(s) will be registered for a fixed period (between 1 to 3 years) depending on the nature of the goods. At the end of this period, the registered supplier(s) willing to continue with registration are to apply afresh for renewal of registration. New supplier(s) may also be considered for registration at any time, provided they fulfill all the required conditions.

(iv) Performance and conduct of every registered supplier is to be watched by the concerned Ministry or Department. The registered supplier(s) are liable to be removed from the list of approved suppliers if they fail to abide by the terms and conditions of the registration or fail to supply the goods on time or supply substandard goods or make any false declaration to any Government agency or for any ground which, in the Opinion of the Government, is not in public interest.

**Rule 143. Enlistment of Indian Agents:** As per the Compulsory Enlistment Scheme of the Department of Expenditure, Ministry of Finance, it is compulsory for Indian agents, who desire to quote directly on behalf of their foreign principals, to get themselves enlisted with the Central Purchase Organisation (eg. DGS&D). However, such enlistment is not equivalent to registration of suppliers as mentioned under **Rule 142 above**.

**Rule 144. Reserved Items:** The Central Government, through administrative instructions, has reserved all items of handspun and handwoven textiles (khadi goods) for exclusive purchase from Khadi Village Industries Commission (KVIC).

It has also reserved all items of handloom textiles required by Central Government departments for exclusive purchase from KVIC and/or the notified handloom units of ACASH (Association of Corporations and Apex Societies of Handlooms). The Central Government has also reserved some items for purchase from registered Small Scale Industrial Units. The

Central Departments or Ministries are to make their purchases for such reserved goods and items from such units as per the instructions issued by the Central Government in this regard.

**Rule 145. Purchase of goods without quotation:** Purchase of goods upto the value of Rs. 15,000/- (Rupees Fifteen Thousand) only on each occasion may be made without inviting quotations or bids on the basis of a certificate to be recorded by the competent authority in the following format.

"I, \_\_\_\_\_, am personally satisfied that these goods purchased are of the requisite quality and specification and have been purchased from a reliable supplier at a reasonable price."

**Rule 146. Purchase of goods by purchase committee:** Purchase of goods costing above Rs. 15,000/- (Rupees Fifteen Thousand) only and upto Rs. 1,00,000/- (Rupees One lakh) only on each occasion may be made on the recommendations of a duly constituted Local Purchase Committee consisting of three members of an appropriate level as decided by the Head of the Department. The committee will survey the market to ascertain the reasonableness of rate, quality and specifications and identify the appropriate supplier. Before recommending placement of the purchase order, the members of the committee will jointly record a certificate as under. "Certified that we \_\_\_\_\_, members of the purchase committee are jointly and individually satisfied that the goods recommended for purchase are of the requisite specification and quality, priced at the prevailing market rate and the supplier recommended is reliable and competent to supply the goods in question. "

**Rule 147. Purchase of goods directly under rate contract:**

(1) In case a Ministry or Department directly procures Central Purchase Organisation (e.g. DGS&D) rate contracted goods from suppliers, the prices to be paid for such goods shall not exceed those stipulated in the rate contract and the other salient terms and conditions of the purchase should be in line with those specified in the rate contract. The Ministry or Department shall make its own arrangement for inspection and testing of such goods where required.

(2) The Central Purchase Organisation (e.g. DGS&D) should host the specifications, prices and other salient details of different rate contracted items, appropriately updated, on the web site for use by the procuring Ministry or Department.

**Rule 148.** A demand for goods should not be divided into small quantities to make piece meal purchases to avoid the necessity of obtaining the sanction of higher authority required with reference to the estimated value of the total demand.

**Rule 149. Purchase of goods by obtaining bids:** Except in cases covered under **Rule 145, 146 and 147(1)**, Ministries or Departments shall procure goods under the powers referred to in **Rule 140** above by following the standard method of obtaining bids in:

- (i) Advertised Tender Enquiry;
- (ii) Limited Tender Enquiry;
- (iii) Single Tender Enquiry.

**Rule 150. Advertised Tender Enquiry.**

- (i) Subject to exceptions incorporated under **Rules 151 and 154**, invitation to tenders by advertisement should be used for procurement of goods of estimated value Rs. 25 lakh (Rupees Twenty Five Lakh) and above. Advertisement in such case should be

- given in the Indian Trade Journal (ITJ), published by the Director General of Commercial Intelligence and Statistics, Kolkata and at least in one national daily having wide circulation.
- (ii) An organisation having its own web site should also publish all its advertised tender enquiries on the web site and provide a link with NIC web site. It should also give its web site address in the advertisements in ITJ and newspapers.
  - (iii) The organisation should also post the complete bidding document in its web site and permit prospective bidders to make use of the document downloaded from the web site. If such a downloaded bidding document is priced, there should be clear instructions for the bidder to pay the amount by demand draft etc. along with the bid.
  - (iv) Where the Ministry or Department feels that the goods of the required quality, specifications etc., may not be available in the country and it is necessary to also look for suitable competitive offers from abroad, the Ministry or Department may send copies of the tender notice to the Indian embassies abroad as well as to the foreign embassies in India. The selection of the embassies will depend on the possibility of availability of the required goods in such countries.
  - (v) Ordinarily, the minimum time to be allowed for submission of bids should be three weeks from the date of publication of the tender notice or availability of the bidding document for sale, whichever is later. Where the department also contemplates obtaining bids from abroad, the minimum period should be kept as four weeks for both domestic and foreign bidders.

**Rule 151. Limited Tender Enquiry.**

- (i) This method may be adopted when estimated value of the goods to be procured is up to Rupees Twenty-five Lakhs. Copies of the bidding document should be sent directly by speed post/registered post/courier/e-mail to firms which are borne on the list of registered suppliers for the goods in question as referred under **Rule 142 above**. The number of supplier firms in Limited Tender Enquiry should be more than three. Further, web based publicity should be given for limited tenders. Efforts should be made to identify a higher number of approved suppliers to obtain more responsive bids on competitive basis.
- (ii) Purchase through Limited Tender Enquiry may be adopted even where the estimated value of the procurement is more than Rupees twenty-five Lakhs, in the following circumstances.
  - (a) The competent authority in the Ministry or Department certifies that the demand is urgent and any additional expenditure involved by not procuring through advertised tender enquiry is justified in view of urgency. The Ministry or Department should also put on record the nature of the urgency and reasons why the procurement could not be anticipated.
  - (b) There are sufficient reasons, to be recorded in writing by the competent authority, indicating that it will not be in public interest to procure the goods through advertised tender enquiry.
  - (c) The sources of supply are definitely known and possibility of fresh source(s) beyond those being tapped, is remote.
- (iii) Sufficient time should be allowed for submission of bids in Limited Tender Enquiry cases.



**Rule 152. Two bid system:** For purchasing high value plant, machinery etc. of a complex and technical nature, bids may be obtained in two parts as under:-

- (a) Technical bid consisting of all technical details alongwith commercial terms and conditions ; and
- (b) Financial bid indicating item-wise price for the items mentioned in the technical bid.

The technical bid and the financial bid should be sealed by the bidder in separate covers duly superscribed and both these sealed covers are to be put in a bigger cover which should also be sealed and duly superscribed. The technical bids are to be opened by the purchasing Ministry or Department at the first instance and evaluated by a competent committee or authority. At the second stage financial bids of only the technically acceptable offers should be opened for further evaluation and ranking before awarding the contract.

**Rule 153. Late Bids:** In the case of advertised tender enquiry or limited tender enquiry, late bids (i.e. bids received after the specified date and time for receipt of bids) should not be considered.

**Rule 154. Single Tender Enquiry.**

Procurement from a single source may be resorted to in the following circumstances:

- (i) It is in the knowledge of the user department that only a particular firm is the manufacturer of the required goods.
- (ii) In a case of emergency, the required goods are necessarily to be purchased from a particular source and the reason for such decision is to be recorded and approval of competent authority obtained.
- (iii) For standardisation of machinery or spare parts to be compatible to the existing sets of equipment (on the advice of a competent technical expert and approved by the competent authority), the required item is to be purchased only from a selected firm.

Note: Proprietary Article Certificate in the following form is to be provided by the Ministry / Department before procuring the goods from a single source under the provision of sub **Rule 154 (i) and 154 (iii)** as applicable.

'(i) The indented goods are manufactured by M/s.....

(ii) No other make or model is acceptable for the following reasons:

.....

.....

.....

(iii) Concurrence of finance wing to the proposal vide:

.....

(iv) Approval of the competent authority vide:.....

\_\_\_\_\_

(Signature with date and designation of the procuring officer)'

**Rule 155. Contents of Bidding Document:** All the terms, conditions, stipulations and information to be incorporated in the bidding document are to be shown in the appropriate chapters as below:-

Chapter – 1: Instructions to Bidders.

Chapter – 2: Conditions of Contract.

Chapter – 3: Schedule of Requirements.

Chapter – 4: Specifications and allied Technical Details.

Chapter – 5: Price Schedule(to be utilised by the bidders for quoting their prices).

Chapter – 6: Contract Form.

Chapter – 7: Other Standard Forms, if any, to be utilised by the purchaser and the bidders.

**Rule 156. Maintenance Contract:** Depending on the cost and nature of the goods to be purchased, it may also be necessary to enter into maintenance contract(s) of suitable period either with the supplier of the goods or with any other competent firm, not necessarily the supplier of the subject goods. Such maintenance contracts are especially needed for sophisticated and costly equipment and machinery. It may however be kept in mind that the equipment or machinery is maintained free of charge by the supplier during its warranty period or such other extended periods as the contract terms may provide and the paid maintenance should commence only thereafter.

**Rule 157. Bid Security:**

(i) To safeguard against a bidder's withdrawing or altering its bid during the bid validity period in the case of advertised or limited tender enquiry, Bid Security (also known as Earnest Money) is to be obtained from the bidders except those who are registered with the Central Purchase Organisation, National Small Industries Corporation (NSIC) or the concerned Ministry or Department. The bidders should be asked to furnish bid security along with their bids. Amount of bid security should ordinarily range between two percent to five percent of the estimated value of the goods to be procured. The exact amount of bid security, should be determined accordingly by the Ministry or Department and indicated in the bidding documents. The bid security may be accepted in the form of Account Payee Demand Draft, Fixed Deposit Receipt, Banker's Cheque or Bank Guarantee from any of the commercial banks in an acceptable form, safeguarding the purchaser's interest in all respects. The bid security is normally to remain valid for a period of forty-five days beyond the final bid validity period.

(ii) Bid securities of the unsuccessful bidders should be returned to them at the earliest after expiry of the final bid validity and latest on or before the 30th day after the award of the contract.

**Rule 158. Performance Security:**

(i) To ensure due performance of the contract, Performance Security is to be obtained from the successful bidder awarded the contract. Performance Security is to be obtained from every successful bidder irrespective of its registration status etc. Performance Security should be for an amount of five to ten per cent. of the value of the contract. Performance Security may be furnished in the form of an Account payee Demand Draft, Fixed Deposit Receipt from a Commercial bank, Bank Guarantee from a Commercial bank in an acceptable form safeguarding the purchasers interest in all respects.

(ii) Performance Security should remain valid for a period of sixty days beyond the date of completion of all contractual obligations of the supplier including warranty obligations.

(iii) Bid security should be refunded to the successful bidder on receipt of Performance Security.

**Rule 159.**

**(1) Advance payment to supplier:** Ordinarily, payments for services rendered or supplies made should be released only after the services have been rendered or supplies made. However, it may become necessary to make advance payments in the following types of cases:-

(i) Advance payment demanded by firms holding maintenance contracts for servicing of Air-conditioners, computers, other costly equipment, etc.

(ii) Advance payment demanded by firms against fabrication contracts, turn-key contracts etc.

Such advance payments should not exceed the following limits:

- (i) Thirty per cent. of the contract value to private firms;
- (ii) Forty per cent. of the contract value to a State or Central Government agency or a Public Sector Undertaking; or
- (iii) in case of maintenance contract, the amount should not exceed the amount payable for six months under the contract. Ministries or Departments of the Central Government may relax, in consultation with their Financial Advisers concerned, the ceilings (including percentage laid down for advance payment for private firms) mentioned above. While making any advance payment as above, adequate safeguards in the form of bank guarantee etc. should be obtained from the firm.

**(2) Part payment to suppliers:** Depending on the terms of delivery incorporated in a contract, part payment to the supplier may be released after it dispatches the goods from its premises in terms of the contract.

**Rule 160. Transparency, competition, fairness and elimination of arbitrariness in the procurement process:** All government purchases should be made in a transparent, competitive and fair manner, to secure best value for money. This will also enable the prospective bidders to formulate and send their competitive bids with confidence. Some of the measures for ensuring the above are as follows:-

- (i) the text of the bidding document should be self-contained and comprehensive without any ambiguities. All essential information, which a bidder needs for sending responsive bid, should be clearly spelt out in the bidding document in simple language. The bidding document should contain, inter alia;
  - (a) the criteria for eligibility and qualifications to be met by the bidders such as minimum level of experience, past performance, technical capability, manufacturing facilities and financial position etc.;
  - (b) eligibility criteria for goods indicating any legal restrictions or conditions about the origin of goods etc which may required to be met by the successful bidder; (c) the procedure as well as date, time and place for sending the bids;
  - (d) date, time and place of opening of the bid;
  - (e) terms of delivery;
  - (f) special terms affecting performance, if any.
- (ii) Suitable provision should be kept in the bidding document to enable a bidder to question the bidding conditions, bidding process and/ or rejection of its bid.
- (iii) Suitable provision for settlement of disputes, if any, emanating from the resultant contract, should be kept in the bidding document.
- (iv) The bidding document should indicate clearly that the resultant contract will be interpreted under Indian Laws.
- (v) The bidders should be given reasonable time to send their bids.
- (vi) The bids should be opened in public and authorized representatives of the bidders should be permitted to attend the bid opening.
- (vii) The specifications of the required goods should be clearly stated without any ambiguity so that the prospective bidders can send meaningful bids. In order to attract sufficient number of bidders, the specification should be broad based to the extent feasible. Efforts should also be made to use standard specifications which are widely known to the industry.
- (viii) Pre-bid conference: In case of turn-key contract(s) or contract(s) of special nature for procurement of sophisticated and costly equipment, a suitable provision is to be kept in the bidding documents for a pre-bid conference for clarifying issues and clearing doubts, if any, about the specifications and other allied technical details of the plant,

equipment and machinery projected in the bidding document. The date, time and place of pre-bid conference should be indicated in the bidding document. This date should be sufficiently ahead of bid opening date.

- (ix) Criteria for determining responsiveness of bids, criteria as well as factors to be taken into account for evaluating the bids on a common platform and the criteria for awarding the contract to the responsive lowest bidder should be clearly indicated in the bidding documents.
- (x) Bids received should be evaluated in terms of the conditions already incorporated in the bidding documents; no new condition which was not incorporated in the bidding documents should be brought in for evaluation of the bids. Determination of a bid's responsiveness should be based on the contents of the bid itself without recourse to extrinsic evidence.
- (xi) Bidders should not be permitted to alter or modify their bids after expiry of the deadline for receipt of bids.
- (xii) Negotiation with bidders after bid opening must be severely discouraged. However, in exceptional circumstances where price negotiation against an ad-hoc procurement is necessary due to some unavoidable circumstances, the same may be resorted to only with the lowest evaluated responsive bidder.
- (xiii) In the rate contract system, where a number of firms are brought on rate contract for the same item, negotiation as well as counter offering of rates are permitted with the bidders in view and for this purpose special permission has been given to the Directorate General of Supplies and Disposals (DGS&D).
- (xiv) Contract should ordinarily be awarded to the lowest evaluated bidder whose bid has been found to be responsive and who is eligible and qualified to perform the contract satisfactorily as per the terms and conditions incorporated in the corresponding bidding document.

However, where the lowest acceptable bidder against ad-hoc requirement is not in a position to supply the full quantity required, the remaining quantity, as far as possible, be ordered from the next higher responsive bidder at the rates offered by the lowest responsive bidder.

- (xv) The name of the successful bidder awarded the contract should be mentioned in the Ministries or Departments notice board or bulletin or web site

**Rule 161. Efficiency, Economy and Accountability in Public Procurement System:**

Public procurement procedure is also to ensure efficiency, economy and accountability in the system. To achieve the same, the following key areas should be addressed:-

- (i) To reduce delay, appropriate time frame for each stage of procurement should be prescribed by the Ministry or Department. Such a time frame will also make the concerned purchase officials more alert.
- (ii) To minimise the time needed for decision making and placement of contract, every Ministry / Department, with the approval of the competent authority, may delegate, wherever necessary, appropriate purchasing powers to the lower functionaries.
- (iii) The Ministries or Departments should ensure placement of contract within the original validity of the bids. Extension of bid validity must be discouraged and resorted to only in exceptional circumstances.
- (iv) The Central Purchase Organisation (e.g. DGS&D) should bring into the rate contract system more and more common user items which are frequently needed in bulk by various Central Government departments.

The Central Purchase Organisation (e.g. DGS&D) should also ensure that the rate contracts remain available without any break.

**Rule 162. Buy-Back Offer:** When it is decided with the approval of the competent authority to replace an existing old item(s) with a new and better version, the department may trade the existing old item while purchasing the new one. For this purpose, a suitable clause is to be incorporated in the bidding document so that the prospective and interested bidders formulate their bids accordingly. Depending on the value and condition of the old item to be traded, the time as well as the mode of handing over the old item to the successful bidder should be decided and relevant details in this regard suitably incorporated in the bidding document. Further, suitable provision should also be kept in the bidding document to enable the purchaser either to trade or not to trade the item while purchasing the new one.

# CONDUCT RULES

**M. Suresh Kumar**  
Chief Admn. Officer, NAARM

**Behaviour** – especially in its moral aspects lead or guide persons conducts himself appropriately.

## **Conduct sheet – Record of person's offences and punishments.**

**Every ICAR/Government servant shall at all times:**

- I] Maintain absolute integrity – Integrity is uprightness
- II] Maintain devotion to duty – Devotion to duty is faithful service
- III] Do nothing which is unbecoming of a government servant

## **Mis-conducts**

- ❖ If a government servant conducts himself in a way inconsistent with the due and faithful discharge of his duties in his service is misconduct.
- ❖ Conduct rules are to be judged from robust common sense point of view on a reasonable standard.
- ❖ Failure to carryout orders is a serious misconduct and may lead to dismissal from service.

Whatever the conduct of the civil servant is regarded as being contrary to an ideal master and servant relationship between the two may be regarded as a lapse on the part of the civil servant and may be considered to be a misconduct in varying degrees.

## **Serious mis-conducts**

- \* Inconsistent or incompatible
- \* Unsafe for the employer
- \* Grossly immoral; employee cannot be trusted
- \* Master cannot rely on the faithfulness of his employee
- \* Abusive and disturbs the peace
- \* Insulting and Insubordination
- \* Habitually negligent – duties

The word 'unbecoming' means unsuitable, indecorous, improper. A conduct which is indecent, reprehensible or abominable involving moral is conduct unbecoming of a government servant.

1. Every government servant holding a supervisory post shall take all possible steps to ensure the integrity and devotion to duty of all government servants for the time being under his control and authority.
2. No government servant shall, in the performance of his official duties, or in the exercise of powers conferred on him, act otherwise than in his best judgment except when he is acting under the direction of his official superior.

3. The direction of the official superior shall ordinarily be in writing, oral direction to subordinates shall be avoided, as far as possible. Where the issue of oral direction becomes unavoidable, the official superior shall confirm it in writing immediately thereafter.
4. A government servant who has received oral direction from his official superior shall seek confirmation of the same in writing as early as possible, whereupon it shall be the duty of the official superior to confirm the direction in writing.

#### **Employment of near relatives of government servants in companies or firms.**

1. No government servant shall use his position or influence directly or indirectly to secure employment for any member of his family in any company or firm.
2. No Class I Officer shall, except with the previous sanction of the government, permit his son, daughter or other dependent, to accept employment in any company or in any other company or firm having official dealings with the government :
  - (i) Provided that where the acceptance of the employment cannot await prior permission of the government or is otherwise considered urgent, the matter shall be reported to the government, and the employment may be accepted provisionally subject to the permission of the government.
  - (ii) A government servant shall, as soon as he becomes aware of the acceptance by a member of his family of an employment in any company or firm, intimate such acceptance to the prescribed authority and shall also intimate whether he has or has had any official dealings with that company or firm :

Provided that no such intimation shall be necessary in the case of a Class I officer if he has already obtained the sanction of, or sent a report to the government under clause (I).

3. No government servant shall in the discharge of his official duties deal with any matters or give or sanction any contract to any company or firm or any other person if any member of his family is employed in that company or firm or under that person or if he or any member of his family is interested in such matter or contract in any other manner and the government servant shall refer every such matter or contract to his official superior and the matter or contract shall thereafter be disposed of according to the instructions of the authority to whom the reference is made.

#### **Taking part in politics and elections**

1. No government servant shall be a member of, or be otherwise associated with, any political party or any organization which takes part in politics nor shall he take part in, subscribe in aid of, or assist in any other manner, any political movement or activity.
2. It shall be the duty of every government servant to endeavour to prevent any member of his family from taking part in, subordinating in aid of, or assisting in any other manner any movement or activity which is, or tends directly or indirectly to be, subversive of the government as by law established and where a government servant is unable to prevent a member of his family from taking part in, or subscribing in aid of, or assisting in any other manner, any such movement or activity, he shall make a report to that effect to the government.

3. If any question arises whether a party is a political party or whether any organization takes part in politics or whether any movement or activity falls within the scope of sub-rule (2), the decision of the government thereon shall be final.
4. No government servant shall canvass or otherwise interfere with, or use his influence in connection with or take part in, an election to any legislature or local authority.

The following action by a Government Servant does not amount to contravention of Rule 5(4).

- (a) Making normal arrangement during election tours of Minister.
- (b) Affordable normal courtesies on their visits of Election campaign.

Provided that –

- (i) a government servant qualified to vote at such election may exercise his right to vote, but where he does so, he shall give no indication of the manner in which he proposes to vote or has voted;
- (ii) a government servant shall not be deemed to have contravened the provisions of this sub-rule by reason only that he assists in the conduct of an election in the due performance of a duty imposed on him by or under any law for the time being in force.

Explanation

The display by a government servant on his person, vehicle or residence of any electoral symbol shall amount to using his influence in connection with an election within the meaning of this sub-rule.

### **Joining of association by government servants**

No government servant shall join, or contribute to be a member of, an association the objects or activities of which are prejudicial to the interests of the sovereignty and integrity of India, or public order or morality.

### **Demonstration and Strikes**

No government servant shall –

- (i) engage himself or participate in any demonstration which is prejudicial to the interests of the sovereignty and integrity of India, the security of the state, friendly relations with foreign states, public order, decency or morality, or which involves contempt of court, defamation or incitement to an offence or,
- (ii) resort to or in any way abet, any form of strike or coercion or physical duress in connection with any matter pertaining to his service or any other government servant.

### **Connection with Press or Radio**

1. No government servant shall, except with the previous sanction of the government, own wholly or in part, or conduct or participate in the editing or management of, any newspaper or other periodical publication.
2. No government servant shall except with the previous sanction of the government or of the prescribed authority, or except in the bonafide discharge of his duties.



- (a) publish a book himself or through a publisher or contribute an article to a book or a compilation of articles; or
- (b) participate in a radio broadcast or contribute an article or write a letter to a newspaper or periodical, either in his own name or anonymously or pseudonymously or in the name of any other person;

Provided that no such sanction shall be required –

- (i) If such publication is through a publisher and is of a purely literary, artistic or scientific character, or
- (ii) If such contribution, broadcast or writing is of purely literary, artistic or scientific character.

### **Criticism of Government**

No government servant shall, in any radio broadcast or in any document published in his own name or anonymously, pseudonymously or in the name of any other person or in any communication to the press or in any public utterance, make any statement of fact or opinion –

- (i) which has the effect of any adverse criticism of any current or recent policy or action of the central government or a state government :

Provided that in case of any government servant included in any category of government servants specified in the second proviso to sub-rule (3) of Rule 1, nothing contained in this clause shall apply to bonafide expression of views by him as an office-bearer of a trade union of such Government servants for the purpose of safeguarding the conditions of service of such Government servants or for securing an improvement thereof; or

- (ii) which is capable of embarrassing the relations between the Central Government and the Government of any State; or
- (iii) which is capable of embarrassing the relations between the Central Government and the Government of any foreign State;

Provided that nothing in this rule shall apply to any statements made or views expressed by a Government servant in his official capacity or in the due performance of the duties assigned to him.

### **Evidence before committee or any other authority**

- (1) Same as provided in sub-rule (3), no Government shall, except with the previous sanction of the Government, give evidence in connection with any enquiry conducted by any person, committee or authority.
- (2) Where any sanction has been accorded under sub-rule (1), no Government servant giving such evidence shall criticize the policy or any action of the Central Government or of a State Government.
- (3) Nothing in this rule shall apply to –
  - (a) evidence given at an enquiry before an authority appointed by the Government, Parliament or a State Legislature; or
  - (b) evidence given in any judicial enquiry; or

- (c) evidence given at any departmental enquiry order by authorities subordinate to the Government.

### **Unauthorized communication of Information**

No Government servant shall, except in accordance with any general or special order of the Government or in the performance in good faith of the duties assigned to him, communicate, directly or indirectly, any official document or any part thereof or information to any Government servant or any other person to whom he is not authorized to communicate such document or information.

Explanation – Quotation by a Government servant ( in his representation to the Head of Office, or Head of Department or President) of or from any letter; to which he is not authorized to have access, or which he is not authorized to keep in his personal custody or for personal purposes, shall amount to unauthorized communication of information within the meaning of this rule.

### **Subscriptions**

No Government servant shall, except with the previous sanction of the Government or of the prescribed authority, ask for or accept contributions to, or otherwise associate himself with the raising of, any funds of other collections in cash or in kind in pursuance of any object whatsoever.

### **Gifts**

- (1) Same as provided in these rules, no Government servant shall accept, or permit any member of his family or any other person acting on his behalf to accept any gift.

Explanation – The expression ‘gift’ shall include free transport, boarding, lodging or other service or any other pecuniary advantage provided by any person other than a near relative or personal friend having no official dealings with the Government servant.

Note – 1 : A casual meal, lift or other social hospitality shall not be deemed to be a gift.

Note – 2 : A Government servant shall avoid accepting lavish hospitality or frequent hospitality from any individual, industrial or commercial firms, organizations, etc. having official dealings with him.

- (2) On occasions, such as weddings, anniversaries, funerals or religious functions, when the making of a gift is in conformity with the prevailing religious or social practice, a Government servant may accept gifts from his near relatives but he shall make a report to the Government if the value of any gift exceeds –
- (i) Rs. 5,000/- in the case of Government servant holding any Group A and Rs. 3,000/- for Group B Post.
  - (ii) Rs. 2,000/- in the case of a Government servant holding any Group C post; and
  - (iii) Rs. 1,000/- in the case of a Government servant holding any Group D post.
- (3) On such occasions as are specified in sub-rule (2), a Government servant may accept gifts from his personal friends having no official dealings with him, but he shall make a report to the Government if the value of any such gift exceeds –

- (i) Rs. 1,000/- in the case of a Government servant holding any Group A or Group B post;
  - (ii) Rs.250/- in the case of a Government servant holding any Group C post; and Group D;
- (4) Notwithstanding anything contained in sub-rules (2), (3) and (4), a Government servant, being a member of Indian delegation or otherwise, may receive and retain gifts from foreign dignitaries if the market value of gifts received on one occasion does not exceed Rs. 1,000/-. In all other cases, the acceptance and retention of such gifts shall be regulated by the instructions issued by the Government in this regard from time to time.
- (5) A Government servant shall not accept any gift from any foreign firm which is either contracting with the Government of India or is one which the Government servant had, has or is likely to have official dealings. Acceptance of gifts by a Government servant from any other foreign firm shall be subject to the provisions of sub-rule (4).

### **Dowry**

No Government servant shall –

- (i) give or take or abet the giving or taking of dowry; or
- (ii) demand directly or indirectly, from the parent or guardian of a bride or bridegroom, as the case may be any dowry.

Explanation – For the purpose of this rule, ‘dowry’ has the same meaning as in the Dowry Prohibition Act, 1961 (28 of 1961).

### **Public demonstrations in honour of government servants**

No Government servant shall, except with the previous sanction of the Government, receive any complimentary or valedictory address or accept any testimonial or attend any meeting or entertainment held in his honour; or in the honour of any other Government servant. :

Provided that nothing in this rule shall apply to –

- (i) a farewell entertainment of a substantially private and informal character held in honour of a Government servant or any other Government servant on the occasion of his retirement or transfer or any person who has recently quitted the service of any Government; or
- (ii) the acceptance of simple and inexpensive entertainment arranged by public bodies or institutions.

**NOTE** – Exercise of pressure or influence of any sort on any Government servant to induce him to subscribe towards any farewell entertainment even if it is of a substantially private or informal character and the collection of subscriptions from Class III or Class IV employees under any circumstances for the entertainment of any Government servant not belonging to Class III or Class IV, is forbidden.

### **Private trade or employment**

- (1) Subject to the provisions of sub-rule (2), no Government servant shall, except with the previous sanction of the Government. –

- (a) engage directly or indirectly in any trade or business, or
- (b) negotiate for, or undertake, any other employment, or
- (c) hold an elective office, or canvass for a candidate or candidates for an elective office, in any body, whether incorporated or not, or
- (d) canvass in support of any business of insurance agency, commission agency, etc. owned or managed by any member of his family, or
- (e) take part except in the discharge of his official duties, in the registration, promotion or management of any bank or other company registered or required to be registered, under the Companies Act, 1956 (1 of 1956) or any other law for the time being in force, or on any co-operative society for commercial purpose.

(2) A Government servant may, without the previous sanction of the Government –

- (a) undertake honorary work of a social or charitable nature, or
- (b) undertake occasional work of literary, artificial, scientific character, or
- (c) participate in sport activities as an amateur, or
- (d) take part in the registration, promotion or management (not involving the holding of an elective office of a literary, scientific or charitable society or of a club or similar organization, the aims or objects of which relate to promotion of sports, cultural or recreation activities, registered under the Societies Registration Act, 1860 (21 of 1860) or any other law for the time being in force, or
- (e) take part in the registration, promotion or management (not involving the holding of elective office) of a co-operative society substantially for the benefit of Government servants, registered under the Co-operative Societies Act, 1912 (2 of 1912) or any other law for the time being in force :

Provided that –

- (i) he shall discontinue taking part in such activities, if so directed by the Government; and
- (ii) In a case falling under clause (d) or clause (e) of this sub-rule, his official duties shall not suffer thereby and he shall, within a period of one month of his taking part in such activity report to the Government giving details of the nature of his participation.

Every Government servant shall report to the Government if any member of his family is engaged in a trade or business or owns or manages an insurance agency or commission agency.

Unless otherwise provided by general or special orders of the Government, no Government servant may accept any fee for any work done by him for any private or public body or any private person without the sanction of the prescribed authority.

Explanation – The term ‘ fee used here shall have the meaning assigned to it in Fundamental Rule 9 (6-A).

### **Investment, lending and borrowing**

1. No Government servant shall speculate in any stock, share or other investment.

Explanation – Frequent purchase and sale of share, securities or other investments shall be deemed to be speculation within the meaning of this sub-rule.

2. No Government servant shall make, or permit any member of his family or any person acting on his behalf to make, any investment which is likely to embarrass or influence him in the discharge of his official duties.
3. If any question arises whether any transaction is of the nature referred to in sub-rule (1) or sub-rule (2), the decision of the Government thereon shall be final.
4. (I) No Government servant shall, save in the ordinary course of business with a bank or a public limited company, either himself or through any member of his family or any other person acting on his behalf –
  - (a) lend or borrow or deposit money, as a principal or an agent, to or from, or with, any person or firm or private limited company within the local limits of his authority or with whom he is likely to have official dealings or otherwise place himself under any pecuniary obligation to such person or firm or private limited company : or
  - (b) lend money to any person at interest or in a manner whereby return in money or in kind is charged or paid

Provided that a Government servant may, give to, or accept from, a relative or a personal friend, a purely temporary loan of small amount free of interest, or operate a credit account with a bonafide tradesman or make an advance of pay to his private employee :

Provided further that nothing in this sub-rule shall apply in respect of any transaction entered into by a Government servant with the previous sanctions of the Government.

- (iii) When a Government servant is appointed or transferred to a post of such nature as would involve him in the breach of any of the provisions of sub rule (2) or sub-rule (4) he shall forthwith report the circumstances to the prescribed authority and shall thereafter act in accordance with such order as may be made by such authority.

### **Insolvency and Habitual Indebtedness**

A Government servant shall so manage his private affairs as to avoid habitual indebtedness, or insolvency. A Government servant against whom any legal proceedings is instituted for the recovery of any debt due from him or for adjudging him as an insolvent, shall forthwith report the full facts of the legal proceedings to the Government.

The burden of proving that the insolvency or indebtedness is as a result of circumstances which with the exercise of diligence, the Government servant could not have foreseen, or over which he had no control and had not proceeded from extravagant or dissipated habits, shall be upon the Government servant.

### **Movable, Immovable and Valuable Property**

- 1) (I) Every Government servant shall on his first appointment to any service or post submits a return of his assets and liabilities, in such form as may be prescribed by the Government, giving the full particulars regarding –

- (a) the immovable property inherited by him, or owned or acquired by him or held by him on lease or mortgage, either in his own name or in the name of any member of his family or in the name of any other person;
- (b) shares, debentures and cash including bank deposits inherited by him or similarly owned, acquired or held by him;
- (c) other movable property inherited by him or similarly owned, acquired or held by him; and
- (d) debts and other liabilities incurred by him directly or indirectly.

Note (1) – sub-rule (1) shall not ordinarily apply to Class IV servants but the Government may direct that it shall apply to any such Government servant or class of such government servants.

Note (2) – In all returns, the values of items of movable property worth less than Rs. 2,000/- may be added and shown as a lumpsum. The value of articles of daily use such as clothes, utensils, crockery, books, etc. need not be included in such return.

Note (3) – Where a Government servant already belonging to a service or holding a post is appointed to any other civil service or post, he shall not be required to submit a fresh return under this clause.

- (iii) Every government servant belonging to any service or holding any post included in Group A or B shall submit an annual return in such form as may be prescribed by the Government in this regard giving full particulars regarding the immovable property inherited by him or owned or acquired by him or held by him on lease or mortgage either in his own name or in the name of any member of his family or in the name of any other person.
3. No government servant shall, except shall with the previous knowledge of the prescribed authority, acquire or dispose of any immovable property by lease, mortgage, purchase, sale, gift or otherwise whether in his own name or in the name of any member of his family.

Provided that the previous sanction of the prescribed authority shall be obtained by the Government servant if any such transaction is with a person having official dealings with him.

4. Where a government servant enters into a transaction in respect of movable property either in his own name or in the name of the member of his family, he shall, within one month from the date of such transaction, report the same to the prescribed authority, if the value of such property exceeds Rs. 15,000/- in the case of a Government servant holding any Class I or Class I or Rs. 10,000/- in the case of a Government servant holding any Class III or Class IV post.

Provided that the previous sanction of the prescribed authority shall be obtained by the Government servant if any such transaction is with a person having official dealings with him.

5. The Government or the prescribed authority may, at any time, by general or special order, require a Government servant to furnish, within a period of specified in the order, a full and complete statement of such movable or immovable property held or

acquired by him or in his behalf or by any member of his family as may be specified in the order. Such statement shall, if so, required by the Government or by the prescribed authority include the details of the means by which, or the source from which, such property was acquired.

6. The Government may exempt any category of Government servants belonging to Class III or Class IV from any of the provisions of this rule except sub-rule (4). No such exemption shall, however, be made without the concurrence of the Cabinet Secretariat (Department of Personnel).

Explanation – 1 – For the purpose of this rule :

- (1) the expressions “movable property” includes –

- (a) jewellery, insurance policies, the annual premia of which exceeds Rs.10,000/- or one-sixth of the total annual emoluments received from Government, whichever is less, shares, securities and debentures;
- (b) all loans whether secured or not, advanced or taken by the Government servant;
- (c) motor cars, motor cycles, horses or any other means of conveyance; and
- (d) refrigerators, radios (radiograms and television sets);
- (e) loans taken by the Government servant.

- (2) “Prescribed authority” means –

- (a)

- ❖ the Government in the case of a Government servant holding any Class I post, except where any lower authority is specifically specified by the Government for any purpose;
- ❖ Head of Department, in the case of a Government servant holding any Class II post;
- ❖ Head of Office, in the case of a Government servant holding any Class III or Class IV post;

- (b) **In respect of a Government servant on foreign service or on deputation to any other Ministry or any other government, the parent department on the cadre of which such government servant is borne or the Ministry to which he is administratively subordinate as member of that cadre.**

Explanation – II – For the purposes of this rule ‘lease’ means, except where it is obtained from, or granted to, a person having official dealings with the Government servant, a lease of immovable property from year to year or for any term exceeding one year or reserving a yearly rent.

Restrictions in relation to acquisition and disposal of immovable property outside India and transactions with foreigners, etc.

Notwithstanding anything contained in sub-rule (2) of Rule 18, no Government servant shall except with the previous sanction of the prescribed authority :

- (a) acquire, by purchase, mortgage, lease, gift, or otherwise either in his own name or in the name of any member of his family, any immovable property situated outside India;

- (b) dispose of, by sale, mortgage, gift or otherwise or grant any lease in respect of any immovable property situated outside India which was acquired or is held by him either in his own name or in the name of any member of his family;
- (c) enter into any transaction with any foreigner, foreign government, foreign organization of concern –
  - (i) for the acquisition, by purchase, mortgage, gift or otherwise, either in his own name or in the name of any member of his family, or any immovable property;
  - (ii) for the disposal of, by sale, mortgage, gift or otherwise, or the grant of any lease in respect of any immovable property which was acquired or is held by him either in his own name or in the name of any member of his family.

Explanation : In this rule 'prescribed authority' has the same meaning as in Rule 18.

#### Vindication of acts and character of Government servant

- (1) No government servant shall, except with the previous sanction of the Government have recourse to any Court or to the press for the vindication of any official act which has been the subject matter of adverse criticism or an attack of defamatory character.
- (2) Nothing in this rule shall be deemed to prohibit a government servant from vindicating his private character or any act done by him in his private capacity and where any action for vindicating his private character or any act done by him in private capacity is taken, the Government servant shall submit a report to the prescribed authority regarding such action.

#### Canvassing of non-official or other outside influence

No Government servant shall bring or attempt to bring any political or other outside influence to bear upon any superior authority to further his interests in respect of matters pertaining to his service under Government.

#### **Restriction regarding marriage**

- (1) No government servant shall enter into, or contract, a marriage with person having a spouse living; and
- (2) No government servant having a spouse living, shall enter into or contact, a marriage with any person;

Provided that the Central government may permit a Government servant to enter into, or contract, any such marriage as is referred to in clause (1) or clause 92), if it is satisfied that -

- (a) such marriage is permissible under the personal law applicable to such Government servant and the other party to the marriage; and
- (b) there are other grounds for so doing.
- (3) A government servant who has married or marries a person other than of Indian nationality shall forthwith intimate the fact to the Government.



## **Consumption of intoxicating drinks and drugs**

A government servant shall –

- (a) strictly abide by any law relating to intoxicating drinks or drug in force in any area in which he may happen to be for the time being;
- (b) not be under the influence of any intoxicating drinks or drugs during the course of his duty and shall also take due care that the performance of his duties at any time is not affected in any way by the influence of such drink or drug.
- (c) Refrain from consuming any intoxicating drink or drug in a public place;
- (d) Not appear in a public place in a state of intoxication.
- (e) Not use any intoxicating drink or drug to excess.

Explanation – For the purpose of this rule ‘public place’ means any place or premises (including a conveyance) to which the public have, or / are permitted to have, access, whether on payment or otherwise.

### **Interpretation**

If any question arises relating to the interpretation of these rules, it shall be referred to the Government whose decision thereon shall be final.

### **Delegation of Powers**

The Government may, by general or special order, direct that any power exercisable by it or any Head of Department under these rules (except the powers under Rule 23 and this rule) shall, subject to such conditions, if any, as may be specified in the order, be exercisable also by such officer or authority as may be specified in the order.

### **Repeal and Saving**

Any rules corresponding to these rules in force immediately before the commencement of these rules and applicable to the government servants to whom these rules apply, are hereby repealed;

Provided that any order made or action taken under the rules so repealed shall be deemed to have been made or taken under the corresponding provisions of these rules;

Provided further that such repeal shall not affect the previous operation of the rules so repealed and a contravention of any of the said rules shall be punishable as if it were a contravention of these rules.

## **ADMINISTRATIVE ETHICS**

Ethics as commonly understood deals with morality and rules of conduct which should govern the behaviour of a man living in society. It evaluates rightness or wrongness of a man's conduct and prescribes ideals to which he should direct his efforts. Administration on the other hand refers to the proper administration and direction of men and material to achieve some desired goals. Administrative ethics would consequently comprise of a code of conduct and a standard of morality which ought to impose the spirit of administration and

govern the interpersonal relationship among different power levels of an administrative organization with a view to achieving maximum output.

A distinction has to be drawn between what constitutes individual ethics and those that comprise of administrative ethics. Individual ethics would also include such personal traits as humility, magnanimity, honesty, abstention from vices, simple living and self effacement. We would be confirming ourselves only to those ethical principles which are relevant to administration for the administrator to be most effective.

Some of the qualities characterizing good administrator :

1. **Loyalty**  
He should have a high sense of loyalty to the objectives of an Institution he serves involving willingness to yield a good deal of himself to its discipline. He must periodically assess the results and out to what extent there has been a gap between plan and performance.
2. **Willingness to accept responsibility**  
Mere tidying things up, house keeping is not administration.
3. **Impartiality**  
It is easier to preach the concept of impartiality, equity and fairplay than to translate these principles into practice.
4. **Integrity**  
He should take positive steps to ensure the integrity of all persons working with him and also assiduously develop a reputation and an image for integrity.
5. **Humanism**  
He is a team worker. He deals with subordinates in a manner showing the same kind of respect he gives to his superiors. He is considerate of others never "soft" and never gullible.
6. **Harmonious relationship**  
In case where interpersonal conflict arises in his organization, he leaves no stones unturned to bring about harmonious relations within the organization.
7. **Empathy and imaginative sympathy**  
He has quick emotional perceptions. Through constant practice, he develops an unique attitude of sympathy and capacity for human imagination to place himself in the other man's position and saves many from avoidable physical suffering and mental frustration.

In actual practice, individual shortcomings can be overcome in large organizations by contributing administrative teams whose qualities complement each other.

## References

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