Concepts, Approaches and Methodologies for Technology Application and Transfer

- a resource book for KVKs

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FOREWORD

Extension plays an important role in the application of proven technologies in the micro-farming system locations. The activities of technology application system include technology assessment, refinement and demonstration along with human resource development through training of farmers, extension functionaries and rural youths. Right technology and methodology are the two key factors deciding the success of extension programmes. In view of this, efforts have been made by the authors to provide relevant and essential information regarding the methodological aspects involved in technology application and transfer.

The contents of the book is arranged in 12 chapters covering the details of extension systems functioning in the country, Farming System Research and Applications (FSR&A), methodologies for conducting training programmes, On-Farm Trials (OFTs)/Frontline Demonstrations (FLDs), etc. The chapters on impact evaluation, knowledge management, project management technologies and globalization issues will be of much useful to the readers in understanding the above concepts for applying them in their day to day activities.

I appreciate the sincere and timely efforts made by Dr. V. Venkatasubramanian and his team in bringing this publication for the benefit of extension professionals. I wish them all success.

(K.D. Kokate)

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PREFACE

The Indian Council of Agricultural Research has established a wide network of Krishi Vigyan Kendras (KVKs) in the country aiming at assessment, refinement and demonstration of technology/ products. The mandated activities of KVKs include conducting on – farm trials to identify the location specificity of technologies under various farming systems, frontline demonstrations to establish the production potentials of improved technologies on the farmers' fields, training of farmers to update their knowledge and skills, and training of extension personnel to orient them in the frontier areas of technology development. Seeds and planting materials produced by the KVKs are made available to the farmers. Large numbers of extension programmes are organized by the KVKs to create awareness about improved technologies about famers.

The Zonal Project Directorate, Zone - III, coordinates and monitors the activities of KVKs under eight North Eastern states namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. Under the tenth plan, 57 new KVKs were established in this Zone. The Directorate has given extensive orientation training to the new Scientists to make them aware of their mandated duties and ways to accomplish them. Of late, it has been noticed that KVK work being highly dynamic and oriented towards use of extension, management and other social science concepts, scientists from other disciplines are finding it difficult to cope up with. Considering the need to address this lacuna, the Zonal Project Directorate, Zone - III, initiated a project 'Standardising concepts, approaches and methodologies for Technology Application and Transfer by KVKS' and based on the findings has come up with this publication for the benefit of all KVK scientists in the system.

The book presents a comprehensive coverage including genesis, growth and importance of KVKs, tools to get started with problem identification in the district, guidelines to conduct technology assessment, refinement and demonstration with examples, training methodology, definitions of various social concepts used in extension, communication and management, tools for impact assessment and basic statistics. The Central schemes and innovations by various KVKs are also included along with Knowledge management strategies and project management techniques. A chapter on WTO and Agreement on Agriculture followed by useful action tools and associated reviews sums up the book.

We express our deep sense of gratitude to Dr. K.D. Kokate, Deputy Director General (AE), ICAR for his constant encouragement and support.

We also express our deep sense of gratitude to Dr. P. Das, former Deputy Director General (AE), Dr. Rajinder Parshad, former Assistant Director General (AE) and Dr. Ramchand and Dr. A.K. Mehta, Assistant Director Generals of Division of Agricultural Extension, ICAR, New Delhi, for their constant support and encouragement.

We also sincerely thank all our Zonal Project Director colleagues, Dr. Prabhukumar, Zone – VIII, Dr. M.K. Mandape, Zone – VI, Dr. A.K. Singh, Zone – IV, Dr. Sudhakar, Zone – V, Dr. A.K. Singh, Zone – II and Dr. U.S. Gautham, Zone – III for their encouraging words and support.

We hope the book will be highly useful as a day to day reference material and guide to all stakeholders engaged in the task of nation building through agriculture development particularly through KVKs.

Barapani,
10-07-2009

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Introduction

India has made considerable progress in improving its food security. The agricultural development strategy pursued in the country, particularly since the mid-sixties, is recognized and appreciated world over. The integration of agricultural research with quality education and a properly planned extension education system has been one of the fundamental foundations of this developmental strategy, which also led to revolutions in many other sectors of agriculture and allied enterprises. As a part of this strategy, several programmes of transfer of technology from research stations to farmers' fields were launched in the country. These included National Demonstration Project, Lab to Land Programme, Operational Research Project and Krishi Vigyan Kendras (Farm Science Centers). The programmes were continuously reviewed from time to time and reformulated for their effectiveness. Presently the Krishi Vigyan Kendras (KVKs) have been recognized as an effective link between agricultural research and extension system in the country.

1.1 The genesis of KVKs

The genesis of KVKs can be traced to the Second Education Commission (1946-66), under the Chairmanship of Dr. D.S. Kothari, which *inter alia* recommended the establishment of 'agricultural polytechnics' to provide vocational education in agriculture to school drop-outs and other rural youths. After careful deliberation by the Union Ministry of Education, Ministry of Agriculture and the Planning Commission and as a follow-up of the Kothari Commission recommendations, the Indian Council of Agricultural Research (ICAR) appointed a committee under the Chairmanship of Dr. Mohan Singh Mehta of Seva Mandir, Udaipur in 1973 for formulating an institutional design for Krishi Vigyan Kendra (KVK) to provide vocational training in agriculture.

The basic principles for KVKs enunciated by the Mehta Committee (1973) included:

i. The Kendra will impart learning through work-experience and hence will be concerned with technical literacy, the acquisition of which does not necessarily require the ability to read and write.

ii. The Kendra will impart training only to those extension workers who are employed and to the practicing farmers and fishermen. In other words, the Kendra will cater to the needs of those who are already employed or those who wish to be self-employed.

iii. There will be no uniform syllabus for the Kendras. The syllabus and programme of each Kendra will be flexible in nature and tailored according to the felt needs, natural resources and the potential for agricultural growth in that particular area.

Krishi Vigyan Kendra (Farm Science Centers), an innovative science-based institution, was thus established mainly to impart vocational skill training to the farmers and field-level extension workers. The concept of vocational training in agriculture through KVK grew substantially due to greater demand for improved/agricultural technology by the farmers. The farmers require not only knowledge and understanding of the intricacy of technologies, but also progressively more and more

skills in various complex agricultural operations for adoption on their farms. The effectiveness of the KVK was further enhanced by adding the activities related to on-farm testing and front-line demonstrations on major agricultural technologies in order to make the training of farmers location specific, need- based and resource-oriented.

The training programmes of KVKs were designed to impart the latest knowledge to the farmers through work experience by applying the principles of 'Teaching by Doing' and 'Learning by Doing'. The prime goal of KVK was to impart training as per needs and requirements in agriculture and allied enterprises to the farmers, farm women, and farm youths including school drop-outs in the rural areas. No formal certificate or diploma was awarded, irrespective of the duration of the courses to avoid the rush for jobs instead of self employment. While designing the courses, the concept of farming system as well as farming situation are taken into account to ensure that the enterprises in which they are trained are commercially and ecologically viable, sustainable and profitable. The vocational training was intended to help them to sustain themselves through self-employment and to make them self-reliant economically and thus discourage them from migrating to the urban areas.

KVKs provided training not only in agriculture and allied vocations but also in other income-generating activities that supplemented the income of farm families. The methods employed in training were formal, non-formal or a combination of both, depending upon the needs but emphasis remained on work-experience, as suggested by Mohan Singh Mehta Committee.

1.2 Mandate of KVKs

In the beginning, the mandate of KVK was confined only to provide skill based training to the farmers, farm women and rural youth in crop production, horticulture, livestock production, fisheries, home science, farm machinery and implements and other allied vocations such as apiculture, mushroom cultivation etc. Besides, various extension activities such as field demonstration, field days, farmers' fairs, exhibitions, radio/TV talks, film show, publication of farm leaflets, etc. were also carried out for creating awareness and to disseminate the agricultural technology. With the consolidation of other front-line extension projects of the Council during the Eighth Five Year Plan, such as National Demonstration Project (NDP), Operational Research Project (ORP), Lab to Land Programme (LLP) and All India Coordinated Project on Scheduled Caste/Tribe, the mandate was enlarged and revised to take up on-farm testing, long term vocational training, in service training for grass root extension workers and front-line demonstrations on major cereal, oilseed and pulse crops and other enterprises. The latest revised mandates of KVKs are as follows:

1. To conduct "On farm Testing" for identifying technologies in terms of location specific sustainable land use systems.
2. To organize frontline demonstrations on various crops to generate production data and feedback information.
3. To organize training to update the extension personnel with emerging advances in agricultural research on regular basis.
4. To organize short and long term vocational training courses in agriculture and allied vocations for the farmers and rural youth with emphasis on "learning by doing" for higher production on farms and generating self employment.

The application of technology in the farmers' field is achieved through conducting of On-farm trial which include technology assessment and refinement. The proven and recommended technologies are then introduced in the system through conducting of frontline demonstrations followed by training programmes to empower the farmers, field extension personnel and rural youths for its adoption. The extension activities such as field day, exhibitions etc are conducted to disseminate the technologies across the system.

1.3 Functional Objectives of KVKs

For fulfilling the prescribed mandate, the KVKs, at present, has to perform the following functions:

i) To plan and conduct survey of the operational area through Participatory Rural Appraisal (PRA) methods and characterize physical and human resources with special reference to identifying the technological and training needs of the farming community.

ii) To compile all relevant recommendations/package of practices for the district to be meaningfully utilized in the training programmes and the follow-up extension activities.

iii) To plan and conduct production-oriented and need-based short and long duration training courses both on the campus as well as in the villages for various target groups with priority on the resource poor sections.

iv) To organize Farm Science Clubs in order to inculcate in the younger generations a scientific temper and an interest on agriculture and allied sciences and for scientific farming through supervised individual and group projects.

v) To develop and maintain the campus farms and demonstration units on scientific lines as the facilities for providing work experience to the trainees, dissemination of the latest technical know-how and also as a means to achieve financial sustainability in due course of time.

vi) To provide practical training facilities of the Kendra to the teachers and the students of vocational agriculture of the higher secondary schools.

vii) To provide added training facilities in the area for home making and nutrition education for rural communities and gradually enlarging the training facilities to encompass other important areas such as home/rural crafts and cottage industries with the requirements of the integrated rural development in collaboration with the concerned organizations.

viii) To implement all such schemes of the ICAR and other related organizations which intend to strengthen the training and technology dissemination programmes as well as follow-up extension activities of the Kendra.

ix) To undertake on-farm testing of the technologies developed by the National Agricultural Research System (NARS) in agriculture and allied fields for their suitability and identifying the constrains.

x) To demonstrate the potentialities of various technologies and recommend for their adoption in maximizing yield/income per unit of time and area under different resource conditions.

1.4 Growth of KVKs

The first KVK was established by the Indian Council of Agriculture Research in Pondicherry during 1974. By the end of Fifth Five Year Plan, 19 KVKs were established. In view of its growing utility and the demand, 70 KVKs were sanctioned during the Sixth Five Year Plan (1980-85). During Seventh Five Year Plan, 20 more KVKs were established. The number of KVKs went up to 183 when 74 new KVKs were established during 1990-91 and 1991-92 by the Council. By the end of Eighth Five Year Plan, there were 261 KVKs in the country. During September 2001, the establishment of 66 new KVKs over a period of three years (2001-02 to 2003-04) was approved, out of which 15 KVKs were sanctioned during the last year of IX Five Year Plan, thus raising the number of KVKs to 276 at the end of IX Five Year Plan (2001-02).

It was decided to establish the remaining 51 KVKs (sanctioned during IX Five Year Plan) during the X Five Year Plan, out of which 15 KVKs were sanctioned during 2002-03. Later, a major decision to establish 201 new KVKs (on 100% funding basis) was taken to have at least one KVK in each district of the country. This has been one of the strong recommendations of the Parliamentary Standing Committee on Agriculture (PSCA) for many years. Considering that the number of rural districts is 578, it was decided to provide one KVK in each rural district by the end of X Five Year Plan raising the number of KVKs to 578.

During IX Five Year Plan, 53 Zonal Agricultural Research Stations (ZARS) were strengthened to function as KVKs for which funds were provided under National Agricultural Technology Project (NATP). It was decided to continue their functioning as full-fledged KVKs during X Five Year Plan also, to be financed out of Plan Budget of KVKs after the termination of NATP. All these KVKs have also started functioning as full-fledged KVKs from 1st April, 2004.

A total of 562 Krishi Vigyan Kendras are established across the country as on 31st December, 2008. Out of these, 382 are under State Agricultural Universities (SAUs) and Central Agricultural University (CAU). 40 under ICAR institutes, 88 under NGOs, 33 under State Governments, three under various Public Sector Undertakings (PSUs) and remaining 16 under other educational institutions.

1.5 Concept of KVK

The KVKs have witnessed several changes in their functions over the years. Accordingly their functional definition also has radically got refined so as to meet the new challenges in agriculture. The most recent definition of a KVK is as follows:

"KVKs are grass root level organizations meant for application of technology through assessment, refinement and demonstration of proven technologies under different 'micro farming' situations in a district" **(Das, 2007).**

It should be clearly understood that transfer of technology is not a primary function of KVKs and the same is the responsibility of State departments. The KVKs on the other hand will assess and

refine (if needed) the newly released technologies, demonstrate the proven ones and train farmers and Extension functionaries on the same.

1.6 Role of KVKs in the Context of Agricultural Extension in India

Agricultural extension in India is largely deployed by government, implemented mainly through government institutions and to some extent through non-government agencies. Krishi Vigyan Kendras (KVKs) or Farm Science Centres as institutes of inducing behavioural change, are being managed by both government and non-government organizations. Literally, Krishi Vigyan Kendras have to serve as repository of scientific knowledge that is useful to the entire district, which is its jurisdiction. In India, agricultural extension and extension education are interchangeably used with the same connotation as used in American tradition, meaning “Extending Information” as a means of educating people to solve their problems. As a result, agricultural extension in India is more of “Informative Extension” than “Emancipatory Extension”.

1.7 Changing needs of farmers for support from Agricultural Extension

As a result of rapidly changing agricultural scenario at the advent of WTO, farmers have to make different decisions than in the past. They now have to face decisions on:

1. Which technology to use?
2. How to manage this technology? Experience shows that the success of a technology on farms depends to a large extent on its management.
3. How to use his capital, land, labour in the most profitable way? The methodology taught in farm management courses to make these decisions becomes more and more important for financial success of a farmer.
4. How and when to change his farming system?
5. Whether or not to take a full time or part time job outside agriculture for himself or his children? This decision is of great importance for the welfare of the farm families. Everywhere with increasing incomes, the proportion of the labour force working in agriculture decreases. Also, in India not all farm families will be able to make a decent living based on income only from agriculture.
6. For which products is there a good demand in the market? With the rapidly changing markets, farm income depends a lot on the choice the farmer makes on which products to grow and whether he produces the quality the market requires.
7. How to increase the share he gets from what the consumer pays for his products? How and when to buy inputs and sell products? Can it help to start a co-operative?
8. How to make decisions collectively on resource use and in farmers’ associations? It is doubtful whether Indian agriculture can develop successfully unless farmers strengthen their associations.
9. How to find and use the most relevant and reliable knowledge and information, which the farmer needs for making decisions? Farmer, who do not receive and use new knowledge

rapidly, will have difficulties to compete with other farmers inside and outside India. But they have to check whether the information they receive is reliable and relevant for their situation.

10. How to get credit and production inputs on time, place and at suitable rate to derive support and profits by the farmers?

It may be wise for the KVK functionaries to decide that they will not try to help farmers with all the decisions they have to make, but to concentrate on few decisions, which the staff of the organization is really competent. The multi-disciplinary organization like KVK should try to make their Subject Matter Specialists competent enough to support farmers on decisions considered as important by the farmers of their district.

1.8 Role of KVKs in Agriculture and Rural Development

Agricultural and rural development encompasses the all round development of people in its effective dimensions of economic, social and agricultural scenario. World Bank defined "Rural Development as a strategy designed to improve the economic and social conditions of life of a specific group of people – the rural poor. It involves extending the benefits of development to the poorest among those who seek a livelihood in the rural areas". Today, this definition still holds good. Hence, it is to be seen how these mandate of reaching the poor with benefits of development to be achieved? There is no second opinion that in India, rural development could be attained through improving agriculture, forestry, animal husbandry, dairying, sericulture, fisheries, rural engineering, and rural crafts. Empowering rural population to enable them to practice these occupations to earn more and live better will be a more specific criterion. Agriculture extension efforts by KVKs have an important contribution to make. It is a grass-root level organisation that can help to fight poverty, to foster education of rural people, and to promote behaviour and technology that link high productivity with natural resources sustainability.

Sustainable agriculture is termed as the system of raising crops for human utility through utilization of resources with greater efficiency without disturbing, unbalancing or polluting the environment. Concern for the coming generations holds the key here. The most important consideration of this kind of agriculture for KVKs is to keep the environment of the district harmonious and balanced through appropriate cropping and farming systems and by using the resources selectively and judiciously. Intensive cultivation of land without maintaining soil fertility and soil structure would cause desertification. Like wise, irrigation without provision for drainage would lead to fertile soil becoming saline and alkaline. Indiscriminate use of pesticides would adversely affect the biological balance. Unscientific and non-judicious tapping of underground water would lead to lowering of water table. Therefore, KVK personnel should note that adoption of exploitative agriculture without proper understanding of its consequences may lead to an era of agricultural and environmental disaster in the long run rather than an era of agricultural revolution and prosperity.

Agriculture, however, must be more than economically competitive. It must also be suitable, which entails conserving natural resources, such as soil, water and biological diversity, and taking into account agriculture's social and cultural context. This complex challenge can also be overcome if traditional and new knowledge are effectively combined in new production systems that are

compatible with the cultural and social values of rural societies. Contributing to the development of such systems will be one of the most important tasks of KVKs.

In India, the extension efforts, particularly transfer of technology efforts, have largely been taken up by the state departments of agriculture and other disciplines as a state subject. The Indian Council of Agricultural Research (ICAR) as the apex body to provide new technologies in agriculture and allied aspects has its own transfer of technology activities too. The extension efforts of ICAR have evolved through National Demonstration Projects, Operation Research Projects, Lab to Land Programmes, and integrating of these approaches to Krishi Vigyan Kendras (KVKs) since 1974. Today, KVKs are the focal point for Assessment, Refinement and Demonstration of front line technologies for all developmental activities related to agriculture, community and industries in rural India. A total of 562 Krishi Vigyan Kendras are established across the country as on 31st December, 2008. Out of these, 382 are under State Agricultural Universities (SAUs) and Central Agricultural University (CAU). 40 under ICAR institutes, 88 under NGOs, 33 under State Governments, three under various Public Sector Undertakings (PSUs) and remaining 16 under other educational institutions.

From the beginning of this century the farm economy of our country has attracted widespread attention and several extension and development attempts have been made for its improvement. The British Administration had formed several committees to understand the features of farming systems and ways for its development. Among the various committees and their reports, the reports submitted by the Royal Commission on Agriculture (RCA) and W. A. Burns report on the Technological Possibilities of Agricultural Development in India (1944) are considered as significant. However, the pre-independence attempts on agricultural development were limited in scale and geographical coverage. These attempts did not have any follow-up action and lacks specificity in terms of programme planning and implementation. The above constraints in the agricultural development has been done away through the introduction of planning in the post-independence period which emphasized by a systematic and intensive approach.

The post independent extension education and development programmes launched by Government of India can be generally grouped into five categories. They are:

1. Community development programmes
2. Programmes for technology development
3. Programmes for development with social justice
4. Frontline extension programmes of ICAR
5. Agricultural Research and development programmes by ICAR and Govt. of India.

The list of programmes implemented under these five categories are given under:

Community development

1952	CDP	Community Development Programme
1953	NES	National Extension Service
1954	CDB	Community Development Block
1957	Panchayati Raj	Democratic Decentralization

Technological development

1960	IADP	Intensive Agricultural District Programme
1964	IAAP	Intensive Agricultural Area Programme
1964-65	ICDP	Intensive Cattle Development Project
1966	HYVP	High Yielding Variety Programme

Development with social justice

1970-71	SFDA	Small Farmers' Development Agency
	MFAL	Marginal Farmers' and Agricultural Labourers Programme
	DPAP	Drought Prone Area Programme
1972-73	PPTD	Pilot Project for Tribal Development
1974	T&V	Training and Visit Programme
1978-79	IRDP	Integrated Rural Development Programme
1979	TRYSEM	Training of Rural Youth for Self-Employment
1980	NREP	National Rural Employment Programme
1982	DWCRA	Development of Women and Children in Rural Areas
1983	NAEP	National Agricultural Extension Project
1986	TMO	Technology Mission on Oilseeds
1989	JRY	Jawahar Rozgar Yojana
1993	EAS	Employment Assurance Scheme
1994	SFAC	Small Farmers Agri Business Consortium
1999	SGSY	Swarnajayanti Gram Swarozgar Yojana

ICAR Frontline Extension Programmes

1965	NDP	National Demonstration Project

1974	KVK	Krishi Vigyan Kendra
1975	ORP	Operational Research Project
1979	LLP	Lab to Land Programme
1995	TAR-IVLP	Technology Assessment and Refinement – Institute Village Linkage Programme

Agricultural Research and Development Programme

1979	NARP	National Agricultural Research Project
1989	TMDD	Technology Mission on Dairy Development
1998	NATP	National Agricultural Technology Project
2007	NAIP	National Agricultural Innovation Project
2008	NADP/ RKVY	National Agriculture Development Programme (NADP) or Rashtriya Krishi Vikas Yojana (RKVY)

1.9 Current Extension Scenario: Issues and Approaches

Extension in this context includes all those agencies in the public, private, NGO and community based initiatives that provide a range of agricultural advisory services and facilitate technology application, transfer and management. Apart from public sector extension arrangements, the number and diversity of private extension service providers has increased during last two decades. These include NGOs, producer associations, input agencies, media and agri-business companies. Many provide better and improved services to farmers, but their effective reach is limited and many of the distant and remote areas and poor producers are neither served by the public nor the private sector.

1.9.1 ATMA/SREP

In the case of public sector extension, the major reform in recent years has been the establishment of a district level co-ordinating agency, the ATMA (Agricultural Technology Management Agency), in 24 pilot districts with the World Bank support. Under ATMA, grass root level extension is mainly channelised through the involvement of BTTs (Block level Technology Teams) and FACs (Farmer advisory committees), farmer groups/ farmer interest groups and self help groups. ATMA is a district level autonomous agency entrusted with the role of agricultural technology management in the district.

ATMA is a society of key stakeholders in agricultural activities for sustainable agricultural development in the district. It is a focal point for integrating Research and Extension activities and decentralising day to day management of the public Agricultural Technology System (ATS). It is a registered society responsible for technology dissemination at the district level. The ATMA was initially pilot tested in 24 districts across six participating states (Andhra Pradesh, Bihar, Himachal Pradesh, Maharastra, Orissa and Punjab).

The ATMA at district level would be increasingly responsible for all the technology dissemination activities at the district level. It would have linkages with all the line departments, research organisations, non-governmental organisations and agencies associated with agricultural development in the district. ATMA management committee comprises of the Project Director of ATMA as the Chairman and members are drawn from line department heads, NGOs and farmers' organization. The management committee carries out PRA, prepares Strategic Research Extension Plan for the district, establishes Farmer Advisory Centres and co-ordinates the execution of annual work plan through participatory line departments such as ZRSs, KVKs, NGOs, FIGs/FOs and allied institutions. The ATMA creates Farmers Advisory Committees to provide feedback. It uses NGOs to organize farmers and encourages private sector in technology transfer. It also validates and refines technology. It also ensures increased use of information technology, arranges in-service training and encourages developing of new public and private partnership. The ATMA Governing Board (GB) comprises District Magistrate /Collector as chairman, Chief Development Officer as Vice Chairman and, Joint Director Agriculture, Head KVKs, one farmer, one NGO representative, one SC/ST farmer, Lead Bank Officer of district and representative from Agricultural Marketing Board as members.

1.9.2 SREP (Strategic Research and Extension Plan)

It is the process of finding the best scenario for agricultural development and setting the best path to reach that destination by rigorous analysis and choices about; goals, opportunities and threats, strengths and weaknesses with respect to agricultural development in a district.

Goals-what is intended to be accomplished?

Opportunities and threats- what is needed and feasible?

Strengths and weakness-what is the capability of doing things?

SREP document provides the details of problems and technological needs for agricultural development in a district. Basic aim of SREP is to link the research and extension system with the farmers. It is a bottom up approach exercise carried out at the district level to identify the technological and training needs of the farmers. It speaks about extension and research priorities to be undertaken by the extension and research system based on the grass root analysis carried out by the SREP team. It is a comprehensive document prepared for the purpose of understanding the district agricultural scenario and to undertake need based research and extension programmes.

Based on the experiences gained from the pilot district, the Ministry of Agriculture, Government of India in 2004-05 decided to expand the ATMA model across all the districts in the country. Extension continues to be funded as part of central and state level schemes/ programmes without much operational freedom at the local level, though the strategic research and extension plans (SREP) under ATMA envisage bottom up planning for extension. Marketing extension has been a recent addition but is understood and implemented mostly as provision of output price information in various markets and this is highly inadequate to address the challenges in marketing. Other extension support facilities created include, Farmer Training Centers (FTCs) at the district level; SAMETI (State Agricultural Management and Extension Training Institute) at the state level, EEI (Extension Education

Institute) at the regional level; and MANAGE (National Institute for Agricultural Extension Management) at the national level. The details of the current institutional arrangements operating in the country is given in table 1.

Table - 1 : Current Extension Institutional Arrangements

Sl. No.	Extension organisations	Functions/ Roles / Capacity
1	ATMA	Aimed at decentralized decision making and bringing convergence among extension providers in a district; Promotion of commodity interest groups; Development of a strategic research and extension plan; Provide additional funds to these agencies for key extension activities such as farm schools, demonstrations, exposure visits and trainings.
2.	KVK	Technology application (technology assessment and refinement) through on-farm trials, front-line demonstration and training, Formation of FIGs, SHGs, etc.
3.	State line departments (Agriculture, Animal Husbandry, Fisheries, etc.)	Regulatory role; Implementation of development programmes that involve distribution of subsidies and subsidized inputs;Organizing extension programmes, farmers training etc.
4.	FTC	Training farmers on new technologies, Formation of SHGs, FIGs, etc.
5.	SAU (Directorate of Extension)	Implement extension programmes of the SAU and oversee activities of KVK.
6.	NGOs	Exhibit wide diversity in terms of reach, credibility and capacity; Have good knowledge and networks with communities in villages they operate; Present in difficult and remote regions; Innovative in their approaches; Can potentially complement approaches of the public sector extension.
7.	Private Agri-Business firms	Agri-input firms mainly involve in product demonstration; Agro-processing and marketing firms mainly commodity oriented but do provide integrated support (inputs, technical support and marketing) for contract growers.
8.	Media	Dissemination of information on new technologies.Eg. E TV – Annadata, Krishi Darshan etc.
9.	Private consultants	Support large farmers growing cash crops and high value horticulture.

Sl. No.	Extension organisations	Functions/ Roles / Capacity
10.	MANAGE	Training senior and middle level extension managers; Conduct studies on extension systems and policies; Conduct management educational programmes in agriculture, Provide consultancy.
11.	SAMETI	Training middle level extension staff at the state level; Conduct studies on extension systems at the state level.
12.	EEI	Training middle level extension managers at the regional level.

The technology generation and its application is focusing upon the themes of optimization by producers of their valuable resources, sustainability and coping with diversity by adapting technology more specifically to agro-ecological or social circumstances. The details of extension reforms initiated are given in the table-2.

Table - 2 : Details of Extension Reforms

Sl. No.	Extension Reforms	Issues addressed and Approaches
1.	Policy Reforms	i) Farming systems Approach Multi agency extension service (a) public extension services (b) private extension services (c) mass media and information technology (ii) Promotion of farmer participatory approach (iii) Promotion of demand driven and farmer accountable extension (iv) Public extension to enable farmers for problem solving skills (v) Encouraging private sector involvement in technology transfer (vi) Public funds for private extension services
2.	Institutional Restructuring	(i) District level Agricultural Technology Management Agency (ATMA) model (ii) Strategic Research and Extension Plan (SREP) through Participatory Rural Appraisal (PRA) (iii) Block/Mandal level technology centre for single window extension system. (iv) Group approach to extension (v) Strengthening Research-Extension-Farmer linkages

	(vi) Promotion of multi-agency extension service for widening the range of extension delivery agencies
3. Management Reforms	(i) Central support to state Govt. for extension services on their undertaking of policy and institutional reforms. (ii) Routing of Central Govt. funds through ATMA (iii) Central Assistance to SAUs for expanded role in field extension (iv) Promotion of community based private extension services (v) Promotion of NGO based private extension services and contracting out extension services (vi) Promotion of para-professional based private extension (vii) Linkage of performance with funding for public sector
4. Strengthening Research-Extension Linkages	(i) Promotion of direct interface between farmers and scientist (ii) Activating existing interface mechanisms (iii) Research priority setting based on SREP
5. Capacity Building of Extension functionaries	(i) Formulation of HRD policies by States (ii) Formulation of training plan for extension functionaries (iii) One time catch-up grant for training infrastructure (iv) Upgrading State level Extension Training Institutions (v) Strengthening role of MANAGE (vi) Developing professionalism in cost effective manner and networking among extension institutes
6. Empowerment of Farmers	(i) Involving farmers in setting extensive agenda (ii) Implementation of programme through farmers users groups (iii) Involving rural youth and mainstreaming of women with crop and livestock (iv) Improving access to extension and training (v) Expounding the sphere of women extension workers and redesigning of extension services to reach women farmers
7. Use of Information Technology	(i) Wider use of electronic mass media and increasing use of information technology in extension (ii) Farmers participation in IT Programmes (iii) State support for information technology and networking (iv) Promoting private information Kiosks (v) Capacity Building for use of IT

8.	Financial sustainability and resource mobilisation	(i) Cost cutting mechanisms for extension services and efficient use of available resources (ii) Privatization of agro services (iii) Towards a realistic cost recovery of agro-services (iv) Co-financing of public extension (v) Initiating new financial systems and management for avoiding bottlenecks and redtapism

Farming System Approach replaces the conventional single discipline based, commodity oriented approach. The Farming system approach considers the farm, the farm household and off-farm activities in a holistic way to take care not only of farming but also all aspects of nutrition, food security, sustainability, risk minimization, income and employment generation which make up the multiple objectives of farm households. Farming system considers interdependencies of the components under the control of members of the households as well as how these components interact with the physical, biological and socio-economic factors not under the household's control. The Farming system approach emphasizes that research and extension agendas should be determined by explicitly defined farmers' needs through an understanding of the existing farming systems rather than the perception of research scientists or extension functionaries.

With current reforms and policies, the public extension system would continue to play a prominent role in technology dissemination. The large scale of small and marginal farmers and landless labourers are benefited by the public extension system. The other players involved in extension/ transfer of technologies such as NGOs, Farmers organisations, Private sector (both corporate and informal), para-workers etc. would actively complement/ supplement the effort of the public extension agency. Extension mechanism will have to be driven by farmer's needs, location specific and address diversified demands. There is room for both the public and private sectors in the development of a demand based and feed back driven system. Technologies required to address total farming systems are knowledge intensive. Public extension system will need to be redefined with focus on knowledge-based technologies to upgrade and improve the skills of the farmers.

Farmers' capacity building is often seen within the limited perspective of giving them the knowledge and skills required to practice crop and animal husbandry in a better way. Though, knowledge and skills are fundamental to efficiency in any enterprise, Indian farmers need more than that because of the limitations and complexities under which they operate. The KVKs which have been mandated to work with farmers, farm workers and rural youth directly as well as through field extension functionaries have the greatest challenge to make their clients more efficient, specialized and to be economically active. The fact that the need for agricultural and rural information and advisory services is to intensify in the immediate future exerts more pressure on KVK performance. This publication is aimed to assist the KVK scientists in equipping themselves for the future challenges by providing a clear cut outline and exclusive guidelines regarding the mandated activities assigned to them. The contents thus are need based covering the basics of KVK functions, tools for problem identification at district level, technology assessment and refinement, technology demonstration, training methodology, impact assessment tools along with basics of statistics, guidelines for participatory technology development and details of various agricultural and current rural development programmes. The book concludes with action tools useful for making KVKs a vibrant institution followed by associated reviews of interest to KVK scientists.

Chapter – II

Identifying Farming Systems, Field Problems and Developing Action Plans

The broad mandates of KVKs call for on farm testing of frontier technologies, demonstrating the proven ones and training the farmers, rural youth and extension functionaries on the same. This requires identification and sourcing of latest technologies in response to field problems. Unless KVK scientists identify the grass root level problems existing in the villages of the district, the processes of OFTs, FLDs and training programmes will prove futile. Identifying the farming systems existing in the district is a prerequisite to all the above activities, the indepth analysis of which will guide the KVK scientists in identifying the field problems.

One of the first tasks of KVK is to facilitate the preparation of Strategic Research and Extension Plan (SREP) of the district. The SREP is prepared through participatory methodologies such as Participatory Rural Appraisal (PRA) involving all the stakeholders and farmers. The SREP contains detailed analysis of all the information on existing farming systems in the district and research – extension gaps required to be filled-up. It also prioritizes the research – extension strategies within the district. It becomes the basis for development of work plans at district level. ATMA districts have a well defined SREP which KVK can refer to.

2.1 Farming Systems

A *farming system* is defined as a complex interrelated matrix of soil, plants, animals, power, implements, labour, capital and other inputs controlled in part by farming families and influenced to varying degrees by political, economical, and institutional and social forces that operate at many levels.

It may also be defined as a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate. Depending on the scale of the analysis, a farming system can encompass a few dozen or many millions of households.

The classification of the farming systems of developing regions has been based on the following criteria:

- available natural resource base, including water, land, grazing areas and forest; climate, of which altitude is one important determinant; landscape, including slope; farm size, tenure and organization; and
- dominant pattern of farm activities and household livelihoods, including field crops, livestock, trees, aquaculture, hunting and gathering, processing and off-farm activities; and taking into account the main technologies used, which determine the intensity of production and integration of crops, livestock and other activities.

Farming System Analysis (FSA) is an in-depth, quantitative analysis of an existing farming system of the study area. The farming system can be defined as "an unique and reasonably stable arrangement of farming enterprises that the farm household manages according to well defined practices in response to physical, biological and socio-economic environments and in accordance with the households' goals, preferences and resources. These factors combine to influence the output and production methods. More commodities are found within the system than between systems. The farming system is part of larger systems, i.e. the local community and can be divided into subsystems/ cropping systems. Central to the system is the farmer himself (Shaner et al., 1982).

KVKs have to begin with Farming System Analysis which studies the farmers of the district and their problems in a comprehensive manner using an inter-disciplinary approach that complements the existing research and development activities and is interactive, dynamic and responsive to the society (Shaner *et al*, 1982). Some of the essential features of Farming System Analysis are as follows:

a) It is a strongly applied and empirical 'problem solving' approach.

b) All activities of the farmers are analyzed in a holistic framework.

c) Relatively homogenous groups of farmers are identified as the clients of on farm research in specific agro-climatic zones. This approach gives the resource poor farmers for the first time a voice in tailoring the research priorities to his needs.

d) It is an inter-disciplinary approach involving social and biological scientists.

e) It involves farmers participation.

f) It is a dynamic 'Learning by doing' approach.

g) It involves on-farm trials, survey (socio-economic and technical) and field demonstration and workshop.

h) It is mainly concerned with the downstream (applied) research which begins with an understanding of the existing farming systems and the identification of key constraints.

i) 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.

FSR, in its many forms, has made a major contribution to understanding small farming systems and to improve agricultural research. These include the farm household and its needs, objectives, biological, economical and human dimensions. Different observers have identified different activities and stages in the FSA. Its objectives differ from straight disciplinary and commodity research; it encompasses benefits to farm family through understanding of its farming system; and the location of some of the work differs, being on-farm instead of on-station.

2.2 Activities Involved in FSA

The basic activities involved are:

(a) Target and research area selection: For KVK it happens to be the district.

(b) Problem identification and development of research base through quick reconnaissance surveys by inter-disciplinary team (PC & SMS)

(c) Planning on-farm research emphasizing alternative cropping and livestock patterns, management practices and other activities of household.

(d) Analysis of results of on-farm research in terms of the statistical meaning of biological performance, actual resource requirement, financial feasibilities and socio-cultural acceptability.

(e) Extension of results through multi-locational testing and

(f) Effective collaboration with other agencies closely associated with the needs of resource poor farmers.

Conducting FSA of the district in a proper way allows the KVKs to identify the immediate problems. In India, the agricultural development could not achieve the desired impact, often because the technologies used are not consistent with their circumstances. In the past, the problems of resource poor farmers were often not clear to the development specialists and policy makers. They failed to appreciate the existing farming system, their problems and farmers' needs, which led them to develop and extend development strategies that were inappropriate to resource poor farmers and ecosystem. Since FSA stresses more on the understanding of the farming systems and the farmers' environment, it is more apt to design technologies that are appropriate and acceptable to resource poor farmers. It starts with farmers and learns about their environments, resources, methods of production, problems and opportunities, aspirations, and how they react to change. Then it moves on to the development of technologies through on-farm trials and finally evaluating them for their appropriateness by the farmers themselves. A checklist based on systems approach for the analysis of Farming systems in the KVK district is given under.

1. Identity and Boundary

Area to be developed needs a thorough analysis. Objective of the analysis, name, map, location of the areas in the district need to be marked out.

2. Elements

Things that one could find in the area: number of people, farms, farming population, types of soils, kinds of crops and animals, climate and water resources.

3. Attributes of Elements

How are the area composed, and a short description of

3.1 The people:

The social organization, social structure, leadership, existing conflicts or tensions, different social classes or farm sizes: what is a BF (big farmer), a MF (medium farmer) and a SF (small farmer), system of land ownership; of trade; for inputs, agricultural produce, credit, land use, tenancy and sharecropping, income differences, relations between men and women.

3.2 The soil:

Soil types, soil fertility and water availability (rainwater, irrigation, drainage, quantity, quality, seasonality)

3.3 The farming activities:

Which crops are grown, which animals are kept, how productive is the agriculture; self-sufficient/deficient/surplus production, for which commodities and for which people.

3.4 Natural vegetation and wildlife:

How are these used by the population: collection of firewood, fruits and vegetables, medicines, meat and fish.

3.5 Levels of education, traditional skills and knowledge, traditional crafts and skills.

3.6 Existing institutions for extension, training, research and mass communication both of government and private organizations.

3.7 Existing road, waterways and infrastructure.

3.8 Availability of farm inputs, markets, transport and processing facilities.

4. Processes of Transformation

What do the people do for a living?

For SF (Small Farmers), MF (Medium Farmers) and BF (Big Farmers);

4.1 What kind of inputs do they use? Which quantities and qualities?

4.2 What activities do they carry out in the farm? Which techniques and methods are used?

4.3 What do they produce, quantity and quality?

4.4 What do they do with their product?

Home consumption/ Processing (Brewing, milling etc.)/ Marketing.

4.5 How is income used?

Saving, consumption, investments, religious and communal investments, wastes, drinking/ gambling?

4.6 Which off farm activities are carried out?

5. Structure

How do the different categories of the population live and work together?

5.1 Which formal and informal groups exist, what are the most important social structures?

5.2 Leadership structure, conflicts or tensions.

5.3 How do men and women divide work and wealth?

5.4 How do goods, money, labour, wood, animal, land and information flow to and from SF, MF, BF, landowners, labourers, traders and other categories?

6. Interaction with Environment

Which movements of information, energy, wood, food and other agricultural produce, people (migrants) and money, takes place between the area and the environment in the region?

6.1 Which channels for transport are used?

6.2 Who benefits and who suffers from these flows? Men and women?

6.3 Which limitations/incentives does national price policy/legislation have on the agricultural production in the area?

7. Changes

Which changes take place in the area?

7.1 History and origin of the people. Which people becomes richer, which people becomes poorer and why?

7.2 Is the quality of the soil, the water and the air changing?

7.3 Which innovations in farming methods and techniques have taken place and still take place: Do SF, MF and BF apply different innovations, which and why?

7.4 Do people change in their social relations, forms of cooperations and leadership?

7.5 Are the observed changes induced from outside the area, if so by whom, and/or they the result of internal forces in the area, which and how?

8. Development Patterns

Which patterns can be observed in the current changes?

8.1 Growth or stagnation in average productivity as a result of technological, economic or social changes;

8.2 Change in stability of production levels as a result of change of vulnerability of systems to influence from weather, diseases and economic conditions.

8.3 Change in sustainability of the system as a result of ecological deterioration or improvement.

A detailed questionnaire developed by ZPD, Zone-III, which the KVKs can utilize to identify the farming systems existing in their district is given in Chapter –XII on action tools and associated reviews.

In order to identify the above factors, KVKs have to invest considerable time and efforts. Participatory methods come in handy under such situations which when used properly can yield the best results. These methods also build rapport between the villagers and KVK staff and facilitate better KVK activities in the long run. The most important participatory method for KVK scientists is the Participatory Rural Appraisal commonly referred as PRA. PRA helps in identifying the farming

systems, understanding the village better and ultimately in problem identification thereby unraveling the technology needs of the farmers of the district.

2.3 Participatory Rural Appraisal (PRA)

PRA comprises a set of techniques aimed at shared learning between local people and outsiders. The term itself is misleading because more and more PRA is being used not only in rural settings, and not only for project appraisal, but throughout the project cycle, as well as for research studies. Indeed, the term PRA is one of many labels for similar participatory assessment approaches, the methodologies of which overlap considerably. It is probably more useful to consider the key principles behind PRA and its associated techniques, rather than the name per se, when assessing its appropriateness to a particular situation.

There are **five key principles** that form the basis of any PRA activity no matter what the objectives or setting:

- **Participation**

  PRA relies heavily on participation by the communities, as the method is designed to enable local people to be involved, not only as sources of information, but as partners with the PRA team in gathering and analyzing the information.

- **Flexibility**

  The combination of techniques that is appropriate in a particular development context will be determined by such variables as the size and skill mix of the PRA team, the time and resources available, and the topic and location of the work.

- **Teamwork**

  Generally, a PRA is best conducted by a local team (speaking the local languages) with few outsiders present, a significant representation of women, and a mix of sector specialists and social scientists, according to the topic.

- **Optimal Ignorance**

  To be efficient in terms of both time and money, PRA work intends to gather just enough information to make the necessary recommendations and decisions.

- **Systematic**

  As PRA-generated data is seldom conducive to statistical analysis (given its largely qualitative nature and relatively small sample size), alternative ways have been developed to ensure the validity and reliability of the findings. These include sampling based on approximate stratification of the community by geographic location or relative wealth, and cross-checking, that is using a number of techniques to investigate views on a single topic (including through a final community meeting to discuss the findings and correct inconsistencies).

PRA offers a “basket of techniques” from which those most appropriate for the project context can be selected. The central part of any PRA is semi-structured interviewing. The various methods used are discussed in detail under the heading ‘participatory methods’.

2.4 The advantages of participatory approaches

Participatory approaches are particularly useful in providing feedback to policy-makers.

- **Economies of scale**

  Participatory groups constitute a grassroots "receiving system" that allows development agencies to reduce the unit delivery or transaction costs of their services, thus broadening their impact.

- **Higher productivity**

  Given access to resources and a guarantee that they will share fully in the benefits of their efforts, the poor become more receptive to new technologies and services, and achieve higher levels of production and income. This helps to build net cash surpluses that strengthen the groups' economic base and contribute to rural capital formation.

- **Reduced costs and increased efficiency**

  The poor's contribution to project planning and implementation represent savings that reduce project costs. The poor also contribute their knowledge of local conditions, facilitating the diagnosis of environmental, social and institutional constraints, as well as the search for solutions.

- **Building of democratic organizations**

  The limited size and informality of small groups is suited to the poor's scarce organisational experience and low literacy levels. Moreover, the small group environment is ideal for the diffusion of collective decision-making and leadership skills, which can be used in the subsequent development of inter-group federations.

- **Sustainability**

  Participatory development leads to increased self-reliance among the poor and the establishment of a network of self-sustaining rural organisations. This carries important benefits: the greater efficiency of development services stimulates economic growth in rural areas and broadens domestic markets, thus favouring balanced national development; politically, participatory approaches provide opportunities for the poor to contribute constructively to development.

2.5 Methods in PRA

Participatory methods are highly dynamic and continuously evolving. The objective of this chapter is to give a basic idea in this regard. Accordingly, only the most important PRA methods are presented below[1].

[1] KVK scientists who are interested on the recent developments in participatory techniques can refer to the latest book by Robert Chambers namely 'Revolutions in Development Enquiry' (2008).

2.5.1 Village Transect

Transects are systematic walks with key informants through the area of interest, observing, asking, listening, looking, and seeking problems and solutions. The main objective of the transect walk is to understand and study the major land uses, topography, water resources, natural vegetation and different ecological zones by observing, interacting and discussing with the Key Informants (KIs), while walking in the deciding direction. The findings can be mapped on a transect diagram. Most transect walks result in the outsiders discovering surprising local practices such as indigenous conservation practices, multiple uses of plants, and a great variety of crops. It has been instructive for many professionals to realize how much they do not see or do not think to ask about. The items for discussion include topics such as soil type, water resources, crops, vegetables, fruit plants, trees and shrubs, forages, animals, land use pattern, interventions, problems and opportunities.

2.5.2 Agro Ecosystem Map

Agro-ecological or agro-ecosystem map shows the macro and micro ecological (sub-systems) features in a village. The meteorological parameters like rainfall, temperature, relative humidity and the major flora and fauna of the village and the basic land use pattern such as crops, agro-forestry, forest cover, wasteland, animals and the natural resources like soil type, water resources (wells, river, channel, ponds etc.), common property resources (CPRs), use of locally available resources are depicted in this map. This map helps in the preparation of perspective planning for the village development.

Here the villagers are encouraged to draw the major land marks such as roads, boundaries, household area, low lying land and high lands first. Then based on the land topography they were asked to indicate soil types, crops, trees, animals, water resources etc.

2.5.3 Resource Map

Resource map is drawn after collecting information by the active participation of KIs of different age groups including female. Resource map describes regarding main crops grown in the village, trees, animals, common property resources (CPRs), types of houses, school, farm implements, luxury and communication items, social resources like women groups, self help groups (SHG), local self government etc.

2.5.4 Seasonal Calendar

This is a calendar, which indicates month wise activities related to agriculture and livelihood, specialties, threats, abundance, and shortage with regard to agriculture in a diagrammatic way. The items to be included in seasonal analysis must be of those items, which really affect the agriculture. This explores seasonal constraints and opportunities by diagramming changes, month by month throughout the year.

The main activities, problems and opportunities of the village are identified by using seasonal calendar. It depicts time-to-time crop related operations being carried out in the existing farm situation. Seasonal analysis helps in identifying the period which are critical in respect of labor demand, pest and disease problems, non-availability of fodder during dry months.

2.5.5 Gender Disaggregated Seasonal Calendar

The animal husbandry activities are being done by both men and women. There are certain activities, which are carried out exclusively by men or women. So it is important to know those specific activities with regard to any particular village for which the above method is used.

2.5.6 Seasonal Analysis

To know about the seasonal problems related to livestock a seasonal analysis is to be carried out. In this method, the diseases affecting various animals are documented pertaining to their months of attack. Other information like availability of labor and fodder for animals are also recorded by involving the farmers. The information collected is depicted in the form of a table.

2.5.7 Social Map

This method gives a social profile of the village. This method can throw light on religious and caste preferences in agriculture and animal husbandry.

2.5.8 Time Line

Historical analyses have been found to be a good icebreaker for field exercises and include detailed accounts of the past, of how things have changed, particularly focusing on relationships and trends. These include livestock technology histories and review, livestock breed histories, labor availability, trees and forest histories, education change, and population change. Folklore and songs are also valuable resources for exploring history.

2.5.9 Time Trend

Time trend shows quantitative changes over the period of time and can be used for many variables of agricultural, livestock, poultry production, price, yield and areas under cultivation.

2.5.10 Mobility Map

The mobility map indicates the places to which the villagers go outside of their village for various purposes like purchasing inputs, family needs, agricultural and animal husbandry needs, getting higher education, medical needs, social relations and recreation etc.

Mobility map indicates:

1. Places to which the villagers go for various purposes.
2. Direction of the place situated.
3. Mode of transportations.
4. Distance of the place from the village and
5. Cost of mobility in term of money spent etc.

2.5.11 Venn Diagram

Venn diagram is used for understanding institutional relationship with village and the villagers for a particular enterprise. Each circle represents individual/ institution and the size indicates the magnitude of influence. Venn diagram is drawn to indicate the contributions of outside and inside agencies to animal husbandry development, organizations and individuals in the decision making process of the inhabitants as perceived by the villagers themselves.

2.5.12 Wealth Ranking

Wealth ranking refers to placing the people on different categories according to their own criteria. The purpose is to find out the persons of the village, who belong to the rich, middle, poor and very poor group categories as perceived by the villagers themselves. Wealth ranking is based on the assumption that the community members have a good sense about fellow villagers in their own village and are able to categorize themselves.

Agricultural development must take into account the differences in wealth among farmers in order to determine the priorities for research and to develop the interventions and technical packages that are to be adopted by the majority of the farmers.

Wealth ranking helps the extension workers, developmental staff, researchers and other concerned for rural and agricultural development to find out the inequalities and differences in wealth in every farmer and which in turn lead to overall understanding of socio-economic conditions of entire village community. This will also help in selecting the right type of beneficiaries for the various programmes.

2.5.13 Livelihood Analysis

Livelihood analysis refers to find out the degrees to which the pattern of life differs from one social class to another social class in term of size of family, size of landholding, type of house, implements, annual income, source of income, expenditure pattern, crisis management pattern, indebtedness etc.

2.5.14 Bio-resources flow Diagram

Bio-resource flow diagram reflects the inflow and outflow of farm and animal products and its byproducts from and to the household. It explains the interrelationship between different farm enterprises that enables holistic planning for development of farm household.

2.5.15 Indigenous Technical Knowledge (ITK)

Indigenous technical knowledge (ITK) is the information gained over a period of time and passed on from generation to generation by word of mouth. ITK is the sum total of knowledge and practices which are based on peoples accumulated experiences in dealing with situation and problems in various aspects of life. Such knowledge and practices are special to a particular culture. ITK in agriculture and animal husbandry is a treasured source of local wisdom.

2.5.16 Technology Map

The technology map depicts the technologies related to agriculture, horticulture, animal husbandry and fisheries etc that are found in villages as well as technology adoption behaviour of farmers that indicates the technologies that are adopted, rejected, discontinued and reinvented for different crops, domestic animal and fish. Technology behaviour includes the processes of :

1. **Adoption**

   It refers to use of technology by an individual for more than once. There are two types of adoption, namely active and passive adoption.

2. **Over adoption**

   It refers to continued adoption of a technology by an individual when experts feel that he or she should have rejected it.

3. **Discontinuance**

   It refers to decision to reject a technology after having previously adopted it. There are three types of discontinuance, namely replacement, disenchantment and forced discontinuance.

4. **Reinvention**

   It refers to the degree to which a technology is changed or modified by the user in the process of adoption.

5. **Rejection**

   It is of two types, namely active and passive rejection. Active rejection consists of considering adoption of technology (including even its trial) but then deciding not to adopt it. Passive rejection refers to the decision of not considering the technology at all from the moment of its hearing.

Technology map is one of the most important maps in PRA exercises necessary for preparing any research or extension programme. This gives a clue to the researcher about the type of technologies that should be developed in the technology development projects so that it will have better adoption rate.

2.5.17 Matrix Ranking

Matrix ranking is used for learning about local people's categories, criteria, choices, and priorities. Matrix scoring takes criteria for the rows in a matrix and items for columns, and people complete the boxes row by row. The items may be ordered for each of the criteria (e.g., for six trees, indicate from best to worst for fuel wood, fodder, erosion control, and fruit supply); or participants may put stones, seeds, or berries into piles for relative scoring.

2.5.18 Consequence Diagram

Consequence diagram of technology is a tool to assess the impact caused by any technology in terms of changes that occurs to an individual or society as a result of its adoption or rejection. It

helps to predict the consequence of similar technology so that positive consequences could be promoted and negative consequences could be minimized. It is also useful for developing the strategies how to reduce the negative effects of the technologies being used.

2.5.19 Problem Identification

The problem identification exercise in animal husbandry is done to address the following aspects:

1. to identify the real problems faced by livestock farmers
2. to undertake research projects addressing the identified farmer problems
3. to target the available and new technologies towards the problems
4. to identify the various research, development and extension gaps and
5. to refine, transfer and develop appropriate technologies.

2.5.20 Problem Tree (Causal Diagram) & Solution Tree

After identifying the top most researchable problem in the village, the problem tree consisting the logical reasoning of the causal factors has to be drawn for it, alternatively the solution tree consisting of possible solutions is also drawn.

An article on a detailed PRA exercise conducted in an Indian village leading to problem identification and action plan preparation is given in Chapter-XII for reference.

2.6 Scientific Advisory Committees (SAC)

Once farming systems are identified and problem identification is over, the KVKs can go for action plan preparation. The action plan consists of the proposed interventions of the KVK for addressing the identified farming problems of the district. Action plans to be meaningful has to take into account the needs and aspirations of the stakeholders in the concerned district. KVKs conduct the above exercise through various exercises, the results of which are refined in the Scientific Advisory Committee meetings (SAC) to develop meaningful action plans (Pourouchottamane and Sajeev, 2008). Earlier known as Local Management Committee, it is the forum in which all the activities of the KVKs are discussed, action plan gets reviewed, implementation of the programmes evaluated and guidance provided to the functioning of the Kendra by the stakeholders of the concerned district. Keeping in view of the agricultural situation of the district, priority areas identified by the government for development, developmental programmes implemented by various agencies in the district, Strategic research and extension plan developed by the ATMA in case of ATMA districts etc., a meaningful and achievable action plan has to be arrived at by the KVKs based on the SAC meeting. Thus SAC meeting forms the basis for all KVK activities.

2.7 Functions of the SAC

The SAC shall perform the following main functions:

1. Providing guidance and necessary support to the KVK for fulfilling their objectives.

2. Reviewing the annual and five yearly action plan of the Kendra before the same being presented in the Zonal workshop meeting and
3. Reviewing the progress of the implementation of the programme and evaluating the achievements made by the Kendra and providing necessary suggestions for overall improvement in functioning of the Kendra.

2.8 Composition of the SAC

The head of the host institute will act as chairman of the SAC. In case of SAUs, Vice Chancellor will be the chairman while in case of the ICAR institutes as well as the State Departments, the Director of the concerned institute or State department will be the chairman of the SAC. The heads of the line departments like agriculture, horticulture, animal husbandry, fisheries etc. of the concerned district and all other stakeholders like representatives of regional research station situated in the district, lead bank branch, All India Radio and Doordarshan representatives of the concerned district and farmer representatives form the members of the SAC.

The normal composition of the committee will be as given below :

Chairman: Head of the Host Institution.

In case, the chairman is unable to attend the meeting, he can nominate one of the members to act as chairman. Usually the Director of Extension of concerned university or the Head/ Chief Scientist of the regional research station of the University will be nominated to act as Chairman of the SAC. In case of the state department KVKs, Joint Director of the concerned district can be nominated.

Member of the committee includes :

1. Director of Extension of concerned SAU
2. Zonal Project Director of the concerned Zone
3. Representative of ICAR Institute/ ICAR Regional Research Station in which KVK is located
4. Associate Director Research & Extension of the Zonal Research Station in which KVK is located
5. District officers of the line departments such as
   - ❖ Agriculture
   - ❖ Horticulture
   - ❖ Animal Husbandry
   - ❖ Soil Conservation
   - ❖ Social/ Agroforestry
   - ❖ Sericulture
   - ❖ Fisheries

- ❖ Irrigation
- ❖ Social Welfare
- ❖ Small Scale Industries

6. Representatives of the Lead Bank of the district
7. Farm Radio Officer of the AIR in which KVK is located
8. Farmers representative nominated by the Head of the Institution
    - ❖ Two representatives of the farmers; one among small farmer group and one from big farmer group
    - ❖ Two representatives of Farm Women

Member Secretary: Programme Coordinator of the concerned KVK.

He is responsible for presenting the annual progress reports, action plans, annual accounts and all other relevant matters for approval to the committee as well as implementation of the recommendations of the committee.

2.9 Selection of members and conducting of SAC

Convening of the meeting: With consent from the Chairman of the SAC, Member Secretary i.e. Programme Coordinator of the KVK will convene the meeting. At least 20 days advance notice should be given to the members for convening the meeting along with the agenda to be taken up for discussion.

Quorum of the meeting: There should be a minimum participation by 50 percent members. If the quorum is short only by one member, chairman of the meeting can nominate one of the SMS of the KVK to attend as member. Such substitute member can attend that meeting only & have all the rights and privileges of the member for that meeting and he cease to be member for subsequent meetings.

Duration and cessation of membership: Members like farmers representatives are nominated for the period of three years. In case of vacancies arising within three years, such vacancies shall be filled like original vacancy and those members will serve the committee only for the remaining unexpired period of three years.

When the person becomes a member of the committee due to his holding the position of office, his appointment as member of SAC will continue till he holds the office and terminate automatically when he cease to hold the office.

When a member ceases to attend continuously three meeting of the committee, nominator can be approached to change the member keeping in view of continued absence in attending the meeting.

2.10 When to conduct the SAC

The committee should meet twice in a year. The time should be fixed conveniently before the zonal workshop so that the progress made by the KVK in the preceding year and the action plan for the forthcoming year may be discussed in the SAC meeting before the same is submitted to the ZPD.

The mid term meeting should be held after the end of one season so that the performance of the KVK during the season can be evaluated and any mid term correction in the action plan as well as the programme of the KVK can be carried out.

2.11 Duties of the Programme Coordinator

As the member secretary of the SAC, the Programme Coordinator of the concerned KVK has varied duties all of which has to be performed without fail. These are:

1. to convene and conduct the SAC meeting.
2. to prepare the agenda notes on the matters to be discussed,
3. to present the action plan of the Kendra,
4. to present the progress achieved to the SAC; and
5. to prepare the proceedings of the SAC meeting and send the same to the concerned Zonal Project Director in order to keep the Zonal Project Directorate and Council informed about the recommendations and functioning of the SAC.

The SAC proceedings represent the needs and aspirations of the KVK stakeholders. To achieve this, KVKs have to reorient their Annual Action Plans in line with the SAC recommendations. Properly conceived and executed SACs contribute to meaningful and achievable annual action plans thus helping KVKs to reach success in accomplishment of their mandates.

Each KVK has to prepare its Action Plan (Annual Action Plan) where in all the mandated activities of KVKs are proposed in a systematic way in the prescribed format. It is prepared in order to direct the efforts of the Krishi Vigyan Kendra in a planned manner. 'Planning' has a direct role to play in achievement of targeted goals of any organisation or agency and it is more relevant and important in the context of KVKs functioning. KVK has to work in diversified socio-economic or agro ecological situation with heterogeneous group of clients (Bordoloi, 2008). Moreover, KVK mandates are also very much wide aiming at holistic development of agriculture through concerted efforts. Under such circumstances the success of KVK activities largely depends on its 'Action Plan'. It is better to perform few tasks with proper plan than more tasks with improper plan. A realistic action plan saves time and money and promotes general efficiency. 'Action plan' is a set of 5 "W"s and 1 "H" i.e. it states clearly Who? What? Where? When? Why? and How? It is a definite outline of procedure for solving different problems related with extension programme. Bordoloi (2008) has spelt out the detailed procedure for preparation of KVK action plans which is provided here.

All SMSs/ PCs of KVK should be accustomed with preparation of their Annual Action Plan. It is often seen/felt that there is a wide gap in their achievement as compared to their targeted Action plan while preparing 'Annual Report'. Each KVK should try to reduce those gaps as far as possible.

2.12 Principles to be followed while preparing an Action Plan

1. It must be based on felt needs and interest of the clients – farmers and farm women, youths, rural entrepreneurs, extension personnel and non-government organizations in the district.
2. It must be in line with local as well as state and national needs and available resources.
3. The programme should be balanced and comprehensive in nature to include all round physical and psychological development of target groups.
4. It should be based on adequate and reliable data and a scientific elaboration and interpretation of the same.
5. It must be developed, understood, conducted and judged as an educational instrument for helping people learn how to help themselves.
6. It should be flexible but with 'back-bone' that gives stability and continuity to the plan.
7. It must be developed through joint participation of village leaders, key informants as well as Researchers/ Scientists.
8. There must be well organized mechanisms for coordination with other developmental organizations.
9. There should be provision for continuous checking and evaluation of results.
10. All mandated activities must be focused in the plan.

2.13 Guidelines to be followed in preparing Action Plans

1. Analyse previous years' Survey/ PRA reports which consists of

- Identified thrust areas.
- Prioritized needs/ problems (short/ medium/ long term).
- Major farming system/ situation of villages.

2. Decide operational villages based on Survey reports. Targeted villages need to be identified and named.
3. For "off campus" programme in operational villages, the following criteria needs consideration for organizing extension programmes.

- Accessibility of road etc.
- Existence of Community hall and other physical facilities for any activities to be organized.
- Social conflict (if any)-needs to be handled well ahead of the implementation of the programme.
- Domain of change: Literacy rate, mass media exposure, knowledge base etc.
- Distance from KVK to the location.
- Key communicators: Youth club members, other organizations, farm leaders are key communicators for facilitating actions.

- Seasonality, Venn diagram, Resource map to be thoroughly studied.
- Completed/ "on going" developmental programme (if any) in the area needs to be identified for possible linkages.

4. Analyse Follow-up reports of earlier programmes: (Training, OFT and FLD etc.)
5. Analyse previous SAC (Scientific Advisory Committee) recommendations and incorporate those in Action Plan.
6. Analyse past experiences with the targeted groups to draw lessons on successes.
7. Analyse achievement of last year's Action Plan critically (i.e. Annual report), percentage of success/ failure on different activities and reasons there of with reference to adopted village (if any), FLD/ OFT, Collaborative programme, Model farm etc.
8. Consideration of extension needs emerging at SREP as per extension reforms, new guidelines from ZPD (if any)
9. Intra organizational factor (related to KVK)

- Strength of manpower.
- HRD provision for staff.
- SWOT analysis of SMSs.
- Budget (sanctioned/ released/ official formalities).
- Infrastructural facilities.
- Transport (vehicle).
- Laboratory facilities, Farm land, Demonstration unit.

10. Collaborative programmes

- Requisition from other departments, agencies, NGOs, POs.
- Mode of collaboration sought for.
- Dovetailing with ongoing projects of other agencies.
- Mutuality, willingness, organization identity.

11. Facilitative (supporting agencies): Consider thoroughly the supports required from external agencies and assurance of timely support from input dealers, market agencies etc.
12. Chalk out possibilities of using progressive farmers (Trainee) and their farms.
13. Differentiate technologies in terms of their relevancy in Training, FLD, OFT, Consult with researchers.
14. For OFT, some points to be considered are source of technology, year of release, profitability, risk, relative cost, sustainability, farmer's safety, farming system compatibility etc.
15. Location and duration of training programme should be planned properly based on nature of topic. Do not prepare the plan hurriedly. Title and behavioural objectives of training should be clear.

16. While deciding for FLD, it is better to select the site as well as demonstrator farmers in consultation with State Department officials. Then it will not create problem to cover area as proposed. In the ATMA districts, it is essential to consult with Project Director of ATMA.
17. Technology for FLD should be Frontier one i.e. recently released. Be sure that the technology selected for demonstration is much superior to the technology already in the use.
18. All the SMSs should prepare their own Action Plan first at their level.
19. Extension activities regarding exposure visit, field day, farmers' fair, and publication of Newspaper should be discussed together with KVK functionaries.
20. Some already assigned activities/ tasks reported to a particular agency or a survey report, etc. can be clubbed with your own programme based on its feasibility to save time.
21. Each SMS should maintain their field diary regularly. It helps enormously in preparation of an Action Plan.

While planning for mandated activities like conducting Training, FLD or OFT, the following questions should be clarified before hand.

1. What is the objective? What do we want to achieve through it?
2. What criteria should be made for assessment? Say, productivity, profit, low cost, low labour requirement, etc.
3. What indicators will show whether these criteria have been made? e.g., yield in Kg/ ha. Adoption percentage etc.
4. What do we measure? What are the indicators? What essential information has to be collected? e.g. total production, number of labour used, amount spent etc.
5. How do we measure these? What techniques of observation and measurement are used? e.g. How income is measured? How seed rate is calculated, etc.?
6. How to record data? How do we keep track of what was measured, so that we can refer to it later when we want to compare and analyze results? e.g. recording in note books, using recording forms, etc.

The format of Annual Report should also be duly considered while planning for execution. Otherwise it may create problem during Annual report preparation. A draft action plan is to be prepared after taking into consideration the annual report. A thorough discussion is to be made amongst all staff. Wherever required, modifications should be done with common agreement. Afterwards, it may be finalized at KVK level and Action Plan is to be prepared as per the prescribed format from Zonal Project Directorate. Each and every table should be filled up in such a way that there is no mismatching within. A clearly defined Action Plan forms the base for programme execution. The programme execution should be coordinated with the extension service and other agencies and organizations as set forth in the plan of work.

Action Plan will be meaningful only when it is translated into Action with full commitment by the staff with proper support from concerned personnel/ agencies. This calls for well defined On-farm trials followed by demonstration and training on proven technologies.

Chapter – III

Technology Assessment and Refinement

3.1 Technology – An introduction

Technology is any systematic knowledge and action applicable to any recurrent activity. Technology involves application of science and knowledge to practical use, which enable man to live more comfortably. The Merriam-Webster dictionary offers a definition of the term: “the practical application of knowledge especially in a particular area” and “a capability given by the practical application of knowledge”.

Technology can be most broadly defined as the entities, both material and immaterial, created by the application of mental and physical effort in order to achieve some value. In agriculture, the term technology often confuses practitioners. This is because agricultural technology is a complex blend of materials, processes and knowledge. Swanson (1997) has classified agricultural technologies into two major categories:

1. Material technology, where knowledge is embodied into a technological product; and
2. Knowledge based technology, such as the technical knowledge, management skills and other processes that farmers need for better farm management and livelihood support.

KVK scientists need to have clarity over the technologies which they are assessing and refining in response to a specific problem in a specific microlocation. For example, a SMS may be assessing the efficacy of a particular management practice on a crop’s yield or growth in the KVK district. Such management practices can be broadly classified as Knowledge based technology. Alternatively, all technological products tested and demonstrated under OFT and FLD fall under material technology. Ex: Seeds, pesticides, fertilizer, farm machinery, irrigation systems etc.

3.2 Technology Development

Technology Development (also called technology innovation) is a process consisting of all the decisions and activities which a scientist does from recognition of a need/ problem with planning, testing, conducting research, verification, testing and dissemination for adoption. During the same time, some problems on the technology might get back to the scientist for solution thus resulting in refinement of the same. Thus, technology development is a continuous process. KVKs act as a crucial player in testing, adaptation and integration of proven technologies. The KVK scientists have to equip themselves for ‘technology application’ - a process which includes the above mentioned processes; thus contributing their part in the overall process of technology development.

3.3 Understanding Technology Development Process

Understanding technology development process in agriculture and its components is vital for success of KVK scientists. Technology development basically constitutes seven processes. They are:

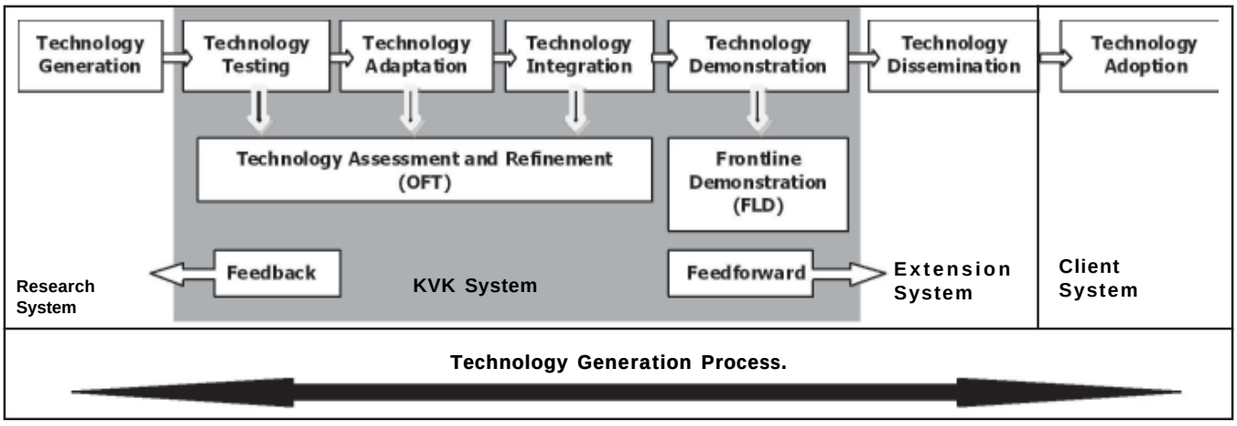
1. Technology generation
2. Technology testing
3. Technology adaptation
4. Technology integration
5. Technology demonstration
6. Technology dissemination
7. Technology adoption

Technology Assessment and Refinement

Frontline Demonstration (FLD)

Technology generation, the starting point of technology development process is mainly a function of research system. Testing, adaptation and integration processes constitute technology assessment and refinement which KVK system executes through OFTs. The feedback is passed over to research system. KVK system also involves in technology demonstration through FLDs. Feed-forward from successful OFTs and FLDs is communicated to the extension system for mass popularization in the district. Technology adoption; the final act, occurs among the members of client system i.e. farmers.

A conceptual model of technology development process in agriculture depicting the components and actors involved is explained below:



Conceptual Model of Technology Generation Process (Developed by Sajeev, M.V and V. Venkatasubramanian)

Research system generates new technologies. In Indian agriculture, research system comprises of ICAR institutes, SAUs, departments like DBT, DST, other Science and Technology Institutions and Commodity boards. NGOs, Corporate and farmer innovators also contribute to technology generation.

Extension system comprises of State departments of agriculture, animal husbandry and veterinary, fisheries, sericulture etc. SAUs, ICAR institutes, commodity boards, NGOs and Corporate sector also contribute to extension system.

Earlier, due to the primary focus on vocational training, KVKs were categorized under extension system itself. But today, with mandates being focused on assessment, refinement and demonstration of frontier technologies, the KVK system positions itself clearly between the research and extension systems thus acting both as a feedback and feedforward mechanism.

Client system comprises of the ultimate end-user i.e. the farmer. Although KVK system does assessment, refinement and demonstration of new technologies as part of technology development process, some technologies get refined or rejected even in the last stage at farmer fields. Hence, client system even though being the final actor in technology development process, plays the ultimate decisive role.

3.4 Technology Management

Technology management can be defined as the integrated planning, design, optimization, operation and control of technological products, processes and services. A better definition for KVK scientists would be "the management of the use of any technology for farmer advantage." The KVK role under technology management is very huge where-in it selects latest technologies, tests them for suitability in different micro-locations of the district and demonstrates the proven ones to farmers and extension system.

3.5 Technology Fatigue

Linkages between the laboratory and farmer fields have weakened and extension services often have little to extend by way of specific information and advice on the basis of location, time and farming system. Good quality seeds at affordable prices are in short supply and spurious pesticides and biofertilizers are being sold in the absence of effective quality control systems. Farmers have no way of getting proactive advice on land use, based on meteorological and marketing factors. No wonder the prevailing gap between potential and actual yields, even with technologies currently available, is very wide (NCF, 2007). In case of KVKs, it was found utilizing old and obsolete technologies for OFTs, FLDs and training programmes thus resulting in poor feed-forward to the extension system. A knowledge deficit as mentioned above coupled with the usage of obsolete technologies and package of practices together leads to a situation called 'technology fatigue'. Indian agriculture, particularly agriculture by resource poor farmers in rural areas is now bearing the brunt of technology fatigue. The KVK role lies in providing timely supply of proven technologies specific to various micro-locations of the district thus alleviating the technology fatigue existing in the district.

3.6 Technology Gap

Technology Gap is the gap between the level of recommendation and the extent of adoption (against recommendations).

Technology gaps are a major source of concern for extension system. The success of traditional transfer of technology (TOT) models were mainly evaluated on the basis of the extent of narrowing down in technology gaps achieved by them. KVK system being primarily focused on assessment, refinement and demonstration of new technologies, its role lies in feeding proven technologies to the main extension system. Thus, the primary focus of KVK should not be mistaken

as reduction of existing technology gaps. Rather, they are meant at alleviating "technology fatigue" by providing timely supply of proven technologies specific to various micro-locations of the district. Alleviation of technology fatigue is accomplished through processes of technology and methodology backstopping.

3.7 Technology backstopping

Backstopping refers to any precaution taken against an emergency condition. Accordingly, technology backstopping can be defined as any technology precaution taken to combat technology fatigue. In simple terms, technology backstopping is the process of making available ready to use technologies for farm families through assessment, refinement and demonstration processes in order to combat the existing/forecasted technology fatigue.

3.8 Methodology backstopping

This is a process almost similar to technology backstopping but differs with respect to the kind of technology solution offered. Instead of material technology, methodology backstopping aims at assessment, refinement and demonstration of knowledge based technologies often referred to as methodologies/package of practices. It provides detailed procedures to carry out the technology application functions by the extension personnel in the field. It includes methodologies for conducting OFT, which includes TAR, demonstrations, training, conducting surveys, impact assessment and evaluation etc.

3.9 Typology of technology passage through KVK system

KVK system has successfully established itself between the research and extension systems. Technology development process as explained earlier, invariably has assessment, refinement and demonstration components. Hence, there is a passage of technologies through various stages in a KVK system. This passage doesn't follow a uniform pattern. For example, a technology may go through assessment stage and demonstration stage but not through refinement stage. Based on the stages passed, five different typologies of technology passage can be identified for KVK system. A proper understanding of these typologies will help KVK personnel in deciding whether a particular technology will go for OFT and FLDs or both. The typologies identified by us are:

1. Source - Demonstration

In this type the technology from any source/provider directly goes to demonstration by KVK. This happens when the KVK is completely sure that the technology is fully suited for the district and can go directly for FLD. Here, the technology doesn't pass through assessment and refinement stages.

2. Source - Assessment

In this type the technology from any source/provider goes for assessment by KVK. This happens when the KVK is not sure that the technology is fully suited for different microlocations of the district. Here the technology fails at assessment stage itself and hence doesn't move to refinement or demonstration stages.

3. Source - Assessment - Refinement

This type is a variation of type 2. Here, the KVK is not sure that the technology is fully suited for different microlocations of the district. The technology goes for and succeeds in assessment but needs refinement and hence moves to refinement stage. Here, the technology fails in refinement stage and hence doesn't move to demonstration stage.

4. Source - Assessment - Demonstration

This type follows type 3. This happens when the KVK becomes sure that the technology is fully suited for different microlocations of the district. The technology fully succeeds in assessment and hence moves to demonstration stage. Here, the technology doesn't require refinement and hence move to demonstration stage.

5. Source - Assessment - Refinement - Demonstration

This type also follows type 3. This happens when the KVK becomes sure that the technology is fully suited for different microlocations of the district. The technology succeeds in assessment and refinement and moves to demonstration stage. Here, the technology is successfully refined by KVK and taken to demonstration stage i.e. FLD.

FLDs are supposed to be taken up on proven technologies only. Hence, it makes obvious that once demonstrated it will go to the extension system and client system. Rarely FLDs may fail thus preventing the technology passage. But KVKs are not supposed to demonstrate such technologies which are not fully proven. The failure of FLD can be due to some extraneous factors rather than technological factors.

3.10 Technology Assessment and Refinement

Technology Assessment and Refinement (TAR) refers to a set of procedures whose purpose is to develop recommendations for a particular agro-climatic situation/ location through assessment and refinement of recently released technology through participatory approach. It refers to the process or a set of activities before taking up new scientific information for its dissemination in a new production system. *OFTs conducted by KVKs are based on this concept and thus distinguish it from agronomic and research trials*. As detailed earlier, the process of TAR has three components. They are technology testing, technology adaptation and technology integration. TAR should be:

- Site specific
- Holistic
- Farmer participatory
- Technical solution to existing problems
- Inter-disciplinary
- Interactive

This process involves Scientist-Farmer linkage in terms of:

- Sufficient understanding of the farming situations
- Adequate perception of farmers' circumstances and their needs
- The variability of conditions on the research status as compared to farmers' fields
- Problem orientation instead of disciplinary approach

Technology assessment in agriculture by KVKs is the study and evaluation of new technologies under different micro locations. It is based on the conviction that new discoveries by the researchers are relevant for the farming systems at large, and that technological progress can never be free of implications. Also, technology assessment recognizes the fact that scientists at research stations normally are not trained field level workers themselves and accordingly ought to be very careful while passing positive judgments on the field level implications of their own, or their organization's new findings or technologies. Considering the above factors, the ICAR has envisaged On Farm Trials (OFTs) through its vast network of 562 KVKs covering almost the entire geographical area of the country.

3.11 On Farm Trials (OFT): Concept

An On-Farm Trial aims at testing a new technology or an idea in farmer's fields, under farmers' conditions and management, by using farmer's own practice as control. It should help to develop innovations consistent with farmer's circumstances, compatible with the actual farming system and corresponding to farmer's goals and preferences.

On-farm-trial is not identical to a demonstration plot, which aims at showing farmers a technology of which researchers and extension agents are sure that it works in the area. *It should be noted that OFTs are strictly to be conducted in collaborating farmer fields and not in KVK land.*

3.12 Stakeholders of On-farm Trials

There are various stakeholders in an on-farm trial. Understanding them and their roles can help KVKs to develop better OFTs. The stakeholders are:

1. The farmers who are the clients for the out-coming results,
2. The SMS who should help the farmers to overcome their problems and improve their economical situation. On farm trials can give them valuable information in this respect,
3. The Scientist who needs to apply promising on-station results under farmers' conditions before releasing the technology to the extension service,
4. The extension system and government itself, who is interested in seeing an efficient and participatory technology development model evolving, since most top-down approaches have failed miserably.

3.13 Typology of On Farm Trials

We can distinguish three types of OFTs in India according to the stakeholder who is going to take the lead role:

- **Type 1, Research driven**

  Research system designed and managed (with the assistance of extension)

- **Type 2, Extension driven**

  Extension System or KVK system designed and managed by farmers

- **Type 3, Farmer driven**

  Farmers designed and managed, with the assistance of Extension system/KVK system.

3.13.1 Research Driven

Rationale

Research has shown promising results in on station trials. Now the concerned researcher wants to evaluate the new technology in multi location as the on station trial does not represent the wide range of conditions (e.g. soil fertility, weed flora, altitude, rainfall, farmers' conditions).

Objective

Assess the performance of the new technology under various conditions and test the acceptability by farmers.

Particular characteristics

The trial is usually planned in advance and included in the annual work-plan of either research or extension. Objective and layout of the trial is thoroughly discussed by the researcher with the Institute/Division head and the respective extension agency. Here,

a. Extension agency involved helps to locate suitable fields.
b. Usually plots are of small size.
c. Researchers design and manage the trials with the help of extension agencies.
d. If necessary, researchers furnish inputs and may exceptionally hire labour.
e. Trials are used for the purpose of field day.

Outputs

Information on the performance of new technology under various conditions; information on the acceptability by farmers and interesting positive results are published in various journals.

3.13.2 Extension Driven

Extension driven OFTs should not be confused as to only extension system managed. The OFTs by KVKs also fall under this type since the whole purpose of OFTs by KVKs is to give feed-forward to the extension system.

Rationale

Type 1 trials have confirmed that the new technology will work in farmers' conditions; therefore SMS plan to implement the trial on a wider scale with active involvement of the farmers. Researchers are interested in getting the information on both biophysical and farmers' assessment of the technology. KVK and SMS have developed their own ideas on how to improve aspects of the new technology. They want to try it out in real farm situation.

Objectives

a. Assess the biophysical performance of a new technology in a wide range of micro-locations within the district.
b. Obtain the farmers viewpoint about the technology.
c. Assess cost/benefit ratio.

Particular Characteristics

a. Interest of farmer having the trial on his land must be ascertained. Objective must be very well understood by farmers,
b. SMS discuss their ideas with PC and researchers.
c. SMS determines on the design and provides instruction.
d. Plots are often larger than in type 1.
e. Farmers' assessment of the result is essential.
f. Scope for refinement after assessment .
g. Feed back of the results to research system and
h. Feedforward of successful technologies to extension system.

Outputs

a. Farmers' reaction on technology, on management requirement and economical sustainability of the technology.
b. Feedback for the design of new future trials and
c. Compilation of a large number of similar trials giving fairly reliable data on performance over a broad range of farm types and circumstances.

3.13.3 Farmer Driven

Toughest of all types, yet the most sought after one. It involves Participatory Technology Development thus contributing to sustainability of results. The KVKs are also expected to bring their OFTs to this level from being an extension driven one at present.

Rationale

a. Farmers are aware of a given technology, they like what they see and would like to experiment it by themselves.
b. Farmers are aware of a problem and would try some methods to solve them and
c. Researchers want to know to which extent and how a technology is adapted by farmers.

Objectives

a. To study how farmers adapt and adopt technologies,
b. To investigate what factors affect the performance of technology.
c. Provide on station researchers with feed back on problems at farm level and provide new research issues and
d. Participatory technology development.

Particular Characteristics

a. Farmers identify problems and choose from menu of technologies.
b. Farmers decide to choose the technologies and modify them to fit their particular farming system. Control plots are not really necessary unless the farmer decides to have one.
c. High level of participation and self mobilization.
d. Feed back of the results to research and other interested entities.
e. Feedforward to other farmers.

Outputs

a. SMS document the farmers' decisions, preference and the management strategies.
b. Information is collected on the uptake of the new technology by fellow farmers.
c. Feedback to researchers on technology performance and on further research needs.

Points to consider

a. It is not wise to force collection of the biophysical data (yield, climate, and soil fertility) in type 3 because of too many confusing factors.
b. Constant monitoring, recording of farmers' comments is necessary.
c. Encourage farmer to take some notes himself (inputs, yield etc.)

d. Self-diffusion of the technology needs to be monitored (e.g. seed distributed to neighbours, area expansion etc) and

e. Socio-economic data should be collected.

3.14 Principles of conducting OFTs

KVKs have to spend considerable time and efforts in planning and implementing OFTs. The basic principles of conducting OFTs are never to be ignored in this process. The principles are:

1. Define a clear question you would like to have an answer for

Narrow your trial down to its simplest form; define a clear simple question to which the OFT should give an answer.

2. Keep it simple

Limit your trial to a comparison of two (or maximum three) treatments.

3. Go step by step

Farmers usually do not adopt entire new systems of production; they go step-by-step adapting components of the technology. Therefore the OFT should not include too many new steps/practices at once.

4. Seek help

When the problem is clear and the idea on how to go about the trial has evolved, the SMS should contact a competent researcher to discuss the plan of the OFT. He can also take help from other SMS and PC of the KVK.

5. Replicate and randomize

Plan on enough field space (in farmers' field) to do more than one strip of each treatment being tested. Mix treatments within blocks.

6. Stay uniform

Treat all the plots exactly the same except for the differing treatments. If possible, locate your experiment in a field of uniform soil type (slope, fertility etc.).

7. Harvest individual plots

Record data from each individual plot separately. Do not club all treatment types together or you'll lose the value of replication.

8. Remain objective

The results may not turn out as you expected or planned. Be prepared to accept and learn from negative results. Negative results show that the technology under testing is not suitable in the present form for the specific microlocation of the district. Such results are hence equally valuable for the benefit of farming systems at large.

9. Manage your time wisely

Expect to devote extra time to your OFT during busy seasons. Make sure you can carry out your trial even though you are busy, or get extra help from other SMS.

3.15 Points to be considered in conducting On Farm Trials by KVKs

- OFTs are being replicated under different farming situations in various microlocations of the district with suitable numbers of treatments.
- Results are being obtained on different parameters both quantitative and qualitative jointly by SMS and farmers.
- Suitable options based on qualitative and quantitative results under the farmers' perspective with their own perceptions would be suggested from the available alternatives.
- Sustainability under farmers' socio-economic, agro-ecological and infrastructural situations are the major criteria for the final recommendations regarding suitability of technology tested.
- The results and the variations from the research station recommendations are to be communicated back to the research system after further refinement in technology on the specific parameters.
- Technologies which failed in assessment stage itself or after refinement too have to be communicated back to research system as not suitable for the district. This will prevent duplication of assessment efforts and prevent loss to farmer community in the district.

3.16 Broad steps in conducting OFTs

The process of On Farm Trial broadly has five steps. They are:

1. Diagnosis
2. Planning
3. Conducting
4. Assessment and
5. Extrapolation/Diffusion.

3.16.1 Diagnosis

The diagnosis involves collection and analysis of information by concerned SMS to design an OFT. In this step, a study of farmers' circumstances and practices are made in order to :

- Understand the farming systems prevailing in the district and system interactions.
- Identify existing/possible productivity problems.
- Begin to develop hypothesis on possible solutions.

Farmers' circumstances include :

a. Agro-climatic circumstances

- Climate and weather conditions.

- Soil and topography.
- Pests, weeds, diseases etc.

b. Socio-economic factors

- Institution (Credit).
- Markets (Inputs and Products).
- Income and Land holding.
- Farmers' own resources (Family labour) etc.

KVKs identify the farming systems/ system interactions through the following sources/methods:

- Secondary data/ sources.
- PRA methods to be exercised by SMS in collaboration with local people.
- Interview with local officials/ opinion leaders.
- Informal farm surveys.
- Farmers' interview using structured/ semi-structured schedules and
- Field observations.

3.16.2 Planning

The planning step in an on-farm trial includes listing of problems, ranking problems in terms of severity, importance and frequency and identifies causes of problems and list possible solutions to well defined problems and screen possible solutions for feasibility. There are various types of on-farm trials like small-plot researcher managed trials for defining problems; level trials or determinative trials for finding profitable practices and input levels; and trials for verification of previous results.

While identifying the solutions from on-farm trial, one should note that the technology will have Profitability and Compatibility with the existing farming systems, reduces risk, and ease of testing for farmers. The assessment of trials is made based on agronomic sense of trial results, statistical significance, economic analysis, and ability to solve the problem-cause and solution developed during diagnosis. The results of trial are extrapolated for defined groups of farmers in specific micro-locations of the district.

Planning involves :

1. Listing problems
2. Ranking Problems
3. Identifying causes of problems and
4. Listing possible solutions

Problems should be ranked so that higher priority problems can be clearly distinguished from lower priority problems. KVK scientists should aim to focus on those problems which, if solved, would lead to a significant benefit to farmers.

Prioritization/ ranking is done with scores based on the following criteria

1. Problems that cause a large productivity loss
2. Problems that occur frequently
3. Problems that affects majority farmers
4. Problems affecting major cultivated crops

Identifying the causes of problems

If the causes of a problem are not understood properly, SMS may waste time and resources on inappropriate solutions. Understanding the root causes of a particular problem would help to get proper solutions which could make timely detection and correction of defects.

Listing possible solutions

KVK scientists have to list possible solutions to well defined problems, whose causes are fairly well understood. At this stage, SMS lists any possible solution that seems to them. The least feasible ones are later screened out.

Solutions are based on :

1. Probability that the technology will function
2. Profitability of the technology
3. Compatibility with the existing farming situation/ systems
4. Contribution to reducing risks and
5. Ease of testing for farmers

3.16.3 Conducting

OFTs are conducted in the fields of representative farmers and to evaluate the selected small numbers of experimental variables in participation with the local people/ farmers.
While conducting OFTs, SMS can

1. Explore production problems
2. Test possible solutions
3. Verify recommendations and
4. Demonstrate them with farmers

3.16.4 Assessment

The results of OFTs are analyzed carefully. The analysis require assessment of :

1. Farmers' reactions and opinions
2. Agronomic interpretation/ feasibility
3. Statistical significance
4. Economic analysis/ profitability and
5. Ability to solve the problems - cause and solution developed during diagnosis.

The following technological attributes are considered while assessing the results in OFTs compared to the existing local ones.

1. Profitability
2. Risks
3. Relative costs
4. Simplicity
5. Sustainability
6. Farmers safety and
7. Farming system compatibility

The results are assessed based on the above technological attributes. After assessment, a technology may be recommended for FLD directly if found fully suitable for the microlocation of the district. In many cases, the technology after assessment may be found totally unsuitable for the district. Or the SMS will find that by little refinement the technology can be made suitable for the microlocation. In such cases, the technology after assessment will go again for refinement in farmer field in the next season. After successful refinement the technology can be taken up for frontline demonstrations. If a technology fails in refinement stage, then it is not to be recommended for the extension system or for FLDs by KVK itself. But the results have to be communicated to research system without fail.

3.16.5 Extrapolation/Dissemination

When SMSs are convinced and satisfied with the results/outcome out of OFTs, they formulate recommendations for demonstrations (FLD) on a larger area in the farmers' fields so as to popularize the technology amongst farming communities and to give feed-forward to extension system. The KVKs ensure that :

1. Extension agents participate in the trial and demonstration process (to transfer recommendations to farmers with skills and confidence) and
2. Farmers involvement in the demonstration process (to participate effectively in the diffusion of new technologies).

3.17 Practicalities of OFTs: Step by step guidelines

Crops, animals and their environments are highly complex systems with a multitude of variables that change from location to location in any district of India. Due to this complexity, practices optimized

for a research station might not be so successful when transferred to farmer field. Though the new location anywhere in KVK district may appear similar to that of research station, there may be an undefined key limitation or combination of minor but different limitations that constrain potential production. In many cases, carrying out a small-scale OFT, actually at the new location, will lead to an optimal local farming practice more rapidly than trying additional sub-treatments at the research station.

This section is concerned with the practicalities of OFTs. Here, we clarify the following issues which every SMS should be thorough with:

1. When an OFT is needed?
2. The benefits and traps of OFTs,
3. The most appropriate types of OFTs,
4. General concepts underlying OFTs,
5. Basic designs of OFTs,
6. Methods of data collection and sample data and
7. Interpreting OFT data to improve existing farming systems.

There should be stimulation of ideas and every SMS can incorporate his/her own ones. The OFTs will need to be adapted significantly to match the requirements of the location.

3.17.1 When are OFTs needed?

OFTs are needed when one or more of the following situations exist in the district.

1. When practices recommended by the research stations and extension system are not being followed in the district;
2. When practices recommended by the research stations and extension system are being followed, but yields/results remain low in the district;
3. When a district has locations that has special attributes which do not fit the general pattern. Eg: the location may be hilly, steep-sided valleys, rocky surfaces, perhaps with more moisture or more salinity; and
4. When particular microlocations are less productive than neighbouring ones in same/ neighbouring districts despite best efforts by farmers.

3.17.2 Elements of a good OFT

A good OFT is supposed to have the following elements:

1. A question based on a clearly identified problem and hopefully a solution;
2. A hypothesis, which is your expected outcome of the OFT;
3. Treatments, that is, variations to the normal procedure;

4. A control, which is what the farmer normally does. This control must always be included to compare or check against any treatment;
5. A design, that is, where treatments are positioned in the field and in relation to each other- the design is very important and may be the difference between obtaining an answer or not;
6. A method, that is, the steps taken to get the answer to the question; and
7. Measurement and recording of effects by counting, linear or volume assessment, or weighing - these give the trial objectivity and show how big the effects are.
8. Recording the weather data during the study is also very important.

Weather changes every season and may affect how well the treatment works. For example, the effect of added fertilizer will be very different depending on the timing and amount of rainfall. Having weather information helps to put the trial into the context of other years.

An OFT that is not carried out properly is often worthless. It may seem to give an answer though the answer may in fact be quite wrong. If forward planning or changed farming practice is based on that wrong answer, the farmer could lose income on future crops.

Every KVK SMS should keep in mind that "*No OFT is preferable to a bad OFT*".

3.17.3 Some benefits of OFTs

There are various benefits of conducting OFTs. These are for both the KVK, SMS, farmers and any other stakeholders.

1. The OFT may show how to increase economic returns by a changed practice that increases yield. The change could be quite minor and cost little;
2. The OFT may show how to reduce costs by reducing the use of fertilizer, machinery, labour or water without loss in yield;
3. In the long-term there may be indirect benefits of any changed technology that improves sustainability. An example might be of lime application which raises pH in the topsoil this season, thereby releasing previously bound nutrients, improving nitrogen fixation, flocculating clays and increasing earthworm populations over time leading to better incorporation of surface organic matter, improved aeration, better drainage, and finally, higher yield;
4. Unexpected positive things may be discovered about the farm because the farmer has been thinking about it differently and observing it more closely and critically;
5. There is close interaction between the SMS and the farming community as they work together. The farmer learns trial methods and concepts from the SMS and the SMS learns more about the local cropping systems and about limitations other than the technological ones;
6. Fellow farmers will be interested in the trial, will be doubtless and also give their opinions, may even join in and will be the first to adopt and then adapt the refined technology if it works.

3.17.4 Some problems in conduct of OFTs

Associated with the benefits explained above, there may be the possibility of various problems in conduct of OFT by KVKs. The most important ones among them are given here.

1. The trial land will be out of normal use during the OFT, so normal production from farm may not be achieved. Including the trial as part of the farm's normal cropping pattern and keeping the trial small and manageable can minimize this cost and make farmers' accept OFTs to be conducted on their farm;
2. The yield from the trial could be appreciably lower than normal yield, even perhaps a total loss. SMS should foresee whether the farmer in question can afford that risk or not;
3. Extra inputs will be a cost, items like fertilizers, labour, machinery and perhaps most importantly, time and
4. There may be a personal and social cost of possible failure on the farmer i.e. the family and friends. Expectations of the OFT should be moderate, not exaggerated. It is always better for KVK SMS to undersell expectations.

3.17.5 Designing of OFTs

The most important points to be taken care while designing an OFT are outlined below.

1. Do not plan too big an OFT, discuss demands on the farms' resources and time as well as your own, aim to complete the study in full. Be realistic;
2. Have a well-defined problem that can be clearly understood by farmers and answered by your approach;
3. If a factor other than the main one appears to be strongly influencing the answer, then formulate with the farmer a subsidiary question by adding sub-treatments, however;
4. Do not add so many sub-treatments that the farmer is lost in the complexity of your OFT;
5. Do not use fancy statistics to confuse yourself and collaborating farmers. Do not be misled by averages. Examine the detail in the data to assess the trends and the significance of any 'external factors'.

3.17.6 Selecting collaborating farmers

Thorough discussions have to be made with the collaborating farmers before start of OFT. The purpose of OFT has to be made clear to the farmer without any scope for doubt. Try to select farmers who have risk bearing ability. Also, the collaborating farmer should have good rapport with other farmers. This will help free interaction of the neighbouring farmers with him thus spreading the message. Also try to avoid 'people biases' wherein the SMS tends to select an influential farmer with lot of land and resources under him. It is easy to conduct OFT under such influential farmers. But, many a times this prevents other interested farmers from interacting with the elite farmer and SMS. This also creates an image of 'inaccessibility' upon the KVK among the villagers.

3.17.7 Selecting OFT plot from farmer field

Many farmer fields have good and less good parts and there are often gradients between the two. Explain to the farmer that if bits of the different parts can be included as sub-trials without jeopardizing the main trial carried out on the dominant land type, the trial will probably provide much more information. However, exclude the areas that are very unrepresentative of the whole field, or unimportant. Also make sure that the OFT plot is easily accessible for all farmers of the village and for the KVK also. This will facilitate easy organizing of farmers' day, field visits etc.

3.17.8 Understanding the OFT plot

The SMS should start discussions about the farm itself by trying to define with farmers the extent of the available growing season. This can be an introduction to thinking about the interplay of the environment and any varieties used. Explain to the farmer that knowing the growing season is important for using any cropping area to its full, achieving sustainable potential, particularly in a rainfed environment.

The critical factors are: how long is the microlocation environment warm enough, moist enough and sunny enough to start and support the growth of the crop; and to what extent can different varieties and management approaches alter the length of the season.

If available, long-term weather records for the district should be collected. This will be useful for calculating the average starting and finishing dates for the area and to illustrate the discussion.

Discuss with collaborating farmers about what they see as the main limitations to the growing season. Its length is likely to be limited by a cold season such as winter and by the start and end of the rainfall period.

Pre-OFT discussions by SMS with collaborating farmers

It can also be affected by sudden catastrophic weather events. There are other catastrophic risks like insects and some diseases that are more likely to occur at specific times in the year and may limit the crop season. If such events occur every year in the district microlocation, they should be avoided by having the crops at stages that are not damaged during these events. In some perennially

warm, damp areas, both starting and finishing dates may be largely under the farmers' control, but in all areas farmers can have a degree of control over season length either through farm management or choice of crop.

3.17.9 Understanding the growing season

The SMS has to make an exclusive effort to understand the growing season. While doing so, the following questions have to be considered which are vital for the success of OFTs. (These questions are in general and will vary depending on crops and technologies tested).

1. Could local crops yield better if sown earlier or later? Why?
2. Are crops maturing fully or are they drying off before their grain is completely filled?
3. Are local temperatures too high or too low at any stage for any of the crops? When?
4. Is there sufficient water available at the right times for the crops? When is it limiting?
5. Is it possible to modify soil structure to enable crops to use the full potential growing season?
6. Is it possible to grow one crop species after another, perhaps using shorter duration varieties, to make more productive use of the potential growing season?

These questions are intended to lead to the conclusion that two main factors determining the potential growing season are the environment and how well the plant material chosen matches the environment. A third all-important factor combining the first two together is the farmer's management of the crop. The OFT activities must be accurately timed around the changes occurring in the environment and in the crop.

3.17.10 Understanding normal operation timings

The normal operation timings of farmers vary even within the district. Hence the SMS has to make sure the following aspects.

1. Is the selected land ready for planting at the start of the season?
2. Is the land too dry or too wet to allow the crop to be planted at the optimal time? Can a change in tillage or planting methods overcome the problem?
3. Are previous crop residues causing delays? Can they be better managed in advance, removed or incorporated or used for mulch?
4. Was the previous crop harvested in time to allow planting of the current crop at the optimum date or should a shorter duration variety have been used?
5. Was the previous crop harvested early to take advantage of the best market price? Would the current crop yield be more if planted early?

3.17.11 Understanding farming efficiency of collaborating farmer

The efficiency with which the farmer previously managed his crop growth activities is also an indicator to the success of present OFT. Some questions for which answers have to be found include:

1. Are fertilizers and irrigation, where available, being applied at the most beneficial time for the crop and are they used efficiently in his/her field?
2. Are pests, diseases and weeds being controlled at the right time and effectively? Could the outcome of present trial be achieved by using less effort or fewer chemicals in smaller amounts?
3. Is machinery available when needed?

Finding out which, and to what extent, these environmental, crop variety and management factors have an impact on the best use of the growing season is the first reason for above questions regarding farmer field.

The second reason for such questions is to test ideas to overcome the constraints to production that have been already identified. Debating the above mentioned questions will improve knowledge of the SMS and the farmers' awareness of local limitations. Hopefully, in discussions SMS will identify the key constraints to productivity on the farm and can debate ways through which the constraints might be overcome. These possible solutions could become the treatments in an OFT.

Design OFT by including possible solutions as treatments. It may take several meetings before the OFT is finalized to the satisfaction of all actors involved but it can be a highly profitable utilization of time for both SMS and the concerned farmers. Throughout, encourage the free-flow of ideas from farmers. Do not dominate these interactions with your scientific theoretical knowledge.

3.17.12 Selecting technologies for OFTs

The KVKs should take utmost care in selecting technologies for OFTs. If the OFT is planned as a simple varietal assessment then, it should be made sure that the variety is newly released. The SMS should take care that the variety is not more than 5 years old. The KVK should always try to assess and refine latest technologies so as to prevent and alleviate technology fatigue in the district. An old variety or technology will become part of an OFT only if the trial is meant for anything else than varietal trial. Eg: testing efficacy of a particular management practice to improve yield of a popular/ ruling variety. But, it should be noted that there is no point in wasting resources for an OFT to assess and refine the management practices of a 20 years old variety. If the trial is about comparing varieties, discuss with the farmer which new variety to include and why. Talk about their pest and disease resistance, lodging tolerance including propensity for tillering, fertilizer and water requirements, grain quality and yield, and likely crop duration from different planting dates.

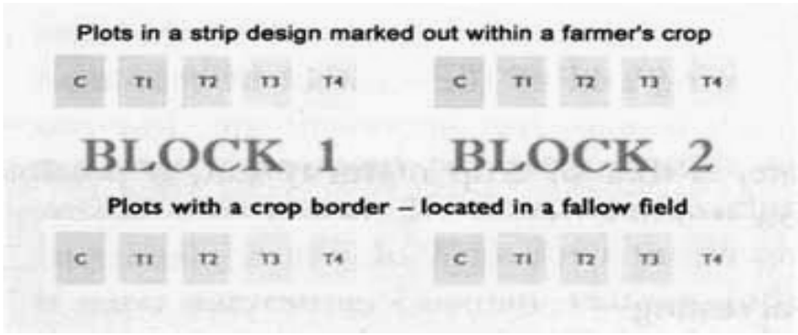
The same applies in testing of other material technologies. Highly successful pesticides, agricultural implements, hybrid seeds etc which are already cultivated by farmers of the district should be never taken up for OFTs. Some KVKs are even found to have attempted to assess and refine management practices of various local varieties. The KVKs should find a more remunerative technological option than assessing and refining local varieties. It should be also noted that the B:C ratio of any assessed technology should be far superior to that of farmer practice so as to advocate the same to them in future. A marginal increase in incomes is not worth advocating as far as replacing ruling technologies are concerned.

3.17.13 Designing OFT plots

If practicable, use a strip design for the OFT. This is the simplest possible form of design that farmers will readily understand. It is a rectangular strip a few meters wide, marked out within a normal farm crop. The treatments are applied in bands along the strip like the stripes across a scarf, and replicated as blocks at intervals.

This design is appropriate for simple trials like checking for fertilizer response of a crop whereas a research layout is better if there are many variables and sub-treatments.

Strip plot positions marked out in a farmer's crop and in a fallow field. Controls (C) and treatments (T_1-T_4) are repeated in two blocks. Harvest areas are the edged squares around the treatment letters.



(Figure courtesy: FAO, 2004)

Plot size

There is no hard and fast rule as to what the size of OFT plot should be. The answer is that it depends on the technology or methodology tested and hence becomes the discretion of the SMS concerned.

Plot size always depends on the technology under testing but larger is usually better in case of crops. Also, explain to farmers why observations and measurements should only be on plants towards the central part of treatment plots, avoiding the outer rows that are subject to 'edge effects'. Plants at the edges of experimental plots have more water, light, and nutrients available to them than the plants within the plots so they often yield better than the norm. These 'edge effects' are naturally offsetted if a clean cultivated border surrounds the plot. So the SMS should consider convincing the farmer in surrounding the OFT plot with a border of additional crop if it is not already located within a crop.

Examples of the two approaches are shown in the above diagram. Plot size, therefore, depends on balancing the need to eliminate edge effects against using bigger plots that may make the trial more costly and harder to maintain.

Control plot and treatment plots

There will always be a control plot (C in the diagram), which is the plot planted with the usual variety and with normal farm practice applied. Additionally, there can be at least one treatment plot, if a main variation to normal practice is also tested along-with. Agronomic trials usually have several treatments that represent degrees of variation to normal practice. It is better to avoid so many treatments in an OFT.

Plot layouts

In a strip design of the above-mentioned OFT the treatments could be applied end to end along the strip. Plots can be of any width within the strip as long as they are wide enough to permit the cutting of at least one harvest in their centre plus a wide enough border of plants around the harvest areas to avoid fertilizer interference from adjacent plots (wash on, root exploration, etc.). The harvest areas are shown as edged squares in the illustration.

If the OFT question is more complex involving two or more interacting factors, like 'What is the best variety by sowing date for the particular microlocation of the district?', requiring three varieties and three sowing dates, a conventional research design is generally required.

Plot locations

Locate the OFT plot in an uniform average area that typifies the farm or field. Avoid areas that are likely to be useless for cropping or are in some way abnormal. If the field has small outstandingly good or substandard parts, also exclude these extreme types from the main trial. You could consider

Plot locations

adding them as sub-trials. Explain to the farmer that responses on the extreme parts will not apply to the farm in general, but could provide useful secondary information about the farm.

The trial plots should preferably be within the normal crop. Mark the locations and dimensions of each plot clearly right from the outset and label the treatments. The demarcating sticks/poles should be clearly visible. White and yellow colours work well for sticks.

3.17.14 Cultivation in OFT plots

The trial plots should be cultivated at the same time and in the same way as the normal crop and as part of the normal crop preparation. There are two exceptions. If the trial is about cultivation methods obviously there will be differences. If the sowing date is a variable, plots for each sowing date must be cultivated and otherwise prepared separately, each at a similar period in advance of its sowing date. This complicates the study because of the need to get machinery to small plots past other plots and through the normal crop.

3.17.15 Observations in OFT plots

For example if the OFT is a simple varietal trial, the following normal observations are to be made.

Seedling emergence

Variable results in trials start with variable plant stands due to uneven cultivation and problems during sowing. These problems are unavoidable in some cases, but if they are noted or measured, their influence on the final data can be allowed for.

Ten days to three weeks after planting, when all seedlings are emerged, lay a meter-long measuring stick next to the row and count the number of seedlings along its length. Do this for one sample in every plot. Note down all the numbers with their plot identifier and determine how homogeneous the seedling density among plots is. Is one treatment poorer than others? If the seeds have been broadcast, put down four sticks of one meter to form a meter square and count seedlings inside the square. A larger or smaller area can be enclosed but its size should be known and the same area enclosed for each plot. If preferred, the meter square approach can also be used in crops that are precision sown in rows by machine.

Flowering

Flowering is a most critical time for the crop, both in terms of the crop's sensitivity to the environment and because flowering marks the beginning of the grain filling phase. For each plot make a record of the date of flowering and of the weather at that time. A useful, though less important and less precise date, is that of crop maturity but, if possible, note it down also.

Harvesting

The common question in trials is, "How will the treatment affect final yield?" So the final yield must be measured accurately and in an unbiased manner.

Here are some basic rules regarding harvesting which a SMS can follow and discuss with farmers too:

1. Don't leave plants in the field after they are ripe while waiting for the next treatment to be ready. Any unexpected event may occur and the ripe treatment will be lost to birds, mice, rain, wind or straying cattle;

2. Use the same method for harvesting all plots. Do not harvest some by machine and others by hand;
3. If a small combined harvester is available, first trim away plot edge rows or borders and then harvest the remainder, plot by plot, collecting the grain (and trash) of each plot separately. The area harvested should be identical for all plots and must be a known area. If it cannot be identical because of driver errors or other factors, then measure and write down the areas actually harvested;
4. If harvesting by hand, ignore edge rows. Do not select individual plants in plots. Use the measuring stick or meter square quadrat to indicate a meter of crop row or crop area to harvest from the central part in each plot. Avoid parts of centre rows that you know established poorly from earlier observations and notes. In general, do not include in the sample sections that have been positively or negatively affected by something other than the treatment;
5. Cut off the plants at ground level but do not include any soil;
6. Tie up and clearly mark the plot sample with its plot identification, block, treatment, and harvest date. Bag if possible so that parts are not lost;
7. Keep the samples together in a vermin proof area;
8. A main source of error in assessing biological and grain yield is that the amount of moisture in samples may differ between treatments. Dry the samples together in the hot sun, a hot greenhouse, a plastic house or in an oven.


Harvesting in OFT plots

Measuring the results

- Weigh the dried samples. Weigh in the bags if the bags are uniform weight and then subtract the bag weight from the total. Write the numbers down;
- If samples are hand harvested, thresh and weigh the grain. If they are machine harvested, just weigh. Write down the weight;
- If hand harvested, calculate Harvest Index (HI) by dividing the weight of the threshed grain by the weight of the whole sample. The result will commonly be between 0.25 and 0.55. If machine harvesting, divide the weight of the threshed grain by the sum of the trash and grain weights.

Recording the weather on the farm

If the KVK is collaborating with literate and resourceful farmers, and there is no weather station close by, think seriously about the possibility of recording temperature and rainfall on the farm. Temperature should be recorded regularly and calculate mean temperatures. All are needed to interpret why a crop yielded well or poorly and matured early or late, and to plan changes in management for future years.

Recording weather in farm

Preferably the farmer should be made to use a maximum and minimum thermometer hung in a flat-sided box painted white or in the shade. Explain how it is used, especially the need to reset it after reading. It is best to read and reset it at least once a week, preferably on the same day each week, and all the year round. The amount of rainfall and its seasonal distribution will be an indicator of both potential yield for the farm and the variability of potential between years. It will also enable the farmer to work out water use efficiency. If available, use a standard rain gauge to collect rain. Otherwise use a large straight-sided can and measure by dipping a ruler into the water. If rainfall is very low, the water should be tipped into another much smaller can, calibrated to the large can, for measurement. Once in a week measure and then discard accumulated rainfall, preferably on the same day each week. Locate the measuring devices in the OFT plot away from buildings, poly houses, shade nets or overhanging tree branches.

Using long-term weather information

Ask collaborating farmers to assess from long-term weather data, if available, how much water is available in the average season, and how much rainfall varies among years. Explain that a crop needs a certain amount of water during its growth to reach its potential. If that water is not available when needed, yield will be lower than potential. A shorter duration variety might be more appropriate for the area as that will require less water but it may also have lower potential yield.

3.17.16 Record Keeping

Records must be collected and set out in a structured way following patterns determined largely before the trial begins. Structured data and worksheets lead to clear and structured thinking. Haphazard trials with haphazard observations and recording are generally worthless. Discuss and

design the worksheets with collaborating farmers before the trial starts. Provide them with hard copies of the final design in a workbook produced for the specific trial. Encourage them to use the workbook for all data and notes.

Some rules for recording data

1. Make observations immediately after specific events. Don't postpone;
2. Do not write important observations on scraps of paper. There is a sure chance in missing them;
3. Dedicate one workbook or worksheet to one OFT. Never use a diary that mixes experimental data with appointments and other details;
4. Enter observations collected on various dates in sequential date order. Avoid mixing up dates in the workbook;
5. Always label data with its plot identifier and date. What seems obvious today will be confusing next month;
6. Organize data in tables (with rows and columns) so comparisons between replicates or treatments can be made by eye;
7. Avoid long, single columns of data;
8. Keep a standard design for tables;
9. Enter the data as it is collected straight into tables so that they can be easily summarized as totals or means at the bottoms of columns and the ends of rows. Rewriting data copied from scraps of paper, sample bags or distributed notes in a workbook can be very time consuming and prone to mistakes.

3.17.17 Analyzing and discussing OFT results

One mistake usually committed by most KVKs is of not discussing the final results of the OFT with collaborating and neighbouring farmers. This often creates a bad impression about the KVK and prevents future collaborations. Further, the purpose of conducting OFT itself is defeated in such cases since the results are meant for the improvement of the existing production practices and farming systems at large.

When SMS discuss with collaborating farmers about the trial results do it in such a way that the numbers discussed are paralleled with a mental picture of the crop. Stick initially to raw data and simple averages and trends. Otherwise the farmer may be unable to comprehend the whole story of the trial.

Get the farmers to think about why a particular trial has done better or worse. Debate its state of weediness, whether it was wetter, whether a carcass of an animal was left there a few years ago and so on. Use the farmer's knowledge and notes in the workbook to involve him/her in the numbers and guide him/her to do the interpretation. The farmer's confidence and enthusiasm will grow rapidly. This will build up a much more reliable picture of what the OFT means than a

statistical analysis. If appropriate, use that analysis yourself to substantiate the farmer's interpretation and if you decide to publish the results of the OFT.

Follow-up these discussions about interpreting the data taking into consideration what these interpretations mean to future practices on the farm. Always link the data back to practicalities. As the discussions proceed, get the literate farmers to note down the conclusions, but make your own notes. Consider follow-up study with an on-farm field day to involve other local farmers in the results. Encourage them to air their views on the weaknesses and strengths of the technology tested and to suggest ideas for future collaborative OFTs.

3.17.18 Reporting OFT results

Reporting OFT results is a crucial point in KVK activity. The stakeholders are very much interested to see how the technology responded to various microclimates. The results have to be reported to the zonal level and from there it gets compiled at the national level. The common format for reporting OFTs is given below with an example. The below mentioned 16 points has to be clearly observed and reported without any scope for vagueness.

Crop/ enterprise	**Farming situation**	**Problem Diagnosed**	**Title of OFT**	**No. of trials***
1	2	3	4	5
Rice	Rain fed low lands with farmers thriving on Rice farming system.	Water stagnation due to flash floods	Assessing Submergence tolerance of variety 'Jalkunwari' in XXX district	5
Technology Assessed	**Parameters of assessment**	**Data on the parameter**	**Results of assessment**	**Feedback from the farmer**
6	7	8	9	10
Rice cv Jalkunwari against local var. Joha	Period of submergence	8 – 10 days	Jalkunwari shows submergence tolerance of 8-12 days in various locations of the district. Thus it withstands the average submergence period of 8-10 days.	Enthusiastic of the performance of Jalkunwari which thrives under periodic submergence under flash flood; want to learn other management practices.
	Plant population	33/sq m		
	Rice yield	22.9 q/ha (Jalkunwari) & 15.6 (local Joha)		
Any refinement done	**Justification for refinement**	**Technology Assessed / Refined**	***Production per unit**	**Net Return (Profit) in Rs. / unit**
11	12	13	14	15
No	Not Applicable	Farmer's practice (Local Var)	15.6 q	NA
		Technology assessed (Jalkunwari)	22.9 q	11,622.00
		Technology refined	NA	NA
BC Ratio				
16				
1.74				

3.17.19 Publishing OFT results

Most KVKs retain OFT results with them without proper publicity. At the most, these results get published in the KVK annual reports and corresponding ZPD annual reports. The KVKs are afraid that results from on-farm trials may not be acceptable to scientific journals because of statistical considerations. But properly planned and conducted OFTs will have supporting data recorded by the concerned SMS. In the interest of the large scientific community, utmost efforts are to be made to publish OFT results. This will also help to prevent duplication of trials in similar microlocations or can also facilitate similar trials on same technology in other parts of the country. The results should also go as popular articles in local language newspapers and magazines thus spreading the timely message leading to alleviation of technology fatigue.

3.18 Examples of meaningful OFTs

In this section we present some model OFTs which KVKs can compare with their ones. These examples are based on successful OFTs conducted by KVKs under Zone – III. The examples vary from those in crop production to fisheries, animal production and management etc.

OFT: 1 Testing effect of 'CIFAX' in control of Epizootic Ulcerative Syndrome (EUS) in fishes (OFT aimed at assessment)

The KVK falls under the Mid Tropical Plain Zone where fish farming system is an important contributor to rural livelihood. The fish farmers were plagued with problem of low yield due to fish diseases. The KVK identified the problem as Epizootic Ulcerative Syndrome (EUS) which the farmers were unaware of. The EUS had lead to significant decline in fish yield.

The KVK formulated an OFT for testing effect of 'CIFAX' in control of Epizootic Ulcerative Syndrome (EUS) fish diseases and increase in fish production. The problem was clearly identified and the technology selected was never assessed in the district previously. The technology CIFAX (formulated chemical medicine) was assessed in farmer ponds. The trial had 10 ponds with same treatment in different microlocations of the district with one control pond at every location. As a supplementary measure, distribution of leaflets among the fish farmers was done in the district along with conduction of group discussions and trainings for fish farmers.

The assessment of the new technology 'CIFAX' proved that the Epizootic Ulcerative Syndrome (EUS) fish diseases could be fully controlled and this has lead to a significant increase in fish production. This meant increased income for fish farmers in place of constant loss due to fish diseases.

Lessons for other KVKs:

1. The KVK in the story clearly identified the actual problem
2. The problem was significant for a large number of farmers
3. The KVK identified the clear cut technological answer
4. The technology was worth assessing in the district
5. The technology assessed by KVK could bring solution to the problem identified

6. The technology assessed could increase farm income due to its use
7. The technology assessed now has been put for FLD and
8. The KVK succeeded in giving useful feedforward to extension system.

The KVK could achieve success in assessment and refinement of a new technology thus increasing farmer incomes in the process. The success in OFT has directly bought the new technology to FLD and it will be released for mass popularization by the KVK subsequently. Through this unique effort the KVK has justified its mandates and its role in bringing increase in farmer incomes from the existing farming systems.

OFT: 2 Assessing feasibility of TPS/HPS technology in Potato cultivation (Var: HPS II/67) (OFT aimed at assessment)

Under the Mid Tropical Plain Zone, horticulture and particularly potato cultivation adds significantly to farmer incomes. The KVK identified that the potato farmers are plagued with problems of low yield from traditional varieties, high disease infestation, high transport costs and production of less uniform and unattractive tubers. True Potato Seed/Hybrid Potato Seed (TPS) is a technology that was found as having a potential in solving the above mentioned problems. Also the technology was never used by farmers of the district.

The KVK identified potato variety HPS II/67 for TPS production. This variety and TPS technology both were new in the district. The KVK conducted OFT in 30 farmer fields through out different microlocations of the district. The farmer practice was kept as control. Two treatments i.e. one of raised bed and another one of flat bed were followed. Similarly in production of potato using TPS/ HPS, the KVK used two treatments viz. that of transplantation and seedling tuber.

HPS/TPS technology in farmer field, KVK West Tripura

The technology tested led to successful outcome with respect to:

1. Cost effectiveness
2. Low seed rate (100gm/ha v/s 2 MT tuber/ha)
3. Negligible transport cost due to low seed rate

4. Disease free seeds
5. Resistance to late blight diseases
6. Higher yield
7. No requirement for cold storage facility

The assessment of the TPS technology by KVK helped in identifying a solution to the above mentioned burning problems which potato farmers of the district were facing till date. The trials have already evinced interest in farmers of the district and the technology is now successfully demonstrated in FLDs. The KVK could successfully find solution to the critical problems in potato cultivation there by contributing to:

1. Increased income
2. Drudgery reduction
3. Labour savings
4. Space savings and
5. Ensured supply of quality seeds

Through this innovative OFT, the KVK could find solution to an age old problem which involves, cost, disease problems and drudgery. Proper identification of field level problem and appropriate technological solution has resulted in this success.

OFT: 3 Assessment and refinement of Ginger rhizome storage measures (OFT for assessment and refinement)

The Mid Tropical Hill Zone provides enough scope for cultivation of ginger. The farmers in this KVK district were growing the crop over the years with varied results. Of late it was found that the farmers lost considerable portion of rhizomes stored by them as seed material. The method followed by these farmers was that of pit storage. The KVK hypothesis was that by providing a cheap and hygienic alternative to pit storage, the problem of rhizome loss can be solved. Accordingly, alternatives were looked for by the concerned SMS.

It was found that bamboo was easily and cheaply available in the area. Most of the farm houses were made up of clay pasted bamboo walls. These houses could withstand the winter effectively. The moisture retention in these houses was very less. The concerned SMS mooted the idea of clayed bamboo structures for storage of rhizomes. This could prevent moisture from spoiling it as in pit method. At the same time the SMS learned that agricultural engineers of a nearby research station have already developed clayed bamboo rhizome storage structures. The technology was then selected for OFT.

The technology was assessed for its performance at the end of next season. The size and shape of bamboo structure and the amount of clay and thickness of pasting were the parameters for assessment and refinement. All the above parameters were found varying from microlocation to

microlocation and were refined accordingly. Today the farmers of the district store their rhizomes without loss.

Lessons for other KVKs:

1. The concerned KVK identified a felt need which was unaddressed for many years
2. The problem was significant for a large number of farmers
3. The KVK could identify a cost effective technological answer
4. The technology was worth assessment and refinement
5. The technology assessed by KVK could bring solution to the problem identified
6. The technology was refined according to specific microlocation requirements
7. The technology assessed and refined now has been considered for FLD

OFT: 4 Assessment and refinement of System of Rice Intensification (SRI)

West Godavari is the pioneering district of Andhra Pradesh in adopting latest technologies in agriculture to achieve higher production and productivity. It is considered as 'Rice Bowl of Andhra Pradesh'. Among all the crops the predominantly cultivated crop is rice. Rice farming accounts for 65-84 % of the total area sown, with an average yield of 3377 Kg/ ha during Kharif (2,47,850) and 4692 kg/ ha in Rabi (1,78,999 h). Most of the cropped area in the district is irrigated through canal network.

Important problems of rice cultivation in West Godavari

- Neglected seed production
- Stagnant rice yields
- Seeds of new varieties are not available to the farmers
- Poor varietal replacement ratio
- Incidence of panicle mite and other pests and diseases
- Indiscriminate use of fertilizers and pesticides leading to economic loss
- Micronutrient deficiencies
- Salinity and low soil organic carbon
- High cost of cultivation

Potential solution to the problems

Despite stagnant rice yields in the delta areas, the farmers are compelled to grow rice, as there is no suitable alternate crop that can be grown for assured and higher returns. In this context, the System of Rice Intensification (SRI) method of cultivation came as a boon to step-up the productivity of rice. The progressive development in rice cultivation in West Godavari district during the period 1960 to 2004 is given below as time line of rice cultivation in West Godavari district:

1960 Introduction of high yielding varieties programme. West Godavari district was selected at national level as IADP district

1970 Farmers have been motivated through entrepreneurial activities in agriculture

1980 West Godavari district became the rice bowl of Andhra Pradesh

1990 The stagnated rice yields made the farming community switch over to aquaculture and horticultural enterprises

2000 Most of the land less labourers became leased farmers of smaller holdings

2001 Acute water shortage in the entire Godavari delta

2002 Water shortage continued, rotational system introduced, panic created among farming community

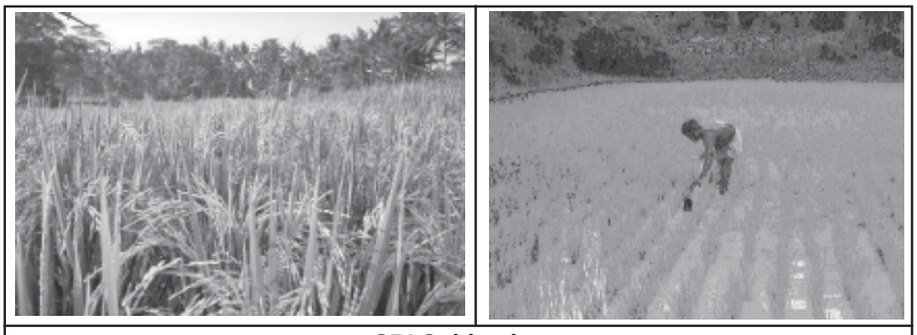
2003 KVK introduced the water saving and high yielding new technology 'SRI' – in 10 acres of KVK farm and in 10 farmer's fields as a trial. Kharif, 2003: KVK successfully organized 'SRI' system in 20 acres at KVK farm and in farmers fields in small (1acre) holding to large holding (100 acres)

2003 A good break through in stagnated rice yields by recording over 10 tonnes yields against 6-7 tons per hectare

2004 A new momentum had come in rice cultivation in West Godavari district

The system of Rice Intensification (SRI) was introduced in Kharif, 2003 and it was simultaneously experimented at University research cum extension centers and farmers fields. SRI technology was demonstrated on a large scale by the KVK, West Godavari, in its farm as well as in farmers' fields.

Pre-screening of technologies involved in SRI was done in association with the selected farmers groups through discussions and interaction sessions. Participation of farmer groups was encouraged at different stages of crop growth. At the crop harvesting stage, yield, cost benefit ratio, practicability, pros and cons of SRI method were assessed. Field days were conducted in farmers' fields as well as at KVK. Farmer conventions were organized with resourceful farmers and those farmers who have already adopted the SRI technology. This had helped for constructive interaction/ discussion among farmers themselves about the feasibility and profitability of the technology and to address the scientists by suitably modifying the techniques of SRI, as perceived by the farmers.



SRI Cultivation

Several experiments were conducted at KVK farm as well as in farmers' fields with the supervision and technical guidance of the KVK. The KVK also helped in developing location specific and cost effective devices like line markers and weeders. This had encouraged other farmers to modify accordingly and had become an eye opener to scientists and extension workers too. The active participation of farmers from the beginning of technological introduction had motivated many others to adopt the technology in larger areas in the ensuing crop season.

At the KVK farm, demonstrations on SRI technology were carried out in 10 acres during Kharif 2003-04. Performance of SRI cultivation in comparison with direct seeding, dibbling and transplanting was demonstrated in 20 ha during Rabi 2003-04. To make SRI technology suitable to local conditions various modifications were also demonstrated with improved varieties, viz. MTU 1071, 1061 7029,1010,1038,2036, and BPT 5204, JGL 384, 1798, 402 and WGL 14.

Demonstrations carried out at the KVK Farm during 2003-04

- Demonstration of SRI technology was conducted involving six major steps.
- Demonstration of different rice varieties with SRI technology, different age of seedlings and different spacing. The demonstration was conducted on one acre with 11 treatments on age (8 days and 24 days), number of seedlings/ hill (1 and 2 seedlings) and spacing (20x15 and 25x25, 50x25 cm).
- Demonstration of varietal interaction with different age of seedlings. This was done in three acres with two varieties and different age seedlings.
- Demonstration of new rice varieties with varied number of seedlings/ hill. This was done with eight varieties in two acres.

SRI Technology at farmers' fields

During Kharif 2003-04, the Krishi Vigyan Kendra conducted SRI technology demonstrations at eight locations in farmers' fields. The KVK provided technical guidance and conducted regular field visits, training programmes and field days. The results indicated that in farmers' fields the production levels were quite encouraging. In Uppuluru and Ballipadu villages the realized yield was 11500 kg/ ha and 10688 kg/ ha respectively under SRI as compared to 6400 kg/ha and 7625 kg/ ha respectively in conventional methods.

Performance on farmers' fields during Rabi 2003-04

During rabi 2003-04, the Krishi Vigyan Kendra conducted SRI technology demonstrations at farmers' fields. The results indicated that the productions levels were quite encouraging. In Ballipadu and Kaikaram villages the yields realized was to the extent of 14500 kg/ ha and 11697 kg/ha respectively under SRI as compared to 9750 kg/ ha and 8437 kg/ha respectively in conventional method.

Advantages of SRI

SRI had the potential to meet the challenge by virtue of its capacity to double or even triple the productivity and less water requirement. SRI encourages rice plant to grow healthy with:

- Large root volume
- Profuse and strong tillers
- Non-lodging
- Big panicle
- More and well-filled spike lets and higher grain weight
- Resists insects and allows rice to grow naturally

The actual benefits of SRI are:

1. Higher yield of both grain and straw
2. Reduced duration (by 10 days)
3. Lesser chemical inputs
4. Less water requirement
5. Less chaffy grain
6. Increase in grain weight without change in grain size
7. Higher head rice recovery
8. Capacity to withstand cyclonic gales
9. Cold tolerance
10. Soil health improves through biological activity

Lesson for other KVKs

KVK West Godavari revitalized rice growing farmers by introducing System of Rice Intensification (SRI) method by following various dissemination mechanisms including training and demonstrations. This could increase the net profit of rice cultivation by Rs. 6700/ha using less water. The KVK not only identified the most burning problem but also addressed it through innovative technological options and bought about agricultural development in the district.

3.19 Specific considerations for OFT with Livestock

On-farm research with livestock poses unique challenges. While sometimes difficult, livestock trials can yield substantial rewards if properly carried out. Ensure reliable measuring instruments and check them frequently with a correct balance (basket for the fodder, pot for the milk etc). Animals unexpectedly die during trial period. Record the date, cause of death and weight of the dead animal as soon as it is discovered. These records are helpful in accounting for the feed and production of the dead animal. Think about what you are measuring. Animal growth or weight gain, feed intake,

days on feed and milk production are common measurable livestock outputs. Livestock trials should also be based on a felt need or problem existing in the district. Ex: “OFT on efficacy of XXXX vaccine against FMD” is needed only if FMD is prevalent in the district and found causing substantial loss to livestock farmers.

3.20 OFTs involving Social Science concepts

Many SMS belonging to Social Science disciplines are found to have no OFT and FLD conducted in their subject area. They are often involved as helping hands for other SMS. In Social Sciences, concepts take the place which technologies do in life sciences. Like technologies, these concepts also can’t fit directly to any social systems. Hence, just like assessment and refinement of new technologies, these new concepts in social sciences too have to be assessed and refined to find solution to social problems in various microlocations of the district.

One question which is always heard repeatedly is: Can SMS (Agricultural Extension) conduct OFTs and FLDs? The answer is YES. Proper conceptualization of farm life dynamics and innovative extension methodologies can open up umpteen opportunities of assessment, refinement and demonstration of social concepts for extension SMS.

Here are some hypothetical examples of OFTs in extension discipline.

OFT: 1 Assessing effect of Group Formation on Social Capital and Rural Livelihoods.

For sustainable rural livelihoods, a high level of social capital is a must in rural areas. It implies the idea that social bonds and norms are important for sustainable livelihoods. In most villages farm families often resort to individual efforts which pay only average dividends. Social scientists have proven beyond doubt that group formation and positive management of group dynamics thereon results in significant build up of social capital thus contributing to increase in economic capital (Sajeev, 2006, Sajeev and Gangadharappa, 2006). The success of Self Help Groups and Farmer Interest Groups in improving rural incomes all over the world has proven this fact.

The SMS (AE) observed that in various microlocations of the KVK district, farm incomes are abysmally low coupled with poor avenues for farm women and rural youth. Village surveys revealed that spirit of group activity is lacking among the rural population. This also resulted in poor response for various developmental initiatives by KVKs and other agencies. Building social capital by way of group formation was recognized as the solution for this social problem. Accordingly, the SMS (AE) conceived an OFT titled ‘Assessing effect of group formation on social capital and farm incomes’. The OFT was conducted in 5 different locations of the district with the following four treatments:

Treatment 1: Self Help Group (SHG) with 20 farmers focusing on group farming.

Treatment 2: Self Help Group (SHG) with 20 farm women focusing on savings and income generation.

Treatment 3: Farmer Interest Groups (FIG) with 15 farmers which are product focused.

Treatment 4: Farmer Interest Groups (FIG) with 15 farm women which are enterprise focused.

In every location, the above four treatments were followed. In total, the OFT covered 200 SHG members and 150 FIG members.

The SMS after initial period of establishment of SHGs and FIGs started making his observations of the OFT. The parameters recorded in the first phase were:

1. Build up of group spirit
2. Spread of 'self help' message
3. Dynamics of groups formed
4. Build up of social capital
5. Increase in saving habit and
6. Initiation of group farming

The SMS could clearly notice a significant improvement in all the above parameters. The data was collected for every three months through village surveys and compared with previous ones to reach at conclusions. The formation of SHGs and FIGs also helped the KVK in finding collaboration from farmers for all their programmes. The other SMS of the KVK also got benefited by these groups. Several hidden benefits were also noticed such as:

1. Outflow of extra income to family savings
2. Better health and education for children from extra savings
3. Group feeling among villagers
4. Increase in cooperative efforts
5. Spirit of entrepreneurship
6. Reduction in farming costs due to group farming
7. Build up of farm assets from extra income
8. Development of better marketing models for rural products through FIGs
9. Culture of hard work among rural youth and
10. Better status of women in villages due to income from SHG and FIG activities.

The success of above mentioned OFT has compelled the SMS to continue the groups for demonstration purpose for farmers of other villages. So the groups will now become part of a 'FLD on impact of group formation on social capital and farm incomes'.

OFT: 2 Testing applicability of 'e-village' concept in providing efficient farm decision support

In recent years, Cyber extension has gained popularity and we have numerous successful cyber extension initiatives under public and private domain in India. The most important role of cyber extension in development is fostering a knowledge intensive sustainable livelihood security system in rural areas, since ICT can enable us to reach the unreached and include the excluded information,

knowledge and skill empowerment becomes easy. Any inclusive knowledge society requires the effective harnessing of ICTs to combat poverty and foster development.

The SMS (AE) observed that in different microlocations of the KVK district, farm incomes are meagre due to poor access to market intelligence coupled with low productivity due to pests and diseases. Even though information on the above aspects already existed, the farmers were unable to make use of the same due to inaccessibility. At this point the SMS (AE) mooted the idea of setting up an 'e-Village' on a pilot basis. Accordingly he formulated an OFT titled: "Testing applicability of 'e-village' concept in providing efficient farm decision support" in a selected microlocation of the district. Under the OFT, a computer with internet connection was provided in the village. Selected farmers were trained in internet usage and data retrieval. Farmers were also introduced to the various websites on pest and disease management as well as market information.

Upon initiation, the SMS recorded the following aspects:

1. Usage of internet by farmers
2. Utilization of market information from internet
3. Utilization of pest and disease information
4. Utilization of other information such as package of practices and
5. Increase in farm income over a period due to 'e-village'.


Women getting trained on e-village

The SMS could clearly notice a significant improvement in all the above parameters. The data was collected for every three months through village surveys and compared with previous ones to reach at conclusions. The various benefits from 'e-village' noticed were such as:

1. Better decision making in farm management by farmers
2. Reduced losses from pest and disease attacks
3. Better crop and animal management
4. Reduction in farming costs due to better information
5. Reduced exploitation by middlemen due to better informed farmers
6. Increased farm income due to better marketing practices

7. Outflow of extra income to family savings
8. Better health and education for children from extra savings
9. Build up of farm assets from extra income and
10. Development of better marketing models at village level

The success of above mentioned OFT has compelled the SMS to continue the facility for demonstration purpose for farmers of other villages. So the facility will now become part of a 'FLD on 'e-village' concept in providing efficient farm decision support'. It is expected that the success of the OFT will create a multiplier effect thus forcing other villages to take up the technology. The SMS in story bought the latest cyber extension technology available to give efficient farm management and marketing decision for the farmers thus bringing a significant increase in their farm incomes.

Other options for OFTs and FLDs in Extension discipline.

Extension SMS should also take into account the OFTs and FLDs conducted by other SMS of their own KVK. They can formulate their own OFTs so as to assess the suitability of various extension methodologies in popularizing the various technologies assessed and refined by other SMS. Through such assessment and refinement of various extension methods they can find out and demonstrate those methodologies best suited to popularize the various new technologies found suitable for the district. This leads to extension methodology backstopping parallel to the technology backstopping done by other SMS thus aiding better technology adoption and diffusion in the district.

This can be explained with a suitable example from one of the KVKs. Let us look in to the OFTs proposed by other SMS of a KVK.

No	Thrust area	Crop/Enterprise	Identified Problem	Title of OFT
1	Situation Specific Variety	Sugarcane	Low Yield	Assessing performance of Rice variety "Lohit" in Nagaon district
2	Nutrient Management	Sugarcane	Low yield and Imbalanced fertilization	Assessment and refinement of soil test based fertilizer application in Sugarcane in Nagaon district
3	Integrated Pest Management	Sugarcane	Injudicious use of Pesticides	Assessing IPM practices on Sugarcane

No	Thrust area	Crop/Enterprise	Identified Problem	Title of OFT
4	Nutrient Management	Boro rice	Imbalanced Fertilization	Assessing soil test based fertilizer application in Boro Rice.
5	Nutrient Management	Boro rice	Potassium Deficiency	Assessing performance of Potassium Management in Boro Rice.
6	Integrated Pest Management	Sali rice	Injudicious use of Pesticides	Assessing performance of IPM on Sali Rice in Nagaon district.
7	Situation Specific Variety	Turmeric	Low Yield & Poor Quality	Assessing performance of Turmeric variety "Megha 1" in Nagaon district.
8	Production Technology	Banana	Low Yield	Assessing performance of High Density Planting in Banana in Nagaon district.

It can be noticed that the KVK has tried to intervene in production of four crops with eight OFTs assessing eight different technological options. The options assessed (and refined later) may be found suitable or not suitable for the district. But the question of proposing the best extension method for popularizing the technologies among the extension personnel and farmers of the district will still remain. Many a times, it is found that KVKs suggest less effective extension methods for popularization of successful technologies thus leading to low adoption and diffusion of the same in the district. This leads to an increase in the already existing technology fatigue. The Subject Matter Specialist (Extension) can formulate OFTs to assess and refine the extension methods most likely suited to popularize the above technologies.

For example, in case of the OFT: 'Assessing performance of IPM on Sali rice in Nagaon district', proposed by SMS (Entomology), the SMS (AE) can formulate an OFT titled: 'Assessment of suitability of Farmers' Field School (FFS) as a method to popularize IPM on Sali rice in Nagaon district'. Suitable refinements in the method can also be thought about in later seasons. Likewise, various extension methodologies as well as various participatory techniques also need to be assessed and refined for suitability and effectiveness in various microlocations of the district so as to aid in their popularization among extension personnel which in turn will aid in successful adoption and diffusion among farmers of the district[1].

[1] The above examples hold good in case of FLDs also and hence are not discussed separately in Chapter – IV on Technology Demonstration.

3.21 Participatory Technology Development (PTD)

KVKs aiming at farmer driven OFTs (Type III) which are a step above the present extension driven ones have to resort to Participatory Technology Development (PTD) process. It is an approach, which involves encouraging farmers and other stakeholders to engage in experiments in their own fields so that they can learn, adopt new technologies and spread them to other farmers. In its purest form PTD is a process in which:

- problems for which solutions have been sought are identified and prioritized by farmers,
- alternative solutions to be tested are defined by farmers
- design of experiment is decided by farmers,
- the implementation is done by farmers,
- monitoring is decided and executed by farmers and
- evaluation is done by farmers

A growing number of documented examples in recent years reveal that PTD has got accepted as a research approach in agriculture, animal husbandry and natural resource management (NRM). It has been recognized that research is effective in improving farmers' livelihoods if farmers play a vital role in the process.

The objectives of PTD approach are to:

- Empower clients to develop and use livestock technologies
- Develop appropriate livestock technologies suited to the farm holdings
- Empower stakeholders, especially the marginalized ones, on their own decision making so that their capacity to make effective demands on research and extension organizations is strengthened and
- To improve the functional efficiency of formal research

The steps in PTD process involves:

1. Getting started in field
2. Understanding problems and potentials
3. Looking for readiness to try
4. Designing experiments
5. Trying out
6. Evaluation of the experiments
7. Sharing results with others
8. Sustaining PTD process and
9. Scaling up/ Phasing out

Obstacles to PTD as viewed by farmers are as follows:

- Research would take too much time
- Too great a risk in their production systems
- Fear that they may be punished, if the technology fails
- Lack of intention to experiment an option, which they consider risky, insignificant, or having delayed benefits
- Lack of communication link with scientists and
- A general feeling that their problems are unimportant to scientists

Obstacles to PTD process from Scientists' view point is as follows:

- Results could be spoiled by mismanagement of factors outside the researchers' control
- Failure of technologies in farmers' fields may be construed as inadequacies of scientists
- Risk of exposing farmers to too many uncertainties
- Lack of skills and experience in participatory research and
- Lack of time, motivation and communication skills to approach farmers

Benefits of PTD process in research/extension include:

- Encourages farmer experimentation
- ITK of farmers can be gainfully tapped
- Farmers' knowledge and creativity are harnessed to develop appropriate technology
- Farmers are motivated when their views are respected
- Technologies are more rigorously tested under users' conditions.
- Technologies to suite diverse agro-ecological & socio-economic situations
- Technologies are more likely to be adopted
- Technologies are in users hands more rapidly
- Complements station-based research

The success of an OFT should not be confused with success of the technology tested. A negative result of a technology tested shows that the technology is not suited for the specific microlocation of the district. This finding also refers to the success of the trial. Some technologies may not need refinement thus qualifying directly for frontline demonstrations. Some may successfully undergo refinement and reach the demonstration stage while some technologies fail to get refined in the farmer field. The technologies which successfully come out of On Farm Trials are then recommended for Frontline Demonstrations (FLDs).

Chapter – IV

Technology Demonstration

'Believing through seeing' and 'learning by doing' accomplished through demonstrations help KVKs in technology integration. This process arouses interest and improves the adoption, because it is based on the principles of 'learning by doing' and 'seeing is believing'. Technology demonstration is the most effective way to show how a thing works, how to do the work, principles involved in an operation and to show the end results of the technology/methodology adopted. On the basis of purpose for which technology demonstration is conducted it is classified into (i) method demonstration and (ii) result demonstration.

4.1 Method Demonstration

A method demonstration is conducted to explain how to carry out a particular operation according to its principles so that it is carried out systematically and yields better result. Through method demonstration we teach the learners about how to do something. The learners will be shown the right method for doing an old practice or taught about a new practice that are introduced to them. The method demonstration teaches new skill and helps the learner to obtain practical knowledge about something they need to practice or do in their day to day life.

Method demonstrations in progress
Left: Induced breeding in fishes, KVK, Imphal East, Manipur
Right: Preparation of Half Moon terraces, KVK, Wokha, Nagaland

Purposes

Some of the specific purposes for which the demonstration is useful are urea molasses treatment of paddy straw, compost pit, biogas plant, pesticide spraying, milking operation, sanitation methods, seed treatment, milk collection and storage, de-beaking of poultry, egg preservation, cattle feed preparation, operation of improved implements, sericultural operation, beekeeping, grooming

of cattle, dehorning, vaccination of poultry and cattle, semen collection, seed bed preparation, judging and selection of dairy and work cattle, haymaking, silage making etc.

Method Demonstrations in progress
Left: Maintenance of Beehives, KVK, Mokokchung, Nagaland
Right: Use of Wheel Hoe, KVK, Dimapur, Nagaland

4.2 Result Demonstration

The value of a new practice can be realized better by seeing the end product or outcome in comparison with the existing practice. Therefore, in extension education the result demonstration serves as an important tool to convince the farmer about the value of a new idea or innovation that are introduced to them as an option to their existing practice. Unless the farmers see the outcome or results of the recommended practice in comparison with their existing practice with their own eyes and experience, it becomes difficult for the extension worker to make the farmer to adopt the recommended variety or practice. In such circumstances, the result demonstration helps the extension worker to make his job easy. From the above discussion it is understood that result demonstration is:

i) the method to show the worth or end product or outcome of a practice or an idea.

ii) conducted mainly to show the differences between two practices especially when one is considered more superior than the other in giving the result or outcome.

iii) to compare the results. For comparisons, records are to be maintained.

Result Demonstrations at farmer fields.
Left: Zero tillage Rapeseed, KVK, Imphal West, Manipur
Right: Hybrid Rice, KVK, Bishnupur, Manipur

Purposes

The result demonstrations may be used for a single recommended practice or a series of practices that come in sequence with respect to a problem. The framework, observability of results, trialability, complexity of operation and compatibility to the local people are the essential points to be considered for deciding a result demonstration. For example, it is easy to conduct the result demonstration for showing an increased yield of a hybrid seed in comparison with a local variety than to show the increased milk yielding potential of a crossbred cow with that of an indigenous one. Here, the time framework required for the former operation is a maximum of three months whereas a minimum period of three years are necessary to show the difference in the milk production and other reproductive parameters. Some of the recommended jobs for which result demonstration is useful are compost production, improved seed, fertilizer application, plant protection, irrigation measures, improved tools and instruments etc.

4.3 Front-Line Demonstrations

Front-Line Demonstration (FLD) is a concept of field demonstration evolved by the Indian Council of Agricultural Research during the inception of Technology Mission on Oilseed Crops during mid-eighties. The field demonstrations conducted under the close supervision of scientists of the National Agriculture Research System is called front-line demonstrations because the technologies are demonstrated for the first time by the scientists themselves before being fed into the main extension system of the State Department of Agriculture. KVKs conduct frontline demonstration only on those technologies suited to their micro location as proved by their own assessment and refinement through OFTs. They can conduct FLD on any technology assessed and refined and found undoubtedly suitable by any other agency involved in developing technologies for regions/agro-climatic zones that include or are similar to the KVK microlocation.

Result Demonstrations at farmer fields.
Left: Rapeseed, KVK, Bishnupur (Utlou), Manipur
Right: Integrated fish farming, KVK, Thoubal, Manipur

The main objective of Front-Line Demonstrations is to demonstrate latest crop production technologies and its management practices in the farmers' field under different agro-climatic regions and farming situations. While demonstrating the technologies in the farmers' field, the scientist are required to study the factors contributing towards higher crop production, field constraints of production and thereby generate production data and feedback information. Front-Line Demonstrations are conducted in a block of two or four hectares land in order to have better impact of the demonstrated technologies on the farmers and field level extension functionaries.

4.4 FLD v/s Other Demonstrations

The Front-Line Demonstrations are different from the normal demonstrations conducted by the extension functionaries. The special features of Front-Line Demonstrations are:

1. Front-Line Demonstrations are conducted under the close supervision of the scientists of the National Agriculture Research System comprising of Krishi Vigyan Kendras, ICAR Institutes, National Research Centers, Project Directorates and the State Agricultural Universities and its regional Research Stations.

2. Only latest proven technologies are selected by KVKs for Front-Line Demonstrations.

3. Front-Line Demonstrations are organized in a block of two to four hectares involving all those farmers whose plots fall in the identified demonstration block.

4. Only critical inputs and training are provided from the scheme budget, remaining inputs are supplied by the farmers themselves.

5. Training of the farmers associated with the Front-Line Demonstrations is a prerequisite for conducting such demonstrations.

6. The target audience of the Front-Line Demonstration is both farmers and the extension officers. The purpose is to convince extension functionaries and farmers together about the potentialities of the technologies for further wide scale diffusion; and

7. Front-Line Demonstrations are used as a source of generating data on factors contributing higher crop yields and constraints of production under various farming situations.

4.5 Typology of Frontline Demonstrations

Frontline demonstration is a long term educational activity conducted in a systematic manner in farmers' fields to show worth of a new practice/ technology. "Seeing is believing" is the basic philosophy of field demonstrations. Only proven technologies (based on OFT results) are selected for field demonstrations. Field demonstrations educate farmers through results obtained in terms of varieties resistant to disease and pest, quality of the grains and overall higher yields. In addition, it also educates the farmers in term of input-output ratio and economic gains in terms of net returns. Basically, there are two types of FLD:

I. Single practice FLD and

II. Composite FLD.

A 'Single Practice FLD' aims at proving the worth of a single practice such as effect of balanced fertilizers in rice crop, higher yields from newly released varieties of hybrid maize, effect of irrigation at crown root initiation stage of wheat, effect of new pesticide on fruit borer in gram etc.

A 'Composite FLD' is a combination of field based result demonstrations and a chain of skill oriented method demonstrations. A long term sequential method demonstration (Composite FLD) aims at demonstrating the superiority of a package of practice in growing a field crop. Here the effect of one practice in harnessing the effect of other practices is also demonstrated and studied. For example, combined effect of irrigation and fertilizer application on grain yield and quality of a newly released rice variety may be demonstrated as a composite FLD.

Many times, there is an over emphasis on FLD in KVK work. Successful FLDs lead to higher adoption of demonstrated practices by the farmers as they develop the confidence amongst them in the practices demonstrated. Field demonstrations provide an effective learning situation as farmers as well as extension personnel of line departments "See the crops themselves", "interact with the KVK scientists on the fields", and "get doubts clarified on the spot". It is, therefore, essential

that all FLDs should be well planned and executed leaving no room for failure. One bad FLD can spoil the impact of many good FLDs. KVK Scientists; therefore, have to be very careful in planning and conducting the FLDs. Without specific purpose, demonstrations should not be organized. Demonstration should be conducted only when situation demands.

As a thumb rule, KVK scientists can conduct FLDs on those technologies which are proven beyond doubt (through OFTs earlier conducted by them) as suitable for various micro-locations of the district.

4.6 Steps in Conducting FLDs

Since FLD is often used as an extension method, it is sometimes laid out in a routine manner. A well conducted demonstration should help the SMS to give finishing touch to changing attitude of farmers and extension workers and improve their knowledge, understanding and skills. The following broad steps need to be followed in conducting FLDs[1].

4.6.1 Planning Phase

a. Know the Vicinity

The scientists need to develop an understanding of the farmers, their farming systems, resources and establish rapport with them. It is essential to gather information on cropping system, present level of use of inputs and productivity of major crops of the area. There are different ways of knowing vicinity. Some are formal and some are informal. A few are as under:

(a) Visiting villages and farmers.

(b) Collection of information using PRA tools.

(c) Meeting people individually and in groups.

(d) Meeting opinion leaders.

(e) Exchanging information with local extension workers; and

(f) Consulting office records of population and basic agriculture.

[1] The step by step guidelines for conducting OFTs given in Chapter – III (See Section 3.17 Practicalities of OFTs: Step by step guidelines) applies for FLDs also with minor modifications. Hence, those steps are not repeated in this Chapter.

All said and done, it should be noted that a KVK which has successfully executed a well planned OFT won't face much problem in planning a good FLD.

b. Select Technologies

Select only proven technologies which have higher potentialities in terms of yield, disease resistance, quality, and can fit in the existing farming systems and situations of the area/farmers. Technology should be frontier ones i.e. recently released technologies or such which are atleast not more than five years old. Be sure that the technology selected for demonstration is much superior to the technology being already in use by farmers. At this stage SMS, responsible for demonstration must have enough consultations with the research scientists who are responsible for release of the technology. They should ask relevant questions from the research scientists and should be satisfied about the superiority of the technology.

A better and exact way is to conduct FLDs only on technologies proven beyond doubt through OFTs conducted by same KVK.

c. Select Demonstration Site

Avoid isolated farm. Demonstration site should be easily accessible for the farmers and extension workers. As far as possible, block of demonstration site should have a good number of farmers of all categories of land holding and status. Never conduct block demonstration in a single farmer's plot. Pay attention to farm size, layout of the field, soil type, fertility status, irrigation facilities and drainage system.

d. Select Demonstration Farmers

A group of farmers with land holdings in the selected demonstration block and who are willing to cooperate in the conduct of demonstration should be selected. Demonstration farmers should be selected finally by holding a meeting in the village where the purpose of demonstration should be clearly stated and suggestion sought from the farmers. Any difference in opinion may be sorted out tactfully. Otherwise there is a chance of having non cooperation from those who are not selected as demonstrating farmers which may ultimately jeopardize the very purpose of demonstration.

e. Finalize Package of Practices

This is an important step in planning FLDs. Collect the new technologies from the ICAR Institute/SAUs and ensure these technologies are frontier ones showing substantial increase in yields or other performance parameters. Involve as many scientists of the parent research station in the discussion as possible. This will help in working out minute details of sequences of method demonstration required; identification of important tasks/practices in which presence of scientists

should be necessary and critical inputs for FLD. Knowledge about farming conditions will be useful at this stage. Involve also demonstrating farmers in finalizing package of practices. This will help in understanding the level of farmers' practices, resource base to sustain the technologies and their perspectives.

f. Prepare for demonstration

Arrange critical inputs for the demonstration. Critical inputs are those agricultural inputs which are vital to help the selected technologies to exhibit its production potentialities on farmer's field and not earlier being used by the farmers. Arrange such inputs viz. seeds, fertilizers, farm equipments and other inputs in time. Only critical inputs need to be supplied by the KVK. Other inputs should be arranged by the farmers themselves. Ensure that the inputs which are to be given by the farmers are available with them. The farmers should never be given an impression that the FLD is a means of receiving free inputs. Also, the KVK should make sure that farmer don't divert the critical outputs supplied to other crops in the field. Rather, they should be educated to understand the educational value of such demonstrations.

4.6.2 Conducting Phase

a. Layout of Demonstration

Guide and assist the farmers in laying out the field. Special training programme may be arranged for all farmers in whose plots demonstrations are to be laid. Keep the control plot if needed; otherwise treat all other neighboring/surrounding plots as control plots. In case of block demonstration, one acre plot as a control is adequate. Sometimes a control plot is not necessary as the "entire memory of the farmer" is taken as a "control" or the neighboring plots would serve the purpose of control plots. Put a publicity board on the fringe of the demonstration plot indicating the technology demonstrated, period of demonstration and technology donor. Mention the KVK name also on the board.

b. Crucial Farm Operations

The SMS should ensure his presence at the time of important operations like, seeding, fertilizer application, weeding, and irrigation, plant protection measures, harvesting, threshing and weighing of produce. Two things are important at this stage:

(i) Using demonstration for farmers' training, and

(ii) Record keeping

Each operation should be used as input of training of farmers. Encourage questions from the farmers at each of these operations. This will help in better understanding of the task/operations.

c. Field Day

Arrange a field day to project the new technologies demonstrated in front of a large manageable group of interested farmers. It is an intensive educational activity in which farm experts, extension workers and farmers are involved and learn from each other.


Field days in progress.
Left: A field day on *Megha Turmeric* at KVK, Ri-Bhoi, Meghalaya.
Right: A field day on *Construction of Jalkund* at KVK, Wokha, Nagaland.

Plan the field day when the crop is fully matured yet green. Ask the demonstration farmers to explain the story of demonstration one by one to the assembled group of farmers and extension workers. Arrange a few method demonstrations on operation of farm machines and equipments, operation of seed drill, seed treatment, fertilizer application, plant protection, etc. Farmer-Scientist-Extension worker discussion should be an important feature of the Field Day.

d. Harvesting

Make an eye estimate of the field. Arrange harvesting in the presence of identified groups of farmers. Ask the farmers to estimate the yield and to say in what way the demonstrated technologies are superior to the earlier ones. Are they satisfied with the performance of the technologies? What lessons they have learned from the demonstration? Will they advice other fellow farmers to adopt this practice? Will they exchange the seed materials of new variety with other fellow farmers? What are the expected profits? Will it be more than what they used to get from their own practices? What are the difficulties in following the demonstrated practices? Idea is to ascertain as to what extent farmers are satisfied with the demonstrated technology and what is the possibility of their continued adoption.

4.6.3 Follow-up Phase

Some farmers may revert to old practices in the absence of follow-up. They need information reinforcement, timely supply of inputs or on the spot guidance. Group approach in follow-up will give better results. It is better to link your follow-up programmes with the local institutions like Farmers Club, Farmers Cooperative Society and Village Panchayat etc.

4.6.4 Record Keeping

There are two types of records which one should maintain for each block demonstration.

a. Information Card

This card contains basic information about the demonstration site viz. previous crops and varieties grown, fertility status of the plots, present productivity of crops, size of holdings of each farmers in the demonstration block, extent of use of inputs etc. It should also contain detail information of demonstration like size of block, variety of crop, seed rate, sowing date, inputs applied, irrigation schedule followed, intercultural operation performed, plant protection measures taken, date of maturity, date of harvesting, incidence of disease and pests, average numbers of tillers, yields of crop etc. The card should remain with the demonstration farmers and is filled up by them or by an educated person in their family or by the KVK staff who visit the demonstration site from time to time.

b. Technical Report

The technical report should contain information on soil analysis, crop variety, germination, plant population, pest and diseases, irrigation, fertilizer application, harvesting, final yield, extension activities undertaken etc. It should also contain information on cost-benefit ratio of the demonstration. This will help to work out the economic returns. A favorable cost-benefit ratio will fully convince the extension officers and the farmers about the profitability of the technologies demonstrated. Submission of technical reports to ZPD/Council in time is as important as conducting good field demonstrations. Late submission of reports may constrain the ZPD/Council as it will not be possible to include them in the Zonal report/national report. Remember, demonstration report helps in planning agricultural development and farm research programme of your area, state and country. Therefore, send technical report of block demonstration in time. Each block demonstration should be concluded with a feature story written in simple and easily understandable language. The story should have supporting data and photographs of demonstration to convince the readers. Role of the scientists in writing of feature story is very important. Such story becomes important learning materials in Krishi Vigyan Kendras.

The FLD has to be reported in the following format as shown below:

Details of FLDs implemented during current year (Information is to be furnished in separate tables for each category i.e. cereals, horticultural crops, oilseeds, pulses, cotton and commercial crops.)

No.	Crop	Thematic area	Technology Demonstrated	Season and year	Area (ha)		No. of farmers/ demonstration			Reasons for short fall in achievement
					Pro-posed	Actual	SC/ ST	Others	Total	
1.	Radish	Varietal performance	Japanese White	Rabi 2007	1.0	1.0	6	-	6	-
2.	Okra	Varietal performance	Arka Anamika	Kharif 2008	1.0	1.0	6	-	6	-

Details of farming situation

Crop	Season	Farming situation (RF/Irri-gated)	Soil type	Status of soil			Previous crop	Sowing date	Harvest date	Seasonal rainfall (mm)	No. of rainy days
				N	P	K					
Radish	*Rabi*	Rainfed	Loamy	L	M	M	Rice	03-10-2007	05-12-2007	120.42	8
Okra	*Kharif*	Rainfed	Loamy	L	L	M	Rice	03-04-2008	25-06-2008	957.40	46

Performance of FLD

No	Crop	Technology Demonstrated	Variety	No. of Farmers	Area (ha.)
1	2	3	4	5	6
1.	Radish	Varietal performance	Japanese White	6	1.0
2.	Okra	Varietal performance	Arka Anamika	6	1.0

Impact on Yield

Demo. Yield Qtl/ha			Yield of local Check Qtl./ha	Increase in yield (%)	Data on parameter in relation to technology demonstrated	
H	L	A			Demo	Local
7	**8**	**9**	**10**	**11**	**12**	**13**
132.75	85.50	113.04	87.25	29.56	Av. yield 113.04 q/ha	Av. yield 87.25 q/ha
165.00	108.50	132.93	95.25	39.56	Av. yield 132.93 q/ha	Av. yield 95.25 q/ha

Economic Impact

Average Cost of cultivation (Rs./ha)		Average Gross Return (Rs./ha)		Average Net Return (Profit) (Rs./ha)		Benefit-Cost Ratio (Gross Return / Gross Cost)
Demonstration	Local Check	Demonstration	Local Check	Demonstration	Local Check	
14	15	16	17	18	19	20
28,500/-	20,800/-	79,128/-	47,987/-	50,628/-	27,187/-	2.78:1(D)
						2.31:1(LC)
48,500/-	32,100/-	1,59,516/-	76,200/-	1,10,016/-	44,100/-	3.29:1(D)
						2.37:1(LC)

4.7 Examples of model FLDs

4.7.1 FLD: 1 Demonstrating 'Mithun Microchip' Technology

Mithuns are semi-domesticated animals in Arunachal Pradesh and under the prevailing system of Mithun rearing they are let-loose freely in the jungle to feed by themselves. They feed on natural fodders with out any supplement feeding or care by the attendants except occasional offering of common salts by the Mithun owners.

Traditionally, Mithuns are identified based on their ear notching (done during the calf-hood), horn structures, body coat colour pattern, sex or the body size. Due to close similarity between the Mithuns of different owners in the locality, often it creates conflicts of Mithun ownership. This leads to controversies among the Mithun owners which ultimately compels them to plead the case to the Judiciary for further investigation on ownership. Taking the importance of social problem in view, one of the KVKs has initiated the FLD: 'Demonstrating 'Mithun microchip' technology'.

Under this composite FLD the following practices and technology were demonstrated:

- The micro-chip (size of rice grain) bearing a specific number for implantation in the Mithuns.
- Method of securing and restraining the Mithun for chip implantation.
- Method of sterilizing the neck region (anterior to the point of shoulder) with the help of absolute alcohol (spirit).

- Subcutaneous implantation of microchip.

- Rechecking and recording micro-chip number in the identity card of the Mithun using transponder (Reader Machine) and handing over to Mithun owners for safe custody.

At the time of conflicts for the ownership of the Mithuns, the microchip reader machine can be brought from the authority and the tag number or the micro-chip number can be read by rubbing the machine near to the site of implantation of the micro-chip.

The FLD was conducted with a total of 55 Mithun owners. This FLD has helped the local community to a great extent as the doubt and conflict over the ownership of Mithuns in the district was eliminated.

Presently, Govt. of Arunachal Pradesh has taken up programme of micro-chip implantation in the Mithun population available in the entire district. The plan is to provide identity card to Mithuns by Dec. 2009. All the districts will be covered in near future.

Output of FLD

- The awareness on use of microchip technology as a fool proof identification method for Mithun was created among the farmers.

- The dispute among the Mithun owners was completely eliminated and farmers now want to adopt this technology for identification of their animals.

Outcome of FLD

- The application of the microchip technology was accepted and taken up by Extension System of the Government of Arunachal Pradesh and it helped to extend the benefit to a larger population in other districts of Arunachal Pradesh and similar areas in the whole NE Region.

- Peace of mind and social harmony is established among the Mithun owner society as the conflict over Mithun ownership in the district is over.

4.7.2 FLD: 2 'Demonstrating Production Technology of Exotic Vegetable; Broccoli (Variety: Pushpa)'

The Mid Tropical Hill Zone provides enough scope for cultivation of exotic vegetables. But the farmers were resorting to traditional crops with average yields. The KVK, under it's OFT assessed the

performance of Broccoli Variety Pushpa in the district and found it suitable for demonstration and popularization among farmers of the district. Accordingly, in the next season, an FLD on Production technology of exotic vegetable Broccoli (Variety: Pushpa) was conducted among selected farmers of different micro-locations in the district.

Under this composite FLD the complete package of practice of Broccoli was demonstrated with a great success.

The FLD was conducted in 8 farmer fields in different locations covering 0.2 ha area. The yields were found excellent with an average primary head weight of 250 gms in comparison to the local check's primary head weight of 212 gms (22.18% increase). B:C ratio of 1.22 was also recorded. The farmers were much enthused with the results. The adoption of this crop in the district is on a rise due to the successful demonstration by KVK.

4.7.3 FLD: 3 'Demonstrating Impact of Group Formation on Social Capital and Farm incomes'

This FLD was a continuation to the successful OFT on 'Assessing effect of group formation on social capital and rural livelihoods'.

In most villages, farm families often resort to individual efforts which pay only average dividends. Social scientists have proven beyond doubt that group formation and positive management of group dynamics thereon will result in significant build up of social capital thus contributing to increase in economic capital. The success of Self Help Groups and Farmer Interest Groups in improving rural incomes all over the world has proven this fact.

The SMS (AE) observed that in various microlocations of the KVK district, farm incomes are abysmally low coupled with poor avenues for farm women and rural youth. Village surveys revealed that spirit of group activity is lacking among the rural population. This also resulted in poor response for various developmental initiatives by KVKs and other agencies. Building social capital by way of group formation was recognized as the solution for this social problem. Accordingly, the SMS (AE) conceived an OFT titled 'Assessing effect of group formation on social capital and farm incomes'. The OFT was conducted in 5 different locations of the district with the following four treatments:

Treatment 1: Self Help Group (SHG) with 20 farmers focusing on group farming.

Treatment 2: Self Help Group (SHG) with 20 farm women focusing on savings and income generation.

Treatment 3: Farmer Interest Groups (FIG) with 15 farmers each which are product focused.

Treatment 4: Farmer Interest Groups (FIG) with 15 farm women each which are enterprise focused.

In every location, the above four treatments were followed. In total, the OFT covered 200 SHG members and 150 FIG members.

The success of above mentioned OFT has compelled the SMS to continue the groups for demonstration purpose for farmers of other villages. So the groups will now become part of a 'FLD on impact of group formation on social capital and farm incomes'.

The following aspects were demonstrated through functioning of SHGs and FIGs in the district:

1. Build up of group spirit
2. Spread of 'self help' message
3. Dynamics of groups formed
4. Build up of social capital
5. Increase in saving habit and
6. Initiation of group farming

Several hidden variables were highlighted and demonstrated such as:

- Outflow of extra income to family savings
- Better health and education for children from extra savings
- Group feeling among villagers
- Increase in cooperative efforts
- Spirit of entrepreneurship
- Reduction in farming costs due to group farming

- Build up of farm assets from extra income
- Development of better marketing models for rural products through FIGs
- Culture of hard work among rural youth and
- Better status of women in villages due to income from SHG and FIG activities.

The KVK will continue the demonstration groups till they reach a stage where they can sustain themselves. The Social output of this demonstration can be termed as far better than the economic outputs from many other demonstrations.

4.7.4 FLD: 4 'Demonstrating effectiveness of 'e-village' concept in providing efficient farm decision support'

The SMS (AE) observed that in various microlocations of the KVK district, farm incomes are abysmally low due to poor access to market intelligence coupled with low productivity due to pests and diseases. Even though information on the above aspects already existed, the farmers were unable to make use of the same due to inaccessibility. At this point the SMS (AE) mooted the idea of setting up an 'e-Village' on a pilot basis. Accordingly he formulated an OFT titled: "Testing applicability of 'e-village' concept in providing efficient farm decision support" in a selected microlocation of the district. Under the OFT, a computer with internet connection was provided in the village. Selected farmers were trained in internet usage and data retrieval. Farmers were also introduced to the various websites on pest and disease management as well as market information. Success of the OFT helped the SMS to initiate an FLD on the same concept.

Upon initiation of the FLD, the SMS recorded the following aspects:

1. Usage of internet by farmers
2. Utilization of market information from internet
3. Utilization of pest and disease information
4. Utilization of other information such as package of practices.
5. Increase in farm income over a period due to 'e-village' facilities.

The SMS could clearly demonstrate a significant improvement in all the above parameters to the villagers and extension personnel from line departments. The data was collected for every

three months through village surveys and compared with previous ones to reach at conclusions. The various benefits from 'e-village' noticed were such as:

1. Better decision making in farm management by farmers
2. Reduced losses from pest and disease attacks
3. Better crop and animal management
4. Reduction in farming costs due to better information
5. Reduced exploitation by middlemen due to better informed farmers
6. Increased farm income due to better marketing practices
7. Outflow of extra income to family savings
8. Better health and education for children from extra savings
9. Build up of farm assets from extra income
10. Development of better marketing models at village level

The success of above mentioned FLD has compelled the SMS to continue the facility for demonstration purpose for farmers of other villages. So the FLD will now be replicated in other villages of the district. It is expected that the success of the FLD will create a multiplier effect thus forcing other villages to take up the technology. The SMS in story demonstrated the latest cyber extension technology available to give efficient farm management and marketing decision for the farmers thus bringing a significant increase in their farm incomes.

Technology demonstration occupies one of the most important positions among technology application activities. Successful demonstrations have a multiplier effect on adoption and diffusion of frontier technologies thus aiding agricultural development in the country. But, technology application is complete only when farmers, rural youth and extension functionaries are trained on the latest proven technologies. The process and requirements of KVK training component is discussed in detail in the next chapter.

Chapter – V

Training Methodology for KVK Scientists

5.1 Training – An Introduction

Training plays an important role in the advancement of human performance in a given situation. Training provides a systematic improvement of knowledge and skills which in turn helps the trainees to function effectively and efficiently in their given task on completion of the training. In KVKs, trainings are conducted at various levels for which the programmes are designed based on the clientele problems and needs. The training programmes are idealistically designed and conducted for inducing changes in the durable aspects of persons, changes in relationships and changes in action. The training strategies vary depending upon the learning outcome the trainer seeks to achieve among their trainees. The training may be for improving the proficiency in the task performed or learning a process. The training modalities also need to be differentiated based on the requirement and type of organization which is imparting the training. Modality is a broader concept than the training method: for example several methods can be used for designing a particular modality. Training modality can be classified on the basis of (i) contact with learner (ii) formalization of training (iii) management of training and content emphasis (Pareek and Lynton, 1990).

Any training programme starts with identification of training needs, followed by translation of training needs into objectives. Based upon the objectives, the contents of the programme are developed, taking into consideration the knowledge, skill and attitude elements needed to achieve each objective. Once the training contents or topics are decided, appropriate training methods suitable for each topic should be selected. Then, the topics have to be put in a particular sequence and a complete course schedule with time and duration is to be decided. All learning and training is best done through active subjects and therefore all extension professionals must understand well the basics of training in order to design and conduct successful training programmes.

5.2 Typology of KVK Training

Normally KVKs have the following types of training conducted by them:

1. Training for farmers (On and Off Campus)

2. Training for rural youth (On and Off Campus)

3. Training for extension personnel (On and Off Campus)

4. Sponsored training programmes (On and Off Campus)

- For farmers, rural youth and extension personnel

5. Vocational training programmes (On and Off Campus)

- For farmers and rural youth

Based on duration, the KVK trainings can be classified to:

1. Short duration trainings (1-7 days) &

2. Medium duration trainings (8-14 days) and

3. Long duration trainings (3-4 weeks)

5.3 Basic Concepts of Training

One of the important duties of the KVK scientists is to communicate the research findings, new innovations and technologies to the farmers and needy people. It involves conducting proper demonstrations of the new technologies as well as training the technology users for providing with required knowledge and skills for adopting the suggested technologies. Therefore, training is an essential component for the successful dissemination and adoption of latest agricultural technologies.

Training indicates a planned activity to which a person or group of persons are subjected to induce learning which brings about desired behavioural changes that are beneficial to them in their day to day life or vocation. In terms of Lynton and Pareek (1990) training consists largely well organized opportunities for participants to acquire necessary understanding and skill. Training aims at bringing about lasting improvement on the job. The kind of education we call as training is not for knowing more but behaving practically and differently. Training is a powerful tool in the hands of KVK scientists to develop competence in their clients. New concepts of training such as andragogy, experimental learning techniques such as sensitivity training, transactional analysis, in basket exercise, critical incidence technique etc., provide new approaches to enhance training outcome. Training of farmers, rural leaders and extension personnel is a must to face the challenges posed by the changing technological and economical scenario.

5.4 Definition of Training

Training is a process of acquisition of new skills, attitude and knowledge in the context of preparing for entry into a vocation or improving ones productivity in an organization or enterprise.

ILO (1986) defined training as activities which essentially aimed to provide attitude, knowledge and skills required for employment in a particular occupation or a group of occupations for exercising a function in any field of economic activity.

Iffner and Douds (1989) viewed training as development and delivery of information that people will use after attending the training. Effective training requires that you have a clear picture of how the trainees will need to use information after training. This also requires that people practice what they have learnt before they apply it after training.

Lynton and Pareek (1990) stated that training consists largely of well organized opportunities for participants to acquire necessary understanding and skill. Training aims at lasting improvement on the job. The kind of education we call as training is not for knowing more but behaving differently.

An analysis of different definitions of training will reveal that:

1. Training is a planned, systematic and purposeful instruction.

2. It is a learning process, aims to improve performance of participants so that they can contribute to effectiveness of the group or organization they belong.

3. Training and education are not the same.

4. Training results in changes in knowledge, skill, practice and improves the productivity.

In brief, training is an instrument to induce change in the behaviour of individuals for personal, social and organizational effectiveness.

5.5 Training Vs Education

Even though the terms training and education look alike, often they have commonalities and differences. According to UN (1966) as reported by Misra (1990), the difference is as follows.

"In technological terms, education is designed as preparation for life, not for earning a living, while training is always understood to have a vocational purpose. With particular reference to the public services, education is understood to be the general cultural preparation which a young person receives before entering public employment, while training is understood to be the specific preparation just before entering public employment or a later point in the career and directed towards the performance of the duties assigned to individual."

Education is vertically focused as it aims to prepare people for future roles. Content of the training are focused on the immediate needs at work place. It is said that education is generally for knowing more whereas training is for behaving differently. Formal education is more rigid and structured but training is non-formal and flexible in nature.

5.6 Training process and Types of Training

Training has been conceived as a process consisting of three phases, viz. pre-training, training and post training (Lynton and Pareek, 1990).

5.6.1 Pre training

Preparatory phase prior to the actual training process is very much essential. Pre training involves planning of training programme. The trainer will assess the training needs and design appropriate course content as well as methods. Arrangements for selection of participants, appraisal of course details and necessary preparations for conducting the training programmes are completed during the pre training phase.'

5.6.2 Actual Training

According to the training plan/schedule the training is organized. The activities such as reception of trainees, boarding and lodging, inauguration, guest lectures, organisation of instructions, demonstration skill training, field trip, evaluation etc. are conducted during this phase. Due care is to be taken for creating proper training climate for the participants to learn new ideas and skills. Good rapport and team building among the trainees need to be encouraged.

5.6.3 Post Training

The success of the training programme largely lies with the follow up activities undertaken after the conclusion of training. Post training tie up with related line departments for continuity, making arrangements with financial institutions for linking up trainees for getting financial assistance, providing them with information about further opportunities available in the field for their improvement, and impact analysis are must for making the training programme successful. The post training evaluation need to be done and based on the feed back, necessary corrections for bringing about further improvement is a must.

5.7 Basic Training Approaches

The training approaches can be classified into traditional, participatory and performance based approaches. In the traditional approach the trainer designs the objectives, contents, teaching

techniques etc. and the participants have no say in the process. In the participatory approach the trainer and trainees jointly decide about the programme. In case of performance-based approach, the emphasis is given to acquiring of specific observable skill or attainment of a specific level of proficiency before clearing the trainee for successive levels.

5.7.1 Learning

A good KVK training programme creates adequate opportunities and situations through which farmers gain the knowledge and skills necessary for successfully meeting their needs and interest in such a way as to attain continuous improvements and self satisfaction. By this process the farmer learner experiences a change in his behaviour through his own efforts. Learning occurs within the learner. Any change of behaviour that takes place as a result of the experience gained is called as learning.

Learning is a process by which sensations are perceived, understood and action taken resulting in desirable changes in knowledge, skill and attitude.

Learning refers to the change in a subject's behavioural or behaviour potential to a given situation brought about by the subjects' repeated experiences in that situation, provided that the behavioural change cannot be explained on the basis of the subjects' native response tendencies, maturation or temporary states.

5.7.2 Learning Principles

A principle is a statement of policy to guide decision and action in a consistent manner. It is a fundamental truth and settled rule of action. The learning principles as applicable to KVK trainees are:

1. Involves active participation of learners.
2. Satisfies the interest and needs of the learner.
3. Learners' participation in planning the learning activities.
4. Involves effective communication, cooperation and inter dependence.
5. Proper physical and psychological environment.
6. Relates theory with practice.

7. Provides challenging and satisfying learning opportunities.

8. Should be meaningful and stimulative.

9. Based on successive reinforcement and interactive method.

10. Individuals differ in their leaning ability and the KVK trainer should facilitate the learning.

5.7.3 Pedagogy and Andragogy

The term pedagogy means the science of teaching children. Andragogy refers to the science of teaching adults. Pedagogy and Andragogy differs in terms of their objectives, curriculum, methods, orientation, teacher role and evaluation. The basic psychological differences between a child learner and adult learner are mainly responsible for the differences that arise between the adult and child learning process. According to Knowles (1993), the child and adult learners differ in terms of their self concept, experience, readiness to learn, leaning orientation and motivation for learning.

5.8 Characteristics of a KVK Trainee

The KVK trainees are self directed individuals, have greater volume and quality of experience. They are problem or life centered and ready to learn according to their perception of developmental needs. They are motivated both by extrinsic and intrinsic rewards.

5.8.1 Characteristics of KVK Trainee Learning

The striking features of KVK trainee learning in terms of their goals, objectives, contents, methodology and evaluation have been summarized below:

1. Goals and Objectives: To help trainees to achieve their human potential

2. Contents: KVK trainee learning is Problem centered, Selection of contents based on their needs.

3. Control: KVK scientist has very less control over learning outcome of a farmer.

4. Method: KVK trainee learning is facilitative.

5. Role of KVK trainer: Role of KVK trainer is clearly defined and considered as important to learning of farmers.

6. Examination/Evaluation: Mostly Self assessment are conducted and ranked based on their marks obtained.

5.8.2 Conditions for Effective Learning

Pareek (1981) has listed the following fifteen different conditions for effective learning. They are as follows:

1. Authentic and open system of training institution or the place of learning.

2. Non-threatening climate.

3. Challenging learning task.

4. Collaborative arrangements for mutual support of learners.

5. Organisation of graduated experiences of challenging successes.

6. Mechanisms for supportive and quick feed back.

7. Opportunities to practice the skills learnt.

8. Opportunities to apply learning.

9. Encouragement for self learning.

10. Support for experimentation.

11. Emphasis on learning through discovery.

12. Indirect and liberating influence by trainer/teacher through minimum guidance.

13. Trainers'/ teachers' human values and faith in man.

14. Trainers' / teachers' high expectations from learners and openness to examine own needs.

15. Trainers' / teachers' competence.

5.9 Training Need Assessment

Need is the gap between what is? And what ought to be? Training need refers to the gap between "what is" and "what should be" in terms of the trainees knowledge, skills, attitude and the behaviour in a given situation and time. It is important to analyse the training needs for designing an effective training programme[1]. Four major approaches for the training needs identification have been proposed by different authors. They are as follows:

5.9.1 Performance Appraisal

In this method the actual performance of the trainee in a given situation is compared with that of the ideal or expected performance. It can be evaluated through direct observation, evaluation of performance records for a period of time and the individuals' self appraisal about their performance compared with their actual output. Through this method one can link between knowledge and skill requirements with their job performance.

5.9.2 Task Analysis

A detailed analysis of the task performed by an individual as per the standards and job chart is to be done. The data pertaining to the knowledge and skill requirement for the task, their performance in the actual situation need to be collected through interviews, case methods, and direct observation techniques. A detailed interview schedule need to be prepared for the assessment of training needs based on the task analysis for collection of relevant data. The schedule contains the details of different tasks and the frequency of performance of each task. The details such as level of importance and level of competency are obtained in a differential rating manner for each task. The common methods used for task analysis are interview, questionnaire, case method and observation. The task analysis is a process by which one can know the different elements or sub-tasks which are critical for its performance.

5.9.3 Survey method

It is one of the most frequently used methods. The need analysis is done based upon the individual perception and opinion of the individuals for whom the training programme is organized.

[1] Please refer Chapter - XII for model schedules on training need analysis developed by Zonal Project Directorate, Zone – III for farmers and KVK personnel separately.

Data will be collected through structured schedule, questionnaires and interviews. This method is fast and inexpensive. Through this method we can involve large number of people in the training needs identification[1].

5.9.4 Competency Study

Under this method, a thorough job analysis is undertaken to know the different qualities needed for the individual to perform his job effectively and efficiently. Based on the qualities required the individuals are further analysed in terms of their competencies in performing the job. The competencies in terms of knowledge, skills and other qualities required and identified by involving the experts. A thorough analysis is made by matching the individual qualities with the expected competencies required for the job. It involves active involvement of experts and the trainees through a whole hearted open discussion approach to arrive at the right conclusion. This method is relatively fast and inexpensive.

The data on current performance such as the current level of production and productivity, work environment and technological level are need to be obtained for doing the training need analysis.

5.10 Skill-gap Analysis

It is a process of determining the training needs of individual trainee in relation to important tasks-steps or components of tasks identified for training. It determines how skilled or proficient individual trainees are on these tasks or components, how many of them differ from desired performance and whether or not they need training in a precise manner.

5.11 Formulating Training Objectives

A trainer's concerns before starting of the training programme lies mainly on clarifying the training objectives based on the identified training needs. Through the training needs identified we can know the gap in performance. Therefore, the training needs identified have to be suitably converted into training objectives from drawing an outline for the training programme. A well defined training objectives help to design an effective training module. The training objectives give the direction to the entire training programme.

5.11.1 Importance of Training Objectives

1. The training objectives help us to draw the outline of the training programme.

2. It helps us to design the training module and plan the technical programme.

3. The trainer can very well decide upon the knowledge and skill components to be imparted to the trainees

4. Helps the overall management of the training programmes.

5. Helps monitoring and evaluation of the training programme.

In general the training objectives can be classified into specific and general based upon their intensity of reference. The general objectives refer to the overall impact of a training programme. The specific objectives give the details of different components of a training programme. The training objectives deal with the changes in knowledge, skill/practice and attitude of the trainee that needs to be achieved through the programme. While formulating the training objectives care must be taken to ensure that the objectives are formulated based on the needs identified. Similarly, the objectives should also be well defined in-terms of condition, performance and standards with a specific reference to the type of behavioural changes attempted. The stated objectives should be well defined, simple and stated with clarity. It should be realistic, attainable and measurable through suitable evaluation.

5.12 Translating Training Needs into Objectives

A systematic procedure is to be adopted to formulate the objectives based on the needs identified. A general outline of the steps involved is given below:

1. List out all the training needs.

2. Group them according to their category such as knowledge, skill and attitude part.

3. Select those needs which can be met by the present training programme.

4. Analyse them for their suitability and screen them based on the institutional objectives, interest of the people and feasibility of achieving them.

5. Translate the selected needs into the training objectives.

6. Clarifying the objectives is to be done before finalizing the training objectives. The clarification is done based on the analysis of job requirements, trainees' capabilities, available resources and time.

5.13 Designing and Conducting Extension Training Programmes

Designing and conducting an extension programme is more of an art than science. On deciding upon the training objectives, the course contents need to be developed based on the objectives selected. On deciding the contents, the relevant topics to cover the individual area of the content are to be finalized. While deciding upon the topic the different learning demands such as knowledge, skill and attitude need to be kept in mind. Further, the topics are to be arranged sequentially in a logical manner to ensure a meaningful learning to the trainees.

5.14 Principles of designing Training Programmes

While designing the training content, the following principles need to be kept in mind.

1. Principle of theory and practical exercise.

2. It is based on experiential learning exercises.

3. Provision of opportunities for feed back through participation of the learners.

4. Facilitates interaction among the group as well as trainer and trainees.

5. Provision for flexibility based on the demand of the trainees during the training programme.

5.15 Designing of the Training Programme

The designing of the training programme otherwise means sequencing the contents of the training curriculum. It is very important to present the topics in a sequential manner as per their importance and the dependence. The basic knowledge and skills to be learned must precede the next in higher order for an easy learning. Sometimes it will be necessary for participants to learn a particular task before another task. Arrangement of tasks is essential to make the learning more interesting and with out any confusion. Thus an analysis of relationship among various tasks to be learned and arranging them in an order which will facilitate an efficient learning in the shortest possible time is a must. This is called as sequencing of training contents.

While sequencing the contents the following principles may be kept in mind.

1. Introduce the topic which is familiar to the trainees first. After giving the basics to the trainees first the difficult and advanced topics need to be introduced.

2. Introduce the general topic first followed by more specific topics to the learners. This will help the learner to focus their attention in a much easier manner.

3. The topics are to be introduced in a logical order based upon which a phenomenon occurs or in a chronological sequence.

4. Always introduce a general problem first and then discussion on those causative factors which contribute to the problem and ways to solve it.

5. The steps under job performance order follows a sequence in which a particular job is completed.

5.16 Guide for Content Sequencing

The following sequencing guide designed by Tracey (1971) and reported by Parshad (1998) may be kept in mind while sequencing the training topics.

1. Place easily learned task early in the sequence.

2. Introduce early in the sequence broad concepts and technical terms, which have application throughout the training system.

3. Place practical application of concepts and principles close to the point of initial development.

4. Place pre-requisite knowledge and skills in the sequence prior to the points where they must be combined with subsequent knowledge and skills.

5. Provide for practice and review of skills and knowledge, which are essential parts of later tasks.

6. Introduce a concept or skill on the task in which it is most frequently used.

7. Do not overload and task with elements that are difficult to learn.

8. Provide for practice of required skills and review of concepts and principles in areas where transfer of identical or related skills is not likely to occur unaided.

9. Place the complex or cumulative skills later in the sequence.

5.17 Conducting Training Programme

Conducting refers to the process of carrying out the training plan into action. Since it involves the co-ordination of different activities, it poses a number of challenges. The experiences of several trainers show that conducting actual training programme happens to be one of the difficult tasks and needs to be done very carefully. The implementation stage consists of the components such as (i) preparation (ii) actual conducting and (iii) creating favourable instructional environment. The preparation starts with the giving of publicity for training through suitable media. A brochure giving the details needs to be prepared for distribution among the target group. In addition, the local media, journals, news paper coverage may also prove helpful in reaching the target audience. On receiving the application and nomination forms from the interested candidates, the application needs to be processed to select the most suitable candidates. A selection committee may be constituted to select the candidates according to the number of seats available based on the bio-data received. On selection, the candidates need to be informed about the same along with the details of their boarding and lodging arrangements available as well as a brief line about the weather and location details of the city or town.

Efforts should be made to secure the confirmation of participation from the selected candidates and prior arrangements for filling up the vacancies arising due to the cancellation of the selected candidates at the eleventh hour before starting of the programme. Pre training rapport with the confirmed participants are to be provided with the basic information about the training to be undergone. They may also be asked to come prepared with the required materials, reports or data likely to be used in the training sessions. The training co-ordinator should conduct the review meeting with his co-trainers and associates to confirm the progress of all activities concerned with the programme.

5.17.1 Registration and Inauguration

The registration of the participants in the prescribed proforma is a must. During the registration, the training materials or manuals, writing pads etc. should be made available. The details of topics to be covered along with the experts, time and data are to be provided to the trainees prior hand. The formal inauguration of the programme is needed to open up the session with a key note address and lectures by noted specialists.

5.17.2 Micro lab

This exercise helps the participants to get acquainted with one another before the start of the training programme. Micro lab consists of a number of mini exercises to help the participants get prepared and receive a maximum output from the programmes. It is called as Micro lab because it is intended to provide an abstracted pre review of the main programme.

According to Pareek and Rao (1992), the micro lab exercise helps the participants to unfreeze and open up them to their fellow participants. Through the Micro lab activities, the inhibitions are removed and an open environment is created. It helps the participants to know the likely main contents and training methods of the main programme. In the micro lab participants are encouraged to share an aspect of his or her life with others.

5.17.3 Creating Suitable Training Environment

Favourable training environment is the most important thing for learning. Some of the factors which can help to create a favourable training environment are as follows:

1. A comfortable, spacious and well lighted room is needed for ensuring physical comfort to the trainees.

2. A climate of mutual control and facilitation is required.

3. The objective of the programme and your expectations from the participants should be made clear.

4. Encourage effective participation and interaction among the participants.

5. Receive the ideas of participants with an open mind and show a genuine concern for participants' interest.

6. Make every effort to secure the punctuality among the participants as well as the timings of the session.

5.17.4 Topic Presentation

A good presentation or delivery of the topics is an important component in a training programme. The clarity of the trainer, his enthusiasm, confidence, and presentation style are the factors influencing the success of a training programme. In addition, the voice modulation, facial expression and body language of the trainer are most important in deciding about the attractiveness. Other factors such as expectancy, utility factor and self evaluation are greatly responsible in influencing the success. The best trainers are those who want the trainees to learn and expect that the participants are capable of learning. The effective trainers while presenting their topics, develop and form high but reasonable expectations about the trainees learning and performances. Their expectations are to be communicated to the trainees through verbal and non-verbal means. Effective trainers always ensure that the topics covered are of practical use and evoke interest in the participants. Further, what is learnt are also to be linked with the job or work situation.

The self evaluation is an important aspect of the training programme. The self evaluation helps to improve the trainers' skills and make necessary corrections in their approach in making the training programme a successful one.

5.17.5 Valedictory Function

The formal valedictory function will provide an opportunity for the policy makers and authorities to know what had happened in the training programme and its impact on the participants. It will help the organizers to know the views of trainees. It also facilitates exchange of ideas and views which will help to bring about suitable modification and refinement in the training modules and methodology adopted.

5.18 Selection and Orientation of Trainers

In any training programme the whole subject is divided into different specialized topics for which experts in the relevant topics are usually invited to deliver the lecture and impart necessary training to the trainees. The selection of trainees are very important in the sense, the trainers must be competent and comfortable enough to handle the given subject. According to the training objectives, audience characteristics and degree of specialization are some of the important points to be considered while selecting a trainer. A scientist of super specialization will be a wrong choice if he is invited to impart training to tribals regarding fertilizer application. The trainer should be comfortable with the local language to which the majority of the trainees belong. It is necessary to explain the difficult concepts in the local language for a better understanding. As far as possible the locally available resource persons are to be considered as a first choice. The local experts are well aware of the local situation and practical knowledge that are required for the trainees. Depending upon the subject coverage of the training programme, the trainers belonging to related discipline are also need to be considered. A mix of trainers with varying degrees of experience will invariably help to make the training programme more lively and interesting. It is also important to keep the gender mix among the trainers at an optimum level. According to the nature of the topics and skills to be imparted the male or female trainers are to be decided. The topics involving heavy field work and demonstrations are normally allotted to male members. The topics such as home science, tailoring, nutrition and health are better performed by female trainers. In this way the suitability of the trainers to the subject is to be analysed well and a judicial selection is to be made. It is also needed to consider an assistant for the main trainer to provide technical assistance during the training programme.

The orientation programme for the trainers is to be conducted before the commencement of the training programme. During the orientation programme the following points are to be discussed so that the trainers will get themselves prepared for the programme.

1. The time and duration of the slot allotted to them.

2. The brief description about the technical standard of the training materials and the lecture to be prepared.

3. Details about the trainers regarding their age group, educational status, gender status, purpose of their training etc., need to be appraised.

4. More important is the preparation and use of instructional materials. The type of facilities available with the organisation in handling a particular type of AV aids, need to be made clear before hand to avoid last minute confusion. Some times we can see that trainer has come prepared with a particular AV aid for which there are no operational facilities available at the training centre.

5. If the training programme involves any hands on training, the type of raw material required, machineries used, number of batches to be made and assistance required need to be clarified during the orientation programme itself. Before commencement of the training, a detailed understanding about the way in which it is to be organized is a must.

6. If there is a specialized training equipment or strategy involved, it should be discussed thoroughly with the trainers and it is necessary to conduct a mock training session to make the trainers comfortable with the situation before commencement of the training it self.

7. Finally, the trainers need to be appraised with the details of the physical facilities available with the organisation so that they can come prepared to match with the available facilities without any assumptions.

5.19 Selection and Preparation of Instructional materials

Instructional materials are just tolls or aids or vehicle for transfer of ideas, technology or message. The success depends upon the selection of right type of materials or aids at the right time and in the right way. Therefore, the trainer needs to be selective in using the aids in consideration of the different situations of his audience and at different stages in the training process. A poster for example is of little help except in the awareness stage. For creating interest in the audience in adopting new technology such as the use of crossbred bullocks for agricultural work, a movie film is the appropriate one.


Selection and preparation of training materials

There is no inherent magic in the visuals. They have to be used in support of a lecture for highlighting the most salient feature in the lecture to make the audience to understand and remember. Instructional materials are usually of audio visual type. They are only aids to your verbal words and your words depend on them as much they depend on your words. Audio-visual aids are not necessary for each and every type of communication. For example, there are ideas simple enough that can be easily communicated through verbal words. Audio-visuals are therefore need to be used for things that are beyond easy comprehension of the audience or out of his experience or abstract enough or complicated enough for their easy understanding. It is only then that audience will have a sustained interest for learning through audio-visual aids. While planning for the use of audio-visual aids the trainer must think clearly about the objectives, audience, the media, the resources and techniques.

5.19.1 Objectives

Clear objectives are the basis of any good presentation, demonstration or training. Objectives should be specific. Trainer must be specific and clear in his mind that what essential points he wishes to have understood by the audience and what type of action he wants them to take. He has to know well the obstacles or the thought barriers of his audience and should be able to overcome the same.

5.19.2 Audience

Audience or trainees must be known well. A clear picture about them gives an idea for enough preparation. It is also very essential to know their field of experience, cognitive make up and their group norms. At Africa, the slide show on malaria control evoked poor response with certain tribes since, the enlarged projected image of the mosquitoes and larva on the screen could not fit with the cognitive experience of the tribes.

Selection and preparation of training materials

Since the tribes could not follow the concept that the small mosquito is enlarged and projected, they disassociated themselves from the message saying that they rarely come across such big insects in the forests. Since, the meaning always lies with the people, it is essential to take care of the audience and their nature before preparing for communication and selecting the visual aids.

5.19.3 Media

Certain media are well suited for certain jobs. For certain types of scientific teaching such as entomology or pests, film-strips are the ideal visual aids. When motion is important for understanding, a film or a demonstration is good. If you are trying to explain how a crossbred bullock work in the field or a bird flies or a tractor moves, it is good that you show the trainees a film giving in slow motion the movement of the particular parts. A working model, if it can do the job, can also explain the techniques to the audience well. If the operation is complicated involving a number of factors, still pictures, charts or slides may be better used during or after a film show. Where the subject needs close examination of the details such as communicating the idea of different parts, you may go in for the model rather than using a set of flash cards.

5.19.4 Resources Availability

When you plan for your aids, the resource potential such as finance, availability of the aids, operational facilities and availability of infrastructural facilities such as power, place etc. for making use of the aids need to be analysed. In case of non-availability of suitable resources and materials, simple visual aids can be prepared using the locally available materials and facilities.

5.19.5 Techniques

There is difference between one visual aid and the other. Therefore, it is necessary to know the techniques of effective use of aids so that the ideas or technologies you want to communicate can go to the receiver.

Preparation of most of the audio-visual aids call for a thorough understanding of the subject matter on which you are trying to prepare on. Different visuals will call for different treatments of the message. While preparing visuals care is to be given to know the local interest. It helps in making the aids more interesting and authentic. Before using the visual aids, technical correctness of the fact that is depicted, operational procedures, and sequence of ideas need to be checked thoroughly. Finally, faith should be kept on the utility of the audio-visual aids and they can be used whenever it is possible and wherever they are necessary during the communication process. The training will be more effective if we opt for the multi media approach than sticking to one aid alone.

5.20 Training methods

The selection of appropriate training methods is important for an effective learning. The training methods refer to a combination of various instructional media used for conducting the training to achieve the learning objective efficiently and effectively. The following items are to be kept in mind while selecting the training methods. It should:

1. Help to minimize the time taken for the learning process.

2. Make the learning process interesting.

3. Allow active participation of the learners.

4. Help the participants to transfer their learning experiences from training to job situation.

5. Provide the learners with knowledge of results about their attempts to improve.

6. Provide some means for reinforcement of appropriate behaviour of the trainees.

7. Provide the learners with an opportunity to practice and to repeat when needed.

8. Help the learners their willingness to change.

The selection of suitable training methods is largely influenced by the training objectives, subject matter handled, participants nature, resources availability such as time, location and budget, organizational considerations and trainers capability.

If the purpose of the training is to increase knowledge, training methods that allow you to present the concepts will be effective. The suitable methods for this purpose are lecture, case study, demonstration, group discussion, buzz session and brain storming.

If the purpose of the training is to help the trainees to acquire new skills, the appropriate methods that are useful are demonstrations, role play, structured exercises, practical exercises and workshop. If the purpose of the training is to change the attitude i.e. to help the trainees to acquire new values, opinions and beliefs, the methods such as role play, case study, demonstrations, field visits, structured games and exercises, instrumented exercises, film and video tape are of useful.

The choice of the training method will also depend upon whether the training is intended to develop a general or specific level of knowledge and skill. The participants learning style, their experience and size of the group are also some of the factors that are to be kept in mind while deciding upon the training methods.

Sl. No.	Training methods	Number of participants
1.	Lecture	10-40
2.	Group Discussion	3-10
3.	Case Study	3-10
4.	Role play	5-7
5.	Field visits	5-20
6.	Seminars and syndicate	15-30
7.	Demonstrations	5-15
8.	Simulation method	8-15
9.	Structured exercise	5-15
10.	Instrumented exercise	8-15

Training methods and optimum number of participants

5.20.1 Lecture

A lecture consists of oral presentation of the subject matter along with the help of audio visual aids such as black board, over head projector, slides, charts etc., so as to help the listeners to understand the concept, principle and method being presented. The lecture method is suitable to an audience size of 10-40.

5.20.1.1 Steps in Lecture presentation

1. Make the purpose of the presentation clear to the trainees at the beginning itself.

2. Build the lecture presentation from the existing level of knowledge of the trainees.

3. Organize the presentation in to introduction, body and summary

4. Adjust the pace and language of presentation as suitable to the trainees

5. Ensure the attention of all the listeners and use questions frequently to check the trainees understanding.

Through lecture it is possible to present large volume of information in a short time. Cost effective and it can be used at any place and time.

5.20.2 Seminar

A seminar is one in which different aspects of a particular subject is discussed in a logical sequence under the guidance of experts and experienced professionals. The duration of seminar may be of 2-3 days and specific time is allotted for different speakers or experts. The purpose of the seminar is to pool the expertise of different professionals and come out with conclusions and concrete recommendations to solve the problems or improve the existing situation.

5.20.3 Group Discussion

A group discussion refers to exchange of ideas and thoughts by two or more people on a selected topic. The purpose of discussion may be related to clarification of ideas or help in understanding and application of ideas to practical situation. Some times the purpose of the group is to arrive at a consensus about a debatable subject.

5.20.3.1 Advantages of group discussion methods

1. It ensures participation of the trainees by providing opportunities for contribution.

2. It enhances the motivation and interest of trainees.

3. It helps in pooling of knowledge and experience of different participants, which can form a basis for effective learning by the entire group.

5.20.3.2 Disadvantages of group discussion methods

1. Effective group discussion demands time and organizational skill.

2. Improper group discussion may end up in unnecessary arguments and heart aches.

3. Care should be taken to ensure the participation of 'shy members' and to prevent the domination by a few.

5.20.4 Workshop

A workshop refers to assembly of interested and select group of people to learn and practice specific skills under experienced professional guidance. Emphasis is given for acquisition of proficiency of every member who participates in the workshop. A mix of theory and practice is provided in a workshop situation.

5.20.5 Symposium

Symposium is a gathering of experts who present their findings or ideas on a specific sub-topic related to a major subject. Each speaker under the method is given specified time and discussion among speakers or audience is not a common feature. The output of the symposium may result in the publication of edited papers presented by the experts.

5.20.6 Syndicate

A syndicate is a group of people (8-10) assigned with a task of investigating a particular problem or topic and to find out the solution. The activities of a syndicate are coordinated through a chair-person and a secretary. Entire group works on its own through collection of data, discussion with relevant people and consultation of literature. The findings of the study including recommendation are presented before the entire group along with the main report. Syndicate helps in widening the understanding of the participants.

5.20.7 Panel Discussion

A panel discussion is an effective method for discussion of any particular topic by a panel of three to five experts representing different areas of the same subject.

5.20.8 Simulation Methods

Simulation method consists of simulating real life experiences. The common simulation exercises are role play, in-basket exercises and games.

5.20.9 Role Play

A role play is a technique where in one or a group of trainees enacts a real life situation which helps the participants to experience the true feelings of that situation. The method of role playing is useful for training in effective or behavioural dimensions. It may be mentioned that there is no pre-determined script or dialogue set before the actors. The actors of a play are expected to behave as if it were a real life situation.

5.20.9.1 Steps in Enacting Role Play

1. Choose a problem which is consistent with the learning objective.
2. Explain the topic and set the climate for role play.
3. Describe the purpose and objective of the activity.
4. Provide a brief introduction of the whole play.
5. Ask the group to select different players to enact the play.
6. The role areas and performance are to be made clear to the actors.
7. Specify the role of observers in the play.
8. Arrange the room and set the stage.
9. Enact the role play in its real sense.
10. Ask participants to list out critical incidences surfaced in the role play.
11. Carry out discussions to find out the views of all the observers.
12. Develop a final understanding on the expected behavioural role in real life situations.

5.20.9.2 Advantages of Role Play

1. Role play acts as a traditional stage between theory and practice.

2. It is an effective method to gain insight about the different behaviours of the participants and get to know the strong and weak points in their behaviour.

3. It increases the participants' ownership of learning.

5.20.9.3 Disadvantages of Role Play

1. Role play sometimes over-personalizes the problem situation or end up in stereotype and caricature roles.

2. Role play, if not planned, organized and processed properly will be viewed as a mere fun exercise.

3. The participants will be tempted to act in an unnatural way and will not reveal their true behaviour.

5.20.10 Psychodrama and Sociodrama

Psycho and socio dramas are also simulation training methods. They are used along with the treatment to help the disordered people to relieve from the situations that upset them psychologically or socially. The importance of the drama lies in the process, in the reacting or reliving itself. The performers are given free hand and no control over their skill or play and it may lead anywhere. It gives opportunity to vent out their blocked emotions and feelings. The purpose of the simulation methods of training is to offer opportunities for specific experiences rather than leading to anywhere else.

5.20.11 In Basket Exercise

It is one of the behaviour simulation games designed for evolving role behaviour simulations. The trainees are asked to act as if they have assumed a particular role and their behaviour is critically observed. On the basis of their performance, the trainer critically evaluates their knowledge, skill and attitude to handle a particular role or take when assigned to it. Based on the evaluation result the trainee will be given training to modify his approach by providing the required knowledge and skill. This method is a most elaborate simulation which creates a complex work organisation, rotate participants through key roles in it, and have them deal with specific situations of a kind they encounter

in real life. The trainees may work at an office situation with training intercoms, telephones and full in-baskets. The trainee has to face a number of inter departmental communication letters, data, reports, forecasts, targets etc. He will be posted with a series of problems, emergency situations and incidences for which he has to respond and try to keep the thing moving. The development of such in basket exercises needs a thorough understanding about the work situation, performance, office procedures etc. This technique plays an important role in training the behavioral dimensions.

5.20.12 Games

"A game is a structured activity in which two or more participants compete within constraints or rule to achieve an objective. A simulation is an operational model, using selected components, of a real of hypothetical process, mechanism or system. A simulation game combines the characteristics of games and simulations in a game based on a simulation". A simulation game combines the element of a game-competition for an objective, rule, and closure-and those of a simulation. (Ksiser and Seeler, 1987).

5.20.12.1 Types of Simulation Games

1. **Gamut-running game** which involves overcoming obstacles by the players until they reach a goal.

2. **Allocation game** are related to resource allocation problems where the resources like money, power etc, are scarce.

3. **Group interaction games** are related to human relation problem which help the participants to experience new points of view.

4. **General system games** are related to total system of an organisation i.e., an institution or a company under highly structured set up.

5.20.12.2 Steps in Designing Simulation Games

Steps in designing a simulation game according to Keiser and Seeler (1987) are given below:

1. Determine the training objective of the exercise and its intended users.

2. Develop the basic specification of the exercise.

   a) Building simulation models.

b) Develop expectations and parameters of the exercise

c) Describe the contents of the exercise and its format.

3) Develop the components of the exercise: scenarios, rules, roles and an accounting system

4) Construct and test a prototype of the exercise including field-testing.

5.20.13 Case Study

A case study consists of material related to an event, or problem. Since most of the case studies are related to real life situation, an analysis of case studies will help in acquiring development of analytical skills. The trainees are presented with cases either through written materials or video and are requested to analyse different situations and make their own decisions. It helps the trainees to develop independent thinking and to discover for themselves the facts and ideas.

5.20.13.1 Types of Case Studies

1. **Case illustration:** Here participants are supposed to evaluate the correctness of decision in the supplied case.

2. **Case problem:** Here the participants have to analyse the given information, make decisions substantiate those decisions using valuable arguments.

5.20.13.2 Steps in Case Analysis

1. Distribute the case study materials to the participants. This means that the trainer should have access to well-prepared case materials related to the learning objectives.

2. Give sufficient time for reading of the cases by the trainees so that they may understand key issues of the cases.

3. Start discussion on the identified questions or issues.

4. Record the key elements of the discussion.

5. Analyse various view points and draw conclusions.

5.20.13.3 Advantages of Case Study

1. It secures active participation.

2. It is an excellent tool to improve analytical thinking, decision making and problem solving.

3. Since good case study materials are based upon real life situation, it helps the participants to apply the concepts into practice.

5.20.13.4 Disadvantages of Case Study

1. Preparation of good case study materials needs expertise and time.

2. Collection of data to prepare cases or case-let may be costly.

5.20.14 Structured Experiences

Though some trainers include all types of simulation under structured experiences, it is note worthy to point out that structured experience is one of the methods of simulation. There is a clear cut difference between games and simulation exercises which could be understood by reading the definition of 'game' and 'simulation exercise' given earlier.

According to Pfeiffer and Ballew (1988) a structured experience is group learning design which is based on the following five stages of experiential learning cycle:

a. Experiencing (Activity, Doing)

b. Publishing (sharing reaction and observations)

c. Processing (Discussion of patterns and dynamics)

d. Generalizing (Inferring principles about the real world)

e. Applying (Planning for more effective behaviour)

a. Experiencing

This is the first stage of experiential learning cycle which deals with generation of data as a result of going through activities which is a part of structured experience. The participants are given instructions about the goal of the activity including "do's and don'ts". Some of the most important activities under structured experiences are:

1. Role play
2. Writing
3. Self disclosure
4. Competing or collaborating
5. Creating objects
6. Making products

The above activities can be done separately by individuals or jointly in small groups.

b. Publishing

In the second stage of experimental learning cycle, the data generated through the first stage i.e. experiencing is made available to the entire group. Efforts are made to collect data at cognitive, effective and behavioural levels. The following methods are used to record the reaction and observation of the participants.

1. Recording of data in the blackboard.
2. Posting the data using flip chart.
3. Collection of data using rating instruments.
4. Interviewing of the participants.

c. Processing

The stage of processing is the fulcrum or the most important step in the experiential learning cycle, which is concerned with analysis of experiences shared by the trainees. Careful planning has to be made to process the data collected and bring out the specific patterns underlying the dynamics of the activity. Unprocessed or ineffective processing will defeat the very purpose of structured experience exercise. Some of the techniques, which can be used in the processing, are: use of process observers, analysis of recorded data and studying the trends and patterns, analysis of role

behaviour of participants. Efforts should be made to help the participants to look back at what happened at the activity stage in terms of group dynamics and "not in terms of meaning".

d. Generalizing

At this stage the participants are helped to relate a classroom or training room experience to the real world experience. It is important that the participants realize that what happened in the classroom is not an exercise but actually happened in the real world back at the work place. The important question to be answered here is 'so what?' Some of the strategies which can be used to develop generalization are:

1. Guided imaginary: Helping the trainees to apply the class room experience to the real world experience.

2. Individual analysis: Helping the participants to make a brief write up on what have been learned and re-learned.

3. The trainer may also bring some theoretical inputs and research findings to help the overall learning process.

e. Applying

Applying is the last stage of the learning cycle to answer the question "now what"? The trainees are assisted in applying the generalizations developed out of learning experience to actual work situation. The actual application of learning results in modification of behaviour. Some of the practices which can be used at this stage are:

1. Goal Setting: The participants may be requested to set goals which reflect the changed behaviour.

2. Contracting: Making agreements with co-trainees about application of the generalization.

5.20.14.1 Examples of Structured Experiences

Some of the most popular structured experiences are:

1. Ring – toss exercise: This game, first used by Kurt Lewin, is effectively used to study risk-taking behaviour.

2. Broken-square exercise: The broken square exercise was developed by Pfeiffer and Jones (1969) which is used to demonstrate one's tendency to collaborate and compete under intra-team situation.

3. Tower building exercise: The Tower building exercise was originally used by Rosen and D' Andrad to investigate the impact of child rearing practices or achievement motivation. The above game can be effectively used to demonstrate goal setting process and to understand the role of helps and expectation (Pygmalion effect) in achievement motivation.

A set of 316 structured experiences have been combined by Pfeiffer and Jones in 1981 and published in eight volumes under the title "Handbook of Structured Experiences for Human Relations Training". Apart from the above publication, Pfeiffer and Company is also publishing an annual handbook since 1972, for group facilitators which contain a number of structured experiences.

5.20.14.2 Advantages of Structured Experiences

1. It helps the trainees to understand different aspects of the behavioural patterns.

2. A lot of interest and curiosity is developed among the participants.

3. It creates an intense involvement among the participants.

5.20.14.3 Disadvantages of Structured Experiences

According to Argyris (1967) as reported by Pfeiffer and Ballew (1988) some of the negative effects of structured experiences are as follows:

1. Lack of theoretical reasoning which support the use of structured experiences.

2. Problem in generalization and its application in real work situation.

3. The participants may become dependent on the trainers due to the dominant role of trainers.

4. Lack of processing skill of the trainer may result in poor learning by the participants.

5. Even if the participants develop some generalization based upon their classroom experience, a true change in their behaviour may not happen as it depends upon so many contextual factors.

5.20.15 Instrumented Exercises

Instrumented exercises refer to use of psychological instruments such as a rating scale, questionnaire and related forms of data collection techniques, which are used to collect information about the trainees' attitude, perception and interest with the purpose of assessing and analyzing their behaviour. These instruments differ from tests, as there is no right or wrong answers while responding to a particular rating scale or questionnaire. The data collected from the instruments can be used to analyse the individual and group behaviour with the purpose of personal growth and understanding a particular concept or theory. For example, an instrument in leadership style can be effectively used to provide information about leadership style can be effectively used to provide information about leadership style of an individual or a group and to discuss the concept of leadership styles. The instrument can also be used to reinforce the learning from the structured experiences (Pfeiffer and Ballew, 1988).

5.20.15.1 Application of Instrumented Exercises

The uses of instrumented exercise are as follows:

1. Providing instrumented feedback to the participants which will help in interpretation of their score in relation to particular behaviour.

2. To introduce new concepts in an interesting way

3. To analyze changes or outcomes out of training programme in human resource development.

5.20.15.2 Steps in use of Instrumented Exercise

Different steps in using of an instrumented exercise in human resource development are as follows:

a. Administration of the Instrument

An appropriate instrument chosen for particular learning objectives are distributed to the participants. Instructions about filling up of the instrument are given and the trainees are encouraged to respond to the question honestly, to promote a higher level of self-learning. The respondents should be told that there are no right or wrong answers to the questions provided in the instrument and the purpose of the instrument is for personal growth. The administration phase may take upto 20-30 minutes.

b. Theoretical Inputs

The phase of theoretical input consists of clarifying the theoretical basis of the instrument. For example, and instrument on motivation may call for explaining the following concepts of motivation briefly:

1. Personal achievement motivation
2. Social achievement motivation
3. Influence

c. Prediction

Under this phase which may only take a few minutes, the trainees are asked to predict whether they will score high, medium or low on the behaviour under study. For example, when the participants are given the instrument on motivation they are asked to predict their motivational level with respect to their personal achievement, social achievement and influence.

d. Scoring

In this phase the scoring procedure for the instrument is explained to the participants and the participants are requested to work out their score. The facilitator may help the participants in scoring. The actual score of the participants and their predicted score are recorded and displayed in the blackboard or poster. The interpretation of the score of the participant is an important phase in an instrumented exercise. The interpretation may vary according to the style of the facilitator or purpose of learning objective. The steps which can help in interpreting are as follows:

1. Comparison of actual score received with predicted score.
2. Comparison of actual score with the group average.
3. Comparison of individual score with others.
4. Evaluation of each trainee's score in terms of absoluteness.

e. Processing

The phase of processing is the most crucial in the instrumented exercise, which depends upon experience and expertise of the facilitator. The processing should help the participants to analyse

their scores and to understand how their scores fit with their self-image. The need and importance of different behaviours and orientations should also be discussed. Effective processing will help the participants to switch from one orientation to another according to the need of the situation.

5.20.15.3 Advantages of the Instrumented Exercises

1. An effective way to learn new concepts.

2. Secures the involvement of the participants.

3. Helps the participants to assess their own behavioural pattern and show the need for its change.

5.20.15.4 Disadvantages of Instrumented Exercises

1. The participants may not respond to the instrument with honesty.

2. The responses may reflect the acceptable behaviour rather than the actual behaviour.

3. Development and testing of instrument including its administration may consume a lot of time.

4. Anxiety may be produced about the test.

5.20.16 On-the-Job Training

On-the-job training is known by different names such as side-by-side training or one-to-one-training. On-the-job training takes place in the work-place and consists of helping an individual trainee to acquire new skills and expertise through practicing them under the guidance and supervision of an experienced trainer or an employee. The trainees under on-the-job-training witness how the work is done. The participants under on-the-job training go through the following stages while learning new tasks (Reay, 1994).

1. Observation of how the job or work is done by his/her trainer

2. Listening to instructions and understanding them.

3. Practicing the job.

4. Receiving feedback from the trainer about the performance.

5. Clarification of doubts and receiving more guidance from the trainer.

6. Practicing the job till performance standard is achieved.

7. Learning another job based upon the above steps.

5.20.16.1 Developing of On-The-Job Training System

The steps in developing of on-the-job training system for any development Organisation are as follows:

1. Prepare a training database on job analysis, learning objectives and individual training needs.

2. Develop a training schedule based upon priorities of training needs.

3. Select the employees (trainers and trainees) for training on phased manner based upon training schedule.

4. Make arrangements for resources needed for the training.

5. Run the training programme.

6. Monitor and evaluate the effectiveness training.

7. Make necessary changes based upon the evaluation.

8. Document the training.

5.20.16.2 Advantages of On-The-Job-Training

1. Training is conducted under real-work situation

2. Skills learnt are relevant to job situation and useful

3. Cost effective.


Trainings in progress

5.20.16.3 Disadvantages of On-The-Job-Training

1. Frequent hindrance during training.

2. The trainer may not be effective in transfer of skill/knowledge.

3. The trainees may feel less enthusiastic to learn from his/her colleagues or supervisors.


Trainings in progress

5.20.17 Programmed Instructions

The programmed instructions individualize the simultaneous training of many participants at a time in several skills. The programmed instructions are given in the form of a teaching machine or a programmed textbook, video or T.V. programme. The programmed instructions consist of an ordered sequence of stimulus items to which a trainee responds in a specified way. The response

given by the trainee is reinforced by immediate results. Therefore, the trainee learns by making right movements and responses from what he knows by a process of successively closer approximation towards what he is supposed to learn from the programme. One of the advantages of programmed instruction over other methods is its flexibility. It also provides in private the step-by-step evaluation and feedback to the trainees. It also provides an uniform training input to the trainees.

5.20.18 Experiential Learning

Experiential learning refers to the type of learning obtained through transformation of experience into knowledge. The learners are encouraged to involve themselves fully into an experience and later reflect and analyse that experience to draw conclusion or knowledge. The experiential learning cycle helps participants draw meaning out of experience through discussion and analysis. This is quite appropriate for skill training because it provides a kind of experience which may easily lead participation to reflection, draw conclusion and identify application points.

In the experiential learning, the participants learn more through group work. Trainers use exercises or problems which involves two or more people in order to encourage team work. The trainer plays a role of facilitator or guide. Trainers settle goals and help in smooth conduct of group work. They intervene to analyse, clarify doubt and draw conclusion. The experiential learning approach involves steps such as experience process, generalization and application. In the experience process, the participant get an opportunity to engage in experience through case study, role play, demonstration etc., after the experience, the trainer guides the group to discuss about the experience critically. The individual reactions, feelings and perceptions are analysed and inferences are drawn. After critically analysing the participants are encouraged to draw conclusion based on the generalized conclusion, how the resultant experience is applied to practical problem situations so that they can plan to use their knowledge to actual work situation.

5.20.19 The Critical Incident Technique

The Critical Incident technique was developed by Flanagan (1950), which provides factual evidences in finding out behavioural characteristics that can qualitatively distinguish between different categories of people.

The methodology of the Critical Incident Technique consists of two steps. The first step involves collection of critical incidents from the respondents with regard to some identified behaviour. For example, a researcher may be interested in finding out the characteristics of effective managers. For this purpose he may interview the employees and ask them to narrate specific incidents which have made them to rate the managers as effective or ineffective. It is essential that the events should have happened recently to avoid the danger of stereotypical responses. The second step consists of content analysis of the critical incidents using the following procedure:

1. Classify all the incidents either as effective or ineffective behaviour

2. Analyse similar behaviours (effective or ineffective) to identify different specific behavioural categories.

3. Editing of specific behaviour category and elimination of repetitions.

4. Work out critical requirements based upon analysis of effective and ineffective behaviour.

5. The final step is to interpret and report the requirements of the effective managers.

6. The T-groups is also known as Laboratory Training methodology. It was first used by the National Training Laboratories Institute, Bethel, USA.

5.20.19.1 Objectives

The main objectives of T-group are: to help the participants to get insight into their own behaviour, to improve their interpersonal relationship with others, to increase one's understanding of group dynamics, to improve ones' sensitiveness to others feelings, to learn the art of giving and receiving feed back, to learn the art of conflict management, and to improve the effectiveness of group functioning.

5.20.19.2 Methodology

Since this method involves active interaction with one another the number of participants will have to be restricted to about 12-15. The task of the group will be to analyze it's own behaviour with a focus on "here and now" behaviour in the group. More emphasis is given on communicating the feeling of the members rather than opinion or information. The members are encouraged to freely disclose their self and to give and receive feedback from others. The duration of the exercise may last for several hours to few days.

5.20.19.3 Role of the Trainer

The role of the trainer is to facilitate the interaction among the participants and not to take the role of a leader. The trainer also helps in helping the participants to learn from the interactions of the group as well as providing direction when necessary. Further, relevant inputs in the form of theory and research results may also be provided.

5.20.20 Transactional Analysis

Transactional Analysis (TA) was developed by Eric Berne in 1950s by watching people's interaction with each other. Transactional Analysis method used popular terminology taken from everyday language to explain human personality and behaviour.

According to Transactional Analysis theory, there are three persons within all 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. The ego states are classified as Parent, Adult and Child.

5.20.20.1 The Parent Ego State

The parent ego state is developed by all the people in early childhood upto the age of six years. When you feel, think or act as you saw parental figures act when you were little, you are in your parent ego state. Parent ego state reflects the life as it is taught. Functionally, it sets limits, gives advice, discipline, protects and nurtures, teaches how to do etc. The parent ego is further classified into critical parent and nurture parent. The critical parent is that part of us which sets limits and makes judgment about ourselves and others. The nurturing parent is the other part of the parent ego state. It gives guidance, supports, protects, nurtures and teaches how to do.

(P) ……Parent

(A) ……..Adult

(C) ……..…Child

5.20.20.2 The Adult Ego State

The adult ego state behaviour is rational, problem-solving and decision-making. 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 adults has to say based on the past decisions; and what one external situation is. After gathering the data it analyses and evaluates 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.

The basic vocabulary of the Adult consists of why, what, where, when and how.

5.20.20.3 The Child Ego State

The child in you is what you were when you were very young. 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 centre 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.

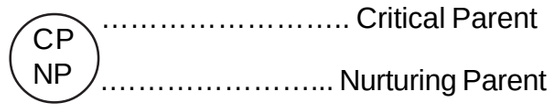
The child ego state is divided into three parts; the Natural Child (NC), the Adopted Child (AC) and the Little Professor (LP).

The Natural Child (NC) is spontaneous, energetic, curious, loving and uninhibited. It is characterized by behaviour such as the joy of soling 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.

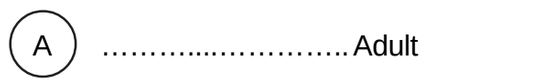
The Adopted Child (AC) acts in patterns learned from the environment. It is developed when you learned to change (adopt) your feelings and behaviour in response to the world around you. Learned feelings of guilt, fear, anxiety, depression and envy are characterized in the AC. The pride you feel when somebody praised you for your good performance often comes from the AC. The little professor (LP) is the intuitive part of the child which thinks without knowledge all the facts believed to be needed. The LP part of us gets those brilliant, non-logical insights that give us solutions to problem.

The three ego states with their sub-parts are diagrammed as shown below:

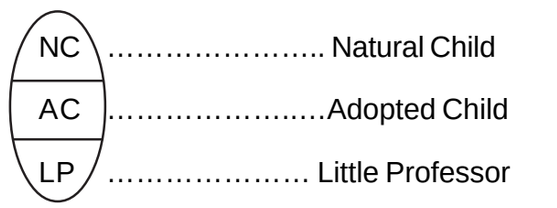
Parent



Adult



Child



Second Order Ego State Diagram

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.

While all the people are structurally alike, in that they all have a PAC, they differ in two ways: content differences and functional differences.

5.20.20.4 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 paprent 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 season 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.

5.20.20.5 Analyzing Transaction

The transaction consists of 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 gesture and facial expressions. The transactions may be verbal or non verbal. The transactions may be:

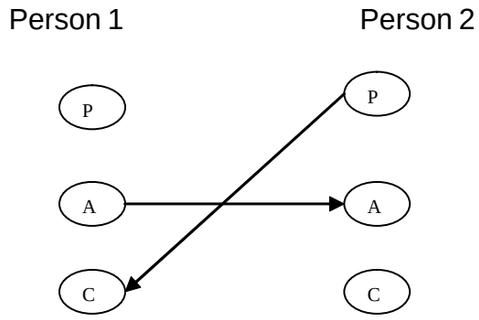
1. Open or complementary or parallel

2. Blocked or uncomplimentary or crossed

3. Ulterior or hidden or disguised transaction.

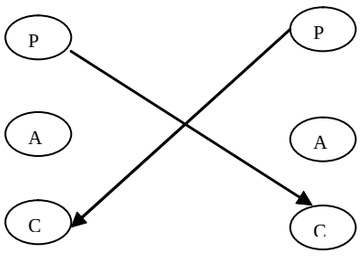
5.20.20.6 Blocked or Uncomplimentary or Crossed Transactions

When the stimulus and response cross on the PAC diagram this is called 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 person 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.



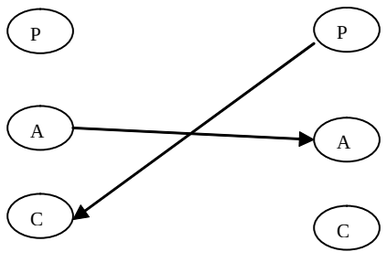
Additional illustrations of crossed transaction are shown below.

1) Trainer: You must complete the work (P → C)



2) Trainer: Give me your report on poultry farming.

Trainee: You have your own copy. Why don't you look for it?

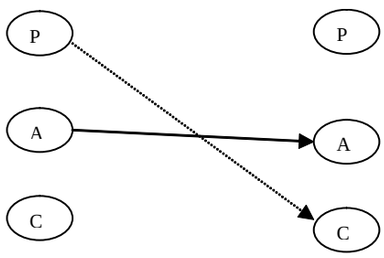


Trainer Trainee

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 advise, the boss can cross his transactions seeking guidance and force him to take decisions for himself.

5.20.20.7 Ulterior or Hidden or Disguised Transaction

In this type of transaction there is one over stimulus and simultaneously there is another covet stimulus. For example, consider the following transaction; Trainer to Training Assistant Where did you hide the posters?



Trainer Training Assistant

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 arrangement too often'.

To sum up, the complimentary transaction involves two ego states and occurs when stimulus originated from one of the ego state of a person gets the intended response from the same ego state of other person. Crossed transaction involves three or four ego states and occurs when the

stimulants received an unexpected response. Adult ego state of one person may desire to engage in complementary adult transaction will another person but second person in transaction is from child stage. The result is crossed transaction. Difference between complementary and crossed transactions is the one effect that they have on the flow of communication. Complementary transaction encourages communication whereas crossed transaction disrupts communication.

Ulterior transaction is one where there is a hidden described meaning. When people say something and mean something other, they are using ulterior transaction. In the angular transaction three ego states are involved and it is something sales man type of transaction. They are social (over or open) communication and psychological or covert type of communication. Four ego states at social and psychological level take place in duplex ulterior transaction. However, at psychological level it can be child – child or parent – child communication or vice versa. These transactions are the means of analyzing the common communication problems that usually arises during a training programme. Knowledge about the above transactional analysis will help the trainer to understand the ego states of the trainees and co-trainees for making necessary adjustments in his approach for a favourable communication atmosphere. This will largely improve the training climate and favour the learning situation very much.

5.21 Evaluation and follow up of Training

Evaluation means assessment of value of merits of a programme. Evaluation can help in assessing gain in knowledge, skills or attitudes due to training. Reactions of participants can be known. Usefulness of methods and approaches used can be gauged. Above all, overall impact of training on work performance and production can be measured. Evaluation should be done soon before training begins, during the course of training and after the training is over; Pre-training evaluation helps in understanding level of participants at entry point. Observations and data collected during the process of training point out lacunae and merits in implementation of training. Post-training evaluation is meant to measure impact.

5.21.1 Methods of Evaluation

There are many methods of evaluation viz. pre-post test, oral evaluation, structured observations and skill test, as discussed below.

5.21.1.1 Pre-post Tests

In order to measure gain in knowledge due to training a set of questions are prepared to be administered both before and after training is done. Similar test is provided both the times and results are compared.

5.21.1.2 Oral Evaluation

In case the number of participants is not very large, it is easy to get reactions of people about different aspects of training. Trainer may begin with purpose of such exercise so as to stimulate participants to express their reactions. Good aspects, problems and suggestions for improvement of training can be discussed.

5.21.1.3 Skill Test

In case of skill training it is possible to design tests, exercises with scores allotted for every step of performance. The participants may be given exercises to complete within allotted time period. Experts can observe and judge them.

5.21.1.4 Reaction Sheet

Relevance of content and methods as well as extent of satisfaction of participants with training may be taken on quick participant reaction sheets. Simple statements may be formulated to encourage spontaneous expression of feeling about training. It is ideal to prepare evaluation report on training incorporating observation and other data with suggestions for modifications.

Monitoring and evaluation is the third phase of management of training programme. Monitoring refers to “a continuous or periodic review and surveillance (overseeing) by management at every level of the hierarchy of the implementation of an activity to ensure that input deliveries, work schedules, targeted outputs and other required actions are proceeding according to plan” (UN 1984, as reported by Misra, 1990). On the other hand, evaluation is a process of investigating how far the objectives of the training programme have been achieved. It also involves analyzing the strengths and weakness of the programme, reactions of the participants, and its over all impact on behavioural change and job performance of the participants. Different steps in evaluation include collection of relevant data at various phases of training programme and analyzing them to assess the effectiveness of training activities.

5.21.2 Types of Training Evaluation

Evaluation can be classified into four types such as Planning Evaluation, Process Evaluation, Terminal Evaluation and Impact (Misra, 1990)

5.21.2.1 Planning Evaluation

The evaluation for planning of the training programme consists of two phases. In the first phase the training needs of the participants are assessed through one of the following four approaches:

- Performance analysis
- Task analysis
- Competency study
- Training needs survey

The skill gap analysis is also a part of assessing training needs. In the second phase, an assessment of instructional methods is done and the most appropriate training methodology and instructional strategy is worked out.

5.21.2.2 Process Evaluation

The process evaluation is also known as formative evaluation. This is done when the training programme is running and it helps in solving the problems arise while implementation of programme.

According to Raabetal (1987) as reported by Misra (1990), "process evaluation is performed to detect or predict defects in the procedural design of a training activity during the implementation phase". As a part of process evaluation, investigations are made on the following:

1. Monitoring of training to know whether it goes on as per the plan.
2. Appropriateness of training methods or audio visual aids used.
3. Effectiveness of delivery or presentation
4. Effectiveness with regard to proper mix of theory and practical
5. Changes in the knowledge, skill and attitude among participants
6. Satisfaction of trainees with boarding and lodging facilities
7. Effective utilization of finance

5.21.2.3 Terminal Evaluation

Terminal evaluation is done at the end of the programme to find out to what extent the objectives and desired benefits of the programme have been achieved. The strengths and weakness is of the programme as perceived by the participants are also analyzed, the results of which will be useful to

make future improvements. 'The terminal evaluation is primarily concerned with learner performance' which can be analyzed using two approaches namely norm-referenced and criterion-referenced. Under the norm-referenced evaluation, the gains are learning are determined based on pre and post training scores. The criterion-referenced evaluation is related to investigation of what was taught and what was learned.

5.21.2.4 Impact Evaluation

Impact evaluation refers to assessing the programme impact on the job-performance of the participants. It attempts to find answer to the following questions:

a) What are the improvements in the performance of job as the result of training?

b) What are the benefits accrued to the participants and organisations as the result of improved job performance?

c) What are the problems in applying the skills learned in real work situation?

d) What can be done to enhance the application of newly learnt knowledge and skill in the work place?

5.21.3 Alternative Evaluation Models and Approaches

An understanding of alternative models of evaluation is necessary to make right choice about the model to be followed in evaluation situations. A brief description of six evaluation models as discussed by Deshler (1997) is presented below

5.21.3.1 Expert Model

Under expert model, evaluation of a programme is done by a team of external or internal experts. Data collection and analysis is done using appropriate tools and techniques. The final report will contain recommendations to make improvements in overall planning and implementation of training programme so as to achieve desirable outcome.

5.21.3.2 Goal-free Model

This model originally developed by Scriven (1972) aims to analyze the impact of training in relation to the interest and utility of participants irrespective of stated goals of the programme. Evaluation of any programme strictly by its stated goals may be narrower in its scope and goal free

model takes a multidimensional approach to uncover the consequence of training which is directly related to the interest of the participants and organizations

5.21.3.3 Attainment of objective Model

As the name suggests the above model is concerned with assessing how far the programme has achieved its stated objectives. This model assumes that the success of the training programme can be worked out through 'measuring a programme outcome against its own goals'. The problem under this approach is that often the objectives of the programmes might be set as a lower level so as to ensure its success.

5.21.3.4 Management Decision Model

Evaluation under decision model is mainly concerned with collection and analysis of data for the purpose of decision making by managers and policy makers.

5.21.3.5 Naturalistic Model

'This model assumes that a programme is a natural experiment and that the purpose of evaluation is to understand how the programme is operating in its natural environment'. The data collected under this method is used for a discussion of issues related to programme objectives, procedures, methods, expectations and benefits.

5.21.3.6 Experimental Model

The experimental model of evaluation is concerned with investigating to what extent the changes occurred or impact can be attributed to training programme as well as due to other extraneous factors or influences.

5.21.4 Frame work for Evaluation

Four criteria such as reaction, learning, behaviour and results can be used as a framework for evaluating training programmes as reported by Kirkpatrick (1976).

5.21.4.1 Reaction

Reaction is concerned with the trainees' opinion of the programme in terms of its contents, methods, duration, and effectiveness of presentation, relevance and utility. Under this evaluation,

the trainer and training environment are evaluated using questionnaires, interviews, group discussions and other appropriate methods.

5.21.4.2 Learning

Learning is concerned with acquisition of new skills, knowledge and attitudes by the trainees as a result of the training programme, in accordance with its objectives. Some of the evaluation techniques for this purpose are : tests, examinations, workplace based assessment of competence, projects etc. It can be done during or at the end of a training programme.

5.21.4.3 Behaviour

Behaviour is concerned with the extent to which the trainees were able to apply their knowledge to real field situations. In other words, the change in the on-the-job performance, which can be attributed to the programme. Assessment of improved performance may not be easy all the times.

5.21.4.4 Results

It is concerned with the overall effect of the training on individuals, their job environment, or the organization as a whole in terms of cost savings, quality improvements and increase in output. Because departmental and organizational results depend on many facts and it is difficult to attribute improvements to the efforts of specific individuals. Experimental approach is needed here.

5.21.5 Tools and Techniques for Evaluation

The most important techniques and tools which can be used for collection of data for monitoring and evaluation are as follows:

1. Questionnaire

2. Interview

    - Structured
    - Unstructured
    - Group interview

3. Projective techniques

4. Observation

   - Participant

   - Non-participant

5. Critical incident techniques

6. Case study

7. Analysis of report

8. Ratings by self, peer & supervisors

9. Use of scales and checklist

10. Document analysis

5.21.6 Steps in Evaluation of Training

According to goal model the essential steps involved in evaluation of training programme include:

1. Identify the objectives of the training programme to define the parameters of impact in terms of knowledge, skill, attitude etc.

2. Develop test and measures to measure the identical parameters.

3. Develop necessary tools and techniques to collect data at various stages as peer the objective of the evaluation.

4. Test for reliability and validity of the data collection devices.

5. Collect necessary data from the participants using the developed instrument.

6. Analyze the data and prepare the reports.

5.22 Follow up

Many KVK training programmes end up without evolving expected impact because of lack of adequate follow up support to the trainees. Ex-trainee meetings are a must and have to be conducted by the concerned SMS of the KVK. The trainees require repeated persuasion, guidance and support put into practical application of the newly acquired skills. Linking up with the financial institutions, state departments, rural development institutions, marketing agencies etc., is a must for KVK trainees to sustain themselves in the field. Most of the time we can see the trainees could not do practically because of lack of financial assistance or continued technological support or marketing support. Such field level constraints need to be addressed carefully by providing them with adequate post training support as per their needs.

Chapter – VI

Extension Concepts in KVK Activities

6.1 Education, Training and Extension

6.1.1 Concept

A concept can be defined as a notion, idea or way in which one can see a thing in his mind, but it itself is not observable (Sharma and Sharma,1983). In other words, concepts are simply abstractions that serve to organize our thoughts and experiences into manageable mental entities. It acts as guide to understand something one can observe. Concepts vary greatly in terms of their precision, scope, clarity and acceptability.

6.1.2 Definition

According to Aristotle, a definition is summum genus et differentia, i.e., it has two components: the genus and the differentia. A genus is the essence belonging to number of things exhibiting difference in kind. The differentia is that part of the essence which distinguishes the species (class under a genus) from other species in the same genus. The sole purpose of definition is the classification of a concept. Words without definition are generally vague and do not know as to what precisely they mean.

6.1.3 System

A system is an entity composed of interrelated parts each of which contributes to the unique characteristics of the whole (Mescon et al, 1973). In an organization set up, it is an orderly arrangement of interrelated activities and related procedures which implements and facilitates the performance of a major activity of the organization.

6.1.4 Process

Process means a course of procedures, something that occurs in a series of actions or events conducting to the desired end.

6.1.5 Theory

According to Talcott Parsons (1949), a theory is a group of closely interrelated concepts used for interpretation of some experience. In other words, it refers to the relationships between facts or the ordering of them in some meaningful way (Goode and Hatt, 1952)

6.1.6 Philosophy

It is pursuit of wisdom, a body of general principles or laws of a field of knowledge. Essentially philosophy is a view of life and its various components. The practical implication is that the philosophy

of a particular discipline would furnish the principle or guidelines with which to shape or mould the programmes or activities relating to that discipline.

6.1.7 Principles

Principles are generalized guidelines which form the basis for decision and action in a consistent way. It may also be defined as a statement of policy to guide decisions and action in a consistent manner.

6.1.8 Procedure

Procedure is a series of logical steps by which all repetitive business action is initiated, performed, controlled and finalized. A procedure prescribes what action is to be taken in a specific situation.

6.1.9 Approach

An approach refers to a specific and chosen way of advancing or proceeding actions.

6.1.10 Policies

Policies are broad guides to action and decision making that facilitates attainment of objectives.

6.1.11 Mission

The primary, overall objective of an organization; its expressed reason for existence; is referred to its mission.

6.1.12 Method

A method is a way of doing something, an orderly arrangement of a set of procedures. It involves a sequence of progressive steps in an orderly and logical regularity in order to accomplish some task or purpose.

6.1.13 Strategies

Strategies are broad decisions to act and allocate resources in certain ways or order to attain objectives.

6.1.14 Goal

Goal refers to higher-order programme or sector objective to which a development intervention, such as a project, is intended to contribute. Thus it is a statement of intent.

6.1.15 Aims

Aims are generalized and broad statement of directions with respect to given activities. For example, improvement of farmers' economic condition.

6.1.16 Scope

It is the area of coverage for study/ investigation on a given subject matter

6.1.17 Objectives

Objectives are expression of the ends towards which our efforts are directed. For example, to increase the yield of wheat by 20 percent.

6.1.18 Situation

Situation is a statement of affairs that includes the cultural, social, economic and physical conditions in which a particular group of people find themselves at a given period of time (Ray, 2003). The situation, which constitutes the environment for planning, is continually changing.

6.1.19 Fact

A fact is taken as something definite or something which happens or which is correct. According to Concise Oxford Dictionary, a fact is happening of an incident, a correct statement, a matter of experience, the reality of situation.

6.1.20 Education

Education is the process of bringing about desirable change into the behaviour of human beings (Dahama and Bhatnagar, 1988). Education is a life-long process which helps an individual (a) adapt himself to the real world through participation and reciprocal interactions with the environment and (b) enhances the quality of social, professional and national life.

6.1.21 Informal Education

Informal education is the lifelong process by which every person acquires and accumulates knowledge, skills, attitudes and insights from daily experiences and exposure to the environment at home, at work, at play etc.

6.1.22 Formal Education

Formal education is the highly institutionalized, chronologically graded and hierarchically structured 'education system', spanning lower primarily school and the upper reaches of the university.

6.1.23 Non-Formal Education

Non-Formal education is an organized, systematic, educational activity carried on outside the framework of the formal system to provide selected types of learning to particular sub-groups in the population, adults as well as children according to their needs. Example is Agricultural Extension.

6.1.24 Learning

Learning is the process by which an individual, through one's own effort's and abilities changes the behaviour. In other words, any change of behaviour which takes place as a result of experience may be called as learning.

6.1.25 Teaching

Teaching is directing the learning process, the process by which one through his own activity becomes changed in behaviour. It is the process of a series of (learning) steps involving communication and interaction set up for a learner to move from one level of competencies to a higher level of competencies. The process may be made up of several methods and techniques through which learner is taken through to learn the competencies.

6.1.26 Effective Learning Situation

An effective learning situation is one in which all the essential elements for promoting learning i.e. learners, teachers, subject matter, teaching materials and physical facilities, relevant to a particular situation, are present in a dynamic relationship with one another.

6.1.27 Learning Experience

The learning experience is the mental and / or physical reaction to seeing, hearing or doing the things to be learnt and through which one gains meaning and understanding, useful in solving new problems.

6.1.28 Experiential Learning

Experiential learning is “learning from experience” which is learner-centered and allows the participants to manage and share responsibilities for their learning with their teachers.

6.1.29 Extension

The word ‘extension’ was originated in England in 1866 with a system of university extension which was taken up first by Cambridge and Oxford Universities, and later by other educational institutions in England and in other countries. The term ‘extension education’ was first used in 1873 by Cambridge University to describe this particular educational innovation. The objective of university extension was to take the educational advantages of universities to ordinary people. (Swanson and Claar, 1984)

In brief, Extension may be defined as the science of developing capability of the people for sustainable improvement in their quality of life.

6.1.30 Extension Education

Leagans (1961) conceptualized extension education as an applied science consisting of contents derived from research, accumulated field experiences and relevant principles drawn from the behavioural sciences synthesized with useful technology into a body of philosophy, principles, contents and methods focused on the problems of out-of-school education for adults and youth.

6.1.31 Cyber Extension

Cyber Extension can be defined as the extension over cyber space i.e, using the power of online networks, computer communications and digital interactive multi-media to facilitate

dissemination of agricultural technology. Cyber space is the imaginary or virtual space of computers connected with each other on networks across the globe. These computers can access information in the form of text, graphics, and audio, video or animation tools.

6.1.32 Agricultural Extension

When the process of Extension Education is confined only to the subject matter of agriculture, it becomes agricultural extension.

6.1.33 Training

Training is a systematic instructional means to develop knowledge, skills and attitude for adults in order to keep pace with the changes in life. It is the process by which individuals are helped to acquire certain specific skills related to a given set of operations in certain specified contexts only.

In organizational set up, a training means acquiring of specific skills to perform a job better. Usually an organization facilitates the employees' learning through training so that their modified behaviour contributes to the attainment of organization goals.

6.1.34 Training for Extension Personnel

It can be defined as a planned and systematic effort to increase Knowledge (K) improve Skill (S), inculcate appropriate Attitudes (A) and develop other attributes (Os) in extension personnel to enable them to better serve their clients-the farmers. In other words, training (T) is concerned with KSAOs and may be described as function (f) as follows T = f (K,S,A,Os)

6.1.34.1 Knowledge (K)

Knowledge may be defined as retained information concerning facts, concepts and relationships.

For Extension Personnel, K covers

- Knowledge of extension methods
- Knowledge in Subject matter
- Knowledge of clients' problems and their solutions
- Knowledge of farm, farm families and farming systems
- Knowledge of farm economics, input supply and marketing

6.1.34.2 Skill (s)

Skill is the ability to do things to effectively apply knowledge and personal aptitude and attitudes in work situations.

For extension Personnel, these skills include –

- Communication skill
- Technological skill
- Demonstration skill
- Organisation skill
- Training skill
- Diagnostic skill.

6.1.34.3Attitude (A)

It refers to an individual's predispositions to view their jobs, other people and the work and the farming environment in certain way. For extension personnel, attitude includes:

- Attitude for serving clients
- Attitude for acquiring latest knowledge and technical know how
- Attitude for problem solving
- Attitude for field work
- Attitude for self-development

Attitudes reflect values which in turn are based on an individual's life experiences and the environment in which he has been brought up.

6.1.34.4 Attributes (Os)

Are characteristic qualities needed of extension personnel. For extension personnel, these includes:

- Personality traits
- Conduct
- Empathy
- Experience
- Self development

Traits are typical thought pattern and resultant behaviour characteristic of a person in a variety of situation.

6.1.35 Training Effectiveness

Training Effectiveness can be defined as the degree to which a training course helps to transfer to make effective performance in one's job through application of knowledge gained, skills acquired and changed attitudes.

6.1.36 Capacity

The ability of individuals and organisations to perform functions effectively, efficiently and in a sustainable manner.

6.1.37 Capacity building

Capacity building is the ability to perform appropriate tasks effectively and sustainably. UNDP (1997), defined capacity building as the ability of an individual or organisation to perform functions effectively, efficiently and sustainably.

6.1.38 Capacity Development

Capacity development can be viewed as a process by which an individual, groups, organisation, institution or societies increase their ability to perform function, solve problems and achieve objectives.

6.1.39 Human Resource Development (HRD)

It refers to planned approach of developing human capabilities, latent talents and contribute to full growth of all aspects of people in terms of skills, maturity, competence, self-awareness, continuous adjustment with changing environment and self-confidence.

6.1.40 Job Satisfaction

It refers to the feelings and the emotional aspects of individuals experience towards his jobs.

6.1.41 Pre-service Training

It is a process through which individuals are made ready to enter a certain kind of professional job, as in agriculture, health care or engineering. The prerequisite to this, is to attend regular classes in a formal institution and need to complete a definite curriculum and courses successfully, and receive a formal degree or diploma.

6.1.42 In-service Training

In-service training is a process of staff development for the purpose of improving the performance of an individual of an incumbent holding a position with assigned job responsibilities. It promotes the professional growth of individuals. In-service training is a problem-centered, learner-oriented, and time bound series of activities which provide the opportunity to develop a sense of purpose, broaden perception of the participants, and increase their capacity to gain knowledge and mastery of techniques. Inservice training may be broadly be categorized into five different types.

6.1.43 Induction or Orientation Training

Induction training is given immediately after employment to introduce the new entrant to the job. This helps in moulding the individuals as per requirement of the organization.

6.1.44 Foundation Training

This training is usually provided at an early stage of service life. Every staff member needs some professional knowledge about various rules, regulations, and procedures of the organization, financial transactions, administrative capability, communication skills, leadership ability, coordination and cooperation among institutions and their linkage mechanism, report writing and so on. This training is made available to the employees to strengthen the foundation of their service career.

6.1.45 Maintenance or Refresher Training

This training is offers to update and maintain the specialized subject-matter knowledge of the incumbents. This deals with new information and new methods, as well as review of older materials. This type of training is given to the employees to keep them at their peak performance level and also to prevent them form getting into a rut.

6.1.46 On – the - Job Training

This is periodical or adhoc training on the job, and is generally provided by the superior officer or specialists to the subordinate field staff. This training is problem or technology oriented and may include formal presentations, informal discussion, and opportunities to try out new skills and knowledge in the field.

6.1.47 Career or Development Training

This type of training is designed to upgrade the knowledge, skills and ability of employees to help them assume greater responsibility in higher positions. This training may lead to the acquisition of higher degree or diploma by the employees, and motivate them to move up in the higher levels of administrative hierarchy.

6.1.48 Vocational Training

It refers to long-term vocation-based and skill oriented training for rural youth, farm women, school drop-outs etc. in agriculture and allied activities for income generation and self-employment.

6.1.49 Sensitivity Training

In this kind of training, members or participants are brought together in a free and open environment in which participants discuss themselves and interact. The discussion is lightly directed by a behavioural expert, who creates the opportunity for participants to express their ideas, beliefs and attitudes.

The objective of this method is to provide the participants with increased awareness of their own behaviour and of how others perceive them, greater sensitivity to the behaviour of others and increased understanding of group processes. Specifically it aims at increased ability to empathize

with others, improved listening skills, greater openness, increased tolerance for differences and improved conflict-resolution skills.

6.1.50 Participatory Training

It is a learning through sharing and doing. A trusting atmosphere is basic to the success of a training programme which is participatory in nature. For example, role playing, case study, brain storming etc.

6.1.51 Institutional Training

This is a traditional approach which includes courses organised away from the farmers' field which requires residential accommodation for the trainees. The most typical example of this approach is the training course imparted in the farmers training centres. The training organised under this approach is more of formal nature.

6.1.52 On-farm Training

The approach under this category provides non-formal training mostly on the farmers' field in a variety of ways. The training programme under this approach are multi-purpose in nature emphasizing skill training in agriculture, home-making and related vocational fields. For example; Farm Science Club, Rural Youth Club etc.

6.1.53 Comprehensive Training

Both approaches viz; "institutional" and "on-farm" are integrated in this approach. Therefore, training imparted through this approach has been found to be the most effective. This approach has been in use in KVKs.

6.1.54 Change Agents

The concept of change agents includes all those persons, groups or the like engaged in bringing about behavioural changes in the people on the behalf of an extension education organisation, to improve their welfare.

6.1.55 Facilitator

A person who helps members of a group conduct a meeting in an efficient and effective way but who does not dictate what will happen.

6.1.56 Stakeholders

An agency, organisation, group or individual who has a direct or indirect interest in the project/ programme, or who affects or is affected positively or negatively by the implementation and outcome of it. Primary stakeholders is the term used for the main intended beneficiaries of a project.

6.1.57 Extension Workers

An extension worker is a leader appointed from outside, by an organisation to work with the rural people.

6.1.58 Target

A specified objective that indicates the number, timing and location of that which is to be realised.

6.1.59 Target group

The specific group for whose benefit the project or programme is undertaken, closely related to impact and relevance.

6.1.60 Performance

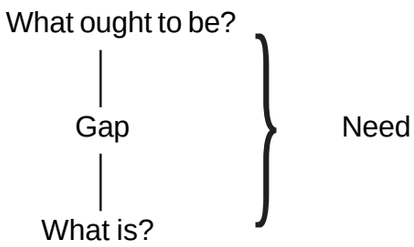
Performance is defined as a desirable outcome or result of an individual in his job in a fixed period.

6.1.61 Performance Appraisal

Performance appraisal is a systematic process of evaluating achievements of an individual with regard to his predetermined job goals in terms of quality and quantity within a fixed time framework.

6.1.62 Need

Need implies a gap between what is, the existing situation; and what ought to be, the desirable situation. The nature and extent of the gap indicates significance of the problem.



6.1.63 Felt Needs

Felt need or consciously recognized need i.e the need of which people are aware of. For example, every year flood causes damage to crops and suffering to the people in an area.

6.1.64 Unfelt Needs

Unrecognized needs i.e. the need of which the people are not aware of at present.

For example, People are not aware of need for mobilization of resources and funds before they come forward to dig out a drainage channel and solve the problem permanently. People may, however, be made aware of unfelt need i.e, unfelt need may be brought to the level of felt need, through appropriate motivation techniques.

6.1.65 Interest

An Interest is a preference for one activity over another. The selection and ranking of different activities along a like dislike dimension is known as expressed interest. An interest is made manifest (visible), when a person voluntarily participates in an activity.

There is no necessary relationship between expressed interest and manifest interest, though in many situations they tend to coincide or overlap. Many individuals engage in some activities which they claim to dislike and just on the reverse, many people may refuse to engage in activities which they claim to enjoy.

6.1.66 Training Needs

The training needs for extension personnel can be defined in terms of gap between job requirement and job performance. Training needs of individuals, groups and organisations have to be analysed by the employer before finalizing training plan of the organization. Training needs are to be identified in terms of knowledge required, skills to be acquired and attitudes to be changed.

6.1.67 Need Assessment

Need assessment is defined as the systematic identification of the needs and problems of a specific target group, tend to be an overlooked part of the rural development project planning process. (Smith, Etling and Diamond, 1991)

6.1.68 Training Needs Assessment (TNA)

Assessment / evaluation of training can be defined as a process by which the desired behavioural changes (in knowledge, skills and attitudes) due to training are measured against set of objectives/ standards. The assessment can be conducted by training institution, participants (trainees) and participating institution (sponsoring agency).

TNA provides information on

(1) Where training is needed

(2) What the content of training should be

(3) Certain kinds of skills and knowledge.

The literature of training needs assessment has traditionally focused on the development of better techniques and method for improving the quality of information collected about organizational tasks and person analyses.

6.1.69 Training Impact Assessment/Evaluation

An Impact Evaluation is a method of assessing changes in on-the-job behaviour (i.e. improved performance) as a result of training effort.

It is concerned with the overall effect of training on farmers or the rural community served by the trainees. Under this evaluation, the impact is usually measured in terms of productivity (crop yield per hectare) production (total crop production in an area) and per capita income of farmers.

6.1.70 Training Plan

A training plan is a manpower document developed on the basis of assessed training needs of extension personnel indicating the category-wise existing strength of extension personnel, their category wise requirements of training and the ways and means for meeting them.

6.1.71 Training Strategy

According to Lynton and Pareek (2000), training strategy is not a static blueprint but is open to clarification, modification, and further development through experience with it .Its initial formulation, testing in practice, and on-going review and development may cost much time and effort, but this is quickly justified by keeping training effective and also economical. According to them, training success depends on designing training systems that capture the five core principles of learning.

6.1.72 Extension Technique

It means either extension teaching methods or extension teaching aids or both. They are used to denote short-cut and dubious methods to achieve an end.

6.1.73 Extension methods

Extension methods are basic and proven methods, for attracting attention, arousing interest, leading villagers to have successful experiences with new ways and of doing things that are an improvement over the old practices.

6.1.74 Training Methods

Training methods are means of communication of message(s) to the trainees. Several methods like lecture, discussion, seminar, conference, case study, role play etc. are being used in training.

6.1.75 Aids

Aids are those instructional devices or teaching aids which makes teaching more effective.

6.1.76 Tools

Tools are means to a trainer for achieving the training objectives by communicating subject matter contents and related skills to the participants.

6.1.77 Teaching Aid

Teaching aid is any device that assists the teacher/ extension worker in transmitting to a learner/ farmers the facts, skills, attitude, knowledge, understanding and appreciation.

6.1.78 Training Aids

They are aids to the trainer to convey his idea/ messages clearly for the trainees and help them learn better such as flip charts, posters, slides, graphs etc.

6.1.79 Audio-Visual Aids (A-V Aids)

A-V Aids are those instructional devices that may be used by a teacher or a communicator in order to facilitate better understanding on the part of learners by involving their many senses, particularly those relating to seeing and hearing.

The commonly used methods for training of extension personnel are discussed in brief. Some of them may be used also for the training of farmers.

6.1.80 Micro lab

A microlab is a package of exercises organized at the beginning of any programme to provide a glimpse of all aspects of the training likely to be covered. It is a combination of physical activity and small group interactions amongst the participants. Its broad aim is to help the participants overcome barriers due to status position, consciousness, unfounded fears, complexes, etc.

6.1.81 Lecture

According to a dictionary meaning, lecture is a discourse on a given subject delivered to a class or audience. A lecture, however, now may be defined as a carefully prepared oral presentation of a subject by a qualified person to group of participants. It may be supplemented by audio-visual aids and question-answer session.

The lecture is an excellent method for presenting information to a large number of persons in a short period of time. Its weakness is that people are not likely to master as such of the information as the speaker is likely to assume; because for the most part, it is a one-way communication. Members of audience listen in terms of their interests and remember in terms of motivation and memory. To compensate somewhat for this weakness, a discussion or question-answer session may be held following the speech.

6.1.82 Case Study

In this method, the trainer gives the trainees information about a situation and directs them to come to a decision or solve a problem concerning the situation. For this, a written case or a problem situation is presented to the participants in a programme for careful study and examination from all facets, so as to enable them to exercise their analytical, synthetical and decision making powers. As there is no single infalliable solution to a problem, different solutions will be evolved and, in course of evaluation of these solutions, participants are enable to appreciate the view points of others and also see the lacunae in their own thinking and analysis. The interrelatedness of various factors operating in the situation is also highlighted.

6.1.83 Group discussion

The lecture method may be made more participative, if at the end the audience are allowed to discuss the topic in presence of the speaker and elicit the latter's comments and clarification on the points raised. This shall lead to a better understanding of the topic, as the participants are more actively involved, have the opportunity to express their views and get their doubts clarified. Learning is reinforced through the interaction of the audience with the speaker. Limitations of traditional group

discussion are that group members may pursue an idea to the exclusion of other alternatives, and pressures to confirm can discourage the expression of deviant opinions.

6.1.84 Buzz sessions

With large groups when there is limited time for discussion, the audience may be divided into smaller units for a short period. This is called 'buzz session' or 'huddle system' or 'Phillips 66'. Groups of 6 to 8 persons get together after receiving instructions to discuss about a specific issue assigned. The secretary of each small group will report the findings or questions to the entire audience when they are resembled. This is actually a device to get more people to participate in a forum than would be the case otherwise.

6.1.85 Brain Storming

It is a type of small group interaction designed to encourage the free introduction of ideas on an unrestricted basis and without any limitations to feasibility. It is a form of thinking in which judicious reasoning gives way to creative initiative. Participants are encouraged to list for a period of time all the ideas that come to their minds regarding some problems and are asked not to judge the out come. At a later period all the contributions will be sorted out evaluated and perhaps later adopted.

6.1.86 Role Playing

A simulation in which participants enact different roles to obtain insight into a behaviour, problem or situation. Participants are encouraged to discuss different roles. It provokes thought and is a learning experience.

6.1.87 Workshop

It is essentially a long meeting from one day to several weeks, involving all the delegates in which the problems being discussed are considered by delegates in small private groups. There must be a planning session where all are involved in the beginning. There must be considerable time for work sessions. There must be a summarizing and evaluation sessions at the close. The workshop as the name implies must produce something in the end like a report, a publication, a visual or any other material objects.

6.1.88 Conference

An assembly of different organizations, departments and even interests for discussing issues of common interest. It is noted for its wide and varied representation. It has agenda for its deliberations. Its end-result is usually a set of recommendations for policy-makers and others. Its handicap is that the mode of participation in it is through speeches. It is the pooling of experiences and opinions among a group of people who have special qualification in an area.

6.1.89 Panel

A moderated discussion of a single subject by experts usually representing different fields or disciplines. Panel provides in-depth informed opinion on the subject. Audience are benefited by

observing interaction among panelists and questioning panelists. It also needs experienced moderator to make it successful.

6.1.90 Syndicate Studies

These essentially follow the seminar method and the focus is on any particular subject or problem. The syndicate studies are conducted with the help of group discussions, supplemented by the available literature on the subject and the end product is an erudite report. Resource men are utilized for the syndicate studies. The studies on any subject can continue for a month or more, with 10 to 12 sittings.

6.1.91 Colloquy

Literally act of conversing, it is modified version of panel with 3-4 experts with audience having greater participation by raising issues or asking questions.

6.1.92 Task Force

Borrowed from military usage and a distinctly American contribution, it is a small team of experts complete in its requirement of specialities for examination of a subject. Usually formed to assist the deliberations of a wider body like a Commission. It is of limited value to extension training.

6.1.93 Round Table

Here, experts sit around a round table to discuss a subject. Beneficial for professional development. Strictly, not a training method. The audience, however, benefits from it by sitting around the round table.

6.1.94 Mission

A powerful group of front-rank experts charged with attainment of specific objectives and goals in a 'thrust' area at the national level like Technology Mission on Oilseeds (TMO). Not a training method but can be immensely useful to specialists for professional development by way of attachment to the mission for a short duration, say, of one week.

6.1.95 Symposium

This is a short series of lectures: usually by 2 to 5 speakers. Each one speaks for a definite amount of time, and presents a different phase or subdivision of a general topic. The topic should be large enough or general enough to permit two or more subdivisions that are sufficiently significant to justify separate discussion by speakers. The subject may or may not be controversial. It is important that the speakers are of approximately equal ability, to avoid one speaker dominating the meeting or giving the audience a distorted view of the subject. The speeches may be followed by a forum to facilitate mastery of information. The advantage of symposium over lecture is that two or more experts present different phases of the topic. It also has an advantage over the debate as it is possible to escape the antagonism that may accompany the letter.

6.1.96 Seminar

It is one of the most important forms of group discussion. The discussion leader introduces the topic to be discussed. Members of the audience discuss the subject to which ready answers are not available. A seminar may have two or more plenary sessions. This method has the advantage of pooling together the opinions of a large number of persons.

6.1.97 Conventions

A convention is an assembly of representatives or delegates from local units of a parent organization who have a common interest or an assembly of representatives or delegates from different organizations or professions who have a common interest.

6.1.98 Committee

A small group of individuals appointed or related to perform a task that cannot be done efficiently by the entire group. A Committee will have terms of reference and its end-result is a report submitted to the present body.

6.1.99 Institute

An Institute is a service of meetings arranged for a group of persons who come together to receive instructions in, or information about, a specific field of work. It is noted for its authoritative instruction. Summer institutes organized by the Indian Council of Agricultural Research (ICAR) every year for teaching scientists in different subjects are examples of this genre.

6.1.100 Demonstration

Demonstration is that activity, process or means by which mind is presented with decisive evidence. In agricultural extension work, it is mostly used to convince farmers about the utility and usefulness of a new practice.

6.1.101 Method Demonstration

A method demonstration is given before a group of people to show how to carry out an entirely new practices or an old practice in a better way. It is essentially a skill training, where the emphasis is on effectively carrying out a job, which shall improve upon the result. It involves seeing, hearing, participating and practicing in a group which shall stimulate interest and action. Method demonstration is sometimes used as complementary to result demonstration.

6.1.102 Result Demonstration

Result demonstration is a method of motivating the people for adoption of new practice by showing its distinctly superior result. The demonstrations are conducted in the farm or home of selected individuals and are utilized to educate and motivate groups of people in their neighbourhood. This is very effective method for the transfer of technology in a community.

Demonstrations may stimulate farmers to try out innovations themselves, or may even replace a test of the innovation by the farmer. They can show the causes of problems and their possible solutions without complicated technical details. A great advantage of demonstration is seeing how an innovation works in practice.

Conducting demonstrations with own hands shall encourage the farmers to act on a scientific basis, rather than something which is magical. Demonstrations, to be effective, should be integrated with the total extension programme.

6.1.103 Field Demonstration

Field demonstration is a long term educational activity conducted in a systematic way in farmers' field to show the worth of a new practice/technology. 'Seeing is believing' is the basic philosophy of field demonstrations. Only proven technologies are therefore selected for field demonstrations.

6.1.104 Composite Demonstration

Composite Demonstration is a combination of field based result demonstrations and a chain of skill oriented method demonstrations. A long term sequential method demonstration (composite demonstration) aims at demonstrating the superiority of a package of practice in growing field crops.

6.1.105 Frontline Demonstration

Front-Line Demonstration is the concept of field demonstration evolved by the Indian Council of Agricultural Research with the inception of the Technology Mission on Oilseed Crops during mid-eighties. The field demonstrations conducted under the close supervision of scientists of the National Agriculture Research System is called front-line demonstrations because the technologies are demonstrated for the first time by the scientists themselves before being fed into the main extension system of the State Department of Agriculture.

6.1.106 Models

A model is a three-dimensional recognizable imitation of an object. It may be of the same size, larger or smaller than the thing it represents. It can be handled, operated and seen from a number of angles, and so it is generally more interesting and instructive than a graphic form of the same.

6.1.107 Mock-ups

A mock-up is a three dimensional imitation of a thing used for the purpose of learning and so it may not be similar in appearance. A most common example is the mock – up clock in schools showing movement of the hands, or a mock-up of a driver's seat in training schools.

6.1.108 Objects

The term object refers to sample of real things minus the natural setting. They are very valuable teaching aids both in formal and adult education. Collection of stamps, coins, minerals, bones, insects-pests and other agricultural products have long been used in teaching.

6.2 Adoption and Diffusion

6.2.1 Data

Data usually means raw, unevaluated facts, figures, symbols, objects, events etc. They are the collection of natural phenomena descriptors including the results of experience, observation or experiment, or a set of premises. This may consist of numbers, words, or images, particularly as measurements or observations of a set of variables.

A data base is a structured collection of records or data. A computer database relies upon software to organize the storage of data. The software models the database structure in what are known as database models.

6.2.2 Database Management System (DBMS)

A Database Management System (DBMS) is computer software designed for the purpose of managing databases based on a variety of data models. A DBMS is a complex set of software programs that controls the organization, storage, management, and retrieval of data in a database.

6.2.3 Information

When data are processed conveying some meaning, it is called information. Information – usually consisting of facts and figures collected at the initial stages of a project – that provides a basis for measuring progress in achieving project objectives and outputs. Davis and Olson (1985) provides a general definition of information which reads as “information is data that has been processed into a form that is meaningful to the recipient and is real or perceived value in current or prospective actions or decisions”. It bears a diversity of meanings, from everyday usage to technical settings. Generally speaking, the concept of information is closely related to notions of constraint, communication, control, data, form, instruction, knowledge, meaning, mental stimulus, pattern, perception, and representation.

6.2.4 Knowledge

Knowledge is the retained information concerning facts, concepts and relationship. Oxford English Dictionary defined Knowledge as (i) expertise, and skills acquired by a person through experience or education; the theoretical or practical understanding of a subject, (ii) what is known in a particular field or in total; facts and information or (iii) awareness or familiarity gained by experience of a fact or situation.

6.2.5 Technology

Technology is any systematic knowledge applicable in a particular area in order to achieve some values. Technology involves application of science and knowledge to practical use, enable

man to live more comfortably. The Merriam-Webster dictionary offers a definition of the term: “the practical application of knowledge especially in a particular area” and “a capability given by the practical application of knowledge”.

Technology can be most broadly defined as the entities, both material and immaterial, created by the application of mental and physical effort in order to achieve some value.

6.2.6 Innovation

An innovation is an idea, practice or object that is perceived as new by an individual or other unit of adoption. The technologies/practices developed through research are innovations which may be new varieties of crops and plants, new breeds of livestock, new chemicals and medicines, new technique of doing things etc. Farmers themselves may develop some new practices which are also innovations. Irrespective of the time period the idea or practice was originally developed, when a person first becomes aware of it, it is an innovation to that person.

6.2.7 Agricultural Technology

Agricultural Technology is a complex blend of materials, processes and knowledge. Agricultural technologies are of two types:

i. **Material Technology** (When knowledge is embodied into technological products such as tools, equipments, seed materials etc.)

ii. **Knowledge-based technology** (Such as the technical knowledge, methodologies, managerial skills, motivational techniques etc. that farmers and rural people need for better production in their enterprises.)

6.2.8 Knowledge management

Knowledge management is a management theory which emerged in the 1990s. It seeks to understand the way in which knowledge is created, used and shared within organizations. A significant part of Knowledge Management theory and practice aligns two models:

(i) the **DIKW** model, which places Data, Information, Knowledge and Wisdom into an increasingly useful pyramid.

(ii) Nonaka’s reformulation of Polanyi’s distinction between *tacit* and *explicit* knowledge.

6.2.9 Wisdom

Wisdom is having gained knowledge, experience, discretion, and intuitive understanding, along with a capacity to apply these qualities well. It is the judicious application of knowledge. To some extent the terms wisdom and intelligence have similar and overlapping meanings. The status of wisdom or prudence as a virtue is recognized in cultural, philosophical and religious sources.

6.2.10 Technology Development

Technology Development is a process which consists of all the decision and activities which a scientist does from recognition of a need/ problem with planning, testing, conducting research,

verification, testing and dissimilation for adopting. During same time, some other problems are sent back to the scientist for solution. Thus, it's a continous process.

6.2.11 Technology Management

Technology management can be defined as the integrated planning, designing, optimization, operation and control of technological products, processes and services, for human advantage.

6.2.12 Technological Gap

Technological Gap is the gap between the level of recommendation and the extent of adoption (against recommendations). The technological gap in respect of different aspects of the technology are computed in percentage by the following formula:

$$\text{Technological Gap (TG)} = \frac{R-A}{R} X100, \quad \text{Where,}$$

R= Maximum possible adoption score that a respondent could be awarded in respect of a given component of the technology.

A= score obtained by a respondent by virtue of his adoption of a given component of technology.

6.2.13 Technology Fatigue

Linkages between the laboratory and field have weakened and extension services have often little to extend by way of specific information and advice on the basis of location, time and farming system. Good quality seeds at affordable prices are in short supply and spurious pesticides and bio-fertilisers are being sold in the absence of effective quality control systems. Micronutrient deficiencies in the soil as well as problems relating to soil physics are crying for attention. Farmers have no way of getting proactive advice on land use, based on meteorological and marketing factors. No wonder the prevailing gap between potential and actual yields, even with technologies currently on the shelf, is very wide. Many KVKs are also found utilizing old and obsolete technologies for OFTs, FLDs and training programmes. A knowledge deficit as mentioned above along with the usage of obsolete technologies and package of practices together leads to a situation called 'technology fatigue'.

6.2.14 Technology Backstopping

Backstopping refers to any precaution taken against an emergency condition. Accordingly, technology backstopping can be defined as any technology precaution taken to combat technology fatigue. In simple terms, technology backstopping is the process of making available ready to use technologies for farm families through assessment, refinement and demonstration processes in order to combat the existing/forecasted technology fatigue.

6.2.15 Methodology Backstopping

This is a process almost similar to technology backstopping but differs with respect to the kind of technology solution offered. Instead of material technology, methodology backstopping aims

at assessment, refinement and demonstration of knowledge based technologies often referred to as methodologies/package of practices. It provides detailed procedures to carry out the technology application functions by the extension personnel in the field. It includes methodologies for conducting OFT, which includes TAR, demonstrations, training, conducting surveys, impact assessment and evaluation etc.

6.2.16 Technology assessment

It is the study and evaluation of new technologies. It is based on the conviction that new developments within, and discoveries by, the scientific community are relevant for the world at large rather than just for the scientific experts themselves, and that technological progress can never be free of ethical implications. Also, technology assessment recognizes the fact that scientists normally are not trained ethicists themselves and accordingly ought to be very careful when passing ethical judgement on their own, or their colleagues' new findings, projects, or work in progress.

6.2.17 Transfer of Technology (TOT)

The term transfer of technology means movement of information from a research (source of technology) or an innovation system through an extension system (which acts as interpreter disseminator and facilitator) to the client (users of technology) system i.e. the target group of farmers who are expected to adopt and integrate the new technology into the existing farming systems and practices. Besides the above three primary systems, the effectiveness of technology transfer also depends on the support systems as well as the socio-economic structures in which other systems operate.

6.2.18 Technology Assessment and Refinement (TAR)

Technology Assessment and Refinement (TAR) refers to a set of procedures whose purpose is to develop recommendations for a particular agro-climatic situation/ location through assessment and refinement of recently released technology through participatory approach. It refers to the process or a set of activities before taking up new scientific information for its dissemination in a new production system.

6.2.19 Participatory Technology Development (PTD)

It is the process of combining local farmers' knowledge and skills with those of external agents to develop site specific and socio-economically adopted farming technologies.

6.2.20 Adoption

Adoption is essentially a decision making process to make full use of an individual innovation as the best source of action available.

Wilkening (1953) described the adoption of an innovation as a process composed of learning, deciding and acting over a period of time. The adoption of a specific practice is not the result of a single decision to act but series of actions and thought decisions. He identified four adoption stages: awareness, obtaining information, conviction and trial, and adoption.

6.2.21 Decision Making

Decision making is the process of consciously choosing courses of action from available alternatives and integrating them for the purpose of achieving the desired goal. It involves deciding on what goals are to be achieved, what means and methods are to be adopted in reaching them, based on what facts are available and how they are interpreted. Decision making is generally influenced by the level of knowledge, cost involved and time available in taking and implementing the decisions.

6.2.22 Diffusion

Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. It is a special type of communication, in that the messages are concerned with new ideas. It is this 'newness' of the idea in the message content of communication that gives diffusion its special character. The diffusion of innovations is essentially a social process in which subjectively perceived information about a new idea is communicated.

6.2.23 Adoption Period

The time taken by a technology or innovation to pass from the awareness of an innovation to its adoption. The main aim of agricultural extension workers is to shorten the length of the adoption periods of individual farmers so that an innovation will diffuse rapidly within a social system.

6.2.24 Rate of Adoption

Rate of adoption is the relative speed with which an innovation is adopted by members of a social system. It is generally measured as the number of individuals who adopt a new idea in a specified period, such as each year. The variables determining the rate of adoption of innovations according to Rogers (1995), are: perceived attributes of innovations, type of innovation-decision, communication channels used or available, nature of the social system, and extent of extension agents' promotion efforts.

6.2.25 Over-Adoption

Sometimes it may happen that farmers continue to adopt an innovation rather vigorously, when experts feel that it should not be done. It is over adoption.

6.2.26 Diffusion Effect

Self-generated pressure towards adoption also increases proportion of the members to adopt innovation. This increasing pressure from interpersonal networks may be termed as the diffusion effect.

6.2.27 Innovativeness

Innovativeness is the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system. In technology transfer programme, it

is of great practical utility for the extension agents to identify the individuals who are likely to adopt innovations early and who may lag behind.

6.2.28 Trial

It is the application of a new idea on a small scale in order to determine its utility in own situations/conditions.

6.2.29 Trial Method

Trial Method is the means of communication of messages to the trainees. Several methods like lecture, discussion, seminar, conference, case study, role play etc. are being used in training.

6.2.30 Skill Gap

It is the difference between the expected and existing standard of skills required to perform the job by the extension functionaries.

6.2.31 Attributes

Attributes are qualities, characteristics or traits possessed by an object. An innovation has some qualities or characteristics such as relative advantage, compatibility, complexity, trialability, observability etc.

6.2.32 Awareness

It is realization of something which is related to one's own need or arouses the need.

6.2.33 Innovators

They are the category of adopters who first adopt a new idea, much ahead of other members in the community.

6.2.34 Laggards

They are the category of adopters who are traditional and the last to adopt an innovation in a community.

6.2.35 Competency

It refers to the ability of an individual to reach a desired goal.

6.2.36 Dissemination

An innovation is disseminated in a social system through a well organised publicity campaign. At this stage, efforts are made to spread new idea in a social system as quickly as possible.

6.2.37 Assimilation

Dissemination is followed by assimilation. It is the level of understandability and popularity of an idea in a social system. Social approval of an idea is the major break-through in its adoption.

6.2.38 Acceptance

Acceptance is the decision of an individual to make full use of an innovation as the best course of action available. The demonstration of the usefulness of an innovation spread up its acceptance.

6.2.39 Discontinuance

Discontinuance is a decision to cease use of an innovation after previously adopting it. It may be due to the dissatisfaction with the innovation or availability of another superior innovation.

6.2.40 Non-Adoption

It is defined as a decision to reject a new idea. It occurs after trial stage. If the adopter does not feel satisfied with the results of the trial of an innovation, he will not adopt it further.

6.2.41 Adaptive or Minikit Trial

Adaptive or minikit trial is a method of determining the suitability or otherwise of a new practice in farmer's situation. This may be regarded as an on-farm participatory technology development process in which farmer's choice and farmer's opinion about the practice are most important. This is the first stage a new and improved practice passes through, before it is taken up for result or method demonstration, or recommended for large scale adoption. Minikits are, however, distributed in some States for assisting the poor farmers or in times of distress, to maintain farm productivity.

6.2.42 On Farm Testing v/s PTD

The major difference of PTD in comparison to OFTs are that in PTD, the problems for which solution have been sought are defined by the farmers, the alternative solution to be tested are defined by the farmers, the design is decided by the farmers, the implementation is done by the farmers, monitoring is decided and executed by the farmers and the evaluation is done by the farmers. All these activities are researcher- controlled in the normal OFTs.

6.2.43 Opinion Leader/ Local Leader

Opinion leader is an individual who is able to influence informally other individual's attitude or overt behaviour in a desired way with relative frequency. Opinion leader is also known as local leader.

6.2.44 Opinion Leadership

Opinion Leadership is the degree to which an individual is able to influence other individuals' attitude or overt behaviour informally in a desired way with relative frequency. This informal leadership is not function of the individual's formal position or status in the system. Opinion leadership is earned and maintained by the individual's technical competence, social accessibility, and conformity to the system's norms. When the social system is oriented to change, the opinion leaders are quite innovative; but when the system's norms are opposed to change, the behaviour of the leaders also reflects

these norms. By their close conformity to the system's norms, opinion leaders serve as a model for the innovation behaviour of their followers.

6.2.45 Leadership Style

It refers to leader's behaviour. Behavioural pattern which the leader reflects in his role as a leader is often described as the style of leadership. Leadership style is the result of leader's philosophy, personality, and experience and value system.

6.3 Communication and Development

6.3.1 Communication

The term communication stems from the Latin word 'communis' meaning common. According to Rogers and Shoemaker (1971), communication is the process by which messages are transferred from a source to receiver. van den Ban and Hawkins (1988) defined communication as the process of sending and receiving message through channels which establishes common meanings between a source and a receiver. Leagans (1961) defined communication as the process by which two or more people exchange ideas, facts, feelings and impressions in ways that each gains a common understanding of the meaning, intent and use of message. Communication, thus is a conscious attempt to share information, ideas, attitude and the like with others.

6.3.2 Development

According to Rogers (1995), development is a widely participatory process of social change in a society intended to bring about both social and material advancement. It includes greater equality, freedom, and other valued qualities, for the majority of people through their gaining greater control over their environment.

6.3.3 Personality

Personality is the unique, integrated and organized system of all behaviour of a person. Personality is the sum total of one's experience, thoughts and actions; it includes all behaviour patterns, traits and characteristics that make up a person. A person's physical traits, attitude, habits and, emotional and psychological characteristics are all parts of his personality.

6.3.4 People's Participation

People's participation may be defined as the process of giving priority to local people's perspective in identifying and analyzing their problems and opportunities, and improving the situation through their self-mobilization. The focus is on the insiders' i.e. local people's perspective, rather than outsiders' i.e. change agents', development administrators' perspective. People's participation is contrary to 'I know what they require' type of bureaucratic approach.

6.3.5 Participatory Development

Participatory development means to sensitize people and thus, to increase the receptivity and ability of rural people to respond to development programs as well as encourage local initiatives. It includes people's involvement in decision making process, where participants on their own set the direction of development, set their priorities, make decision about it, plan action and execute them.

6.3.6 Communication Gap

Communication gap refers to the difference between what was communicated by the extension agents and what has actually been received by the audience. Desirable action by the audience cannot take place if there is a large communication gap. The nature of communication gap may be of two types. (i) The message does not reach the target and (ii) the message fails to produce the desired impact, even if reaches the target.

6.3.7 Interaction

Interaction is the mutual and reciprocal influencing of each others' behaviour. The concept of interaction is control to an understanding of the concept of process in communication. If two individuals make influence about their own roles and take the role of others at the same time then they are communicating by interacting with each other.

6.3.8 Participatory Communication

Participatory communication means moving from focus of informing and persuading people to change their behaviour or attitude to focus on facilitating exchange between different stakeholders to address a common problem.

6.3.9 Communication Effectiveness

Communication effectiveness means a communication encounter that has produced desired results.

Communication effectiveness = Comprehension (clearance) + Validity (consonance, credibility and congruity) + Utility (relevance).

Communication effectiveness can be measured in terms of comprehension, validity and utility on the part of the receiver.

6.3.10 Human Relations

Human relations are integration of people into works situation that motivate them to work together productively and co-operatively to provide economic, psychological and social satisfaction.

6.3.11 Group Dynamics

Group dynamics may be defined as the social process by which people interact face to face in small groups.

6.3.12 Entropy

The information can be measured by entropy, which is a measure of the degree of randomness or choices or one's degree of freedom of choice to select a message.

6.3.13 Redundancy

This refers to the amount of information that could be omitted or added in a noiseless channel, so that the message would still retain information or same meaning.

6.3.14 Noise

This refers to any sound, distortion etc., that may be added into the channel which is not intended by the communicator. Due to noise, the received message will contain certain distortion/ errors leading to an increased uncertainty.

6.3.15 Communicator

A communicator is that person who initiates the process of communication. He is the source, originator or sender of message. He is the first one to give expression to a message intended to reach an audience.

6.3.16 Communication Behaviour of Communicator

Communication behaviour of a communicator may be defined as his expression of results from information seeking, information processing and information dissemination behaviour.

6.3.17 Communication Behaviour of Farmer

Communication behaviour of the farmers refers to the degree to which a farmer exposes himself to various information sources communicating agricultural technology, the extent to which he processes the information so received and the extent to which he uses or passes on the information received by him to others.

6.3.18 Communication Skills

As Berlo (1960) points out that there are five verbal communication skills. Two of these are encoding skills, writing and speaking while two of them are decoding skills, reading and listening. The fifth is crucial to both encoding and decoding i.e. thought or reasoning. There are other encoding skills also, such as painting, drawing and gesturing.

From extension education's point of view, communication skills also include an extension worker's ability to plan a communication strategy vis-a–vis a given objective, his ability to write, speak, prepare and use a teaching aid, treat a message to suit a given situation and to analyse feedback.

6.3.19 Attitude

Attitude is the feeling of an individual towards an object, event or something. The attitude of a communication source affects the ways in which he communicates. We can argue that the source's attitudes affect communication in at least three ways:

(i) Attitude towards Self:

Attitude towards self is important. A favourable attitude leads to self – confidence, while a negative attitude will reflect pessimism. However, an extension worker conscious of his favourable/ unfavourable/ attitude towards self, can manipulate/ hide/ neutralize it during communication with others.

(ii) Attitude towards Subject matter:

Listener is likely to pick up the attitude of a speaker towards his subject matter. Quite often it is reflected in his message. If he does not believe in the value of his subject matter, convincing communication is difficult to achieve. A study by Sinha (1969) revealed that the village level workers and extension officers themselves did not like the farm-planning concept in the IADP, which they were expected to 'sell'. To be an effective communicator the extension worker must be aware of his attitude towards the contents of his message, and must be able to manipulate it to advantage, if favourable, or be able to hide/ neutralise it, if unfavourable.

(iii) Attitude towards Receiver:

The source's attitude towards his receiver(s) also affects communication. When listeners or readers realise that the source is really speaking or writing for them, they are much less critical of his message, and much more likely to accept what he says. Aristotle called this perceived characteristic of the speaker as 'ethos', a quality in the speaker that is personally appealing to the listener.

6.3.20 Aptitude

Aptitude is a person's potential capacity to do something. It is the innate ability of a person to do something. E.g., Some students are good in music/ mathematics. A little effort/ training helps him to do excellent.

6.3.21 Communication Intelligence Quotient (CIQ)

Communication intelligence quotient refers to a person's level of understanding of the intricacy of communication effectiveness.

6.3.22 Message

From Agricultural Extension point of view, a message is the facts, feelings, impressions, attitude, information etc. that a communicator wishes his audience to receive, understand, accept and act upon.

6.3.23 Empathy

Empathy is the ability on the part of a person to understand the other person's internal frame of mind and reference, and accept the same. This acceptance does not mean agreement. Empathy

is also defined as the ability of an individual to project oneself into the role of another person, to be able to appreciate the feelings, thinking and actions of another person.

An extension agent who is empathic shall be able to understand and appreciate the farmers' situations and communicate with them effectively. Similarly, an empathic farmer shall be able to communicate with the outsiders to get the desired information. Empathy is an indispensable skill for people moving out of their traditional settings.

6.3.24 Perception

Gibson (1959) defined perception as the process by which an individual maintains contact with the environment. Kollat, Blackwell and Engel (1970) explained perception as the process whereby an individual receives stimuli through the various senses and interprets them. Perception of the same situation may differ from individual to individual due to differences in their experiences and ways of looking into it. The expectations, needs and ways of thinking influence how an individual interprets what is observed.

6.3.25 Credibility

Credibility means trust-worthiness and competence. Before the audience accept any message, they will judge whether the communicator and the organization the individual represents, can be relied upon and is competent enough to give the information or not.

6.3.26 Organizations

Organizations are social units, or human groupings, deliberately constructed to seek specific goals. The goals of an organization serve many functions. They provide orientation by depicting a future state of affairs which the organization strives to realize. Thus they set down guidelines for organizational activity. Goals also constitute a source of legitimacy which justifies the activities of an organization and, indeed, its very existence. Moreover, goals serve as standards by which members of an organization and outsiders can assess the success of the organization i.e its effectiveness and efficiency. A proper understanding of the goals of an organization is of crucial importance for its success.

6.3.27 Emotion

Emotion denotes a state of being moved, stirred up or aroused and involve impulses, feelings and physical and psychological reactions. A negative emotional response may lead to non-cooperation and non-participation in programmes, stoppage of work or even destruction of the work done. In a programme of planned change, the extension agent should take care of the state of emotion of the client system.

6.3.28 Initiation

This is the process that unfolds naturally bringing people together for a common action. It is based on the initiative of the people, by the people and for the people.

6.3.29 Facilitation

This is a process catalyzing action by an outside agent. It is planned intervention to create awareness and motivate action by a group or a community to change a situation or redress the cause or causes of problems.

6.3.30 Co-operation

This is a process through which a programme is decided upon, designed and packaged for implementation in the community. It is a participatory process of decision making.

6.3.31 Authority

Authority is the limited right to use the organisation's resources and channel the efforts of some of its people to perform tasks.

6.3.32 Responsibility

Responsibility is an obligation to perform tasks and account for their satisfactory completion.

6.3.33 Accountability

Obligation of government, public services or funding agencies to demonstrate to citizens that entrusted work has been conducted in compliance with agreed rules and standards or to report fairly and accurately on performance results vis-à-vis mandated roles and/or plans. This may require a careful, even legally defensible, demonstration that the work is consistent with the contract terms. Projects commonly focus on upward accountability to the funding agency, while downward accountability involves making accounts and plans transparent to the primary stakeholders. Ensuring accountability is one part of the function of monitoring and evaluation (learning and management are the other two).

6.3.34 Feedback

Feedback means carrying some significant responses of the audience back to the communicator. Extension communication is never complete without feedback information. The extension agent should know what has happened to the audience after the message has reached them.

6.3.35 Code

It is a system of signals for communication.

6.3.36 Symbols

A symbol is something that represents something else. The most function type symbol is a word. Pictures, numbers and gestures also are widely used as symbols.

6.3.37 Encode

It means to put the message into code or cipher.

6.3.38 Channel

It means the medium through which signals move. According to Rogers and Shoemaker (1971), communication channels are the means by which messages travel from a source to a receiver.

6.3.39 Decode

It means conversion of the message in the code into ordinary language which may be easily understood.

6.3.40 Treatment of message

It means the way a message is processed so that the information gets across to the audience. The purpose of treatment is to make the message clear, understandable and realistic to the audience.

6.3.41 Models

Models are symbolic representations of structure, objects or operations.

6.3.42 Fidelity

It is the faithful performance of communication process by all its elements-communicator, message, channel and receiver. Fidelity of communication process is the degree of exposure and effectiveness of various communication sources at various stages of adoption.

6.3.43 Homophily and Heterophily

Accordingly to Rogers (1995), a fundamental principle of human communication is that the exchange of ideas occurs most frequently between individuals who are alike, or homophilous. HOMOPHILY *is the degree to which a pair of individuals who communicate are similar in certain attributes, such as beliefs, education, social status and the like*. On the other hand, HETEROPHILY *is opposite of homophily, and is the degree to which pairs of individuals who interact are different in certain attributes.*

When two individuals share common meanings, beliefs, and mutual understandings, communication between them is more likely to be effective. Individuals enjoy the comfort of interacting with others who are similar. Heterophilious communication between dissimilar individuals may cause *cognitive dissonance* because an individual is exposed to messages that are inconsistent with existing beliefs and create an uncomfortable psychological state.

6.3.44 Effect

Intended or unintended change resulting directly or indirectly from a development intervention.

6.3.45 Efficacy

The extent to which the project's objectives were achieved or expected to be achieved, taking into account their relative importance.

6.3.46 Effectiveness

A measure of the extent to which a project attains its objectives at the goal or purpose level; i.e. the extent to which a development intervention has attained, or is expected to attain, its relevant objectives efficiently and in a sustainable way.

6.3.47 Efficiency

A measure of how economically inputs (funds, expertise, time, etc.) are converted into outputs.

6.4 Programme Planning and Evaluation

6.4.1 Plan

A plan is a predetermined course of action. Plans may be tailored to specific projects, or they may be established as standing plans (eg. Five Year Plans) for future actions. Planning not only involves predetermining a course of action to be taken, but also includes mentally searching for possibilities of future problems that might appear later.

6.4.2 Programme

A programme is the total educational job being done in a particular setting. It is a prospectus or a statement issued to promote understanding and interest in an enterprise.

6.4.3 Planning

Planning is a process which involves studying the past and present in order to forecast the future and in the light of that forecast determining the goals to be achieved and what must be done to reach them.

6.4.4 Extension Programme

Extension programme is a statement of situation, objectives, problems and solutions. It is relatively permanent but requires constant revision. It forms the basis for extension plans.

6.4.5 Programme Planning

Programme planning is a decision making process involving critical analysis of the existing situation and the problems, evaluation of the various alternatives to solve these problems and the selection of the relevant ones, giving necessary priorities based upon local needs and resources by the cooperative efforts of the people both official and non-official with a view to facilitate the individual and community growth and development.

6.4.6 Extension Programme Planning

Extension Programme Planning is a social-action, decision-making, interactional process in which advance thinking is needed for identifying the needs, interests and resources of the people through educational means to prepare a blueprint for action.

6.4.7 Programme Projection

Programme Projection is an expanded concept of extension programme planning. Programme projection also means improved programme planning by looking more broadly, looking more deeply, looking longer or farther ahead and necessarily, involving more people. It involves the logical analysis of all available information and the setting of long-range goals and objectives to the people.

6.4.8 Levels of objectives

Three levels of objectives are generally well recognized.

Fundamental or all-inclusive objectives of society; say, people's participation in planning at the gross roots level.

General but more definite social objectives; say, mandatory creation of Panchayati Raj bodies in the States.

Working or specific objectives are say, enactment of suitable laws relating to Panchayats, holding Panchayat elections in time, providing funds and facilities to the Panchayati Raj bodies.

6.4.9 Problem

Problem is a condition that the people after study, with or without outside help, have decided needs changing.

6.4.10 Solution

Solution is a source of proposed action to change an unsatisfactory condition to one that is more satisfying.

6.4.11 Project

Project is a specification of work to be done or procedures to be followed in order to accomplish a particular objective.

6.4.12 Work plan

A detailed document stating which activities are going to be carried out in a given time period, how the activities will be carried out and how the activities relate to the common objectives and vision. The work plan is designed according to the logical framework and contains a description in each cell of the work plan table of each activity and output, its verifiable indicators, the means of verification and its assumptions.

6.4.13 Plan of Work

A Plan work is an outline of activities so arranged as to enable efficient execution of the programme. It is a statement of activities to be undertaken by an individual, a group of people or an organization, within a definitely stated time, to carry out the recommendations in the programme.

The plan of work indicates what is to be done, who is to do it, how it is to be done, when it is to be done, who are to be served or reached and how the results will be evaluated.

6.4.14 Calendar of work

A calendar of work is a plan of activities to be undertaken in a particular time sequence.

6.4.15 Baseline Survey/ Study

An analysis describing the situation in a project area – including data on individual primary stakeholders – prior to a development intervention. Progress (results and accomplishments) can be assessed and comparisons made against it. It also serves as an important reference for the completion of evaluation.

6.4.16 Benchmark

Reference point or standard against which performance or achievements can be compared. A benchmark might refer to what has been achieved in the past, by other comparable organisations, or what could reasonably have been achieved under the circumstances.

6.4.17 Risk

Risk refers to the degree of uncertainty with which an outcome can be predicted.

6.4.18 Commitment

Commitment is a state of being in which an individual becomes bound to do his actions and through these action to beliefs that sustain the activities and his own involvement.

6.4.19 Households

Household is a social organisation in which members normally live and sleep in the same place and have their meals. They may or may not be a joint family.

6.4.20 Rules

A rule specifies exactly what is to be done in a specific, single situation.

6.4.21 Budget

A budget is a technique for allocating resources, expressed quantitatively, to attain objectives expressed in the same terms.

6.4.22 Delegation

Delegation is the assignment of tasks and authority to a recipient who assumes responsibility for them.

6.4.23 Indicator

Quantitative or qualitative factor or variable that provides a simple and reliable basis for assessing achievement, change or performance. A unit of information measured over time that can help show changes in a specific condition. A given goal or objective can have multiple indicators.

6.4.24 Input

Something that is put into a process/program. Eg. An amount put in an investment, a fertilizer application for increasing the crop yield. It is a component of production such as land, water, labour, seed, package of practices, plant protection measures, energy etc.

6.4.25 Outputs

The tangible (easily measurable, practical), immediate and intended results to be produced through sound management of the agreed inputs. Examples of outputs include goods, services or infrastructure produced by a project. These may also include changes, resulting from the intervention, that are needed to achieve the outcomes at the purpose level.

6.4.26 Outcome

The results achieved at the level of “purpose” in the objective hierarchy. Outcome is part of impact (result at purpose and goal level).

6.4.27 Impact

It is the change that has taken place across the system over a period of time due to a development initiative. It is something that follows as a result or consequence.

6.4.28 Decision trees

Decision trees are management science technique for choosing the best alternative course of action. A decision tree is a schematic representation of a decision problem. Decision trees can be developed for the more complex situation in which the outcome of a decision affects later decisions.

6.4.29 Qualitative

Something that is not summarised in numerical form, such as minutes from community meetings and general notes from observations. Qualitative data normally describe people’s knowledge, attitude or behaviours. The aroma, colour, taste etc are some of the qualitative parameters and are intangible.

6.4.30 Quantitative

Something measured or measurable by, or concerned with, quantity and expressed in numbers or quantities.

6.4.31 Relevance

The extent to which the objectives of a project are consistent with the target group’s priorities and the recipient and donors’ policies.

6.4.32 Reliability

Consistency or dependability of data and evaluation judgements, with reference to the quality of the instruments, procedures and analysis used to collect and interpret evaluation data. Information is reliable when repeated observations using the same instrument under identical conditions produce similar results.

6.4.33 Resources

Items that a project has or needs in order to operate, such as staff time, managerial time, local knowledge, money, equipment, trained personnel and socio-political opportunities.

6.4.34 Result

The measurable output, outcome or impact (intended or unintended, positive or negative) of a development intervention.

6.4.35 Review

An assessment of the performance of a project or programme, periodically or on demand. A review is more extensive than monitoring, but less so than evaluation.

6.4.36 Sample

The selection of a representative part of a population in order to determine parameters or characteristics of the whole population.

6.4.37 Situation Analysis

The process of understanding the status, condition, trends and key issues affecting people, ecosystems and institutions in a given geographic context at any level (local, national, regional, international).

6.4.38 Triangulation

Use of a variety of sources, methods or field team members to cross check and validate data and information to limit biases.

6.4.39 Validity

The extent to which something is reliable and actually measures up to or makes a correct claim. This includes data collection strategies and instruments.

6.4.40 Validation

The process of cross-checking to ensure that the data obtained from one monitoring method are confirmed by the data obtained from a different method.

6.4.41 Attitude

Attitude is the degree of positive or negative feeling associated with some psychological object towards which people differ in varying degrees.

Allport (1937) defined *attitude* as a mental state of readiness, organized through experience, exerting a directive and dynamic influence upon the individual's response to all objects and situations with which it is related.

6.4.42 Motive

Motive is that which moves or activates. In psychology, it refers to some internal activator within an individual. The motives are the directing tendencies inside the individual to follow a particular course of action.

6.4.43 Motivation

Motivation means movement or motion, an inner state that energizes, activates or moves and directs human behaviour towards goals. It is a need satisfying and goal seeking behaviour.

6.4.44 People's Participation

People's participation may be defined as the process of giving priority to local people's perspective in identifying and analyzing their problems and opportunities, and improving the situation through their self-mobilization. The focus is on the *insiders'* i.e. local people's perspective, rather than on 'outsiders' i.e., change agents', development administrators' perspective.

6.4.45 Value System

It is viewed as relatively permanent perceptual framework which influence the nature of an individual's behaviour.

6.4.46 Semi- structured Interview

It is a form of guided interviewing where only some questions are predetermined. Many questions are formulated during the interview, as in a journalistic interview.

6.4.47 Rating

Rating means judging an object in absolute term against some specified criteria.

6.4.48 Ranking

Ranking is the relative judgement of an object against other similar objects according to some criteria. It is useful for sensitive information like income or wealth. Ranking scores are easier to obtain than absolute measurements. They may be used either as a part of interview or separately.

6.4.49 Participatory Evaluation

Participatory evaluation is designed to help people to help themselves and improve their programmes using a form of self-evaluation and reflection. It is characterized by maximum community involvement at all levels, with emphasis on cooperation, collaboration and shared resources. The participants are seen as experts, and power residing with them. The participants have shared responsibility, accountability, and appreciation of ethnic diversity (Lynton and Pareek, 2000).

6.4.50 Organizing

Organizing involves establishing an intentional structure of roles for people to fill in an organization. It involves, (a) the identification and classification of required activities, (b) the grouping of activities necessary to attain objectives, (c) the assignment of each grouping to a manager with authority necessary to supervise it (delegation), and (d) the provision for coordination horizontally and vertically in the organization structure.

An organization structure should be designed to clarify who is to do what and who is responsible for what result, to remove obstacles to performance caused by confusion and uncertainty of assignment, and to furnish decision making and communication networks reflecting and supporting enterprise objectives.

6.4.51 Coordination

Coordination means establishing harmonious relationship between the efforts of individuals and groups for accomplishment of enterprise objectives. For smooth running of an enterprise coordination is necessary within the organization, as well as with outside organisations. Some sort of basic coordination is essential within an organisation throughout its lifetime for its survival and for unified action.

6.4.52 Staffing

Staffing is the process of selecting, maintaining and developing personnel in position to fulfill the organizational objectives.

6.4.53 Reporting

A report is a formal record of activities or performance. It generally reflects the achievement or otherwise of a programme. Preparation of too many reports may hinder the day-to-day work, particularly field extension work. However, it is useful to bring out at least an Annual Report by each ongoing programme or project and also by the organization. Reporting should be standardized as far as possible, so that comparable data are obtained from the units and summarized for the organization. However, there should be provision for reporting something significant and unusual.

6.4.54 Questionnaire and Schedule

A questionnaire is a device for securing answers to questions by using a form which the respondent fills in or marks himself, while schedule is administered by an interviewer in a face- to-face situation (sometimes modifies also). It may be with the help of instruments like telephones, etc.

6.4.55 Interview

Interviewing being an interesting and skillful process becomes a sort of battle of wits between the respondent and interviewer, involving lots of interaction. It swings between acceptance and rejection attempts from both sides. During this process the interviewer has to perform two major functions, viz,(i) motivating the respondents and (ii) collecting and securing measurable data by using predetermined aids and / or devices.

6.4.56 Surveys

Surveys are investigations of subjects with respect to values, conditions, traits and situations, which provide needed information on a limited number of topics, clients, conditions and facilities on a usually extensive scale. It is designed to give an overview about a population. Surveys are combined with other methods of evaluation. It may cover the entire population or may be restricted on sample surveys. Their biggest problem is to establish their reliability and validity.

6.4.57 Testing (Tests)

A test is a systematic procedure for comparing the behaviour of two or more persons, with a set of constructed stimuli (test items) which enables the tester to assign the testee a numeral from which inferences can be made about the testee's possession of whatever the test is supposed to measure.

Tests are developed and designed to measure maximal rate (speed), their achievements, skills, creativity, intelligence, emotions and hosts of socio-psycho-cultural variables.

6.4.58 Scaling Techniques

Physical scales for weighing or measuring things are very common. In recent years socio-psycho-cultural and attitudinal measurements (or weighing) are practiced by using empirical techniques, with gradual measuring instruments of appropriate levels, by assigning the numerals to the psycho-social-attitudinal object according to rules which are called scaling techniques.

6.5 Extension Activity in Transfer of Technology

6.5.1 Farmer

The term "farmers" refers to both men and women, and include landless agricultural labourers, sharecroppers, tenants, small, marginal and sub-marginal cultivators, farmers with larger holdings, fishers, livestock and poultry rearers, pastoralists, small plantation farmers, as well as rural and tribal families engaged in a wide variety of farming related occupations such as apiculture, sericulture and vermiculture.

The KVKs should also include tribal families engaged in shifting cultivation and in the collection and use of non-timber forest products. Farm and Home Science Graduates earning their livelihoods from crop and animal husbandry, fisheries and agro-forestry will also have their rightful place in the world of farmers and farming.

6.5.2 Agriculture

Agriculture is the process of producing food, feed, fiber, fuel and other goods by the systematic raising of plants and animals. It is also defined as the science of working with the land, such as the harvesting of crops, and the rearing and care of live stock (animals on a farm). Agriculture is also the science and art of farming; work or business of cultivating the soil, producing crops, and raising livestock.

6.5.3 One straw Agriculture

Refers to system of natural farming without ploughing, chemical fertilizers, weeding and chemical pesticides and herbicides.

6.5.4 White Agriculture

System of agriculture based on substantial use of micro organisms, particularly fungi.

6.5.5 Green Agriculture

Cultivation with the help of integrated pest management, integrated nutrient supply and integrated natural resource management systems.

6.5.6 Organic Agriculture

Cultivation without any use of chemical inputs like mineral fertilizers and chemical pesticides.

6.5.7 Evergreen Revolution

Refers to increasing productivity in perpetuity without associated ecological harm.

6.5.8 Eco Agriculture

Agriculture based on conservation of soil, water and biodiversity and the application of traditional knowledge and ecological prudence.

6.5.9 EM Agriculture

System of farming using effective micro organisms (EM).

6.5.10 Adult

An adult is a human being after an age of 21 (or say 18) years, as specified by law. An adult is considered to be a fully developed and mature person. As a person matures, his or her self-concept moves from a dependent personality towards a self-directing human being.

6.5.11 Rural Youth

The Ministry of Human Resource Development (1985) considers ‘youth group’ in India as persons in the age group 15 to 35 years. Youth forms nearly one-third of the population of India. Rural Youth constitute over two-and half times of the size of urban youth.

6.5.12 Group

It is a collection of two or more individuals in reciprocal communication and interaction.

6.5.13 Community

A group of people living in the same locality and sharing some common characteristics.

6.5.14 Institution

An institution is an organized system of social relationships which embodies certain common values and procedures, and meets certain basic needs of the society. Institutions are culturally approved patterns of behaviour including prescribed roles and procedures, and are grouped to satisfy some basic social needs. These have persisted long enough to be considered as permanent.

6.5.15 Organizations

Organizations are social units, or human groupings, deliberately constructed to seek specific goals.

6.5.16 KVK

KVKs are grass root level organizations meant for application of technology through assessment, refinement and demonstration of proven technologies and training of same under different 'micro farming' situations in a district.

6.5.17 Extension Service

It is mainly to provide educational services to the people according to their needs, for improving their life through better working.

6.5.18 Expert System

An "Expert System" is an intelligent computer program that uses knowledge and inference procedures to solve problems that are difficult enough to require human expertise for their solution. The knowledge necessary to perform at such a level plus the inference procedures used can be thought of as a model of the expertise of the best practitioners in the field. (Daniel Hunt, 1986)

6.5.19 Self Help Group (SHG)

SHG is a people's institution which provide the poor with the space and support necessary to take effective steps towards greater control of their lives in private and in society. SHG is not a static institution. It grows on resources and management skills of its members and their increasing confidence to get involved in issues and programmes that require their involvement in the public and private sectors.

6.5.20 Beneficiaries

The individuals, groups or organisations who, in their own view and whether targeted or not, benefit directly or indirectly from the development intervention. Here, they are referred to as the primary stakeholders of a project.

6.5.21 Sustainability

Sustainability refers to the successful management of resources to satisfy changing human needs, while maintaining or enhancing the quality of environment and conserving natural resources. The KVK staff while formulating their programs should focus on maintaining the sustainability of the micro farming system in their districts.

6.5.22 Activity

Actions taken or work performed in a project to produce specific outputs by using inputs, such as funds, technical assistance and other types of resources.

6.5.23 Field Days

A field day is a day in which an area containing successful farming or other practices is open for people to visit. This way, a group of farmers could witness the performance or results of certain practice (s) under local conditions. Filed days could be planned to deal with one specific topic at a time or a number of items of interest to the farmers. The purpose of the field day is to permit extension clientele to observe personally, ask about successful and locally applicable practices, and to create a situation in which informal contacts and learning can take place.

Filed days are normally held once or twice a year, usually in each crop season. They are held on farmers' fields, regional research stations, agricultural universities and government farms to demonstrate successful farming techniques or research.

6.5.24 Farmers' Field School (FFS)

The farmers' field school (FFS) is basically "a school without wall". FFS consists of a group of people with a common interest who get together on a regular basis to study the "how or why" of a particular topic. The topic covered can vary considerably from IPM, organic agriculture, and husbandry etc, to income generating activities such as handicrafts.

6.5.25 Clinic

A meeting of a group of people with common interests. It is established for the purpose of diagnosing, analyzing, and seeking solutions to specific problems.

6.5.26 Agri- clinics

Agri- clinics are those which provide expert services and advice to farmers on cropping practices, technology dissemination, crop protection from pests & diseases, market trend and prices of various crops in the market and also clinical services for animal health etc, which would enhance productivity of crops/animals.

6.5.27 Farm Clinic

Farm clinic is a facility developed and extended to the farmers for diagnosis and treatment of farm problems and to provide some specialist advice to individual farmers. The extension agency

may set up farm clinics in the village and/or in the organization's headquarters and sub-centres, where the relevant subject matter specialists, in collaboration with the extension agents, discuss, diagnose and prescribe treatment to farmers' problems, meeting those present individually, on a fixed place, day and time. The specialist may visit the local area if needed, for an on–the-spot diagnosis and guidance or follow-up. This method is suitable for treatment and prevention of pest and disease problems relating to plants, animals and soils.

6.5.28 Agri-Business centre

Are those which provide input supply, farm equipment on hire and other services. Commerce/ trade related to agriculture sector is carried out.

6.5.29 Exhibition

Exhibition is a planned and systematic display of real objects, specimens, models, charts and posters presented to public view for instruction, judging a competition, advertising or entertainment. It helps to create awareness, develop interests and stimulate action amongst the public. It accommodates both exhibits and display.

Displays use two dimensional or flat materials like pictures, photograph, chart, posters etc, while exhibits tend to use more three dimensional materials like real objects, specimens and models.

6.5.30 Field visit

Visit to successful farmers' fields in addition to KVK farms to reinforce the relevant technologies imparted in the training programme. The principle of "seeing is believing" can be fulfilled. Field visit gives participants exposure to the real life situation and also provide an idea about the possible solutions to the problems.

6.5.31 Success Stories

Experience of successful farmers as success stories carry special significance both for trainees as well as the KVKs and boost the technology dissemination process. For example, the success stories reported by KVK West Tripura on True Potato Seeds (TPS) have stimulated farmers in the surrounding villages. Other mass media like Radio and Television can broadcast and telecast success stories to create awareness and motivate farmers about successful technologies that could be practiced by them as well.

6.5.32 Campaign

It is an intensive teaching activity undertaken at an opportune time for a brief period, focusing attention in a concerted manner on a particular problem, with a view to stimulate the widest possible interest in a community. Campaigns are launched only after a recommended practice has been found acceptable to the people as a result of other extension methods like method or result demonstrations.

Its purpose is to encourage emotional participation of a large number of people and to foster a favourable psychological climate for quick and large scale adoption of improved practices.

6.5.33 Field Trips/ Farm Tour

It is a method in which a group of interested farmers accompanied and guided by an extension worker, goes on tour to see and gain first hand knowledge of improved practices in their natural setting (whether on research farmers demonstration farms, institutions or farmers field). It is a series of field and demonstration meetings arranged in a sequence.

6.5.34 Study Tour

In study tour, a group of interest persons accompanied and guided by one or more extension agents moves out of their neighbourhood to study and learn significant improvements in farm and home elsewhere.

The main purpose is to motivate the visitors by showing what others have been able to achieve. The programme may include visit to farmers' place as well as research stations, and may be held within the district, outside the district or even outside the State. Study tours may be synchronized with programmes of national importance like National Fair, World Fair etc. Visit to some places of interest may be included in the programme. A group of 30 to 50 persons may be convenient for a study tour. However, a maximum number of 80 to 100 persons may be accommodated in one batch.

6.5.35 Farm Publication

Farm publication is a class of publications prepared by the extension agency in printed form, containing information relating to the improvement of farm and home. Farm publications are of various types such as leaflet, folder, bulletin, newsletter, journal and magazine. Farm publications may be used singly or in combination with other extension methods.

6.5.36 Extension / Publications

Extension publications are very useful extension tools which provide precise and reliable scientific information in simple language and in an interesting manner. They are written with a clear message for farmers, in simple language. Such publications may include a leaflet, folder, pamphlet etc. Attractiveness of extension publications can be increased by using different colours, illustrations, photographs and lettering style.

6.5.37 News

News is any timely information that interests a number of persons and the best news is that which has the greatest interest for large number of people. Accurate, unbiased account of the main facts of a current event is of interest to the readers of a newspaper.

6.5.38 Newspaper

A newspaper is a bunch of loose printed papers properly folded, which contains news, views, advertisement etc. and is offered for sale at regular intervals, particularly daily or weekly.

6.5.39 Newsletter

It is a miniature newspaper in good quality paper, containing information relating to the activities and achievements of an organization. It has a fixed periodicity of publication. News letters are generally distributed free-of-cost.

6.5.40 Circular letters

These are specially prepared intimate letters using a personal approach for a specific message, which are mailed to a large number of farmers periodically or on special occasions. They are written to maintain a continuous contact with farmers and to communicate specific ideas to them. They are also used as a follow-up of several other extension teaching methods.

6.5.41 Pamphlet

Pamphlet varies in size from 12 to 24 pages. A pamphlet may contain and deal with a number of related topics.

6.5.42 Leaflet

It is a single printed sheet of paper of small size, containing preliminary information relating to a topic. It is made as, and when needed. Leaflets are generally distributed free-of-cost.

6.5.43 Folder

It is a single printed sheet of paper of big size, folded once or twice, and gives essential information relating to a particular topic. It is printed as and when required. Generally distributed free-of –cost.

6.5.44 Bulletin

It is a printed bound booklet with a number of pages containing comprehensive information about a topic. It is made as and when necessary. A small price may be fixed on some important bulletins.

6.5.45 Journal, Magazine

These are periodicals, containing information related to various topics of interest not only for the farmers but also for the extension agents. It has a fixed periodicity of publication. Generally supplied against pre-payment of subscription for a particular period.

Farm publications are extremely useful to the literate farmers. Even illiterate farmers can make use of them with the help of literate members in their family. Farm publications are used by all types of media- persons. These may be used in most of the individual, group and mass methods.

6.5.46 Specimen, Model, Diorama

Specimen is a sample which represents the whole, **model** is miniature replica of an object and **diorama** is a scenic representation of the original, with specimen, model and painting. The term **'diorama'** is derived from the Greek which means 'to see through'. In extension work when it is not

possible to expose the audience to the real life situation, these may be used to communicate a reliable idea of the original. Specimen and model are used in method demonstration, group meeting, training programme, exhibition etc. Diorama is generally used in exhibition and in communication centres.

6.5.47 Media Forum

Media forums are organised small groups of individuals who meet regularly to receive a mass media programme and to discuss its contents. The mass media linked to the forum may be radio, television, video etc.

6.5.48 Assigned Reading

The trainer gives the trainees reading assignment that provide new information on the subject matter of the training.

6.5.49 Demonstrations

The trainer shows the correct steps for completing a task, or shows an example of a correctly completed task to the trainers.

6.5.50 Radio Talk

Radio is a device with which the whole mass can be contacted at a time, efficiently and economically. It is a useful tool for extension work in rural areas. The best time for broadcasts for rural people is the evening time between 6 P.M .and 8 P.M., because at this time majority of them are free to listen and usually assemble at their meeting places. Short, simple sentences, familiar words, straight forward ideas, repetition of important facts, and example and not too many ideas will make the talk move effective.

6.5.51 TV Show

TV is a very powerful medium of communication. Television has the quality of direct address; in other words, every viewer feels as if he is being talked to personally.

6.5.52 Film show

It is an effective extension tool which helps extension workers to disseminate agricultural innovation in rural areas whenever they are organised in a village. Most of the time, they are interested in such shows for entertainment. However, with careful selection and use of films, messages about improved farm and home practices can also be effectively conveyed. Attendance at film shows can be increased by telling children that they will be allowed only in the company of parents.

6.5.53 Farmers' Fair/ Kisan Mela

Fairs, or melas, are part of our culture. Rural fairs attract a large number of persons dressed in their best, with joy and gaiety, bringing together rustic culture and traditions.

With the establishment of agricultural universities, the concept of rural fairs has been used to organize farmers' fairs as an effective method of communicating improved practices to a large number of farmers. These fairs generally include an interesting agro- industrial exhibition, effective demonstration of improved seeds in small packets. These fairs are generally held at a place where some institution or research farm is located as their organisers need the participation and coordination of a larger number of departments and persons.

6.5.54 Kisan Call Centre (KCC)

The Department of Agriculture & Cooperation, Ministry of Agriculture, Govt. of India has launched **Kisan Call Centers** with a view to leverage the extensive telecom infrastructure in the country to deliver extension services to the farming community. The purpose of these Call Centers is mainly to respond to issues raised by farmers instantly in the local language, on continuous basis. It operates nation wide through a toll free number 1551 which farmers can dial freely from anywhere in the country.

6.5.55 Farmer-Scientist Interaction

It is defined as "the collaboration of farmers and scientists in agricultural research and development for better understanding of information and experiences".

6.5.56 ATMA/SREP

ATMA is a society of key stakeholders in agricultural activities for sustainable agricultural development in the district. It is a focal point for integrating research and extension activities and decentralizing day to day management of the public Agricultural Technology System (ATS). It is a registered society responsible for technology dissemination at the district level. The ATMA was initially pilot tested in 24 districts across six participating states (Andhra Pradesh, Bihar, Himachal Pradesh, Maharashtra, Orissa and Punjab).

The ATMA at district level would be increasingly responsible for all the technology dissemination activities at the district level. It would have linkage with all the line departments, research organisations, non-governmental organisations and agencies associated with agricultural development in the district. ATMA management committee comprises of the Project Director of the ATMA as the Chairman and members are drawn from line department heads, NGOs and farmers organization. The management committee carries out PRA, prepares Strategic Research Extension Plan for the district, establishes Farmer Advisory Centres and co-ordinate the execution of annual work plan through participatory line departments, ZRSs, KVKs, NGOs, FIGs/FOs and allied institutions. The ATMA creates Farmers Advisory Committees to provide feedback. It uses NGOs to organize farmers and encourages private sector in technology transfer. It also validates and refines technology. It also ensures increased use of information technology, arranges in-service training and encourages developing of new public and private partnership. The ATMA Governing Board (GB) comprises District Magistrate /Collector as chairman, Chief Development Officer as Vice Chairman and, Joint Director, Agriculture, Head KVKs, one farmer, one NGO representative, one SC/ST farmer, lead Bank Officer of District and representative from Agricultural Marketing Board as members.

6.5.57 SREP (Strategic Research and Extension Plan)

It is the process of finding the best scenario for agricultural development and setting the best path to reach that destination by rigorous analysis and choices about:

- Goals-what is intended to be accomplished
- Opportunities and Threats- what is needed and feasible
- Strengths and Weakness-what is the capability of doing things

6.5.58 ATIC (Agricultural Technology Information Centre)

ATIC is a “Single Window” support system linking the various units of a research institution with intermediary users and end users (farmers) in decision making and problem solving exercise.

Chapter – VII

Impact Evaluation Tools and Basic Statistics

7.1 Evaluation for Impact Assessment

KVK programmes are investments where we expend capital resources to create sustainable functional units at gross root level from which we can expect to realize the benefits over an extended period of time. According to USDA, Evaluation is the process of determining how well one is doing in what one is trying to do. Evaluation when applied to the field of extension may be defined as a process of systematic appraisal by which we determine the value, worth or consequences of the extension programme/activity. Most KVK programmes are similar of extension programmes which are at the interface between the demand and supply systems of agricultural technology. Most of the evaluation study conducted in extension was of mostly comparison of production yield before and after the implementation of the programme. However, it must be understood that evaluation is not simply a measurement of achievements, which is usually done after a programme is executed. A complete evaluation for KVK programmes is one which aims at the full length enumeration of both tangible and intangible costs and benefits involved. Both tangible costs and benefits are easy to identify but it is not so for intangible ones. Knowledge, once disseminated by the extension service and acquired by farmers, has a tangible measurable product only if applied (Orievel, 1983; Feder and Slade, 1985).

The application of such knowledge by farmers is generally termed as adoption and is usually measured by adoption rates, that is, the proportion of farmers applying knowledge of a particular technology that they have acquired from extension agents. Moreover, adoption cannot take place without knowledge. It is not an automatic consequence of the acquisition of knowledge as many other influences may affect a farmer's decision to adopt. Among these are the profitability of the technology, the availability of key inputs, credit and complementary knowledge (Fitzhugh et. al.1982). Moreover, many of the farm production technologies are often not available to the resource-poor farmers living in remote areas, and clients of these services are semi-commercial farmers who benefit from such technology (Perviaz and Hendrik, 1989). So it is not entirely correct and complete method of evaluating the extension through the adoption rate alone. An application of the economic concept in the evaluation of extension projects brings about the total net cost and benefit of the project

7.2 Various Stages/ Phases in Economic Evaluation of Extension

Where does economic evaluation fit into extension programmes? Economic evaluation is a part and parcel of all phases in an extension programme right from its initial planning to implementation and completion. The economic concept of extension is applied:

(1) at project selection,

(2) during implementation, and

(3) after completion of the project

7.3 Evaluation Criteria during Project Selection

An extension project can be either selected or rejected once its cost and benefits are identified and valued. Moreover, the realistic estimation of costs and benefits is a pre-requisite for the successful evaluation of an extension project at its selection stage. Most of the extension projects suffer from incomplete identification usually resulting into over-estimation of benefits and under-estimation of costs (Evenson, 1978). The compounding and discounting are the techniques to enable the benefits the costs streams (or cash inflow and cash outflow) from different projects at a particular point of time to examine the profitability of each project and relative profitability of the projects.

Usually, a wide range of criteria are applied to evaluate a project during the selection stage for choosing the investment proposals. These criteria are classified into (1) Non-discounting criteria which includes urgency, payback period and accounting rate of return for estimation, and (2) Discounting criteria which includes the Net present worth , Internal rate of return, Benefit-cost ratio and Net Benefit Investment Ratio as its tool. The figures obtained during the initial stage of project selection are purely on the basis of conceptual ideas. This has to be confirmed before actually implementing the project on a large scale. This could be done through conducting on field extension trials and evaluating the results.

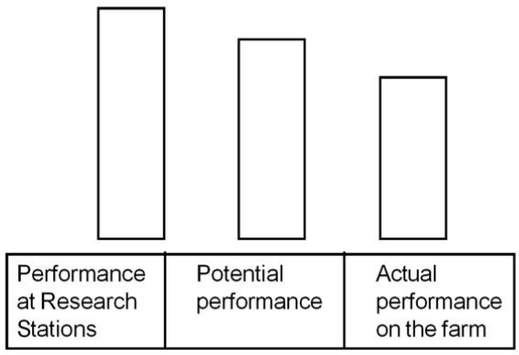
7.4 Economic Analysis of On Farm Trials (OFTs):

The consequences expected out of selected extension projects and technologies that are to be transferred to the farmers can be assessed by carrying out the evaluation of On Farm Trials (OFTs) under different client group settings. The objective here is to ascertain the initial estimated cost and benefits of the project on its large scale implementation. Thus OFT will help us as a screening tool in eliminating the extension projects and technologies which are not viable before going for a large scale implementation. The initial cost-benefit estimates worked out at the time of project selection is purely based on the projected and conceptual figures whereas results of the OFT gives us the estimates nearer to the real costs and benefits of the project on its large scale implementation.

Although the need to develop bio-economic models to screen new technologies has been stressed, data are so limited that such complex models can be developed only in advanced countries. They become mere academic exercises when applied to developing country situation. Even though the OFT can guide research, evaluation as well as to identify the weaknesses in the extension system, such models were rarely conceived and tried in the practical situation because the models suffer with various limitations. Demonstration farm models have widely been used to conduct the economic analysis of OFT.

The demonstration farm approach has helped to determine the economic value of new dairy technology for different sizes of farms (Patel, 1981). The yield-gap model gives the difference between the yields that are technically and economically feasible and the actual yields obtained by majority of the farmers. This model presented by Gomez and Santos (1981) is mainly used to explain the differences in the performance of technology at the farmers' farm and research station (Refer figure). What is the effect of extension in reducing this gap? Only an effective evaluation will give the answer.

Production differences



Environmental Differences

i. Biological Differences : Species, Diseases, Parasites, Nutrition.

ii. Managerial and Socio-Economic Constraints: Knowledge, preference, practices, credit, market costs and input availability.

Fig.: Yield Gap Model

The profitability of an extension programme should be verified through giving special attention to the identification of net costs and benefits of the technology to be transferred. In the preliminary stage, profitability should be estimated at the optimal input levels, with appropriate discount for risk. In addition, farmers should be consulted to identify the inputs, such as cash, labour, training requirements that play a part on the decision to experiment with the new technology which is to be implemented through the existing extension system. An evaluation that takes into account only the cash inputs (such as gross margin analysis) may be appropriate for certain type of technologies only (Pervaiz and Hendrik, 1989). Table 1 shows how economic tools can be matched for screening the technologies involved in farm/animal production before incorporating into the extension system.

Table1: Economic tools for screening the technologies

Technology	Farmers criteria	Tools of analysis
Effects of new yoke design on draft power	Weight and durability	Benefit – cost analysis
Effect of feeding practices on milk production	Changes in milk yield	1) Marginal analysis 2) Production function 3) Linear programming
Health related	Disease prevention and control	Benefit – cost analysis
Breeding and Management	Genetic potential production	Gross-margin analysis
Effects of feed supplementation	Physical performance and weight gain	1) Partial budgeting 2) Financial analysis

Source : Pervaiz and Hendrik (1989).

7.5 Cost-Benefit Analysis in Extension

"Every possible thing in this world is at some cost". The net cost and benefit in any extension programme includes both tangible and intangible costs. According to this, we cannot ignore the social cost (which is intangible) which the society incurs on the execution of the programme. Even though it is intangible, it is considered for the cost estimation because of the social value attached to it. The difficulty involved in measuring the social cost benefit is anybody's imagination. Yet without the inclusion of these intangible costs the efforts to evaluate the extension largely remains non-functional.

The social cost is anything the society pays/sacrifices save monetary contributions for the execution of an extension programme. Likewise the social benefits are those benefits other than its monetary benefits derived from the outcome of the project on its execution. Mostly, the social cost and benefits are indirect in nature.

Vaccination campaigns and knowledge about the animal diseases directly reduced the number of animals affected by the diseases and indirectly improved the relationship between the village rival groups as no longer the farmers believe the ailment of his animals as the handiwork of his village witchcraft and rival group. The extension programme brings knowledge to the farmers and their family. In broader sense, the cost of bringing out the knowledge to the family can be worked out but what the knowledge brings/does to the farm family is multi-dimensional in nature in which the economic benefit is one of its dimensions. The other dimensions are, due to increase in production, the farmer becomes economically well-off and his sons and daughters could get educated and take up new occupations. What about the services rendered by these benefited classes to their society? Is it an outcome of extension or not? How we can cover all these dimensions while attempting to measure the social cost and benefit of the extension? Is it possible to cover all its dimensions or not? If yes, up to what extent, if not what are those impeding forces and alternatives perceived? These are the questions, which need to be answered. Still there are no definite criteria or standardized procedures or ways to measure the social cost and benefit in the extension. As already stated, the economic cost-benefit is one aspect of the whole which we have to measure for determining a project's worth. It is the responsibility of the social scientists to take up this issue for attempting a complete evaluation of extension in this direction.

The final step in the evaluation required that the value of the increase in farm output resulting from our estimates of the productivity differential attributable to extension, be set against the additional costs incurred to make the additional output possible. To do so, the familiar technique of cost benefit analysis has to be applied to the extension system. As the analysis has to be undertaken ex-post availability of a complete series of either costs or benefits for the entire life of the project will help in arriving at an accurate evaluation result. If the costs and benefits for the entire life of the project is not available, we have to make number of assumptions relevant of an ex-ante analysis (Feder and Slade, 1985).

The stream of incremental extension cost should be constructed using data on the actual costs of the project during the initial years. In scenarios where the project life was assured to be less than the life span of physical structures and equipments, appropriate residual values were calculated and deducted from the costs (Feder and Slade, 1985), For arriving at an actual impact of extension,

the econometric techniques which accounted for differences in the quantities of variables and fixed inputs, the type of soils, human capital, and the production environment are used to estimate the percentage output differentials between the two areas with differences. If variable inputs are not taken into account then the output differentials includes the effect of extension on farm efficiency as well as the effect on the use of inputs, provided that price differential are also controlled (Feder and Slade, 1985). A complete accounting for the effects of extension should, therefore, take both types of effect into account.

7.6 Basic Statistical Tools

A branch of knowledge can be called as science only on condition that it can be studied through scientific methods. Science goes with the method and not with the subject matters. Scientific method consists of systematic observation, classification and interpretation of data. The main difference between our day to day generalization and the conclusion usually recognized as scientific method lies in the degree of formality, rigorousness, verifiability and general validity of the latter (Lunmdberg, 1960). Science may be defined in terms of six major processes that take place within it. These are testing, verification, definition, classification, organisation, orientation, which includes prediction and application. The scientific method is marked by the following features;

a) Careful and accurate observation, collection and classification of facts.

b) Observation of factual correlation and sequence.

c) The validity and reliability features.

d) Measurements and statistical analysis.

In this part the above features involved in the scientific method is briefly taken up for discussion.

7.7 Methods of Observation and Collection of Facts

7.7.1 'Ex post facto' method of observation

The term 'Ex post facto' was originally used by Chapin and Greenwood to mean a quasi experiment in which an attempt was made to control independent variables by matching and symbolic methods. The term 'Ex post facto' method refers to such method of observation or empirical inquiry in which the scientist doesn't have direct control of independent variables because their manifestations have already occurred or because they are inherently not manipulable. Inferences about the relationships among the variables are made from concomitant variation of independent and dependent variables without any direct intervention. In this method no direct control is possible and neither experimental manipulation nor random assignment can be used by the researcher. In the ex-post facto method of observation he does not have any manipulative control of independent variable.

7.8 Collection of Data or Facts

7.8.1 Survey

In social sciences the facts about a society or a social phenomenon is collected through survey technique or method. The survey is in brief a method of process by which quantitative facts

are collected from a given population. If the survey method is applied to collect a given quantitative data from all the units in a selected population then it is called as complete enumerative survey method. When the population size is big, it is not possible to collect data or observe the fact from every unit of the population. In such case sample survey technique is used.

7.8.2 Sampling Technique

Sample is a small group or unit which is taken as the representative of the whole. The whole group from which the sample has been drawn is referred as the population and the small group or unit drawn from the population to represent the population for the study is called as the sample. Sampling method has the advantages of saving time and money, in addition to the possibility of a detailed study. The accuracy of the results, high validity and reliability of the method make the sampling technique highly useful.

Methods used for drawing the sample from a given population are given under:

1) Random sampling
2) Purposive sampling
3) Stratified sampling
4) Quota sampling
5) Multistage sampling and
6) Convenience sampling

7.8.2.1 Random Sampling

Is the method of selection which assures each individual or element or unit in a given population an equal chance of being chosen. Lottery method, Tippets number system and selection from sequential list are the commonly used random sampling techniques.

7.8.2.2 Purposive Sampling

When the researcher purposively selects certain units or elements from the population, it is known as purposive sampling technique. In purposive selection the number of groups or units is selected in such a way that the selected units together yield the same average as the totality with respect to those characteristics which are under observation.

7.8.2.3 Stratified Sampling

It is a combination of both random sampling and purposive selection. The population is divided into a number of strata or groups. Then from each group or strata the required number of samples is drawn randomly.

7.8.2.4 Quota Sampling

In this method initially the population is divided into different strata. After the stratification, the number of sample to be selected from each stratum will be decided. This number is known as quota. Then the fixed quota of samples is drawn from each stratum.

7.8.2.5 Multistage Sampling

This method is suitable when sample is to be selected from a large population. The selection of the sample is made in different stages. For example, at the first stage the districts in a state are grouped according to region wise and from each of the region one district is selected. Then from each of the district, one taluk representing each area of the district is selected. The villages in the selected taluks are divided into developed and developing and from each of the category two villages are selected. Finally, from the selected villages, the house holds are grouped into various categories and from each category a fixed number of sample households are picked up randomly. Here, the selections of final sample units are made in number of stages. This method is a combination of stratified sampling and random sampling technique. By this method in a large population the representation from every unit can be obtained.

7.8.2.3 Convenience Sampling

Sample is selected according to the convenience of the researcher. The convenience may be anything such as availability, accessibility of the units etc. This method is generally unsystematic, or opportunistic.

The reliability of the sample selected can be tested by means of drawing a parallel sample or by comparing the measurement of the sample with those of the known population scores or by drawing a sub sample from the main sample.

7.8.3 Schedule and Questionnaire

The schedule and questionnaire are the forms containing some statements expressed in wide varied formats. The basic difference between the schedule and questionnaire is, in terms of schedule the researcher will personally administer it to the subject for collection of data or make observations. The questionnaire is the one when such formatted statements are mailed to the subjects for getting the response. Generally, the schedule and questionnaire are classified into structured or non-structured one. The structured format contains a definite, concrete and pre-ordinated question. The non structured format which is often known as interview guide is very much general and provides guidelines and instructions only.

The purpose of a schedule or questionnaire is to obtain the required information from a subject. Different types of schedules are observation schedule, rating schedule, document schedule and interview schedule. A good schedule should aid the required communication between the subject and researcher. It should also get the right response from the subject. The schedule should be simple and convey accurate meaning without any ambiguity. The size of the schedule should be optimum. Too small schedule will cut short the information and lengthy schedule will be difficult to use and at the end huge volume of data will complex the coding, analysis and interpretation process.

7.9 Observation Methods

Science begins with observation and must ultimately return to observation for its final validation. The observation is classified into participant observation and non-participant observation, controlled and uncontrolled observations. In the participant observation, the observer participates

with the activities of the subject under study and collects the required facts. In non participant observation the observer does not actually participate in the group activities and keep himself detached from the subject under observation and collect the required facts. In the former method the observer identifies himself with the group and its activities and in the later case he maintains distance and remains as an outsider.

7.9.1 Controlled and uncontrolled Observations

The observation may be controlled or uncontrolled. When the observations are made under natural surroundings and the activities are performed in their normal course without being influenced or manipulated by external force, it is known as uncontrolled observations. In case of controlled observation the experimenter exercises his control over the phenomenon and observation. The main purpose of controlled observation is to check any bias due to faulty perception and to avoid the influence of external factors which are not meant or connected with the experiment.

7.10 Measurement and Statistical Analysis

Measurement is the basic act of all scientific research. The outcome of all experiment is observed and measured. On qualification the data is subjected to statistical analysis to draw meaningful inferences from the figures or numbers obtained as a result of basic observation and measurement. Statistical analysis gives the meaning to observation. It establishes the reliability and validity of the results obtained. In this part, the fundamentals of measurement, reliability and validity of the data and basic statistical methods are discussed in brief.

7.10.1 Measurement

Assignment of numbers/numerals to objects or events according to rules is called as measurement. A numeral is a symbol of the form 1, 2, 3 or I, II, III. It has no quantitative meaning unless we give it such a meaning; it is simply a symbol of a special kind. Numerals are used because measurement ordinarily uses numerals which after being assigned quantitative meaning become numbers. A number, then, is a numeral that has been assigned quantitative meaning. General equation for any measurement procedure is f = {[x,y]; x =any object, and y=numeral}. This is read as “The function, or the rule of correspondence, is equal to the set of ordered pairs (x,y) such that x, is an object and each corresponding y is a numeral (Kerlinger, 1964).

7.10.2 Postulates of Measurement

Nine postulates of measurement given by Campbell are briefly given under. Out of the nine postulates of measurement, the first three postulates measures the identity. The fourth and fifth postulates measure the order and the remaining last four postulates deals with the activity. The postulates are:

1) a=b or a # b; it indicates the identify of the number.

2) If a = b, then b = a; here the relationship is symmetrical.

3) If a = b, and b = c then a = c; things equal to same thing are equal to each other.

4) a > b or b > a; indicates the order.

5) If a > b and b > c; then a >c; helps to put the variables in a rank order continuum.

6) If a = p and b >0 (Zero) then a+b > p; addition of zero leaves a number invariable.

7) a+b = b+a: Then order in which things are added makes no difference in the result.

8) If a = p and b = q then a+b = p+q (i.e) then identical objects may be substituted for one another in addition.

9) If (a+b)+c = a+(b+c) i.e. the order of combinations or associations make no difference in addition.

7.10.3 The Levels of Measurement

There are four general levels of measurement; nominal, ordinal, interval and ratio. These four levels lead to four kinds of scale. They are discussed hereunder:

7.10.3.1 Nominal scale

Simple and pre-requisite to all scales. Its major part is equivalence. In this scale we take into consideration the categories on the basis of the numbers and objectives.

7.10.3.2 Ordinal Scale

Ordinal type of scales take into consideration the relationship “greater than” or “higher than”. It is the relationship of asymmetrical which is possible for us to put our objectives in a psychological continuum. But in this scale, we are not interested to find out how much greater or how much higher (i.e) the distance between the two levels may not be equal but it is possible only to put in an order. In the interval scale we consider the distance.

7.10.3.3 Interval Scale

Here, we have the characteristics of nominal and interval scales. In addition, it has the consideration of distance between the two points i.e. the distance between a & b and b& c. In addition we have an arbitrary zero and we do not know from where this zero starts.

7.10.3.4 Ratio Scale

It includes all the qualities of ordinal, nominal and interval scale. In addition to this we have one absolute zero. But in social scale construction, it is not possible to go for such higher scale for measurement. In the nominal and ordinal type of scales mostly non-parametric tests are used. In the interval and ratio scale both parametric and non parametric type tests are used.

7.11 Reliability and Validity

7.11.1 Reliability

It means the accuracy or the precision of the measurement. It indicates the dependability or consistency or predictability of the measuring instrument or the method of approach followed in a research. If we measure the same concept twice after some interval and get more or less same result both the time, then we can say that our measurement has stability, dependability and predictability. Before accepting a method or measurement we have to estimate the reliability. The reliability can be estimated by the following methods.

1) Test Retest method

2) Parallel or Equivalent form method

3) Split Half method

7.11.1.1 Test Retest Method

In the test-retest method the same scale of measurement is applied two times. The results are then correlated by applying the Pearson-Product Movement test. This co-efficient or correlation is called as coefficient of stability. While using the test-retest method the main constraint is time. If the distance or time between the two tests is longer then the score may be altered due to the changes that have taken place in the subject quality in the mean time due to external factors. So the resultant "r" value is unreliable. If the time interval is too short then the "r" value is high and so we get a very high reliability of the scale. So, we have to avoid too short and too long time interval between two tests.

7.11.1.2 Parallel Form or Equivalent Form Method

Here the whole measuring scale is divided into two groups taking into consideration that all the items in one group is equivalent to the second group. On the basis of this they are called equivalent. The two groups of test should be administered under similar condition. Then the 'r' value is calculated between the two groups. The 'r' is called as correlation of equivalent.

7.11.1.3 Split Half Method

This method is extension of the equivalent form method. Here instead of dividing the whole scale into two halves, we divide the scale on the basis of odd and even numbers basis. If an attitude measuring scale have 20 statements, the statement number 1,3,5,7,9……19 forms one group and even number statements 2,4,8……20 forms the other group. The statements are administered to the subject and corresponding score for each group is calculated. Then correlation co-efficient between the two groups using the Spearman Brown formula is obtained.

7.11.1.4 Standard Error of Measurement

If we administer the same scale under the same condition repeatedly, every time we get the score more of less same but may not be actually same. Then we have to calculate the true score by applying the correction factor. Calculate the mean of the scores you obtained in 4 to 5 times of

measurement and then derive the standard deviation. Then the standard error of the measurement is calculated by the following means.

$$Se = s\sqrt{1-rtt}$$

Where Se = Standard error of measurement

S = Standard deviation and

rtt = Reliability co-efficient of the test

7.11.2 Validity

It means, are we measuring the same thing which we are supposed to measure? The test of measurement is valid only if it measures the same item which it intends to measure. The one way of establishing the validity of the measuring tool is to analyse for its content validity which means the representativeness or sampling adequacy of the content of the measuring instrument to measure the particular logic or concept. Nunally (1967) indicated two major standards for ensuring content validity: (i) a representative collection of items, and (ii) sensible method of test construction. The measuring instrument need to be constructed in accordance with the steps enunciated or recommended for the particular measuring technique.

7.12 Measures of Central Tendency

7.12.1 Average

An average is a quantitative figure that expresses the quantitative nature of a population. An average is a figure or expression that conveys the qualities or characteristics of any group. Average can convey the common qualities of the group, or in other words those characteristics that are common to all or atleast most of the units. The different types of averages used can be conveniently categorized into the following ways.

1) Average of location
   a) Mode
   b) Median
2) Mathematical Average
   a) Arithmetic Average
   b) Geometric Average
   c) Harmonic Average

7.12.2 Mode

Mode is the value of the item that has highest frequency. It is the measurement that is directly applicable to a large number of cases. The calculation of mode in a given data depends on the frequency of the items. The data is to be grouped in discrete or continuous series and the item value with higher frequency would be the mode.

7.12.3 Median

Median is the measurement of the middle item arranged in ascending or descending order. The underlying assumption of median is that measurement increase by regular order and thus total measurement above the middle item is the same as the total measurement below it. Naturally the size of the middle item is the representative of average size.

7.13 Chi Square Test or Goodness of Fit

The chi-square test and its application to the theory of statistical inference were first introduced by Karl Pearson. Chi-square is a measure of the degree to which a series of observed frequencies deviates from corresponding theoretical or hypothetical frequencies.

Determination of reliability on the basis of chi-square test is also known as 'goodness of fit'. This is because we try to fit the theoretical frequency distribution upon the observed frequencies. If this fit is quite close we can say that the fit is good or in other words there is no significant difference between the observed and theoretical frequencies. If on the other hand the disparity is very great, the fit is not considered good and we shall consider the difference to be significant.

7.14 Statistical concepts for KVK Scientists

Statistics is the science of collecting, organizing, analyzing, and interpreting data.

There are 2 types of data sets in statistics. They are population and sample.

Population is a data set consisting of *all* outcomes, measurements, or responses of interest while

Sample is a data set which is a subset of the population data set.

Examples:

- If we are interested in measuring the salaries of KVK SMS in India, the population data set would be a list of the salaries of every SMS in India. A sample data set could be obtained by selecting 100 SMS from across the country and listing their salaries.
- A survey organization wants to know whether Indians favour increased defence spending. The population data set would consist of the responses of every citizen. A common way of choosing a sample data set would be to randomly call 1000 citizens and gather their responses to the question of whether they favour increased defense spending.

7.15 Types of Measurements

Parameter - a numerical measurement made using the population data set

Statistic - a numerical measurement made using a sample data set

Examples:

- Using the SMS salary data sets, we could calculate the average salary for the SMS. The average calculated from the population data set would be the parameter. The average calculated from the sample of 100 SMS would be a statistic.
- Using the opinion poll data on defence spending, we could calculate the percentage of Indians who favor increased defence spending. The actual percentage of all citizens who favored increased defence spending would be the parameter. The percentage of the 1000 citizens in our sample who favored increased spending would be a statistic.

Notice that unless the population is very small it is probably impossible to gather the population data set, and so it is usually impossible to calculate the parameter we are interested in.

The main idea of the science of statistics is that we can get around this difficulty by selecting a sample, calculating the sample statistic, and use the sample statistic to make an estimate of the parameter.

Unfortunately, statistical estimates can never be 100% certain. (But they can be 90% or 95% or 99% certain)

7.16 Types of Data

7.16.1 Qualitative Data - non-numerical characteristics or labels

Examples: Eye Color, First Name, Favorite Movie, Political Party

7.16.2 Quantitative Data - numerical measurements or quantities

Examples: Height, Weight, Income

7.17 Levels of Measurement

7.17.1 Nominal Data

Can be qualitative only. Data values serve as labels, but the labels have no meaningful order.

Examples: Blood type, Graduation subject, Breed of a dog.

7.17.2 Ordinal Data

Ordinal data can be qualitative or quantitative. Data values serve as labels but the labels have a natural meaningful order. Differences between values, however, are meaningless.

Examples: Semester Grade, ICC Cricket Rankings.

7.17.3 Interval Data

Interval data are always quantitative. Data values are numerical. So they have a natural meaningful order, and differences between data values are meaningful. The ratio of two data values, however, is meaningless. This occurs when zero is an arbitrary measurement rather than actually indicating "nothing".

Examples: Temperature, Year of Birth

7.17.4 Ratio Data

Ratio data are always quantitative. Data values are numerical, have order, and both differences and ratios between values are meaningful. Zero measurement indicates absence of the quantity being measured.

Examples: Weight, Height, Volume, Number of Children

7.18 Frequency Distributions

A **frequency distribution** is a table used to describe a data set. A frequency table lists intervals or ranges of data values called **data classes** together with the number of data values from the set that are in each class. This number is called the **frequency** of the class.

Example: Statistics exam grades. Suppose that 20 statistics students' scores in an exam are as follows:

97, 92, 88, 75, 83, 67, 89, 55, 72, 78, 81, 91, 57, 63, 67, 74, 87, 84, 98, 46

We can construct a frequency table with classes 90-99, 80-89, 70-79 etc. by counting the number of grades in each grade range.

Class	*Frequency (f)*
90-99	4
80-89	6
70-79	4
60-69	3
50-59	2
40-49	1

Note that the sum of the frequency column is equal to 20, the number of test scores.

Additional Terminology

Lower Class Limit – The least value that can belong to a class.

Upper Class Limit – The greatest value that can belong to a class.

Class Width – The difference between the upper (or lower) class limits of consecutive classes. All classes should have the same class width.

Class Midpoint – The middle value of each data class. To find the class midpoint, average the upper and lower class limits.

7.19 Mathematical Notation

The following symbols and variables normally carry meanings as given below. (unless otherwise specified)

Variables

x = data value

n = number of values in a sample data set

N = number of values in a population data set

f = frequency of a data class

Symbol

$\sum$ indicates the sum of all values for the following variable or expression.

Example: Using our notation, we can write the statement that the sum of the frequencies in a frequency table should equal the number of values in the data set as follows:

$$\sum f = n$$

7.20 Cumulative Frequency

The **cumulative frequency** of a data class is the number of data elements in that class and all previous classes. (can be done ascending or descending)

Example:

Class	*Frequency (f)*	*Cumulative Frequency*
90-99	4	4
80-89	6	10
70-79	4	14
60-69	3	17
50-59	2	19
40-49	1	20

Notice that the last entry in the cumulative frequency column is $n = 20$.

7.21 Relative Frequency

The **relative frequency** of a data class is the percentage of data elements in that class. We can calculate the relative frequency for each class as follows:

$$\text{relative frequency} = \frac{f}{n}$$

Example:

Class	Frequency (*f*) Frequency	Cumulative Frequency (*f* / *n*)	Relative
90-99	4	4	.20
80-89	6	10	.30
70-79	4	14	.20
60-69	3	17	.15
50-59	2	19	.10
40-49	1	20	.05

Note: The sum of the relative frequencies should be 1.

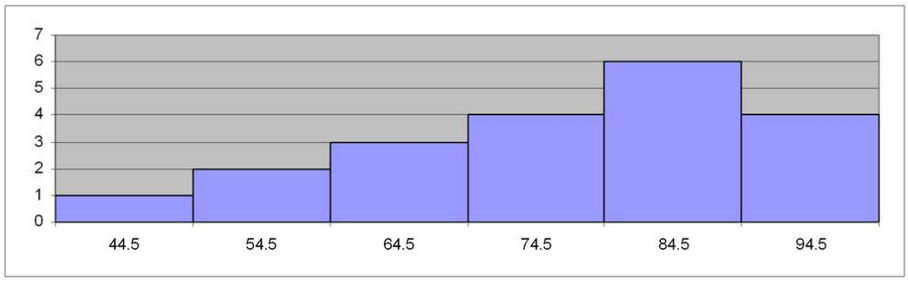
$$\sum \frac{f}{n} = 1$$

7.22 Histograms

A **histogram** is a graphical representation of the information in a frequency table using a bar graph.

The histogram should have the variable being measured in the data set as its horizontal axis, and the class frequency as the vertical axis. Each data class will be represented by a vertical bar whose height is the frequency of the class and whose width is the class width.

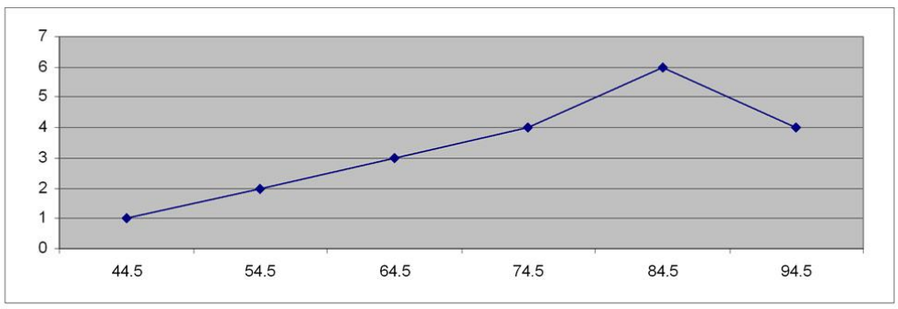
Notice that the bar for each class is centered at the class midpoint, and the bars for successive classes touch.



7.23 Frequency Polygon

A **frequency polygon** is a line graph representation of the information in a frequency table.

Like a histogram, the vertical axis represents frequency and the horizontal axis represents the variable being measured in the data set. To construct the graph, a point is plotted for each class at its midpoint and with height given by the frequency of the class, the points are then connected by straight lines.



7.24 Measures of Central Tendency

A **measure of central tendency** is a value used to represent the typical or "average" value in a data set.

Three Common Measures of Central Tendency

Mean – the sum of all data values divided by the number of values in the data set. The mean of a sample data set is denoted by $\overline{x}$ and the mean of a population data set by the Greek letter μ.

$$\overline{x} = \frac{\sum x}{n} \qquad \mu = \frac{\sum x}{N}$$

- **Median** – the value which separates the largest 50% of data values from the lowest 50%. To calculate the median, place data values in number order. If *n* is odd, the middle value is the median. If *n* is even, the mean of the two middle values is the median.
- **Mode** – the data value (or values) which appears the largest number of times in the set. If no data value is repeated, we say that there is no mode.

Properties of Mean, Median and Mode

- Mean is the most commonly used measure of central tendency.
- One drawback of the mean is that it is heavily influenced by a few very high or very low data values. In these cases it is more common to use the median.
- The mode has the advantage that it can be used to measure data sets even if they contain only qualitative data. A disadvantage is that a data set may not have a mode.

Weighted Means

A **weighted mean** is used when we want some data values in a set to factor more often into the calculation of the mean than others.

In this case, we attach a numerical **weight** to each value and calculate the mean as follows:

$$\overline{x} = \frac{\sum (x \cdot w)}{\sum w}$$

Note: This is equivalent to counting each data value the number of times given by its weight.

Examples:

- Grade point average. We assign the letter grades the number values A=4, B=3, C=2, D=1, F=0, and then each grade value is counted into the GPA according to the number of credits earned with that grade.
- Course grade. The final grade in this course is calculated according to the following scale: Homework counts for 15%, 3 exams count 20% each, and the final exam is worth 25%. We can weight the score for each component of the final grade with its percentage to calculate the final grade.
- Yield data from OFT and FLD of KVKs also uses weighted means.

Estimating a Mean from a Frequency Table

Given the frequency distribution of a data set, we can make the best estimate of the mean for the data set by using a weighted mean.

1. Calculate the **class midpoint** for each data class. These will be our data values for calculating the weighted mean.

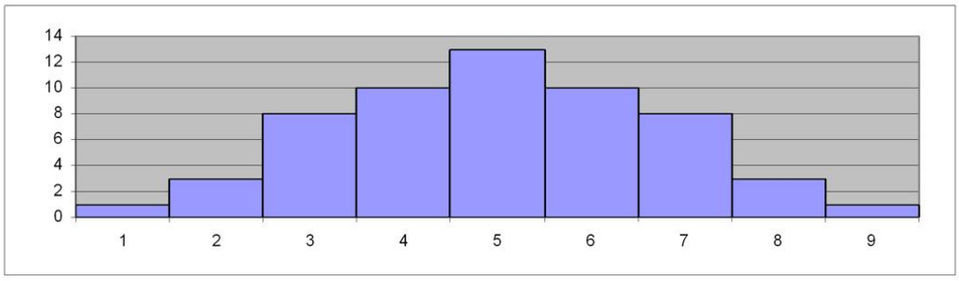
2. Use the **frequency** of the data class as the **weight** for each data class midpoint.

3. Calculate the weighted mean by the weighted mean formula, or:

$$\overline{x} = \frac{\sum (x_{mid} \cdot f)}{\sum f}$$

7.25 Shapes of Data Distributions

Symmetric – The data distribution is approximately the same shape on either side of a central dividing line.

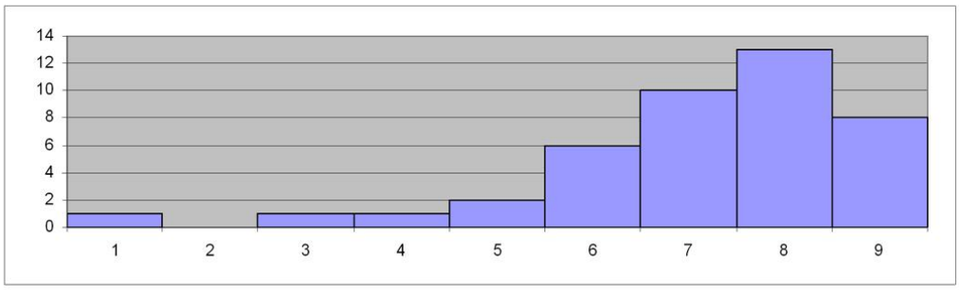


The mean and median (and mode if unimodal) are equal in a symmetric distribution.

Examples: Men's Heights

Left-Skewed – A few data values are much lower than the majority of values in the set. (Tail extends to the left)

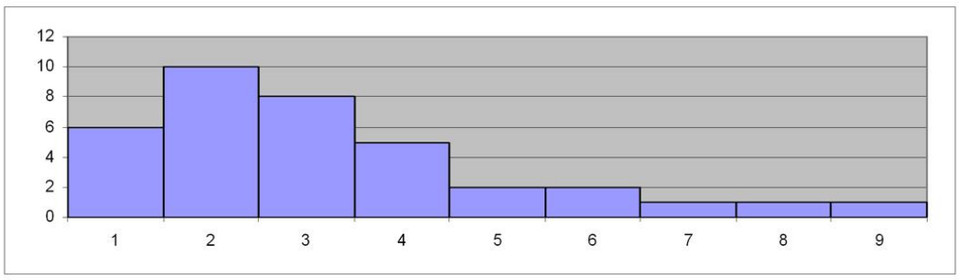
Generally the mean is less than the median (and mode) in a left-skewed distribution.



Example: Yield of a variety with a few farms doing poorly

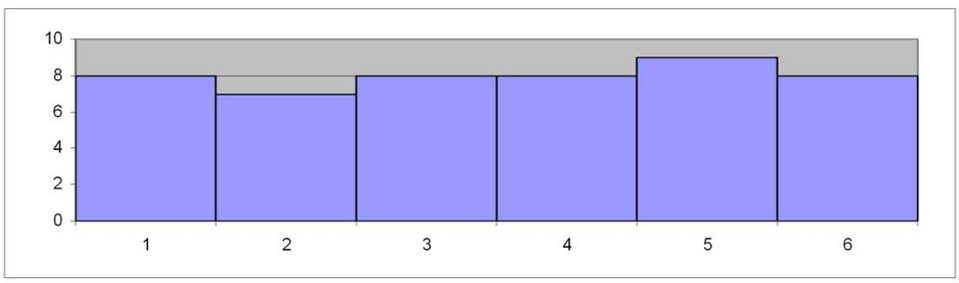
Right-Skewed – A few data values are much higher than the majority of values in the set. (Tail extends to the right)

Generally the mean is greater than the median (and mode) in a right-skewed distribution.



Examples: Income from poultry farming

Uniform – All data values are equally represented.



Example: Number of eggs laid in a farm

7.26 Variation

Variation in a data set is the amount of difference between data values.

In a data set with little variation, almost all data values would be close to one another. The histogram of such a data set would be narrow and tall.

Example: Training Scores: 3, 3, 4, 4, 4, 4, 4, 4, 5, 5, 5

In a data set with a great deal of variation, the data values would be spread widely. The histogram of this data set would be wide and low.

Example: Attribute Scores: 1, 3, 4, 5, 6, 6, 7, 8, 8, 9, 10

7.27 Common Measures of Variation

1. **Range** – the difference between the largest and smallest data values in a data set.
2. **Standard Deviation** – The most commonly used measure of variation. Its a measure of the "average" distance of a data value from the mean for the data set.

Standard deviation is calculated using two different formulae depending on whether the data set being considered is a population data set or a sample data set.

Population standard deviation is represented by the small Greek letter sigma σ and is calculated using the following formula:

$$\sigma = \sqrt{\frac{\sum (x-\mu)^2}{N}}$$

Sample standard deviation is represented by *s* and is calculated using the following formula:

$$s = \sqrt{\frac{\sum (x-\bar{x})^2}{n-1}}$$

3. **Variance** – the square of the standard deviation. Population variance is represented by σ^2 and sample variance by s^2

Calculating Standard Deviation Using the Formula

1. Calculate the mean of the data set.
2. Subtract the mean from each data value in the set. These values are called the **deviations** of the data values.
3. Square each of the deviations calculated in Step 2.
4. Sum the squares calculated from Step 3.
5. Divide the sum from Step 4 by the population size for population standard deviation or the sample size minus 1 for sample standard deviation.
6. Take the square root of the result of Step 5.

Estimating Standard Deviation using a Frequency Table

Given the frequency distribution of a data set, we can make the best estimate of the standard deviation for the data set by using the same technique as for mean.

1. Calculate the class midpoint for each data class. These will be our data values for calculating the standard deviation.

2. Use the frequency of the data class as the weight for each data class midpoint.

3. Calculate the standard deviation by using the formula:

$$s = \sqrt{\frac{\sum (x_{mid} - \bar{x})^2 \cdot f}{n-1}}$$

Theorems Involving Standard Deviation

The standard deviation of a data set is an important quantity because it limits the number of data values that can be very far (high or low) from average.

The Empirical Rule (68-95-99.7 Rule)

- Applies only to bell-shaped distributions.
- Approximately 68% of data values must be within 1 standard deviation of the mean.
- Approximately 95% of data values must be within 2 standard deviation of the mean.
- Approximately 99.7% of data values must be within 3 standard deviation of the mean.

Example: Men's Heights have a bell-shaped distribution with a mean of 69.2 inches and a standard deviation of 2.9 inches.

7.28 Measures of Position

Fractiles divide a data set into consecutive intervals so that each interval has (at least approximately) the same number of data values. The most common fractiles are:

- **Percentiles** – divide a data set into 100 parts. For example, the 36th percentile is the value which separates the lowest 36% of data values from the highest 64% of data values and is denoted by $P_{36.}$
- **Quartiles** – divide a data set into fourths. For example, the first quartile Q_1 divides the lowest quarter of a data set from the upper three quarters.
- **Deciles** – divide a data set into 10 parts. For example, the 7th decile is the value which separates the lowest 7/10 of data values from the highest 3/10 of data values and is denoted $D_{7.}$

Note: There are 99 percentiles P_1-P_{99}, 3 quartiles Q_1-$Q_{3,}$ and 9 deciles D_1-$D_{9.}$

Note: $P_{50} = Q_2 = D_5$ = Median

7.29 The Standard Score

The **standard score** (or **z-score**) of a data value is the number of standard deviations that the value lies above or below the mean.

Standard Scores can be calculated using the formula:

$$z = \frac{x - \mu}{\sigma}$$

Note: The z-score of a value is positive if the value is above the mean and negative if it is below the mean. The mean itself always has a z-score of 0.

A data value is considered to be **unusual** if it is more than two standard deviations from the mean. A data value is unusually high if it has a z-score larger than 2 and unusually low if it has a z-score of less than -2.

7.30 Statistical Hypotheses

A **statistical hypothesis** is a mathematical claim about a population parameter.

Examples:

- The mean height of women is less than 65 inches tall.
- The percentage of NE farmers favoring organic farming is 97%.
- The average fertilizer use by NE farmers is less than 10 kgs.
- At least 5% of Indian farmers earn more than Rs. 100,000 per year.

We could write the claims above as $\mu < 65$, p=.97, $\mu > 10,000$, and $p \geq .05$

Hypothesis Testing - Basic Procedure

If we wanted to know whether any of the above hypotheses are true, we would conduct a *hypothesis test*. When we test a statistical hypothesis, we follow the following basic procedure:

1. Draw a random sample for the random variable in question.
2. Determine if the results from the sample data are consistent or inconsistent with the hypothesis.
3. If the sample data is significantly different from the claimed hypothesis, we would reject the hypothesis as being false. If the data is not significantly different, we would not reject the hypothesis.

Formal Hypothesis Tests

In a formal hypothesis test, the opposite claims would be given the names **null hypothesis** and **alternative hypothesis**. The null hypotheses is denoted by H_0 and the alternative hypothesis is denoted by H_a. The null and alternative hypotheses need to be assigned as follows:

The null hypothesis is the hypothesis being tested. It must:

- be the hypothesis we want to **reject**
- contain the condition of equality

The alternative hypothesis is always the opposite of the null hypothesis. It must:

- be the hypothesis we want to **support**
- not contain the condition of equality

A formal hypothesis test will always conclude with a decision to reject based on sample data, or the decision that there is not strong enough evidence to reject .

7.31 Types of Error

Whenever sample data is used to make an estimate of a population parameter, there is always a probability of error due to drawing an unusual sample. There are two main types of error that occur in hypothesis tests.

Type I Error – A sample is chosen whose sample data leads to the rejection of the null hypothesis when, in fact, H_o is true.

Type II Error – A sample is chosen whose sample data leads to not rejecting the null hypothesis when, in fact, H_o is false.

	H_o **True**	H_o **False**
H_o **Rejected**	**Type I Error**	**Correct Decision**
H_o **Not Rejected**	**Correct Decision**	**Type II Error**

7.32 Level of Significance

In hypothesis tests, a conservative approach is usually taken toward the rejection of the null hypothesis. That is, we want the probability of making a Type I Error to be small.

The maximum acceptable probability is usually chosen from the beginning of the hypothesis test, and is called the **level of significance** for the test. The level of significance is denoted by , and the most commonly used values are $\alpha = .10, \alpha = .05,$ and $\alpha = .01$.

The probability of making a Type II Error in a hypothesis test is denoted by β. Once α is determined, the value of β is also fixed, but the calculation of this value β is beyond the scope of this chapter.

7.33 Types of Tests

There are three basic types of hypothesis tests:

Left-tailed Test – used when the null hypothesis being tested is a claim that the population parameter is **at least** a given value. Note that the alternative hypothesis then claims that the parameter is **less than** (<) the value.

Example:

$$H_0 : \mu \geq 35,000$$

$$H_a : \mu < 35,000$$

We would reject in the case above if our sample mean was significantly less than 35,000. That is, if our sample mean was in the **left tail** of the distribution of all sample means.

Right-tailed Test – used when the null hypothesis being tested is a claim that the population parameter is **at most** a given value. Note that the alternative hypothesis then claims that the parameter is **greater than** (>) the value.

Example:

$$H_0 : \mu \leq 35,000$$
$$H_a : \mu > 35,000$$

We would reject in this case if our sample mean was significantly more than 35,000. That is, if our sample mean was in the **right tail** of the distribution of all sample means.

Two-tailed Test – used when the null hypothesis being tested is a claim that the population parameter is **equal to** (=) a given value. Note that the alternative hypothesis then claims that the parameter is **not equal to** the value.

Example: The Census claims that the percentage of Shillong residents with a bachelor's degree or higher is 24.4%. We would write the null and alternative hypotheses for this claim as:

$$H_0 : p = .244$$

$$H_a : p \neq .244$$

In this case, we would have to reject if our sample percentage was either significantly more than 24.4%, or significantly less than 24.4%. That is, if our sample proportion was in **either tail** of the distribution of all sample proportions.

Testing a Claim about the Mean Using a Large Sample

When a hypothesis test involves a claim about a population mean, then we will draw a sample and look at the sample mean to test the claim. If the sample drawn is large enough, then the Central Limit Theorem applies, and the distribution of sample means is approximately normal. As usual, we also have that $\mu_{\bar{x}} = \mu$ and

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \approx \frac{s}{\sqrt{n}}.$$

Note: Since *s* and *n* are known from the sample data, so we have a good estimate of $\sigma_{\bar{x}}$, but we do not know μ since this is the parameter we are testing a claim about. In order to have a value for μ, we will **always assume that the null hypothesis is true** in any hypothesis test.

Since the null hypothesis must be of one of the following types:

$$\mu = \mu_0,\ \mu \geq \mu_0, \text{ or } \mu \leq \mu_0$$

where μ_0 is a constant, we will always assume for the purpose of our test that $\mu = \mu_0$.

7.34 The Standardized Test Statistic

There are two methods we will use to determine whether to reject or not reject the null hypothesis, but in both cases it will be more convenient to convert our sample mean $\bar{x}$ to a z-score which will be called our **standardized test statistic**.

Since we are assuming $\mu = \mu_0$, we also have $\mu_{\bar{x}} = \mu_0$, and so:

$$z = \frac{\bar{x} - \mu_{\bar{x}}}{\sigma_{\bar{x}}} = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

As long as $\mu = \mu_0$ as assumed, the distribution of the standardized test statistic *z* defined above will be the Standard Normal Distribution.

Example: Suppose we believe that the mean body temperature of healthy adults is less than the commonly accepted measurement of F. A sample of 60 healthy adults is drawn with an average temperature of $\bar{x} = 98.2^\circ$ F and with a sample standard deviation of $s = 1.1^\circ$.

Our hypotheses in this case would be:

$$H_0 : \mu \geq 98.6$$

$$H_a : \mu < 98.6$$

So we have a left-tailed test with $\mu_0 = 98.6$.

Based on our sample data, our standardized test statistic is:

$$z = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} = \frac{98.2 - 98.6}{1.1/\sqrt{60}} = \frac{-0.4}{.142} \approx -2.82$$

The P-Value Method

The **P-value** of a test is the probability of drawing a random sample whose standardized test statistic is at least as contrary to the claim of the null hypothesis as that observed in the sample group.

Example: In the hypothesis test for body temperature given above, we had:

$$H_0 : \mu \geq 98.6$$

$$H_a : \mu < 98.6$$

Our sample had a mean temperature of $\bar{x} = 98.2^\circ$ which is contrary to the null hypothesis. Only a sample group with an average temperature less than 98.2 would be stronger evidence against H_0. Thus the P-value of this test is $P(\bar{x} \leq 98.2)$. Since the z-score of $\bar{x}$ is just our standardized test statistic z which has the Standard Normal Distribution, $P(\bar{x} \leq 98.2) = P(z \leq -2.82) = .0024$.

Since the probability of drawing a sample as contrary to the null hypothesis as the observed sample (assuming H_0 is true) is small, we would decide to reject H_0.

Calculating P-Values

In the example above, we calculated the P-value of the test by finding the area to the **left** of the standardized test statistic *z* on the standard normal curve. Notice that the example above was also a **left-tailed** test, and that any hypothesis test which is left-tailed will have the P-value calculated exactly as above.

Similarly, for a **right-tailed** test, we would calculate the P-value by finding the area to the **right** of the standardized test statistic.

For a **two-tailed test**, the null hypothesis is always claiming that $\mu = \mu_0$, and so the sample data is contrary to this claim if the sample mean is either much higher or much lower than μ_0. The P-value for a two tailed test then is the area in both tails of the normal distribution more extreme than the standardized test statistic. Since the normal distribution is symmetric, this is just **twice the area in one tail**.

Deciding to Reject the Null Hypothesis

In the examples above, we saw that a very small P-value would lead us to reject the null hypothesis, and a high P-value would not.

Since the P-value of a test is the probability of randomly drawing a sample at least as contrary to H_0 as the observed sample, we can also think of the P-value as the probability that we will be wrong if we choose to reject H_0 based on our sample data. The P-value then is the probability of making a Type I Error.

Recall that the maximum acceptable probability of making a Type I Error is the level of significance, and is usually determined at the outset of the hypothesis test.

The rule we will use to decide whether to reject H_0 is:

Reject H_0 if $P \leq \alpha$

Do not reject H_0 if $P > \alpha$

7.35 Rejection Regions and Critical Values

A second method to determine whether to reject the null hypothesis is to use **rejection regions** and **critical values**.

A **rejection region** for a hypothesis test is the range of values for the standardized test statistic which would cause us to decide to reject the null hypothesis. **Critical values** for a hypothesis test are the z-scores which separate the rejection region(s) from the non-rejection region. The critical values will be denoted by z_0.

The rejection region for a test is determined by the type of test (left/right/two tailed) and the level of significance α for the test. For a left-tailed test, the rejection region is a region in the left tail of the normal distribution, for a right tailed test, it is in the right tail, and for a two tailed test, there are two equal rejection regions in either tail.

Since the level of confidence is the maximum acceptable probability of a Type I Error, we want the area under the normal curve in the rejection region to have an area of α. We can use this area to find our critical values.

Once we establish the critical values and rejection region, if the standardized test statistic for a sample data set falls in the rejection region, we will reject the null hypothesis.

Example: In our body temperature example, we were using a left-tailed test. If the level of significance was $\alpha = .05$, then the rejection region would be the values in the lowest 5% of the standard normal distribution. Looking up .05 in the standard normal table, we see that this corresponds to a z-score of at most -1.645, so this would be our critical value z_0, and so our rejection region is $z \le -1.645$. Since our standardized test statistic $z = -2.82$ falls into this region, we would choose to reject H_0.

Testing a Claim about the Mean Using a Small Sample

Recall that if a sample of values for a normal random variable is drawn and if the sample size is less than 30, and the population standard deviation is unknown, then the random variable has the Student t-distribution with $n-1$ degrees of freedom.

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

When testing a claim about the mean using sample data from a small sample, we should therefore use the appropriate t-distribution instead of the standard normal distribution to determine our standardized test statistic, critical values, rejection regions, and P-values.

The standardized test statistic for a t-distribution test will be given by:

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

7.36 Finding Critical Values for the t-distributions

The process for locating the rejection regions for a t-distribution hypothesis test are the same as for the normal distribution tests. The critical values however will be different.

To find the critical value(s) t_0 for a test, first determine if the test is one-tailed or two-tailed, and the level of significance α. The critical values can be found in the t-distribution table in the front of the book by looking up the entry in the column giving the level of significance and the row giving the degree of freedom.

Note that:

- For a right-tailed test, t_0 is the value in the table
- For a left-tailed test, t_0 is the negative of the value in the table

- For a two-tailed test, there are two critical values t_0 both the value and its opposite

Example: In a knowledge test scores are normally distributed. A sample of scores for 16 trainees has mean score of $\bar{x} = 522.8$ with a sample standard deviation of $s = 154.5$.

Suppose we wished to support the claim that the average knowledge score exceeds 500 using a $\alpha = .05$ level of significance.

The null and alternative hypotheses in this case would be:

$$H_0 : \mu \leq 500$$

$$H_a : \mu > 500$$

So the test is right-tailed with $\mu_0 = 500$.

Using the t-distribution table with One Tail $\alpha = .05$ and 15 degrees of freedom, we get a critical value of $t_0 = 1.753$. The rejection region is thus: $t \geq 1.753$.

The standardized test statistic is given by:

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} = \frac{522.8 - 500}{154.5/\sqrt{16}} = \frac{22.8}{38.625} \approx .59$$

Because the standardized test statistic is not in the rejection region, we would not reject H_0, and so the sample data is not sufficient to support the claim that the mean exceeds 500 at the .05 level of significance.

7.37 Testing a Claim about a Population Proportion

Recall that if a random sample is drawn and if the sample proportion $\hat{p}$ is measured and $n\hat{p} \geq 5$, $n\hat{q} \geq 5$, then the distribution of $\hat{p}$ is approximately normal with $\mu_{\hat{p}} = p$ and $\sigma_{\hat{p}} = \sqrt{pq/n}$.

When testing a claim about a population proportion, the null hypothesis has one of the following forms:

$p = p_0$, $p \geq p_0$, or $p \leq p_0$

So as with the mean, we will assume $p = p_0$ and we will use the following standardized test statistic for a proportion test:

$$z = \frac{\hat{p} - \mu_{\hat{p}}}{\sigma_{\hat{p}}} = \frac{\hat{p} - p_0}{\sqrt{p_0 q_0 / n}}$$

This random variable should have the standard normal distribution, and so we will calculate all of our rejection regions, critical values, and P-values using the standard normal distribution as we did when testing a mean using a large sample.

Example: An irrigation pump manufacturer tests pump motors coming off the production line. In one sample of 577 motors, 37 were found to have defects. The company wants to claim that the proportion of motors that are defective is only 4%. Can the company's claim be rejected at the $\alpha = .01$ level of significance?

The null and alternative hypotheses in this case would be:

$$H_0 : p = .04$$

$$H_a : \mu \neq .04$$

So the test is two-tailed with $p_0 = .04$.

Since $\hat{p} = 37/577 \approx .064$, the standardized test statistic is given by:

$$z = \frac{\hat{p} - p_0}{\sqrt{p_0 q_0 / n}} = \frac{.064 - .04}{\sqrt{(.04)(.96)/577}} \approx \frac{.024}{.008} = 3.0$$

Looking up $z = 3.00$ in the standard normal table we get a value of .9987, so $P(z \geq 3.00) = 1 - .9987 = .0013$ and since we have a two-tailed test, the P-value is just twice this amount or .0026. Since this is less than $\alpha = .01$, we can reject the company's claim.

7.38 Correlation

A **correlation** is a relationship between two statistical variables measured from the same population. In this chapter, we will consider only **linear correlation** which comes in three types:

Positive Linear Correlation - *high* values for one variable tend to correspond to *high* values for the second variable.

Examples:

- Height vs. Weight for adults
- Fertilizer dosage vs. Plant growth

Negative Linear Correlation - *high* values for one variable tend to correspond to *low* values for the second variable.

Examples:

- Age vs. Resale Value of a tractor
- Room temperature vs. keeping quality of fruits

Non Linear Correlation - no relationship between the variables or a non-linear relationship.

Examples:

- Plant height vs. Size of farm
- Day of the year vs. Hours of daylight

7.39 Scatter Diagrams

One way to determine the type of linear correlation between two variables is by means of a **scatter diagram**. To construct a scatter diagram, we plot the value of one variable along the x-axis and the other along the y-axis, and then for each member of our population or sample group, we plot a point corresponding to the measurements of the individual.

We can then determine the type of linear correlation as follows:

Positive Linear Correlation

General trend in the plotted points is from **bottom left to top right.**

Negative Linear Correlation

General trend in the plotted points is from **top left to bottom right.**

Non Linear Correlation

No general trend in plotted points, or a non-linear trend.

The **strength** of the linear correlation can be judged by looking at how closely the points approximate a straight line.

Example: The following table shows the Height (x) vs. Femur Length (y) measurements (both in inches) for 10 men:

x	70.8	66.2	71.7	68.7	67.6	69.2	66.5	67.2	68.3	65.6
y	42.5	40.2	44.4	42.8	40	47.3	43.4	40.1	42.1	36

The diagram shows a positive linear correlation between the variables.

7.40 Coefficient of Correlation

A more precise method of determining the type and strength of a linear correlation is to calculate the **coefficient of linear correlation** (denoted by *r*) for the two variables using the formula:

$$r = \frac{n\left(\sum xy\right) - \left(\sum x\right)\left(\sum y\right)}{\sqrt{n\left(\sum x^2\right) - \left(\sum x\right)^2}\sqrt{n\left(\sum y^2\right) - \left(\sum y\right)^2}}$$

The coefficient of linear correlation will always be a number between -1 and 1, with a positive value indicating a positive correlation and a negative value a negative correlation. A coefficient of $r = 1$ for a data set indicates perfect positive linear correlation, and $r = -1$ indicates perfect negative linear correlation, while $r = 0$ would indicate no linear correlation. The closer the value of *r* is to ± 1, the stronger the correlation, and the closer to zero, the weaker the correlation.

7.41 Calculating the Coefficient of Correlation

The coefficient of correlation between two variables is most easily calculated by constructing a table (see example below) with columns that contain the *x* and *y* variable values for each individual, the value of *xy* for each individual, and the values of x^2 and y^2 for each individual.

The sum of each column is found, and these sums can then be substituted into the formula above to find *r*.

Example: Using our previous data set of height vs femur length for 10 men, we get the table:

Variable	*x*	*y*	*xy*	x^2	y^2
	70.8	42.5	3009	5012.64	1806.25
	66.2	40.2	2661.24	4382.44	1616.04
	71.7	44.4	3183.48	5140.89	1971.36
	68.7	42.8	2940.36	4719.69	1831.84
	67.6	40	2704	4569.76	1600
	69.2	47.3	3273.16	4788.64	2237.29
	66.5	43.4	2886.1	4422.25	1883.56

Variable	x	y	xy	x^2	y^2
	67.2	40.1	2694.72	4515.84	1608.01
	68.3	42.1	2875.43	4664.89	1772.41
	65.6	36	2361.6	4303.36	1296
Sum	681.8	418.8	28589.09	46520.4	17622.76

The coefficient of correlation for the variables is thus:

$$r = \frac{10(28589.09) - (681.8)(418.8)}{\sqrt{10(46520.4) - (681.8)^2}\sqrt{10(17622.76) - (418.8)^2}} =$$

$$\frac{353.06}{\sqrt{352.76}\sqrt{834.16}} = \frac{353.06}{542.4558} \approx .651$$

7.42 Significance of the Coefficient of Correlation

When the coefficient of correlation is calculated from sample data sets, there is a chance that a linear correlation will be found when, in fact, no correlation exists between the population variables. Therefore, before deciding that a linear correlation exists between two variables when using sample data, we will run a test for significance.

The population parameter representing the coefficient of correlation for population data is denoted by ρ, and we use the sample coefficient r to determine if the hypothesis $H_0 : \rho = 0$ can be rejected.

7.43 Linear Regression

If a pair of variables has a significant linear correlation, then the relationship between the data values can be roughly approximated by a linear equation. The process of finding the linear equation which best fits the data values is known as **linear regression** and the line of best fit is called the **regression line**.

It is a fact of linear algebra and analysis that the least squares line of best fit to a set of data values has an equation of the form $\hat{y} = mx + b$ where:

$$m = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2} \quad \text{and} \quad b = \bar{y} - m\bar{x} = \frac{(\sum y) - m(\sum x)}{n}$$

Conclusion

Since KVK work is highly social science oriented, a basic understanding of statistical tools is a must for every KVK scientist. Keeping this in view the chapter has presented the fundamental concepts of statistics along with details of basic statistical tests. The same may be utilized in deriving meaningful conclusions from OFT and FLD datas obtained by KVK scientist for better interpretation of the same.

Chapter – VIII

Rural Development : Central Schemes and KVK Innovations

8.1 Rural Development: Role of Agricultural Extension through KVKs

Agricultural extension through KVKs has a crucial role to play in the context of growing demands of agricultural production in a sustainable manner. Reforms in the system envisage an extension service more broad-based and holistic in content and scope, thus beyond agricultural technology transfer. Its normal task of transferring and disseminating appropriate technologies and agronomic practices would not be sufficient. Extension agencies, services and functionaries will need to exercise a more proactive and participatory role to serve as knowledge information agents, initiating and facilitating mutually meaningful and equitable knowledge based transactions among primary producers, agricultural researchers and trainers. All these need to be done in an effective and cost efficient manner. The importance of KVK system is highlighted in this new development paradigm.

The need for reforms in Agricultural Extension has been explicitly raised in the National Agriculture Policy; the report of Expenditure Reforms Commission, as well as, the Tenth Plan Approach paper. Keeping the recommendations of these policy initiatives in view, and to provide policy directives for extension reforms, a broad Policy Framework for Agricultural Extension (PFAE) has been developed by the Ministry of Agriculture, Govt. of India. The five major guiding elements of the Policy Framework are as follows:

- Reforming Public Sector Extension.
- Promoting private sector to effectively complement, supplement and wherever possible to substitute public extension.
- Augmenting media and Information Technology support for Extension.
- Mainstreaming gender concerns in Extension.
- Capacity building/skill up-gradation of farmers and extension functionaries.

The reforms enlisted above have been pilot tested under Innovations in Technology Dissemination (ITD) component of World Bank funded National Agricultural Technology Project (NATP) with effect from November, 1998 in six states viz. Andhra Pradesh, Bihar (including present Jharkhand),

Himachal Pradesh, Maharashtra, Orissa and Punjab covering four districts in each State. An autonomous institution – Agricultural Technology Management Agency (ATMA) has been established in these project districts as a registered society representing various stakeholders, including farmers, in project planning and implementation.

ATMA facilitates the preparation of Strategic Research and Extension Plan (SREP) of the district. The SREP is prepared through participatory methodologies such as Participatory Rural Appraisal (PRA) involving all the stakeholders and farmers. The SREP contains detailed analysis of all the information on existing farming systems in the district and research – extension gaps required to be filled-up. It also prioritizes the research – extension strategies within the district. It becomes the basis for development of work plans at district level.

8.2 Recommendations of National Commission on Farmers (NCF)

The National Commission on Farmers (NCF) has examined the issues relating to farmers and made the following recommendations.

I. Commodity based farmers' organizations should be promoted to combine the advantages of decentralized production and centralized services, post-harvest management, value addition and marketing, for leveraging institutional support and facilitate direct farmer–consumer linkage. It would provide small farmers 'power of scale'.

II. Considering that majority of our farmers are small and resource poor and depend heavily on public good technologies and information, the public sector agricultural extension; men and women should be empowered and sensitized to meet the demands particularly by forging research–extension–education–farmer–market linkages.

III. Farmer to farmer learning is the most credible and effective. For this purpose, Farm Schools may be established in the fields of outstanding farmers and awardees of nationally recognized awards for farmers.

IV. Recognizing that input dealers and suppliers were second most common source of information for farmers, regular trainings of the dealers / suppliers / retailers should be organized not only to update their knowledge but also to improve their communication skills and attitudes to empower farmers with new information on inputs use and farming operations.

V. Information and Communication Technology (ICT) should be effectively harnessed to empower rural men and women through 'Every Village a Knowledge Centre' movement with farming system and season specific information as well as market and price information.

8.3 XIth Plan Approach Paper

The XIth Plan Approach Paper has given high priority to the revitalization of the extension system. Some of the important thrust areas mentioned in the Approach Paper are:

1. Revitalization of extension system focusing on known technologies.

2. Improvement of research-extension linkages.

3. Convergence of schemes of Ministry of Agriculture.

4. Encouragement of partnership between civil society organization and Government/ Panchayat Raj Institutions (PRIs)

5. Mainstreaming gender concerns.

It will be worth to have a glimpse of the various rural/agriculture development programmes that Govt. of India is running at present. Each programme throws an opportunity and challenge for the KVKs to collaborate and contribute to agricultural development in India. The most important ones are:

8.4 National Horticulture Mission

National Horticulture Mission has been launched as a Centrally Sponsored Scheme to promote holistic growth of the horticulture sector through area based regionally differentiated strategies. The scheme will be fully funded by the Government.

National Horticulture Mission (NHM) will be implemented in all the States and Union Territories of India except the North Eastern States, Himachal Pradesh, Jammu & Kashmir and Uttaranchal (for which a separate Technology Mission for integrated development of horticulture exists) to promote holistic growth of the horticulture sector covering fruits, vegetables, root & tuber crops, mushroom, spices, flowers, aromatic plants, cashew and cocoa. Programmes for the development of coconut will be implemented by the Coconut Development Board (CDB), independent of the Mission. This will be a centrally sponsored scheme in which Government of India shall provide 100% assistance to the State Missions during Tenth Plan. During the XI Plan, the Government of India assistance will be 85% with 15% contribution by the State Governments.

The main objectives of the Mission are:

i) To provide holistic growth of the horticulture sector through an area based regionally differentiated strategies which include research, technology promotion, extension, post harvest management, processing and marketing, in consonance with comparative advantage of each State/region and its diverse agro-climatic feature;

ii) To enhance horticulture production, improve nutritional security and income support to farm households; To establish convergence and synergy among multiple on-going and planned programmes for horticulture development;

iii) To promote, develop and disseminate technologies, through a seamless blend of traditional wisdom and modern scientific knowledge;

iv) To create opportunities for employment generation for skilled and unskilled persons, especially unemployed youth.

v) To achieve the above objectives, the mission would adopt the following strategies:

vi) Ensure an end-to-end holistic approach covering production, post harvest management, processing and marketing to assure appropriate returns to growers/producers; Promote R&D technologies for production, post-harvest management and processing;

vii) Enhance acreage, coverage, and productivity through Diversification, from traditional crops to plantations, orchards, vineyards, flower and vegetable gardens;

viii) Extension of appropriate technology to the farmers for high-tech horticulture cultivation and precision farming. Assist setting up post harvest facilities such as pack house, ripening chamber, cold storages, Controlled Atmosphere (CA) storages etc, processing units for value addition and marketing infrastructure;

ix) Adopt a coordinated approach and promotion of partnership, convergence and synergy among R&D, processing and marketing agencies in public as well as private sectors, at the National, Regional, State and sub-State levels;

x) Where-ever appropriate and feasible, promote National Dairy Development Board (NDDB) model of cooperatives to ensure support and adequate returns to farmers;

xi) Promote capacity-building and Human Resource Development at all levels.

8.4.1 Key Elements of NHM

- Base line survey.
- Area based Annual and Perspective Plans based on end to end approach with backward and forward linkages.
- Research to be guided by Research Advisory Committee on the basis of felt need by Boards such as ATMA and SHM and funded by respective organizations out of their own budget.
- Demand driven production based on cluster approach for potential crops having comparative advantage in different areas.
- Best quality seeds and planting material to be produced and made available
- Technology driven programmes to improve productivity and quality , e.g.
- Introduction of improved varieties.
- Rejuvenation with improved cultivars.
- Use of Plastics.
- High Density Plantations.
- Capacity building of farmers and personnel
- Marketing infrastructure development linked with reforms
- Meticulous reporting and monitoring

In pursuance of the above goals, the National Horticulture Mission will focus in the areas of horticultural research, development, post harvest management, processing and marketing. The programmes under horticultural research will concentrate on technology generation appropriate to each region/ state keeping in view their specific agro-climatic and socio-economic conditions. Emphasis will be given for effective transfer of technologies in production, which are already available in India and abroad. The Indian Council of Agricultural Research (ICAR) in association with State Agricultural

Universities (SAUs) and other research institutes/ organizations in the public and private sector having capabilities will be involved in the research programme.

The programme under horticultural development aims at increasing the production and productivity of all horticultural crops through adoption of improved technologies in crop production. Under this programme, special emphasis will be given for regionally differentiated crops, which are most suitable for the state/region. This programme will be implemented by the Horticultural Departments of the State Governments, which may also include cooperative organizations, self-help groups, NGOs and commodity organizations for achieving the targeted production and productivity of identified crops. Risk management in the form of crop insurance is also proposed. Post harvest management would include creating suitable infrastructure for efficient post harvest management and marketing of horticulture produce such as handling, transport, storage and markets etc. besides taking up market promotional activities such as dissemination of market information to the farmers, processors, traders, and consumers. Special thrust would be provided to promote the export of horticultural produce through establishment of Agricultural Economic Zones (AEZs), for which there is potential global market. National Horticulture Board, Directorate of Marketing and Inspection, National Cooperative Development Corporation, NERAMAC, TRIFED and Agriculture and Processed Food Products Export Development Authority will be involved for the purpose. It is proposed to make use of the existing schemes of the National Horticulture Board (NHB), Directorate of Marketing and Inspection (DMI) and National Cooperative Development Corporation (NCDC) to maximum possible extent.

The Mission will also focus on promoting processing of horticultural produce and value addition by providing incentives for setting up of horticulture processing industries and food parks in potential areas and to encourage linkages between the markets for the horticulture produce and processing industry. This activity will be supported by the Ministry of Food Processing Industry (MFPI) and implemented through agencies under the administrative control of MFPI and other organizations and the concerned departments of the State Governments. These programmes would be credit-linked through NABARD/IDBI/State Financial Corporations.

8.5 National Food Security Mission (NFSM)

In view of the stagnating food grain production and an increasing consumption need of the growing population, Cabinet Committee on Economic Affairs (CCEA) approved launching of a Centrally Sponsored Scheme 'National Food Security Mission'. The National Development Council in its 53rd meeting adopted a resolution to enhance the production of rice, wheat and pulses by 10, 8 and 2 million tons respectively by 2011. Hence the CCEA gave its approval for launching the NFSM' to operationalise the resolution.

The Mission aims at increasing production of rice, wheat and pulses through a set of measures such as area expansion, productivity enhancement in selected districts; restoring soil

fertility; creating employment opportunities and enhancing farm level economy to restore the confidence of the farmers of the targeted districts

NFSM will have three components –

(i) National Food Security Mission – Rice (NFSM-Rice)

(ii) National Food Security Mission – Wheat (NFSM-Wheat) and

(iii) National Food Security Mission – Pulses (NFSM-Pulses).

Total financial implications for the NFSM will be Rs.4882.48 crores during the XI Plan (2007-08 to 2011-12). Beneficiary farmers will contribute 50% of cost of the activities / work to be taken up at their / individual farm holdings. Beneficiaries can choose to draw loans from the Banks in which cash subsidy amount prescribed for a particular component for which the loan availed will be released to the Banks. The implementation of the NFSM would result in increasing the production of rice by 10 million tones, wheat by 8 million tones and pulses by 2 million tones by 2011-12. It would also create additional employment opportunities.

8.6 Macro Management of Agriculture Scheme

The Macro Management of Agriculture (MMA) Scheme is a Centrally Sponsored Scheme formulated with the objective to ensure that the Central Assistance is spent on focused and specific interventions for development of agriculture in areas of priority of different States. It became operational in 2000-01 in all States and UTs. The Scheme provides sufficient flexibility to States to develop and pursue the programmes on the basis of their regional priorities. Thus States have been given a free hand to finalize their sector-wise allocation as per requirements of their developmental priorities. The approved pattern of Assistance under the Scheme is in the ratio of 90:10 between the Centre and the State respectively except in the case of North Eastern States in case of which 100 per cent Central Assistance is extended. The Central Assistance to the States is released in two installments in the ratio of 80 per cent Grant and 20 per cent Loan.

Objective

Macro Management Scheme will aim at all round development in agriculture through Work Plans prepared by States. These include:

- Reflection of local needs/crop/regions specific/priorities etc.

- Providing flexibility and autonomy to States
- Optimum utilization of scarce financial resource
- Maximization of returns
- Removal of regional imbalances.

8.6.1 Salient Features

It has been decided to move away from schematic approach to Macro Management mode by integrating 17 Centrally Sponsored Schemes. Integration of Centrally Sponsored Schemes under Macro Management approach will enhance the productivity of support programmes and accord greater flexibility to State Governments to develop and pursue activities on the basis of regional priorities. It is, thus, a major step towards achieving decentralization in pursuance of restoring primacy of States in agricultural development planning. The Central Government will supplement/complement the State Governments' efforts through regionally differentiated Work Plans comprising crop/area/ target group specific interventions, formulated in an interactive mode and implemented in spirit of partnership with the States.

8.7 National Rural Employment Guarantee Act (NREGA)

The Act was enacted in September 2005 and brought into force in 200 most backward districts with the objective of providing 100 days of guaranteed unskilled wage employment to each rural household opting for it. The NREGA marks a paradigm shift and stands out among the plethora of wage employment programmes, as it bestows a legal right and guarantee to the rural population through an Act of Parliament and is not a scheme unlike the other wage employment programmes.

The ongoing programmes of Sampoorna Grameen Rozgar Yojana (SGRY) and National Food for Work Programme (NFFWP) have been subsumed in NREGA. The NREGA would cover all districts of the country within five years. The focus of the Act is on works relating to water conservation, drought proofing (including afforestation/tree plantation), land development, flood control/protection (including drainage in waterlogged areas) and rural connectivity in terms of all-weather roads. Each district has to prepare perspective plan of 5 years with a bottom up approach deriving from the needs of the local community. The said plan should have the approval of especially the derived community and the Panchayati Raj Institutes (PRIs). Panchayats have a key role in planning, implementation and monitoring of the Act through preparation of perspective plan, approval of shelf of projects, execution of works at least to the extent of 50 per cent in terms of costs. The Act envisages strict Vigilance and Monitoring. Gram Sabha has the power of social audit. Local Vigilance and Monitoring Committees are to be set up to ensure the quality of works.

8.8 Micro Irrigation (MI) Scheme

Micro Irrigation (MI), which aims at increasing the area under efficient methods of irrigation viz. drip and sprinkler irrigation.

8.8.1 Salient features

A Centrally Sponsored Scheme under which 40% will be borne by the Central Government, 10% by the State Government and the remaining 50% will be borne by the beneficiary either through his/her own resources or soft loan from financial institutions. Assistance to farmers will be for covering a maximum area of five ha per beneficiary family. The Panchayati Raj Institutions (PRIs) will be involved in selecting the beneficiaries. All categories of farmers are covered under the Scheme. However, it need to be ensured that at least 25% of the beneficiaries are Small & Marginal farmers The focus will be on horticultural crops being covered under the National Horticulture Mission. The Scheme includes both drip and sprinkler irrigation. There will be a strong HRD input for the farmers, field functionaries and other stake holders at different levels. Besides there will be publicity campaigns, seminars/workshops at extensive locations to develop skills and improve awareness among farmers about importance of water conservation and management

8.9 Mini-Mission- II of Technology Mission on Cotton

8.9.1 Objective

To enhance the production, per unit area through (a) technology transfer, (b) supply of quality seeds, (c) elevating IPM activities/ and (d) providing adequate and timely supply of inputs to the farmers .

8.9.2 Salient features

The components under the scheme include: (a) assistance for production of breeder, foundation and certified seed and distribution of certified seed (b) Field and Integrated Pest Management Demonstrations (c) Training of farmers and Extension Workers (d) Distribution of Plant Protection Equipments water saving devices; Bio-agents and pheromone traps. Assistance is also being provided for the establishment of bio-agents labs and seed delinting plants for adequate availability of bio-agents and quality delinting seed respectively.

8.10 Transport Subsidy for the Movement of Seeds

8.10.1 Objectives

- To ensure supply of seeds to the farmers in time at reasonable prices in the identified States.
- To subsidies the cost of transportation of seeds required by the farmers in the North Eastern States, Sikkim, Himachal Pradesh, Jammu & Kashmir, Uttaranchal and; Hill Areas of West Bengal so as to make seed available at reasonable rate as prevailing in other parts of the country.
- To make available seeds well in time before sowing season to the farmers in above areas.

8.11 National Project on Development and Use of Biofertilizers

8.11.1 Activities

- Production and distribution of Biofertilizers (BFs)
- Develop Standards for different BFs and Quality control
- Release of grants for setting up BF units
- Training and Publicity

Under this scheme the Government provides non-recurring grants-in-aid up to Rs.20.00 lakhs for setting up biofertilizer production units of 150 MT capacities. The grant-in-aid is offered to State Departments of Agriculture/cooperatives/public sector undertakings of fertilizers, NGOs and private agencies provided their proposals are received from respective State Governments. One time grant-in-aid to the extent of Rs.1.50 lakhs is provided for establishment of Blue-green algae sub-centre to produce 30-40 tonnes of BGA/annum provided their proposals are received from respective State Governments. This scheme is being implemented in the country with the help of a National and 6 Regional centres for training, field demonstration and its promotion and also through Department of Agriculture & Cooperation i.e. release of one time grant-in-aid for setting up BF units.

8.12 Promotion of Integrated Pest Management (IPM)

IPM is a broad ecological pest control approach aiming at best mix of all known pest control measures to keep the pest population below Economic Threshold level (ETL). It is an economically justified

and sustainable system of crop protection that leads to maximum productivity with the least possible adverse impact on the total environment. In crop production technology IPM is a schedule of practices which starts from field selection till harvest of a crop. The major components in this approach are cultural, mechanical, biological and chemical methods of insect pests, diseases, weeds and rodent control in a compatible manner.

8.12.1 Activities

- Popularizing IPM approach among farming community
- Organising regular pest surveillance and monitoring to assess pest/disease situation and study agro-eco-system to advise timely IPM control measures
- Rearing biological control agents for their field use and conservation of naturally occurring biological control agents for control of crop pests
- Promoting use of biopesticides, neem based pesticides, bacillus based biopesticides, insect pathogen as alternative to chemical pesticides
- Play a catalytic role in transfer of innovative IPM skills/methods/ techniques to extension workers and farmers in all states including the rich.
- Preserve eco-system and environment.
- Human Resource Development in IPM by imparting training to master trainers, extension workers and farmers by conduct of trainings.

8.13 Human Resource Development Training Support to Agriculture

8.13.1 Objectives

- To improve professional competence of Senior & middle level extension functionaries in the areas of extension, training and communication management and that of Subject Matter specialists in the areas of Agriculture, Horticulture, Animal Husbandry & allied disciplines – both working under States/Union Territories, though NTCs, STCs, Regional & Overseas Training Programmes.
- To create and strengthen training infrastructure at National, Regional and State/UTs levels for organizing effective training programmes through MANAGE, Extension

Education Institutes (4), Centres of Excellence (16), State Agriculture Management and Extension Training Institutes (SAMETIs), Selected SAUs, ICAR Institutes & other Central Institutes.

- To strengthen extension & training activities of North Eastern Hilly States, Sikkim, Goa, & UTs by providing adequate financial support on priority basis.

- To expose farmers to latest Crop Production followed by their counter parts in progressive States through Exchange visits.

8.14 Skill Development Initiative

It is a new initiative of Ministry of Agriculture, Govt. of India to provide training to the farmers in modern methods of agriculture, as well as imparting of skills relevant for non-agriculture activities. Actions for implementing this resolution may have four components:

- Target group i.e. farming community and other stakeholders

- Identification of training needs

- Identification of training institutions

- Financial resources

Farming community and other stakeholders – it may include

- Farmers

- Extension functionaries belonging to both governmental and non-governmental sectors

- Trainers at different levels

Identification of training needs consistent with overall National Development Council (NDC) resolution, training needs may be identified as a part of preparation of District Development Plan, Skill Gap Analysis will be done by assessing the gap between the existing technological and management practices and the recommended practices in major crops / enterprises. In addition, skill upgradation required on non-agricultural activities, which support the agriculture and allied sector like farm machineries, motor winding, fitting and repair of borewells, sprayer maintenance, tractor

driving skills and skills required for post harvest and value addition (grading, sorting, farm level processing, and packaging etc.), information support services and skills required for other income generating activities in the rural areas will be assessed.

The identified skill gaps will be prioritized based on the relevance, immediate applicability in the field and their contribution for raising the farm and non-farm income of the farming community. This exercise will be conducted in the form of Strategic Research and Extension Plan (SREPs) and also through focused group discussion with cross section of the people.

8.15 National Agriculture Development Programme (NADP) / Rashtriya Krishi Vikas Yojana (RKVY) (2008)

Concerned by the slow growth in the Agriculture and allied sectors, the National Development Council (NDC), in its meeting held on 29th May, 2007 resolved that a special Additional Central Assistance Scheme (RKVY) be launched. The NDC resolved that agricultural development strategies must be reoriented to meet the needs of farmers and called upon the Central and State governments to evolve a strategy to rejuvenate agriculture. The NDC reaffirmed its commitment to achieve 4 per cent annual growth in the agricultural sector during the 11th plan. The Resolution with respect to the Additional Central Assistance scheme reads as below:

Introduce a new Additional Central Assistance scheme to incentivize States to draw up plans for their agriculture sector more comprehensively, taking agro-climatic conditions, natural resource issues and technology into account, and integrating livestock, poultry and fisheries more fully. This will involve a new scheme for Additional Central Assistance to State Plans, administered by the Union Ministry of Agriculture over and above its existing Centrally Sponsored schemes, to supplement the State-specific strategies including special schemes for beneficiaries of land reforms. The newly created National Rainfed Area Authority will on request assist States in planning for rainfed areas.

The Department of Agriculture, in compliance of the above resolution and in consultation with the Planning Commission, has prepared the guidelines for the RKVY scheme, to be known as NADP (RKVY).

8.15.1 Basic Features of the RKVY

The RKVY aims at achieving 4% annual growth in the Agriculture sector during the XI Plan period, by ensuring a holistic development of Agriculture and allied sectors. The main objectives of the scheme are:

a. To incentivize the states so as to increase public investment in Agriculture and allied sectors.

b. To provide flexibility and autonomy to states in the process of planning and executing Agriculture and allied sectors schemes.

c. To ensure the preparation of Agriculture plans of the districts and the states based on Agro-Climate conditions, availability of technology and natural resources.

d. To ensure that the local needs/crops/priorities are better reflected in the Agricultural plans of the states.

e. To achieve the goal of reducing the yield gaps in important crops, through focused interventions.

f. To maximize returns to the farmers in Agriculture and allied sectors.

g. To bring about quantifiable changes in the production and productivity of various components of Agriculture and allied sectors by addressing them in a holistic manner.

These guidelines are applicable to all the states and Union Territories that fulfill the eligibility conditions.

8.16 Scientist – Extension – Farmers Interface and Technology Assessment and Refinement (TAR) - Through Institute Village Linkage Programme (IVLP)

The Green Revolution was one of the greatest success stories of the second half of the 20th century in India. This country, from a meager production of 50 million tones of food grains in 1950 characterized by acute scarcity of food, has made a tremendous impact in achieving the self-sufficiency in food grains. However, such an impact was not visible in raising the productivity of irrigated small farms, and all rainfed farms and there is still a wide gap in “technology application”. Earlier, non adoption of modern technologies by small and resource poor farmers was attributed to the inadequate support systems for small farm agriculture, such as extension services, credit, input supplies, etc. These conditions are well appreciated and recognized but they are only a part of the problem. An important reason put forth for the non-adoption of improved technology is the attitudinal constraint on the part of small farmers, such as innate conservatism, ignorance, resistance to change besides a resource crunch. This perception of the problems is largely the product of basic assumption that the technology is good and appropriate in all resource conditions and often not supported by field investigations of small farm systems. However, the main aspect which has not been duly considered earlier is whether the so called modern technologies are appropriate for farms of CDR and also for resource poor farmers of irrigated area. The field investigations conducted in the last decade world over, clearly suggest that many modern technologies are simply inappropriate for the

specific conditions of small-farm production systems which are highly diverse in nature and are largely influenced both by socio-economic as well as bio-physical factors.

In view of the fact that the technology adoption by resource-poor farmers is low, the social and biological scientists are becoming aware of the existing complex farming systems and the relevant decision making by these farmers and understand the reasons for non-adoption. They have, therefore, emphasized the need for participation of farmers in technology selection management process for generation of appropriate technologies. In the FPR a beginning is made with the knowledge, problem analysis and priorities of the farmers and farm families. In other words, this approach takes the whole farm as a system and not as an individual activity. Further, the farmers and researchers are actively involved in the technology generation process as partners. This approach encompasses an understanding of farmer's resources, their requirements, and goals in the technology generation process so that it can lead to a final adoption.

In the past the strategy followed in designing and implementing transfer of technology projects has been based more on the supply of technological information than on the consideration of limitations at the farm level. The usual approach has been that any technology, which produces the best results at the experimental level, is superior, and that is what should be offered to the farmers. Failure to consider the actual circumstances under which small farms operate has seriously affected the appropriateness of these technologies. What is needed is a technology generation and transfer mechanism and a methodology that will make it possible to recognize and classify the different types of small farmers. Then, and only then, the organizational design can generate and make available to farmers an appropriate technology, which they could adopt.

A more holistic approach in terms of diagnosis of problems, identification of technological interventions based on farmers knowledge and technology identification for various production systems is called for to generate appropriate technologies. It is in this concept a programme captioned TAR-IVLP was evolved to address the above elements to arrive at appropriate technologies. The programme originally started during 1995, got its fillip and momentum since 1999 when it was brought under the fold as part of NATP.

8.16.1 Main Objectives of TAR - IVLP

- To introduce technological interventions with emphasis on stability and sustainability along with productivity and profitability taking into account environmental issues in well endowed and small production systems.

- To introduce and integrate appropriate technologies to increase the productivity with marketed surplus in commercial and off farm production systems.

- To monitor socio-economic impact of technological interventions for different production systems.

- To identify extrapolation domain for new technology/technology modules based on environmental characterization as at meso and mega levels.

8.16.2 Operation of TAR-IVLP

8.16.2.1 Selection of operational area

A village is the unit of operation under TAR-IVLP. Selection of suitable village or a cluster of villages covering about 1000 farm families and having representation of various production systems is of paramount importance. Villages having primary institutions like cooperative, schools, Panchayat (village-elected body of representatives etc.) shall be an important component to forge better advantage for having better linkages, In addition, factors such as proximity to the implementing agency center, willing nature of farm families, absence of political/social/class conflicts etc. need to be borne in mind while selecting the village for the programme.

8.16.2.2 Constitution of multidisciplinary team of scientists

The project is implemented by Central Agricultural Research Institutes/State Agricultural Universities through a multidisciplinary core team of scientists numbering 4-5 from the implementing institution led by a Team Leader (Principal Investigator). The TAR-IVLP also envisages an optional team of scientists drawn from other institutes to look into specific issues.

8.16.2.3 Agro-ecosystem analysis (AESA)

The AESA of the village using PRA techniques was the first step towards launching the programme. It provided information on resource availability, production practices, interaction within and amongst various resources and enterprises on spatial and temporal basis.

8.16.2.4 Problem diagnosis and technology intervention

Based on the information elicited from AESA and the legitimization through focused group discussion, problems of various enterprises in terms of bio-physical and socio-economic causes were identified. The identified problems were prioritized and possible technological interventions were assessed in a focused group discussion with farmers and scientists.

8.16.2.5 Action Plan for technology assessment and refinement

The technological interventions contemplated were categorized down into specific action plans in terms of on-farm trials/demonstration, treatments, local checks, number of trials, plot size, critical inputs etc. Action plans were prepared keeping in view the AESA and in consultation with farmers. The technologies were evaluated not solely in terms of their technical/economic performance, but also in terms of their conformity to socio-economic and cultural circumstances, goals and needs with active participation of farmers.

8.16.2.6 Site committee meetings

Action plans were also discussed in the site committee meetings to improve the nature of interventions. Site committee was constituted for proper implementation including site selection and project submission considering the guidelines of ICAR. Site committee meetings were held to advise the TAR-IVLP core team on the selection, modifications and approval of techno-interventions and action plan in the adopted villages and overall review of the project.

8.16.2.7 Monitoring and Evaluation

The goals of this component are to measure the scale of success. Review team was constituted comprising of subject experts for this purpose. The peer review team visited the TAR-IVLP villages to monitor the progress of the project and made specific recommendations. The progress of TAR-IVLP was also monitored through organizing workshops and Agro-Ecosystem Director visits.

8.17 Agricultural Technology Information Centres (ATICs) (1998 - 99)

The primary goal of agricultural extension is to assist farming families in adapting their production and marketing strategies to rapidly changing social, political and economic conditions so that they can, in their long term, shape their lives according to their personal preferences and those of the community. The task of extension is to improve interactions with the Agriculture Knowledge System (AKS) so that farmers have optimum access to any information that could help them enhance their economic and social situation.

To attain these objectives, the Indian Council of Agricultural Research initiated Transfer of Technology (TOT) projects through various means like Krishi Vigyan Kendras, and Institute-Village Linkage Programme centers.

Though the aforesaid TOT projects and their vast mechanisms are made to help and serve the farming community, some of the important needs of the farmers are not yet met.

The five important needs of the farmers are:

1. Awareness of and motivation to use improved technologies / management practices.

2. Advice on appropriate farm planning and resource management.

3. Practical farming skills relevant to new technologies / management practices.

4. Production inputs and credits and

5. Post harvest and marketing services to farmers to get a good price in a competitive global agriculture.

Interestingly these needs of the farmers irrespective of their locations and farming practices are not realized by the existing transfer of technology projects. Hence a new and innovative transfer of technology mechanism named, Agricultural Technology Information Centre (ATIC) has been conceived and put into practice since 1998-99 under National Agricultural Technology Project (NATP) sponsored by World Bank and implemented through ICAR Institutes and State Agricultural Universities (SAUs) located in various parts of the country.

8.17.1 ATIC – Distinctive Features

ATIC is intended to provide all basic needs of the farmers through a single window service. This unique system not only serves the farmers but also other stakeholders of the farming practices to provide solution to their location specific problems and make available all the required technological information together with technology inputs and products for testing and use by them. The rationale behind the establishment of ATIC has been:

1. Providing diagnostic services for soil testing, plant and livestock health;

2. Supplying research products such as seeds and other planting material, poultry strains, livestock breeds, fish seed, processed products, etc., emerging from the institution for testing and adaptation by various clientele;

3. Disseminating information through published literature and communication materials as well as audio-visual aids; and

4. Providing an opportunity to the institutes / SAUs to have resource generation through the sale of their technologies.

8.17.2 Objectives of ATIC

1. to provide a single window delivery system for the products and species available from an institution to the farmers and other interested groups as a process of innovativeness in technology dissemination at the institute level;

2. to facilitate direct access to the farmers to the institutional resources available in terms of technology, advice, products, etc., for reducing dissemination losses; and

3. to provide mechanism for feedback from the users to the institute.

8.17.3 Attributes of ATIC

The inbuilt mechanism of ATIC ensures:

1. Availability and accessibility of new technologies

2. Relevance of new technologies

3. Responsiveness of new technologies to the needs of different categories of farmers

4. Varied requirements for different categories of farmers and

5. Sustainability of such unit within overall institutional framework.

It is expected that if ATIC works with its full vigour and mandated objectives there will be no doubt that farmers of India will be able to accomplish their coveted goal and produce more with quality and with reduced cost and will be competitive partner in the agriculture market in the context of WTO and globalization of agriculture. Not only ATIC will help farmers to use modern technology for demand driven agriculture but also help developing viable, responsive and sustainable agriculture with linkages among research, extension and farmer's systems.

8.18 National Agricultural Innovation Projects (NAIP) for rural livelihood security (2006-12)

Agricultural innovations and diffusion of new technologies are the important factors in the country's quest for food, nutrition, environmental security and enhancement of income and employment. Agricultural research in India has generated outstanding productivity increases in the past and shall continue to play an important role in supporting rural livelihoods and accelerating rural growth. However,

rising population and per capita income are pushing up the food-demand, which needs to be met through enhanced productivity per unit area, input, time and energy. At the same time, the issues of decreasing productivity factor and resource-use efficiency have also emerged.

Furthermore, many promising research findings have not reached the farmers, due to either inadequacies in research designs or research results, deficiencies of delivery systems or lack of economic incentives. This is particularly visible in the complex environments and less-favored areas. In order to address the problems of poverty and hunger, it is critical to redirect and augment resources devoted to agricultural research to the farming and livelihood systems of the poor rural communities. Further, to utilize the technological breakthroughs that are already available for commercial use, the agricultural research priorities and strategies will have to be revisited and new system-wide approaches need to be developed and adopted.

The NAIP will address the above issue through a coordinated effort on changing the content and process. Policy and technology options will be screened or tested by the end-user for applicability as well as for economic social and environmental sustainability. In the applied and adaptive research projects, the end-user of innovations will be involved from the start of programmes and projects and will remain partner till their completion. Both indigenous knowledge and frontier technologies will be used to generate the targeted products.

The overall objective of the NAIP is to facilitate an accelerated and sustainable transformation of the Indian agriculture so that it can support poverty alleviation and income generation through collaborative development and application of agricultural innovations by the public organizations in partnership with farmers' groups, the private sector and other stakeholders. The specific objectives envisaged are :

i) To build the critical capacity of the ICAR as a catalyzing agent for management of change in the Indian NARS

ii) To promote 'production to consumption systems research' in priority areas / themes to enhance productivity, nutrition, profitability, income and employment.

iii) To improve livelihood security of rural people living in the selected disadvantaged regions through technology-led innovation systems encompassing the wider process of social and economic change covering all stakeholders.

iv) To build capacity to undertake basic and strategic research in frontier areas of agricultural sciences to meet challenges in technology development in the immediate and predictable future.

The NAIP is planned for six years (2006-12) to allow time for piloting, learning and scaling-up, wherever possible.

8.18.1 Institutional Development Priorities of the NAIP

The NAIP is aware of the growing importance of access to information in the global competitive economy. Competitiveness and access to information are of sufficient relevance to poor-population groups to save them from further marginalization. The quantum of new information and the rapid rate at which the existing knowledge is becoming obsolete may pose a threat to the traditional and indigenous knowledge of our country. The NAIP plans to support efforts to protect the useful traditional knowledge. Thus, the NAIP shall strive for a better balance between utilization of the existing /indigenous knowledge, creation of new knowledge and protection of useful traditional knowledge through documentation, validation, dissemination and utilization.

India's agricultural sector is composed of a large number of small individual entrepreneurs. Farmers are becoming increasingly dependent on other entrepreneurs for services, inputs, implements, marketing and processing. The capacity of these large numbers of entities to adjust to the rapid changes in the institutional, economic and political environments, and inter-collaborations is highly crucial for the success of agricultural development. Capacity building and strengthening of partnerships will be major elements in all the components of the NAIP. Capacity building applies to individual farmers, farmers' groups / organizations, and agrarian institutions and businesses, which support them.

Partnerships refer to collaborations among public sector institutions, farmers' organizations, self-help groups, NGOs and the private sector. The NAIP is well aware that women farmers, whose number and contributions are significant in the Indian agriculture; have to be increasingly involved in the development process. Participatory mode of technology development, learning and action shall be the essential ingredients for capacity building and project management in the NAIP.

With the increasing importance of marketing in the Indian agriculture, enhancing the business skills of agricultural research institutions assumes high significance. There is a need to develop business development units / groups as models in potential institutions for business planning, and market development for commercialization of agro-technologies.

Agriculture in India is quite related to other sectors of the economy with mutual influences. Modernization of agriculture has made it dependent on various inputs within the country and outside. While discussing the challenges of the Indian agriculture in the coming years, it is necessary to discuss it keeping in view the growth, sustainability, and labour availability and government policies.

Many a times, the above mentioned schemes are implemented without proper integration of each other. To realize the holistic growth of agricultural sector, extension functionaries particularly

KVK scientists need to know various on going central sector and state specific schemes and programs. These schemes should be dovetailed so as to realize the maximum benefit by the farming community.

8.19 Innovations in extension work by KVKs

KVKs aim at conducting only frontline extension work, thus leading to successful innovations in technology dissemination. Some of the innovative efforts by KVKs are listed below:

8.19.1 'aAqua' – A Bilingual Portal, a Virtual University Model by KVK Pune, Maharashtra

aAqua – A Bilingual Portal, a Virtual University Model was developed jointly by KVK, Pune and IIT, Mumbai. The KVK is responsible for content development while the IIT is associated in software development and maintenance of the site. Looking at the success and utility of the model, the Programme Coordinator envisaged developing the broad based digital content on agro technologies for various crops grown in the State, expert and decision support systems, and query based redressal in local language and keyword browsing during XI Plan. The KVK recently started providing mobile SMS services called agro-advisory services to the villages.

8.19.2 'Vasundhara': Software for soil and water test based nutrient recommendations by KVK Ahmednagar, Maharashtra

The KVK has successfully demonstrated the use of ICT in disseminating improved agricultural technologies in rural areas under its Cyber Extension Programme. The KVK pioneered the pest and disease forewarning through its SMS based alert system to the registered users. A number of technology CDs has been developed on crops, livestock and other agri-enterprises for use by the farmers. It also developed software called 'Vasundhara' for soil and water test based nutrient recommendations and also released CDs on statistical information and FAQs on farmer's needs and problems. The KVK suggested providing facilities for automatic weather station, infrastructure for market intelligence, quality assessment and certification in XI Plan.

8.19.3 Refinement of SRI method of Rice cultivation by KVK West Godavari, Andhra Pradesh

The KVK is located in the major rice growing zone of Andhra Pradesh and identified several problems associated with low productivity of rice which include water scarcity, nutrient stress and incidence of pest and disease under rice-rice system. Rice farming was not found to be attractive due to increased cost of cultivation and low profitability. System of Rice Intensification (SRI) originally developed in Madagascar was recommended by Acharya N.G. Ranga Agricultural University during 2003. The farmers refined various tools such as marker, liner and weeder in consultation with the

Subject Matter Specialists of the KVK and the University to facilitate better intercultural operations. The KVK organized 20 training programmes with the participation of 800 farmers and 100 state departmental officials and conducted 110 frontline demonstrations. For creating awareness one Kisan Mela was also organized, besides a number of field days and exposure visits. The yield advantage was found to be 18-22% due to SRI cultivation. Recognizing its potential, Government of Andhra Pradesh took initiatives to popularize this technology throughout the state.

8.19.4 Increasing Ginger productivity by KVK Sirmour, Himachal Pradesh

Ginger is an age-old cash crop in Sirmour district of Himachal Pradesh and stands first in India in terms of production. Due to the sudden outbreak of devastating pests and diseases during 1989-90, farmers suffered huge financial loss and were hesitant to grow ginger. As a result there was drastic reduction in the area. The KVK identified five major constraints that are associated with the low profitability of ginger which include improper selection of seed, occurrence of Pythium and Fusarium wilt, Phyllosticta leaf spot, and Rhizome fly and poor storage. A number of training and demonstration programmes were organized on improved technologies including selection of healthy seed and its treatment, control of leaf spot, rhizome fly and proper storage technique besides creating awareness through several extension activities. As a result, the area under ginger cultivation has gone up approximately by about 700 ha besides increased productivity.

8.19.5 Reclamation and utilization of Sodic lands and formation of Water Users' Groups by KVK Sultanpur, Uttar Pradesh

The KVK highlighted the results of demonstration on reclamation and utilization of sodic lands in the district spanning 1.2 lakh ha with soil surface pH upto 10.5. Other important features include predominance of carbonate and bicarbonate, occurrence of hardpan at a shallow depth and low productivity. A working model was developed and demonstrated by using various improved technologies like application of soil amendment, planting of trees, improved cropping pattern, and provision of proper surface drainage facilities. The KVK conducted 551 training programmes on improved management techniques with the participation of 19,655 farmers and mobilized the farming community by organizing several awareness and motivation campaigns and forming 5,852 water user groups (including 848 women Self Help Groups) covering 26,887 farmers. With the effort, approximately 27,162 ha of soil were reclaimed resulting increased crop productivity and manifold appreciation of land value after reclamation.

8.19.6 'Beej Gram' concept by KVK Begusarai, Bihar

The KVK demonstrated an alternate channel of availability of quality seed to meet its demand in the district through Seed Village Programme. The KVK imparted training to 10-20 rural youth on various aspects of seed production in potato and wheat during 2000-01 and formed a seed village called 'Beej gram' in Khodawandpur. By the year 2006, 23 such seed villages were formed, resulting

in production of 1200 tonnes of quality seed of wheat, potato and vegetables. An agricultural graduate was deputed to monitor the activity of seed production in each village by the District Magistrate. Each of the Subject Matter Specialists in the KVK was given the responsibility of overseeing three such seed villages. The KVK organized 23 awareness programmes and 27 field days with the involvement of 1266 and 1697 farmers respectively besides 145 diagnostic visits to these villages.

8.19.7 Hybrid seed production in vegetables by KVK Patiala, Punjab

The KVK presented the hybrid seed production activity in Chili, Brinjal, Tomato, cauliflower, Sarson, Muskmelon, Maize, Sunflower, Rice and Cotton. So far 89 training programmes on hybrid seed production were organized with the participation of 920 farmers. As a result, a number of entrepreneurs in hybrid seed production were developed in Chilli (31), Muskmelon (11) and Brinjal (11), with average annual income varying from Rs. 10 to 12.5 lakh.

8.19.8 Farmers' Field Schools for IPM by KVK Pondicherry, Pondicherry

The impact of the activities on IPM technologies to reduce pesticide consumption in the State was highlighted. There were 158 Farmers' Field Schools established by the KVK involving 4,740 farmers in rice, cotton and groundnut. Such community participation facilitated rapid spread of IPM technologies like light trap, pheromone trap, bird perch and parasitoid, use of neem oil and bio pesticide through Farmers Field Schools. The KVK organized 700 guest lectures, 21 method demonstrations and 269 farm advisory services besides 23 training programmes on IPM technologies on rice, groundnut, sugarcane, banana, coconut and vegetable covering 280 farmers. Due to adoption of IPM practices, there was Rs. 13000 increase in gross income per ha besides large-scale reduction in pesticide consumption in the State.

8.19.9 IPM through Self Help Groups by KVK Medak, Andhra Pradesh

The KVK successfully implemented IPM model to control Helicoverpa Spp in rainfed villages of Zaheerabad Taluk through formation of a number of Self Help Groups. Large-scale awareness on IPM technologies were created by arranging wall posters, paintings and Kala Jatas (folk dance and songs) in the villages, besides implementing the crop insurance scheme sponsored by its host institution (Deccan Development Society). There was yield advantage of 2.5 quintal and a saving of Rs. 1250 per ha due to adoption of IPM technologies.

8.19.10 Land shaping technology for optimal utilization of natural resources by KVK 24 Parganas (South), West Bengal

The KVK highlighted the impact of land shaping technology for optimal utilization of natural resources in Sundarbans area of West Bengal. The area being low lying is primarily mono-cropped. The

technology involves creation of a small pond in one portion of the plot and raising simultaneously the remaining part of the plot. A three-tier model to integrate land, water and air for double and triple cropping in the raised area including the area under tank bund was demonstrated. The model not only facilitated increased cropping intensity and fishery in the embankment areas but also in the pond and conservation of ground water and energy. The technology was disseminated to 14 blocks (5128 units) and 3758 families and created opportunities for on-farm employment, increased family income, reduced labor migration, scope for multiple cropping and empowered the rural women. Looking at the benefits to the community, Sundarban Development Board allocated Rs. 20 crore to State Department to implement this innovative model in entire Sundarban Region.

8.19.11 Model for rainwater harvesting by KVK Akola, Maharashtra

This KVK is situated in the drought prone Vidharbha Region of Maharashtra where the average annual rainfall is 750-800 mm and the water table has gone down rapidly by approximately 2.12 m during the last decade. A model for rainwater harvesting was developed by the KVK was implemented with the formation of several women groups and organizing training and demonstrations on rainwater harvesting techniques in Isambri village. A number of awareness campaigns, exposure visits, workshops, field days to create large-scale awareness in the area, besides bringing out two publications on various improved practices for increasing productivity. Various in-situ soil and water conservation practices were also demonstrated such as contour sowing, sowing across slope, ridges and furrows, dead furrows, micro catchments etc. So far KVK has constructed 60 small ponds, 11 gabain structures, 10 check dams and 18-roof water harvesting structures to facilitate water harvesting and recharging of the ground water. It was estimated that about 441 TCM of rainwater was harvested in an area of 354 ha of watershed during the last 5 years.

8.19.12 IPM package on groundnut by KVK Guntur, Andhra Pradesh

The KVK has developed an IPM package on groundnut in consultation with the scientists of ANGRAU and ICRISAT and implemented in 13 villages, covering approximately 240 ha of groundnut area and benefiting 650 farmers. A number of trainings, demonstrations, and field days, exposure visits were organized in these villages besides conducting a weekly farmers' field school. IPM model enhanced the net income by approximately Rs. 7000 per ha and contributed to reduction in pesticide consumption in the region. The farmers of 72 nearby villages covering 4085 ha of groundnut also adopted the IPM model developed by the KVK. It was estimated that there was an overall saving of Rs. 10 crore due to reduced pesticide usage in this region.

8.19.13 Alternate Land Use System by KVK Purulia, West Bengal

The KVK demonstrated an alternate land use system for use of rainfed lateritic upland soils of Purulia district in West Bengal through demonstration of insitu soil moisture conservation practices and improved agro-techniques for various field crops. Women self help groups were trained on

various aspects of post harvest handling of mango, guava and acid lime. It was estimated that the average annual family income went up by approximately Rs, 11000/- and the model was adopted by 31 farmers in 18 villages in the drought prone uplands of Purulia.

8.19.14 Soil reclamation techniques for 'Usar' lands by KVK Una, Himachal Pradesh

The KVK presented the highlights of soil reclamation techniques for 'Usar' lands. Application of gypsum (50% GR value) followed by green manuring with Daincha and mulching (paddy straw) facilitated considerable reduction in surface soil pH (10.0 to 8.0). It was suggested to demonstrate this technology by all the KVKs located in 'Usar' affected areas.

8.19.15 'Mithun Microchip' Technology by KVK, Papumpare, Arunachal Pradesh

Mithuns are semi-domesticated animals in Arunachal Pradesh and under the prevailing system of Mithun rearing; they are let-loose freely in the jungle to feed themselves on natural fodders with out any supplement feeding or care by the attendants except offering of common salts occasionally by the Mithun owners.

Traditionally, Mithuns are identified based on their ear notching (done during the calf-hood), horn structures, body coat colour pattern, sex or the body size. Due to close similarity between the Mithuns of different owners in the locality, often it creates conflicts for the Mithun ownership among the owners. This leads to controversies among the Mithun owners which ultimately compels them to plead the case to the Judiciary for further investigation for ownership. Taking the degree of social importance in view, staff of KVK Papumpare has initiated the micro-chip implantation drive as a means of identification of true owners of Mithun in the locality in collaboration with State Forest Department. (Microchip implantation was done originally for location and identification of wild elephants in jungle by the state Forest Department).

The process of Micro-chip implantation involves the following procedure-

- The micro-chip (size of rice grain) bearing a specific number is loaded in the syringe (inserter) for implantation in the Mithuns.
- The Mithun is secured and restrained with the help of strong rope tied in its neck controlled by the Mithun owner and the attendant.
- The site at the neck region (anterior to the point of shoulder) is sterilized with the help of absolute alcohol (spirit) and kept ready.

- The skin of the site (sterilized) is gripped with the fingers and the syringe (loaded with the micro-chip) is pricked with plunger and micro-chip is implanted subcutaneously.

Further, with help of the transponder (Reader Machine), the micro-chip number is rechecked and recorded in the identity card of the Mithun and handed over to Mithun owner for the safe custody.

At the time of any conflict for the ownership of the Mithuns, the microchip reader machine is brought from the authority and the tag number or the micro-chip number can be read by rubbing the machine near to the site of implantation of the micro-chip.

A total of 55 Mithuns had been micro-chipped by the KVK Papumpare in collaboration with the State Forest Department for identification of disputed Mithuns in the district during the year 2008. This initiative has helped the local community in a great extent as the doubt and conflict over the ownership of Mithuns in the district was eliminated.

Presently, the KVK Papumpare is collaborating with the State Wild Life Department under the Department of Forest and Environment, Govt. of Arunachal Pradesh has taken up programme of micro-chip implantation in the Mithun population available in the entire district to provide identity card to Mithuns, by Dec. 2009.

Out put

The awareness and use of microchip technology as a fool proof identification for Mithun was created among the farmers.

The dispute among the Mithun herd owners was completely eliminated and farmers now wanted to adept this technology for their animal identification.

Outcome

The application of the microchip technology was accepted by the Government and it helped to extend the benefit to a larger population in other district of Arunachal Pradesh and similar condition in the NE Region.

Peace of mind and social harmony is established in the society as the conflict over Mithun ownership in the district.

8.19.16 Reclamation of Mandarin Orchards by KVK, West Sikkim, Sikkim

Sikkim Mandarin represents the most important commercial fruit crop of Sikkim. It is cultivated in an area of 2325 ha in West district and 925 ha. in South district with a production of 3268 and 1740 tones respectively.

The important orange producing areas lie in the Rangit valley, namely, Tashiding, Omchung, Tikjek, Lingchom, Bermoik, Berthang, Rinchenpong, Chingthang, Chakung, Zoom and Timburbong in West Sikkim and Kewzing, Lingmoo, Sangmoo, Payong, Rateypani, Namthang, Tarku, Tokal-Bermiok, Turuk and Sumbuk in South Sikkim.

Though Sikkim Mandarin has been cultivated in Sikkim from time immemorial and is very popular in Kolkata market, the orange industry is now facing serious problems.

Identified Problems

A conglomeration of several faulty farmer activities led the decline of mandarin industry in Sikkim. Some of the major problems identified are as follows:

- Improper selection of Orchard site.
- Poor quality of planting material.
- Random intercropping especially with exhaustive crop.
- Infestation of insect pest like trunk borer, bark eating Caterpillar, Aphid, fruit fly.
- Almost 30-40% fruit drop during maturity due to fruit fly attack.
- Non- adoption of recommended package of practices.

Krishi Vigyan Kendra, west Sikkim formulated suitable strategies to combat the identified problems. Krishi Vigyan Kendra has accelerated the technological interventions for the successful rejuvenation of orange orchards in Sikkim..

The current programme was implemented at Geyzing block of West Sikkim. This includes:

- Conducting of FLD & OFT on the selected technologies for citrus rejuvenation.

- Training to practicing farmers, rural youths and extension functionaries on nursery management, orchard soil management, rejuvenation, pest and disease management, nutrient management etc.

- Specialized training on Bordeaux mixture preparation and application.

- Campaign on fruit fly control.

The Kendra in collaboration with Horticulture and Cash Crop Development Department, Government of Sikkim, organized massive campaign for control of fruit fly during 2007-08 and 2008-09. During the campaign, farmers were taught about the life cycle of fruit fly, its control and prevention. The technique of poison baiting, destruction of fallen fruits etc. were also taught. Though the insect is not mentioned as very harmful at national level but the loss due to fruit fly in Sikkim is very severe. Almost 30-40 % fruit drops during maturity due to this attack. The campaign is still on. Every Gram panchayat unit and wards were covered during the campaign. During 2007-08, special drive on collection of fallen fruit and destruction was also organized and a news release through news paper and local television network was also done.

FLD

To demonstrate farmers the complete package on the technology for rejuvenation of declining orchard, Krishi Vigyan Kendra, West Sikkim have conducted a FLD on orange rejuvenation during the year 2007-08 and 2008 -09. The programme aimed at demonstrating and popularizing the technology related to orchard soil management, nutrient, pest and disease management, irrigation, intercropping etc. The orchards under demonstration have started giving better performance. Special operations like Bordeaux mixture application, basin clearance, manure application, removal of mosses and loranthus, application of bio-pesticides are demonstrated at the adopted orchard time to time to the farmers. After learning by seeing, farmers in the district have started adopting the recommended cultural practices taught to them. Almost 100 % farmers under the target group adopted the cultivation practices during the year.

OFT on Pre-bearing Orchard

New orange plantations have never come to the bearing stage satisfactorily. The seedlings easily survive after transplanting. The orange plantations in Sikkim hills have still not taken the status of sole or mono crop. Since it is planted in dry field, where the cultivation of maize is most likely observed, the common intercrop in new orange plantation area is maize. It was observed through several studies that the orange intercropping cannot be avoided. PRA among farmers revealed that they need a technology which allows them to sow maize as intercrop without affecting the orange saplings. Therefore, KVK west Sikkim, initiated an On Farm Testing of the technology for assessment

and refinement. During the OFT the effect of maize intercropping on orange plantation was assessed. It was found that:

- The field was ploughed during February for sowing maize, which damage the fibrous roots of young orange plants.
- If maize was grown in close vicinity without basin clearance, pests like bark eating caterpillar and trunk borer easily get the environment to bore the trunk and to eat the bark.
- Farmers couldn't watch the activities of different pest and diseases in and around trunk for 5-6 months till the maize crop gets harvested.
- Different operations like manuring and Bordeaux mixture application couldn't be performed.
- Maize competes for the nutrient and moisture with orange.

Under the testing of the technology, the following assessments were made under farmers' field condition:

- Planting of orange in good alignment.
- Careful ploughing, not to plough the soil at least 1m diameter around the trunk.
- Leaving 1m diameter around the tree trunk for sowing maize or do not sow maize with in an area of 1m diameter around the trunk.
- Cleaning the basin and providing mulching.
- Leaving a space of 1m diameter around the trunk facilitated the easy operation of cultural practices like manuring, Bordeaux paste application, pest and disease monitoring etc. Moreover, competition for moisture and nutrient was also reduced.

The OFT was conducted in 10 farmer fields across the district with 10 plants per farmer. The parameters chosen for study were tree volume, shoot growth (current season) and number of holes in trunk due to trunk borer.

On the basis of the results of the OFT conducted and the technology assessment made, the KVK West Sikkim has initiated the integrated citrus rejuvenation programme among the farmers of West Sikkim. The efforts of the KVK resulted in the development of a technology package for rejuvenation of orange orchards thus resulting in increased yield and income for the orange farmers of the district.

The output

- A technology package for rejuvenation of orange orchards was developed.
- The package of practice for maize intercropping was also standardized.
- The pest and disease incidence was greatly reduced due to new package of practice adopted
- The package helped increase the orange yield and income
- Orange farmers could get better returns from their old farms itself.

The outcome

- The orange crop across the district was rejuvenated
- The farmers learnt the reasons for decline in yield and the proper management practices
- A proper package for maize intercropping was also learnt by farmers
- The technology package thus lead to rejuvenation of old orchards thus providing better income to orange farmers and saving the orange industry in the district.

8.19.17 Economic Advantage from TPS Technology by KVK, West Tripura, Tripura

Under the Mid Tropical Plain Zone, horticulture and particularly potato cultivation adds significantly to farmer incomes. The KVK West Tripura identified that the potato farmers are plagued with problems of Low yield from traditional varieties, high disease infestation, high transport costs and production of less uniform and unattractive tubers. True Potato Seed/Hybrid Potato Seed (TPS) is a technology that was found as having a potential in solving the above mentioned problems. Also the technology was never used by farmers of the district. The KVK identified potato variety HPS II/67 for TPS production. This variety and TPS technology both were new in the district. The KVK conducted

OFT in 30 farmer fields through out different microlocations of the district. The farmer practice was kept as control. The technology tested led to successful outcome with respect to:

- Cost effectiveness
- Low seed rate (100gm/ha v/s 2 MT tuber/ha)
- Negligible transport cost due to low seed rate
- Disease free seeds
- Resistance to late blight diseases
- Higher yield
- No requirement for cold storage facility

The assessment of the TPS technology by KVK helped in identifying a solution to the above mentioned burning problems which potato farmers of the district were facing till date. The trials have already evinced interest in farmers of the district and the technology is now successfully demonstrated in FLDs. The KVK could successfully find solution to the critical problems in potato cultivation there by contributing to:

- Increased income
- Drudgery reduction
- Labour savings
- Space savings and
- Ensured supply of quality seeds

Through this innovative OFT, the KVK could find solution to an age old problem which involves cost, disease problems, labour, space saving issues, ensured seed supply and drudgery. Proper identification of field level problem and appropriate technological solution has resulted in this success.

8.19.18 Banana Fibre Extractor Machine by KVK, Rajahmundry, Andhra Pradesh

East Godavari district of Andhra Pradesh is traditionally famous for banana cultivation. The fruit bunches and leaves are the main sources of income and other portions ore often left as waste. Farmer often faces the problem of disposal of pseudo stem and huge stocks of the pseudo stems are getting accumulated in the banana growing areas. Extraction of fibre and preparation of organic manure etc., from these stems are some of the possible utilization options for this plant waste. The manual fibre extraction process presently followed by farmers is cumbersome with less economic output. An inter institutional project initiated by KVK Rajahmundry developed a need based user friendly 'Banana Fibre Extractor' machine for commercial exploitation of unutilized banana wastes. The machine provided the following benefits to farmers over the manual process:

- Reduced drudgery
- Fifty times increase in fibre production
- User friendly and economic
- Less maintenance cost
- Clean work atmosphere and clean hands
- 25 kg of fibre production per day against 500 grams in manual process
- Superior quality fibre in terms of length, softness, strength and colour.

An additional maximum income of Rs. 2,500/- per acre (@ Rs. 5/- per plant with an average of 500 plants in an acre) is assured to the banana cultivators. The banana cultivators often used to incur heavy losses due to natural calamities. The KVK innovation helped them to recoup their cultivation cost appreciably during these calamities. Once the fibre extraction process is popularized and an assured market is created, the banana cultivation can be a no risk enterprise.

Chapter – IX

ICT led Knowledge Management in KVKs

9.1 ICT and Indian Agriculture

Indian Agriculture contributes 22% of our GDP, and approximately 60% Indians derive their livelihood from the agricultural sector. Today's farmers want not only the two-time bread for their families from their hard sweat, but also surplus food production, which can be sold in the market to get sufficient money to fulfill their other daily needs. Also, private sector initiatives like contract farming have commercialized the Indian agricultural sector. It has also seen many new concepts and theories substituting the traditional methods. Introduction of Information and Communication Technology (ICT) is one of them, which enables the dissemination of requisite information at the right time. This revolution in information technology has made access to the information easy and cost-effective.

9.2 ICT: A definition

ICT is an integration of the technologies and the processes to distribute and communicate the desired information to the target audience and making the target audience more participative in nature.

9.3 Need of ICT in Indian Agriculture

At present, the ratio of the farmers to the extension worker is 1000:1, which is really very less. Although the appointed Village Local Workers (VLWs) disseminate the information, they hardly accept any accountability. These two issues have created the urgency to help and guide the poor farmers properly. The cost factor in face-to-face information dissemination at the right time, and the difficulties in reaching the target audiences, has also created the urgency to introduce ICT. It is only by the introduction of ICT that information can also be upgraded at the least cost. There are several models of ICTs in Indian agriculture, which have made a significant difference in the delivery of services in Indian agriculture like, the establishments of Kisan Call Centers, Gyandoot project, Bhoomi project, Village Knowledge Centers, and AGMARKNET. These examples are discussed in detail later in this chapter.

9.4 Knowledge Management – A general overview

Knowledge Management (KM) comprises a range of practices used in an organization to identify, create, represent, distribute and enable adoption of insights and experiences. Such insights and experiences comprise knowledge, either embodied in individuals or embedded in organizational processes or practice. An established discipline since 1995, Knowledge Management initially included courses taught in the fields of business administration, information systems, management, and library and information sciences only. More recently, other fields, to include those focused on information and media, computer science, public health, and public policy, also have started

contributing to KM research. Knowledge Management in agriculture is still in an evolving stage while the amount of knowledge available in agriculture related organisations is enormous when compared to the above mentioned fields. Many large companies and non-profit organisations have resources dedicated to internal KM efforts, often as a part of their 'Business Strategy', 'Information Technology', or 'Human Resource Management' departments. Several consulting companies also exist that provide strategy and advice regarding KM to these organisations. In a public organization like KVK, the scientists themselves have to take initiative towards Knowledge Management efforts.

KM efforts typically focus on organizational objectives such as improved performance, competitive advantage, innovation, the sharing of lessons learned, and continuous improvement of the organization. KM efforts overlap with Organizational Learning, and may be distinguished from by a greater focus on the management of knowledge as a strategic asset and a focus on encouraging the exchange of knowledge. KM efforts can help individuals and groups to share valuable organizational insights, to reduce redundant work, to avoid reinventing the wheel per se, to reduce training time for new employees, to retain intellectual capital as employees turnover in an organization, and to adapt to changing environments and markets.

9.5 History and research

KM efforts have a long history, to include on-the-job discussions, formal apprenticeship, discussion forums, corporate libraries, professional training and mentoring programs. More recently, with increased use of computers in the second half of the 20th century, specific adaptations of technologies such as knowledge bases, expert systems, knowledge repositories, group decision support systems, and computer supported cooperative work have been introduced to further enhance the such efforts. A broad range of thoughts on the KM discipline exists with no unanimous agreement; approaches vary by author and school. As the discipline matures, academic debates have increased regarding both the theory and practice of KM, to include the following perspectives:

- **Techno-centric** with a focus on technology, ideally those that enhance knowledge sharing and creation
- **Organizational** with a focus on how an organization can be designed to facilitate knowledge processes best and
- **Ecological** with a focus on the interaction of people, identity, knowledge, and environmental factors as a complex adaptive system akin to a natural ecosystem.

Regardless of the school of thought, core components of KM include People, Processes, Technology (or) Culture, Structure and Technology, depending on the specific perspective. Different KM schools of thought include various lenses through which KM can be viewed and explained, to include:

- Community Of Practice
- Social Network Analysis
- Intellectual Capital
- Information Theory
- Complexity Science
- Constructivism

9.6 Dimensions of Knowledge

Different frameworks for distinguishing between knowledge exist. One proposed framework for categorizing the dimensions of knowledge distinguishes between *tacit knowledge* and *explicit knowledge*. Tacit knowledge represents internalized knowledge that an individual may not be consciously aware of how he or she accomplishes particular tasks. At the opposite end of the spectrum, explicit knowledge represents knowledge that the individual holds consciously in mental focus, in a form that can easily be communicated to others.

Early research suggested that a successful KM effort needs to convert internalized tacit knowledge into explicit knowledge in order to share it, but the same effort must also permit individuals to internalize and make personally meaningful any codified knowledge retrieved from the KM effort. Subsequent research into KM suggested that a distinction between tacit knowledge and explicit knowledge represented an oversimplification and that the notion of explicit knowledge is self-contradictory. Specifically, for knowledge to be made explicit, it must be translated into information (i.e., symbols outside of our heads).

A second proposed framework for categorizing the dimensions of knowledge distinguishes between embedded knowledge of a system outside of a human individual (e.g., an information system may have knowledge embedded into its design) and embodied knowledge representing a learned capability of a human body's nervous and endocrine systems.

A third proposed framework for categorizing the dimensions of knowledge distinguishes between the exploratory creation of "new knowledge" (i.e., innovation) vs. the transfer or exploitation of "established knowledge" within a group, organization, or community. Collaborative environments such as communities of practice or the use of social computing tools can be used for both knowledge creation and transfer.

9.7 Strategies for Knowledge Management

Knowledge may be accessed at three stages: before, during, or after Knowledge Management related activities. Different organisations have tried various knowledge capture incentives, including making content submission mandatory and incorporating rewards into performance measurement plans. Considerable controversy exists over whether incentives work or not in this field and no consensus has emerged.

One strategy to KM involves actively managing knowledge. In such an instance, KVK personnel can strive to explicitly encode their knowledge into a shared knowledge repository, such as a database, as well as retrieving knowledge they need that other persons have provided to the repository. The development of a database and sharing it through a dedicated website comes into picture here. Another strategy to KM involves individuals making knowledge requests of experts associated with a particular subject on an ad hoc basis. In such an instance, expert individual(s) can provide their insights to the particular person or people needing this.

9.8 Data Mining

Humans have been "manually" extracting information from data for centuries, but the increasing volumes of data in modern times has called for more automatic approaches. As data sets and the information extracted from them have grown in size and complexity, direct hands-on data analysis has increasingly been supplemented and augmented with indirect, automatic data processing using more complex and sophisticated tools, methods and models. The proliferation, ubiquity and increasing power of computer technology has aided data collection, processing, management and storage. However, the captured data needs to be converted into information and knowledge to become useful. Data mining is the process of using computing power to apply methodologies, including new techniques for knowledge discovery, to data.

Data mining identifies trends within data that go beyond simple data analysis. Through the use of sophisticated algorithms, non-statistician users have the opportunity to identify key attributes of processes and target opportunities. However, abdicating control and understanding of processes from statisticians to poorly informed or uninformed users can result in false-positives, no useful results, and worst of all, results that are misleading and/or misinterpreted.

Although data mining is a relatively new term, the technology is not. For many years, businesses and governments have used increasingly powerful computers to sift through volumes of data such as airline passenger trip records, census data and supermarket scanner data to produce market research reports. (Note, however, that reporting is not always considered to be data mining). Continuous innovations in computer processing power, disk storage, data capture technology, algorithms, methodologies and analysis software have dramatically increased the accuracy and usefulness of the extracted information.

The term data mining is often used to apply to the two separate processes of knowledge i.e. discovery and prediction. Knowledge discovery provides explicit information about the characteristics of the collected data, using a number of techniques (e.g., association rule mining). Forecasting and predictive modeling provide predictions of future events, and the processes may range from the transparent (e.g., rule-based approaches) through to the opaque (e.g., neural networks).

Data mining is the process of extracting hidden patterns from data. As more data is gathered, with the amount of available data doubling every three years, data mining is becoming an increasingly important tool to transform this data into information. It is commonly used in a wide range of profiling practices, such as marketing, fraud detection and scientific discovery. KVKs can apply Data mining to data sets of any size for producing useful new knowledge for further innovations.

9.9 Knowledge Discovery in Databases (KDD)

The most well-known branch of data mining is Knowledge Discovery, also known as Knowledge Discovery in Databases (KDD). Just as many other forms of knowledge discovery it creates abstractions of the input data. The knowledge obtained through the process may become additional data that can be used for further usage and discovery.

Knowledge discovery is a concept that describes the process of automatically searching large volumes of data for patterns that can be considered knowledge about the data. It is often described as deriving knowledge from the input data. This complex topic can be categorized according to 1) what kind of data is searched; and 2) in what form is the result of the search represented.

Once KVKs set up their own dynamic databases and make it available to all in the form of websites, the next step can be on KDD. This creates additional data that can be used for further usage and technological innovations. At the zonal level, Zonal Project Directorates maintain their own databases and websites which KVKs can utilize. For example, the Zonal Project Directorate, Zone – III, maintains a fully updated website which is available at www.icarzcu3.gov.in

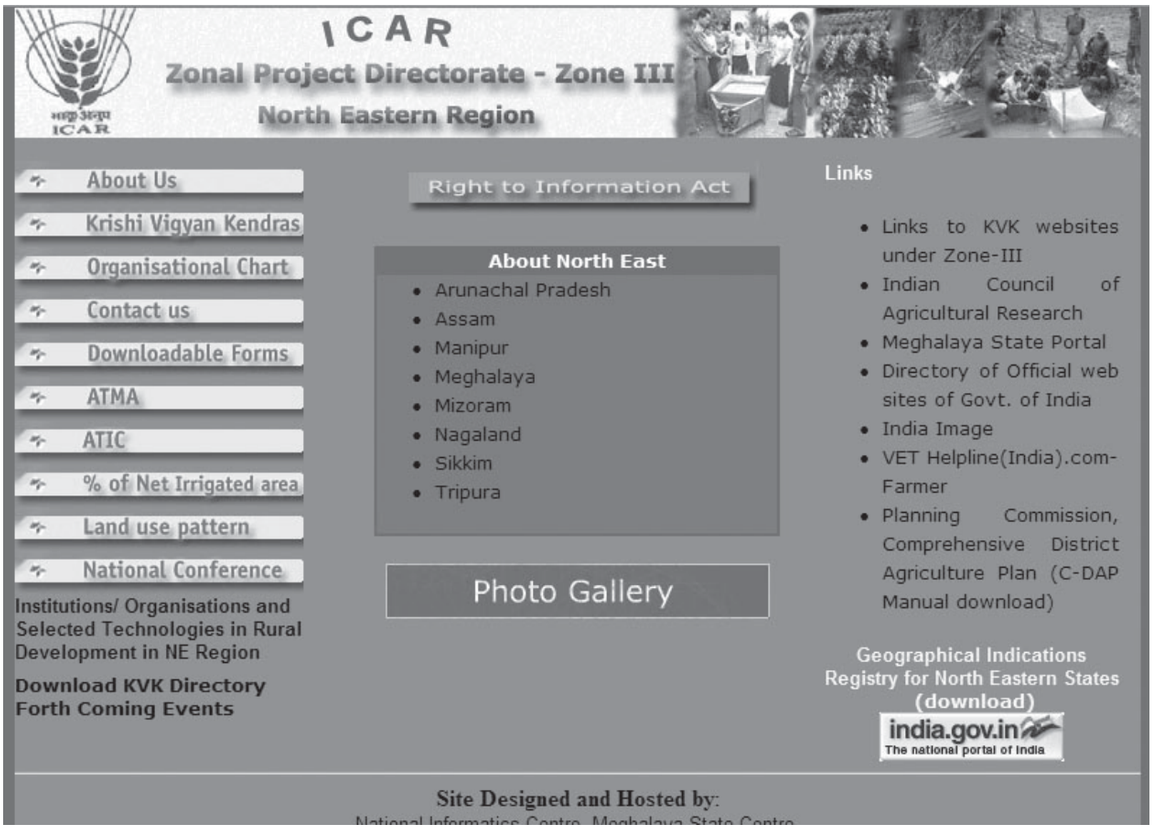


Fig: Home page of www.icarzcu3.gov.in

9.10 Cyber extension

Cyber extension refers to the process of extension done over cyber space. Cyber space refers to the virtual space of interconnected networks over the globe which provides connectivity round the clock. Information and communication technologies commonly referred to as ICTs make this possible over the cyber space. In recent years cyber extension has gained popularity and we have numerous successful cyber extension initiatives under public and private domain in India.

The most important role of ICT in development is fostering a knowledge intensive sustainable livelihood security system in rural areas, since ICT can enable us to reach the unreached and include the excluded information, knowledge and skill empowerment. Any inclusive knowledge society requires the effective harnessing of ICTs to combat poverty and foster development. The issues of importance for KVKs are:

1. Access
2. Content and
3. Capacity Building

9.10.1 Access to information and knowledge for all

Access to information and knowledge is impeded for much of our population due to poverty, illiteracy and isolation. Linkages among professional partners is essential to reach those who are unreached by ICT and especially those who are under the greatest risk of being left out of the knowledge societies (rural population, urban poor, illiterate and marginalized).

9.10.2 Content

Promotion of free exchange of knowledge has never been more relevant. KVKs have to promote diversity of content in their media and information networks. For this, use of ICTs is a must. ICTs increase access to information and knowledge from a rich variety of sources. As information streams become more globalised, it is imperative that the means exist to share technology and skills. E – Connectivity initiatives aim to ensure knowledge diversity and genuine pluralism through local content production in every KVK. It is a must to ensure a strong public domain of information, readily accessible to all in the KVK and outside.

9.10.3 Capacity building

Capacity building in KVK knowledge management requires a continuous process of reinforcing media, libraries and other institutions, of improving the knowledge and skills of KVK professionals as well as the general information and awareness of farmers. Training, continuing education and life long learning for extension/ media and information specialists are also essential. Special effort is needed in the area of media and information literacy, especially for farm women and rural youth.

9.11 Dynamics of ICTs: *The 8 Cs*

The dynamics of ICTs can be well summed up to the 8 Cs. They are:

Parameters	Attributes
1. Connectivity	How affordable and widespread are ICTs (Eg. PCs, internet access, software etc) for rural citizens?What technologies are emerging and appropriate?

Parameters	Attributes
2. Content	Is there useful content (local or global) for rural citizens to use in their daily lives? Can rural citizens access and create relevant content?Does the content meet the educational and other needs of farmers?
3. Community	Are there online/offline forums where rural citizens can discuss ICTs, community radio, applications and relevant issues of concern?Will decision makers take part in such forums?
4. Commerce	Is there infrastructure for e-commerce for citizen, businesses and government? How much commerce is transacted electronically?What hybrid means of fulfilling transaction can be leveraged for Govt. to Citizen (G2C), Business to citizen (B2C), lab to land (L2L) and Business to Business (B2B) commerce?
5. Capacity	Do rural citizens/organization have human resources (technical/legal/ managerial/ policy) to effectively harness digital tools for daily use?Is there adequate organizational capacity as well? Can content/community activities be converted into knowledge assets?
6. Culture	Is there a forward looking, often progressive culture at the level of policy makers, businesses, educators, citizens and the media in opening up rural areas to ICTs and harnessing them?OR is there nervousness, phobia and lethargy about ICT impacts?
7. Cooperation	Is there adequate cooperation between citizens, businesses, academics, NGOs and policy makers to create a favourable climate for using ICTs in rural areas?Can this cooperation extended to policy initiatives at national level?
8. Capital	Are there enough financial resources to invest in ICT for development in rural area?What kind of financial and social reforms can be expected from rural ICT for development?What kind of knowledge goods & capital can emerge from ICT?

KVKs should also note that while trying to establish and develop an online knowledge centre, the following phases are normally seen. The growth path can be summarized as below:

Phase	Characteristics
1. **Basic**	Basic computer access, surfing net & downloading forms.
2. **Interactive**	E mail, customization of forms.
3. **Publishing**	Creating web sites, pages, intranet, CD ROMS
4. **Trans-active**	E commerce, job creation and marketing
5. **Knowledge enabled**	Digesting/ localizing knowledge assets, creating local knowledge assets
6. **Integrative**	ICTs, radio and traditional media
7. **Knowledge capitalizing**	Leveraging intellectual capital for financial returns, gain.
8. **Globalizing**	Exporting model/ IP to other parts of world
9. **Transformative**	Radical restructuring of rural economy, networks

9.12 India's Position in Use of ICTs

India is positioned as the highest English speaking population in Asia with the highest number of Information Kiosks implemented across rural sectors. 45 per cent of the worlds' ICT projects are implemented in India. India also has a proposal for Rural Info Kiosk project where in one Rural Info Kiosk in each of the 600,000 villages will be established.

9.13 Unique Features of Successful ICT Projects in our country

- The "Bhoomi" project (digitalized land records) in Karnataka today serves as an excellent example of governance in its ideal form, transparent and accountable.
- e-Shringula, a one-stop, Web-enabled portal for information and services relating to the government-citizen interface creating an "e-Shringula" ("electronic chain") of information and e-governance.
- 'Drishtee' besides providing technical expertise and management consultancy to build the IT infrastructure and the human capacity to link service providers (government department and private firms) with rural citizens.
- 'Info-Village' of Puducherry by MSSRF developed community ownership and collective action with a "pro-poor", "pro-nature" and "pro-women" approach to development.
- In Gyan Ganga project, Gujarat all comprehensive education, support and services including agriculture and veterinary services were provided.

- 'e-Choupal' is a huge private sector investment by ICT, which revolutionized agricultural commodity marketing in India procuring Soya, Coffee, and Prawns at the doorsteps of the villagers and provides all real time data on crop prices, products and services and facilitate supply of high quality farm inputs in partnership mode.
- ICT devices into the management of operations of the National Dairy Development Board and their milk collection centres in Gujarat and the Swayam Krishi Sangram (SKS) smart cards project use of ICT to reduce transaction costs and reduce the cost of credit are other two successful examples of commercial ventures of ICT in India.
- Info knowledge Village at Puducherry, Warna Wired Village project in Maharashtra, Krishi Vigyan Kendras of ICAR at Ahmednagar and Baramati provided quality offline, static content including packages of practices, recommendations, locally relevant technologies, government schemes, FAQ etc. in local languages.
- Women empowerment through SEWA in Gujarat, mobile classrooms through IT buses in rural Pune, Project Shiksha – computer literacy, Action Aid at Bolangir, Orissa, Akshaya at Malappuram, Kerala, and EDUSAT address the issue of capacity building and empowerment of farmers, farm women, rural artisans and also large number of extension personnel and use of ICT for education and alleviation of poverty from rural sector.
- SATCOM, Madhya Pradesh, Teja TV in Andhra Pradesh and E-TV telecasted programmes on location specific agricultural technologies integrated and Interactive live question answer sessions in local languages resulting in high percentage of farmer-viewers.

9.14 Scalability of ICT projects

The scalability of ICT projects in India depends on the following factors:

- The value addition in the services for farmers
- Appropriate management model
- Government role in supportive policy environment
- Institutionalizing the public-private-community partnership model at the grass root level
- Appropriate and affordable technologies that can be adopted by the end users, and
- Increase in functional literacy level of farmers

9.15 Recent ICAR-ICT Efforts

ICAR has established IP-Telephony and Video Conferencing at 23 ICAR Institutes with Head Quarters. VSAT Connectivity is provided to 200 KVKs through ERNET, KVK and ICAR Network. Upgradation of ICAR-ERNET network involving all ICAR Institutes and SAUs is on-going under NAIP Project Component.

9.16 ICAR-ICT efforts for KVKs: The future strategy

ICAR has to focus on development of situation specific (district wise) virtual repository of information thus taking farmers technological contributions on a world/ national platform. Sharing

farmers' experiences from region to region through internet/intranet, online availability of advisory services and integration of PC and mobile services also has to be initiated in all the KVKs. This can be achieved through development of situation specific content/ information, ensuring satisfactory connectivity, adequate training to all SMS, developing static multimedia content, developing ethics, codes and standards for content hosting, registering exclusive common domain and web space for KVKs for web hosting.

9.17 Accessibility of e-information in Indian Languages

Accessibility of e-information in various regional languages is also important. Chennai based Lastech Systems Private Ltd has launched e-mail Software called 'Indomail' in 12 Indian languages. Indian Operating System called Bharatbhasha for use in computers in Indian and South Asian languages is also developed. Bharatbhasha gives freeware fonts in Bangla, Hindi, Marathi, Gujarati and Gurmukhi. Other Indian language software products include 'Lingua Indica' and 'SRD Akruti' of Bangalore, 'Cirrus Software' of C-DAC, Modular Systems and Seacom of Pune.

9.18 ICT and Livelihood Security

The most important role of ICT in development is fostering a knowledge intensive sustainable livelihood security system in rural areas. Since ICT can enable us to reach the unreached and include the excluded information, knowledge and skill empowerment, communication and information hold the key to development in the 21st century. An inclusive knowledge society requires the effective harnessing of ICTs to combat poverty and foster development.

9.19 Examples of successful Public Private Partnerships

At a state wide level, project Akshaya has brought together a state player (Kerala Govt.) and private sector player (TULIP IT services) to create an internet backbone network for the state, which can be used as a platform to launch a number of infrastructure initiatives. Financial institutions play a key partnering and nurturing role for knowledge centers. Successful examples include NABARD's e-governance services in Himachal Pradesh and SBI's rural information kiosks in Tamil Nadu. Information communication centre initiatives and knowledge centre. Successful examples by cooperatives include rural automation, smart card, AMCs and ERP (Enterprise Resource Planning) implementation by Vijaya Dairy, Vijayawada. DISK (Dairy Information & Services Kiosks) a Decision support system developed by them provides database, internet connectivity, dairy cooperative society accounts management system, ID code/ smart card for dairy farmers, disk database that contains breed and history of disease, artificial Insemination and pregnancy, data on milk production by individual farmers and forecasting of milk collection and provide feed back to farmers.

9.20 Other highly successful Cases from India

9.20.1 I-Kisan (I kisan portal & I kisan information kiosks)

I-kisan portal (**www.i_kisan.com**) is developed by Nagarjuna fertilizers. The portal provides agriculture information about 20 crops, online chatting with experts, market information with respect to products & services of Nagarjuna group, weather forecasting, current events in agriculture and

directory of input and output suppliers. I – kisan information kiosks presently operates in Andhra Pradesh and Tamilnadu. It provides a CDROM database which covers the topics of crop disease and pest management, soil and water management, agricultural equipments, agricultural inputs, market information, animal husbandry and insurance and policy information.

9.20.2 E – Choupal

This was started by international business division of ITC Ltd in June 2000. Six states namely AP, Karnataka, MP, Maharashtra, Rajasthan and UP are under this and its popular in Madhya Pradesh with 900 kiosks. E – Choupal is having distinct websites (portals), through which farmers can get required information on various crops. The portal details are given below:

www.echoupal. com	Wheat, Pulses, Rice	Hindi	UP, MP, Rajasthan
www.soyachoupal.com	Soyabean	Hindi, Marathi	MP, UP, Rajasthan, Maharashtra.
www.plantersnet. com	Coffee	English, Kannada	Karnataka.
www.aquachoupal.com	Shrimp	Telugu	Andhra Pradesh.

9.20.3 Information Village and Village Knowledge Centers (VKCs)

Village knowledge centers of MS Swaminathan research foundation were launched in 1998 in Puducherry. The main aim behind the establishment of VKCs was to provide sustainable food security in rural areas of Puducherry. To fulfill this aim, it provides technical information related to agricultural inputs. It helps in procuring quality seeds, in providing information about the daily market price from the government as well as private bodies, and advices farmers on rotation of crops as well as about the use of fertilizers and pesticides. VKCs receive information by voice mail, and disseminate it through any public address system. It has also identified 13 districts in Pondichery, where there is a huge potential for agriculture business, and where the government will invest Rs. 170 cr.

9.20.4 Warana Wired Village (WWV) Project

Warana Wired Village Project was launched in 1998 as a collaboration of NIC, Govt. of Maharashtra with collaborative attempt of Warana Vibhag Shikshan Mandal (WSM), Education Department and Warana Group of Cooperatives. The project aims to provide information about agriculture, market and education to 70 villages around Warana Nagar. Information dissemination is by web based and intranet based model. The project has developed a GIS based map of 70 villages.

9.20.5 The Gyandoot Project

The Gyandoot project was started in the Dhar district of Madhya Pradesh, which covers five lakh people of 311 gram Panchayats, 600 villages and 26 Soochnalayas. Soochnalayas are nothing but information centers at the village level set up by the Government of India in collaboration with local bodies. This center is operated by unemployed rural youth (Soochaks), who is thereafter trained.

A committee called Gyandoot samiti manages it. The district collector is the president of this soochnalayas, and the sarpanch of district panchayat acts as the secretary of the committee. The service covers to provide information about the agricultural produce, auction center rates, copies of land records, on-line registration of applications, village auction sites and more. The Village Auction Site project was started in June 2002, which allows farmers and villagers to advertise and sell land, agricultural machinery, equipment, and other durable commodities. Minimum user fees are charged by the information centers to provide information. Likewise, information about a commodity on sale is provided for a charge of Rs. 25 for three months, and Rs. 10 is taken for finding the list of salable commodities.

9.20.6 Kisan Call Centers (KCCs)

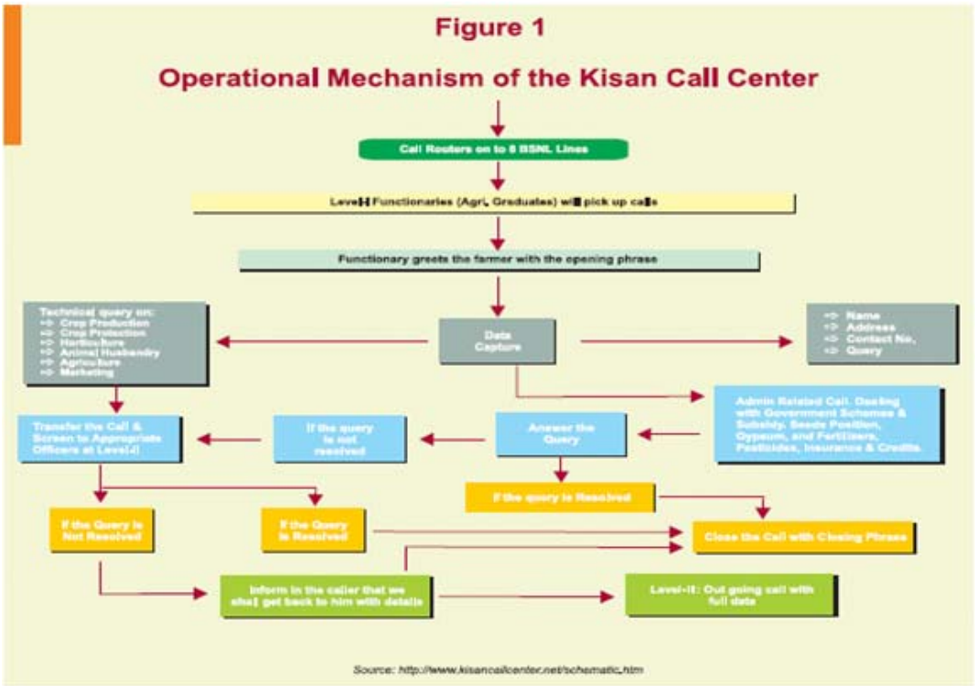
KCCs were launched on January 21, 2004 by the Department of Agriculture and Co-operation. The main technologies involved in Kisan call centers are:

- Desktop computer system with Internet connectivity.
- High bandwidth telephone line (preferably 128 kbps ISDN line).
- Telephones with headphones and teleconferencing facility (if required).

The main aim is to deliver the extension services to the farming community in the local languages. The farmer dials the help line, a toll free number, 1551, and the agricultural graduates provide the initial enquiry. If the queries handled by the agriculture graduates are not satisfactory to the farmers or the farmers want more information, the call is forwarded to level II and level III executives. (See Figure I)

Figure 1

Operational Mechanism of the Kisan Call Center



Source: http://www.kisancallcenter.net/schematic.htm

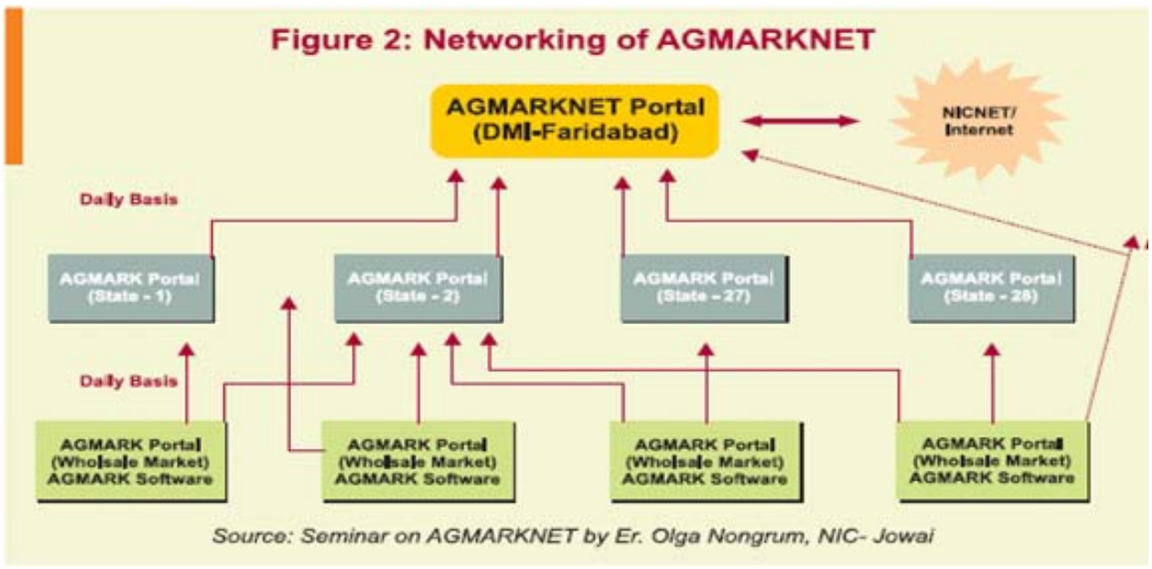
Thus, KCCs are the important information gateway for farmers. The cost to the farmers is almost zero, and they get the response in their local languages. If needed, the agricultural scientists also visit the field to resolve any further queries.

9.20.7 Bhoomi Project

This project includes the computerized land records throughout Karnataka State. For the same, a farmer can now walk into any of the taluk offices and ask for a printout of his computerized land record for a mere Rs. 15 from the land records booth. This computerized land record facilitates the farmers in obtaining, so-called technically, the Rights, Tenancy and Cultivation (RTCs) certificates. RTCs are important as they ensure land ownership, and help farmers in getting bank loans, for which most banks seek some security. Moreover, the Bhoomi project also provides online connectivity to various courts to make use of the land records database to settle civil disputes on land ownership and cultivation.

9.20.8 AGMARKNET

AGMARKNET, (Agricultural Marketing Information Network), is a joint venture of the Directorate of Marketing and Inspection (DMI) and the National Informatics Center (NIC). DMI and NIC are the sponsoring agency of AGMARKNET. It has increased the efficiency in marketing activities by establishing a nation-wide information network, which provides details about market functionaries, sold and unsold stocks, as well as the sources of supply and destination. These timely information data are helpful to producers, traders and consumers. AGMARKNET has been connected to 670 agricultural produce markets and 40 State Agricultural Marketing Boards & Directorates. Each AGMARK portal of wholesale market provides daily information to AGMARK portals of its respective states, and then each state's AGMARK portal sends the information to the AGMARKNET portal. All these software are maintained by the National Information System (See Figure 2).



APEDA (Agricultural and Processed Food Products Export Development Authority), NAFED (National Agricultural Co-operative Marketing Federation of India Ltd), Food Corporation of India, Central Warehousing, SFAC (Small Farmers Agri-Business Consortium) are the main users of the AGMARKNET portal. The food processing units, traders and different village kiosks, to help the farmers in taking the right decisions, mainly use these portals[1].

9.21 Millennium Development goals

We will spare no effort to free our fellow men, women and children from the abject and dehumanizing conditions of extreme poverty, to which a more than a billion of them are currently subjected'

- Declaration by UN, Sept, 2000 maiden year of the new millennium

Millennium declaration was adopted by 189 world leaders in September, 2000 to free all men, women and children from the abject and dehumanizing conditions of extreme poverty by 2015. For the purpose, eight millennium development goals (MDGs) were set up to cope with a variety of issues such as promotion of education, maternity, health care, gender equality, poverty reduction policies, child mortality, AIDS and other fatal diseases. MDGs were set for the year 2015 with reference to the international situation prevalent in 1990.

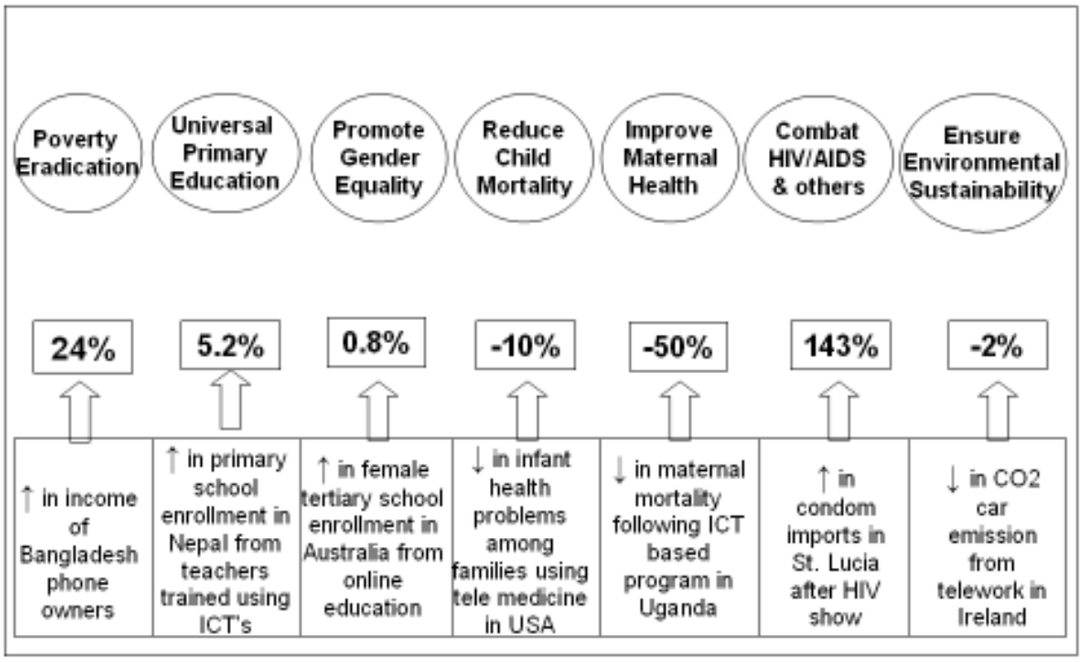
Eight objectives/ goals are;

1. Eradicate extreme poverty & hunger
2. Achieve universal primary education
3. Promote gender equality & empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV/ AIDS, malaria and other disease
7. Ensure environmental sustainability and
8. Develop a global partnership for development.

[1] ***Refer Associated Review V (Chapter XII) for articles on Experience of TNAU, Coimbatore in ICT led Knowledge Management***

Impact of ICT's on the MDG's

Percentage of change in different MDG indicator caused by ICT-based actions.

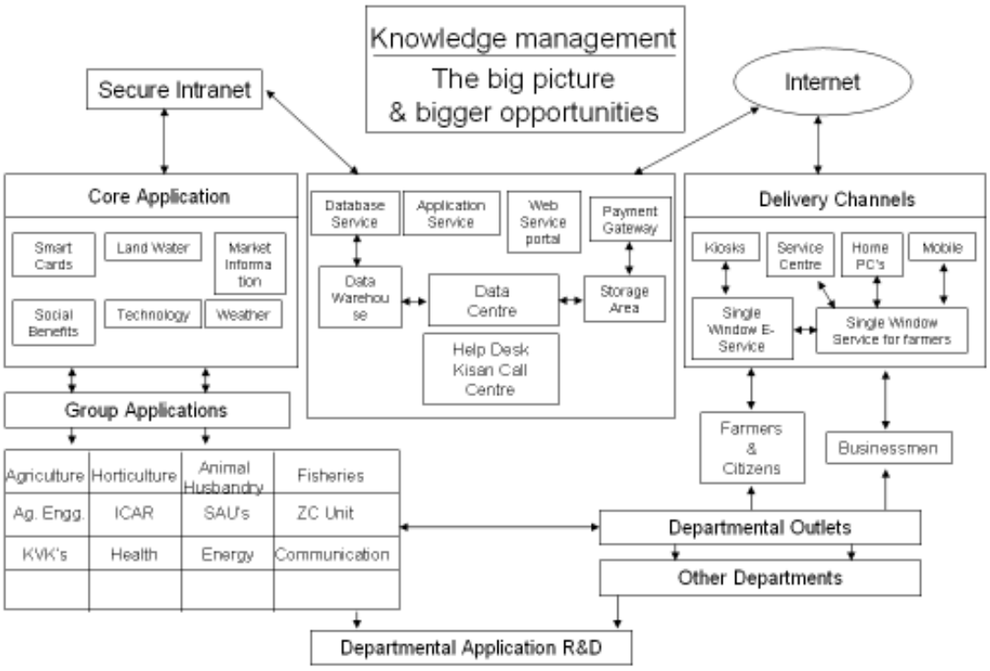


Role of ICT in eradicating extreme poverty and hunger

- Increase access to market information and lower transaction costs for poor farmers and traders
- Increase efficiency, competitiveness and market access
- Enhance the technology availability and accessibility to the farmers
- Information on monsoon, money and market
- Use of remote sensing technologies
- Effective monitoring, resource management and mitigation of environmental risks
- Increase access to/ awareness of sustainable technologies, waste land management
- Facilitates knowledge exchange and networking
- Online database and
- Promotion of digital literacy through 'e learning'.

9.22 Kiosks

Kiosks are a computer terminal or touch screen displays that runs customized software which serves the functions for which it is programmed to, while, at the same time, preventing users from accessing system functions. ICTs such as email, www and computer kiosk promise to provide innovative solutions to the problems of poverty and inequality by accelerating development introducing transparency to the systems and operations.



Kiosks are accepted due to the availability of content in local languages or multilingual platforms. They provide easy access of timely and accurate information without wasting time and money.

Content preparation for Kiosks involve identification of information needs from various stakeholders, prioritization of needs using statistical analysis, construction of information base using technical books, expert opinion, internet, journal etc and content development in the required format.

Kiosk Hardware

The Kiosk hardware has a cabinet containing a central processing unit, a display screen, and peripherals like printer, scanner etc and additional signage area. Connectivity can be through dialup, VSAT, leased lines, ISDN lines, braodband, Wi-Fi, wireless loop (WLL) and peripherals consisting of web chambers, video conferencing unit and audio conferencing unit.

Kiosk software

Kiosk software consists of the following:

1. Operating system: Novell NetWare, Windows NT, Windows 2000, Sun Solaris, IBM OS/2, CISCO internet operating system etc.
2. Management software: Useful for security, application & management software is capable of distinguishing between those who are allowed to access and others who are forbidden.
3. Enterprise software: Dbase, GIS etc.
4. Information worker: MATLAB, D base, statistical packs, E mail etc.
5. Media development software: web development software, image editing etc.

9.23 Development of visual solutions by CDAC (GOI)

CDAC (Centre for Development of Advanced Computing) has the following objectives:

- Identify the needs and requirements of digitally impoverished communities which are to be addressed with the application of ICT
- To apply the ICT solutions specifically tailored to address the requirements identified
    - Initial focus is on internet technologies, language technologies and speech technologies
    - Sectoral areas proposed to be covered are agriculture, health care and education
- To investigate the selected ICT solutions with a view to possible adaptation, customization and/or localization as the case may be for addressing such requirements
- To pilot test the solutions developed in selected areas and critically gauge the effectiveness and impactness of these solutions.
- To establish and support mechanisms for information dissemination on ICT based developments

They also design and deliver specialized training programmes in the use of ICT solutions developed, relevance to the farming system. Solutions like virtual class room environment for extension education, health care solutions etc and SMART (Small and Medium Applications of Rural Technicalization) helps to link the developed technology with well identified end user requirements.

9.24 Development of usable content

Access to relevant information is primary contribution of ICT. Availability of such information in human readable and electronic form is important. Content needs to be in local language apart from English. This is addressed through a number of related initiatives which are discussed below.

9.25 Open Office.org office suite

Enabling need based transition of English content to desired local languages will make the vast English language content accessible to non English speakers. OpenOffice.org Office Suite is an open source office productivity tools suite across platforms that will enable the creation of documents and other content in Indian languages and will thus make relevant content available in local languages. The products include Bharateeya-OO, Matrubhasha, DAAL, SETU, ECKO, e-kamps, Vyapar and multilingual Virtual class room etc.

9.25.1 Bharateya-OO

Bharateeya-OO project is an initiative of C-DAC to bring Open Office.org to India in Indian languages. OpenOffice.org is an Open Source Project developed by sun Microsystems for the popular Star Office™ productivity suite. The objective is to enable Indian language support in all applications of the OpenOffice.org suite on Windows and Linux Platforms. Currently the product is enabled with Indian language support in Localisation (Translation of interfaces from English to Hindi and Tamil)

and Internalisation (complex text layout (editing, selection, deletion and so on), transliteration, spell checking, processing within controls). Some of the languages supported currently are Devanagari, (Hindi, Konkani, Marathi and Sanskrit) Gujarati, Gurmukhi (Punjabi), Kannada, Malayalam, Oriya, Tamil, Telegu and Bengali.

9.25.2 Matrubhasa

Matrubhasa is Unicode and MBROLA based software solution for Text to Speech synthesis (TTS) in Indian languages. It can be used by Software developers to incorporate speech capabilities (in Indian languages) into their Software thereby increasing its usability across different sections of society. TTS cover seven Indian languages- Hindi, Tamil, Kannada, Telugu, Bengali, Marathi and Gujarati and more in coming years. The tools developed under this project Matrubhasa cater to three different kind of users:

- For end users: Matrubhasa provides PRAVAKTA which is an extensive plug – in framework for office Suites and Browsers (Microsoft office, Open Office, Internet Explorer and Mozilla Browser)
- For Software developers: BHAASHANAPI is available in the major languages like Java, C, C++ and com.
- For linguists, various language and speech modeling tools like Uccharak, Bhavna and Anuvaachak which help rapid development of Speech Synthesis components.

9.25.3 DAAL – Document Access across Languages

DAAL is essential for bridging the language divide. It is a combination of two technologies:

- Cross lingual information Retrieval (CLIR) for identifying documents in a language different from the query language
- Machine translation (MT) for translating the documents to the query language.

9.25.4 SETU

SETU is one such system based on DAAL. SETU enables a person to query and retrieve documents on the internet in Hindi. This system is built on the existing search engine.

9.25.5 ECKO (Empowering Communities through Knowledge)

ECKO is a kind of Content Management Software (CMS) which focuses on building rural communities by collaborating and sharing their knowledge. It is built completely on Open Source Solutions (PHP, Apache My SQL) and runs on the Linux platform. The system is highly optimized for server performance, as it has to run in constrained environments like low band width availability. The unique feature of this system is its availability to communicate with ECKO system by various communities. Currently the system is evolving as a knowledge inferential system. This is a simple, yet powerful user interface easy to use and does not take much time to download to local machine. ECKO has been developed by C-DAC as a part of Community based Content Delivery Network (CCDN) Project.

9.25.6 E - Kamps

E - Kamps is a web based application to assist health care authorities in three major activities like:

- Plan a medical camp – Step by step activities to ensure a successful and complete execution of a medical health camp.
- Deploy the camp defined (Camp Plan) on to select health care bodies to conduct the camp on a specific time in the calendar.
- Collect the data during the Camp using customized electronics survey forms uploaded from an e-kamps application on to a 'Simputer' or any other hand held device and provide it for further port camp analysis by higher level authorities in time.

A notable tool that the e-kamps application provides is:

- A user friendly form designing tool, using which, a healthcare camp designer can design their own need based forms (details collected are different for different diseases) for collecting data during the course of the camp conduction, using any hand held device like Simputer/ PDA or using a laptop/ desktop.
- Provides this form in local languages to increase its utility.

9.25.7 Vyapar

Vyapar provides a common on-line meeting ground for villagers where they can trade and get most information about their foods, products and services. The main purpose of this product is to eliminate the middle men generally involved in any type of transactions. The people who choose to sell their items, post it in the system, which is viewed by various people residing in other villages. Interested buyers can then contact the person. The system provides facilities to the administrators, Kiosk operator, and member for various activities related to the transactions. The system has been completely developed using free software. Currently, one such system is in use in Melur, near Madurai, Tamil Nadu.

9.25.8 Multi Lingual Virtual Class Room (MULVIRC)

These are solutions that will cater to the communication needs of people in their local language. This includes two core components namely – Multilingual Communication Channel (MCC) and Virtual Classroom (VC).

9.25.9 MCC – Multilingual Communication Channel

MCC facility allows online interactive text communication such as one-to-one, one-to-many, and many-to- many users, using intuitive interface, and also includes features of file transfer, session logging, and session replay. MCC facility is very useful for online conferencing in 'e-governance' applications.

9.25.10 VC – Virtual classroom

Virtual classroom is an extension of MCC facility and provides an interactive environment suited for online teaching. It includes features such as virtual white board wherein a teacher can write

or draw figures to explain concepts, doubt raising and answering facility, storage of compiled classes and control over the classroom session. The facility will be a very useful support tool in academic environment especially in extension education, distance education and ODL. The solution is also to be integrated with text to speech systems to augment its usability.

9.26 UNESCO Programmes/ Initiatives

UNESCO has two programmes called International Program for the Development of Communication (IPDC) and Information for All Program (IFAP). IPDC assists the development of communication infrastructure, and professional training in order to reduce the gap between countries in the communication field. IFAP provides a platform for international policy discussion and guidelines for action on the preservation of information and universal access to it.

9.27 eNRICH

eNRICH is a software solution which enables community groups to built their own gateway to web and other multimedia. It is customizable and designed to work in local languages for non experts. It is a simple way to organise and animate information resources, making access earlier for local users. It is available at http://enrich.nic.in

CDS/ ISIS – IDAMS (UNESCO)

These are two interrelated software packages for data base management (CDS/ ISIS) and date mining/ statistical analysis. These are developed, maintained and disseminated free of charge by UNESCO.

9.28 Issues in ICT implementation in Indian agriculture

There are various issues of importance which has to be considered for successful implementation of ICT in Indian agriculture. The most important ones are:

1. **Regional priorities:** The remote regions of India, especially the North East is to be given priority for launching the S&T based Agricultural development programme using ICT in a significant way. The 'e-connectivity' programme implemented by Government of India in KVKs would have been more beneficial to the remote regions like NE region since other connectivity options are also limited or nil for KVKs here. In areas of mainland, KVKs can utilise public as well as private facilities which are very common.
2. **Information, knowledge and skill empowerment of SHGs.**
3. **Every village knowledge centre:** ICT to all the 6, 00,000 villages by 2007 – 60th anniversary of our independence. Not achieved yet.
4. **Domestic Software Development and Application:** Government Projects mainly provides static information. Hence, dynamic information like wealth, markets, health, and other day to day information needs to be given priority.

5. **Community Radio:** For eg. Fishermen in Catamarans, Government of India should liberalise policies for the operation of community and farm radio thus reaching the unreached through the integrated ICT system.
6. **Technology upgradation in villages**
7. **Content creation:** consortium of content providers will have to be developed for each agro climatic zones.
8. **Women and ICT**
9. **Participatory knowledge system:** E-governance is invariably a passive system of information empowerment. Hence, there is a need for promoting participatory methodologies of content creation & knowledge management. The present approach is of partnership and not patronage. Farmer Participatory Knowledge System (FPKS) could replace the existing beneficiary and patronage approach to knowledge dissemination.
10. **Sustainability and replicability: s**hould be the bottom line in the development of National Action Plan for the 'every village a knowledge centre'movement with involvement of Gram Sabha & Panchayat.
11. **Virtual Academy for Food Security and Rural Prosperity.**
12. **Political commitment.**

9.29 Future Outlook

India is a country with over 1 billion population and 5 million computers. 80% of the 5 million computers used in offices and hardly, 20 per cent are available for use in development work. Despite all the barriers, the Indian agriculture is bound to adopt and implement ICT to double the agricultural production. This aim can be achieved only when there is proper utilization of ICT and more investment in it. As ICT helps in information dissemination in less time with effective ways of communication, its implications cannot be ignored by KVKs. There is a great scope to implement ICT in order to communicate and integrate the complete agri-food supply chain, as the e-choupals are doing in Madhya Pradesh to procure soyabean. The other beneficiaries of ICT can be food-processing companies, and suppliers within the agri-food sector. On the other hand, the need to market the agricultural produce at reasonable prices will also change the farmers' attitude, and they will be more dependent on ICT. ICTs will, thus, definitely help the KVKs in sustaining the Indian agriculture.

Chapter – X

PROJECT MANAGEMENT FOR KVKs

'The right technology, at the right place, at the right time, at the right cost and the right methods'

10.1 Management – An Introduction

Management is needed where ever people work together and try to reach a common goal. Management is an art and it can be defined as working with people to determine, interpret and achieve organizational objectives by performing the functions of planning, organizing, staffing, leading and controlling. Researchers work together in an organization because they can accomplish more by cooperating with one another than they can accomplish working alone. An organization is a group of people working together to achieve a common mission, or goal. Management is needed whenever and wherever people work together in an organization. The managerial functions must be performed by anyone who manages any type of organized activity. An understanding of the management activities and techniques will help the KVK scientists to manage their mandated activities effectively and efficiently.

10.2 Levels and Types of KVK Management

Essentially KVK management is more concerned with setting objectives, planning of the mandated activities, organizing the resources, staffing and controlling of the KVK activities in a coordinated manner so that the mandated objectives of the KVK can be achieved. The management skills required at the different levels of management differs very much. In general, people in the lower level of management are expected to possess more technical skill for performing the job and little about human relationship and conceptual skills. The middle level functionaries on the other hand occupy a sandwich position between the top level and bottom level managers. They are expected to possess all such skills like human relationship, technical and conceptual for their smooth functioning. On the other hand the top level functionaries are least worried to technical skills while it is important for them to have a higher conceptual skill. It is also important for them to have a higher conceptual skill. It is also important to note that no management position is exclusively technical or administrative. All levels have elements of both.

In any research organization, the number of people at each level decreases as employees move from non managerial level up through the managerial levels. Technical personnel represent the bulk of the organization membership, and there is a great variation regarding their status and pay. This level includes low skill level positions i.e. the level of a lab technician or laboratory assistant to high skill level positions i.e. a level of a principal scientist or a consultant technologist in the field. Within the managerial ranks, the number of managers at each level decreases as individuals move up from operative to the administrative level. Finally, at the apex of the organization there is normally only one, the chief executive officer, whatever his or her title may be. [Eg. DG, ICAR]

10.3 Management Skills to be Developed

What managerial skills are generally needed to become an effective research manager? They can be summarized as follows:

1. Conceptual skills,
2. Human relations skills,
3. Administrative skills and
4. Technical skills.

The relative importance of any one of these skills to a research manager at a given time depends on the type of research organization, the managerial level, and functions being performed.

10.3.1 Conceptual Skills

It refers to the mental ability to acquire, analyse and interpret information received from various sources. It involves the ability to understand the whole by breaking into parts. It helps the managers to imagine what goes on in their work environment and help them to react appropriately. This is the ability to plan ahead rather than to react. KVK Programme Coordinators need more of these skills.

10.3.2 Human Relations Skills

A network of contacts and human relationships to achieve the organizational goals by using the efforts of other people is needed and considered as important in any organization. Therefore, it is essential for the managers to possess many different behavioural and analytical skills which consist of many abilities required to understand other people and to interact effectively with them. Interpersonal skills are needed to create and maintain a network of contacts with people outside ones' own chain of command. SMS working with farmers need more of these skills.

10.3.3 Administrative Skills

The term refers to the whole range of skills associated with planning, organizing, staffing and controlling. These skills include administrators' abilities to follow policies and procedures, process paperwork in an orderly manner, and manage expenditure within the limits set by the budget. These skills are needed for Programme Coordinators and Host Institute Heads for better management of KVKs.

10.3.4 Technical Skills

Technical skills include the ability to use the knowledge, tools and techniques of a specific discipline, or field. These skills are relatively more important for the first line of managers than for top managers. First line managers are closer to the actual work being performed, often must guide their team how to perform it and must know how it is done properly. Hence, particularly important for SMS.

10.4 Research Project Management Techniques

Research project management can be classified in different ways. Clay gives a broad classification of this technique based on their objectives. He has classified the project management techniques under eight classed according to the purpose for which they are used to achieve. A brief description of the classification is given below:

1. To discover

To find out or to detect or to know something that is going on. The techniques classified under this are input-output analysis, attitude survey, break even analysis, production study etc.

2. Evaluation

For estimating the value or worth of a practice. For example; Job evaluation, Performance appraisal, Cost Benefit analysis and Work measurement fall under this category.

3. Improvement

Performance improvement and attainment of perfection. The techniques such as Management by Objective (MBO), Method Study etc., can be used for this purpose.

4. Specification

For deciding or specifying an expected value or situation or course of action. For example; planning, designing etc.

5. Optimization

Performance optimization can be achieved through the techniques such as linear programming and operations research.

6. Control

Through techniques such as budget control and cost control, we can control the resource utilization in the research programmes.

7. Communication

Report writing, Management Information System (MIS) are useful for the communication flow or information utilization in the research.

8. Demonstration

For learning or to demonstrate something e.g. job instruction, training, programmed learning etc. The management techniques are used to bring about increased

capabilities, efficiency, effectiveness and productivity in an organization. These techniques are employed to manage various resources in an organization such as human, material, time and finance.

The list of few management techniques concerned with the above aspects is given below:

1. Management By Objectives (MBO)
2. Management Information System (MIS)
3. Time and Motion Study
4. Input Out Analysis
5. Break Even Point Analysis (BEP)
6. Production Study
7. Method Study
8. Linear Programming (LP)
9. Critical Path Method (CPM)
10. Programme Evaluation Review Technique (PERT)
11. Activity Bar Charts (ABC)
12. Schedule Bar Charts (SBC)
13. Activity Slack Bar Charts (ASBC)
14. Prudence Diagram (PD)
15. Manpower Utilization (MU)
16. Line of Balance (LOB)
17. Implementation, Planning and Control Technique (IMPACT)
18. Contractual Requirement, Recording, Analysis and Management (CRAM)
19. Least Cost Estimating Schedule (LCES)
20. Computer Operated Management Evaluation Technique (COMET)
21. Activity Balance Line Evaluation (ABLE)
22. Cost Planning and Appraisal (CPA)
23. Integrated Control (IC)

24. Management Planning and Control Technique (MPC)
25. Programme Evaluation Procedure (PEP)
26. Project Audit Report (PAR)
27. Planning Network (PLANNET)
28. Programme Reliability Information System for Management (PRISM)
29. Resources Allocation and Multipurpose Scheduling (RAMPS)
30. Scheduling and Control by Automated Network System (SCANS)
31. Computer Performance Evaluation and Review Technique (COPERT)
32. Computer Programme for Scheduling, Time and Distribution (CPSTD)
33. Trade Off Evaluation System (TOES)
34. Task Reporting and Current Evaluation (TRACE)
35. Weapon Systems Programming and Control System (SPACS)
36. Venture Evaluation Review Technique (VERT)
37. The Operational PERT System (TOPS)
38. Gantt Bar Charts (GBC)
39. Milestone Bar Charts (MBC)
40. Performance Budgeting (BP)

The project management techniques are the recognized methods for analyzing or solving a recognized type of management problem in a detailed systematic way. They are rational, methodological in approach and have direct applicability to the solution. Some depend on mathematical and some on scientific approach. Therefore, the management techniques are considered as scientific way of solving problems. Some of the management techniques that are of frequent use to the research project management are discussed briefly here.

10.5 Performance Budgeting

Budget is a statement of receipt and expenditure which gives an idea to ensure the accountability. Budget consists appropriation of such items like pay, allowances, and contingencies that are evolved in running an organization. Performance budgeting (PB) is a technique of performing present operation in terms of programmes, projects and activities. The activities are identified in the budget in terms of financial and physical terms so that proper relationships between input and output could be established. The performance budgeting is considered as the financial estimates to run the selected programmes effectively, efficiently and economically. Thus, it is the performance of resources in relation to cost.

10.5.1 Purpose of Budgeting

1. To aid in financial operation,
2. To clarify the operations of a programme,
3. To promote coordination among different activities,
4. To help in future planning and
5. To measure efficiency.

10.5.2 Advantages

1. It facilitates the rational budgeting based on logic and avoid arbitrary spending.
2. It ensures proper utilization of money and provides coordination between various agencies.
3. It facilitates proper evaluation of the existing programme and thus helps in careful considerations of non policy alternatives and framing of new area.
4. It defines efficiency in terms of the most logical way of allocation of organizational resources.
5. It provides the discipline of constant and interim analysis of programme results in terms of outputs, giving regular feed back on the performance of each programme.

10.6 Training

10.6.1 Definition of Training

The process by which organization helps its employees to acquire knowledge, skills and attitudes required for performing their job effectively are known as training. Training is different from education in the sense that education is for knowing more but training is for doing more.

10.6.2 Objectives of Training

The training programmes are mainly aimed at achieving the following objectives in the development of an individual.

10.6.2.1For new employees

- To develop him to accept more responsibility,
- To develop the ability for cooperation and coordination at all levels,
- To develop ability in the effective utilization of equipment and resources and in their proper upkeep and maintenance and

- To show what the new job comprises of to enable one to adopt his/her knowledge and skills for the specific situation.

10.6.2.2 For deficient employees

- To develop the skill of dealing with people in solving problems and handling grievances to improve the morale and team spirit of the employee,
- To increase the skills, technical ability of those whose performance is lower than the desired standards and
- To make them conscious of the need for higher productivity.

10.6.2.3 For employees going for different jobs

- To develop his overall ability to reduce costs, improve quality and increase production,
- To train people for future jobs who are going for different jobs,
- To train to use modern techniques for the full and optimum utilization of men and materials and
- To develop his/her skill to train others.

10.6.3 Contents of training

1. Factual information,
2. Approaches and techniques for problem solving and decision making,
3. Attitudes,
4. Interpersonal skills and
5. Knowledge of self.

10.6.4 Requirement of a Training Programme

1. Should provide successive glimpses of the job in such dimensions that the skills required for each can be grasped and practiced as and when required.
2. Should provide time and resources.
3. Should make the participants feel safe if he lacks any knowledge.
4. Should make the learning process itself conscious for the participants.
5. Should expose participants to new ideas and method.
6. Should give the trainees the experience of belongingness.
7. Should provide opportunities to step back from day to day tasks to think about one's job as a whole.

10.6.5 Training Process

Training process includes:

1. What does the trainee undergo?
2. What inputs does the user organization provide? and
3. What inputs the training organization is providing?

In general an operative training calls for specific increase in skill and knowledge of individuals according to the organizational goals and objectives.

10.7 Cost- Benefit Analysis (CBA)

Cost Benefit Analysis (CBA) is a technique that helps in making better decisions relating to investment. CBA is a practical way of appraising the project involving public expenditure in terms of net social gain to the society. CBA is carried out based on the cost and its benefits derived from the project. It is a project appraisal technique which test economic feasibility, financial profitability and resource productivity of a project.

According to Dorfman, CBA is closely analogous to the methods of investment project appraisal used by businessmen. The only difference is that estimates of social value are used in place of sales value. In the present century CBA has come in prominence in scientific project evaluations. The basic argument that underline a cost benefit appraisal of a scientific project is that a project can normally be an asset if the total benefits from the project are greater in some sense than total cost. CBA is applied as a method of project appraisal to determine the project feasibilities or to find out the usefulness of a project or programme which is to be implemented.

10.8 Social problems of calculating social cost benefits

10.8.1 Social Price

The prices of various inputs and outputs in terms of their social values are called social prices. The value of inputs and outputs is not calculated in terms of actual market price but in terms of shadow or accounting price. For many benefits which do not have market prices, valuation is often attempted by indirect means. Example, Heavy loss is incurred on a medicine project but it gets a benefit to the society. TB is a wide spread contagious disease in cattle. The estimated loss from morality, morbidity and the total cost is Rs. 220.4 crores per annum. The value of production loss is very large as compared to control programme. The annual direct cost for a cattle population of about 6 million works out to Rs. 0.49 per cattle per annum. Hence the eradication is not only a control activity but an ultimate gain is also aimed at.

10.8.2 Social Rate of Discount (SRD)

It is the marginal rate of substitution between consumption at consecutive points of time and is used to link the costs and benefits occurring in different time periods. The rate of discount in cost benefit analysis is social rate of discount particularly in the developing country. It may be mentioned

that since social rate of discount is less than private rate of discount, a project that private sector R&D may consider unprofitable proposition, is considered profitable by a public sector. Application of cost and benefit analysis in the public sector R&D is limited. It is very difficult to quantify the innumerable variables impinging upon the project. Though the problems of measuring benefits is a serious limitation we cannot leave it as we cannot avoid the cost benefit analysis approach while selecting and administering projects which can raise the standard of people and helps the millions of people suffering from poverty, disease and hunger. Inspite of the inherent limitations we must make use of this technique to ensure effective policy making and planning in research for welfare of masses. The advantage is not in ensuring decision making simpler but in the possibilities for the systematic examination of each part of a problem in hand.

10.8.3 Cost

Cost is of two types:

(a) Fixed cost: are over head costs that must be born by the enterprise regardless of the volume of output. They are long run costs like, building, fences, land use, farm and cattle yard, machinery, herd replacement, general farm expenses and interest charges on fixed capital.

(b) Variable cost: are those charges that have direct function of output and include items which vary with the production. They are short term cost and hence attended by the management. Items of variable cost includes cattle feed, fodder, labour and supervision, seeds and fertilizers, veterinary medicines and detergent, miscellaneous expenses, interest charges on working capital.

10.8.4 Benefit calculation

The benefit of a project is derived from the produce when sold in the market. Benefits derived are of two types.

1. Direct benefit

   By selling product/ product called income.

   For example: sale of milk in dairy project.

2. Indirect Benefit

   Use of produce or product for own purposes otherwise would have been required to be purchased i.e. Biogas plant serves as indirect income in a way that compost is used for field and gas for cooking.

10.8.5 Cost Benefit analysis in scientific projects

Analysis is carried out to judge the profitability and feasibility of a project. On the basis of this a project can be rejected or recommended. The indicators/ parameters and set of tools which are used/ applied for knowing worth of scientific projects are as under:

i) **Net Income (NI)**

Net Income can be worked out as:

Net Income = Gross Receipt – Total cost

ii) **Internal Rate of Return (IRR)**

The IRR is defined in terms of expected profit as a percentage of the investment made. This is rate of return on a project and normally expressed by percentage earned on the amount of capital investment in each year of life of the project.

Year	Capital Investment	Interest @ 10%	Total
1st	100	10	110
2nd	220	11	221
3rd	121	12.10	133.10
4th	133.10	13.10	146.20
5th	246.20	14.60	160.80

After 5 years of a project, the present value of Rs. 160.80 is of Rs. 100/- invested in the initial year. The rate of interest is reverse and this should be minimum of 15%. However greater IRR value, the project is sound and acceptable.

iii) Present Value of Investment of the Project

In this technique, the Present Value of Investment (PVI) is calculated as:

$$PVI = \frac{R1}{1+r} + \frac{R2}{(1+r)^n} \text{ ---- } \frac{Rn}{(1+r)^n} + Sn$$

Where,

PVI = Present value of Investment

R = Return

R = Value of internal rate of return

(Cost of money available in the market)

n = Life of project

S = Scrap value of project (end of project)

iv) Average Annual Margin of Profit (AAMP)

It is the average profit likely to be generated by the project every year throughout the life span of the project. It is calculated as under:

$$AAMP = \frac{NPV}{1/(1+r)^n}$$

Where,

$$NPV = \frac{M1}{(1+r)} + \frac{M2}{(1+r)^2} + \frac{M3}{(1+r)^3} + \frac{M4}{(1+r)^4} + \frac{M5}{(1+r)^4}$$

Where,

n = indicates the life span of project

M = the margin between the benefit and cost

NPV = Non Projective Value

v) Profitability Index (PI)

It expresses the percentage of increase in the capital sum over the present value of the budget.

$$PI = \frac{NPV}{\text{Original amount investment}}$$

This simply indicates the rate at which the benefit exceeds the cost. This tells us how much benefits can be generated per rupee of investment.

vi) Pay Back Period (PBP)

It is the period just enough for recovering the initial capital cost of any project. It means the cutting point when the benefit equalizes the capital cost of a project. Shorter the Pay Back Period better the investment position and vice versa. It involves calculation of the cash flows which would arise from the investment in each year in the life of the project. The cash flows are accumulated year by year till the time they equal the amount of the original investment made in the project. The length of time it takes to obtain the necessary cash flows equals to the original investment and determines the Pay Back Period (PBP) for the project. It is not a good criterion for project evaluation as it concentrates its attention on the profitability of the project in the beginning and it ignores the returns obtained in the later life of the project.

10.9 Management by Objectives (MBO)

MBO is a process by which superiors and subordinates in a scientific organization jointly identify its common goals, define the areas of responsibilities and plan the ways to achieve the results expected out of them.

MBO is an approach to project management. It is a blending of individual plans and needs towards a large scale accomplishment within a specific period of time.

MBO is designed to determine:

i) What must be done?

ii) How it must be done?

iii) When it must be done?

iv) How much it will cost?

v) What constituents determine satisfactory performance?

vi) How much progress is being achieved?

vii) When and how to take correct action?

10.9.1 Definition

There are various definitions of MBO. One of the comprehensive definition of MBO states "MBO is a result centered, non – specialist, participative and operational managerial process for the effective utilization of all the resources contributing to the integration of the individual with the organization and of the organization with the environment". The aspects comprising this comprehensive definition of MBO are:

i. Result centered

Any act in this world should focus on the result it is going to produce. An organization must have a clear cut result or objective.

ii. Non-specialists

MBO believes in generalist rather than specialists. Specialists fail to visualize the problem in its wider horizons. On the contrary, generalists can better manage the affairs of an organization.

iii. Participative

The philosophy of MBO is that participatory management yields the desired results. With the participation, employee gets a sense of belongingness with the organization and tries hard to achieve organisations' objectives. For an effective execution of operations sense of involvement is essential.

iv. Operational

In an organization three kinds of processes can be visualized:

a) Lower Management – Doer – doing task

b) Middle Management – Supervisor – supervises the men and material

c) Top Management – Manager – managing the whole show.

v. Effective Utilization

MBO is greatly concerned with effective and efficient utilization of resources especially human resources. MBO believes in 'Theory Y' that human beings have the willingness to do work and ability to do things. Depending upon the congenial environment, or work atmosphere, efficiency and effectiveness are achieved.

vi. Goal Congruence

One of the most important aspects of MBO is that individual goals and organizational goals must coincide and both in turn must agree with the environment in which they are existing.

10.9.2 MBO is a five phase process as under

i) Finding Objectives

It is the systematic identification of potential areas where improvement is needed such as improvement in researchers, new facilities, lowering the expenses, work simplification, method improvement possibilities, coordinated research projects, productivity improvement and employees' satisfaction and motivation.

ii) Setting the objectives

This is a formal written statement of objectives supported by the top management. We relate the resources of the organization to the involvement of those expected to deliver the results.

iii) Validation of objectives

This is validation statement of commitments. Commitment is on the part of individual department and on the organization as a whole. Here, the promises, assurances are given to provide resources, materials, methods, people and the management. Some of the objectives can be discarded or eliminated.

iv) Implementing the objectives

At this stage activities are operated upon towards achieving the objectives. Activities pertaining to their objectives are planned and allotted to different components of objectives.

v) Controlling and Reporting

This is the stage of reporting according to the schedule and establishing the target. The activities are measured and reported to different status as well as the progress made in concluding the project. Management team gives its position in relation to their stand where they are going.

10.9.3 Steps of MBO

Following are the steps of MBO

i. Define Roles and Missions

a) Identify organization's roles and missions.

b) Prepare role and mission statement.

c) Get approved by the superior and understanding by others directly concerned.

ii. Forecasting

a) Determining what type of effects is to be forecasted.

b) Determining the critical factors related to research outcome in terms of practical point of view.

c) Determining the primary factors, i.e., human skills, tools and equipments, work space and material requirements.

d) Determining and evaluating all other important factors that might directly and indirectly influence the efforts during the forecast period.

iii. Setting Objectives

a) On the basis of role and mission, identify the type of specific improvement you wish to place in objective form.

b) Determine means of measurement i.e units, percentage, cost and milestones etc.

c) Determine realistic and achievable target for each objective. Establish priorities for identified objectives.

d) Review your objectives against key questions for evaluating them.

Criteria for Good Objectives

a. Should be verifiable.

b. Should state time of their achievement.

c. Should indicate quality.

d. Should state cost of achieving them.

e. Should present challenge.

f. Should indicate priorities.

g. Should promote personnel and professional growth and development.

iv. Programming

Each objective requires further break down as given below:

a) Study situation and select suitable method;

b) Gain agreement and support from the co-workers in the field;

c) Develop plan;

d) Test and review the plan;

e) Implement and

f) Follow up.

v. Scheduling

a) Establish a calendar time block during which each critical programme is to be completed.

b) Confirm or modify target dates, if needed.

vi. Budgeting

a) Estimate the cost, human efforts, materials, facilities needed by each project staff.

b) Confirm or modify the target cost if needed.

c) Determine the availability of necessary resources.

vii. Establishing standards

a) Determining what is to be measured.

b) Determining the point of measurement.

viii. Measuring performance

a) Select the method of measurement.

b) Review the selected method against key question for evaluating control measures.

ix. Taking corrective actions

a) Determine when performance variance requires corrective action.

b) Determine probable causes and their variances.

c) Determine appropriate type of corrective action and it should be applied accordingly.

10.9.4 Advantages of MBO

1. MBO is a process or progress or performance oriented but not procedure oriented. Improvement in the job for managing the things is possible.
2. It is a systematic approach to the research project management.
3. It lets the project manager/KVK P.C to know what is expected of them.
4. It aids in planning and budgeting.
5. It improves communication between P.C and SMS.
6. It makes people more aware of organization's goal.
7. It induces achievement motivation.
8. Evaluation procedure is more suitable.
9. It is development oriented.
10. Its emphasis is on situation management.
11. It is better suited to modern research project management.
12. Improves organizational performance.
13. It has accurate performance appraisal.
14. Goal attainment of the organization is high.
15. It breeds a culture of constant innovation.
16. It leads to better goal congruence.
17. Coordinates team work with organizational clarity. It breeds team spirit.
18. It tries to improve the effectiveness and efficiency of the entire system itself.
19. Leads to better managing. MBO forces the project managers to think of planning for results rather than merely planning activities of work. It also requires the project managers to think of the way to accomplish the given results.

20. Clarifies organization. MBO tends to force clarification of organisational roles and structures.

21. Elicits commitment.

22. Helps to develop effective controls.

10.9.5 Disadvantages/ Weaknesses of MBO

1. Failure to teach philosophy.

2. Failure to give goal setters guidelines.

3. Goals are difficult to set.

4. Goals tend to be short run.

5. It may create tension, insecurity and all other discomforts among people since it is progress oriented.

6. It may crate rat race among SMS/scientists for achieving progress, where each rat wants to become a cat in the progress.

7. It may spoil interpersonal relation.

8. It may require more paper work and time.

9. Subjectivity still may creep in.

10. All accomplishments may not be quantifiable.

11. After some time it may become a routine approach.

12. Setting arbitrary goals may lead to failures.

13. There is over insistence on number.

14. Makes use of inapplicable standards.

10.10 Work study/ Work measurement

It is productivity technique which helps to think beyond what you are doing. It would help in establishing wastages in labour, efforts, drudgery and fatigue. It would assist in:

a. Work simplification;

b. Job evaluation;

c. Man power planning;

d. Production planning and control;

e. Setting time standards and

f. Designing incentive schemes.

Work measurement assists to carry out the job under defined standard.

10.10.1 Purpose of work study/ work measurement

1. Calculation of initial time an individual requires handling the job. Different job requires different time. Time may be standard time, optimum time, minimum time etc.
2. There is effective planning and scheduling of operations.
3. It forms as a scientific tool for controlling the workers.
4. Workers' cost control and
5. Rational basis of incentives scheme; Work appreciation incentives can be determined.

10.10.2 Procedure of work study/ work measurement

1. Analysis

Analysis occurs when the work is broken down into elements, e.g. harvesting, cutting, serving and feeding etc.

2. Measurement

Ascertain the basic task.

3. Synthesis

This is the stage when available methods gathered and put into suitable forms according to the purpose for which they are planned.

4. The cost of work measurement

There are two components of cost of work measurement.

(i) The cost of installing the work, and

(ii) The cost of maintaining the work.

Mostly the cost of installation is higher than the maintenance.

10.11 Time Study

Time study is a technique of recording the time and rate of working for the element of specific operations carried out under specific conditions for analyzing the data so as to obtain the time necessary for carrying out the job and define the level of performance. The sole objective is to determine the allowed time, normal time and standard time.

10.12 Management Information System (MIS)

Management Information System can be easily understood by explaining the three terms:

1. Management,
2. Information and
3. System.

10.12.1 Management

Which means planning, organizing and controlling.

10.12.2 Information

Information consists of classified and interpreted data that are being used for decision making. Information is important to the life of the research system as the flow of blood to the life and health of an individual.

10.12.3 System

A system is a set of two or more elements such as peoples' things and concepts which are joined together to attain common objectives. A system is a complex whole which consists of structurally and functionally interacting subsystems.

MIS can be defined as an organized structural complex of (i) individuals (ii) materials and (iii) procedures, for providing pertinent information from both external and internal resources. The planning, controlling and operational functions of an organization by providing uniform information for use are the basis for decision making. MIS facilitates administrative action. This is meant to focus on these explicit record keeping activities that most administration see as directly related to decision making or project management. In other words MIS is an approach of furnishing adequate and accurate information in time to right person in the hierarchy to assist him/her in decision making, pertaining to the organizational goals. It also provides him/ her information regarding important constraint which could be analyzed and put before the policy maker for introducing timely change and initiating corrective measures.

Management Information System is thus more or less a conceptual system so designed to provide information for management. It is based on the premise that measurement needs information in order to be effective. MIS is something like a machine which takes in some inputs from the environment, processes it and gives out a product in the form of a desired result.

The feedback constitutes the monitoring process which is used to maintain the systems output within the desired limits of control. Information flow is very vital for the successful function of a system, but very difficult to visualize because of its intangibility. The need for a MIS becomes necessary which imparts structure and procedures for the flow of information such that any turbulence becomes discernible before it is too late.

10.12.4 How MIS functions?

MIS provides the necessary information for management. Each aspect of management namely, planning, organizing, controlling and initiating requires decision making and hence MIS in other words produces the necessary information for decision making. In any situation that requires decision making, a good manager has to think of all the alternative actions that he can take in the situation.

10.12.5 MIS Design

In designing a MIS, therefore, one has to identify various levels of hierarchy, determine the decision making process at each stage, the kind of information that it requires and the network that can satisfy this requirement. Good MIS requires a very careful study of the above type and very creative but pragmatic attitude by the designer. One must note that a very common misunderstanding exists about MIS is that it is a computerization of office records. In designing a MIS considerable data has to be processed in order to provide information, and it may become extremely difficult to do it manually. That is why computers have become a tool which is used extensively by MIS. MIS has nothing to do with computers. So MIS is a concept by itself which has to be conceived of with or without the presence of a computer which happens to be most sophisticated tool for the purpose. Thus MIS is neither mechanization nor it is gathering of “statistics”. It is a profound concept which has been found to be very powerful for the successful functioning of any system. MIS and formal system together, integrate, compare, analyze and disperse information internal and external to the enterprise in a timely, effective and efficient manner. MIS has to be tailored to specific needs and may include routine information such as monthly reports, information that points our ‘expectations’ especially at critical points and information necessary to ‘predict’ the future.

10.13 Record Management

Record management is a programme that involves the functions of creating, administering, retaining, submitting and destroying of records. Records are the memory of the internal and external transactions of an organisation. The proper maintenance of records in right quality and quantity is the essence of record management. The source of this record keeping would be reflected in the timely availability of all the records. Some of the important points that are to be kept in mind are comprehensiveness, proper planning, economy, accuracy, and timeliness. The records should:

1. Serve specific costs.
2. Have specific objectives and purposes.
3. Be kept to a minimum with respect to number, scope and content.
4. Be designed for less expensive handling.
5. Be upto date.
6. Be worth their cost.
7. Be related directly to tabulations and reports that will stem from them.

8. Be available when needed and

9. Be considered valuable by supervisions and top management.

10.13.1 Types of Records

The types of records differ from organization to organization. General classifications of records that are available in a research organization are:

1. Personnel;

2. Accounts;

3. Purchases and receipts;

4. Stock;

5. Activities and

6. Beneficiaries/ clients/ consultancies, etc.

10.13.2 Aspects of Records Retention Management

The steps involved in preservation or arranging of records are given below:

1. Classification

   The records must be classified and numbered according to their contents, nature and period of maintenance. However, it would be useful to classify them into the following four types of classification such as vital records (preserved for long time), important records (not in current use but are of high value), useful records (in current use), and transit records (short period).

2. Retention Period

   The decision regarding the retention period should be taken on the basis of their usefulness, requirements and objectives.

3. Transfer of Records

   Dating of unimportant records for destruction and moving the records from active to inactive files and to stores are to be done. Microfilming of records can be kept to minimize storage space and easy handling.

4. Storage of Records

   Storage should be done at a proper place where proper conditions of temperature, circulation of air and humidity are provided. Dust and dirt accumulation should be avoided by proper sealing and shelving. The protective measures should be adopted for the preservation of valuable records for the use of future generation. The activity and accuracy ratio of a record storage system is calculated by the following means.

1. Activity ratio = $\frac{\text{Number of reference found}}{\text{Number of documents filed}}$

2. Accuracy ratio= $\frac{\text{Number of references not found}}{\text{Number of reference found}}$

If the activity ratio is below ten percent, it represents that there is too much inactive material. More than 20 percent activity ratio shows that the records are in bad shape. If the accuracy ratio is half or one percent, it is considered as excellent and more than one percent is not desirable.

10.14 Filing of records

Filing is the process of classifying, arranging and storing records in a systematic manner so that these can be easily retrieved. Filling is the systematic arrangement for keeping the records so that these may be found and delivered quickly when needed for references in future. It is the process by which the documents are placed in proper carriers according to some predetermined arrangements so that any of these when required may be located quickly and conveniently. The common filing arrangements are based on alphabetical, numerical, geographical, chronological and subject wise orders. Recently, many achievements in the filing procedures have been arrived and it is according to convenience and necessity, the design of the filing system is selected and put in use.

10.14.1 Advantages

1. Easy retrieval;
2. Records are protected from damage or loss;
3. Eliminates the need of duplication;
4. Enhances the economy of operation;
5. Serves as a reference in a future date and
6. Ensures uniformity and standardization in record maintenance.

10.15 Network Analysis - PERT and CPM

Project management involves several tasks such as decision making, planning, organizing, staffing, directing, coordinating and controlling. It is the art of getting the best out of available resources-men and materials. It demands meticulous planning and systematic execution. Planning is one of the basic functions of management. It involves selecting a course of action from various alternatives available to a project manager to achieve certain objectives. It is deciding in advance what to do, how to do, when to do and who to do it? It bridges the gap from where we are to where we want to be in a desired future. The task of planning is therefore to minimize the risk factor. Network analysis techniques are used to aid the project management in planning and to control the implementation of the same. The most important network analysis techniques are known as Programme Evaluation and Review Technique (PERT) and Critical Path Method (CPM).

PERT, a part breaking introduction to project management systems was originally developed by the U.S. Navy special project office during the course of a research project started in January, 1958. The objective of this project was to design a management control system for the development of the Polaris missile system; a programme whose activities were subject to a considerable degree of uncertainty in performance time, as well as being widely spaced geographically and also involved several thousand agencies and contractors. Since time was of the essence, the research team concentrated on planning and controlling this element of the programme. One of the principal features of PERT is the statistical treatment of the uncertainty in activity performance time. It includes an estimate of the probability of meeting specified scheduled dates at various stages in the project. PERT also emphasizes the control phase of project management by various forms of project status reports.

Using the logic of mathematics, the DuPont Company and the Univac Division of Sperry Rand jointly developed a similar technique in 1957 for scheduling problems associated with building construction. This technique was designed independent of the work of the Navy Special projects office and became known as the Critical Path Method (CPM).

The PERT technique was somewhat revolutionary in the sense that it did away with the traditional bar charts for showing schedules and substituted a network showing graphically the inter-relationship between specific accomplishments and the work that needed to be done to achieve each goal. It involves the basic concepts of statistical probability to complete the programme.

10.15.1 What is PERT?

Programme Evaluation and Review Technique (PERT) is the technique evolved for planning, scheduling and controlling the execution of a project which is usually large in size and complex in its ramifications. It is known to be of special value when the job/ project consists of a group of inter related activities which are performed by several units. It is basically a programme planning technique and can be applied to project(s) that need careful planning and scheduling of activities for smooth execution. It can be successfully applied where the project involves more persons, institutions and agencies. It is basically a “look ahead” process for the planning and execution of projects. In view of the fact that task of technology assessment, refinement, demonstration and integration by KVKs is a stupendous one and a host of departments, agencies and organisations are involved in it, PERT is a sophisticated and highly dependable tool which can be used for planning and controlling of KVK projects.

10.15.2 Similarities and differences of PERT and CPM

1. Normally PERT is used for variable activities while CPM is used for deterministic activities. Variable activities mean the activities which may have never occurred before and/ or which contain a considerable number of chance elements. Deterministic activities are those for which we have considerable experience and whose mean value is accurately known and whose variance in performance time is negligible.

2. PERT is used where the emphasis is on shortening and monitoring project execution time without too much concern for cost implication, while CPM is used where the emphasis is on optimizing resource allocation and minimizing overall cost for a given project execution time.

3. In CPM no allowance is made for uncertainty in the estimates of their durations.

4. In CPM therefore, is based on single time estimation while in PERT, control of time is vital for programme performance.

5. CPM takes account of costs whereas PERT is concerned with time.

6. PERT is event oriented while CPM is activity oriented.

10.15.3 Basic terminologies in PERT

A PERT Network diagram is known as Arrow Diagram. A network consists of arrows and circles. Arrows represent activities while circles represent events. Any project can be broken up into a number of activities. The start and end of each activity can be recognized and are known as 'Events' in PERT terminology. The following are the operational definition of terms used in any PERT.

10.15.3.1 Activity

An activity is also known as job, task, assignment, work etc. An activity consumes either time or resource or both which have definite start and finish. It is denoted by arrows. The length and direction of the arrow has no relation to activity time, except that the tail of the arrow denotes the beginning and the head denotes the completion of an activity. The head of arrow represents the direction of flow of work.

10.15.3.2 Dummy Activity

Some activities which do not consume time or resources are known as Dummy activities. This is denoted by a dotted arrow. This activity is only for indicating interdependency of activities. It is used solely to illustrate precedence relationship when the use of actual jobs would lead to the complications.

10.15.3.3 Event

The beginning and ending points of activities are called events. An event is also known as function, stage, milestone etc. Unlike an activity, an event does not consume time or resource. An event is a clearly definable movement in time, which is the beginning or end of an activity for a number of activities. Event is nothing but an instantaneous point in time. Events are of activities. Events are denoted by circles or rectangles. An activity is always bounded by two events.

i) Merge Event

If an event represents the joint completion of more than one activity is called a merge event.

ii) Burst Event

If an event represents the joint initiation of more than one activity, it is called as burst event.

iii) Successive Events

This is the event that immediately follows a particular event.

iv) Predecessor Event

That comes immediately before a particular event.

10.15.3.4 Network

When all activities and events in a project are connected logically and sequentially they form a network. It is a graphical representation of a project plan with various activities. In a network, activity is represented by an arrow and an event by a circle.

10.15.3.5 Project

A project is any task which has a definable beginning and a definable end, and requires the expenditure of one or more resources in each of the separate but interrelated and inter-dependent activities which must be completed to achieve the objectives for which the task was initiated.

10.15.3.6 Activity duration/Span(Te)

In PERT, the activities duration or time is calculated by using three time estimates such as optimistic, pessimistic and most likely time. The activity duration (Te) is calculated from the following formula.

$$Te = \frac{a + 4m + b}{6}$$

Where,

a = the optimistic performance time estimate. This is the estimate of the shortest possible time in which an activity can be completed under ideal conditions. In arriving at this estimate no provisions are made for delays or setbacks.

b = the pessimistic performance time estimate. This is the maximum possible time it could take to accomplish the job, if everything went wrong and abnormal situations prevailed.

m = the most likely performance time estimate. This is the time estimate which lies between the optimistic and pessimistic performance time estimates.

Te = mean activity performance time based on the three time estimates.

10.15.3.7 Critical Path

It is the path which takes the longest duration of time to reach the objective event. If it is required to complete the project in less time, the duration of the activities lying in the critical path will have to be shortened. Time for an activity can be reduced by employing more resources or by using improved technology.

10.15.3.8 Float/ Slacks (S)

Since the critical path is defined as the longest path in time from the starting event to the objective event, all other events and activities in the network must lie on paths which are shorter. This means that along these paths there is a slack, or time to spare. These paths are referred to as slack paths and are the areas where surplus resources of men, facilities, or time are to be found. The difference between the earliest expected and the latest allowable time is called slack or floats.

10.15.3.9 Early Start (ES)

The early start of a job in a project is the earliest possible time that the job can begin.

10.15.3.10 Early Finish (EF)

The early finish of a job is its early start time plus the time needed to complete the job.

10.15.3.11 Late Start (LS)

Late start of an activity is the latest time it can take to begin without pushing the finish date of the project further into the future.

10.15.3.12 Late Finish (LF)

The latest finish of an activity is its late start time plus its duration.

10.15.3.13 Predecessor Activity

Is the activity which precedes another activity. Without the completion of the predecessor activity the work on successor activity cannot be started.

10.15.3.14 Basic steps for application/steps for 'PERT'ing a project

Once it has been decided that a project is to be planned, scheduled and controlled with the help of PERT, certain procedures are followed for its implementation. The main steps in using the PERT system are as under:

1. Determine (Decide) the objectives and project structure.
2. List out (prepare) the list of key events, determine sequences of events and departmental responsibilities (individual job/ activities).
3. List out activities and their inter-relationship.
4. Construct net work.
5. Obtain time estimates for each activity and compute estimated time.
6. Enter the time estimated in the network.
7. Calculate ES, EF, LS and LF.

8. Calculate critical path and floats.

9. Prepare a table of ES, EF, LS and Floats for each activity.

A detail explanation of the above basic steps of PERT network is given under:

1. Determine (DECIDE) the objectives and the project structure

A project with clear and correct objectives can be better planned. Before providing for PERT application, it is desirable to state whether planning aims at minimizing the duration of project or also aims at resource scheduling and cost optimization.

2. List out (PREPARE) the key events and determine individual responsibilities

This step consists of analyzing the total work into the individual tasks or activities which must be carried out in order to complete the project. While preparing the list of activities, one is faced with the difficulty of deciding upon appropriate size of the individual activities. The level of details that should be shown depends to a large extent upon how the final network is to be used. The temptation to add more detailed information should be avoided. In considering any particular activity or group of activities with regard to expanding, condensing, or eliminating it, designer can ask himself the following questions to guide his decision:

i) Who will use the network, and what are their interests and span of control?

ii) Is it feasible to expand the activity into more detail?

iii) Are there separate skills, facilities, or areas of responsibilities involved into the activity, which demands more details?

iv) Will the accuracy of the logic or the time estimates be affected by more or less detail?

Clearly, these questions are only guidelines to the subjective decision that must be made in each case. There are no firm rules that may be followed in determining the level of detail.

3. List out activities and their inter-relationship and construction of network

Establishing activity inter-relationship consists of specifying the sequence in which the activities will be performed. The basic factor which governs the inter-relationship of activities is the logical sequence which exists between activities. A systematic questioning procedure is followed to throw light on the sequence in which a project is to be completed. The questions are:

i) What other activities must be completed before (precede) an activity can be started?

ii) What other activities can start (succeed) as soon as an activity is completed?

iii) What other activities can be performed at the same time (concurrently)?

With the help of this procedure, an activity dependency list may be prepared and used in the network planning. However, it is not necessary to analyse and prepare an activity dependency list,

as after working with one or two networks, one person can draw network straight from list of activities. After establishing activity inter-relationship, the next step is construction of network. Network, as already stated, is a pictorial representation of a project plan showing the inter-relationships of the various activities and to exhibit their inter-relationships, a precise plan of work depicted in the form of a network is prepared. While constructing networks, certain rules and conventions are usually followed. They are:

i) No activity can be shown twice in the network unless it occurs twice in the project in which case it should bear a different activity identification;

ii) Before an activity may begin, all activities preceding it must be completed;

iii) An event cannot occur until all activities leading to it are completed.

iv) No activity can begin until its immediate preceding event has occurred.

v) Arrows imply logical precedence only. Neither the length of the arrow nor its compass direction has any significance.

vi) Any two events may be directly connected by not more than one activity.

vii) Event numbers must not be duplicated in a network; and

viii) Network may have only one initial event and only one terminal event.

The last three rules hold good only when computation is to be done with computer. In case of hand calculation they are not considered essential. It is extremely difficult to draw a neat network at the very first attempt, when the number of activities becomes fairly large. Practice helps one to develop an eye for constructing networks. As an aid to identify the activities in a network, it is a common practice to allot codes to different activities or to reduce the activity details into two to three words to accommodate it in the network.

4. Event numbering

In some cases instead of allocating code to activities, the events are numbered in numerical numbers to facilitate easy identification of an event and activity in a network. In such cases event is referred by its number and activity is referred by its preceding and succeeding event numbers.

5. Obtain time estimates and computer estimated time

Once the first draft of the project network has been developed, it is desired to refine the network and add time estimates to obtain a practical, working draft ready for the scheduling and computations. In practice, the process of time estimation and network refinement are closely inter-related and are usually accomplished at that time. For example, as one begins to make time estimates, it is found that certain activities need to be redefined, in order to represent the project accurately and at the desired level of detail. Time estimates are important as they form the basis of the work schedule, and the work schedule can be no better than the basic data from which it is derived. It is therefore, important to obtain the most accurate estimates as far as possible. The estimating of time for activities is perhaps the facet of PERT system.

There are occasions when the duration of an individual activity is liable to deviate considerably from its average, because of the effects of random disturbances. So to accommodate such random disturbances in PERT, we make three time estimates as under:

a) Optimistic time

The time which would be required if everything worked out or proceeded ideally. Such estimate is unrealistic and occurs very rarely.

b) Pessimistic time

This is just opposite of the optimistic estimate, barring totally uncontrollable situation such as fire, floods etc. It tells us what would be required if everything which could logically go wrong does go wrong. This estimate is also unrealistic and occurs very rarely.

c) Most likely time

The time which, in terms of the estimate's own experience, is most likely to take under the circumstances expected to exist. The most likely time need not to be midway between the other two time estimates.

These three time estimates are reduced to one, statistically by making use of the formula:

$$\text{Activity expected time (Te)} = \frac{a + 4m + b}{6}$$

Where,

a = Optimistic time; **4m** = Most likely time and **b** = Pessimistic time.

The activity expected time is used in network analysis and for preparing schedules for the project. However, it is not always imperative to make three time estimates. In a network, single time estimation may also be used if the person responsible for carrying out a project or an individual activity feels that this one time estimate will be valid and practicable.

Guidelines for getting better time estimates

i) As far as possible, the time estimate should be obtained from the personnel who will have the ultimate responsibility for executing the work; and

ii) It is necessary to consider the possible tendency of setting high estimates for self protection.

6. Enter time estimates or scheduling the network

At this stage, in the application of PERT, the project plan has been computed and the mean performance time has been estimated for each activity. It is not appropriate to begin scheduling the activities and to determine the network, critical paths, and the duration of the project.

The basic scheduling computation is to value a forward and a backward pass through the network. Based on a specified occurrence time for the initial network event, the forward pass computations give the earliest expected start and finish time for each activity, and indirectly the earliest expected occurrence time of each event. By the specification of the latest allowable occurrence time for the terminal network event, the backward pass computations will give the latest allowable start and finish time for each activity and indirectly the latest allowable occurrence time for each event. After the forward and backward pass computations are completed, the slack (float) can be computed for each activity and the critical and sub-critical path(s) of the network is determined. The conversion of these computational results to calendar dates merely requires the modification of calendar dates wherein the working days are numbered consecutively from a prescribed calendar date for the start of the project.

Computation Nomenclature

The following nomenclature is usually used in the schedule computations:

t = Single estimate of mean activity duration time;

TE = Earliest event occurrence time;

TL = Latest allowable event occurrence time;

ES = Earliest (activity) start time;

EF = Earliest (activity) finish time;

LS = Latest allowable (activity) start time;

LF = Latest allowable (activity) finish time;

S = Total slack of activity (float) and

SF = Activity free slack (or float).

7. (i) Calculation of forward pass computation (ES & EF)

As stated above, the purpose of the forward pass is to compute the earliest start and finish time for each activity in the project on working days basis. To accomplish this, the forward pass computation arbitrarily starts with an earliest occurrence event, and they assume that each activity starts as soon as possible, when its predecessor event occurs. According to network logic, an event occurs when all of its predecessor activities are completed. Hence, the earliest event occurrence time is equal to the largest of the earliest finish times of the activities merging to the event in question. Regardless of how many activities merge to a given event, the earliest merge event time is the largest of the earliest finish times of the merging activities. These rules or assumptions are summarized below.

	Forward Pass Rules	Formulae
1.	The Earliest occurrence time of the (single) initial event of the network is taken as zero	TE = 0(For initial event)
2.	Each activity begins as soon as the predecess or event occurs	ES = TE (for predecessor event)
3.	The earliest event occurrence time is the largest of the earliest finish times of the activities merging to the event in question	EF = ES + t = TE + t where TE = largest of (EF_1., EF_2., EF_n) for an event with n merging activities

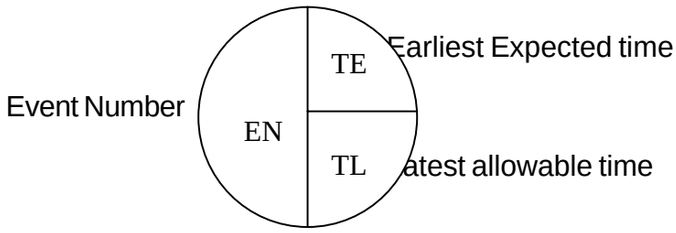
These assumptions/rules have been applied to the network.

7. (ii) Calculation of backward pass computation (LS& LF)

The purpose of the backward pass is to compute the largest allowable start and finish times for each activity, which will permit the terminal event to occur at its earliest expected time as computed in the forward pass. To accomplish this, the backward pass computation starts with the project terminal event and arbitrarily assigning to it a latest allowable occurrence time equal to its earliest occurrence time. When TL= TE, the latest allowable activity start time is computed by subtracting the activity duration time from the latest allowable finish time. According to network rules, an event must occur before any succeeding activity commences. Hence, the latest allowable occurrence time for an event is equal to the smallest of the latest allowable start times of the activities bursting from the event in question. These assumptions or rules are summarized below:

	Backward Pass Rules	Formulae
1.	The latest allowable occurrence time of the (single) terminal event of the network is set equal to the earliest occurrence time computed in the forward pass.	TL = TE (for terminal event)
2.	The latest allowable start time for an activity is its successor event (latest allowable time minus the duration of activity in question).	LF = TL (for successor event)
3.	The latest allowable time for an event is the smallest of the latest allowable start times of the activities bursting from the event in question.	TL = Smallest of (LS_1, LS_2, LS_3 … LS_n) for an event with bursting activities

In the network, the earliest expected time of occurrence of an event or an activity pending, it is denoted in upper portion of an event circle and the latest allowable occurrence time is denoted in lower portion of an event circle as shown below:



8. Calculation of critical path (s) and floats(s)

i) Determining the critical Path

It is the longest path through the network and it determines the shortest time in which the project can be completed. The critical path in a network passes through all the critical events and critical activities. If any activity on the critical path is delayed, the whole duration of completion of project is delayed. Determination of critical activities and critical path helps management to concentrate on critical activities at the time of executing the project to obviate delays. A tabular procedure for critical path computation such as earliest occurrence time, earliest finish time, latest occurrence time, latest finish time, free slack, total slack, and critical activities have been mentioned. However, it cannot be that efficient as hand computations made directly on the network. This is only one aspect of the PERT technique which aims at controlling the overall duration for completion of the project. But this technique is equally applicable for resource allocation and cost control. This relates to four factors such as time, cost, resource and performance. Being out of the domain of the KVK work, other aspects of PERT have not been dealt with in this book.

ii) Slack/ Float

Two types of slacks in a network are of most value that they are called total activity slack/ float or simply total slack and activity free slack/ float or simply free slack/float.

iii) Total Slack

Total activity slack is equal to the latest allowable time of the activity's successor event minus the earliest finish time of the activity in question; S = TL – EF. It is equal to the amount of time that the activity completion time can be delayed without affecting the earliest start of occurrence time of any activity or event on the network critical path. In general, we can say that the total slack is the time by which the actual activity completion time can exceed its earliest expected time of any event on the critical path. Any activity for which the total slack is zero is said to have exercised a critical control over the overall duration of the project. They have no flexibility in time with them and a delay in any one of them will delay the completion of the project and vice versa.

iv) Free Slack

Merge point activities which lie along slack paths has what is called free slack. Activity free slack is equal to earliest expected time to the activity's successor event minus the earliest finish time for the activity in question, SF = TE- EF. It is equal to the amount of time that the activity or event in the network, may be critical or non critical. The free slack measures the amount of time by which an activity can be delayed without of the earliest start time of any other activity in the network whether critical or non critical.

9. Scheduling computation

With the network already drawn and duration of activities known following information can be obtained:

ES = Earliest activity start time;

EF = Earliest activity finish time;

LS = Latest activity start time and

LF = Latest activity finish time.

As we have already discussed, the calculations of ES and EF are known as "Forward pass" and calculations of LS and LF are known as "Backward pass".

10.15.4 Merits/Advantages of PERT

The majority of PERT applications contain the phases like the preparation of the network diagram, the estimation of expected time to perform each activity, the computation of the critical path schedule, and the proper interpretation of the results.

Experiences with these applications under a broad range of project types have shown that the PERT:

1. Encouraged a logical discipline in the planning, scheduling and controlling of the project.
2. Encourages more long range and detailed planning of projects. It develops in advance a plan of action required to produce a project.
3. Provides a standard method of documentation and communicating project plans, schedule, time and cost performance. Enables project manager to predict with some degree of certainty the probable time and rupees it will take to achieve desired objectives.
4. Identify the most critical elements in the plan focusing the managers' attention on the most constraining part of the project.
5. Illustrates the effects of technical and procedural changes on the overall schedule.

6. Provides a ready made standard against which performance can be measured as the plan is placed into action.

7. Enables management to better manage the resources available on the project.

8. With continuous reporting of progress it affords project manager a great deal in the way of control.

9. Enables project manager to determine when delay begins to develop, precisely where they are and what can be done to correct them.

Network analysis techniques (PERT/ CPM) are useful for eliminating delays and reducing costs. They are simple to apply and a high degree of saving is possible. Network analysis is one of the most effective and successful tools in the planning and control of any research project.

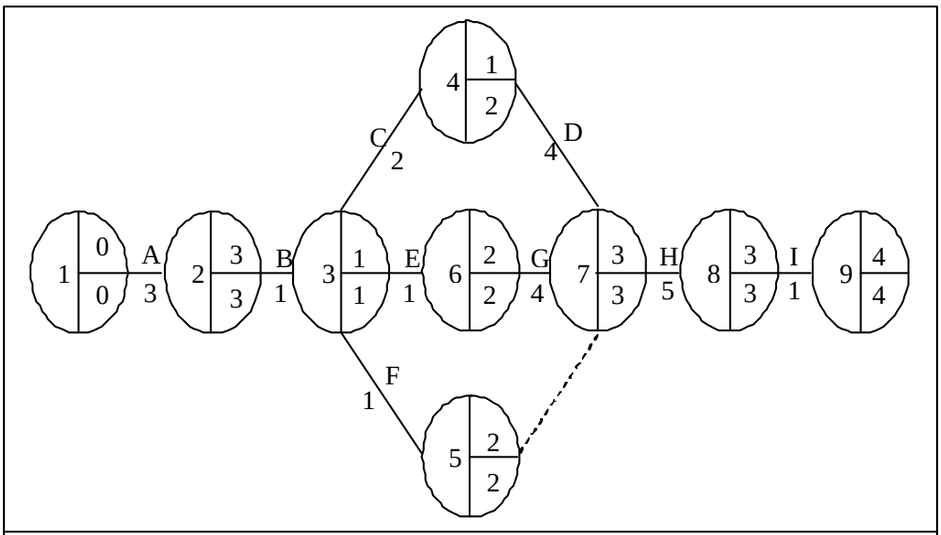
Example 1: Suppose the following are the activities, draw PERT diagram

Sl. No.	Activity	Activity symbol (S)	Preceding activity (PA)	Time Duration (Months)
1.	Aerial photograph	A	-	3
2.	Soil survey	B	A	12
3.	Photo analytical transfer	C	B	2
4.	Soil preparation	D	C	4
5.	Soil physical analysis	E	B	12
6.	Soil chemical analysis	F	B	12
7.	Interpretation of data	G	EF	4
8.	Final report preparation	H	GD	5
9.	Field demonstration	I	H	12

Pert Diagram

10.16 How to draw the CPM network

Draw the largest activity path horizontally on a paper indicating the events by circles and connecting the event by activity arrows. Label them with numbers and letters respectively. Thereafter look at the precedence relationship between the activities and draw the activity arrows with events appropriately connecting the events on the length path. When two or more activities emerging from same event circle and all of them becoming precedent to a succeeding activity a broken arrow is introduced. Connecting the events depict the continuity of the network. These broken arrows are



PERT DIAGRAM

called 'dummy' activities and do not consume any resources. In this way all the activities are to be shown in the CPM network and then write the time estimate for each activity below the activity arrow.

10.17 CPM analysis

After the network is drawn each event circle is divided into 3 segments as shown below:

Left semi circle carries the event number. Right top segment contains earliest starting time (EST). Right bottom segment contains the latest starting time (LST) for an event. The network is first solved from start to finish or forward pass. The rules are as follows:

1. EST for the start event is assumed to be zero.
2. Each activity starts as soon as the event at which its start is realized. The earlier finishing time for an activity is equal to EST to the event from which it starts plus the duration of that activity.
3. EST of an event is equal to the largest of the earliest finishing times of the activity merging on the event.

Network is analyzed in the same way working backward from finish to start or backward pass. The rules are as follows.

1. LST of the finish event is equated to its EST.
2. The latest finishing time for an activity is equal to the LST of its successor event. The latest starting time for an activity is its latest finishing time minus duration.
3. LST for an event is smallest of the latest starting time for the activities emerging from the event.

With these rules the network is analyzed and the EST and LST are noted on the event circles. We find that the EST and LST are equal to the event of the largest path. The difference between LST and EST is called the 'Event slack' which gives the margin of time by which the commencement of an activity can be delayed without dislocating the total duration of the project. Thus, events with zero slack trace the critical path which is also the longest path.

The slack time for an activity is obtained as follows:

Activity slack is equal to LST of event minus EST of start event minus duration of reference activity.

These slacks indicate that the activities concerned can be performed at the slow phase twice by releasing some of the resources for use of critical activity. From the analysis we can draw the project in the form of network as given in PERT.

Advantages:

1. A comprehensive view of the entire project is available for the project management.
2. Because of current and sequential relationships, time duration becomes effective, thereby monitoring the progress of the project becomes easier.
3. Identifying the critical activities keeps the project leader alert and well prepared for alternate plans if needed.
4. Breaking down the project into smaller components permit better closer control of the project. Thus CPM is a dynamic tool of project management.

10.18 Bar Charts

Bar charts are the pictorial representation of various activities of a project with the help of bars against time scale. The important bar charts considered for detailed description are Gantt Bar Charts, Milestone Bar Charts, Modified Gantt Bar Charts and Activity Slack Bar Chart.

10.19 Gantt Bar Charts

These bar charts were developed by H.L.Gantt, who was contemporary of "the father of the scientific management", F.W. Taylor. Gantt used the bar charts first on production officers. Bar chart is a pictorial representation of various tasks of a project to be done. It is made up of two coordinate axes-one represents for tasks to be undertaken and the other for time elapsed. The tasks are denoted by bars and the length of bar indicates the time requirement for accomplishing particular task.

For example, there is a project consisting of five tasks i.e. A, B, C, D and E. These tasks are represented by means of bars. The bar chart with the bars representing the tasks clearly indicates the independent nature of tasks. Usually, for many projects some job may start at a time and would go simultaneously and some will have to be accomplished prior to others can begin with and thus the dependency between the tasks exists.

10.19.1 Limitation

In bar charts dependency between the tasks is not there. Critical activities cannot be ascertained for project completion.

10.20 Activity – Slack Bar Chart (ASBC)

In this technique each activity is shown by means of a bar. The broken bar is divided into two parts – one is with parallel lines and the other with broken parallel lines. If the activity has the inbuilt slack which means that the activity cannot be commenced upto a certain stage (growth of crop or animal), though it needs 2 or 3 days (few days) for accomplishing. The continuous parallel lines in the bar represent the exact time requirement for completing the work activity. In other words the former is for the critical period and the later is for inbuilt slack. The normal slack of any activity can be easily understood by the graph itself. All the bars are shown against time scale of horizontal axis (X-axis). The vertical axis (Y-axis) is meant for naming/ symbolizing the activities. The relationship between the activities is indicated by arrows. The head of arrow indicates the succeeding activity. The arrow may be upward or downward direction. The length of arrow and direction do not have any significance. The ASBC was developed at NAARM, Hyderabad in the year 1986.

10.20.1 Intrinsic Merits of ASBC

1. Unlike PERT or CPM networks, ASBC clearly indicates the slacks of the activities.
2. The technique is highly relevant and completely applicable for biological projects related to plants, animals, birds and fisheries, whereas PERT and CPM networks are not suitable for many cases.
3. It is more effective for short duration projects, which consist of sequential activities with three to four concurrent activities.
4. ASBC represents all aspects i.e. time requirement for each activity, inbuilt slack period, critical activity period, activity relationships and duration of project.
5. Identification of inbuilt-slacks facilitates for taking up more projects.
6. It is easy to draw the ASBC chart by using a graph sheet unlike PERT and CPM network, wherein complicated procedures and analysis are involved.

10.20.2 Limitation

1. ASBC may not help when activities of more than 50 are involved in the project.
2. It is cumbersome to draw the bars, if the project has many concurrent activities.

10.21 Six – Sigma Concept

Six Sigma aims at continuous quality improvement and it is a step by step problem solving frame work and work breakdown structure, which can be remembered by using the acronym **DMAIC**

First the problem is

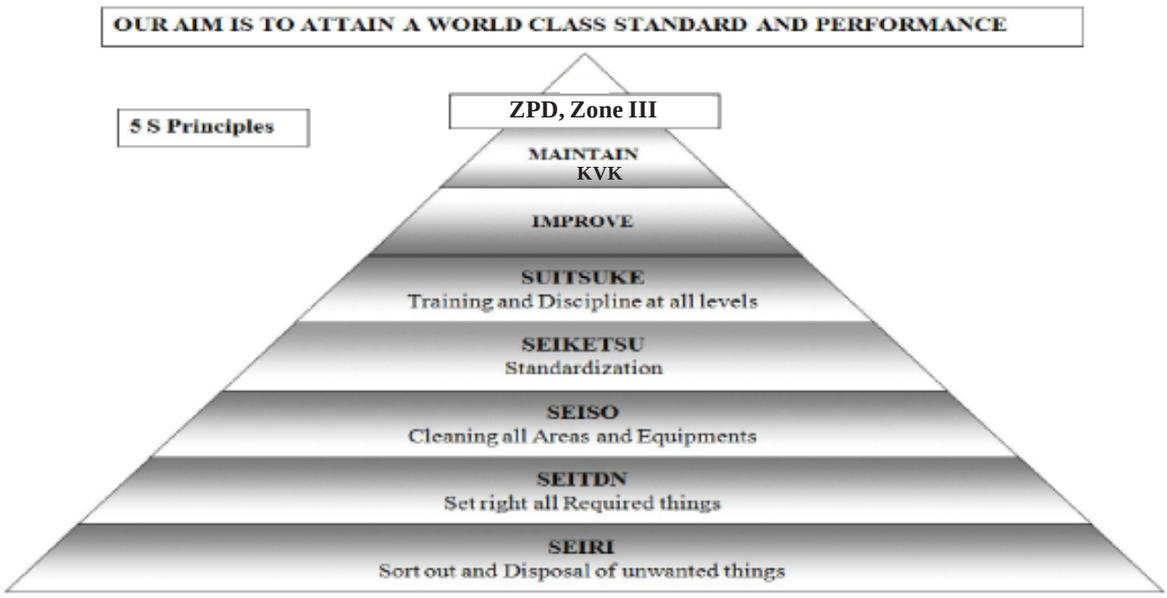
1. **D**efined to determine what needs to be improved.
2. **M**easures the current status against the desired status.
3. **A**nalyses the root causes of the production gap.
4. **I**mplements improved solution (after brainstorming and selecting).
5. **C**ontrols the long term sustainability of the improvements by establishing monitoring mechanisms, accountabilities and work tools.

10.22 5 – S Principles

5-S principles are followed to attain a better quality standard in an organization. This involves five steps as detailed below.

1. Seiri: Sorting out and disposal of unwanted things
2. Seitdn: Set right all required things
3. Seiso: Cleaning all areas and equipments
4. Seiketsu: Standardization
5. Suitsuke: Training and discipline at all levels

Above this the KVKs have to continuously aim for improvement and maintenance of standards and performance. At the zonal level, Zonal Project Directorates also have to follow the same. The 5-S model followed by Zonal Project Directorate, Zone - III, is given below.



Chapter – XI

WORLD TRADE ORGANIZATION AND INDIAN AGRICULTURE

11.1 WTO: An Introduction

The work on formulating an international trade policy was started during the post-world war-II when Breton Woods attempted to restructure international institutions in the areas of finance, trade and macro-economic stability. This has materialized with the setting up of World Trade Organization (WTO) in January 1995 at Geneva, Switzerland. The liberalized trade regime under WTO became operational with the Marrakesh Agreement, ratified in 1994 at the conclusion of Eighth/ Uruguay round of trade talks which began in 1982. India is one of the 136 member countries, which were signatories to the agreement that altered the whole framework of international trade. Three fourths of the member countries are developing countries and accounts for less than 30 percent of World Trade. WTO is an international organization dealing with the rules of trade across the nations. The focus is on how producers of goods and services, exporters and importers conduct their business. The WTO's overriding objective is to help international trade to flow smoothly, freely, fairly and predictably through:

- Administering Trade Agreements
- Acting as a forum for trade negotiation
- Settle trade disputes
- Reviewing National Trade Policies
- Assisting developing countries in trade policy issues through technical assistance and training programmes
- Cooperating with other international organizations.

Currently there are 150 countries (including recent entrants China and Taiwan) as members and there are 42 countries including Russia, Nepal, and Bhutan etc, which are in the queue for the WTO membership. The entire members make decisions by consensus. As World trade involves a number of complex transactions across national borders, more than one national law applies to the transaction. Therefore, there is a need for uniformity in laws on trade transactions, which in turn facilitate efficiency in trade.

11.2 The Basic Principles of WTO

11.2.1 Non - discrimination between countries: The most Favoured Nation (MFN) Treatment

The trading system should be without discrimination. A country should not discriminate between its trading partners. Most Favoured Nation (MFN) means that every time a country lowers a

trade barrier or opens up a market, it has to do so for the same goods and services for all its trading partners who are the members of WTO. Therefore, under WTO each member treats all the other members equally as most favoured trading partners. However, there is an exception for the regional trade block like NAFTA, EEC, and SAFTA etc., to have a clause on each other treatment in trade. MFN exemptions can be applied to the 'services' sector in a country.

11.2.2 Non – discrimination within a country: National Treatment

Imported goods and services on entering the countries' border after fulfilling the requirements has to be treated on par with locally produced goods and services. The same rule should apply to foreign and domestic goods, services, trademarks, copyrights and patents.

11.2.3 Free Trade: Gradually through negotiations

Lowering trade barriers is one of the most obvious means of encouraging trade. The barriers are custom duties (or tariffs) and measures such as quantitative restrictions like import bans or quotas that restrict quantities selectively.

11.2.4 Predictability through Binding

Binding means, helpful legalities helps to predict the trade environment more precisely. The multilateral trading system is an attempt by the Governments to make the business environment stable and predictable. In WTO, when countries agree to open their markets for goods and services, they bind their commitments through ceilings on customs tariff rates.

11.2.5 Promoting Fair Competition

The WTO promises to provide open and fair competition. The tax reduction and elimination exercises go hand in hand. The net result is the domestically produced goods facing same environment regarding taxes and subsidies as those in other countries. The 'level playing field' between local and foreign goods encourages and fosters competition, efficiency and consumer choices.

11.2.6 Encouraging Development and Economic Reforms

It is a widely recognized fact that WTO favours development in developing countries. These countries need flexibility of time to implement the agreements and the agreement themselves inherit the earlier provisions of GATT that allow for specific assistance and trade concessions for developing countries.

11.3 Difference between GATT and WTO

- GATT was ad hoc and provisional. The WTO and its agreements are permanent with a sound legal basis.
- WTO has permanent memberships. GATT had "contracting parties" with official legal texts with no legal body or organization.
- GATT dealt with trade in goods. WTO covers service, intellectual property as well.

- Despite settlement, procedure is faster and more automatic in WTO than GATT.
- WTO more or less contains the GATT texts with certain modifications.

11.4 GATT/WTO – A Brief History

Sl. No.	Year/Date	Name of the Round/ Place	Major Decisions
1.	1947, October 30	Palais des Sations, Geneva	The birth of GATT, 23 nations including India, are the founder members of the GATT Agreements
2.	1948, January 01	Geneva	GATT entered into activities
3.	1948, February 28 to March 20	First Round Havana, Cuba	The first real business of contracting parties was conducted
4.	1949, April to August	Second Round, Annecy, France	The contracting parties exchange about 5,000 tariff concessions
5.	1950-51 September to April	Third Round, Torquay	The contracting parties exchanged some 87,700 tariff concessions. Four more countries acceded to GATT
6.	1956, May 21	Fourth Round, Geneva	Produced some US$ 2.5 billion worth of tariff reductions
7.	1960, September 14	Fifth (Dillion) Round, Geneva	Negotiations with EEC member states for the creation of a single schedule of concessions for the community based on its Common External Tariff.
8.	1964, May 07	Sixth Round (Kennedy)	Meeting at the Ministerial level
9.	1965, February	Geneva	A new chapter added to the GATT, with developed countries according high priority to the reduction of trade barriers to the products of developing counties
10.	1967, June	Geneva	About 50 counties signed, the Kennedy Round's Final Act.

Sl. No.	Year/Date	Name of the Round/ Place	Major Decisions
11.	1973, September	Seventh Round, Tokyo	Some 99 counties participated in negotiating a comprehensive body of agreement covering both tariff and non-tariff matters
12.	1974, January 01	Geneva	Arrangement regarding international trade in textiles, otherwise known as the Multi Fibre Arrangement (MFA) entered into force
13.	1982, November	Eighth Round Uruguay	The work programme on which Ministers agree became the starting point for what was to become the Uruguay Round negotiating agenda
14.	1986, September	Punta del Este, Geneva	Adopted a Ministerial declaration, which contained the biggest negotiating mandate on trade ever agreed
15.	1988, October 05	Montreal, Canada	Mid-term review of Punta del Este declaration
16.	1990, December	Brussels	Ministerial Meeting did not achieve the expected success
17.	1993, December 15	Geneva, Switzerland	The final Act of the Uruguay Round signed by officials
18.	1994, April 15	Marrakesh, Morocco	The final Act of the Uruguay Round signed by Ministers
19.	1995, January 01	Marrakesh, Morocco	Conversion to World Trade Organization (WTO)
20.	1995, May 31	Geneva	WTO General Council approved by Headquarters. Agreement with the Swiss Confederation including the decision to locate the WTO in Geneva

Sl. No.	Year/Date	Name of the Round/ Place	Major Decisions
21.	1996, December 9-13	Singapore	The establishment of three working groups on trade and investment, trade and competition and transparency in government procurement, plus a mandate to conduct a study on trade facilitation
22.	1997, February 15	Geneva	Successful conclusion of negotiations on basic telecommunications services. Sixty-nine governments agreed to wide-ranging liberalization measures
23.	1997, March 26	Geneva	Forty governments agreed to cut customs duties on information technology products, beginning on 1st July 1997
24.	1999, November 30 to December 03	Seattle	Wide scale protest in Seattle against WTO on issue of labour and environment. The meeting took up new issues like labour, trade facilitation, investment, competition policy, agriculture subsidies, biotechnology, and market access. Negotiations collapse and meeting ended with a formal communiqué.
25.	2000	Geneva	Agriculture : negotiations for continuing the process of substantial progressive reduction in support and protection
26.	2001, November	Doha, Qatar	Review on Agreement on Agriculture
27.	2004	Marakkesh, Morocco	Textiles and Clothing: review of the implementation of the agreement by 26 nations.

11.5 Areas handled by WTO

11.5.1 Agriculture

Disciplining the trade in agriculture has been agreed for a long time in GATT. Due to the huge subsidy component in agriculture and support by the developed countries and its repercussion on developing countries stretched the negotiations so long.

11.5.2 Sanitary and Phyto-Sanitary Measures (SPS)

SPS mainly deals with food safety, animal and plant health standards. In this regard WTO has not set standards. Instead, it encourages the member countries to set their own standards broadly based on international standards set by international organizations.

11.5.3 Technical Barriers of Trade (TBT)

TBT agreement deals with other technical standards to be allowed by the member countries. According to the agreement member countries need to consider the developing countries standards when they prepare their regulations.

11.5.4 Textiles and Clothing

Agreement on textiles and clothing presently covers under multi-fiber agreement. By 2004 the quota system was to be replaced by tariffs.

11.5.5 Anti-dumping, safeguards and countervailing duties

Under the Anti-dumping agreement, WTO members can restrict imports to protect their domestic industry by imposing dumping margin on imported products. On the other hand, the agreement on subsidies and countervailing measures empowers a member country to impose countervailing duty on subsidized imports.

11.5.6 Customs Valuation

The agreements on customs valuation obligate members to follow certain rules, while calculating the duty on imports.

11.5.7 Rules of Origin

Rules of origin are the criteria used to define where a product is made. They are linked to the application of trade measures such as quotas, preferential tariffs, anti-dumping actions and countervailing duties.

11.5.8 Services

Under the agreement of Trade in Services (GATS), WTO members have made commitments in their service sectors that they are willing to open to foreign competition. Banks, insurance firms, telecommunication companies, tour operators, noted chain and transport companies now enjoy the principles of free and fair trade that originally applied to trade in goods only.

11.6 Trade-Related Intellectual Property Rights (TRIPS)

The WTO's intellectual property agreement amounts to rules for and investment in ideas and creativity. The Member State now recognizes copy rights, trademarks, geographical names used to identify products, industrial designs, integrated circuit layout-designs and undisclosed information such as trade secrets should be protected when trade is involved.

11.6.1 Dispute Settlement

The WTO procedure for resolving trade quarrels under the dispute settlement understanding is vital for enforcing the rules and therefore ensures that trade flows smoothly. A country brings disputes, if their rights are being infringed. However, system encourages countries to settle the differences through consultation. Failing that, they can follow a carefully mapped out, stage-by-stage procedure that includes the possibility of ruling by a panel of experts, and chance to appeal against the ruling on legal grounds.

11.7 Trade-Related Investment Measures (TRIMS)

TRIMS mainly deal with foreign investment in terms of trading activities. Developing countries retains the flexibility to choose investment promotion policies, which the country consider necessary to fulfill their developmental needs.

11.7.1 Withdrawal Provision (Under Article XXXI)

Any country may withdraw from the WTO agreement any time if they wish. Simple thing the country has to do is to float an application. The withdrawal shall take place upon the expiration of six months from the day written notice was received by the Secretary General of the United Nations. India being one among the first 23 founder members of GATT, it is not wise for it to lose the initial advantage. India has an advantage of bilateral agreement automatically with other member countries of WTO.

11.8 Agreement on Agriculture (AoA)

The long-term objective is to establish a fair and market oriented agricultural trading system. The immediate action proposed is to initiate a reform process through the negotiation of commitments on a support and protection leading to substantial progressive reductions in agricultural support and protection and finally resulting in correcting and preventing restrictions and distortions in the world agricultural market.

The Agreement on Agriculture sets a perspective on reform process and outlines the modalities to be adopted while going further in this direction. The agreement also gives the nature of commitments and the thrust areas for reforms. Market access, domestic support and export competition are listed as main areas, where specific binding commitments have to be undertaken. It calls upon the developed country members to provide improved market access for products of specific interest to developing country members.

Overall, the results of the negotiations provide a frame work for the long-term reforms of agricultural trade and domestic policies over the years to come. It makes a decisive move towards

the objective of increased market orientation in agricultural trade. The rules governing agricultural trade are strengthened which will lead to improved predictability and stability for importing and exporting countries alike.

In this backdrop every State and Union territory in the country must prepare themselves to face the challenge and grab the opportunity in India's agricultural trade. It is necessary to watch this sector carefully both from the import and export front in order to protect the interest of domestic traders and producers, if necessary it is essential to fine tune the balance between domestic market, exportable surplus and imports. The act of such optimization, therefore involves a large number of issues that needs to be discussed.

11.9 Tariff Reduction

The newly committed tariffs and tariff quotas, covering all agricultural products, took effect in 1995. Uruguay round participants agreed that developed countries would cut the tariff-quotas by an average of 36 per cent in a phased manner over six years, while developing countries would make 24 percent cuts over ten years. Several developing countries also used the option of offering ceiling tariff rates in cases, where duties were not bound (i.e. committed under GATT or WTO regulation) before the Uruguay round. Least developed countries are not bound to affect any tariff cuts under the agreement.

For products whose non-tariff restrictions have been converted to tariffs, governments are allowed to take special emergency actions (safeguards) in order to prevent swiftly falling prices or surges in imports from hurting their farmers. But the agreement specifies when and how these emergency cautions can be introduced (for example, they cannot be used on imports within a tariff quota).

11.10 Special Safeguards (SSG)

The expectations are the possibilities of taking special safeguard action, and provisions, which allow "special treatment" for certain products. Under Special Safeguard (SSG) provisions, a WTO member can impose additional duty in excess of that committed in its national schedule on the imports of an agricultural product, which is designed in its schedule with the symbol 'SSG' and whose volume of imports during any year exceeds a trigger level. The SSG provisions cannot be invoked for products, which were terrified in pre WTO period.

11.11 Current and Minimum Access Commitments

For products covered by the tarification process, the maintenance of current market access opportunities is provided for, supplemented by the establishment of minimum access tariff quota (at reduced tariff rates), where the current access is less than five per cent of domestic consumption. These minimum access tariff quotas are to start at three percent and are to be expanded to reach five percent at the end of the implementation period.

11.12 Domestic Support

The main grievances about policies that support domestic prices of subsidized production in some other way, is that they encourage over-production. This squeezes out imports or leads to

export subsidies and hence low priced dumping on world market. The agricultural agreement distinguishes between support programmes that stimulate production directly, and those that are considered to have no direct effect.

The central thrust of the domestic support provisions of AoA is to encourage a further shift away from trade distorting measures and policies. The agreement particularly targets subsides granted by governments to farmers to support price level with a view to keeping out imports. However, certain subsidies are allowed under the agreement, as they are not supposed to distort trade.

Provisions of the Agreement on domestic support measures have two main objectives:

- *to identify acceptable measures of support to farmers and*
- *to discipline trade distorting support to farmers.*

These commitments regarding domestic support are primarily aimed at containing the high levels of domestic agricultural support. This objective is to be achieved by quantification of domestic support, in the form of Aggregate Measure of Support (AMS) and then by progressive reduction of the AMS.

There are three categories of support measures that are subject to reduction under the Agreement. These three categories of exempt support measures are green, blue and amber box measures.

11.13 Green, Blue and Amber Box Measures

11.13.1 "Green Box" Measures

These are considered to have a minimum trade distorting impact. These include the following types of assistance:

i. Government assistance on general services like research, pest and disease control, training, extension, and advisory services.

ii. Public stock holding for food security purposes.

iii. Domestic food aid.

iv. Direct payment to producers, such as, governmental financial participation in income insurance and safety nets, relief from natural disasters, and payments under environmental assistance programmes.

v. De-coupled income support.

vi. Government financial participation in income insurance and income safety-net programmes.

vii. Payments (made either directly or by way of government financial participation in crop insurance schemes) for relief from natural disasters.

viii. Structural adjustment assistance provided through producer retirement programmes; resource retirement programmes; and investment aids.

ix. Payments under environmental programmes.

x. Payments under regional assistance programmes.

Special and Differential Treatment for developing countries:

i. Investment subsidies which are generally available to agriculture in developing countries, and

ii. Agricultural input services generally available to 'low income and resource poor producers' in developing countries.

11.13.2 "Blue Box" measures

These represent direct payments under production limiting programme. These are relevant from the point of view of developed countries alone.

11.13.3 "Amber Box" measures

These consist of those domestic supports to agriculture which are considered to be trade distorting. The Aggregate Measures of Support (AMS) quantifies these supports in two parts:

- Product specific subsidies, that is, the difference between the administered price (minimum support prices in India) and external reference prices.
- Non product specific subsidies, that is, subsidies on inputs such as fertilizers, electricity, irrigation etc.

The net AMS of exempted categories of support measures is subject to reduction commitments as under:

Domestic Support (Base 1986-88)	Developed Countries (1995-2000)*	Developing Countries (1995-2004)*
AMS	20%	13%

*Developed countries to meet the commitment of reducing their base year level AMS during 6 years and developing countries during 10 years.

Domestic support given to the agricultural sector within the specified de minimis level, that is, upto 10% of the total value of agricultural produce in developing countries and 5% in developed countries is allowed. In other words, AMS within this limit is not subject to any reduction commitment.

Also permitted, are certain direct payments to farmers where the farmers are required to limit production (sometimes called blue box measures), certain government assistance programmes to encourage agricultural and rural development in developing countries and other support in a small scale when compared with the total value of the product or products supported five percent and less in the case of developed countries and ten percent and less for developing countries , often called 'de minimis' support. The 'de minimis' levels at which support is regarded as having minimal effect are defined. These subsidies are allowed under the agreement and are exempt from reduction commitments. Amber box subsides are considered to be trade distorting and therefore comes under programme reduction commitments.

11.14 Aggregate Measure of Support (AMS)

The amount of total subsides, subject to reduction commitments given by government to its agriculture sector is measured in terms of Aggregate Measure of Support (AMS). It is calculated on a product-by-product basis using the difference between the average external reference prices for a product and its applied and administered price multiplied by the quantity of production. To compute AMS, non-product specific domestic subsidies are added to the total subsidies calculated on a product-by-product basis.

The initial AMS calculations were based on how much support of this kind were provided for the agricultural sector per year in the base year of 1986-88. Developed countries agreed to reduce their AMS by 20 percent in six years starting from 1995. Developing countries agreed to making 13.3 per cent cuts over ten years. Least developed countries were not required to make any reduction.

11.15 Export Subsidies

The agricultural agreement prohibits export subsidies on agricultural products unless the subsidies are specified in members' lists of commitments. Wherever they are listed, the agreement requires WTO members to cut both the amount of money they spend on export subsidies and the quantities of export that receive subsidies. Taking average for 1986-90 as the base level, developed countries agreed to cut the value of export subsides by 36 per cent over six years starting in 1985, which was 24 per cent over ten years for developing countries. Apart, developed countries also agreed to reduce the subsidized exports by 21 per cent over the six years, which was 14 percent over 10 years for developing countries. Least developing countries do not need to make any cuts.

During the six years implementation period, developing countries are allowed under certain condition to use subsides to reduce the costs of marketing and transporting. The agreement includes an understanding that certain actions available under subsidies agreements will not be applied with respective green box policies, domestic support and export subsidies maintained in conformity with commitments. The agreement has set up a committee that will monitor the implementation of commitments and follow up decisions.

The Export Subsidies are also subject to reduction commitments as under:

Export Subsidies (Base 1986-90)	Developed Countries (1995-2000)	Developing Countries (1995-2004)
Subsidy Value Subsidised quantities	36%21%	24%13%

Export subsidies of the kind listed in the Agreement which attract reduction commitments are non existent in India.

The export subsidy subject to reduction commitment:

- Direct subsides contingent on export performance
- Government export sales or stock disposals are prices below domestic market prices.
- Other payments on the export of an agricultural product that are financed by virtue of government action.
- Subsidies on agricultural products contingent on their incorporation in export products and
- Subsidies affecting marketing and transport costs of exports.

11.16 Sanitary and Phyto-Sanitary Measures (SPS)

The agreement on the application of SPS measures is closely linked with AoA. The agreement covers the application of sanitary and phyto-sanitary measures in other words food safety, animal and plant health regulations. In order to harmonize sanitary and phyto-sanitary measures on wide basis as possible, members are encouraged to base their measures on international standards, guidelines and recommendations where they exist. However, members may maintain or introduce measures, which results in higher standards, if there is scientific justification or as consequences of consistent risk decision based on an appropriate risk assessment. The agreement spells out procedures and criteria for the assessment of risk and the determination of appropriate levels of SPS protection. It is expected that members would accept the sanitary and phyto-sanitary measures of others as equivalent if the exporting country demonstrates to the importing country that its measures achieve the importing country's appropriate level of health protection. The agreement includes provisions on control, inspection and approval procedures.

11.17 Subsidies and Countervailing Measures

The agreement contains a definition of subsidy and induces the concept of a 'specific' subsidy. The agreement establishes three categories of subsidies. 'Prohibited' subsidies are those contingents in law, upon export performances, upon the use of domestic over imported goods. Prohibited subsidies are subjected to new settlement procedures, and if it is found that the subsidy is indeed prohibited, it must be immediately withdrawn, if this is not done within the specified time period, the complaining member is authorized to take measures.

The second category is 'actionable' subsidy. The agreement stipulates that no member should cause, through the use of subsidies, adverse effects to the interests of other signatories i.e., injury to domestic industry of another signatory, multification or implement of benefits accruing directly or indirectly to other signatories under the General Agreement (in particular the benefits of bound tariff concessions), and serious prejudice to the interests of another member.

The third category involves 'non-actionable' subsides, which could either be non-specific subsidies or specific subsidies or specific subsidies involving assistance to industrial research and pre-competitive development activity, assistance to disadvantaged region or certain type of assistance for adapting regulations. As this is lapsed and hence under renewal, the agreement also concerns the use of countervailing measures on subsidized imported goods. If the case is found genuine, then in addition to tariff, the country can also impose 'countervailing duty' (CVD) on the goods.

11.18 India's Agricultural Trade

Despite being an agrarian economy, where the agricultural sector provides employment to 65 percent of the population and contributes 25 percent to the GDP of the country, India has remained a marginal player in world agricultural trade. Currently, it has a share of less than 2 percent of the world market in agriculture. India is an importer of pulses, oilseeds and edible oils. The share of agricultural products including coffee, tea and fisheries in the total exports of India was around 14.6 percent in the year 1999-2000.

The post-Uruguay Round experience has been a mixed one for agricultural trade in India. While in certain cases, exports have increased and in others a decline has been registered. However, these cannot be attributed solely to the impact of the Agreement on Agriculture. An increase in traditional export items is largely due to the comparative advantage that India enjoys in production of certain items and because of a large number of ethnic Indians living abroad who have a preference for Indian products. The traditional item, which have registered an increases are rice, sesame seed, oil meals, etc. Other factors, which are acknowledged to have limited our exports are, infrastructure inadequacies as well as ad-hoc domestic and trade policies. Meeting the sanitary and phytosanitary requirements of most trading partners also call for substantial investment in developing quality standards and developing adequate infrastructure facilities.

Another emerging area, which posses a challenge, is trade in genetically modified agricultural products. While it is viewed by experts, as a panacea for food and nutritional security problems of the country, doubt-mongers feel that we may be led into uncharted territory, which is fraught with serious implications for health.

11.19 Removal of Quantitative Restrictions (QRs)

India has maintained QRs for Balance of Payments (BoP) reasons. Consequent to improvement in India's Balance of Payments position, the US contended that the QRs should be immediately removed and they resorted to the Dispute Settlement procedures of the WTO. India lost the dispute both at the panel and the Appellate Body level and consequently, as per the decision of the Dispute Settlement Body (DSB) of WTO, had to remove all the QRS that were maintained on

BoP grounds. As per the bilateral understanding with USA for the determination of a Reasonable Period of Time (RPT) for implementing the decision of DSB, India was required to remove all its QRs since the early 1990 as part of the reform process of economic liberalization. Thus, out of a total number of 10,202 tariff lines (at 10 digit level), 6161 lines were already made free by 1.4.1996. Similarly, in successive years more tariff lines were freed and at the time of losing its case in the WTO's Dispute Settlement Body in September 1999, India had QRs only on 1429 tariff line on BoP grounds.

Ever since, there have been apprehensions that removal of QRs would open the floodgates of imports, but these fears appear to be unfounded. Actual empirical data reveals that at the aggregate macro level, the removal of QRs has not altered either the overall rate of growth of imports or even their composition. The non-oil imports have so far (April-January, 2001) witnessed a negative growth of 8.16 per cent. India's import basket has not been significantly affected with the QR phase out. The top 20 product groups continue to constitute 86 to 88 per cent of total imports. The picture is not reversed even if we look at the data at the disaggregated micro level.

The removal of QRs need not be seen as a threat since it provides an opportunity for our farm sector to become competitive which in turn should lead to increased exports. Only 4 or 5 countries like Bangladesh, Pakistan, Nigeria and Tanzania out of 141 WTO member countries are presently maintaining QRs, and that too with a predetermined phase out period. The removal of QRS being an inevitable reality, we will have to convert this challenge into an opportunity for increasing our competitiveness and exports.

11.20 Strengthening of Monitoring Mechanism

Continuous monitoring of about 300 sensitive items is being done. An Inter Ministerial Committee has gone into the impact of QR removal and has suggested corrective measures. Based on the Inter Ministerial Committee discussions, recommendations were made to the Finance Ministry for raising the applied tariffs of certain sensitive items and accordingly the import duty on several sensitive items have been increased from time to time. The imports are being closely monitored and in cases where any injury has been caused due to unfair trade practices by the foreign exporters or due to import surge, anti dumping action or safeguard action have been taken as provided in the various WTO agreements to give necessary protection to the domestic producers.

11.21 Creation of a Level Playing Field for the Domestic Producers

With a view to see that domestic producers do not have to face unfair competition and a level playing field is created, in addition to tariff protection, all imports are subjected to domestic laws, rules, regulations, procedures, technical and sanitary and phyto-sanitary standards applicable to the domestic industry. In this connection, DGFT had issued orders in November 2000 that all packaged imported products will have to indicate the maximum retail price as per the provisions of the Weights and Measures Act and also for the 131 items for which the Bureau of Indian Standards (BIS) certification is compulsory, the foreign exporters will have to get themselves accredited with BIS.

Further, the following notifications are being issued by DGFT to create a level playing field for the domestic industry/ domestic producers:

a. Import of tea waste is to be allowed only subject to fulfillment of conditions of the provisions of the Tea Waste (Control) Order, 1959.

b. The import of alcoholic beverages will be subject to the compliance of various mandatory requirements as might have been stipulated by the various State governments.

c. Import of all edible and food products as regards their quality and packaging requirements shall be subject to the conditions and the standards as might have been fixed under Prevention of Food Adulteration Act, 1954.

d. All meat and poultry products will have to comply with the conditions regarding manufacture, slaughter, packing, labeling and quality conditions as laid down under Meat Food Products Order, 1973.

e. Import of various edible products will be subject to the compliance of quality specifications, norms for packing, and limits of poisonous metals in fruit products and restrictions regarding use of food colours, preservatives and salts as have been prescribed in Fruit Products Order, 1955.

f. Besides, for items such as sugar where the domestic producer has to give a particular percentage of levy to FCI or Government at a fixed price, the same requirement will have to be met in the case of imported items.

g. Besides, Agriculture Ministry will make use of the provisions of the Plants, Fruits and Seeds (Regulation of Imports into India) Order, 1989 for ensuring that the foreign imported agricultural goods do not carry any pests or create any risks to human or animal life or plant health.

11.22 Assessment of the Impact of QR removal and available Trade Defense Measures

The QRs have been removed in stages for the last several years and in fact all the 1429 tariff lines on which QRs on BoP grounds were being maintained as notified to WTO in the year 1997, except for about 36 canalised tariff lines, have been freely importable from the SAARC countries since 1/8/1998. While the non-oil import figures for the period April-January 2001 have shown a negative growth of 8.16 percent, the exports during the April-January 2001 have growth at 20.7 per cent. Even at the micro level, it is seen that out of 714 tariff lines on which QRs were removed, 235 items were not imported at all during April-December, 2000 and overall only 12 percent growth in volume of imports has been observed for these 715 tariff lines during April-December, 2000. By and large, it is felt that the shifting of QRs is not going to disrupt the economic activity in any manner.

11.23 Capacity building and other corrective measures taken by the Government

The following are some of the measures taken by Government to build up the capacity of the farmers to face the challenges arising out of increased foreign competition in the wake of removal of QRs.

a. A high level task force was been created to consider problems arising from economic liberalization and to suggest steps to safeguard the interest of farmers; to integrate the use of information technology; and to ensure effective risk management.

b. A group of Ministers has been constituted in December 2000, to review the gamut of policies relating to incentives for increasing agricultural productivity and enhancing value addition; institutional arrangements to bring about greater price stability; and measures to build indigenous capacity to meet international competition and expand exports.

c. Series of steps taken to increase farm credit. Kisan Credit Cards have been issued providing flexibility and security in the flow of credit.

d. 50 percent subsidy is being given to the small and marginal farmers under the National Agriculture Insurance Scheme (NAIS).

e. A tax holiday for 5 years and 30 per cent deduction of profits for the next 5 years for the enterprises engaged in the integrated business of handling, transportation and storage of food grains.

For about 15 sensitive tariff lines where we had historically bound ourselves at zero or very low rates, Government of India successfully completed GATT Article XXVII negotiations and were able to raise the bound rates for items such as rice, skimmed milk powder, maize, mustard oil, spelt wheat etc. Department of Commerce has also strengthened its Designated Authority for Anti Dumping and Countervailing Duties. As per the latest WTO data, India is second only to South Africa in the use of anti-dumping action. In the last few months, preliminary anti dumping duties have been imposed with a gap of only about 75 to 80 days from the date of investigation as against the statutory minimum period of 60 days.

11.24 Experience of implementation of AoA

Experience during the last years shows that the AoA has not brought about the anticipated deepening of world trade in agriculture or spatial redistribution of agriculture production or improved returns to farmers in developing countries or greater transparency in agricultural trade. It is evident that a good number of provisions of AoA lack the required degree of rigor or contain ambiguities leading to the possibilities of varying interpretations. It is well known that the advantage of the lack of vigor and ambiguities in the Agreement have been accruing to those very members who are mainly responsible for the distortions in the international trade in agriculture. For example, tariffs continue to be quite high on products of interest to developing countries like sugar, rice or dairy products, because commitments Under the AoA require reductions only on an un-weighted average basis.

11.25 State of Play

Several countries in their proposals to the WTO have highlighted their positions. As regards proposals submitted by the European Communities, Switzerland, Japan, Norway, etc. some amount of reluctance in liberalizing agriculture trade is evident. Their contention is that the Agreement on Agriculture prescribes the time for commencement of the negotiations and not its culmination. Another

aspect highlighted in these proposals is the concern relating to the multifunctional nature of agriculture as distinct from the food and livelihood security concerns of developing countries. US position is to call for tariff reductions from applied levels, eliminating export subsidies and providing transparent, predictable and timely decisions for trading in genetically modified products.

11.26 Implication on Indian Agriculture

Being under a balance of payments cover, India had been maintaining Quantitative Restrictions (QRs) and had not undertaken any commitments with regard to market access and this has been clearly stated in our schedule filed in WTO. The only commitment India had undertaken was to bind its primary agricultural products at 100 per cent. However, there are a few tariff lines, which had been bound at lower tariff levels in the earlier rounds of negotiations. Out of these tariff lines, the bound levels of 15 tariff lines, which include milk, skimmed milk powder, spelt wheat, maize, rice, millet, sorghum, rape and mustard oil, were raised through successful negotiations under GATT Article XXVIII in December 1999.

India does not provide any product specific support other than market price support. During the reference period (1986-89), the total product specific AMS was (-) Rs. 24,442 crores. Since product specific AMS is calculated by subtracting the international price (fixed at 1986-88), from the domestic price and then multiplying the resultant figure by the quantity of production eligible to receive the support, a negative figure would arise if international prices were higher than domestic prices, hence the negative figures of AMS. Non-product specific subsidy is calculated by taking into account subsidies given for fertilizers, water, seeds, credit and electricity. During the reference period, the total non-product specific AMS came to Rs. 4581 crores.

Since our total Product Specific AMS is negative, and that too by a huge magnitude, and the Non-Product specific AMS is also well within the de minimis level, the question of our undertaking any reduction commitments did not arise. As such, we have not undertaking any commitment in our schedule filed in WTO. Even the calculations for the marketing year 1995-96 show the product specific AMS figure as (-) 38.47 percent and non-product specific AMS as 7.52 percent of the Agri –GDP. This still keeps our aggregate AMS well below the de minimis level of 10 percent. Moreover, the explanatory note to the AMS notifications also indicated that non-product specific support figures did not exclude the input subsidies given to low income and resource poor farmers, which India is entitled to exclude from AMS calculations Article 6.2 of AoA.

In India, exporters of agricultural commodities do not get any direct subsidy. The only subsidies available to them are in the form of exemption of export profit from income tax under section 80-HHC of the income Tax Act which is also not one of the listed subsidies (even normal agricultural income is non taxable in India); and the subsidies on cost of freight on export shipments of certain products like fruits, vegetables and floricultural products.

The agreement on Agriculture does not in anyway, require us to reduce our existing subsidies for research, pest and disease control, marketing and promotion services and various infrastructural support services. It does not in any way affect our existing PDS. India has not taken any obligation for providing market access opportunities to other trading partners. We are free to follow our own agricultural policy and various domestic support programmes for our farmers.

11.27 The Agreement on Agriculture (AOA): Summary of Salient features

The Agreement on Agriculture (AoA) forms a part of the Final Act of the Uruguay Round of Multilateral Trade Negotiations. The AoA was signed by the member countries in April, 1994 at Marrakesh, Morocco and came into force on the 1st January, 1995. The long term objective of the Agreement "is to establish a fair and market oriented agricultural trading system and that a reform process should be initiated through the negotiation of commitments on support and protection and through the negotiation of commitments on support and protection and through the establishment of strengthened and more operationally effective GATT rules and disciplines". It has been further stated that "the long term objective is to provide for substantial progressive reductions in agricultural support and protection sustained over an agreed period of time, resulting in correcting and preventing restrictions and distortions in world agricultural markets."

The Agreement incorporates three broad areas of commitments from Member states, namely:

1. Market access i.e. the disciplines on import restraints and tariffs;
2. Domestic support, i.e. subsidies by Governments to domestic producers, and
3. Export subsidies.

11.28 Market Access

On market access, the Agreement primarily envisages tariffication of all non-tariff barriers. In other words, non- tariff barriers such as, quantitative restrictions (quota, import restrictions through permits, import licensing etc.) are to be replaced by tariffs to provide the same level of protection and thereafter progressive reduction of the tariff levels is to be made.

The reduction commitments on import tariffs are as under.

Tariffs (Base: 1986-88)	Developed Countries (1995-2000)*	Developing Countries (1995-2004)*
Average cut for all agri. products	36%	24%
Minimum cut per product line	15%	10%

*Developed countries to meet the reduction commitments during 6 years and developing countries during 10 years.

11.29 India's Commitments

Being under a balance of payments cover, India had been maintaining Quantitative Restrictions (QRs) and had not undertaken any commitments with regard to market access and this has been clearly stated in our schedule filed in WTO. The only commitment India had undertaken was to bind its primary agricultural products at 100%; processed foods at 150% and edible oils at 300%. However, there are a few tariff lines, which had been bound at lower tariff levels in the earlier

rounds of negotiations. Out of these tariff lines, the bound levels of 15 tariff lines, which include milk, skimmed milk, powder, spelt wheat, maize, rice, millet, sorghum, rape, mustard oil, were raised through successful negotiations under GATT Article XXVIII in December, 1999.

India does not provide any product specific support other than market price support. Since products specific AMS is calculated by subtracting the international price (fixed at 1986-88 levels) from the domestic price and then multiplying the resultant figure by the quantity of production eligible to receive the support, a negative figure would arise if international prices were higher than domestic prices. During the base period, except for tobacco and sugarcane, international prices of all products were higher than the domestic prices, hence the product specific support under AMS was negative for India.

Moreover, the explanatory note to the AMS notifications also indicated that non-product specific support figures did not exclude the input subsidies given to low income and resource poor farmers, which India is entitled to exclude from AMS calculations under Art. 6.2 of AoA. Therefore, India is under no obligation to reduce domestic support currently extended to the agricultural sector.

11.30 Trade Defence Measures available and Action Taken

The various trade defence measures compatible to WTO are available to guard the domestic market and producers against import surges and dumping. Besides, several other actions have also been taken to strengthen the trade defence mechanism. The important measures as under:

- The imports are being closely monitored and in cases where any injury has been caused to the domestic producer or any serious injury has been apprehended due to unfair trade practices by the foreign exporters or due to import surge, anti dumping action or safeguard action can be taken as provided in the various WTO agreements to give necessary protection to the domestics producers.
- Anti dumping, anti subsidy countervailing duty or safeguard action as provided under various WTO agreements can be taken under certain circumstances.
- Article XX or XXI of GATT providing for general exception and on national security considerations respectively can be invoked to put QRs on any item as could be justified under these Articles of GATT.
- Department of Commerce has also strengthened its Designated Authority for Anti Dumping and Countervailing Duties. In the last few months, preliminary anti dumping duties have been imposed with a gap of only about 75 to 80 days from the date of investigation as against the statutory minimum period of 60 days.
- The time gap in the collection of import data, which used to be about 10 months in the Director General of Commerce Information and Statutes (DGCI &S) office, has been brought down to less than 3 months and efforts are being made to ensure that import data are available within a period of less than 30 days.

- Continuous monitoring of import about 300 sensitive items and monitoring of the impact of QR removal is done to enable the initiation of corrective measures as and when necessary.

- With a view to see that domestic producers do not have to face unfair competition and a level playing field is created, in addition to tariff protection, all imports are subjected to domestic laws, rules, regulations, procedures, technical and sanitary and phytosanitary standards applicable to the domestic industry.

11.31 Negotiations on Agreement on Agriculture

As mandated under Article 20 of the Agreement on Agriculture (AoA), the negotiations for further progressive liberalization to establish a fair and market oriented agricultural trading system have begun from 1st January, 2000. These discussions are taking place in Special Sessions of the WTO Committee on Agriculture.

11.32 India's proposals for the Negotiations

Based on the inputs received from the consultations held with various stakeholders, India's objectives in the negotiations are:

a) To protect its food and livelihood security concerns and to protect all domestic policy measures taken for poverty alleviation, rural development and rural employment.

b) To create opportunities for expansion of agricultural exports by securing meaningful market access in developed countries.

Indian proposals submitted to WTO on 15.01.2001 can be broadly classified into the following 2 categories:

i. Increasing the flexibility enjoyed by developing countries for providing domestic support to the agriculture sector under the special and differential provisions as also further strengthening of trade defence mechanisms with a view to ensuring the food security and to take care of livelihood concerns.

ii. Demanding of substantial and meaningful reductions in tariffs including elimination of peak tariff and tariff escalation, substantial reductions in domestic support and elimination of export subsidies by the developed countries so as to get meaningful market access opportunities.

11.33 Competiveness of Indian Agriculture

- Liberalization of world trade in agriculture has opened up new vistas of growth. India has a competitive advantage in several commodities for agricultural exports because of near self-sufficiency of inputs, relatively low labour costs and diverse agro-climatic conditions. Increasing the level of productivity to internationally competitive levels is one of the major challenges, which the country is facing today consequent upon dismantling of quantitative restrictions on imports, as per the WTO Agreement on

Agriculture. A regionally differentiated strategy, taking into account the agronomic, climatic and environmental conditions, is therefore sought to be pursued to realize the full potential of yield in every region.

- Given the constraint of limited arable land, increase in increase in production has to be from productivity enhancement through water shed development, land improvement programmes, and expansion of irrigation infrastructure. Input resources has to receive highest priority, so that cropping intensity can be increased. Sustainability issues need to be addressed on priority through frontline research and delivery programmes. Restoration of the health of soils fatigued by toxic residues of indiscriminate use of chemicals and water, optimal use of energy, bio diversity systems are equally crucial.

- The competitive advantage in itself is a relative concept and it depends upon the relative changes in the international market. If the international market is having distortions due to unreasonable support given by the countries to their domestic produce, the efficiency of agriculture produce comes under severe stress thus the competitive advantage is a dynamic phenomenon and is dependent on endogenous and exogenous parameters. In a study done by NCAER, the dynamics of competitive advantage was measured in terms of nominal protection coefficient, which is the ratio of border price and the domestic price. Due to dearest trend of prices in the international market the competitiveness of Indian produce has suffered during the decade. Hence, it is all the more imperative to evolve concrete strategies to make Indian agriculture competitive and enhance its efficiency.

11.34 Coping Strategies

It is expected that the Trade liberalization as a result of WTO-Agreement on Agriculture (AoA) would bring about a structural change in the global agricultural trade and a less distorted trading regime in which more efficient agricultural producers would stand to benefit. The National Agriculture Policy has identified various thrust areas primarily for accelerated sustainable growth of agriculture. This in turn addresses the issue of long term efficiency of Indian Agriculture. Enhancement of efficiency of Indian Agriculture would improve competitiveness in the International market resulting in greater market access for our agricultural produce. This would necessitate a focused agenda for reforms and enhancing efficiency of Indian Agriculture. The salient aspects of the same are:

- Support in the areas of research, extension, water and land management, infrastructure, post-harvest management, rural credit and agricultural risk management to sustain the growth and attain competitiveness.

- Investment in irrigation, watershed development, power and rural infrastructure.

- Re-organise production and export efforts on the basis of specific products in identified geographical areas with the tenet of comparative advantage. Encompass all areas from production to post harvest management, quality standards, processing, storage, transport and marketing activities. Setting up of facilities for grading, sorting and other post harvest technologies.

- Convert India's low use of agro chemicals into an opportunity.
- Compliance with international quality including hygiene and safety standards.
- Standards by Codex Alementarius and declaration of pest free areas for education and training on post harvest management and exportability of products.
- Establish a credible system of registration of accredited laboratories for quality certification.
- Redefining role of Agricultural Produce Marketing Centre (APMC) in a more competitive environment, integrate existing agricultural markets through information access, reduce the price spread, reduce trade barriers.
- Better network of existing institutions using more affordable technology, with the priority on coverage and local participation.
- Rationalisation of statutory levies.
- Improve credit, insurance and cooperative institutions.

11.35 Policy Thrust for Structural Reform, National Agriculture Policy

Policy thrust is needed for structural reform and national agricultural policy. These include:

- Enhancing comparative advantage
- Productivity acceleration
- Efficient use of inputs and their assured availability
- Diversification

11.36 DUS test guidelines for Protection of Plant Varieties and Farmers' Rights Act

India did not have any legislation on protection of plant varieties till recently. The commercial varieties were therefore freely available for research, seed production and cultivation. During 2001, significant developments have taken place with respect to the realization of the rights of breeders, farmers and local communities. The Protection of Plant Varieties and Farmers' Rights Act (PPV & FRA) was passed by the Indian Government, in tune with the WTO resolution.

11.37 The main objectives of the PPVFR Act

- To recognize and protect the rights of farmers in respect of the contribution made at any time of conserving, improving and making available plant genetic resources for the development of new plant varieties.
- To accelerate agricultural development in the country, protect plant breeders' rights; stimulate investment for research and development in public/ private sector for development of plant variety.

- Facilitate the growth of seed industry, which will ensure the availability of high quality seeds and planting materials to the farmers.

The act is published in the News letter of Seed Association of India. The act has eleven chapters and divides in to 97 clauses.

11.38 Salient features of the PPVFR Act

The Central Government shall establish an authority to be known as the **Protection of Plant Varieties and Farmers' Right Authority**. It shall consists of a chairperson and fifteen members as representatives of different concerned ministries and departments, seed industry, farmers organization, tribal communities and State level Women's organizations etc.

The act allows registration of new plant varieties that includes essentially derived varieties, extant varieties, or farmers' varieties provided they are novel and conform to the criteria of distinctiveness, uniformity and stability (Section 15, PPV and FR Act).

According to Section 15 of the act **'novelty'** means commercial novelty, i.e. the propagated or harvested material of the variety should not have been sold or otherwise disposed off earlier than one year in India, or outside India, not earlier than four years before the date of filing such applications.

'Distinctiveness' means that a variety is clearly distinguishable by at least one essential characteristic from any other variety whose existence is a matter of common knowledge.

'Uniformity' implies that the variety should be sufficiently uniform in its essential characteristics subject to variation as expected from features of its propagation.

'Stability' requires that the essential characteristics remain unchanged after repeated propagation. The new varieties will be subjected to DUS testing by the PPVFR Authority. The authority shall develop and publish in its journal, guidelines for DUS tests for each crop. (Section 29(9), PPVFR Rules).

11.39 Protection of Extant Varieties

The varieties which have been released during the last 15 years can be protected. The Registrar shall register every extant variety within three years from the date of notification under the Act, with respect to the genera and species eligible for registration subject to conformity to the criteria of distinctiveness, uniformity and stability as laid down under the legislation (Section 24, PPVFR Rules)

11.40 Farmers' Rights

Notwithstanding anything contained in this Act,

(i) A farmer who has bred or developed a new variety shall be entitled for registration and other protection in like manner as a breeder of a variety under this Act;

(ii) The farmers' variety shall be entitled for registration if the application contains declarations as specified in clause (h) of sub-section (1) of section 18;

(iii) A farmer who is engaged in the conservation of genetic resources of land races and wild relatives of economic plants and their improvement through selection and preservation shall be entitled in the prescribed manner for recognition and reward from the Gene Fund;

(iv) Provided that the farmer shall not be entitled to sell branded seed of a variety protected under this Act.

Explanation.

1. For the purposes of clause (iv), "branded seed" means any seed put in a package or any other container and labeled in a manner indicating that such seed is of a variety protected under this Act.

2. Where any propagating material of a variety registered under this Act has been sold to a farmer or a group of farmers or any organisation of farmers, the breeder of such variety shall disclose to the farmer or a group of farmers or the organisation of farmers, as the case may be, the expected performance under given conditions, and if such propagating material fails to provide such performance under such given conditions, the farmer or the group of farmers or the organisation of farmers, as the case may be, may claim compensation in the prescribed manner before the Authority and the Authority, after giving notice to the breeder of the variety and after providing him an opportunity to file opposition in the prescribed manner and after hearing the parties, it may direct the breeder of the variety to pay such compensation as it deems fit, to the farmer or the group of farmers or the organisation of farmers, as the case may be.

11.40.1 Comments

Any farmer who has bred or developed a new variety shall be entitled for registration and other protection in the like manner as a breeder of a variety, the farmers' variety shall be entitled for registration. Any farmer who is engaged in the conservation of genetic resources of land races and wild relatives of economic plants and their improvement through selection and preservation shall be entitled of reorganization and reward from the Gene Fund. He shall be deemed to be entitled to save, use, sow, resow, exchange, share or sell his farm produce including seed of a variety protected under this Act.

11.41 Rights of Communities

1. Any person, group of persons (whether actively engaged in farming or not) or any governmental or non-governmental organisation may, on behalf of any village or local community in India, file in any centre notified, with the previous approval of the Central Government by the Authority in the Official Gazette, any claim attributable to the contribution of the people of that village or local community, as the case may be, in the evolution of any variety for the purpose of staking a claim on behalf of such village or local community.

2. Where any claim is made under sub-section (1), the centre notified under that sub-section may verify the claim made by such person or group of persons or such

governmental or non-governmental organisation in such manner as it deems fit and if it is satisfied that such village or local community has contributed significantly to the evolution of the variety which has been registered under this Act, it shall report its findings to the Authority.

3. When the Authority, on a report under sub-section (2) is satisfied, after such enquiry as it may deem fit, that the variety with which the report is related has been registered under the provisions of this Act, it may issue notice in the prescribed manner to the breeder of that variety and after providing opportunity to such breeder to file objection in the prescribed manner and of being heard, it may subject to any limit notified by the Central Government, by order, grant such sum of compensation to be paid to a person or group of persons or governmental or non-governmental organisation which has made claim under sub-section (1), as it may deem fit.

4. Any compensation granted under sub-section (3) shall be deposited by the breeder of the variety in the Gene Fund.

5. The compensation granted under sub-section (3) shall be deemed to be an arrear of land revenue and shall be recoverable by the Authority accordingly.

11.42 Protection of innocent infringement

Notwithstanding anything contained in this Act,

i) A right established under this Act shall not be deemed to be infringed by a farmer who at the time of such infringement was not aware of the existence of such right; and

ii) A relief which a court may grant in any suit for infringement referred to in section 65 shall not be granted by such court, nor any cognizance of any offence under this Act shall be taken, for such infringement by any court, that at the time of the infringement he was not aware of the existence of the right so infringed.

11.43 Authorization of farmers' variety

Notwithstanding anything contained in sub-section (6) of section 23 and section 28, where an essentially derived variety is derived from a farmers' variety, the authorization under sub-section (2) of section 28 shall not be given by the breeder of such farmers' variety expect with the consent of the farmers or group of farmers or community of farmers who have made contribution in the preservation or development of such variety.

11.43.1 Exemption from fees

A farmer or group of farmers or village community shall not be liable to pay any fee in any proceeding before the Authority or Registrar or the Tribunal or the High Court under this Act or the rules made there under.

Explanation: For the purposes of this section, "fee for any proceeding" includes any fee.

11.44 Gene Fund

(1) Central Government shall constitute a Fund to be called the National Gene Fund and there shall be credited thereto:

a) The benefit sharing received in the prescribed manner from the breeder of a variety or an essentially derived variety registered under this Act, or propagation material of such variety or essentially derived variety, as the case may be;

b) The annual fee payable to the Authority by way of royalty under sub-section (1) of section 35;

c) The compensation deposited in the Gene Fund under sub-section (4) of section 41;

d) The contribution from any national and international organisation and other resources;

(2) The Gene Fund shall, in the prescribed manner, be applied for meeting:

a) Any amount to be paid by way of benefit sharing under sub-section (5) of section 26;

b) The compensation payable under sub-section (3) of section 41;

c) The expenditure for supporting the conservation and sustainable use of genetic resources including in-situ and ex-situ collections and for strengthening the capability of the Panchayat in carrying out such conservation and sustainable use;

d) The expenditure of the schemes relating to benefit sharing framed under section 46.

11.44.1 Duration of Protection

The registration shall be valid for 18 years for trees and vines and will be reviewed after nine years if found fit will be extended for the remaining period.

11.45 Requirement of DUS testings

1. Guidelines.
2. Database of extants/ notified varieties.
3. Selection of DUS test centre.
4. Pure seed of extant/ notified varieties and then safe storage.
5. Software for database/ analysis.

6. Awareness/ capacity building.

11.46 Some important definitions

11.46.1 Variety

A plant grouping except microorganisms within a single botanical taxon of the lowest known rank, which can be

i) Defined by the expression of the characteristic resulting from a given genotype of a plant of that plant grouping.

ii) Distinguished from any other plant grouping by expression of at least one of the said characteristics; and

iii) Considered as a unit with regard to its stability for being propagated, which remains unchanged after such propagation and includes propagating material of such variety, extant variety, transgenic variety, farmers' variety and essentially derived variety.

11.46.2 Farmer

Any person who:

i) Cultivates crops by cultivating the land himself, or

ii) Cultivates crops by directly supervising the cultivation of land through any other person, or

iii) Conserves and preserves severally or jointly with any person any wild varieties or traditional varieties or adds value to such wild species or traditional varieties through selection and identification of their useful properties.

11.46.3 Extant variety

A variety available in India which is:

i) Notified under Section 5 of Seeds Act, 1966 or

ii) Farmers' variety or

iii) A variety about which there is a common knowledge or

iv) Any other variety which is in public domain.

11.46.4 Farmers' variety

i) A variety that has been traditionally cultivated and evolved by the farmers in their fields.

ii) Is a wild relative or land race of a variety about which farmers possess common knowledge.

11.46.5 Farmers' Rights

i) The PPV & FRA, 2001, provides certain rights to the farmers, to save, use, sow, re-sow, exchange, share and sell his farm produce including that of the registered variety except that he cannot make and market it as branded seed with packing label, etc. that is demanded by the market.

ii) Farmers who develop new variety of plants like any other plant breeder can apply their material for registration by DUS testing procedures.

11.46.6 Researchers' Rights

i) Can use any of the variety registered under this act by any person using such variety for conducting experiment or research.

ii) The use of a variety by any person as an initial source variety for the purpose of creating other varieties.

iii) Authorization of the breeder of a registered variety is required where repeated use of such variety as parental line is done for commercial production of other new developed variety.

11.46.7 Essentially Derived Variety (EDV)

i) EDV is predominantly derived from another variety or initial variety; or from a variety that is derived from the initial variety, retaining the expression of the essential characteristics that result from the combination of genotypes of the initial variety and is clearly distinguishable from the initial variety except for differences that result from the act of derivation, confirms to the initial variety.

ii) The plant variety developed from an initial variety through transgenic approach, backcross derivative, mutants, chimera, somaclonal variants, and chimera and alike can come under the EDV.

KVK Action Tool - I

Problem Identification and Action Plan Preparation at Village Level: A Detailed PRA Exercise

Soumen Naskar, Sajeev, M.V., Gouranga Biswas, Narottam Kumar Meena & Ram Swarup Jat.

The article below presents results of a PRA exercise conducted at Sohenkhera village of Chittorgarh district of Rajasthan to understand various researchable, development and extension gaps existing in the village and to formulate solution to the researchable problems related to agriculture to address the needs of the farmers. The article provides detailed methodology of utilizing 26 PRA tools and analyzing them to reach at conclusions. The methodology of problem identification and making of problem tree and solution tree and final action plan is also given in detail.

1. Basic information of the village

Key Informants: Mohd. Rafeeque, Ratan Lal Jat, Gopu Jat, Bhaironlal Jat, Narayan Gayari, Kishan Gayari, Amarchand Lohar.

Basic information about the village was collected from the villagers (KIs), which constituted the primary data. The local panchayat member Mr. Mohd. Rafeeque helped a lot in gathering the primary data. Apart from this the secondary data were collected from the Agriculture Department, Panchayat Office, Patwari of Revenue Department, Veterinary Officer, KVK, Chittorgarh, Bio-resource Centre of MPUAT and Bhadsoda Sanwaliaji Mandir. The primary and secondary data collected from different sources were then crosschecked by triangulation between different stakeholders.

Name of the village	:	Sohenkhera
Gram Panchayat	:	Bagund
Panchayat Samiti	:	Bhadesar
Uptehsil	:	Bhadsoda
District	:	Chittorgarh
State	:	Rajasthan

Climate

Mean annual rainfall- 1100 mm (2006)

Annual temperature Range- 13-45° C (Max. 45° C, Min. 1° C)

Relative humidity: 20%

Scientist Probationers, 80th FOCARS, NAARM, Hyderabad and presently Scientists at NRC on Pig, Gauhaty, Assam, Zonal Project Directorate, Zone - III, Barapani, Meghalaya, CIBA, Kakdwip, West Bengal, NRC on Orchids, Pakyong, Sikkim and NRC on Groundnut, Junagarh, Gujarat respectively.

Geographical coordinates (in hectares)

Total area- 412.87

Cultivated area- 332

Irrigated area- 138.14

Residential area- 6.07

Other area: Fallow land: 35.16

Pasture land: 35.05

Panchayat land: 3.25

Demographic pattern

Total household number - 99

Total number of families - 124

Number of joint families - 109

Number of nuclear families - 15

Total population - 530

Number of male - 263

Number of female - 267

Literacy- 31.35% (Male- 51%, Female- 12%)

Community categorization

Number of Muslim families- 11

Number of Hindu families- 113

Number of tribal families- 5

Name of tribe(s) - Bheel

Major caste structure- Gayari & Jat (OBC)

Major social occupation- Agriculture & animal Husbandry

Occupational distribution of family

Families engaged in agriculture- 121

Families engaged in agriculture + business- 1

Families with government service (+Animal Husbandry): 2

Agricultural scenario

Land distribution (in hectares):

Kharif- 189 (0.18 I + 188.82 UI)

Rabi- 147.48 (138.14 I + 9.34 UI)

Summer- 1.56 (I), (I-Irrigated, UI- Unirrigated)

Average land holding per household- 2.9 Hectare

Largest land holding by any person- 8 Hectare

Kharif crops (in hectares for 2005-2006)

Maize- 137.26(UI)

Black Gram- 3.28(UI)

Sesame- 0.34(UI)

Groundnut- 39.86(UI)

Soya bean- 2.3(UI)

Lucerne- 0.17(I)

Sorghum (fodder)- 5.78(UI)

Total area cultivated (Hectares) - 0.17 (I) & 188.82 (UI)

(I-Irrigated, UI- Unirrigated)

Rabi crops (in hectares for 2005-2006)

Wheat- 35.32(I)

Barley- 2.47(I)

Chick pea-5.24(I)

Fenugreek- 1.22(I)

Mustard- 93.61(I) & 3.94(UI)

Taramira- 0.16(UI)

Potato- 0.5(I)

Onion- 0.11(I)

Lucerne- 3.73(I)

Total area cultivated (Ha) - 138.14(I) & 9.34(UI)

(I-Irrigated, UI- Unirrigated)

Summer crops (in hectares for 2005-2006)

Sorghum fodder- 0.05(I)

Ground nut- 1.51(I)

Total- 1.56(I) (I-Irrigated)

Highest recorded yield/hectare : Wheat- 50 qtl.

Mustard- 23 qtl

Maize- 28 qtl

Chick pea- 14 qtl

Total cropped area: 332 ha

Water sources

Wells- 26, tube wells- 1, water harvesting structure- 10.8 ha (Aug-Nov)

Fish species found

Murrells, minnows, spiny eels, glass fish and barbs (during monsoon).

Animal Husbandry

Cattle: 234 (Breeding bull- 5, Bullock- 158, Desi cow- 63,

Crossbred cow- 8)

Buffalo: 303 (Breeding bull- 2, Bullock- 50, She buffalo- 251)

Sheep: 103 (Ram & young male- 15, Ewe & young female- 88)

Goat: 332 (Buck & young male- 46, Doe & young female- 286)

Horse: 12 (all mare)

Poultry: 10 (2 cock, 8 hen)

Major breeds of livestock & poultry

Cattle- Nagori, Nimari, Jersey & HF crossbred nondescript

Buffalo- Nondescript, upgraded stock with Surti (earlier) & Murrah (ongoing), Pure Murrah

Sheep- Nondescript, Sonadi

Goat- Marwari, Jhakrana, Sirohi (Deogarh) pure & crossbred, nondescript

Horse- Kathiawari

Poultry- Nirbhik

Average milk, meat & wool yield

Cattle: Crossbred- 5-7 litre/day, Nondescript- 2-2.5 litre/day

Buffalo: Murrah- 6.5 litre/day, Nondescript (with Surti) - 4-5 litre/day

Goat- 20-22 Kg at one year

Sheep- 200-250 gm wool/shearing, three shearing/year

Grasses: *Cyanodon dactylon*, sudan, napier, doob.

The basic information collected from primary and secondary sources show that the village is entirely dependent on agriculture and animal husbandry for the livelihood. The farmers are taking crops in all the three seasons and animal husbandry is also practiced along with. Almost all the kharif and rabi crops are cultivated regardless of the productivity. The same situation is there with respect to rearing of animals. Joint families dominate in this village where all caste and religious people are living harmoniously. The literacy level is very low among the villagers especially with respect to women.

2. Village Transect

Key Informants: Md Rafeeque, Narayan Gayari, Ganeshlal Gayari, Bhalla Jat, Gangaram Gayari.

High land in the village

Field visit

Intercropping (Lucerne+Papaya)

Villagers traveling atop bus

Transects are systematic walks with key informants through the area of interest, observing, asking, listening, looking, and seeking problems and solutions. The main objective of the transect walk is to understand and study the major land uses, topography, water resources, natural vegetation and different ecological zones by observing, interacting and discussing with the KIs, while walking in the deciding direction. The findings can be mapped on a transect diagram. Most transect walks result in the outsiders discovering surprising local practices such as indigenous conservation practices, multiple uses of plants, and a great variety of crops. It has been instructive for many professionals to realize how much they do not see or do not think to ask about. The items for discussion include topics such as soil type, water resources, crops, vegetables, fruit plants, trees and shrubs, forages, animals, land use pattern, interventions, problems and opportunities. The village transect of Sohenkhera is presented along with.

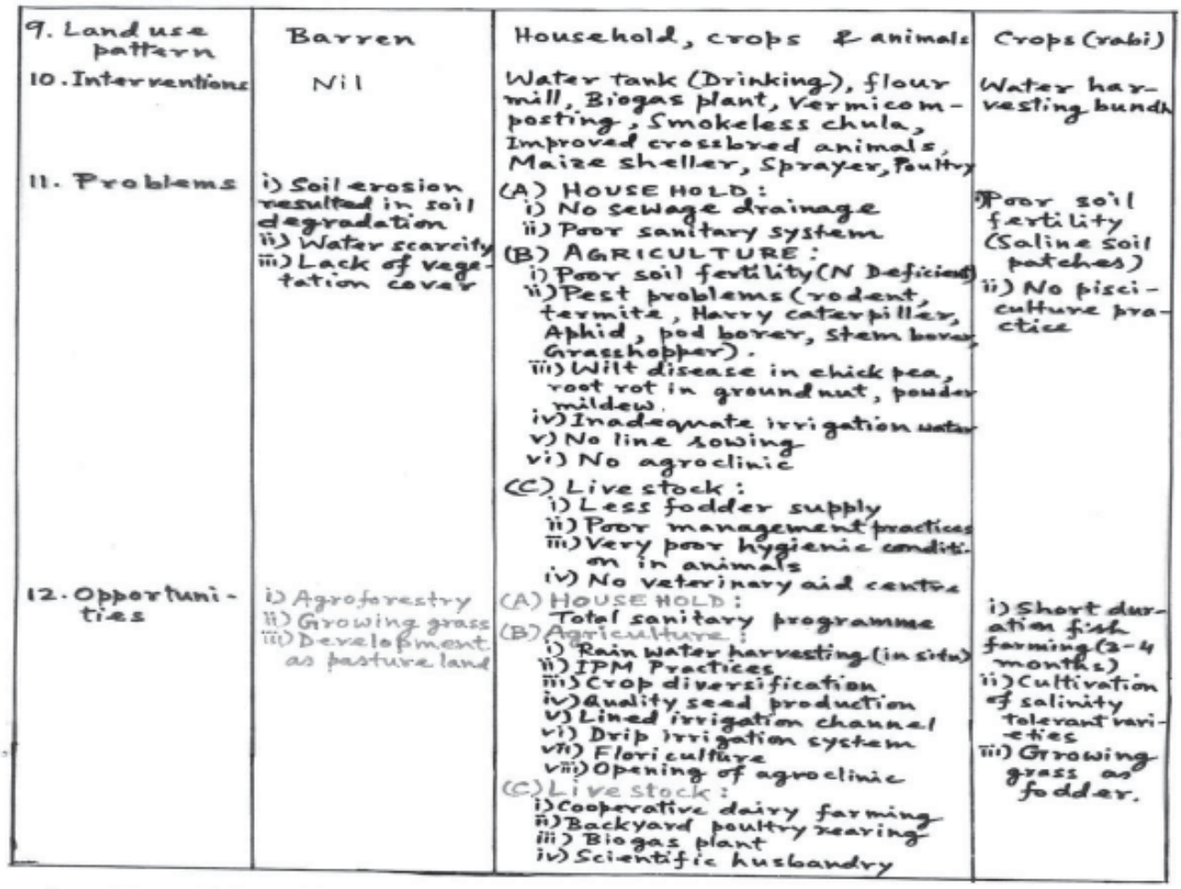
VILLAGE TRANSECT :

KIs:
Md Rafique
Narayan Gayari
Ganeshlal Gayari
Bhalla Jat
Gangaram Gayari

	High Land	Medium Land	Low land
1. Soil type	Sandy loam	Clayey loam, Black cotton soil	Black soil, Saline soil
2. Water resources	Nil	Wells & tube wells	Pond water (seasonal)
3. Crops	Nil	Wheat, Mustard, Ground nut, Chickpea	Wheat
4. Vegetables	Nil	Tomato, Broad beans, Cucumber, Chilly	Nil
5. Fruit plants	Nil	Mango, Lemon, Aonla, Ber, Papaya, Sehjana	Nil
6. Trees & Shrubs	Babul, Cactus, Ber-beri	Neem, Carange, Babul, Mahua, Palash, Eucalyptus, Amaltas, Chandan, Propopis, Bamboo	Nil
7. Forages	Babul leaves, Cyanodon, Penisatum	Lucerne, Sudan grass, Napier grass, Doob grass, Dry fodder	Doob grass, Sudan grass
8. Animals	Nil	Cattle, Buffalo, Sheep, Goat, Horse, Poultry	Fish (Murrals, minnows) — seasonal only

Contd.....

This village is directly in contact with the KVK, Chittorgarh and MPUAT, Udaipur. Even though they have witnessed many technological interventions in agriculture and animal husbandry practices, majority of the high cost technologies were given to influential farmers only while the remaining farmers are still following improper crop and animal husbandry management practices which have pushed them to very poor living standards. The top down approach followed by the various development agencies involved has taken its toll on the poor of this village.



9. Land use pattern	Barren	Household, crops & animals	Crops (rabi)
10. Interventions	Nil	Water tank (Drinking), flour mill, Biogas plant, Vermicomposting, Smokeless chula, Improved crossbred animals, Maize sheller, Sprayer, Poultry	Water harvesting bundh
11. Problems	i) Soil erosion resulted in soil degradation ii) Water scarcity iii) Lack of vegetation cover	(A) HOUSE HOLD: i) No sewage drainage ii) Poor sanitary system (B) AGRICULTURE: i) Poor soil fertility (N Deficient) ii) Pest problems (rodent, termite, Harry caterpiller, Aphid, pod borer, stem borer, Grasshopper). iii) Wilt disease in chick pea, root rot in groundnut, powder mildew. iv) Inadequate irrigation water v) No line sowing vi) No agroclinic (C) Live stock: i) Less fodder supply ii) Poor management practices iii) Very poor hygienic condition in animals iv) No veterinary aid centre	i) Poor soil fertility (Saline soil patches) ii) No pisciculture practice
12. Opportunities	i) Agroforestry ii) Growing grass iii) Development as pasture land	(A) HOUSE HOLD: Total sanitary programme (B) Agriculture: i) Rain water harvesting (in situ) ii) IPM Practices iii) Crop diversification. iv) Quality seed production v) Lined irrigation channel vi) Drip irrigation system vii) Floriculture viii) Opening of agroclinic (C) Live stock: i) Cooperative dairy farming ii) Backyard poultry rearing iii) Biogas plant iv) Scientific husbandry	i) Short duration fish farming (3-4 months) ii) Cultivation of salinity tolerant varieties iii) Growing grass as fodder.

3. Agro ecosystem map

KIs: Rameswar Gayari, Ratan Lal Jat, Umachand Gayari, Bhagavan Bheel, Basir Khan

Agro-ecological or agro-ecosystem map shows the macro and micro ecological (sub-systems) features in a village. The meteorological parameters like rainfall, temperature, relative humidity and the major flora and fauna of the village and the basic land use pattern such as crops, agro-forestry, forest cover, wasteland, animals and the natural resources like soil type, water resources (wells, river, channel, ponds etc.), common property resources (CPRs), use of locally available resources are depicted in this map. This map helps in the preparation of perspective planning for the village development.

Here the villagers were encouraged to draw the major land marks such as roads, boundaries, household area, low lying land and high lands first. Then based on the land topography they were asked to indicate soil types, crops, trees, animals, water resources etc.

The village Sohenkhera is situated in the Chittorgarh District of Rajasthan and surrounded by villages viz. Bhadsoda in the north, Bagund and Daulatpura in the east, Amarpura in the south and Sutharon ki Khera in the west. The maximum rainfall occurs during June- August which amounts to

around 1100 mm (2006). Average temperatures range between 13-45°C with the lowest of 1°C for a very short span during December-January. Average relative humidity prevailing here is 20%. There are high lands in two locations and it is characterized by sandy loam soil and sparsely covered by thin vegetation of Babul, Cactus and Zherberi. No crops and vegetables are grown here as there are no water sources. The household area, agricultural fields and pasture lands fall under the medium land category which covers the maximum portion of the village.

Clayey loam and black cotton soil of the medium land are used for growing wheat, mustard, maize, ground nut, chick pea, sorghum, black gram, sugar cane, fenugreek, garlic, lentils and vegetables like tomato, cucumber, chilly, broad beans etc. Irrigation is mainly with well water and in few areas with tube well water lifted through pumps. Organised orchard of fruit plants are not grown here. Fruit plants viz. lemon, mango, ber, papaya, sehjana, aonla are grown all over. Neem, carnage, babul, eucalyptus, prosopis, bamboo and cactus are the naturally growing trees of medium land. Lucerne and Napier grass are grown for fodder purpose and some naturally occurring grasses like sudan grass, doob grass and Panicum sp. are also available. Weeds such as *Cyanodon dactylum*, *Phalaris minor*, *Solanum nigrum* are found commonly. Babul trees and zherberi are common in pasture lands.

There is a small area of low lying land covering around 12 ha and mainly used for water harvesting during monsoon months. One artificial earthen bund was erected in one side of the low land to hold the water from catchment areas. Here water remains from August to November. Naturally occurring some fishes are found during the monsoon, these are minnows, murrels, spiny eels, glass

fish, barbs etc. No pisciculture practice is performed here since water remains for 3-4 months only and the water body is not an enclosed one. When water dries up during November wheat is cultivated here. Naturally growing grasses such as sudan grass, dhoob grass are found here. Black soil is prevalent in the low land and also there are some saline soil patches in between. No distinct forest is present in the village.

Mustard is the major crop cultivated during rabi season and it covers around 94 ha. The varieties grown are Vasundhara, Pusa Jaikisan and T59 (Varuna). The next important rabi crop is wheat covering 35 ha. Wheat varieties cultivated here are Raj 3765, Raj 4037, Raj 3077 and Lok 1. The other rabi crops are barley, chickpea (variety- Dahud yellow, Pratap Channa 1), fenugreek and lucerne fodder. The predominant kharif crops are maize, ground nut, soyabean, sorghum, black gram and sesame. Maize is the main crop of kharif season cultivated in 137 ha area. Commonly grown maize varieties are Navjot, Mahi Dhawal and Mahi Kanchan. Ground nut is cultivated both in the kharif and summer seasons covering around 40 ha and 2 ha respectively. Ground nut varieties, namely TAG-24 and DH-86 are grown here.

Cows (Nimari, Nagori, Jersey cross bred, HF crossbreed, non-descript), buffalo (non-descript, upgraded stock like Surti, Murrah), sheep (non-descrip, Sonadi), goat (non-descript, Marwari, Sirohi, Jhakrana), horse (kathiawari) are the animal species reared by farmers. Poultry (Nirbhik) promoted by MPUAT and KVK, Chittorgarh is reared as backyard enterprise. Farmyard manure is heaped in one place without following proper scientific practices and then later brought to the field.

There is ample scope to improve soil fertility status using village bio-resources. Crop productivity is relatively low but the farmers are unaware of it and they are satisfied with the present yield. Moreover, adopting the basic management practices which is presently lacking in animal husbandry will help the farmers in earning higher returns. Paucity of water is one of the major drawbacks in agriculture. If met up with, vegetable cultivation and floriculture can be promoted on a large scale in the village.

4. Resource Map

Key Informants: Rizia Begum, Pema Lal, Kishan Gayari, Sohan Kumar, Champalal Jat.

Resource map was drawn after collecting information by the active participation of KIs of different age groups including female. Resource map describes regarding main crops grown in the village, trees, animals, common property resources (CPRs), types of houses, school, farm implements, luxury and communication items, social resources like women groups, self help groups (SHG), local self government etc.

Land resources: The total geographical area of the village is 412.87 ha of which residential area covers only 6.07 ha and cultivated area is around 332 ha. Among the cultivated area, irrigation facilities are available in 138.14 ha.

Crops and crop based resources: Mustard is the main crop cultivated during Rabi season and it covers around 94 ha area. On an average 17-18 qtls/ha is harvested. The next important Rabi crop is wheat covering 35 ha land with average productivity of 45-48 qtls/ha. The other Rabi crops grown are barley, chick pea, fenugreek, lucerne fodder. The predominant kharif crops are maize

cultivated in around 137 ha area with average productivity of 25-28 qtls/ha. Other kharif crops are ground nut, Soyabean, sorghum, black gram, sesame etc. Ground nut is cultivated both in the kharif and summer season covering around 40 and 2 ha, respectively. Vegetables are grown for both household consumption and selling purposes. The vegetable crops cultivated are tomato, broad beans, cucumber, chilly.

Trees: Neem, Babul, Palash, Mango, Eucalyptus, Prosopis are found all over the village. There is no forest area in the village.

Fruit plants: The commonly occurring fruit plants of the village are Lemon, Mango, Papaya, Sehjana, Aonla etc. No organized fruit cultivation is seen here.

Animal resources: The village possesses about 63 desi cows, 8 crossbred cows, 163 bullock bulls, 52 male buffaloes, 251 female buffaloes, 105 sheeps, 355 goats and 6 horses. There is complete lack of scientific management practices in animal husbandry resulting in less income. Some backyard poultry are also reared by few families and this has recently been promoted by the KVK, Chittorgarh.

Common Property Resources (CPRs): There is pasture land in three places covering 35 ha area. Other CPRs include water supply tank, Choupal made by Gram Panchayat recently as a

meeting and resting place of villagers, temple, and two separate cremation grounds for Hindus and Muslims and a water harvesting bund constructed by Panchayat.

Government Institutions: There is one middle School (up to class VII) and one Anganwadi centre located beside the main road.

Water Sources: Source of irrigation is mainly by wells. There are 26 wells from which water is drawn by pumps. Also there are other sources of irrigation, namely tube well and water from low lying area harvested by the bund during monsoon months (August to November).

Types of houses: There are two types of houses- Kuchcha and Pucca. Kuchcha houses have earthen walls with roofing made of earthen tiles and these are generally owned by poor people, whereas the pucca or concrete houses are mainly owned by the rich villagers.

Farm implements and machinery: Animal driven implements like desi plough, bullock carts are found. Side by side six tractors (owned by rich farmers), six tractor trolley, six cultivators, eight disc plough, one foot sprayer, twenty eight sprinkler system, six tillers, six mould bored ploughs, five ferti-seed drills, three thrashers, and one maize sheller are owned by the villagers. Seventeen diesel and forty five electric pump sets are used for lifting the well water for irrigation purpose.

Luxury items: The village got electricity connection in 1970. TV, refrigerators, CD players and radios are mainly owned by rich and medium farmers.

Communication items: There is one WiLL (Wireless in Local Loop) telephone connection in the village. Mobile phones have already reached many farmers. For transportation purposes they use bicycles, motorbikes apart from tractor trolleys, auto rickshaws and private buses.

Self Help Groups (SHGs): There are six women SHGs existing in the village of which three were formed by the KVK, Chittorgarh, two were by Anganwadi Centre and one newly formed by the Bio-resource Centre, Bhadsoda Sawariaji Mandir. Now all these have been adopted by the Bio-resource Centre. The SHGs mainly has taken training on stitching, handicrafts, bag making, and other drudgery reduction efforts.

Shops: There are three small shops in the village. Two small grocery shops and one cycle repairing shop meet the villagers need to some extent.

There is scope of agricultural diversification in the village, but the major constraint is irrigation. New agricultural ventures like floriculture, vegetable cultivation are to be encouraged as these may give them more income.

5. Seasonal Calendar

This is a calendar, which indicates month wise the activities related to agriculture and livelihood, specialties, threats, abundance, and shortage with regard to agriculture in a diagrammatic way. The items to be included in seasonal analysis must be of those items, which really affect the agriculture. This explores seasonal constraints and opportunities by diagramming changes, month by month throughout the year.

PARTICULARS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
CROPS												
Wheat	Weeding Irrigation	Irrigation	Harvesting							Land preparation	Sowing Irrigation	Sowing late sown wheat 2nd top dressing Irrigation
Mustard	Irrigation	Harvesting								Sowing	Weeding Irrigation	Irrigation Pesticides spray
Groundnut		Sowing of ***summer*** crop	Irrigation Weeding	Irrigation	Irrigation	Harvesting Sowing of ***kharif*** crop	weeding	Pesticides spray	Irrigation	Harvesting		
Maize						Sowing	Sowing Weeding	Weeding Pesticides spray	Harvesting			
Others				Deep ploughing FYM application	Field preparation for ***kharif*** crops							
LIVE STOCK												
Cattle & Buffalo	← Daily management, Marketing of milk & young/adult animals, Health care, AI, Natural matting →											
							Free range grazing					
Sheep	← Daily management, Free range grazing, Marketing of wool & young/adult animals, Health care, Natural matting →											

The main activities, problems and opportunities of the village were identified by using seasonal calendar. It depicts time-to-time crop related operations being carried out in the existing farm situation. Seasonal analysis helps in identifying the period which are critical in respect of labor demand, pest and disease problems, non-availability of fodder during dry months.

Key informants: Neema Ram Jat, Amarchand, Gayari, Rama Jat, Ganga Ram Gayari

6. Gender Disaggregated Seasonal Calendar

The field activities are being done by both men and women. There are certain activities, which are carried out exclusively by men or women. So it is important to know those specific activities with regard any particular village.

Key informants: Hajari Lal Jat, Ghasi Gayari, Shankar Lal, Heera Lal

The Information regarding participation of men and women in various farm activities was collected by discussing it with them. The collected data was consolidated and presented in the form of a table. The problems associated with it were also analyzed based on the discussion.

7. Seasonal Analysis

To know about the problems related to crops, vegetable, and livestock a seasonal analysis is carried out. In this method, the pests and diseases affecting various crops and vegetables are documented pertaining to their months of attack. Other information like availability of labor and fodder for animals are also recorded by involving the farmers. The information collected is depicted in the form of a table.

Key informants: Bhaira Chamar, Pratap Gayari, Gokal Gayari, Bhera Jat

8. Social Map

KIs: Ratan Lal Chaudhary, Narayan Gayari, Behra Lal Jat, Ganesh Lal Gayari, Mohd. Rafeeque

A. Caste, Community & Religion: Majority of the families at Sohankhera village are Hindu. Muslim is minority here with 11 families. People of nine different castes of Hindu religion, namely- Gayari, Jat, Regar, Chamar, Lohar, Sain, Vaishnav, Nayak and Bheel live here. Gayari and Jat (OBC) are more in number and Jat caste members wield maximum influence. Scheduled caste (e.g. Chamar) and scheduled tribe (Bheel) with few families have low presence socially. Muslim (Mirasi) community is relatively well of compared to them.

B. Neighbourhood: To the north of Sohankhera village, Bhadsoda (2 km away), a very prosperous village, is situated with all the amenities. In the east, Bagund and Daulatpura, in the south, Amarpura and in the west, Sutharan ki Khera are located.

C. Family: Joint families are more common with few nuclear families. Old people being family head in joint families draw respect and have their own say and tradition.

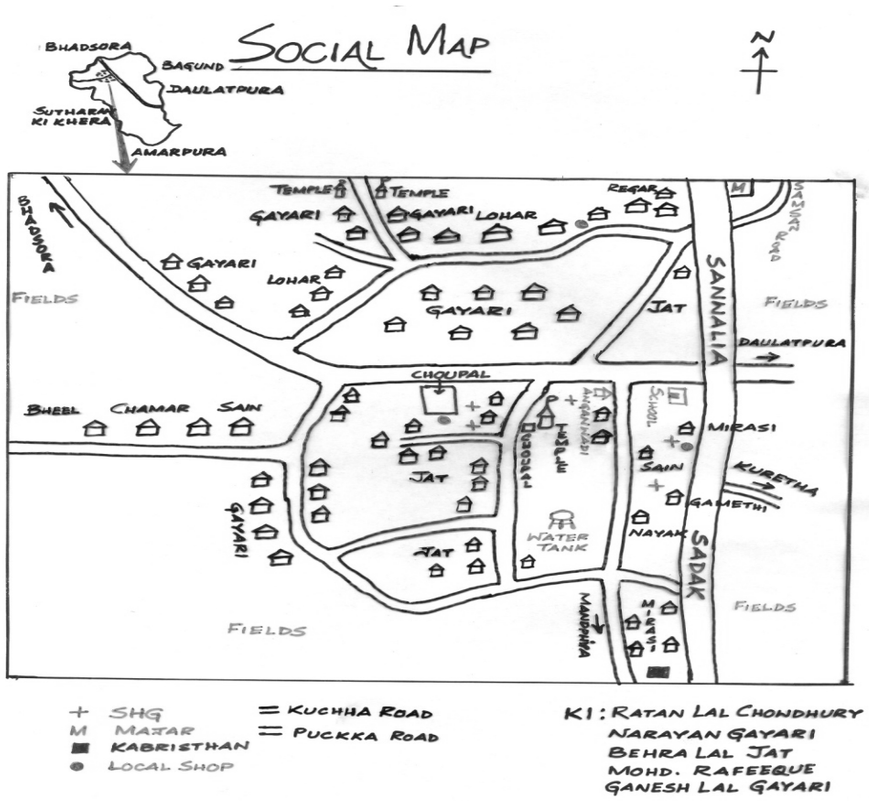
D. Economy: Agriculture with animal husbandry is the main source of income. More than 90% of the families depend on it for livelihood. Since draught is frequent visitor here, animal husbandry is very important. Twelve BPL families almost exclusively draw their livelihood from animal husbandry. Rich people of the village have business of agriculture implements along with large amount of land.

E. Social Institutions: Village temple (with limited access to lower class people) is important with the religious people of Sohenkhera. One newly constructed choupal forms the social bridge. One anganwadi centre and six SHGs (formed by KVK, Chittorgarh and Women Bio-resource Centre of MPUAT, Udaipur) have given voice to the women folk by providing training and developing entrepreneurship.

F. Governmental Institutions: One middle school (up to class VII) and one Anganwadi centre are the two government institutions here.

G. Media of Communication: Cycle, motorbike, cart and tractor (with trolley) are main mode of transportation. Few private buses operate here to go to the neighbouring places like Bhadsoda, Mandphiya. National highway 76 passes north to the village (2 km away) where good facilities of transportation exist for going to district head quarter (Chittorgarh) and Udaipur city. Mobile and land line phones are very few in number.

H. Entertainment: Radio and TV are popular mode of entertainment. One cinema hall at Mandphiya (5 km away) is sometime visited. No popular sports (like cricket and football) are played by the children and youth.



I. Educational Background: Low literacy (especially among women with just 12%), high school drop outs are serious concern and hindering the progress of the village. For quality education, they have to go to Chittorgarh (district head quarter and 35 km away) and Udaipur (88 km away).

J. Leadership Pattern: Panchayat system is fully functional here with one elected member from this village (from minority community). However, caste based leadership is more visible in daily life. One large farmer – Mr. Ratan Lal Jat draws respect and command across communities.

K. Value System: It is strong and relatively orthodox. Farmers from Jat community proudly boast that they would better die of hunger than to go for other labour work. Girls' education is not at all encouraged. Poor social status of the women in the village along with low encouragement for their education and rampant underage marriages sums up for the deplorable value system.

L. Social Cooperation: Fair degree of social cooperation exist as different communities live in perfect harmony and have unified voice to get different benefits from Governmental agencies. Accommodation of minorities by the majority in the village is praiseworthy.

M. Status of Women and Children: Very low level of literacy, limited exposure to outside world and superstitions make the women folk particularly vulnerable. Health care facilities are poor and at distant places. Hygiene of households is poor and practically there is no drainage system. All these factors along with malnutrition have a negative impact on average health of the children. With the formation of SHGs for women, the condition is fast changing.

N. Social Evils: The average age of marriage (Male 18-20 years & Female 14-15 years) is low. Reverse dowry is sometimes practiced in Jat and Gayari communities as the sex ratio is skewed against the women.

9. Time Line

KIs: Ratan Lal Jat, Gangaram, Bhairu Lal Jat, Ganesh Lal Gayari

Historical analyses have been found to be a good icebreaker for field exercises and include detailed accounts of the past, of how things have changed, particularly focusing on relationships and trends. These include technology histories and review, crop histories and biographies, livestock breed histories, labor availability, trees and forest histories, education change, and population change. Folklore and songs are valuable resources for exploring history.

We started our PRA exercise in the village with the time line tool. The interesting results are arranged in chronological order and presented below.

1700 AD	:	Establishment of Sohenkhera village (name due to goldsmith who settled here)
1955	:	Establishment of temple
1957	:	Bicycle
1960	:	Radio
1962	:	Fertilizers (Urea & SSP), fungicides, pesticides
1965	:	Bus service (Private: Udaipur to Avari Mata)
1966	:	HYVs (Wheat: Kalyan Sona, Maize: Sankar Makka)
1968-70	:	Drought
1970	:	Road, electricity
1972	:	Hand operated chaff cutter, motor pump
1975	:	Primary school
1977	:	Murrah buffalo, Sirohi goat
1980	:	Thresher (Wheat & maize)

1982	:	Hand pump, motor cycle (Rajdoot)
1990	:	Tractor (Massey Ferguson), TV
1991	:	Tractor trolley with compressor
1992	:	Jersey cow, Flour mill
1995	:	Bore well
1996	:	Water tank
1997	:	Seed drill, Power operated chaff cutter, Dish antenna, Cable TV
1998	:	Telephone (land line)
2000-04	:	Severe drought
2003	:	Mobile phone, Jeep
2004	:	Vasundhara variety of mustard, Smokeless Chulha
1980	:	Thresher (Wheat & maize)
2005	:	WLL
2006	:	Vermicompost, Auto-rickshaw & Van service,
2007	:	Biogas, Choupal

As shown in the time line, the village derived its name from the gold smiths who settled here. Surprisingly today they are not present here. This village presents a typical picture of a minority of innovative farmers introducing all the latest technologies from time to time. But all-weather roads, sanitary and drainage systems still eludes the village.

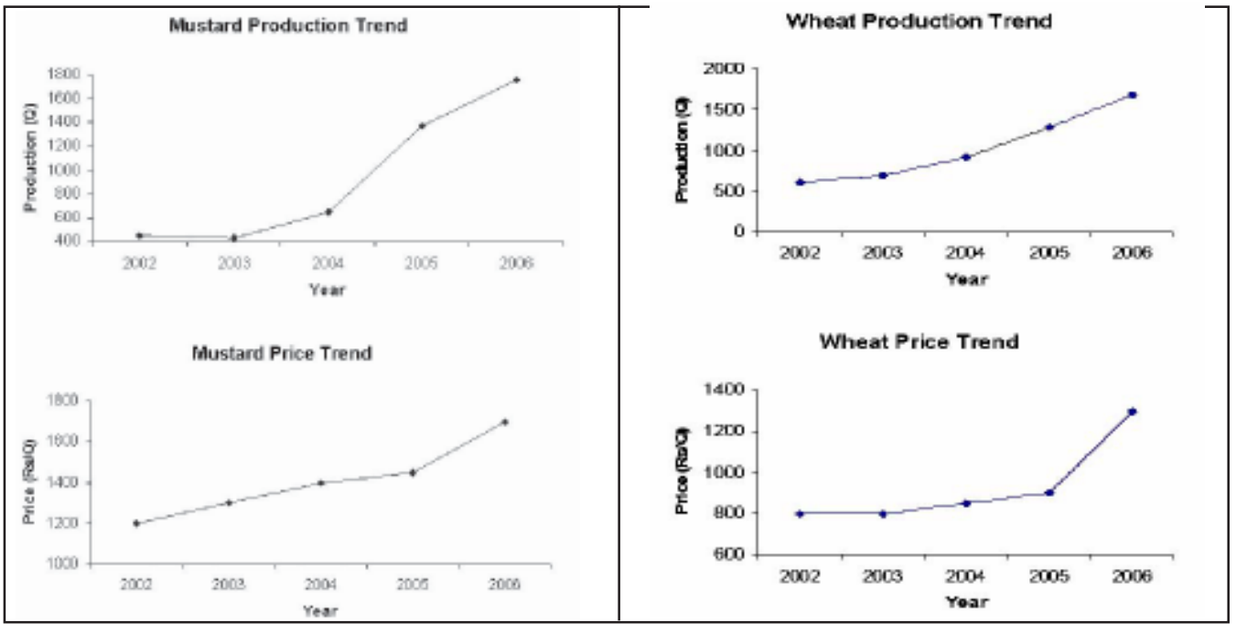
10. Time Trend

Key informants: Sh. Ratan Lal Jat, Bhairu Lal Jat, Kalu Lal Gayari.

Time trend shows quantitative changes over the period of time and can be used for many variables of agricultural, livestock, poultry production, price, yield and area under cultivation.

Time trend for wheat and mustard production and prices

The production (Q/ha) and price (Rs/Q) of wheat is presented in the figure. There was steady increase in wheat production and its price during the last five years. During the year 2002 to 2004, the production was increasing slowly due to less availability of water and frost attack. Similar trend in term of production and price was also observed in mustard.



Time trend for milk and meat prices

The milk and meat price in Sohenkhera village for the last five years is presented in the figure. The trend of milk price was slightly in increasing order and similar trend was found in meat price over the years.

11. Mobility map

Key informants: Sh. Ratan Lal Jat, Prithvi Raj Gayari, Md. Rafeeque.

The mobility map indicates the places to which the villagers go outside of their village for various purposes like purchasing agricultural inputs, family needs, animal husbandry needs, getting higher education, medical needs, social relations and recreation etc.

Mobility map indicates

1. Places to which the villagers go for various purposes.
2. Direction of the place situated.
3. Mode of transportations.
4. Distance of the place from the village.
5. Cost of mobility in term of money spent etc.

All the people of the Sohenkhera village frequently visit nearby Bhadsoda for purchasing agricultural inputs, repairing motorbike, selling milk, veterinary medicine, loan etc. They mostly go to either Fatehnagar or Nimbara for selling agriculture produces. They visit Mandphiya for availing hospital, Bank and court facilities. Chittorgarh is the district head quarter where villagers go for

higher education, contacting KVK, Horticulture dept. and other administration work purposes. Udaipur is 88 km away from the village. Villagers go to Udaipur for visiting the MPUAT regarding their agricultural problems, getting higher education and also having some entertainments.

Sl. No.	Place of travel (km)	Dis-tance	Purpose	Mode of transport	frequency of travel	Cost of traveling
1.	Bhadsoda	2	Animal feed & medi-cine, agri implements, cooperative society, milk selling, agri inputs, provisions, education, veterinary hospital, vehicle repair	Bicycle, bike, walk, bus, auto	Daily	Rs. 2
2.	Chittorgarh (Dist Hq)	35	Administration works, education, health, Horticulture Dept, KVK, Electricity Board	Bus	Daily, monthly	Rs. 20
3.	Bagund	3	Public Distribution System (Ration shop)	Bicycle, bike, walk, bus, auto	Daily, weekly	Rs. 2
4.	Mandphiya	5	Bank (LDB), entertainment (theatre), court, referral hospital, Sanwaliji temple	Bicycle, bike, bus, auto	Weekly	Rs. 3
5.	Udaipur	88	MPUAT, education, entertainment	Bus	Weekly, monthly	Rs. 41
6.	Fatehnagar	30	Selling of agri produce (Mandi)	Tractor, tempo	3 times/ year	Rs. 20/ Qntl
7.	Nimbara	40	Selling of agri produce (Mandi)	Tractor, tempo	3 times/ year	Rs. 20/ Qntl

12. Venn diagram

Key Informants: Bhansilal Lohar, Kalu Gayari, Narayan Gayari, Sholaji Regar, Devji Gayari, Chuna Gayari, Rajeswar Jat, Govind Regar, Sankar Jat, Hira Jat.

Venn diagram is used for understanding institutional relationship with village and the villagers for a particular enterprise. Each circle represents individual/ institution and the size indicates the magnitude of influence.

Venn diagram is drawn to indicate the contributions of outside and inside agencies, organizations and individuals in the decision making process of the inhabitants as perceived by the villagers themselves.

Venn diagrams for two enterprises are given in next page.

i) Technology adoption for wheat

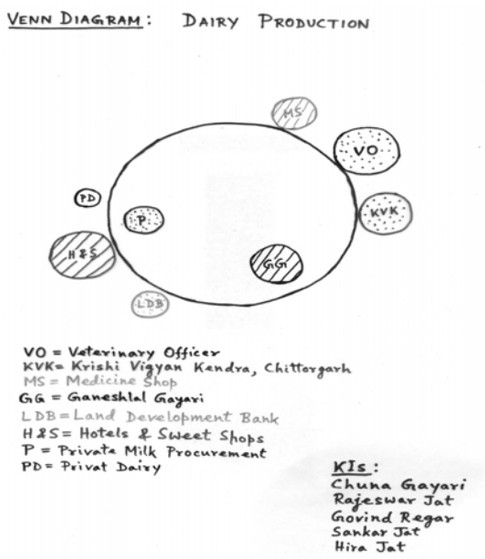
Purpose	Individual or Institution influencing
Technical information, technology diffusion, intervention, minikit distribution	MPUA&T, KVK, Chittorgarh, Ratanlal Jat (early adopter), Field Supervisor of Agriculture Dept.
Financial support (Kisan Credit Card, Short term credit)	Cooperative Society, Bhadsoda, outside money lenders, Land Development Bank, Mandphiya
Marketing	Whole sellers (75%) come at village, Mandi (25%) influences the price
Supply of inputs	Input shops and Cooperative Society at Bhadsoda

Though money lenders from outside influence much (lesser than the Cooperative Society) by extending immediate financial need for agriculture, but also take high interest on credit resulting in lesser profit to farmers. Till then, the farmers are going to them as they are getting money as per their needs in emergency. The credit procedure in Cooperative Society and Land Development Bank needs to be simplified so that the farmers can avail them as per their convenience.

ii) Dairy production

Purpose	Individual or Institution influencing
Technical information, interventions	KVK, Chittorgarh, Veterinary Officer, Bhadsoda
Treatments, animal insurance, AI	Veterinary Officer, Bhadsoda, Ganeshlal Gayari as quack in the village for treatment only
Financial help	Land Development Bank, Mandphiya for purchasing animals
Medicines	Veterinary Officer and medicine shops at Bhadsoda and Chittorgarh
Milk marketing	Hotels and sweet shops, Bhadsoda, private milk procurement firm comes at village and Private Dairies at Bhadsoda.

The villagers have good buffaloes having potential of high milk production. But due to lack of basic scientific management practices in animal husbandry, milk production in this village remains far below the expectation. There is no organized milk marketing. The cooperative dairy farming may solve the problem.



13. Wealth ranking

Wealth ranking refers to placing the people on different categories according to their own criteria. The purpose is to find out the persons of the village, who belong to the rich, middle, poor and very poor group categories as perceived by the villagers themselves. Wealth ranking is based on the assumption that the community members have a good sense about fellow villagers in their own village and are able to categorize themselves.

Agricultural development must take into account the differences in wealth among farmers in order to determine the priorities for research and to develop the interventions and technical packages that are to be adopted by the majority of the farmers.

Wealth ranking helps the extension workers, developmental staff, researchers and other concerned for rural and agricultural development to find out the inequalities and differences in wealth in every farmer and which in turn lead to overall understanding of socio-economic conditions of entire village community. This will also help in selecting the right type of beneficiaries for the various programmes. For wealth ranking of Sohenkhera village, list of all households is obtained from the village Panchayat Office, Bagund. The head of each household along with numbers of household members is written in separate small peace of card meant for wealth ranking. Four key informants (KI) viz. Shri Kalu Lal Gayari, Md. Rafeeque, Bhairu Lal Jat, Prithvi Raj Gayari who claimed to know each and every house in the village is asked separately to sort out the cards (having the name, no. of family members and household no.) into as many groups according to their own classification of different wealth classes. The criteria on which each KI was sorting the households was asked and noted separately. Each KI had full freedom to use as many numbers of categories as possible.

The categorization/classification, criteria as well wealth status of each household at Sohenkhera village according to the four KIs are given in the following table.

Categories according to KI (1): Kalu Lal Gayari

Sl. No.	Category	Criteria	Household No.
1.	Rich	Land>60 bigha Buffalo>10TV/Mobile	33, 63, 64, 94, 95, 96, 119, 120
2.	Medium	Land: 30-60 bigha Buffalo: 4-5TV/Mobile	3, 35, 37, 38, 41, 45, 48, 61, 62, 67, 68, 71, 79, 83, 103, 104, 118, 126, 127
3.	Poor	Land <30 bigha Buffalo <1-2Sheep/Goat	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 39, 40, 43, 47, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 65, 66, 69, 70, 72, 74, 75, 76, 77, 78, 80, 81, 82, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 97, 99, 100, 101, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 121, 122, 123, 124, 125, 128, 128, 129, 131, 132, 133, 134

Categories according to KI (2): Md. Rafeeque

Sl. No.	Category	Criteria	Household No.
1.	Very rich	Land:50-70 bigha Buffalo>10tractor	3, 33, 37, 41, 48, 62, 63, 64, 67, 68, 71, 79, 94, 95, 96, 104, 119, 120
2.	Rich	Land:30-50 bigha Buffalo: 8-10	38, 45, 47,61, 62, 83, 103
3.	Medium	Land: 20-30 bigha Buffalo: 5-8 No. of house 2	7, 31, 32, 34, 35, 39, 40, 49, 58, 59, 69, 70, 61, 72, 74, 82, 88, 90, 93, 112, 116, 118, 126
4.	Poor	Land:10-20 bigha Buffalo: 2-5 Sheep/Goat	1, 2, 4, 5, 6, 9, 10, 13, 14, 22, 24, 25, 28,29, 30, 51, 54, 60, 65, 66, 75, 78, 89, 91, 92, 100, 107, 108, 109, 110, 111, 113,115, 117, 121, 122, 123, 124, 127, 128, 129, 132, 133, 134
5.	Very poor	Land <10 bigha Buffalo <2 Sheep/Goat	8, 11, 12, 15, 16, 17,18, 19, 20, 21, 23, 26, 27, 43, 50, 52, 53, 55, 56, 57, 76, 77, 80, 81, 84, 85, 86, 87, 97, 99, 101, 114, 125, 131

Wealth ranking by KI 1

Wealth ranking by KI 2

Wealth ranking by KI 3

Livelihood analysis of a very poor farmer

Categories according to KI (3): Bhairu Lal Jat

Sl. No.	Category	Criteria	Household No.
1.	Rich	Land >30 bigha Buffalo >5Tractor Tube wellBike	3, 9, 33, 37, 38, 41, 45, 47, 48, 62, 63, 64, 67, 68, 71, 79, 83, 94, 95, 96, 103, 104, 116,118, 119, 120, 122, 126
2.	Medium	Land: 20-30 bigha Buffalo: 4-5Well	7, 11, 14, 31, 32, 34, 39, 40,70, 74, 82, 88, 90 112
3.	Poor	Land: 6-20 bigha Buffalo: 2-3	1, 2, 4, 5, 6, 10, 15, 16, 17, 25, 26, 30, 49, 51, 54, 66, 69, 72, 75, 91, 92, 93, 100, 108, 109, 110, 111, 113, 115, 117, 121, 128, 132, 133, 134
4.	Very poor	Land <5 bigha Buffalo <2	8, 12, 13, 18, 19, 21, 22, 23, 24, 27, 28, 29, 35, 43, 50, 52, 53, 55, 56, 57, 58, 59, 60, 65, 77, 78, 80, 81, 84, 85, 86, 87, 97, 99, 101, 107, 114, 123, 124, 125, 127, 129, 131

Categories according to KI (4): Prithvi Raj Gayari

Sl. No.	Category	Criteria	Household No.
1.	Rich	Land >30 bighaBuffalo >5Pucca house TractorBike Gold	3 33, 48, 63, 64, 69, 94, 95, 96, 103, 118, 119, 120, 123, 126
2.	Medium	Land: 15-30 bigha Buffalo: 4-5Pucca house Bike	7, 35, 37, 38, 41, 61, 62, 67, 68, 71, 83, 91, 104, 116
3.	Poor	Land: 5-15 bigha Buffalo: 2-3Kacha house	1, 4, 6, 9, 10, 11, 15, 31, 32, 34, 39, 40, 45, 47, 48, 79, 90, 93, 100, 109, 110, 111, 112, 121, 122, 124
4.	Very poor	Land <5 bighaBuffalo <2 Kacha house	2, 5, 8, 12, 13, 14, 16, 17, 18, 19, 20, 21,22, 23, 24, 25, 26, 27, 28, 29, 30, 43,49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 65, 66, 72, 74, 75, 756, 77, 78, 80, 81, 84, 85, 86, 87, 92, 97, 99, 101, 107, 108, 113,114,117,125,127,128, 129,131,132,133,134

Scoring of households:

Scores were given to various households according to the following formulae:

Score= n+1-Ci/nX100

Where, n= Total no. of categories made by KIs

Ci= i^{th} category in which a particular household placed by the KIs

Then average wealth score for each household is calculated by the formulae:

Average wealth score = Score of KI-1+KI-2+KI-3+Ki-4/4

Since different KIs used four nos. of wealth categories,

Average no. of wealth categories= Sum of no. of categories used by each KI/Total no. of KI

Categories =3+5+4+4/4 =4

The four categories are:

1. Rich
2. Medium
3. Poor
4. Very poor

All the households at Sohenkhera village are to be categorized into these four categories. All the wealth categories should have equal interval of scores. This can be calculated as follows:

Correction factor = (Max. – Min. score)/wealth category

CF = (100 - 25.75)/4 = 18.56

100 -18.56 = 81.44

81.44 -18.56 = 62.88

62.88 -18.56 = 44.32

Thus the score ranges for different categories are as follows

Sl. No.	Category	Score range
1.	Rich	81.44 to 100
2.	Medium	62.88 to 81.44
3.	Poor	44.32 to 62.88
4.	Very poor	25.76 to 44.32

The common criteria identified for wealth ranking in Sohenkhera village

Sl. No.	Common criteria	Rich	Medium	Poor	Very poor
1.	Land owned	>30 bigha	20-30 bigha	5-20 bigha	<5 bigha
2.	Buffalo	>5	4-5	2-3	<2
3.	Sheep/Goat	-	-	5-10	<5
4.	Tractor	One	-	-	-

Based on the score range and categories, the final wealth ranking table for the village is prepared (household kept blank when could not be identified by KI).

Wealth score of house holds of Sohenkhera village

House No.	Head of house hold	KI-1	KI-2	KI-3	KI-4	Avg. Score	Wealth category
1.	Onkar Gayari	33	40	50	50	43.25	Very poor
2.	Mangu Lohar	33	40	50	25	37.00	Very poor
3.	Udailal	66	100	100	100	91.50	Rich
4.	Uda Chamar	33	40	50	50	43.25	Very poor
5.	Dhapu Gayari	33	40	50	25	37.00	Very poor
6.	Bhagwan Gayari	33	40	50	50	43.25	Very poor
7.	Nimaram Jat	33	60	75	75	60.75	Poor
8.	Sarif Mohd	33	20	25	25	25.76	Very poor
9.	Amar Chand	33	40	100	50	55.75	Poor
10.	Shankar	33	40	50	50	43.25	Very poor
11.	Nagjiram	33	20	75	50	44.50	Poor
12.	Gokul Bheel	33	20	25	25	25.76	Very poor
13.	Hakim Khan	33	40	25	25	30.75	Very poor
14.	Gangaram	33	40	75	25	43.25	Very poor
15.	Nangjiram	33	20	50	50	38.25	Very poor
16.	Mewa Regar	33	20	50	25	32.00	Very poor
17.	Bhola Regar	33	20	50	25	32.00	Very poor
18.	Chunni Bai	33	20	25	25	25.76	Very poor
19.	Lakhma Regar	33	20	25	25	25.76	Very poor
20.	Bhairulal	33	20	25	25	25.76	Very poor
21.	Bhagwan Nai	33	20	25	25	25.76	Very poor
22.	Naran Jat	33	40	25	25	30.75	Very poor
23.	Jetun Bai	33	20	25	25	25.76	Very poor
24.	Ramlal	33	40	25	25	30.75	Very poor
25.	Shankar Nayak	33	40	50	25	37.00	Very poor
26.	Rameswar Nayak	33	20	50	25	32.00	Very poor
27.	Nanda Regar	33	20	25	25	25.76	Very poor
28.	Dalla Regar	33	40	25	25	30.75	Very poor
29.	Vardhu Lohar	33	40	25	25	30.75	Very poor

House No.	Head of house hold	KI-1	KI-2	KI-3	KI-4	Avg. Score	Wealth category
30.	Amarchand Lohar	33	40	50	25	37.00	Very poor
31.	Kajor Gayari	33	60	75	50	54.50	Poor
32.	Dalla Gayari	33	60	75	50	54.50	Poor
33.	Rama Jat	100	100	100	100	100	Rich
34.	Chatra Gayari	33	60	75	50	54.50	Poor
35.	Harli Bai	66	60	25	75	56.50	Poor
36.							
37.	Gangaram Gayari	66	100	100	75	85.25	Rich
38.	Kishore Gayari	66	80	100	75	80.25	Medium
39.	Rameswar Gayari	33	60	75	50	54.50	Poor
40.	Bhera Jat	33	60	75	50	54.50	Poor
41.	Hajarilal Jat	66	100	100	75	85.25	Rich
42.							
43.	Laxmilal	33	20	25	25	25.76	Very poor
44.	Ganesh Jat						
45.	Hiralal Jat	66	80	100	50	74.00	Medium
46.	Virdhichand						
47.	Narayan Jat	33	80	100	50	65.75	Medium
48.	Shankar Jat	66	100	100	100	91.50	Rich
49.	Ghasi Gayari	33	60	50	25	42.00	Very poor
50.	Sardar Khan	33	20	25	25	25.76	Very poor
51.	Rameswarlal	33	40	50	25	37.00	Very poor
52.	Govind	33	20	25	25	25.76	Very poor
53.	Bhagchand	33	20	25	25	25.76	Very poor
54.	Kishan Gayari	33	40	50	25	37.00	Very poor
55.	Amir Khan	33	20	25	25	25.76	Very poor
56.	Sardar Khan	33	20	25	25	25.76	Very poor
57.	Aziz Khan	33	20	25	25	25.76	Very poor
58.	Shankar Gayari	33	60	50	25	41.25	Very poor
59.	Kishan	33	60	50	25	21.25	Very poor

House No.	Head of house hold	KI-1	KI-2	KI-3	KI-4	Avg. Score	Wealth category
60.	Narayan Nai	33	40	50	25	37.00	Very poor
61.	Heera	66	60	-	75	67.00	Medium
62.	Bhairu	66	100	100	75	85.25	Rich
63.	Harlal Jat	100	100	100	100	100	Rich
64.	Bhagwan Jat	100	100	100	100	100	Rich
65.	Badridas	33	40	25	25	30.75	Very poor
66.	Shankardas	33	40	50	25	37.00	Very poor
67.	Gopu Jat	66	100	100	75	85.25	Rich
68.	Gokal Gayari	66	100	100	75	85.25	Rich
69.	Navanram	33	60	50	100	60.75	Poor
70.	Mangilal	33	60	75	-	56.00	Poor
71.	Gangaram Jat	66	100	100	75	85.25	Rich
72.	Udailai Gayari	33	60	50	25	42.00	Very poor
73.							
74.	Bhaira Chamar	33	60	75	25	48.25	Poor
75.	Madhu Lohar	33	40	50	25	37.00	Very poor
76.	Appar Khan	33	20	-	25	26.00	Very poor
77.	Nola Regar	33	20	25	25	25.76	Very poor
78.	Shankarlal Gayari	33	40	25	25	30.75	Very poor
79.	Narayan Gayari	66	100	100	50	79.00	Medium
80.	Kashiram	33	20	25	25	25.76	Very poor
81.	Bhagwan Bheel	33	20	25	25	25.76	Very poor
82.	Pratap Gayari	33	60	75	-	56.00	Poor
83.	Bhairalal Gayari	66	80	100	75	80.25	Medium
84.	Bhanwar Khan	33	20	25	25	25.76	Very poor
85.	Muneer Khan	33	20	25	25	25.76	Very poor
86.	Naranilal Bheel	33	20	25	25	25.76	Very poor
87.	Bhagawandas Bheel	33	20	25	25	25.76	Very poor
88.	Ganeshlal	33	60	75	50	54.50	Poor
89.	Mohan	33	40	-	-	36.50	Very poor

House No.	Head of house hold	KI-1	KI-2	KI-3	KI-4	Avg. Score	Wealth category
90.	Prithviraj Gayari	33	60	75	50	54.50	Poor
91.	Jeetmal	33	40	50	75	49.50	Poor
92.	Bhairu Nayak	33	40	50	25	37.00	Very poor
93.	Ramu Jat	33	60	50	50	48.25	Poor
94.	Bhaira Jat	100	100	100	100	100	Rich
95.	Shyani Bai	100	100	100	100	100	Rich
96.	Shankarsingh	100	100	100	100	100	Rich
97.	Rais Mohd	33	20	25	25	25.76	Very poor
98.	Madanlal Gayari						
99.	Ramjan Khan	33	20	25	25	25.76	Very poor
100.	Ratanlal Gayari	33	40	50	50	43.25	Very poor
101.	Dalchand Nai	33	20	25	25	25.76	Very poor
102.	Rama Jat						
103.	Shankarlal	66	80	100	100	86.50	Rich
104.	Rameswar Jat	66	100	100	75	85.25	Rich
105.	Dalla Jat						
106.	Roduram Gayari						
107.	Gangaram Lohar	33	40	25	25	30.75	Very poor
108.	Onkarlal	33	40	50	25	37.00	Very poor
109.	Laluram	33	40	50	50	43.25	Very poor
110.	Roda Gayari	33	40	50	50	43.25	Very poor
111.	Narayan	33	40	50	50	43.25	Very poor
112.	Chuna Gayari	33	60	75	50	54.50	Poor
113.	Mangilal Gayari	33	40	50	25	37.00	Very poor
114.	Basir Khan	33	20	25	25	25.76	Very poor
115.	Bhairulal Gayari	33	40	50	-	30.75	Very poor
116.	Narayan Gayari	33	60	100	75	67.00	Medium
117.	Champalal Gayari	33	40	50	25	37.00	Very poor
118.	Sabairam	66	60	100	100	81.50	Rich
119.	Ratanlal Jat	100	100	100	100	100	Rich

House No.	Head of house hold	KI-1	KI-2	KI-3	KI-4	Avg. Score	Wealth category
120.	Lachhiram Jat	100	100	100	100	100	Rich
121.	Bhagwan	33	40	50	50	43.25	Very poor
122.	Amarchand	33	40	100	50	55.75	Poor
123.	Kaluram	33	40	25	100	49.50	Poor
124.	Sadhu	33	40	25	50	37.00	Very poor
125.	Bhera Nayak	33	20	25	25	25.76	Very poor
126.	Amarchand	66	60	100	100	81.50	Rich
127.	Shankar	66	40	25	25	39.00	Very poor
128.	Lakhma Gayari	33	40	50	25	37.00	Very poor
129.	Champalal Jat	33	40	25	25	30.75	Very poor
130.	Omkar						
131.	Shambudas	33	20	25	25	25.76	Very poor
132.	Rama Gayari	33	40	50	25	37.00	Very poor
133.	Naran Gayari	33	40	50	25	37.00	Very poor
134.	Lalu Gayari	33	40	50	25	37.00	Very poor

Wealth category of Sohenkhera village, District Chittorgarh in Rajasthan

Sl. No.	Category	Number of families	Percentage
1.	Rich	20	16.13
2.	Medium	7	5.64
3.	Poor	20	16.13
4.	Very poor	77	**62.10**

15. Livelihood Analysis

Livelihood analysis refers to find out the degrees to which the pattern of life differs from one social class to another social class in term of size of family, size of landholding, type of house, implements, annual income, source of income, expenditure pattern, crisis management pattern, indebtedness etc. The livelihood analysis at Sohenkhera village was carried out after completion of wealth ranking. One representative villager from each of the wealth category (Rich, Medium, Poor and Very poor) was selected randomly.

The data on relevant information were collected from each of the categorized farmer which is explained in detail.

Variables	Rich (Ratan Lal Jat)	Medium (Pema Lal Gayari)	Poor (Ganeshlal Gayari)	Very Poor (Ganga Lohar)
Type of house	Pucca	Kuchcha	Kuchcha	Mud made
Family size	5	5	2	7
Men	2	2	1	3
Women	2	1	1	3
Children	1	2	-	1
Land holding	37 bigha	25 bigha	12 bigha	4 bigha
Nature of farming	Mixed	Mixed	Mixed	Mixed
Livestock:				
Buffalo	12	4	3	1
Cow	-	1	-	1
Sheep/goat	-	-	5	2
Income source	Agriculture-50%, Business- 50%	Agriculture- 91%, Livestock- 9%	Agriculture- 97%, Ghee selling- 3%	Agriculture- 43%, Blacksmith- 43%, Credit- 14%
Expenditure	Agriculture- 30%, food- 20%, celebration- 20%, health- 5%, savings- 25%	Agriculture- 45%, food- 36%, clothes- 9%, education- 3%, livestock- 3%, health- 2%, savings- 2%	Agriculture- 33%, food- 17%, celebration- 14%, livestock- 16%, transport- 3%, health- 3%, savings- 15%	Agriculture- 15%, food- 70%, clothes- 15%

Among the four wealth categories, there is a clear cut indication in the type of house owned by the villagers. Rich category people have pucca houses and medium and poor category people of the village live in Kuchcha houses, whereas, very poor category people live in mud made houses. There is no marked difference in family size of rich, medium and poor category but slightly big family

was observed in very poor category people. Rich category invariably has more than 30 bigha land and more than 5 buffaloes, while many of the very poor category villagers have land size less than 5 bigha with less than two buffaloes. Regarding source of income, rich category villager has another source of income other than agriculture, while medium and poor category villagers are totally dependent on agriculture along with very poor families in the village (especially in Lohar community having 43% income from blacksmith works). There are almost uniform expenditure patterns among the different groups with slight difference. Poor category people spend more on food and clothing due to their bigger family size and less in entertainment and there is no way of saving in very poor category. All rich category people go for saving as LIC etc. and very poor category people borrow money from local money lenders for crisis management.

16. Bio-resources Flow Diagram

Bio-resource flow diagram reflects the inflow and outflow of farm products and its byproducts from and to the household. It explains the interrelationship between different farm enterprises that enables holistic planning for development of farm household.

Key informant: Bhairon Lal Jat

A typical village household was selected for this purpose. Based on the discussion with farmer's information regarding bio-resource flow from farm to household and vice versa was collected. During the study, all bio resources such as agricultural and animal produces as well as their by products and wastes were taken into consideration for the diagram construction. In addition, possible bio-resource interventions were also indicated in the diagram for efficient use of bio resources.

The key informant had agriculture components such as wheat, mustard, chick pea, maize, groundnut, papaya, aonla, ber and lemon and animal components cow, buffalo, bullock, goat and sheep on his farm.

Existing flow:

The farmer utilizes the wheat and maize fodder as feed for cow and buffalo. The mustard fodder is used for fuel purposes in the house. The husk of chickpea was fed to goats. The grains of wheat, mustard, chickpea, maize and groundnut are used in house & remaining sold in the market. The animals are fed the grasses from the pasture land. The dung of cow and buffalo are used as manure in the field and as fuel in the house.

Proposed flow:

Many of the animal and plant components were not recycled properly, so the key informant was given with the new bio resource flow. The proposed flow included utilization of crop residues, cow & buffalo dung and kitchen wastes and suggested to prepare the vermicompost and biogas. The dung & dry fodder can be used for the preparation of vermicompost. From the dung he can make biogas and from biogas, gas can be used in the cooking & slurry either for the preparation of vermicompost or as manure directly in the field. He can use kitchen wastes for the preparation of vermicompost that is an important organic fertilizer in the fields.

7. Indigenous Technical Knowledge (ITK)

Key informants: Ganesh Gayari, Pema Lal, Prithvi Raj and Kishan Lal Gayari

Indigenous technical knowledge (ITK) is the information gained over a period of time and passed on from generation to generation by word of mouth. ITK is the sum total of knowledge and practices which are based on peoples accumulated experiences in dealing with situation and problems in various aspects of life. Such knowledge and practices are special to a particular culture.

ITK on Agriculture

Sl. No.	Practice	Purpose
1.	Neem leaves in granary	To control insects & pests
2.	Ash of cow dung in granary	To control insects & pests
3.	Ash of cow dung	To control chilli powdery mildew
4.	Ash of cow dung	To control insects in garlic field
5.	*Aloe vera* + cactus	As fencing around the fields

ITK on Animal Husbandry

Sl. No.	Practice	Purpose
1.	Feeding of excreta of pigeon	To cows to bring in heat
2.	Feeding of machis kept in roti	To buffaloes to bring in heat
3.	Butter milk applied to eyes	To stop excess tears in animals
4.	Red hot iron	Put in joints of dislocated limbs of cattle
5.	Feeding of neem leaves to new born calves	To control worms
6.	Feeding of mustard oil+hing+ water in the ratio1:1:1	To cattle in indigestion condition

ITK on Human

S. No.	Practice	Purpose
1.	Bark of Neem	Healing of wounds in Human beings
2.	Fig latex	To control skin dieses
3.	Saratha juice	To control menstrual problems in ladies

18. Technology Map

The technology map depicts the technologies related to agriculture and allied sectors that are found in villages as well as technology adoption behaviour of farmers that indicates the technologies that are adopted, rejected, discontinued and reinvented for different crops, domestic animal and fish.

Technology behaviour includes the process of

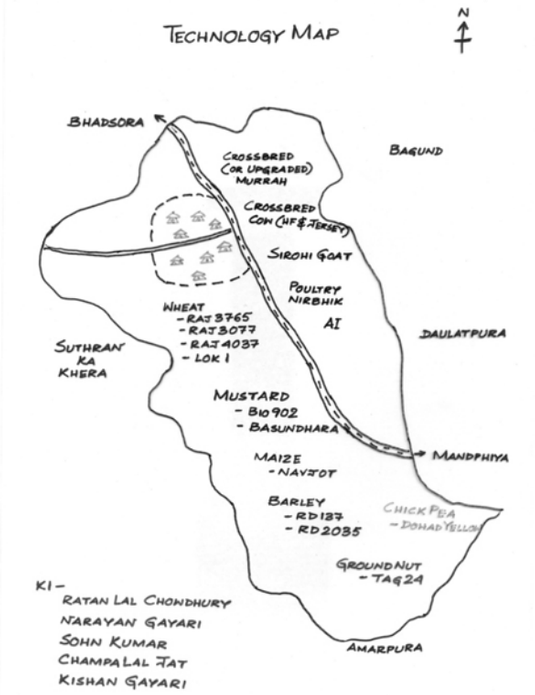
1. **Adoption:** It refers to use of technology by an individual for more than once. There are two types of adoption, namely active and passive adoption.

2. **Over adoption:** It refers to continued adoption of a technology by an individual when experts feel that he or she should have rejected it.

3. **Discontinuance:** It refers to decision to reject a technology after having previously adopted it. There are three types of discontinuance, namely replacement, disenchantment and forced discontinuance.

4. **Reinvention:** It refers to the degree to which a technology is changed or modified by the user in the process of adoption.

5. **Rejection:** It is of two types, namely active and passive rejection. Active rejection consists of considering adoption of technology (including even its trial) but then deciding not to adopt it. Passive rejection refers to the decision of not considering the technology at all from the moment of its hearing.



Technology map is one of the most important maps in PRA exercises necessary for preparing any research programme or extension programme. This gives a clue to the researcher about the type of technologies that should be developed in the technology development projects so that it will have better adoption rate.

Technology Map (Crop & Farm Power Machinery)

Sl. No.	Technology		Decision Behaviour	Reason
1.	Wheat	Raj 3765	Active adoption	High yield, more income, disease resistant
		Raj 3077	Active adoption	High yield
		Raj 4037	Active adoption	High yield, chapatti taste good
		Lok 1	Over adoption & Rejection	Moderate yield, good fodder yield
		Raj 1482	Replacement discontinuance	Low yield, less profit, susceptible to pest & diseases
		Raj 1485	Replacement discontinuance	Low yield, less profit
		Raj 1555	Replacement discontinuance	Low yield, chapatti taste poor
2.	Barley	RD 137	Active adoption	High yield, nematode resistant
		RD 2035	Active adoption	High yield, nematode resistant
		RD 103	Replacement discontinuance	Low yield
		RD 2552	Replacement discontinuance	Low yield
3.	Maize	Navjot	Active adoption	Hybrid, high yield
		Mahi Dhawal	Replacement discontinuance & over adoption.	Low yield
		Mahi Kanchan	Replacement discontinuance & over adoption.	Low yield

Sl. No.	Technology		Decision Behaviour	Reason
4.	Mustard	Bio 902	Active adoption resistant	High yield, disease
		Vasundhara	Active adoption	High yield
		T 59 (Varuna) discontinuance & over adoption.	Replacement	Low yield
		Pusa Bold	Replacement discontinuance & over adoption.	Low yield
		RH 30	Disenchantment discontinuance	Low yield
		RH 7	Disenchantment discontinuance	Low yield
5.	Chick Pea	Dahud Yellow	Active adoption yield, wilt resistant	High
		Pratap Channa	Passive adoption	Low yield
		C 235	Replacement discontinuance	Late variety, grows long
6.	Groundnut	TAG 24	Active adoption yield, disease resistant	High
		GG 2	Replacement discontinuance	Low yield
	DH 86	Replacement discontinuance	Low yield	
7.	Fertilizers & Chemicals	DAP, SSP, Urea, Endosulphan,	Active adoption yield, local availability, Furadon)	More protection against diseases
8.	Tractor	Massey Fergueson	Active adoption	Better & easy cultivation of land, labour saving

Sl. No.	Technology	Decision Behaviour	Reason
9.	FYM	Active adoption of soil, low cost, easy availability	Increased fertility
10.	Vermi compost ——	Yet to be assessed	
11.	Biogas Plant	——	Yet to be assessed

KIs: Bhairon Lal Jat, Narayan Gayari, Pema Lal, Mohd. Rafeeque, Kalu Lal

Technology Map (Animal Husbandry)

Sl No.	Technology	Decision Behaviour	Reason
1.	Crossbred (& upgraded) buffalo with Murrah breed	Passive adoption	More milk yield, 100% conception with AI, high fodder requirement, low fat%
	Native (with some Surti breed inheritance)	Over-adoption	Moderate milk yield, low fodder requirement, high fat%, milk taste good
2.	Crossbred cow (with HF & Jersey breed)	Passive adoption	High milk yield, high fodder requirement, limited pasture, low fat%
	Nagori bullock (or native upgraded with Nagori breed)	Active adoption	Very good for ploughing, hardy, disease resistant
3.	Sirohi Goat (Pure bred & crossbred)	Active adoption	Faster growth, more income, more milk yield, low production & labour cost, disease resistant
4.	Poultry (Nirbhik)	Active adoption	Low input, backyard farming, more egg production, cost effectiveness, disease tolerance
5.	Vaccination against FMD & HS	Active adoption	Low cost, easy availability, protection against disease, easy access to veterinarian
6.	Artificial Insemination	Passive adoption	High conception rate in buffalo, insufficient number of servicing male animal in village

KIs: Shankar Lal, Onkar Lal, Mangilal Gayari, Basir Khan, Bhairu Lal Gayari

19. Matrix Ranking

Matrix ranking is used for learning about local people's categories, criteria, choices, and priorities. Matrix scoring takes criteria for the rows in a matrix and items for columns, and people complete the boxes row by row. The items may be ordered for each of the criteria (e.g., for six trees, indicate from best to worst for fuel wood, fodder, erosion control, and fruit supply); or participants may put stones, seeds, or berries into piles for relative scoring.

For the present study, the popular wheat varieties in the village were ranked based on the yield, price in market, taste of roti, grain quality, pest and disease resistance and fodder quality (criteria given by the farmers). The results show that Raj 3765 is the most preferred wheat variety based on these parameters. Next to that, the choice varieties are Raj 3765, Raj 3077 and Lok1. For taste of roti, Raj 4037 is preferred and for fodder purpose Lok 1 is grown.

On the same line, different crossbred species reared by the farmers were ranked based on production, milk price (based on fat %), taste, low reproductive problem, low disease incidence, low fodder requirement, natural service/ AI access and low cost of procurement of animals. Crossbred Goat (SirohiXLocal/Jhakrana/Marwari) is the most preferred species followed by crossbred buffalo (MurrahXLocal/Surti) and crossbred cow (Jersey/HFX Local/Nimari).

Farmers' reaction during matrix ranking

Crowd watching matrix ranking

Snow ball technique going on

Ranking of problems

20. Consequence Diagram

Consequence diagram of technology is a tool to assess the impact caused by any technology in terms of changes that occurs to an individual or society as a result of adoption or rejection. It helps to predict the consequence of similar technology so that positive consequences could be promoted and negative consequences could be minimized. It is also useful for developing the strategies how to reduce the negative effects of the technologies being used. Wheat is one of the most important rabi crops for Sohenkhera village as it meets their household consumption as well as contributes income and profit. The wheat variety Raj 3765 is the most widely accepted and extensively cultivated here. Its positive and negative consequences as felt by the farmers are shown below. Buffalo is the most commonly reared animal for milk production purpose. Murrah crossbred of buffalo is an important animal resource of this village. Its positive and negative impacts as realized by the farmers are also depicted below.

Technology: Wheat variety - Raj 3765

Low pest and disease incidence

Good grain quality

Good price in market

(+) High production/yield

Raj 3765

(–) Shedding of grains when harvesting is delayed

Needs more irrigation

KIs : Devji Gayari, Sholaji Regar, Champa Lal Jat.

Technology: Crossbred Murrah buffalo

100% conception with AI

More milk production (with better feed)

More lactation period

High reproductive performance

(+) Gives more manure

Crossbred Murrah

(–) Disease prone

More feed cost (more feed needed)

Low fat% in milk

KIs : Rodi Lalji Gayari, Mohd. Rafeeque, Geheri Lal Gayari

21. Problem Identification

The problem identification exercise is done to address the following aspects:

1. to identify the real problems faced by farmers
2. to undertake research projects addressing the identified farmer problems
3. to target the available and new technologies towards the problems
4. to identify the various research, development and extension gaps and
5. to refine, transfer and develop appropriate technologies.

It goes on parallel to the conduct of other PRA tools since it involves the snowball technique of moving from one farmer to other over a period of time. We used the snowball technique and elucidated ranking from 30 farmers on the various problems affecting agriculture and animal husbandry as listed by them.

During the process the farmers identified 16 problems affecting agriculture and animal husbandry. The problems are listed down as follows:

1. CROP LOSS DUE TO FROST (WHEAT, MUSTARD AND CHICK PEA)
2. INADEQUACY OF IRRIGATION WATER
3. INFERIOR SEED QUALITY
4. WATER SALINITY
5. NON AVAILABILITY OF LABOUR
6. UNEVEN FARM LANDS
7. FOOT AND MOUTH DISEASE IN CATTLE
8. DIARRHEA IN CATTLE
9. TERMITE ATTACK IN FIELD
10. RAT ATTACK
11. LOW AVAILABILITY OF FODDER
12. PEST ATTACK IN FODDER
13. LACK OF IMPROVED FODDER VARIETIES
14. DIARRHEA IN SHEEP
15. LODGING IN CEREALS
16. ELECTRICITY PROBLEM

The problems were subjected to ranking by the farmers. A maximum of up to 10 ranks were given by the farmers. The problem ranking matrix is given below.

Ranks / Problems	1	2	3	4	5	6	7	8	9	10
Crop loss due to frost	23	5	2	-	-	-	-	-	-	-
Inadequacy of irrigation water	4	7	6	6	5	1	-	-	-	-
Inferior quality of seed	-	7	10	4	5	3	-	-	-	-
Poor quality of irrigation water	-	-	-	2	-	-	-	-	-	-
Non availability of labour	-	-	2	10	4	2	6	2	2	-
Uneven farm lands	-	-	-	-	2	-	-	-	-	-
Economic loss due to										
FMD in cattle -	-	3	2	6	13	2	-	-	-	
Diarrhea in cattle	-	-	-	1	-	-	2	1	-	-
Termite attack in field	-	2	1	2	7	3	9	3	1	-
Rat attack in field	2	-	-	1	-	5	-	3	-	2
Low availability of fodder	-	-	-	-	-	-	1	1	9	5
Pest attack in fodder	-	-	-	-	-	-	4	5	4	-
Non cultivation of improved fodder varieties	-	-	-	-	-	-	-	2	2	11
Diarrhea in sheep	-	-	-	-	-	2	-	-	1	-
Lodging in cereals	1	5	4	1	1	-	1	-	-	1
Inadequate electricity supply	-	2	2	-	1	-	1	4	-	1

The above listed problems were then categorized by us in to researchable problems, development problem and extension problems. Later based on the above rankings, the RBQs (Rank Based Quotients) were calculated for each of the problems by using the formula:

$$RBQ = \frac{\sum f_i (n+1-i) \times 100}{n \times N}$$

Where,

f_i = frequency (No:of farmers reporting that particular problem)

n = number of rank (rank given by farmer)

N = No:of farmers (30)

i = concerned ranks (1-10)

Later the VBI (Value Based Index) of the researchable problems were also calculated using the formula:

VBI = RBQ X total economic loss (average loss experienced x area under the crop(s) / no:of animals).

The categorization along with RBQ and VBI values are given below.

Problem category	**RBQ**	**VBI**
Research Gaps		
Crop loss due to frost (Wheat, Mustard and Chick pea)	**98.06**	**198392**
Economic loss due to FMD	63.10	686
Extension Gaps	**RBQ**	**VBI**
Diarrhea in cattle	8.73	
Termite attack in field	76.85	
Rat attack in field	30.34	
Low availability of fodder	27.49	
Pest attack in fodder	25.61	
Non cultivation of improved fodder varieties	24.37	
Diarrhea in sheep	7.28	
Lodging in cereals	33.68	
Development Gaps	**RBQ**	**VBI**
Inadequate electricity supply	34.28	
Inadequacy of irrigation water	93.65	
Inferior seed quality	68.82	
Non availability of labour	67.07	
Uneven farm lands	25.00	
Poor irrigation water quality	5.41	

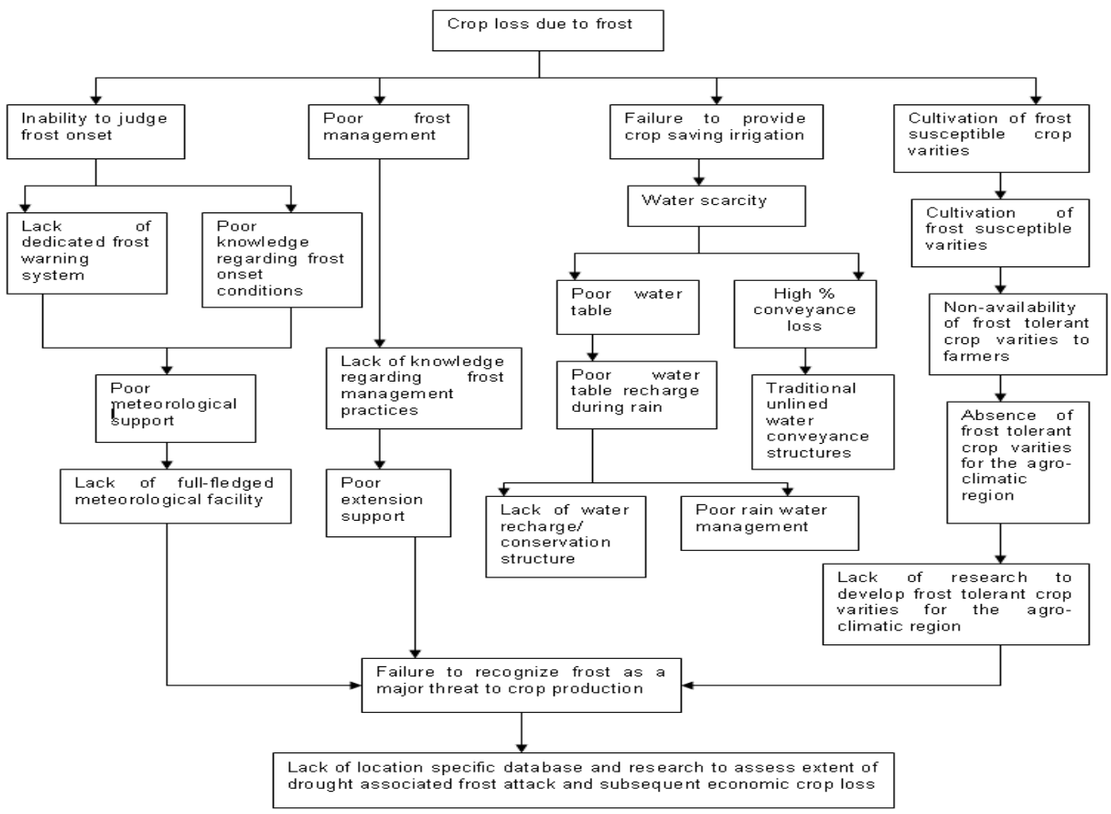
Based on the above calculation it was concluded that crop loss due to frost in wheat, mustard and chick pea during rabi season was the top most researchable problem in the village.

22. Problem Tree (Causal Diagram)

After identifying the top most researchable problem in the village, the problem tree consisting the logical reasoning of the causal factors has to be drawn for it. The top most researchable problem identified was crop loss due to frost attack. This had created a huge quantum of loss in the village during the drought years from 2000 to 2006 but was left unrecognized by the line departments and research agencies as a major threat to crop production. During the initial triangulation it was written off entirely by the officials of line departments and university but later after several rounds of triangulation at different levels, it was proved without doubt that the temperatures in the month of January was dipping to near 0 degrees and this had caused frost attack in the location. Farmers tried to manage frost with indigenous methods but in vain.

During the drawing of problem tree farmers were again consulted and the possible reasons according to the perception of the KIs were also discussed. The scientists at district head quarters (KVK Chittorgarh) and FET center actively participated in the discussion. The field supervisor and members of nearby villages also gave their opinions regarding the issue and the problem tree drawn later considering all the view points. The problem tree came up as shown below:

Inability to judge frost onset by the farmers, poor frost management practices, failure to provide crop saving irrigation and cultivation of frost susceptible crop varieties were found to be the four major reasons for crop loss due to frost.



In case of inability to judge frost onset, poor knowledge regarding frost onset conditions and lack of dedicated frost warning system were the second level factors leading to it. Poor meteorological support to farmers during frost onset conditions due to lack of full fledged meteorological facility at district head quarters were the third and fourth level reasons behind this.

Poor frost management by farmers was due to lack of knowledge regarding frost management practices. This was due to the fact that the extension system failed to deliver information about the already available frost management practices like smoking and spraying of sulphuric acid and DMSO.

Failure to provide crop saving irrigation before the onset of frost has cost the farmers dearly. This was mainly due to the factor that frost occurred mostly during drought years and water scarcity was severe during drought years. This situation was aggravated by the poor water table level in the village and high percentage of conveyance losses. Poor water table was due to the poor water table recharge during rainy periods which in turn was caused by the lack of water recharge and conservation structures in the village and due to poor rainwater management. The high percentage of conveyance losses was due to traditional unlined water conveyance existing in the village.

Cultivation of frost susceptible crop varieties was the fourth reason and was directly due to the fact that there are no frost tolerant crop varieties developed for the region as such due to the lack of location specific research to develop frost tolerant crop varieties.

It was also found out that the underlying root cause for the reasons and sub reasons mentioned above are due to the failure to recognize frost as a major threat to crop production by research and line departments. This was again due to the fact that there was a total absence of location specific database and research to assess the extent of frost attack and the subsequent economic loss to farmers over the years.

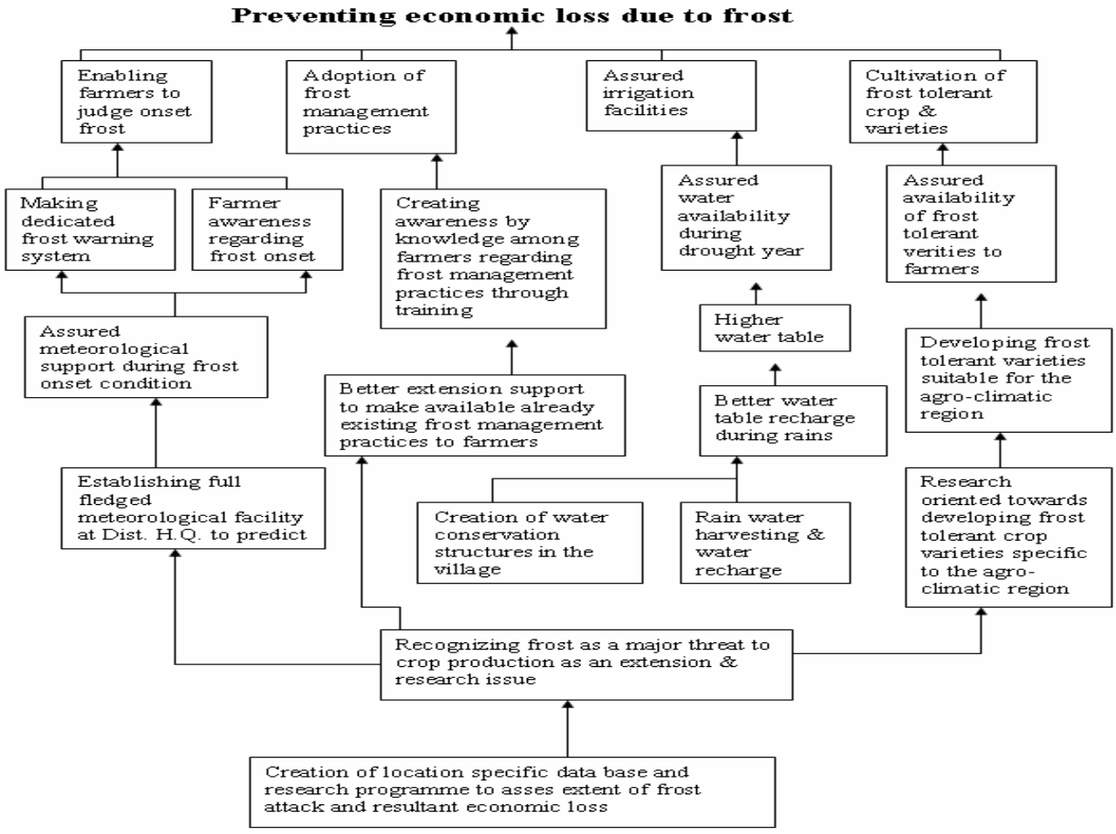
23. Solution Tree

The solution tree for the problem of crop loss due to frost attack was also developed by later in consultation with the KIs and other villagers. For all the four first line problems identified in the problem tree the solution lied in addressing the root cause first. i.e. the creation of location specific database and research to assess the extent of frost attack and resultant crop loss. This will in turn lead to recognition of frost as a major threat to crop production in the area and as a researchable issue.

Establishment of full fledged meteorological facility at the district H.Q. level will help in assured meteorological support to farmers during frost onset conditions. This will help the establishment of a dedicated frost warning system and better farmer awareness regarding frost onset conditions. Both this will ultimately enable farmers to judge the onset of frost by themselves and thereby preventing the crop loss due to frost.

Better extension support to make available already existing frost management practices to farmers through training programmes at KVK will lead to capacity building of farmers and in turn will create awareness among farmers regarding frost management practices. This in turn will lead to adoption of frost management practices by farmers thus preventing crop loss.

In case of failure to assure the crop saving irrigation before frost attack, creation of water conservation structures in the village across the slope along with water recharge pits is a must. This will result in better water table recharge during rains and higher water table thus resulting in assured water supply during drought years. This will make sure that farmers have enough water for giving the life saving irrigation during the onset of frost.



Regarding the research component in frost management, there are no frost tolerant varieties of any crops available for the farmers. Recognizing frost as a major thereat to crop production is a must towards developing research projects oriented towards developing frost tolerant crop varieties specific to the agro climatic region. This will help in development and extension of such varieties to the farmers. Assuring availability of frost tolerant varieties is the only ultimate solution to save farmers from crop loss due to drought associated frost.

Problem Tree (Animal Husbandry)

Foot and mouth disease (FMD) is a chronic problem at the village- Sohenkhera. Almost every year, dairy farmers of the village incur huge economic losses due to it because of high mortality, morbidity, loss of/ reduced production, reduced draft power and treatment cost. All these factors can be grouped in to three major factors-

A. Mortality & morbidity

B. Production loss

C. Reduced draft power

A. Mortality & morbidity: High degree of mortality (up to 20%) and morbidity (up to 100%) is due to different factors. Susceptibility of the animal is one important factor as it is found more in crossbred cattle and buffalo. Low vaccination coverage is another important factor. This is because of low awareness about vaccination, lack of follow up vaccination (booster dose administration, half yearly/ annual vaccination) as well as failure to vaccinate the animals at right time so that they have sufficient antibody titer at the onset of monsoon (May-June) as the disease is most prevalent during this time. Migration of animal is another important factor as the disease spreads with the selling of the 'carrier' and purchasing animal from enzootic area. The disease is found more in poorly managed animals. Poor management at Sohenkhera is very evident. There is very poor health and hygienic conditions, low availability of potable water, practically no stall feeding, no chaffing of fodder and high worm load.

B. Production loss: As a result of FMD, the cow either completely stops producing milk or gives little milk. Presence of blood flakes and pus makes it unfit for human consumption. Moreover because of high bacterial presence, keeping quality of milk goes down.

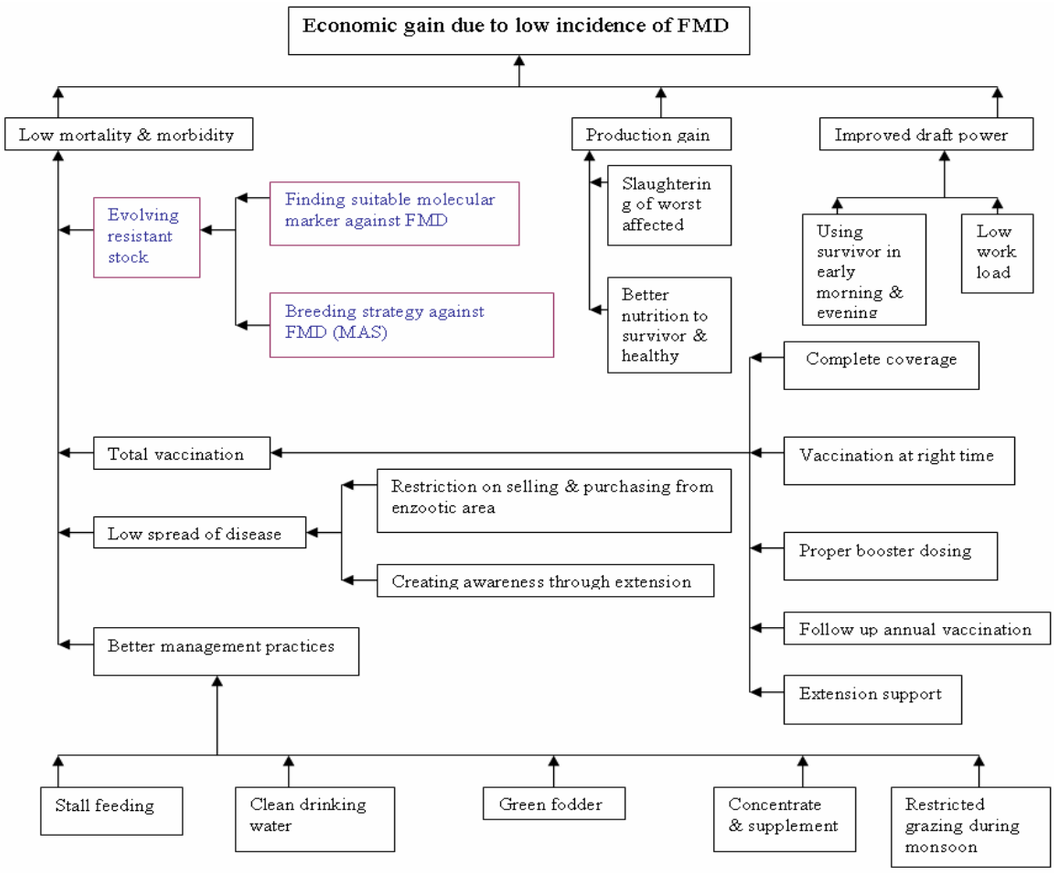
C. Reduced draft power: At Sohenkhera, almost all dairy farmers keep at least a pair of bullock for ploughing purpose which saves them from high cost of fossil fuel. Nagori bullock available in this region is world famous for draft power. Bullock affected with FMD becomes less heat and work tolerant and easily becomes fatigued because of different physiological (primarily endocrinal) problems. These associated factors are due to 'sequel' and the bullock becomes 'panters'.

Solution Tree (Animal Husbandry)

Economic gain due to low incidence/absence of FMD is possible by appropriate interventions. They are discussed in three broad categories.

A. Low mortality and morbidity: it is possible by evolving resistant stock, total vaccination, low spread of disease and better management practices. Disease resistant stocks can be made by marker assisted selection (MAS) for which we have to identify suitable molecular markers for FMD. Prevalence of the disease can easily be brought down by complete vaccination coverage for which extension support to create awareness is required. Vaccination at the onset of monsoon, proper booster dosing and regular annual or half yearly vaccination may ensure protection against this disease. Legal measures in the form of restriction on selling and purchasing of animals from the affected area will help in low spread of the disease. Better management practices have no alternate to reduce the incidence. It includes providing stall (manger feeding), providing potable water, sufficient supply of green fodder, providing concentrates and supplement and restricted grazing during monsoon as the worm load of the pasture (specially flukes) is very high which reduces the animal vitality in this region.

B. **Production gain:** This is possible by slaughtering the critically affected (or sending them to Gaushalas/Gausadan) and providing healthy nutrition to the survivors and healthy stock.



C. **Improved draft power:** Since the survived bullock becomes 'panters' their reduced draft power can be effectively used during early morning or late afternoon hours as well as reduced load to carry out agricultural works.

24. Village seminar feedback

A village seminar was held on 06-04-2007 at the Charbhuja temple premises in the village. Nearly sixty farmers were present in the seminar along with Prof. S.L. Mehta, Vice Chancellor, MPUAT, Dr. V.N. Joshi, Director, DEE, MPUAT, Dr. Tyagi, I/C, KVK, Chittorgarh and all the faculty members of the KVK. Problems identified by the farmers during FET were discussed elaborately. Suggestions and necessary corrective measures that need to be taken to overcome those problems were presented by the scientist probationers. Main researchable problem in agriculture (crop loss due to frost) that came out by snowball technique for problem identification was totally ruled out by the experts present there. Problem of FMD in animal husbandry was triangulated. The meeting could not be made an informal one where the farmers would feel totally free to express their views. Hence, the problem of frost was not ruled out.

25. Action Plan

Based on the problem and solution tree it was noticed that the top most researchable problem of crop loss due to frost comes no way under the purview of three scientists in the multidisciplinary group. Hence the Agricultural entomology, aquaculture and animal genetics and breeding scientists have prepared their individual action plans in relation to the other problems faced by the villagers in agriculture and animal husbandry. The individual action plans are detailed below.

Who	What	When	Where	How	Cost	Outcome
Scientist, Agricultural Extension.	Development of dedicated frost warning system and farmer capacity building towards sustainable frost management	2007-2010	KVKs, Meteorological stations, MPUAT & Villages under arid sub humid agro climatic region	1. Creation of location specific data base regarding extent of crop loss due to drought associated frost attack. 2.Strengthening and linking of meteorological facilities at district headquarters with KVKs and mass media for forecast of frost onset 3. Creation of village level "frost management committees" and training of member farmers regarding frost onset conditions and management practices.	50 lacs .	1. Enables quantitative measurement of frost associated crop losses. 2. A dedicated frost warning system put in place for the benefit of farmers. 3. Sustainable frost management and prevention of crop loss and building up of social capital in villages through creation of village level "frost management committees".
Scientist, Aquaculture	Production of carp advanced fingerlings – a technology for seasonal water bodies of Chittorgarh district of Rajasthan	2007-2008	Sohenkhera village	Field experiment with three different stocking densities of IMC in duplicate replications.	3 lacs	Optimum utilization of available seasonal water bodies

Agronomist	Development of suitable Agro-technique to mitigate the frost in arid sub-humid regions of Chittorgarh	Sohenkhera village of district Chittorgarh	2007-08 to 2010	Conduction of field trials on wheat & mustard, frost resistant varieties and atmospheric & soil moisture levels.Analysis of growth and yield parameters of wheat & mustard accoratments.	3.5 lacs	Increased crop production, productivity and income
Scientist, Animal Genetics & Breeding	Molecular Characteri-zation and Association Studies of Immune Response (Ir) genes against Foot & Mouth Disease (FMD) in Cattle & BuffaloIt includes two steps-1. Molecular characteri-zation of genes known to control immune response (Ir) against FMD in cattle & buffalo 2.Identifi-cation of suitable markers against FMD & its asso-ciation	1. Village (Bloods ample+ records)+ Institute 2. institute	1.May, 2007-Feb, 2008 2.Mar, 2008-Aug,2008	1. Cloning & characterization of cDNA of Ir genes 2. Identification of polymorphism of genomic DNA of the Ir genes 3. Identification of suitable molecular marker against FMD 4. Association of the markers with FMD susceptibility/ association	15 lacs	Database of Ir genes against FMD. Identification of molecular markers for FMDFuture marker assisted selection

Who	What	When	Where	How	Cost	Outcome
Scientist, Entomology	Develop-ment of termite resistant Variety of wheat crop	Identifying the reasons for termite attack Finding out the suitable manage-ment prac-tices Varietal screening of wheat varieties. Identify a variety/ entry of wheat resistant termite for irrigated and unirri-gated area.	2007-2010	Collection of wheat varie-ties, screen-ing of wheat varieties for resistance against termite, Collection of data and analysis, propagation () up to F6 of varieties/ entries resistant to termite, final selection of wheat varieties/ entries in accordance to farmers' preferences.	3.5 lacs	Develop-ment of termite resistant wheat varieties

"*Go and meet your people, live and stay with them, love them, work with them. Begin with what they have, plan and develop from what they know, and in the end, when the work is over, they will say:*

"We did it ourselves"

(from the poem "the essence of participation" by Chinese philosopher Lau Tse)

KVK ACTION TOOL - II
An instrument for Farming System Identification and prioritisation of research and development strategies

V. Venkatasubramanian, Sajeev, M.V. & A. K. Singha

FARMING SYSTEM ANALYSIS OF _____ DISTRICT, _____ STATE

About farming systems:

A *farming system* is defined as a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate. Depending on the scale of the analysis, a farming system can encompass a few dozen or many millions of households.

The classification of the farming systems of developing regions has been based on the following criteria:

- available natural resource base, including water, land, grazing areas and forest; climate, of which altitude is one important determinant; landscape, including slope; farm size, tenure and organization; and

- dominant pattern of farm activities and household livelihoods, including field crops, livestock, trees, aquaculture, hunting and gathering, processing and off-farm activities; and taking into account the main technologies used, which determine the intensity of production and integration of crops, livestock and other activities.

For further reading refer: (http://www.fao.org/farmingsystems/description_en.htm)

Analyzing existing farming systems of the district is a fundamental need of any KVK. Hence, this study is aimed at identifying the various farming systems existing in a KVK district, the analysis of which will help in developing and executing meaningful action plans by individual KVKs.

How to use this questionnaire?

This questionnaire contains two parts of which the first part is titled '**Agricultural characteristics of the KVK district'.** This part aims at collecting the bench mark data which in turn is used later for identifying the various farming systems existing in the KVK district. The data required in this part is secondary in nature. This can be collected from State Departments, SAUs, ICAR and other government publications. The same is also available in various websites over the internet. Care should be taken to collect data only from authentic sources particularly while using internet as the source.

ADG (AE), Division of Agricultural Extension, ICAR, New Delhi & Scientist (AE) & Senior Scientist (AE), Zonal Project Directorate, Zone-III, Baparani, Meghalaya.

The second part titled '**Farming systems in the KVK district'** has to be done by the KVK staff itself based on the data collected in first part. The basis/criteria for identifying farming systems are provided. Based on the criteria listed in part two, the agro-ecological situations identified in part – I have to be classified into homogeneous farming situations. The same may be compiled in a table as shown in part two. Based on the farming systems identified the constraints under each element has to be listed out. The KVKs has to develop action plans to mitigate these constraints by providing the development strategy pertaining to each case.

(Note: Please don't change any of the units specified in the questionnaire. The data has to be strictly compiled confirming to the units specified in the questionnaire)

Part - I

1. Agricultural characteristics of the KVK district, _____

1.1.1 A brief description of the district (in about 250 words)

1.1.2 Position in relation to longitude and latitude:

1.1.3 Altitude from MSL :

1.1.4 Boundaries of your district :

E: W: N: S:

NE: SE: SW: NW:

1.1.5 Total population : _____

1.1.6 Area of the district : _____ sq km

1.1.7 Population density : _____ (to be calculated based on total population and area of the district)

1.1.8 Literacy percentage : _____

1.1.9 Status of agriculture : _____ (Rainfed/irrigated/Shifting etc)

1.1.10 Farmers :

a. Big farmers : _____ (nos)

b. Small farmers : _____

c. Marginal farmers : _____

d. Agricultural labourers : _____

1.1.9 Farm labour mobility

a. Is sufficient farm labour available in your district: YES/NO

b. If 'NO' from which places do they come from?

c. If 'YES' whether they do work in near by or other districts also? YES/NO

d. if 'YES' to which districts they go for work?

1.2 Physiography

1.2.1 Highlands : _____ (in ha)

1.2.2 Midlands : _____

1.2.3 Lowlands : _____

1.2.4 Hilly tract : _____

1.2.5 General nature of the terrain (in about 50 words)

1.3 Climates (Please tick the appropriate one)

1.3.1 Arid/Semi-arid/Not Applicable

1.3.2 Tropical/Sub-tropical/Not Applicable

1.3.3 Temperate/Sub-temperate/Not Applicable

1.3.4 Humid/Sub-humid/Not Applicable

1.3.5 Pattern of rainfall in different months (Provide as high, medium or low)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

1.3.6 Did you observe any special weather phenomenon in your district? If yes, please provide a short write up in about 100 words.

Sl. No.	Crop	Critical period of growth	Coinciding calendar month(s)
1.			
2.			
3.			
4.			
5.			

1.3.7 Maximum and minimum temperatures recorded: Max: ____ Min: ____

1.3.8 Critical periods for plant growth in your district (Provide major crop wise)

1.4 **Soils**

1.4.1 Which are the Soil group classifications present in your district?

1.

2.

3.

4. (Add more if any)

1.4.2	Black soils	:	Present (_____ ha) / Not Present
1.4.3	Red soils	:	Present (_____ ha) / Not Present
1.4.4	Alluvial soils	:	Present (_____ ha) / Not Present
1.4.5	Sandy soils	:	Present (_____ ha) / Not Present
1.4.6	Laterite soils	:	Present (_____ ha) / Not Present
1.4.7	Saline and alkaline soils	:	Present (_____ ha) / Not Present
1.4.8	Acid soils	:	Present (_____ ha) / Not Present
1.4.9	Soil fertility status (in general)	:	High/Medium/Low

1.5 **Irrigation**

1.5.1	Area under irrigation	:	_____ ha
1.5.2	Irrigation potential	:	_____ ha

1.5.3 Source of irrigation

1.	Rivers	:	_____ nos
2.	Tanks	:	_____ nos
3.	Open wells	:	_____ nos
4.	Bore wells	:	_____ nos
5.	Any other sources: _____	:	_____ nos
	_____	:	_____ nos

1.6 **Land use and Cropping intensity**

1.6.1	Gross cropped area	:	_____ ha

1.6.2 Net Area sown : _____ ha

1.6.3 Fallow lands : _____ ha

1.6.4 Cultivable waste lands : _____ ha

1.6.5 Forest cover : _____ ha

1.6.6 Barren lands : _____ ha

1.6.7 Cropping intensity : _____

1.7 **Major Crops**

1.7.1 Principal crops, area, production and productivity (Please don't change the units specified below)

Sl. No.	Principal Crops	Area (in ha)	Production (in tones) (1 ton=1000 Kg)	Productivity (kg/ha)
1.				
2.				
3.				
4.				
5.				
6.				
7.				

1.7.2 Crop rotations followed : 1.
2.
3.

1.7.3 Crop sequences followed : 1.
2.
3.

1.7.4 Inter-cropping done, if any : 1.
2.
3.

1.7.5 Mixed cropping done, if any : 1.
2.
3.

1.7.6 Catch crops grown, if any : 1.
2.
3.

1.8 Socio-economic Characteristics, Land Holding Pattern

1.8.1 Average size of land holdings : _____ ha

1.8.2 Average fragmentation intensity : _____ nos (ie a holding gets fragmented to this many nos)

1.8.3 Existing land tenure system(s) :

1.8.4 Source(s) of finance for farming : Rank 1. _____

Rank 2. _____

Rank 3. _____

1.8.5 Main source of income for farmers : Rank 1. _____

Rank 2. _____

Rank 3. _____

1.8.6 Commercial commodities produced : Rank 1. _____

Rank 2. _____

Rank 3. _____

1.9 **Farm Machinery and Implements available in your district**

1.9.1 Number of tractors : _____ nos

1.9.2 Number of power tillers : _____ nos

1.9.3 Number of carts : _____ nos

1.9.4 Types of implements-Ploughs : _____ nos

Cultivators : _____ nos

Discs : _____ nos

Harrows : _____ nos

Others : _____ nos

1.9.5 Pumps (Oil and electrical) : ____&___ nos

1.9.6 Harvesters and Threshers : ____&___ nos

1.9.7 Sprayers and Dusters : ____&___ nos

1.10 Livestock

1.10.1 Cattle : _____ nos

1.10.2 Buffaloes : _____ nos

1.10.3 Sheep and goats : ____&___ nos

1.10.4 Pigs : _____ nos

1.10.5 Poultry and ducks : ____&___ nos

1.10.6 Production of milk : _____ ltr

1.10.7 Production of meat : _____ ton

1.10.8 Production of eggs : _____ nos

1.10.9 Production of wool : _____ qtl

1.11 Livestock holding patterns

1.11.1 Livestock holding pattern for big farmers

Sl. No.	Animal/bird	Average nos possessed	Rank according to nos possessed
1.			
2.			
3.			
4.			
5.			

1.11.2 Livestock holding pattern for small farmers

Sl. No.	Animal/bird	Average nos possessed	Rank according to nos possessed
1.			
2.			
3.			
4.			
5.			

1.11.3 Livestock holding pattern for marginal farmers

Sl. No.	Animal/bird	Average nos possessed	Rank according to nos possessed
1.			
2.			
3.			
4.			
5.			

1.11.4 Livestock holding pattern for agricultural labourers

Sl. No.	Animal/bird	Average nos possessed	Rank according to nos possessed
1.			
2.			
3.			
4.			
5.			

Average yields of various animals and bird in your district.

Sl. No.	Animal/bird	Average yield (Specify Units)
1.		
2.		
3.		
4.		
5.		

1.12 Research Resources

1.12.1 Number of research stations : _____ nos

1.12.2 Number of ICAR institutes/substations : _____ nos

1.12.3 Number of state seed farms : _____ nos

1.12.4 Number of private seed farms : _____ nos

1.13 Agricultural Marketing Status and Constraints

1.13.1 Ways of disposal of farm produce and by-products

Sl. No.	Major Farm produce	Marketing channel	Bye product (if any)	Marketing channel
1.				
2.				
3.				
4.				
5.				

1.13.2 Market types – whole sale and retail markets in your district

a. Wholesale markets : 1._____ 2._____ 3._____

b. Retail markets : 1._____ 2._____ 3._____

1.13.3 Major modes of transport to market:

1. _____
2. _____
3. _____
4. _____

1.13.4 Available/commonly used conveyance facilities (roads/waterways) to market :

1. _____
2. _____
3. _____
4. _____

1.14 Agro-climatic Zones (map to be collected and added with)

1.14.1 Various zones in your state :

1. _____
2. _____
3. _____
4. _____

1.14.2 List the various zones in your district :

1. _____
2. _____
3. _____
4. _____

Part - II

2. Farming systems in the district

2.1 Basis/Criteria for identifying farming systems:

Each farming system must be homogeneous, in general for the following.

1. Soils
2. Rainfall
3. Physiography
4. Altitude
5. Irrigation pattern
6. Temperature

2.2 Summary of farming Systems

Based on the criteria listed under the above items, classify the agro-ecological situation into homogeneous farming situations and thus may be furnished in a table as shown below.

Farming system	Soils	Rainfall	Altitude	Principal crops/ breeds	Important features	Location (area), extent of area in ha.

2.3 Agricultural characteristics of each farming System

(Classify and arrange the data collected in Part-I into Farming system wise under the following headings given below. The pattern followed under part – I can be repeated here for compilation)

2.3.1 Boundaries of the FS

2.3.2 Soils under the FS

2.3.3 Climates under the FS

2.3.4 Physiography under the FS

2.3.5 Irrigation facilities under the FS

2.3.6 Major crops and cropping intensity under the FS

2.3.7 Major cropping systems under the FS

2.3.8 Land use pattern under the FS

2.3.9 Land holding pattern under the FS

2.3.10 Populations and socio-economic characteristics under the FS

2.3.11 Adoption pattern for each crop/breed/other technology under the FS

2.3.12 General production constraints for each crop under the FS

In the same fashion the required information may be furnished for all farming systems. After identifying constraints/gaps (technology/extension) under each farming system, the priorities have to be delineated and the development strategy in form of action plan has to be prepared and presented below.

2.4 Research Priorities and Strategy

2.4.1 Research gaps identified for each farming system and crop

Sl. No.	Farming system	Crops under the FS	Research gaps identified

2.4.2 Research priorities finalized for each farming system and crop

Sl. No.	Farming system	Crops under the FS	Research priority finalized

2.4.3 Research strategy proposed for each farming system and crop

Sl. No.	Farming system	Crops under the FS	Research strategy proposed

2.5 Development Strategy

2.5.1 Extension gaps for each farming system and crop

Sl. No.	Farming system	Crops under the FS	Extension gaps identified

2.5.2 Extension priorities finalized for each farming system and crop

Sl. No.	Farming system	Crops under the FS	Extension priority finalized

2.5.3 Extension strategy for each farming system and crop

Sl. No.	Farming system	Crops under the FS	Extension strategy proposed

THANK YOU

KVK ACTION TOOL - III
Training Needs of KVK Staff in Training Management: An Assessment Instrument

A.K. Singha.

Training Needs of KVK Staff in Training Management in N.E. Region

PART - I

1. Name of your KVK : …….....……
2. Name of Host Organisation : …….....……
3. Year of establishment : …….....……
4. Number of SMSs : …….....……

PART-II

Please indicate your opinion in consensus with all your SMSs, about the degree of training you need in each specific area in the nine major areas of competencies related with "training management". You are requested to indicate your judgment in consensus by putting a tick mark (√) in each specific are of competency on a 3-point continuum scale, where

3 = Highly needed

2 = Needed

1 = Slightly needed

Further, you are also requested to rate each specific area of competency in terms of how important the area is in your job situation. Use scores from 1 to 3, where

3 = Very important

2 = Needed

1 = Slightly needed

Senior Scientist (AE), Zonal Project Directorate, Zone - III, Barapani, Meghalaya.

Sl. No.	Training Needs	Your training Need			Important on job situation		
		3	2	1	3	2	1
A.	**Concept in Training**						
	(i) Concept of KVK training (ii) Steps in training process (iii) Characteristics of adult learning (iv) Role of trainers (v) Effective training-learning situation						
B.	**Training needs assessment**						
	(i) Design of questionnaire (ii) Identify training needs through surveys etc. (iii) Identify training needs through discussion (iv) Identify training needs through observation in the field (v) Set priority of needs (vi) Prepare training plans						
C.	**Design course programme**						
	(i) Establish behavioural/learning objectives for programme. (ii) Develop criteria for selection of participants (iii) Decide on programme contents, duration (iv) Decide on the training activities needed to achieve objectives (v) Sequence training contents (vi) Selection of appropriate methods and audio-visual aids (vii) Identify equipments required (viii) Develop session by session details (ix) Develop schedule for the course (x) Develop course materials (Exercise, cases, work-book, manuals etc.)						

Sl. No.	Training Needs	Your training Need			Important on job situation		
		3	2	1	3	2	1
D.	**Arrangement for training**						
	(i) Write letters/announcement for training (ii) Write proposals for training for outside assistance (iii) Plan budget for training (iv) Design proforma for registration (v) Formulate check-list for observation on training (vi) Plan duty-chart for staff (vii) Arrange logistics (facilities for meals, lodging, travel etc.) (viii) Design training aids (ix) Organise space for training (x) Procure stationery for training						
E.	**Implementation of training**						
	(i) Co-ordinate inaugural session (ii) Introduction of participants and course (iii) Use lecture method (iv) Use demonstration during training (v) Use group discussion technique (vi) Use film/videotape (vii) Operate audiovisual equipments (viii) Organise group-exercises (ix) Use cases method (x) Use role-play technique (xi) Use work-experience (xii) Use field-visit as method of training (xiii) Maintaining interests of participant during training (xiv) Establishing personal relationship with participants (xv) Tackling problem in class-room management						

Sl. No.	Training Needs	Your training Need			Important on job situation		
		3	2	1	3	2	1
F.	**Evaluation of training**						
	(i) Design knowledge test for pre and post-evaluation (ii) Conduct skill-test (iii) Measure reactions of trainees about courses (iv) Measures impact (effect) of training on adoption (v) Develop check-list for observation of on-going training						
G.	**Follow-up of Training**						
	(i) Publish news-letters (ii) Organise get-together of trainees (iii) Organise village level forum of trainees (iv) Involve development agencies in giving support of trainees						
H.	**Organisation linkages**						
	(i) Seek support from state development departments (ii) Maintain linkage with central govt. departments. (iii) Linkages with other training centres (iv) Seek technical support from institute (v) Involve local non-officials						
I.	**Basic knowledge and skill**						
	(i) The ability to communicate effectively orally (ii) The ability to write effectively (iii) The ability to gather and analyse data (iv) The ability to prepare simple audio-visual aids (v) Knowledge about literature on training management (vi) Knowledge about rural communication (vii) Knowledge about current rural development programmes						

KVK ACTION TOOL - IV
Training Needs Analysis of Farmers and Rural Youth: A modified tool for KVK Scientists

Sajeev, M.V., A.K. Singha & V. Venkatasubramanian

Training Needs Analysis of Farmers towards Agricultural Development in North East Region

Questionnaire

General Information

1.	**Brief personal profile**	**:**	_____
1.1	KVK District	:	_____
1.2	Name of interviewee	:	_____
1.3	Gender	:	_____
1.4	Age	:	_____
1.5	Level of education	:	_____

2. Area available for cultivation

2.1 Operation land holding

	Type	**Area (in ha)**
2.1.1	Own land	_____
2.1.2	Leased in land	_____
2.1.3	Leased out land	_____
2.1.4	Joint property land	_____
2.1.5	Other (specify)	_____

3. Agricultural activities

3.1	**What are the main crops grown?**	**Area (in ha)**
3.1.1	_____	_____
3.1.2	_____	_____

Scientist (AE) & Senior Scientist (AE), Zonal Project Directorate, Zone - III, Barapani, Meghalaya & ADG (AE), Division of Agricultural Extension, ICAR, New Delhi.

3.1.3 _____ _____

3.1.4 _____ _____

3.1.5 _____ _____

Other (specify) _____ _____

3.2 What are the major vegetable grown? Area (in ha)

3.2.1 _____ _____

3.2.2 _____ _____

3.2.3 _____ _____

3.2.4 _____ _____

3.2.5 _____ _____

Other (specify) _____ _____

3.3 What are the main fruits grown? Area (in ha)

3.3.1 _____ _____

3.3.2 _____ _____

3.3.3 _____ _____

3.3.4 _____ _____

3.3.5 _____ _____

Other (specify) _____ _____

3.4 What are the main utilities of your agricultural produce? (Tick one answer)

_____ Mainly for family consumption

_____ Mainly for sale

_____ Partly for home consumption and partly for sale

_____ Other (specify) _____

4. Other sources of food and income for the household

4.1 Does the household own any livestock? *(Tick "Yes /"No". if 'No' then go to Question 4.2)*

Yes/No (Go to Question 4.2)

4.1.1 Kind of livestock and poultry (Nos)

Cows _____

Bulls _____

Yak _____

Mithun _____

All other cattle _____

Pigs _____

Chickens _____

Other (specify) _____

4.2 Does any member of the household do fishing? *Tick "Yes/"No". if 'No' then go to Question 4.3)*

Yes/No (Go to Question 4.3)

4.2.1 Type of fishing	**Consumed**	**Sold (Approx Wgt/Nos)**
Inland (ponds, tanks)	_____	_____
River fish	_____	_____
ea fish	_____	_____
Other (specify)	_____	_____

4.3 Did the household plant any forest trees (specify names)?

_____

_____

_____

_____

4.3.1 What is the purpose of planting forest trees (specify)?

_____

_____

_____

_____

5. Constraints to agricultural/livestock/fishery production

5.1. What are the main constraints to increasing production in your farm? (Specify in rank order)?

5.1.1. Agriculture

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

5.1.2. Livestock

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

5.1.3. Fishery

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

5.1.4 Others (Ex: Apiculture/mushroom cultivation etc.)

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

5.2. Which of these *(from Question above) do* you consider should be taken up by the KVKs for providing training to you?

(Give priority wise rank listing from 1 to below)

5.2.1. Agriculture

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

5.2.2. Livestock

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

5.2.3. Fishery

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

5.2.4. Others (Ex: Apiculture/mushroom cultivation etc.)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

6. What is your assessment of the technology advice and training that is currently being provided by KVK? Please explain any advice and/or training being implemented by you for further improvement. List your suggestions rank wise.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. Please indicate your opinion about the degree of training needed in each specific area under given major areas related to agricultural development. You are requested to indicate your judgment by putting a tick mark (√) in each specific area on a 3-point continuum scale namely, "Very important". "Important" and "Not so important"

Training Needs	Response categories		
	Most important	Moderately important	Less important
Crop Production			
Weed Management			
Resource Conservation Technologies			
Cropping Systems			
Crop Diversification			
Integrated Farming			
Water Management			
Seed Production			
Nursery Management			
Integrated Crop Management			
Fodder Production			
Production of Organic Inputs			
Horticulture			

Training Needs	Response categories		
	Most important	Moderately important	Less important
Vegetable Crops			
Production of low volume and high value crops Off-season vegetables			
Nursery raising			
Exotic vegetables like Broccoli			
Export potential vegetables			
Grading and standardization			
Protective cultivation (Ex: Green House, Shade Net)			
Fruits			
Training and Pruning			
Layout and Management of Orchards			
Cultivation of Fruit			
Management of young plants/orchards			
Rejuvenation of old orchards			
Export potential fruits			
Micro irrigation systems of orchards			
Plant propagation techniques			
Ornamental Plants			
Nursery Management			
Management of potted plants			
Export potential of ornamental plants			
Propagation techniques of Ornamental Plants			
Plantation crops			
Production and Management technology			

Training Needs	Response categories		
	Most important	Moderately important	Less important
Processing and value addition			
Tuber crops			
Production and Management technology			
Processing and value addition			
Spices			
Production and Management technology			
Processing and value addition			
Medicinal and Aromatic Plants			
Nursery management			
Production and management technology			
Post harvest technology and value addition			
Soil Health and Fertility Management			
Soil fertility management			
Soil and Water Conservation			
Integrated Nutrient Management			
Production and use of organic inputs			
Management of Problematic soils			
Micro nutrient deficiency in crops			
Nutrient Use Efficiency			
Soil and Water Testing			
Livestock Production and Management			
Dairy Management			
Poultry Management			

Training Needs	Response categories		
	Most important	Moderately important	Less important
Piggery Management			
Rabbit Management			
Disease Management			
Feed management			
Production of quality animal products			
Home Science/Women empowerment			
Household food security by kitchen gardening and nutrition gardening			
Design and development of low/minimum cost diet			
Designing and development for high nutrient efficiency diet			
Minimization of nutrient loss in processing			
Gender mainstreaming through SHGs			
Storage loss minimization techniques			
Value addition			
Income generation activities for empowerment of rural Women			
Location specific drudgery reduction technologies			
Rural Crafts			
Women and child care			
Agril. Engineering			
Installation and maintenance of micro irrigation systems			
Use of Plastics in farming practices			
Production of small tools and implements			
Repair and maintenance of farm machinery and implements			
Small scale processing and value addition			

Training Needs	Response categories		
	Most important	**Moderately important**	**Less important**
Post Harvest Technology			
Plant Protection			
Integrated Pest Management			
Integrated Disease Management			
Bio-control of pests and diseases			
Production of bio control agents and bio pesticides			
Fisheries			
Integrated fish farming			
Carp breeding and hatchery management			
Carp fry and fingerling rearing			
Composite fish culture			
Hatchery management and culture of freshwater prawn			
Breeding and culture of ornamental fishes			
Portable plastic carp hatchery			
Pen culture of fish and prawn			
Shrimp farming			
Edible oyster farming			
Pearl culture			
Fish processing and value addition			
Production of Inputs at site			
Seed Production			
Planting material production			
Bio-agents production			

Training Needs	Response categories		
	Most important	Moderately important	Less important
Bio-pesticides production			
Bio-fertilizer production			
Vermi-compost production			
Organic manures production			
Production of fry and fingerlings			
Production of Bee-colonies and wax sheets			
Small tools and implements			
Production of livestock feed and fodder			
Production of Fish feed			
Capacity Building and Group Dynamics			
Leadership development			
Group dynamics			
Formation and Management of SHGs			
Mobilization of social capital			
Entrepreneurial development of farmers/youths			
WTO and IPR issues			
Agro-forestry			
Production technologies			
Nursery management			
Integrated Farming Systems			
Others (Pl. Specify)			

Training Needs	Response categories		
	Most important	Moderately important	Less important
Rural Youth			
Mushroom Production			
Bee-keeping			
Integrated farming			
Seed production			
Production of organic inputs			
Integrated Farming			
Planting material production			
Vermiculture			
Sericulture			
Protected cultivation of vegetable crops			
Commercial fruit production			
Repair and maintenance of farm machinery and implements			
Nursery Management of Horticulture crops			
Training and pruning of orchards			
Value addition			
Production of quality animal products			
Dairying			
Sheep and goat rearing			
Quail farming			

Training Needs	Response categories		
	Most important	Moderately important	Less important
Piggery			
Rabbit farming			
Poultry production			
Ornamental fisheries			
Para vets			
Para extension workers			
Composite fish culture			
Freshwater prawn culture			
Shrimp farming			
Pearl culture			
Fish harvest and processing technology			
Fry and fingerling rearing			
Small scale processing			
Post Harvest Technology			
Tailoring and Stitching			
Rural Crafts			

A. R. - I

Chapter - 1
Need for Policy Re-orientation

1.1 The importance of agriculture in the socio –economic fabric of India can be realized from the fact that the livelihood of majority of the country's population depends on agriculture. The agriculture sector contributes only about 18 percent of the total Gross Domestic Product (GDP), with more than 60% population dependence, resulting in low per capita income in the farm sector. Consequently, there is a large disparity between the per capita income in the farm sector and the non-farm sector. Therefore, it is essential to deal with those issues which impact the income levels of farmers. The income levels are determined by the overall production, supported by reasonable levels of yield and prices realized by the farmers. Several constraints such as preponderance of small and marginal holdings accounting for about 82 percent of total holdings, imperfect market conditions and lack of backward and forward linkages affect the income levels of farmers adversely. Accordingly, an appropriate policy needs to be evolved to ensure that farming activity becomes more viable and the economic condition of farmers is improved on a sustainable basis.

1.2 Several steps have been taken in the past to strengthen agricultural research, education and extension, as well as to ensure timely and adequate availability of essential inputs such as seeds, fertilizer and electricity. Also, several major and minor irrigation projects have been implemented. An integrated programme of agricultural development was initiated in the early 1960s to improve productivity and to benefit farmers. Our scientists contributed by developing high yielding varieties/ hybrids of crops. These were introduced to farmers who in turn, adopted the new seeds and technology. As a result, a major breakthrough in productivity and production occurred in wheat in the late 1960s. Moreover, the new strategy laid emphasis on greater cropping intensity. Since then, the progress of agricultural production was steady and the growth rate in food production maintained a level above that of population growth. This came to be known as the "Green Revolution Era" that resulted in a situation of self sufficiency in food grains. This era was characterized by synergy among technology, services, public policy and farmers' entrepreneurship. However, during the past decade, the growth rate shows a declining trend; production and productivity have remained almost stagnant. A considerable effort, therefore, is required to reverse the deceleration and get agriculture moving forward once again.

1.3 The National Agriculture Policy approved by the Government of India during 2000, aimed to achieve annual growth of more than 4 percent in the agriculture sector on a sustainable basis, through the efficient use of natural resources and combination of other measures. However, the annual growth rate achieved during the Tenth Five Year Plan (2002-03 to 2006-07) averaged around 2.3 percent. On the other hand the non-farm sector has grown

faster. Considering the high growth of GDP in the recent past, a major reorientation in the policy is necessary to make this growth more inclusive. The decline in agricultural growth coupled with declining profitability in the agriculture sector, in the face of rapid growth of non-farm sector, is one of the major concerns. The declining profitability is partially due to commodities and the efforts to keep the domestic prices low to protect consumers' interest, which resulted in decline in the terms of trade for the farm sector. This, coupled with the stagnating and declining yield levels, resulted in low income to the farmers.

1.4 Another major problem confronting the rural areas in general and farm households in particular is the lack of employment opportunities. Efforts are needed to increase job opportunities. Efforts are needed to increase job opportunities in the farm sector through increased investment in irrigation, watershed development, wasteland development, land reclamation, etc. In addition, there has to be a greater focus on the accelerated development of the rural non-farm sector and development of clusters around towns/ market centres. A growing farm sector, better rural infrastructure and connectivity, skill development, adequate power supply and easy availability of credit would help in the creation of more employment opportunities in the rural non-farm sector and, in turn, enhance the income of farm households.

1.5 In view of the above, there is a need to focus more on the economic well-being of the farmers, rather than just on production. Socio economic well-being must be a prime consideration of agricultural policy, besides production and growth. The aim of the Policy is, therefore, to stimulate attitudes and actions which should result in assessing agricultural progress in terms of improvement in the income of farm families, not only to meet their consumption requirements but also to enhance their capacity to invest in farm related activities.

Chapter - 2
Recent Initiatives

2.1 Several significant initiatives have already been taken in recent years by the government to reverse the downward trend in agricultural production and to find sustainable solutions for strengthening the farmers' livelihood and income. Some of these important initiatives include: (i) Bharat Nirman; (ii) National Rural Employment Guarantee Programme; (iii) National Horticulture Mission; (iv) Expansion of Institutional Credit to Farmers; (v) Establishment of the National Bee Board; (vi) Establishment of the *National Rainfed Area Authori*ty; (vii) Establishment of the National Fisheries Development Board (NFDB); (viii) Watershed Development and Micro Irrigation Programmes; (ix) Reforms in Agricultural Marketing and Development of Market infrastructure; (x) Revitalization of Cooperative Sector (xi) Agri- Business Development through Venture Capital Participation by the Small Farmer Agri-business Consortium (xii) Reform and Support for Agriculture Extension Services; (xiii) National Rural Health Mission; (xiv) National Food Security Mission; (xv) Rashtriya Krishi Vikas Yojana in agriculture; (xvi) Integrated Food Law; (xvii) Legislative Framework for Warehousing Development and Regulation; (xviii) Protection of Plant Varieties and Farmers' Rights (PPVFR) Act, 2001; (xix) National Bamboo Mission and (xx) knowledge Connectivity through Common Service Centres (CSC) and IT initiatives.

Chapter - 3
Major Policy Goals

3.1 The major goals of the National Policy for farmers are:

i) To improve economic viability of farming by substantially increasing the net income of farmers and to ensure that agricultural progress is measured by advances made in this income.

ii) To protect and improve land, water, bio-diversity and genetic resources essential for sustained increase in the productivity, profitability and stability of major farming systems by creating an economic stake in conservation.

iii) To develop support services including provision for seeds, irrigation, power, machinery and implements, fertilizers and credit at affordable prices in adequate quantity for farmers.

iv) To strengthen the bio-security of crops, farm animals, fish and forest trees for safeguarding the livelihood and income security of farmer families and the health and trade security of the nation.

v) To provide appropriate price and trade policy mechanisms to enhance farmers' income.

vi) To provide for suitable risk management measures for adequate and timely compensation to farmers.

vii) To complete the unfinished agenda in land reforms and to initiate comprehensive asset and aquaria reforms.

viii) To mainstream the human and gender dimension in all farm policies and programmes

ix) To pay explicit attention to sustainable rural livelihoods.

x) To foster community-centered food, water and energy security systems in rural India and to ensure nutrition security at the level of every child, woman and man.

xi) To introduce measures which can help attract and retain youths in farming and processing of farm products for higher value addition by making it intellectually stimulating and economically rewarding.

xii) To make India a global outsourcing hub in the production and supply of the inputs needed for sustainable agriculture products and processes developed through biotechnology and Information and Communication Technology (ICT)

xiii) To restructure the agricultural curriculum and pedagogic methodologies for enabling every farm and home science graduate to become an entrepreneur and to make agricultural education gender sensitive.

xiv) To develop and introduce a social security system for farmers.

xv) To provide appropriate opportunities in adequate measure for non-farm employment for the farm households.

For the purpose of this Policy, the term "FARMER" will refer to a person actively engaged in the economic and / or livelihood activity of gr**ow**ing crops and producing other primary agricultural commoditie**s and will include ralll agricultural operational holders, cultivators, agricultural labourers, sharecroppers, tenants, poultry and livestock rearers, fishers, beekeepers, gardeners, planting labourers, as well as persons engaged in various farming-related occupations such as sericulture, Vermiculture, and agro-forestry. The term will also include tribal families/ persons engaged in shifting cultivation and in the collection, use and sale of minor and non-timber forest produce.**

Chapter - 4
Asset Reforms to Empower Farmers

4.1 **The purpose of asset reforms is to ensure that every farm**er household in villages possesses and/or has access to productive assets like land, livestock, fishpond, homestead farm and/or income through an enterprise and or market-driven skills, so that the household income is increased substantially on a sustainable basis. This, in turn, would ensure nutrition and livelihood security and their education and health requirements.

4.2.1 Considering the skewed ownership of land, it is necessary to strengthen implementation of laws relating to land reforms, with particular reference to tenancy laws, land leasing, distribution of ceiling surplus land and wasteland, providing adequate access to common property and wasteland resources and the consolidation of holdings. Following the conferment of land rights to women under the Hindu Succession (Amendment) Act, 2005, the provision of appropriate support services to women farmers has become urgent. Joint pattas for both homestead and agricultural land are essential empowering women to access credit and other services.

4.2.2 The land Acquisition Act would be reviewed with particular reference to the assessment of compensation. Prime farmland must be conserved for agriculture except under exceptional circumstances, provided that the agencies that are provided with agricultural land for non-agricultural projects should compensate for treatment and full development of equivalent degraded/commitment under the existing re-settlement policy of the Central/ State governments would be fulfilled in letter and spirit. For non-agricultural purposes, as far as possible, land with low biological potential for farming would be earmarked and allocated. State governments would be advised to earmark lands with low biological potential such as uncultivated land, land affected by salinity, acidity, etc. for non-agricultural development activities including industrial and construction activities.

4.3.1 Non-availability of timely and adequate water for irrigation is now becoming a serious constraint in achieving higher productivity and stability of farming in many parts of the country. Therefore, assured irrigation is the need of the hour. Though the total rainfall in our country is satisfactory, its distribution is highly skewed. Therefore, rainwater harvesting and improving the efficiency of water-use are important. It has been assessed that even a 10 per cent increase in the present level of water-use efficiency in irrigation projects may help to provide lifesaving irrigation to crops in large areas. Water-use efficiency can be further enhanced by generating synergy with seed varieties, nutrients (macro and micro) and farm implements. The concept of maximizing yield and income per unit of water would be used in all crop production programmes. Water users'

associations would be encouraged to gain expertise in maximizing the benefits from the available water.

4.3.2 The majority of farmers depend on groundwater for irrigation. This resource, in which farmers may have invested their hard-earned savings, is being depleted and the water table is receding fast. Therefore, rainwater harvesting and aquifer recharge would be accorded priority for ensuring the stability and sustainability of water supply. Water quality also needs attention, since it often get polluted at the source due to its over-exploitation and the indiscriminate use of fertilizers, pesticides and toxic chemicals.

4.3.3 Besides addressing the problems relating to adequacy and quality, equity in water distribution would be ensured. Water is a public resource, and not a private property. Therefore, priority would be given to evolve mechanisms for just and equitable access to water and to include local people in managing water resources. Women would be given a significant role as water users, both in access and management.

4.3.4 The following steps would be taken for augmentation of water availability and its efficient use:

(i) Rainwater harvesting and aquifer recharge would be given priority for ensuring the stability of supply. Necessary legislative measures to regulate and control the development and management of ground water would be taken up simultaneously.

(ii) Existing wells and ponds would be renovated.

(iii) Demand management through improved irrigation practices, including sprinkler and drip irrigation, and through *Pani Panchayats* or water users associations would be accorded a high priority.

(iv) A water literacy movement would be launched and regulations would be put in place for the sustainable use of ground water.

(v) Integrated and coordinated development of surface and ground water resources and their conjunctive use would be envisaged right from the project planning stage and would form an integral part of project implementation.

4.3.5 Symbiotic interaction and convergence of efforts would be made through various initiatives of the central/state governments such as the National Rainfed Area Authority, the National Horticulture Mission, the Technology Missions on Oilseeds and Pulses and the National Rural Employment Guarantee Programme to promote water-use efficiency and water conservation measures.

4.3.6 For drought-prone areas, a Drought Code would be introduced identifying the action needed to minimize the impact of adverse monsoons and to maximize the benefits of a good season. Similarly, in areas prone to heavy rainfall, a Flood Code would be introduced to mitigate distress, take care of the needs of the farmers immediately after floods and help convert the flood free seasons into major agricultural production periods.

For the arid areas, a Good Weather Code would be introduced for taking advantage of occasional heavy rainfall for strengthening the ecological infrastructure essential for sustainable livestock production, drinking water security and sand dune stabilization. The National Rainfed Area Authority would provide technical and other support in this regard.

4.4.1 Livestock, including poultry, is also one of the important sources of livelihood, contributing about one fourth of the agricultural GDP. These activities engage women in much larger proportion. The ownership of livestock is much more egalitarian since poor farmer families mostly own cattle, buffalo, sheep and goats. The major constraints experienced by farmers relate to breed, fodder, feed, healthcare and remunerative prices for their produce. There is a need to address these issues through an appropriate strategy. Further, to enhance the income of livestock owners, agri-clinics operated by veterinary and farm science graduates would be encouraged to improve productivity and overall efficiency of livestock. At the same time, crop-livestock mixed farming systems would be promoted, apart from encouraging production of organic manures and bio-fertilizers. Livestock insurance would also be revamped and made accessible to all farmers.

4.4.2 For poultry farming, the following steps would be taken:

(i) Quarantine and testing facilities for imported birds and vaccines at all ports of entry would be established and strengthened, since such safeguards are necessary for the health and survival of the poultry industry and for the protection of life and life and livelihood.

(ii) Testing for safety and efficacy of imported poultry vaccines before they are allowed to be marketed, as is done in the case of human vaccines, would be made compulsory.

(iii) Poultry rearing would be recognized as an agricultural activity and appropriate support would be provided to backyard poultry farmers to promote clusters or small holders' poultry estates.

4.5.1 Both coastal and inland fisheries provide employment and livelihood to millions of families. There is considerable scope for improving the income of fishermen families on an environmentally sustainable basis by encouraging scientific fish rearing, harvesting and processing. In the area of public policy, there is a need for well-planned agrarian reforms in order to provide landless labour families access to village ponds and other water bodies in the public domain for aquaculture.

4.5.2 The NFDB has been established by the Government of India to bring major activities relating to fisheries and aquaculture for focused attention and professional management. The guiding principles for the NFDB would be ecology, economics, gender equity, employment generation and advising the state governments to facilitate rational and equitable allocation of public water bodies and reservoirs for practicing modern aquaculture.

4.5.3 Following steps will be taken to promote modern aquaculture practices and value addition:

(i) "Fish for All" training and capacity building centres to impart training to fisher families and fisher-women in all aspects of the capture/ culture/ consumption chain, quality literacy for hygienic handling and other aspects.

(ii) Provision of small dredgers for ensuring the efficiency of fish-landing centres.

(iii) Centralized services to support the decentralized capture and culture fisheries sectors.

(iv) Inland aquaculture, including the culture of ornamental fish and air breathing fish, by providing necessary space in ponds and reservoirs.

(v) Artificial coral reefs to compensate for the loss of natural coral reefs to revive the fish catch.

(vi) Raising bio-shields comprising Mangroves, Casuarina, Salicornia, Aatriplex and other halophytic plants, to safeguard the lives and livelihoods of coastal fisher and farm families in the event of cyclonic storms and seawater inundation during calamities like tsunamis.

4.5.4 A dynamic policy for the management and economic use of the Exclusive Economic Zone (EEZ) for a variety of economic activities, including fisheries, will be evolved and put in place with the assistance of MFDB.

4.6.1 Bio-resources refer to the abundant wealth of flora and fauna, including soil micro flora and micro fauna, which, after land and water, form the third important natural resource available to farmers. Efforts will be made to conserve as well as enhance these resources and to ensure their sustainable use with equitable sharing of benefits. Two major legislations- the Protection of Plant Varieties and Farmers' Rights (PPVFR) Act, 2001 and the Biological Diversity Act, 2002 – are in place to achieve some of the above aims. Implementation of these Acts would be strengthened and detailed guidelines would be developed in such a manner as to recognize the rights of farmers and the farming community. The National Gene and Biodiversity Fund would be used to recognize and reward contributions of farmers and to support revitalization of *in situ* farm conservation traditions of such communities. A beginning has already been made by the government in establishing the Plant Genome Saviour Community Recognition Award for farmers.

4.6.2 For conservation and development of bio-resources, the following would be promoted:

(i) Documentation of traditional knowledge through community bio-diversity registers with the involvement of women, who hold much of this knowledge.

(ii) Support to tribal and rural people for revitalizing their *in situ* farm conservation traditions.

(iii) Participatory breeding procedures involving scientists and local conservers for improving the productivity of land races.

(iv) Genetic engineers working in public institutions to perform the role of pre-breeding i.e., development of novel genetic combinations for important biological and economic traits, such as resistance to biotic and abiotic stresses, in participatory breeding programmes with farmers, to integrate genetic efficiency and genetic diversity in an effective manner.

(v) Genetic homogeneity enhances genetic vulnerability to pests and diseases. Therefore, pre-breeding and participatory breeding would be integrated to help insulate small farmers form the risks of pest and disease epidemics.

(vi) Launch of literacy movement on genetic and legal aspects, in areas rich in agro-biodiversity such as the North East, Western and Eastern Ghats and the arid and semi-arid zone.

(vii) Genome clubs will be encouraged in rural schools and colleges for imparting an understanding of the importance of genetic resource conservation.

(viii) Literacy and awareness to help tribal and rural families understand the provisions of the PPVFR Act and the Biological Diversity Act with reference to their entitlements.

(ix) Training of farm and tribal families in methods of preventing gene erosion.

(x) Conservation of coastal biodiversity, including coral reefs and sea grass beds and support to traditional methods of conservation.

(xi) Organise and support herbal bio-valleys in the Western Ghats, Eastern Ghats, Vindhyas and Himalayan region for the conservation and sustainable use fo medicinal plants. In such bio-valleys, farmers would be assisted through venture capital and other support to take to conservation, selection and multiplication lof medicinal plants of value to health security.

(xii) A nationwide programme will be taken up for the ex situ and in situ conservation of plant genetic resources at the field/ farmer level. Farmer- level gene/seed banks would be set up in areas where traditional varieties are in danger of extinction. Seed exchange programmes undertaken by some state governments, should take due care to ensure that the traditional rice gene pools is not lost in this process.

(xiii) Participatory management of national parks, bio-sphere reserves and gene sanctuaries.

4.7.1 A system of rewards and incentives will be developed to enable and motivate people to conserve their breeds under the Biological Diversity Act. The Biodiversity Fund would be used for such purposes. Livestock keepers' inherent rights to continue to use and

develop their own breeding stock and breeding practices will be acknowledged and encouraged. The government will be recognize there rights, acknowledge livestock keepers' contribution to the national economy, and adopt its policies and legal frameworks accordingly so as to protect the same and to pre-empt attempts to use the intellectual property system to obtain control over animal resources.

4.7.2 Apart from conserving genetic diversity and acknowledging the vital role of livestock keepers, there is a need to document the indigenous knowledge of pastoral communities about animal maintenance and breeding. Community-based conservation and development of indigenous livestock breeds and species will be encouraged, with a special focus on both hot and cold arid and semi-arid areas where genetic diversity and associated indigenous knowledge are particularly will developed. State farms may be used to promote in situ conservation of animal breeds. Grazing lands must earmarked to enable the conservation of animal genetic resources. Documentation of special biological and economic traits would be done in the context of the new biological and nutritional needs or for other economic traits like hide/leather quality. Creation of disease-secure facilities for screening of germplasm and selection of disease resistant varieties would be promoted.

4.7.3 Indian breeds of cattle and buffaloes are in demand in other countries. Animal science graduates, self-help groups (SHGs) and progressive livestock farmers would be encouraged and supported to maintain pedigree animals of these breeds for exploiting export opportunities. However, export of all biological material including animals would be in accordance with the provision of the Biological Diversity Act.

Chapter - 5
Support Services

5.1.1 Science and technology are the key drivers of change in farm operations and output. New technologies which can help enhance productivity per unit of land and water are needed for overcoming the prevailing technology fatigue. Frontier technologies like bio-technology, ICT, renewable energy technologies, space applications and nano-technology provide opportunities for launching and "Evergreen Revolution" capable of improving productivity on a sustainable basis. In order to ensure social inclusion in access to new technologies, public investment in socially relevant agricultural research should be stepped up under the umbrella of the National Agricultural Research Systems (NARS) comprising large numbers of Indian Council of Agricultural Research (ICAR) institutions, state agricultural universities, all India coordinated research projects and national bureaus. Non-governmental Organisations (NGO) and private sector research and development (R&D) institutions would also be included under the NARS umbrella. NARS would be restructured so as to effectively address the problems faced by small and marginal farmers.

5.1.2 The research strategy should be pro-nature, pro-small farmer and gender sensitive. Community-managed seed villages and seed technology training centres are needed, with women playing the major role because of their traditional knowledge of seeds and seed management, especially in tribal communities. Scientific literacy and removal of doubts and fears about the risks and benefits associated with bio-technology and other new technologies can be achieved through farmers selected in each panchayat and provided with adequate training, so as to enable them to serve as farm science managers in their respective villages.

5.1.3 A National Bio-technology Regulatory Authority would be set up for ensuring the safe and responsible use of recombinant DNA technology or genetic engineering.

5.1.4 Need-based breeding of crop varieties would be stepped up such as processing quality fruits and vegetable.

5.1.5 High level multidisciplinary effort will be made for enhancing scientific inputs in organic farming that meet the needs of farmers. Integrated crop-livestock- fish production systems offer scope for the adoption of the principles and methods of organic farming.

5.1.6 In intensively cultivated mono-crop areas, crop diversification may be beneficial from the points of view of ecology, economics and employment generation. However any

advice on crop diversification must be accompanied by stops to ensure effective market support for the alternative crops. In planning for crop diversification, particularly from food to nonfood crops, such as for the production of bio-fuels, the food security of the nation would be kept in view.

5.1.7 The intellectual property rights regime will make provisions for compulsory licensing of rights in the cases of research products and processes of value to farmers. In all cases of health and food security, social inclusion will be the guiding factor.

5.1.8 Conservation farming would be given priority in the heartland of the Green Revolution and turning the Indo-Gangetic Plains into a major food basket through an appropriate mix of technology services and public policies.

5.2 Agricultural Bio-security

5.2.1 Agricultural bio-security coveting crops, trees and farm and aquatic animals is of great importance since it relates to both the work and income security of a majority of the population and the food and trade security of the nation. An integrated National Agricultural Biosecurity System (NABS) covering crops, animal husbandry, fisheries, forestry and agriculturally relevant micro-organisms will be established with the following objectives:

(i) Safeguard the income and livelihood security of farmer families, as well as the food, health and trade security of the nation, through effective and integrated surveillance, vigilance, prevention, and control mechanisms designed to protect the productivity and safely of crops, farm animals, fishes and forest trees.

(ii) Enhance national and local capacity in initiating proactive measures in monitoring, early warning, education, research, control and international cooperation.

(iii) Introduce an integrated bio-security package comprising regulatory measures, education, improved sanitary and phyto-sanitary measures and social mobilization.

(iv) Organise an integrated national agricultural biosecurity programme on a hub-and-spoke model, with effective home and regional quarantine facilities capable of insulating the major agro-ecological and farming system zones of the country from invasive alien species of pests, pathogens and weeds as well as from the introduction land release of Genetically Modified Organisms (GMOs)

5.3 Agro – meteorology

5.3.1 The nation has considerable capacity in short, medium and long range weather forecasting. Generic information about weather has to be translated into location-specific land-use advice, based on cropping patterns and water availability. The agro-meteorological advisories issued from time to time, would be used by Panchayat-level functionaries, trained to give appropriate land-use suggestions to farmers with the least

possible time lag. For marine fisheries, data on wave heights and location of fish shoals available would be transmitted to the fishermen. Frontline technologies such as internet-FM/ HAM radio/ cellphone services would be very helpful to fishermen in this regard.

5.4 Climate Change

5.4.1 Climate change leading to adverse changes in temperature, precipitation and sea level is an emerging issue. Most experts agree that the impact of global warming has been in a worrisome measure, as evident form the melting of glaciers and Antarctic and Arctic ice caps. Coastal storms and cyclones are also increasing in frequency and intensity. Consequent to these changes, droughts and floods are likely to be more frequent. Although climate change is a product of unsustainable consumption of non-renewable forms of energy, the harmful impact of climate change will be felt more by those nations with limited resources and coping capacity. Proactive measures to reduce the vulnerability to climate change will be taken. Based on simulation models, contingency plans and alternative land-use and water-use strategies will be developed for each major agro-climatic zone. In drought and flood-prone areas, experienced farmers would be trained as “Climate Managers” in the art of managing drought, flood and aberrant monsoons.

5.5 Inputs and Services

(i) Seeds: Good quality seeds and disease free planting materials, including in-vitro cultured propagules, are essential for crop productivity and security. Hybrids are now becoming available for many crops. In the case of new varieties, foundation seeds would be provided to grass root level seed growers and their groups such as cooperative societies and SHGs. Mutually beneficial farmer-seed company partnerships will be encouraged. Agricultural universities would be encouraged to organize courses on seed technology and business, and mainstream business princeiples in all applied courses. A national seed grid will be established to ensure supply of seeds across the country, as per the area specific requirement.

(ii) Soil Health: Soil health enhancement hold s the key to raising farm productivity. Steps would be taken to ensure that each farmer is issued with a soil health passbook containing integrated information on the physics, chemistry and microbiology of farm soils with corresponding advisories. More laboratories to detect specific established for this purpose. Soil organic matter would be increased by incorporating crop residues in the soil. Proper technical advice on the reclamation of wastelands and on improving their biological potential will be made available. Fertilizer pricing policies will be reviewed to promote balance use of fertilizers. Agro forestry will be encouraged for efficient nutrient cycling, nitrogen fixation, organic matter addition fan for improving drainage. Appropriate production

and marketing mechanisms for bio-fertilizers, organic manures etc. will be put in place to promote their use for improving/ maintaining soil health.

(iii) Pesticides: The triple alliance of pests, pathogens and weeds is the cause of substantial crop losses every year. The development, introduction and diffusion of environmentally safe and effective pesticides will be given priority. There is a need for incorporating the use of chemical pesticides in a n integrate Pest Management (IPM) system. Suitable quality control, safety evaluation and other regulatory systems would be strengthened. The sale of spurious and substandard pesticides would be prevented and bio-pesticides would be promoted.

(iv) Implements: Farmers need region and crop specific machines and implement s for timely sowing, management of weeds and improving their post-harvest operations. Women especially need woman-friendly implements/ tools which can reduce drudgery, save time, enhance output and can be handled comfortably. Agri – entrepreneurs including farm graduates and progressive farmers would be encouraged to provide implements and tools, machinery, tractors and other farm implements on a custom-hire basis.

(v) Vaccines and Sero-diagnostics: Major gaps in the presently available facilities would be filled in the case of imp9ortant animal diseases. Bio-technology research in the area of vaccine development would be stepped up, encouraging public private partnerships.

(vi) Fish Seed and Feed: Good quality and disease-free fish seed holds the key to successful inland aquaculture. Progressive fishermen and their groups such as SHGs would be trained in induced fish seed breeding, production and availability of seed and fish seed feed at affordable process, with appropriate technical assistance from the NFDB and other agencies.

(vii) Animal Feed: Inadequate nutrition is the primary cause of low milk yield in dairy animals. Both conventional and non-conventional approaches for conversion of cellulosic wastes into good animal feed through appropriate treatment and enrichment, planting of nutrition rich fodder plants and dissemination of technologies would be encouraged.

(viii) Other essential support services: These include establishing genetic evaluation systems for indigenous breeds as well as crosses, so that selection can leas to genetic improvement of production characteristics; upgrading of breed through artificial insemination; cross breeding suited to the farmers' resources; and improved processing and marketing. The livestock sector has to become sanitary and phyto-sanitary compliant. A cadre of par-veterinarians would be trained to set up support service centres for the farmers, to promote early detection and treatment of diseases and other veterinary services.

(ix) Support Services for Women Empowerment: For capacity building and livelihood, women working in the farms need appropriate support services like crèches, child care centres, nutrition, health and training, etc. For funding such activities, existing schemes of the Ministry of Panchayati Raj, the Ministry of Rural Development and the Ministry of Agriculture would be augmented and utilized and new schemes would be introduced, if required.

5.6 Credit and Insurance

5.6.1 Improvement in the outreach and efficiency of the rural banking system is the need of the hour. Towards this end, the financial services would be galvanized for timely, adequate and easy reach to the farmers at reasonable interest rates. The banking system would endeavour to meet the large credit potential needed to raise agriculture to higher thresholds and for the growth of rural and agri-business enterprises and employment, and would take steps to achieve financial inclusion.

5.6.2 The Government of India has already put in place an agriculture credit policy to improve access of farmers to institutional credit. Steps would be taken for extensive coverage of farmers under the Kisan Credit Card Scheme. Micro credit and micro insurance will be promoted as an effective tool for encouraging production and reducing risk. Credit cooperatives have an important position and role in the rural financial system and priority would be given to reforms and revamping of cooperative credit institutions as per the recommendations of the Vaidyanathan Committee. Credit counseling centres would be established where severely indebted farmers can be provided a debt rescue package/ rescheduling to save them from a debt trap. National Bank of Agriculture and Rural Development (NABARD), as the leader of agriculture and rural credit, should facilitate convergence between credit availability and credit absorptive capacity of the farmers and other rural borrowers and an efficient credit delivery system. NABARD should actively involve itself in institution building and provide backup support through research and development initiatives. NABARD should function like a national bank of farmers.

5.6.3 Since agriculture is a high-risk economic activity, farmers need user-friendly insurance instruments covering production, right from sowing to post-harvest operations. The insurance should also cover the market risks for all crops, in order to insulate the farmers from financial distress and in the process make agriculture financially viable. Steps would be taken to revamp the National Agricultural Insurance Scheme to make it more farmer friendly.

5.6.4 There is also need for credit and insurance literacy in villages. Gyan Chaupals (village knowledge centres) can help in this task. Awareness on credit and insurance issues among farmers would be promoted.

5.6.5 Women need special attention in credit access because of their lack of land title/ collateral. Kisan credit cards would be issued to women speedily with joint pattas for

homestead/ agricultural land. For the cases without joints pattas, indemnity bands/ guarantees from husband, and relatives would be considered by the banks for extending credit and kisan credit cards to the women farmers.

5.7 Cooperatives

5.7.1 Cooperatives have an important role to play in banking, input supply, marketing, agro-processing and other agri-business to protect farmers from the vagaries of existing imperfections in the supply of inputs, production, value addition and marketing. Cooperatives should function as economic enterprises and not as an extended arm of the state. They require an entrepreneurial approach, competitive edge through suitable enterprise focus and strategic alliances with private and public sector units. Appropriate mechanisms would be put in place as that farmers have greater control of the market channels and improve profit opportunities through cooperatives and SHGs.

5.7.2 With economic liberalization and market competitiveness, cooperatives would require much larger capital and other financial resources. Changes in the legal framework and regulatory system would help gain greater access to capital/ financial resources. The policy and legal framework under which cooperatives are functioning would be reviewed so as to create an enabling environment for them to attain autonomy and run their operations in a business-like manner, subject to provisions of law. The management of the cooperatives needs to be made professionally competent, with clear demarcation of functions of the elected members and the managers. The audit and accounting systems would be improved and made transparent so as to give greater confidence to all the members of cooperatives.

5.8 Extension, Training and Knowledge Connectivity

5.8.1 The gap between scientific know-how and field level do-how has been widening in the recent years. This knowledge deficit would be overcome speedily to enhance farm productivity and profitability. Krishi Vigyan Kendras (KVKs) would take up training and lab to land demonstrations in the area of post-harvest technology, agro-processing and value addition to primary products to provide skilled jobs in villages. State governments would be supported for strengthening the extension machinery through retraining and retooling of existing extension personnel and for promoting farmer to farmer learning by settling up farm schools in the fields of outstanding/ progressive farmers. The farm schools with linkages of KVKs can speed up the process of technological upgradation of crop and animal husbandry, fisheries and agro-forestry. Efforts will be made to bring farmers, processors, retailers and other stake holders together to support modern agricultural practices. Convergence of extension efforts especially at the district level and below would be ensured.

5.8.2 The potential of ICT would be harnessed by establishing Gyan Choupals in villages. Further, the common service centres of the Department of Information Technology,

Government of India and those set up by the state governments and private initiative programmes will be evolved for inclusive and broad-based development. Thus, the structure of the ICT-based knowledge system would, inter alia, include setting up of such village centres. Last-mile and last-person connectivity would be facilitated with the help of technologies such as broadband internet, community radio, or internet-mobile phone synergies.

5.8.3 Empowering farmers with the right information at the right time and place is essential for improving the efficiency and viability of small and marginal holdings. Mass media, particularly the radio, television and local language newspaper, will be used to play an important role in this regard.

5.9 Social Security

Coverage of farmers, particularly small and marginal farmers and landless agricultural workers, under a comprehensive national social security scheme is essential for ensuring livelihood security. The government would, therefore, take necessary steps to put in place an appropriate social security scheme.

5.10 Agricultural Prices, Marketing and Trade

5.10.1 Assured and remunerative marketing opportunities hold the key to continued progress in enhancing farm productivity and profitability. Several significant market reforms have already been initiated by the Central and the state governments. These reforms provide more options to farmers for selling their produce, allowing the private sector, including cooperatives, to develop markets, promote direct sales to consumers, processors and retail chain suppliers/ exporters and remove scope for corruption and harassment. The following steps would be taken:

(i) The Minimum Support Price (MSP) mechanism would be implemented effectively across the country.

(ii) The Market intervention Scheme (MIS) would be strengthened to respond speedily to exigencies especially in the case of sensitive crops in the rainfed areas.

(iii) The establishment of community foodgrains banks would be promoted to help in the marketing of underutilized crops and thereby generate an economic stake in the conservation of agro-biodiversity.

(iv) The food security basket will be enlarged by storing and selling nutritious millits such as bajra, jowar and ragi and other crops through the network of the Public Distribution Systems (PDS).

(v) Efforts will be made to develop a single national market by relaxing internal restrictions. All controls and regulations hindering increase in farmers' income will be reviewed and abolished.

(vi) Terminal markets for agriculture would be developed in public-private market access to farmers with better price realization in a transparent trading environment with suitable backward linkages to give technical backstopping services needed for quality and demand driven production.

(vii) The role of the Agriculture Produce Market Committees and State Agriculture Marketing Boards would be transformed from mere regulatory focus to promotion of grading, branding, packaging and development of markets for local produce.

5.10.2 Farmers require authentic advice based on meteorological, marketing and management information for land-use decisions and investments. Infrastructure support would be put in place to minimize the post-harvest losses and enable agro-processing and value-addition at the village level itself to increase employment and income. Farmers' organisations and other entities like cooperatives and small farmers' estates would be encouraged so that farmers can get a fair deal and enjoy the economies of scale. Producer groups and cooperatives will be encouraged to promote agro-processing industry. Constraints would be removed for improving the negotiability of ware house receipts.

5.10.3 The trace policies in agriculture would aim at protecting the livelihood of farmer families and fostering their economic well-being. Effective livelihood security for farmers would be put in place. Quality and trade literacy programme would be launched across the country. Appropriate measures would be introduced to mitigate price risks and enable the stakeholders, particularly the farmers, to hedge their risk.

5.10.4 Farmers' associations and SHGs would be supported to export on competitive terms by spreading awareness of the opportunities available for external agricultural trade and for value addition. The agri-export zones would be further strengthened to become places where farmers will get the best possible price for their produce.

5.10.5 The twin goals of ensuring justice to farmers in terms of a remunerative price for their produce and to consumers in terms of a fair and affordable price for staples (as farmers are also consumers) would be achieved through the following integrated strategy:

(i) The government, while taking decisions on MSP, would ensure that the farmers' interests in receiving remunerative prices for their produce are adequately safeguarded.

(ii) Stable and efficient market environment, including effective implementation of MSP in rainfed areas, would add to the improvement in productivity and income in dry land farming.

5.10.6 The terms of reference and status of the Commission for Agricultural Costs and Prices (CACP) would be reviewed to make the MSP regime more effective.

5.11 Integration with Processing and Value Chain

5.11.1 It is well recognized that value addition to agricultural produce increases income levels of the farmers. Therefore, it is necessary to integrate their production with processing and other value chain activities. However, the post-harvest infrastructure in the country is grossly inadequate, resulting in huge inefficiencies and wastages. The percentage of post harvest losses at various stages of storage, grading, packing and marketing due to improper handling and transportation, vary greatly depending on the nature of crop and climatic conditions. The food processing industry has the potential to provide long term economic sustainability to the farmers by adding value to their produce, improving post-harvest management linking the farmers to the market and promoting demand-driven farming. Further, the food processing activities also need modernization. Hence, effective steps would be taken to facilitate and stimulate this process, modernize the food processing sector and enhance its competitiveness.

5.12 Curriculum Reforms

5.12.1 Agricultural/ Animal Science Universities: The motto of these universities would be to groom “every scholar/ student as an entrepreneur”. This will call for integrating business management principles with major applies courses. The agriculture/ farm universities would also restructure their curricula in a manner that the gender roles in farming are recognized and they are equally empowered technologically. There is a need to restructure the curricula to focus on nutrition, post-harvest technology, quality and safety standards. The farm universities would be reoriented to give emphasis on entrepreneurship and capacity building on quality including sanitary and phyto-sanitary measures and Codex Alimentarius standards of food safety.

5.12.2 The mandate of the ICAR would be expanded to provide for registration and accreditation ton the farm graduates as registered farm practitioners to provide quality service to the farmers. Centres of excellence in agriculture (crop, animal husbandry fishery and forestry) modeled after the Indian Institutes of Technology (IITs) and Indian Institutes of Management (IIMs) would be developed to enhance the competitiveness of the graduates. Taking into account the new opportunities opened up ICT, pedagogic methodology for promoting a learning revolution among students would be adopted. University centres would also establish employment and business advisory services and promotion centres and special one-stop windows for generating awareness of self-employment opportunities.

Chapter - 6
Special Categories of Farmers

6.1 Tribal Farmers

Tribal farmers are among the most disadvantaged category of farmers. A majority of tribal communities across the country are dependent on forests and animal husbandry for their livelihoods. These include cultivation (shifting cultivation in many cases), collection of fuel, fodder and a range of non-timber forest produce. Uplifting of their economic conditions would be a priority for the government. For this purpose, the following actions would be initiated:

(i) Updating land records in areas inhabited by tribal farmers.

(ii) Strengthening the institutional structure to enable a more participatory process in decision making.

(iii) Easy access to institutional credit to all tribal farmers and adequate provision of Kisan credit cards for them.

(iv) Documentation of the traditional crops and knowledge of the tribal farmers and creating an economic stake in conservation of such crops.

(v) Provision of appropriate technology and extension services and relaxed criteria for providing inputs such as water, fertilizers, seeds etc. for tribal areas.

6.2 Pastoralists

The following steps would be initiated to ensure better livelihood opportunities for pastoralists:

(i) Restoration of traditional grazing rights and camping rights in respect of forest areas and in those areas earmarked for grazing purpose in village common lands.

(ii) Formalizing entitlements (including issue of permanent grazing cards) for traditional pastoralists/herders maintaining native animal breeds to enable free access to notified or demarcated grazing sites and migration routes.

(iii) Grazing land and drinking water sources for livestock will be conserved and expanded to the extent feasible.

(iv) In-dept documentation and characterization of indigenous livestock breeds and preservation thereof would be carried out to recognize and protect the intellectual property rights of the local communities/individuals conserving these livestock breeds.

(v) Pastoralists would be involved in all local natural resource management programmes, including village forest committees and joint forest management.

6.3.1 Besides the above two groups, there are several small groups with distinct and special needs such as small plantation farmers, island farmers, urban farmers and organic farmers.

6.3.2 A large number of small farmers are engaged in cultivation of plantation crops like tea, coffee, rubber cardamom pepper and vanilla. Price fluctuation and competition from products imported from aboard are among the major problems facing them. Therefore, the Price Stabilisation Fund for plantation crops will help them to be insulated from the vagaries of the market.

The farming and fisher families in the Andaman and Nicobar Islands, Lakshadweep group of islands and other islands need special attention including technology, training, techno-infrastructure and trade. Island agriculature also has the problem of transport costs, particularly for perishable commodities like fish which may have to be sold in the mainland. The ancient tribes of the Andaman and Nicobar Islands have rich traditional knowledge and wisdom. Steps would be taken to recognize and reward their indigenous knowledge in the areas of biodiversity conservation and traditional healthcare. Horticulture development programmes would be taken up in islands wherever feasible. The creation of mangrove and non-mangrove based bioshields would be initiated to safeguard the lives and livelihoods of island populations in the event of the rise of sea levels due to global warming and calamities like tsunamis.

6.3.3 In urban areas, home gardens and nurseries would be encouraged. Nutrition gardens would be supported to supplement the nutritional requirement.

Chapter - 7
Special Categories of Farming

7.1 Organic Farming

The organic farming movement in India suffers from a lack of adequate institutional support in the areas of research, extension, certification and marketing and it requires more scientific support than chemical farming. KVKs would be equipped to provide training in organic agriculture, internationally accepted certification procedures would be strengthened to make them farmer-friendly and affordable. Organic farming zones would be identified, like the hill areas, islands where chemical fertilizer use is low, and for medicinal plants where the use of chemical pesticides and fertilizers is not advisable. Organic farming would also be encouraged in selected rainfed area backed up by required supports, including marketing. It would also be supported through contract farming. Food safety and quality specifications should conform to the Codex Alimentanus standards since there are occasional reports of heavy metals being present in organic foods. Farmers engaged in organic farming should be linked to niche markets where they will obtain a premium price. Progressive farmers and farm graduates would be supported for establishing agri-clinics and agri-business Centres for organic farming. Bio-fertilizers, organic manures and bio-pesticides would be treated at par with the chemical fertilizers for support and promotion.

7.2 Green Agriculture

Green agriculture involving integrated pest management, integrated nutrient supply and integrated natural resources management is recognized as the pathway to an “Evergreen Revolution”. Unlike organic farming, green agriculture permits the safe and minimal use of mineral fertilizers and chemical pesticides, as well as crop varieties developed by genetic modification. Green agriculture products would be encouraged with distinct labeling and certification as in the case of organic farming.

7.3 Genetically Modified (GM) Crops

There is a need to assess the risks and benefits associated with GM crops in a credible and transparent manner. Priority would be given for genetic modification to incorporate genes which can help impart resistance to drought, salinity and other stresses. Water-use efficiency as well as improvement of both nutritive and processing quality would also be accorded priority in the research agenda. Training and awareness in agronomic management procedures in respect of GM crop varieties would be introduced.

7.4 Protected (Greenhouse) Agriculture

With the rapid growth of horticulture, there is an opportunity for greenhouse cultivation of vegetables, fruits and flowers supported by economic methods of water and fertilizer use such as fertigation (the application of nutrients through irrigation systems). Support would be given to farm and home science graduates and other entrepreneurs to undertake green house horticulture under the agri-business programme and horticulture development programmes. Low-cost green houses, along with micro-irrigation and fertigation techniques, would be popularized in areas where evaporation exceeds precipitation during several months in a year. Suitable support would be given for such technologies that would increase income in water deficit areas.

Chapter - 8
Special Regions

8.1 Distress Hotspots

Several steps have been taken by the government to mitigate agrarian distress experienced in some parts of the country. It is important that special attention is paid to such areas to reduce risk and promote inputs for sustainable agricultural practices. In such areas, knowledge connectivity, social support systems and marketing infrastructure will be strengthened. Convergence of the benefits under different schemes would also be encouraged.

8.2 Mega Bio-diversity Areas

Local communities would be involved in the conservation of mega bio-diversity areas such as Western and Eastern Ghats, eastern Himalayan region, other North East and tribal area. These communities would be given an incentive and their contributions would be appropriately recognized steps would also be taken to enable local communities in mega bio-diversity areas to convert bio-resources into economic wealth in a sustainable manner.

Chapter - 9
Farmers of the Future

9.1 The slow growth of opportunities in the non-farm employment sector has led to the proliferation of tiny act economically non-viable holdings. Increase in small farm productivity and creating multiple livelihood opportunities through crop-livestock integrated farming systems as well as agro-processing would be supported for increasing farmers' incomes. Methods of achieving economies of scale by small and marginal farmers though the farming groups would be popularized to enhance yield and income. Women would be encouraged to participate in such group activities. The following are some of the methods which may benefit the small and marginal farmers for gaining efficiency and economies of scale in their farming operations.

(i) Cooperative Farming and Service Cooperatives: These have been successful in the case of the dairy industry. Marketing cooperatives are successful since members cooperate on the basis of enlightened self-interest. Other forms of service cooperatives are slowly emerging but the pace needs to be accelerated. Small farmers' cooperatives would, therefore, be encouraged and supported to take up activities such as processing, value addition and marketing of agro products.

(ii) Group Farming by SHGs: SHGs for supporting mico-entreprises operated by women with the help of micro credit have been highly successful. With the growing diminution in the size of operational holdings, it will be useful to promote SHGs and commodity-based farmers' organisations at the production end of the farming enterprise by encouraging groups for consolidating farming activities. This will be particularly helpful in the case of "Green Agriculture" involving integrated pest management, integrated nutrient supply, scientific water management and improved post-harvest technology. SHGs would also be promoted for improving access to credit.

(iii) Small Holders' Estates: The formation of small holders' estates, for examples, in cotton, horticulture, medicinal plants, poultry and aquaculture will help promote group cooperation among farmers living in the village or watershed, or the command areas of irrigation projects. Improving productivity, reducing the cost of production and entering into marketing contracts with textile mills, food processing industries, pharmaceutical companies, and fish marketing agencies will be some of the advantages. Such small holders' estates can also manufacture products under brand names and enhance income security so that group insurance becomes feasible. Agri-clinics and agri-business centres would be linked to such estates.

(iv) Contract Farming: Symbiotic contracts which confer benefits to both producers and purchasers would be encouraged for ensuring assured and remunerative marketing opportunities to the farmers. Contract cultivation based on a well-defined code of conduct will be helpful to small producers in getting food quality inputs, fair prices and prompt payment for their produce. A code of conduct for contract farming or a model contract will be developed to meet the commodity-specific requirements. Farmers will not be alienated from their land under any circumstances under contract farming. State governments may set up a monitoring committee involving farmers to encourage a farmer-friendly contract farming system.

(v) Farmers' Companies: Private limited companies, registered under the Companies (Amendment) Act, 2002, are now coming into existence in the area of seed production, the production of bio-fertilizers, bio-pesticides and other forms of biological software essential for sustainable agriculture. Small farmers and the SHGs would be associated in such companies as stakeholders and not just as shareholders.

(vi) State Farms: State farms inter alia, would also be used for developing Living Heritage Gene Banks of the germ plasm of local crops and breeds of cattle, sheep and poultry in order to preserve the plant and animal genetic wealth.

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Chapter - 10
Attracting Youth

Educated youths would be helped and supported for setting up agri-clinics and production-cum-processing centres to undertake outsourcing hobs both from within and outside the country. In order to attract youths to the agriculture sector, a number of vocational training courses in different aspects of agricultural and allied activities including value addition and processing of agro-products shall be introduced and recognized. The KVKs, institutions of state governments/ICAR and competent private institutions may also provide such recognized vocational training to the youth. Trained persons would be supported through various schemes to launch self-employment ventures for value addition to improve productivity and income of the farmers.

Chapter - 11
Other Policy Measures

11.1 The following policy measures will also ensure well-being and livelihood security of the farmers:

(i) Existing state land use boards would be revamped and linked to district-level land-use committees to be constituted by the state government so that they can provide quality and proactive advice to farmers on land use. These are expected to emerge as virtual organisations with the capacity to link land-use decisions with ecological, meteorological and marketing factors on a location and season-specific basis.

(ii) Major thrust would be given to the development of floriculture, roots and tuber crops, aromatic and medicinal plants, bee-keeping and sericulture. Appropriate market linkages would also be provided so that such efforts would improve employment and income opportunities in rural area.

(iii) Market intervention scheme would continue and would be strengthened. Suitable measures would be taken for expeditious processing and sanctions.

(iv) A well-defined food security policy with homegrown foodgrains is important for eradicating rural poverty and malnutrition. In order to strengthen and regularly monitor food security issues, the government would constitute a Cabinet Committee on Food Security.

(v) Farm families would also be protected from becoming victims of HIV/AIDS and tuberculosis (TB). Anti-retroviral drugs would be made available in villages free of cost. The approach to the treatment of farmers who are victims of serious diseases like HIV/AIDS and TB in villages would take into account access of the patient to food and nutrition to assist recovery and restoration of productive life.

(vi) There is a need for a rural non-farm employment initiative for farm households. The initiative would bring for farm households. The initiative would bring all rural non-farm employment programmes together in order to generate convergence and synergy among them. A consortium approach involving the different agencies concerned would be adopted.

(vii) Along with production growth rates, income growth rates would also be measured and published. Improving income and livelihood of farmers would be incorporated as a primary objective of all schemes implemented in the agricultural sector.

(viii) Article 243 G of the Constitution (73rd Amendment) Act, 1982, entrusts panchayats with the responsibility for agriculture including agricultural extension. IF the problems faced by farmers are disaggregated and dealt with by the gram sabhas and panchayats, location-specific problems can be attended to speedily and effectively. In order to implement various schemes and programmes at the grass roots level, the Government of India would support state governments for devolution of functions and functionaries for empowering the panchayats. Steps would be taken to strengthen and accord centrality to panchayats in addressing the problems of farmers.

(ix) Mass media (conventional, electronic and the internet) constitute an important pillar of our democratic system of governance. In order to assist the mass media with timely and scientifically accurate information on issues relating to agriculture, food security and farmers welfare regional media resource centres would be set up, associating farmers, media representatives and scientists, including extension personnel.

(x) There is a need for integrated approach for rural energy where renewable energy systems / devices, biofuels would be promoted apart from improving the rural infrastructure, including rural electrification, which is essential for agricultural development.

Chapter - 12
Operationalisation of the Policy

12.1 The National Policy for Farmers will be adopted and operationalised to suit the local needs in different states and union territories. State governments would be supported to convert national goals into local action points by preparing operational plans for implementing this policy, taking into account the agro-climatic and other local conditions. Such operational plans will be prepared at the district level by a multi-disciplinary professional group and integrated at the state level. States would be encouraged to have an effective mechanism for continuous feedback from the farmers to ensure that measures taken under the policy address the problems of the farmers.

12.2 The Department of Agriculture and Cooperation would constitute an Inter-Ministerial Committee to suggest a plan of action for operationalisation of this policy. Appropriate mechanisms and guidelines would be evolved by concerned Ministries/Departments to implement this policy.

12.3 The Agriculture Coordination Committee under the chairmanship of the Prime Minister would oversee and coordinate the integrated implementation of this policy.

Technology Transfer and Extention : Towards a Second Green Revolution

V.V. Sadamate, V. Venkatasubramanaian and Rasheed Sulaiman

I. Towards a second green revolution

A series of interventions initiated in mid-1960s that led to the green revolution in cereal production transformed the country from a situation of food deficiency to self sufficiency. The green revolution was however, restricted to productivity improvements in cereals- especially wheat and rice- in the initial decades, primarily grown in irrigated regions. In subsequent decades, productivity increased in other crops, namely oilseeds, sugarcane, cotton, fruits and vegetables. The Green Revolution generally bypassed India's vast rainfed tracts, especially arid zones, hill and mountain ecosystems and coastal regions, thus exacerbating agro-ecological and economic disparities. Although self sufficiency was attained in food grain production, potential of different crop varieties are yet to be attained. The main features of the first green revolution were:

- Exclusive focus on food grains
- Intensive use of water, fertilizer and pesticides to maximize yields from High Yielding Varieties (HYVs)
- Practically no focus on sustainability issues
- Benefited the resource-rich and large farmers and
- Dependent on few technological options focusing on hybrids, changes in plant architecture.

The equity, efficiency and sustainability of these approaches became a matter of serious concern since the 80's. Over a period of time, especially during the last two decades, the course of Indian agriculture has largely been influenced by factors such as globalization, trade liberalization and increasing role of private sector. Apart from these the agricultural sector has been challenged by the following factors:

- Shrinking resource base
- Changes in demand and consumption pattern
- Changes in farming systems including increasing diversification to high-value crops

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- Declining public investments in agriculture
- International developments- WTO (subsidies in agriculture and trade liberalization) and
- Climate change (global warming, seasonal variations, changes in rainfall pattern and increasing occurrence of natural disasters)

The policy approach to agriculture, particularly in the 1990s has been to secure increased production through subsidies on inputs such as power, water, and fertilizer. It also focused on increasing minimum support prices rather than building new capital assets in irrigation, power, and rural infrastructure or improving the standards of maintenance of existing assets. Despite its past achievements, Indian agriculture continues to face serious challenges because of its ever-increasing population, limited land and water availability, and degradation of natural resources. There are wide gaps in yield potential and national average yields of most commodities are low. Although the Green Revolution increased production and productivity of food crops, improved food security and raised rural incomes, India still has a large poor (27.5 % living below the poverty line in 2004-05) and malnourished population.

Although the annual growth rate in total GDP has accelerated from below six percent during the initial reform years (starting 1991) to more than eight percent in recent years, agricultural growth has decelerated. While the non-agriculture sector has witnessed rapid growth, there has not been any significant decline in the labour force employed in agriculture and this has created a serious disparity between the agriculture and non-agriculture sectors and urban and rural India. The output growth of the majority of commodities has decelerated after the mid-90s. And currently Indian agriculture is at crossroads.

Addressing these emerging challenges would require a new approach which has to be distinct from the earlier green revolution approach. Agricultural research and extension therefore need to emphasise the following new dimensions in the second green revolution era:

- Focus on gene revolution, emphasizing application of biotechnology- tissue culture for multiplication of elite germplasm, GM crops, marker assisted breeding etc
- Emphasise use of bio fertilizers, bio pesticides and bio remediation of ground water
- Address issues like sustainability, resource integration and technology integration as the primary focus
- Apply precision farming and mechanization for optimal use of precious resources and human labour
- Linkage with industry, market driven and export oriented agriculture
- Increase application of cutting edge technologies
- Thrust on post harvest, food processing and value addition technology
- Highlight quality in addition to increase in quantity

- Protect IPR and farmers' rights and
- Integrate livestock, fisheries and other allied agro-enterprises with crop production and Exploit advances in information technology.

II. Agricultural Extension and the Second Green Revolution

In the second green revolution context, agricultural extension needs to assume new challenges and reform itself in terms of content, approach, structure and processes. Adequate focus has to be given on effective technology selection, optimization, application and management. Hitherto the extension efforts were largely influenced by the approaches and models that evolved during the 60's to 80's. These are insufficient to deal with the current concerns emerging out of globalization, sustainability, and other dimensions of agricultural development envisaged by the second green revolution.

The framework of strengthening the extension system includes:

- Assessment of existing extension system, approaches and organisations against the backdrop of second green revolution and determine whether these have to be strengthened or restructured and whether new initiatives have to be launched;
- Broadening the technical mandate keeping in view the current demand scenario;
- Promoting pluralism, by involving and integrating public, private, and civil society organizations and through public-private partnerships;
- Development and application of information and communication technology through rural knowledge centres/hubs;
- Location specific, participatory, gender sensitive and customized extension materials and methodologies;
- Effective operational linkages between research, extension, farmer, market and other key stakeholders;
- Farming systems and farmer participatory extension approach and
- Empowering farmers and organizing them into commodity groups/associations and federating them

The working group on agricultural extension for the formulation of XIth Five Year Plan acknowledges the current limitation of public sector extension and emphasizes the following for strengthening agricultural extension. These include:

- Adoption of farming system and farmer participatory approach
- Research –extension farmer and market linkages
- Focus on vulnerable groups

- Up-scaling ATMA to all districts,
- Routing all state and central government extension funds through ATMA
- Support to private extension and public private extension
- Focus on women in agriculture
- Strengthening Kisan Call Centres
- Market led extension and
- Promotion of Agri-clinics and agri-business centres

However, these measures though appear to be important, are not adequate to address the the second green revolution challenges.

Changing needs of farmers for extension support

Due to the changing nature of agriculture, farmers currently have to make a number of complex decisions. Most relevant of them are as follows:

- What technological options could be used profitably in his/her situation keeping in view the potential resource constraints in terms of land, capital, labour and knowledge?
- How to manage various technologies (eg: how to make optimal use of new inputs in his farm)?
- How and when to change his farming systems (eg: diversifying from crop production to mixed farming or vegetable or animal production)?
- For which type of products, is there a good demand in the market?
- What are the quality specifications he should achieve to get good value for his produce and how to achieve them (eg: for export markets, organic farming)?
- How to find quickly the most relevant and reliable knowledge and information?
- What are the feasible off-farm income generation options available for him and how far he could depend on them?
- What are going to be the implications for his farming if input subsidies are phased out and/or if trade in agriculture is further liberalized?

To support farmers in addressing these changing needs, extension needs more diverse types of expertise than what is available at present.

Current extension scenario: a critical analysis

Extension in this context includes all those agencies in the public, private, NGO and community based initiatives that provide a range of agricultural advisory services and facilitate technology

application, transfer and management.. While public sector line departments, mainly the Department of Agriculture was the main agricultural extension agency in the 60's and 70s, the last two decades have witnessed the increasing involvement of private sector, NGOs, community based organisations and media. In the public sector, the extension machinery of the state Department of Agriculture (DoA) reaches down to the block and village level. The village extension workers of the DoA continue to be an important source of information for farmers in India, even though information is clearly targeted at grain production, visits are irregular, and the service is pre-occupied with the implementation of government schemes linked to subsidies and subsidised inputs. With the external support drying up with the end of the T&V (Training and Visit) system of extension in the early 1990s, states have been left to fund their extension machinery and this has led to considerable weakening of public sector extension.

In the case of public sector extension, the major reform in recent years has been the establishment of a district level co-ordinating agency, the ATMA (Agricultural Technology Management Agency), in 28 pilot districts with the World Bank support. Under ATMA, grass root level extension is mainly channelised through the involvement of BTTs (Block level Technology Teams) and FACs (farmer advisory committees), farmer groups/ farmer interest groups and self help groups. ATMA is a district level autonomous agency entrusted with the role of agricultural technology management in the district. The district collector/deputy commissioner heads ATMA Governing Body, with members drawn from the line department, KVKs, farmers and NGOs (Fig 2).

The number of KVKs (Krishi Vigyan Kendras) funded by the ICAR has increased during this period. Presently 571 KVKs are established in the country. The motto is to cover each district with one KVK with a mandate of technology application through OFTs, demonstrations and training. It is an institutional approach and is comprehensive in nature. It functions on farm based model with a built in research-extension linkage through a multi-disciplinary team. It ensures feedback and feed-forward through participatory management. It is the largest research based extension body in the country by the ICAR at the district level. However, the effective reach of these KVKs is marginal mainly due to inadequate linkages with other development agencies. Moreover, their main focus is on technology testing, assessment and application under farmers' condition through conducting on-farm trials, demonstrations and training.

Extension services in the case of animal husbandry and fisheries continue to remain weak. While public sector extension arrangements have weakened, the number and diversity of private extension service providers has increased during last two decades. These include NGOs, producer associations, input agencies, media and agri-business companies. Many provide better and improved services to farmers, but their effective reach is limited and many of the distant and remote areas and poor producers are neither served by the public nor the private sector.

Based on the experiences gained from the pilot district, the Ministry of Agriculture, Government of India in 2004-05 decided to expand the ATMA model across all the districts in the country. Apart from bringing some additional resources for extension activities to be decided at the district level in consultation with farmer representatives, ATMA is yet to fully address many of the institutional constraints affecting extension performance.

Extension continues to be funded as part of central and state level schemes/programes without much operational freedom at the local level, though the strategic research and extension plans (SREP) under ATMA envisage bottom up planning for extension. While the farmers require a wider range of support to address the emerging challenges, extension mainly functions as an agency for technology dissemination. Most of the organizations including the public sector departments continue to work in isolation. Marketing extension has been a recent addition but is understood and implemented mostly as provision of output price information in various markets and this is highly inadequate to address the challenges in marketing. Other extension support facilities created include, farmer training centres at the district level; SAMETI (State Agricultural Management Extension and Training Institute) at the state level, EEI (Extension Education Institute) at the regional level; and MANAGE (National Institute for Agricultural Extension Management) at the national level.

Table 1: Critical analysis of capacity to deal with second GR challenges

Sl. No.	Extension organisations	Functions/Roles/Capacity	Gap/Limitations
1	ATMA	Aimed at decentralized decision making and bringing convergence among extension providers in a district:Promotion of commodity interest groups; Development of a strategic research and extension plan: Provide additional funds to these agencies for key extension activities such as farm schools, demonstrations, exposure visits and trainings	No dedicated manpower; Limited resources, Convergence limited to activities undertaken with the specific budget for ATMA (Rs.80-100 lacs an year)
2	KVK	Technology application (technology assessment and refinement) through on-farm trials, front-line demonstration and training	Limited reach; Several vacant positions Inadequate operational funds; Weak linkages with other development agencies in the district; Poor technology and methodological back stopping from the host institution; Non availability of critical facilities like soil and water testing facility, farming system models, demonstration units etc in some KVKs
3	State line departments (Agriculture, Animal Husbandry, Fisheries, etc)	Regulatory role; Implementation of development programmes that involve distributon of subsidies and subsidized inputs; Organising and village level; Large extension programmes	Only the Department of Agriculture has staff assigned upto block number of vacancies, especially in remote and distant regions; Grass root level VEWs lack technical competence to deal with emerging challenges; Lack expertise on cutting edge technology, organizational, management and marketing aspects; Implementation of

Sl. No.	Extension organisations	Functions/Roles/Capacity	Gap/Limitations
			schemes/programmes leave little time for extension. Extension is weak in animal husbandry and fisheries departments.
4	FTC	Training farmers on new technologies	Defunct in most places, Acute shortage of funds and manpower.
5	SAU (Directorate of extension)	Implement extension programmes of the SAU and oversee activities of KVK	Staff and fund shortage; Weak state support; Inadequate links with development departments; No adequate field presence.
6	NGOs	Exhibit wide diversity in terms of reach, credibility and capacity; Have good knowledge and networks with communities in villages they operate; Present in difficult and remote regions; Innovative in their approaches; Can potentially complement approaches of the public sector extension.	Effective reach restricted to select villages in their areas of operation. Many of them do not have adequate technical capacity. Wide variation in credibility and track record.
7	Private Agri-business firms	Agri-input firms mainly involved in product demonstrations; Agroprocessing and marketing firms mainly commodity oriented but do provide integrated support (inputs, technical support and marketing) for contact growers;	Present in only select regions; Narrowly focused on business interest; Lack focus on long term capacity development of farmers
8	Media	Dissemination of information on new technologies	Low literacy levels constrain penetration of print media; Poor content, inadequate coverage and little telecast time through television channels; Potential of media yet to be fully realised due to lack of integration of mass media with other extension programmes/approaches
9	Private consultants	Support large farmers growing cash crops and high value horticulture	Limited to select crops and regions Affordable only by large farmers
10	MANAGE	Training senior and middle level extension managersConduct studies on extension systems and policiesConducts management educational programes in agriculture Provide Consultancy	Need greater focus on extension systems research and policy initiatives Limited faculty and funding Need to establish international linkages

Sl. No.	Extension organisations	Functions/Roles/Capacity	Gap/Limitations
11	SAMETI	Training middle level extension staff at the state level Conduct studies on extension systems at the state level	Lack of infrastructure, expertise (faculty); Inadequate focus on extension studies; Weak links with actors outside the public sector
12	EEI	Training middle level extension managers at the regional level	Inadequate infrastructure Inadequate training capacity, linkages and autonomy.

III. Way forward: Critical Issues and Recommendations

To deal with the challenges of the second green revolution, the extension organizations needs to gear up their capacity in terms of manpower, expertise, finance, structure, institutional linkages; and the kinds of methods, approaches and delivery systems they employ. The major recommendations to be taken up for strengthening transfer of technology and extension system to address the challenges of the second green revolution are grouped under the following heads.

I. Farmer empowerment and farmer organizational development

II. Institutional issues

III. Public -private partnerships

IV. Technology backstopping, integration and management

V. Frontier areas for extension, HRD and skill development

VI. Policy issues

I. Farmer empowerment and farmer organizational development

Addressing the complex challenges of bringing about the second green revolution would require solutions which are beyond the decision-making capacities of individual farmers. This would necessitate new forms of collaboration as the agriculture sector in India is dominated by small farms. Collective decisions on resource use and marketing would necessitate forming new forms of collaboration and this is particularly important as this sector is dominated by small farms — often with weak bargaining powers and limited political voice. To deal with the new set of challenges, farmers need a wide range of information and support and these include aspects related to technologies, organizational development, entrepreneurial development and access to appropriate financial services. This would necessitate a reformulation of the objectives of extension.

Recommendation

1. **Reformulate the objective of extension as farmer empowerment and farmer organizational development.** Programmes and activities should focus on:

- Facilitating adoption of improved knowledge on production, value addition and marketing by farmers
- Farmer organizational development including leadership development and supporting farmer organizations to take up new initiatives (technology application, networking, financing and marketing including supporting producer companies)
- Organise special programmes for women in agriculture to achieve the above two objectives

II. Institutional Issues

Extension faces several institutional challenges. These include: rigid hierarchy and centralized modes of planning; a tradition of assessing performance in terms of technology adoption; history of working independently; a mistrust of other agencies; and a tradition of upward accountability for resource utilization rather than output achievement and client satisfaction. For instance, lack of dedicated manpower, functional autonomy and attitudinal barriers at all levels have constrained ATMA in its effective functioning. Still most of the line department and extension functionaries are not clear about the approach and ways of integrating extension activities through ATMA. The KVKs are 100% funded as a centrally sponsored programme under plan budget. The functioning of KVKs is mostly limited to the central grant only as there is no corresponding matching grant either from the state or the host organisation. This has led to lack of ownership of KVKs and lack of accountability resulting in improper manpower deployment, delay in sanction and utilization of the budget, and non-establishment of required infrastructure. These institutional issues currently constrain integrated delivery of support and services at the district and block levels. ICAR has recently suggested a framework developed by ICAR for technology development and delivery system (Fig 3). It illustrates the roles of different organizations and the functional linkages among them and is worth considering in this context.

Recommendation:

2 Improve integrated delivery of support and services at the district and block levels through strengthening the capacity for improved interaction and joint functioning of KVKs, ATMA, BTT, FIAC and Panchayat Raj Institutions (PRIs).

Measures include:

- Create platforms for regular interaction at the district and block levels and fix accountability on these forums
- Provide additional funding only for joint programme proposals
- Monitor programmes for institutional bottlenecks and address each as it arises
- Implement similar approaches for improving extension performance at the zonal and sub-zonal levels

III. Public private partnership issues

Despite repeated emphasis on collaborative extension efforts involving public and private agencies, this approach is yet to get adequate attention. There are very few successful partnerships in the country. Some of the critical constraints related to establishment of successful public private partnerships (PPPs) include:

- Bureaucratic hurdles,
- Delays in decision making,
- Hoarding of information/technologies,
- Fear of operational compatibility,
- Lack of a common platform to get into an operational MoU among partners,
- Lack of initiatives and mission mode approach
- Unwillingness to share credit among partners and
- Reluctance for investments from private players.

Suitable partnership among national and regional players involving commodity boards, research institutes, farmer organizations and business houses will certainly prove to be successful, provided such partnership arrangements are made on professional terms and conditions, centered around teams, free from conventional bureaucratic control with incorporation of inbuilt project planning, implementation and monitoring arrangements. For example, a viable partnership among NDRI (National Dairy Research Institute), NDDB (National Dairy Development Board), Dairy co-operatives and the state Department of Animal Husbandry in the field of dairying can potentially lead to a successful technology generation, support, transfer and application for dairy development.

Similar arrangement could be worked out in the area of production and marketing of agricultural commodities. Big corporate players like Reliance, ITC, Pepsico and Bharati, have entered the business of marketing agricultural commodities. Partnership arrangements with the public sector for technological support in the areas of production, value addition, cold chain management etc at the farmer end can ensure farmers from receiving holistic benefit from such partnerships. Lack of a common platform to broker such alliances has led to non-operationalisation of PPP in practice. Under present circumstances, a suitably conceived and operated PPP arrangement will certainly will help the country to address the second green revolution challenges, promote client centered extension, and lessen the burden on government exchequer.

Recommendation:

3. Promote public private partnerships through

- Explore options for PPP in district plans and SREPs
- Senior staff to be made accountable for operationalising PPPs

- Establish a separate cell for promoting industry and market driven extension
- Orient the staff at various levels on the advantages of PPPs and lessons from experiences so far and
- Address bureaucratic delays that constrain partnerships

IV. Technology backstopping, integration and management

The most important and neglected area of the present extension system is its limited ability to integrate different kinds of technologies. As a result, farmers adopt such technologies in isolation and blames extension and research system for its failures. This has resulted in confusion at the field level and erosion in extension's credibility on technological aspects. Therefore, an arrangement has to be evolved by the extension system for selection and integration of technologies. Promoting sustainable agriculture involves adopting an integrated approach keeping in view the nutrient status, water availability, crop animal combinations, pest and disease build-up, labour, markets, and availability of other support. Approaches such as INM (integrated nutrient management), IPM (integrated pest management), integrated soil and water management, etc involves integration of a wide range of technologies relevant to each area. Extension therefore needs to take up the challenge of integrating suitable technologies focusing on specific issue of agricultural development. One potential approach is as follows:

- Decide on the problem and what needs to be improved
- measure the current status against the desired status
- analyse the root causes of the problem
- analyse the merits and demerits of potential solutions
- test different combinations through on-farm trials and demonstrations
- implement solutions and monitor long term improvements on sustainability parameters.

Establishment of ICT centres involving corporate sectors under Corporate Social Responsibility (CSR) schemes can be thought of to popularize ICT mode extension initiatives. These centres however have to be linked to the state agricultural universities and research institutes for technology and methodological backstopping. Content development for each technological area is a must. ICT centres need to be supported by content, technological inventories and methodological issues by the research partners. For instance, the ITC's *e-chaupal* initiative has got a strong technological and methodological support from Central Tobacco Research Institute (CTRI/ICAR) and ILTD Division of ITC with respect to tobacco production technology. It is one of the strong successful cases of public-private partnership in agricultural extension through ICTs. Similar arrangements could be thought of in other sectors too. For instance, NDRI-NDDB-Dairy co-operatives can come together to establish ICT networks for the benefit of dairy farmers. Similarly partnerships between commodity boards and farmer association can establish ICTs in their respective areas of operation. Sustained technological and methodological backstopping arrangement among partners

having similar interest is a pre-requisite for the successful implementation of ICT based agricultural extension. As discussed earlier, clear cut assignment of responsibility and freedom from bureaucratic hurdles are necessary for bringing dynamism in its operation.

Recommendation:

4. Strengthen technology backstopping, integration and management. Options include:

- Improve the ability of extension organization to integrate technologies, test and develop integrated packages for different areas and monitoring performance
- Improve technological backstopping through partnerships and contracting arrangements
- Use the full potential of ICTs to bring together different types of knowledge and technologies from public and private sources
- Promote distance learning and virtual extension through ICTs
- Exploit the advances in mass media to improve reach and relevance and obtaining feedback

IV. Frontier areas for extension, HRD and skill development

Lack of quality manpower dedicated to the cause of agricultural development is a serious constraint and challenge encountered by the system. Agricultural extension should to an agri-business extension mode and this is possible only if the system recruits personnel who can bring in different kinds of expertise. For instance expertise related to cutting edge technologies, organizational development, market development, legal issues related to farmer rights, IPR etc are crucial for extension. This would also involve some de-learning of its conventional technology dissemination approach and learning new ways of doing things. Extension is weak in animal husbandry and fisheries sector and this would need considerable strengthening. Strengthening of national and regional level training facilities for continuous skill up gradation of extension professionals is to be taken up immediately. Assessment of the quality of extension personnel is a must and a national level mission mode approach is needed in this regard.

Recommendation:

5. Strengthen expertise of extension organization in the following areas:

- Frontier areas of technology
- Resource conservation and management
- Market development, linking with markets and export development
- Quality and standards
- Organic agriculture

- Enterprise/entrepreneurship development,
- Skill development in horticulture, seed and plant material production
- Research and extension in response to adaptation to climate change and risk management
- Financing and insurance
- Extension for resource conservation and management
- Extension management techniques (programme/project management- PERT, CPM, log frame, 5-S etc)
- Legal and regulatory issues (farmer rights, IPR)
- Promotion of public-private partnership
- Application of ICTs, content development and updating
- Skills related to farmer organizational development and farmer empowerment

6. Strengthen extension in animal husbandry and fisheries sector

7. Initiate manpower planning in extension organizations, create new positions and fill existing vacancies based on manpower planning

8. Address HRD and skill development in extension organizations through the following strategies:

- New recruitments,
- Contract arrangements,
- Consultancies,
- Staff trainings
- Partnering with organizations having expertise

V Policy Issues

Several organisations implement extension programmes with very little co-ordination. Co-ordination is lacking even among public sector organisations. Establishment of a national extension authority (similar to the National Rainfed Area Authority), can potentially bring about the much needed integration for effective planning and delivery of extension programmes. Integration of extension activities at the district level also needs policy support. Several initiatives that were successful at the pilot stage had failed when external support was withdrawn. Another major constraint is the declining financial support for extension. Enhanced funding is crucial for improving the ability of extension to deal with the complex challenges of the second green revolution. Extension also needs crucial

research backup on new approaches, methodologies and management techniques relevant for different situations.

Recommendation

9. Address policy issues in extension. This includes:

- Enhanced funding
- Strengthen research in extension
- Establish a national extension authority
- Developing strategies to improve sustainability of pilot initiatives and
- Strengthen mechanisms for district level planning

Fig 1 : Future Role And Competencies For Extension

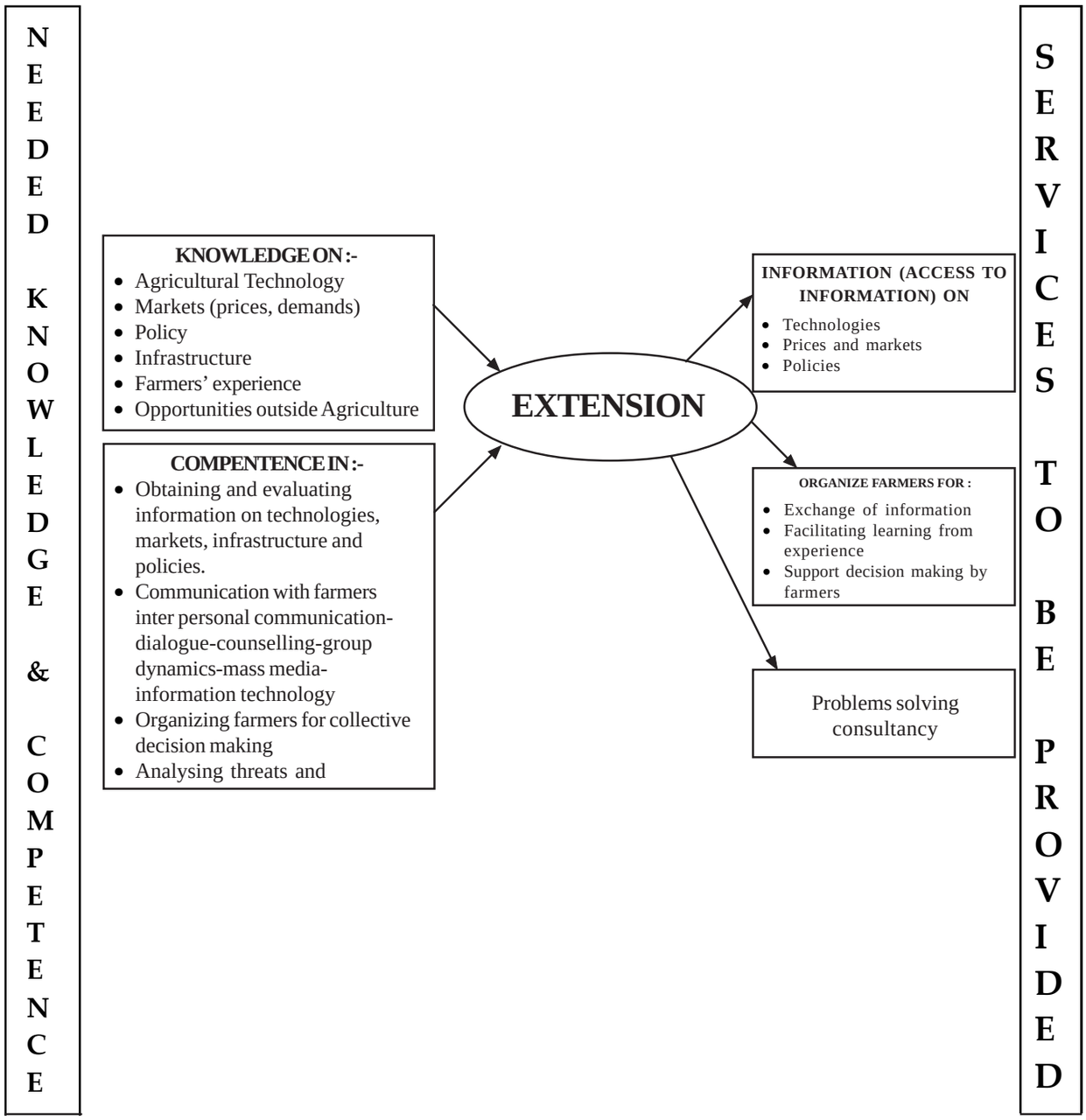


Fig 2: Organizational Structure of Agricultural Technology Management Agency (ATMA)

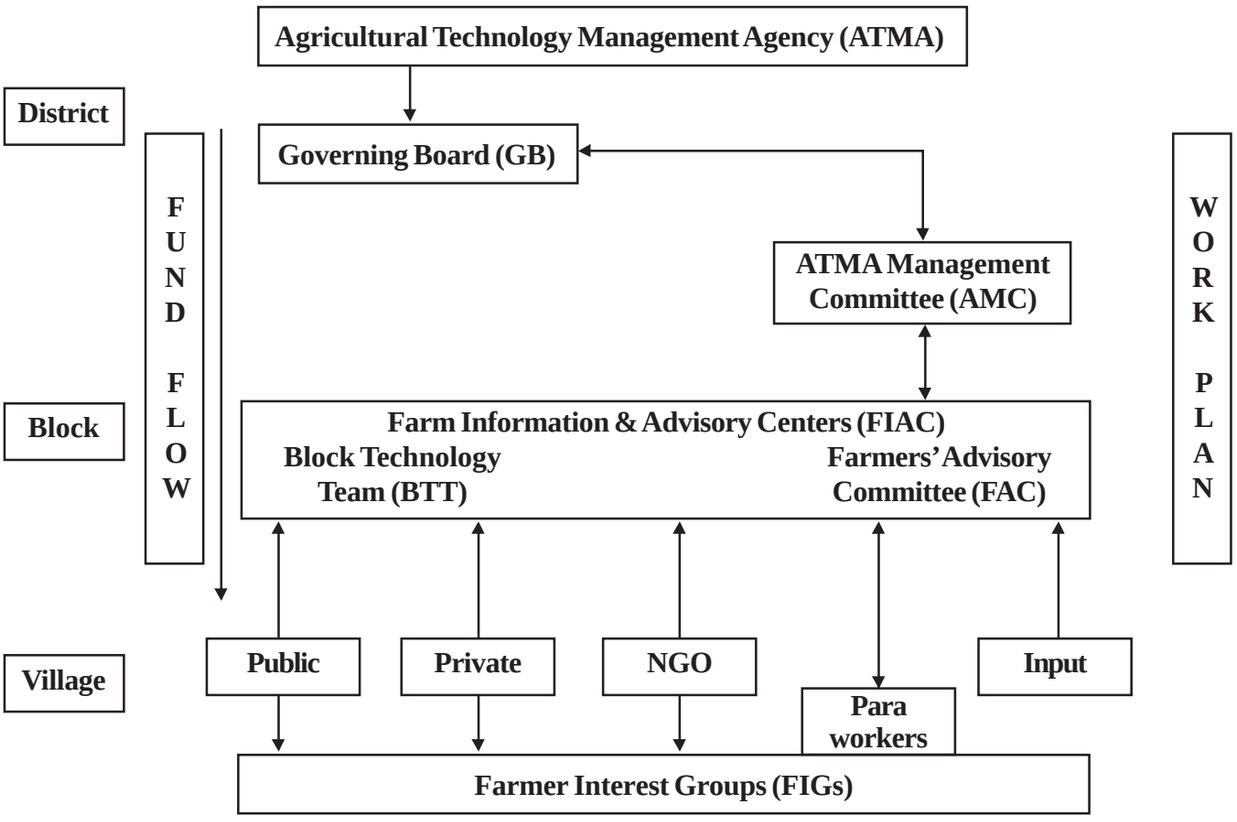
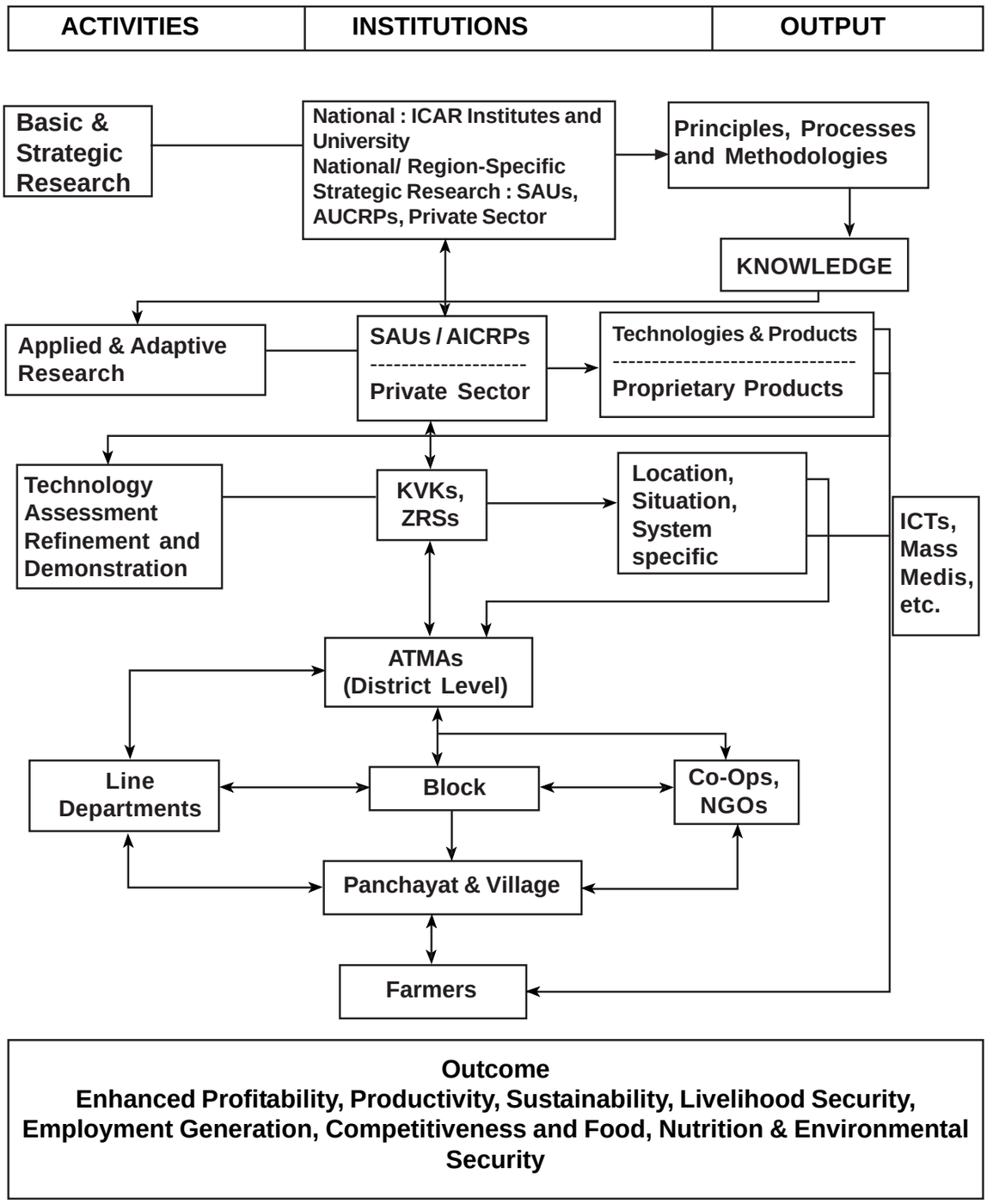


Fig. 3. A Framework for Technology Development and Delivery System (Source: ICAR)



Agriculture Extension Systems : Issues and Strategies for Convergence

V. Venkatasubramanian[1], V.V. Sadamate[2] and M.J. Chandre Gowda[3]

The National Development Council has visualized an overall growth rate of 10 percent for XI Plan for which agricultural sector has to contribute a growth rate of about 4.1% which is in fact require a concerted effort. It is now widely accepted fact that sound agricultural development is essential for overall economic progress. Given its range of agro ecological setting and more than 120 million farmers, agriculture is faced with a great diversity of needs, opportunities and prospects. Therefore, there is an immediate need of a vibrant, dynamic and innovative approach to be adopted for agricultural extension. If it is to respond successfully to the new challenges posed, greater attention will have to be paid to information based technologies, convergence of extension efforts by different agencies to strengthen means of dissemination to transmit the information to farmers.

The major concern is duplication of efforts with multiple agencies doing extension work without convergence. A coordinated effort is a must to synergise and converge these efforts at the district and below to improve the performance of various stake holders. This paper examines the current scenario of the public extension system and issues related to the convergence of extension services functioning in the country.

Current Extension Scenerio:

Extension in this context includes all those agencies in the public, private, NGO and community based initiatives that provide a range of agricultural advisory services and facilitate technology application, transfer and management.. While public sector line departments, mainly the Department of Agriculture was the main agricultural extension agency in the 60's and 70s, the last two decades have witnessed the increasing involvement of private sector, NGOs, community based organisations and media. In the public sector, the extension machinery of the state Department of Agriculture (DoA) reaches down to the block and village level. The village extension workers of the DoA continue to be an important source of information for farmers in India, even though information is clearly targeted at grain production, visits are irregular, and the service is pre-occupied with the implementation of government schemes linked to subsidies

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and subsidised inputs. With the external support drying up with the end of the T&V (Training and Visit) system of extension in the early 1990s, states have been left to fund their extension machinery and this has led to considerable weakening of public sector extension.

In the case of public sector extension, the major reform in recent years has been the establishment of a district level co-ordinating agency, the ATMA (Agricultural Technology Management Agency), in 28 pilot districts with the World Bank support. Under ATMA, grass root level extension is mainly channelised through the involvement of BTTs (Block level Technology Teams) and FACs (farmer advisory committees), farmer groups/ farmer interest groups and self help groups. ATMA is a district level autonomous agency entrusted with the role of agricultural technology management in the district. The district collector/deputy commissioner heads ATMA Governing Body, with members drawn from the line department, KVKs, farmers and NGOs.

The number of KVKs (Krishi Vigyan Kendras) funded by the ICAR has increased during this period. Presently 562 KVKs are established in the country. The motto is to cover each district with one KVK with a mandate of technology application through OFTs, demonstrations and training. It is an institutional approach and is comprehensive in nature. It functions on farm based model with a built in research-extension linkage through a multi-disciplinary team. It ensures feedback and feed-forward through participatory management. It is the largest research based extension body in the country by the ICAR at the district level. However, the effective reach of these KVKs is marginal mainly due to inadequate linkages with other development agencies. Moreover, their main focus is on technology testing, assessment and application under farmers' condition through conducting on-farm trials, demonstrations and training.

Extension services in the case of animal husbandry and fisheries continue to remain weak. While public sector extension arrangements have weakened, the number and diversity of private extension service providers has increased during last two decades. These include NGOs, producer associations, input agencies, media and agri-business companies. Many provide better and improved services to farmers, but their effective reach is limited and many of the distant and remote areas and poor producers are neither served by the public nor the private sector.

Based on the experiences gained from the pilot district, the Ministry of Agriculture, Government of India in 2004-05 decided to expand the ATMA model across all the districts in the country. Apart from bringing some additional resources for extension activities to be decided at the district level in consultation with farmer representatives, ATMA is yet to fully address many of the institutional constraints affecting extension performance.

Extension continues to be funded as part of central and state level schemes/programes without much operational freedom at the local level, though the strategic research and extension plans (SREP) under ATMA envisage bottom up planning for extension. While the farmers require a wider range of support to address the emerging challenges, extension mainly functions as an agency for technology

dissemination. Most of the organizations including the public sector departments continue to work in isolation. Marketing extension has been a recent addition but is understood and implemented mostly as provision of output price information in various markets and this is highly inadequate to address the challenges in marketing. Other extension support facilities created include, farmer training centres at the district level; SAMETI (State Agricultural Management Extension and Training Institute) at the state level, EEI (Extension Education Institute) at the regional level; and MANAGE (National Institute for Agricultural Extension Management) at the national level.

Convergence of Extension Services:

There are many extension service providers in the field, providing different kinds of useful services like information and service support to farmers. They are state, central government agencies, agribusiness companies, agri-preneurs, input dealers, manufacturing firms, NGOs, farmers organisations and progressive farmers. There is duplication of efforts with multiplicity of agents attending extension work without convergence. There should be coordinated attempt to synergise and converge these efforts at the district and below to improve the performance of various stake holders.

Some of the issues related to the convergence of extension services are:

- What type of institutional arrangement could be made keeping in view of the operational convenience, for achieving an effective convergence?
- What is the frame work of reference and strategies for such convergence?
- Identification of need for convergence, drawing a convergence model, operational steps for convergence and coordinating the identified activities for effective convergence.
- What is the operational working plan for such convergence?

The critical areas in which such convergence effort is required are:

- Farmer empowerment and farmer organisational development
- Technology backstopping and management
- Public private partnership's
- Frontier areas for extension, HRD and skill development

An exercise has been made to indicate the possible convergence in the above critical areas of extension and presented given below.

1. Farmer empowerment and farmer organisational Development

As a first step the details of the areas of capacity building exercise in terms of training, method, or procedure of capacity building, infrastructure required need to be worked out. It is beyond doubt that combination of human performance with proper resource structure lead to development. An effective convergence of method/ procedure, Agency/ infrastructure no doubt will ensure proper use of scarce resources, time and energy. The details of the areas of capacity building, method/ procedure adopted and agency/ infrastructural convergence are given here under:

Sl. No.	**Areas of capacity building**	**Method / Procedure**	**Agency/ Infrastructure/ convergence**
1.	Farmers knowledge, skill and attitude		
	i) Breeding ii) Feeding iii) Health care and disease prevention iv) Value addition and marketing	i) Training/ Demonstration ii) Exhibition & farmers fair iii) Extension literature iv) Mass Media v) Use of ICT and cyber extension vi) Field campaign	KVKs, SIRD, NIRD, IIE, ICAR & SAU Extension system. State level livestock development agency and Department of Veterinary and Animal Husbandry.
2.	Leadership, communication, skill and managerial development		
	i)Strengthening of village level leadership ii) Developing inter-personal communication iii) Managerial skills such as planning, organizing, coordi-nation etc.	i) Training/ Role play ii) Success stories and cases iii) Management games	KVKs, EEI, IIE, MANAGE, NIRD & SIRD

3.	Organisational Skills		
	i) Organisation of farmers groups. ii) Organisation of producer/ cooperatives/ societies/ union or federations.	i) Training in leadership ii) Training in group dynamics & group formations iii) Performance linked specialized training iv) Record keeping v) Financial management	i) Cooperative training institute. ii) IIE iii) NIRD/ SIRD iv) EEI
4.	Marketing and Business Skills		
	i) Market Analysis ii) Demand and supply Forecasting iii)Supply chain, Cold chain and networking iv) Retail marketing and creation of market network	i) Lectures and skills training by practical ii) Exposure visits to progressive states and leading co-operative dairies	i) Cooperative training institutes ii) MANAGE iii) IIE/EEI iv)NIRD/SIRD v) Leading management institutes in Rural development.
5.	Establishment of grass root level infrastructural facilities		
	i) AI Centres ii) Mobile unit iii) Fodder demonstration units iv) Milk Collection centres v) Bulk Coolers vi) Chilling centres vii) Rural Marketing Network and centres viii) Establishment of Milk Processing centres at regional level ix) Value addition and manufacturing facilities at district level	i) Analysis of the types of breed requirement and quantity of semen requirement ii) Ensuring quality semen supply and availability of skilled insemination iii) Training of rural youths for paid insemination services. iv) Preparation and submission of suitable projects for the establishment of milk collection centres, chilling centres and rural marketing centres through funding agencies.	i) Department of Animal Husbandry and Dairying ii) State Milk Federation iii) NDDB iv) NEDFI v) NABARD

2. Technology Backstopping and management

Technological backstopping to the centrally sponsored schemes such as NREGS and SGSY is a must at the ground level leading to sustainable development in rural areas. The appropriate technological support will help to create grass root level assets/ infrastructure through these schemes which in turn will help as a local resource in their command to undertake sustainable agriculture. Such an attempt ensures self reliance and less external input dependence agriculture. For example, under the NREGS one such attempt was made in Sikkim state which by means of convergence brought the organisations like Sikkim Government, KVKs, IGNOU, NIRD, ICAR Research Complex for NEH Region, and Zonal Coordinating Unit in solving the problems of farmers by using the NREGA fund. A multidisciplinary team constituted for the purpose visited villages in the South Sikkim District and analysed the grass root level problems, technological solutions and recommendations problems, technological solutions and recommendations for action were made. The problem areas identified were:

- Improper use and water management
- Non availability of seeds and planting material
- Lack of resource support for development of livestock

The details of the problems, technological solution and Action point suggested is briefly given under:

(1) Land Use and Water Management

Problems:

i) Non-availability of water in lean seasons.

ii) Unscientific soil working techniques

iii) Problem of wasteland and non utilization of sloppy land

Technological solution:

i) Soil and land use planning

ii) GIS/ GPS aided development plan

iii) Rain water harvesting

iv) Development of irrigation channels using natural gradients by remote sensing

v) Sloppy Agricultural Land Use Technique (SALT)

vi) Soil and moisture conservation in hilly terrain, contour terracing across the slope for drought prone areas.

Recommendations/Action points under NREGS:

i) Creation of local water shed

ii) Creation of public drainage/ irrigation channels

iii) Siltage removal of natural drainage/ irrigation channels/ water bodies.

iv) Soil and moisture conservation by afforestation programme on public lands/ slopes/ degraded forests etc.

v) Common property resource management

(2) Non Availability of Quality Seeds and Planting Materials

Problems:

i) Poor quality of seeds and planting materials for ginger, orange and other food, vegetable crops as well as fodder.

ii) Non availability/ lack of technical know-how on seed production.

Technological solutions:

i) Use of seeds and planting material production technologies

ii) Biotechnological means such as tissue culture

iii) Production of hybrid seeds, establishment of progeny orchards.

Recommendations/ Actions Points:

i) Establishment of community nursery facilities

ii) Creation of community owned progeny orchards and planting materials production farms and operationalising it under community ownership or through SHGs.

(3) Livestock and Poultry Development:

Problems:

i) Non availability of quality semen of high yielding breeds

ii) Inadequate fodder availability

iii) High cost of concentrate feed

Technological Solution:

i) Frozen semen and AI techniques

ii) Embryo transfer

iii) Establishment of community bull farms

iv) Hybrid fodder varieties such as CO_3/ CO_4/ Lucerne/ Berseem etc.

v) Silage and hay making

vi) Enrichment of paddy straw

vii) Mineral manure lick

Recommendations/ Action Points:

i) Establishment of semen production centres and mobile units for reaching the unreached through AI.

ii) Training the rural youth for AI as lay inseminators

iii) Establishment of community fodder farms/ satellite fodder farms in the wastelands, sloppy lands etc.

Convergence: NREGA, Ag. Dept, KVK, IGNOU, ICAR, Panchayat Institution, NGOs, Farmer Interaction group, Spice Board etc.

3. Swarnjayanti Gram Swarojgar Yojana (SGSY) – SHGs – Technnology - Financial Institutions – Linkages

The SGSY provides credit cum subsidy for various income generating activities of SHGs including those related to irrigation and land development, horticulture, animal husbandry and dairy development, fisheries, village and agro based industries, rural handicrafts, handlooms etc. The key issue under SGSY is a social mobilization of rural poor into SHGs; setting up of sustainable micro enterprises by selection of key economic activities depending on available resources, occupational skills, appropriate technology and; financial assistance through a mix of Bank Credit and Government Subsidy; infrastructure, technology and marketing support with forward and backward linkages.

The appropriate technologies developed by ICAR and KVKs for these sectors need to be demonstrated and disseminated through SHGs. One such example of convergence of efforts by KVK, ICAR Institute, DRDA and SHGs in developing entrepreneurship development in East Godavari district, Andhra Pradesh is given here under.

A total number of 293 SHG groups with 2158 beneficiaries from 143 villages established 514 household units. Each individual is earning about Rs. 1000 to Rs. 3000/ month depending upon the activity they have taken up. The KVK CTRI, Rajamundry developed very good linkages with various financial institutions and rural development agencies of state, central and NGOs in a more effective way for economic viability and sustainability of these units in rural areas. These organisations besides acting as a resource centres and programme sponsors, provided financial support, scheme and subsidy components. The details of linkages is given in the figure presented below:

4. Case Studies on Convergence:

Under this section five case studies drawn across the country are presented. The case studies presented shows the details of the technology source, output and outcome achieved due

to the convergence efforts of different stakeholders in the development process. The details are presented here under.

CASE – 1

Banana Fibre Extractor: A case of successful convergence:

The manual fibre extraction process from banana stem is a cumbersome process. In the manual process an expert person can hardly produce a maximum quantity of 500 to 600 grams of dry fibre in eight hours. It is a tedious process involving patience, drudgery by means of straining palms of the person who extracts the fibre. Blackening of nail ends, finger tips and nail ulcers are some of the common problems associated with the manual extraction process. In addition it also creates a poor working condition due to the spillage of juice and waste pit in and around the extractor. Due to this cumbersome process with less economic output the extraction of fibre from the pseudo stems of banana has not receive desired attention and therefore no commercial extraction of the fibre is made from the pseudo stem of banana even though good quality of fibre material can be extracted and used for commercial purposes.

The survey conducted by the KVK- CTRI confirmed the above problems associated with the banana fibre extraction process. Therefore, it was felt that a suitable user friendly fibre extraction device which is highly essential to solve the above problem is essential. An inter institutional project team consisting of V. Venkatasubramanian, R. Sudhakar, K.Deo Singh from CTRI, Hyderabad designed and developed the need based user friendly machine “Banana Fibre Extractor” for the commercial exploitation of unutilized Banana wastes such as pseudo stems, peduncles and leaf stalks.

Machine Highlights

- Reduces drudgery
- 50 times increase in fibre production compared to manual process
- User friendly and economic
- Less maintenance cost and safe to operate
- Clean work atmosphere and clean hands
- 25 kgs of fibre production/ day against 500 grms through manual operation.
- Superior quality fibre in terms of length , softness, strength and colour.

The machine helps banana cultivators to get an additional income of Rs. 2500/ per acre @ Rs. 5/ per plant with an average of 500 plants in an acre.

How convergence happened?

- Andhra Pradesh Agro industries ltd, Hyderabad purchased the commercial manufacturing rights of the machine.

- Andhra Pradesh announced 50% subsidy for the machine and ensured the training and distribution of the mission through DRDA and SGSY.

- KVK-CTRI offered the training/ technology backstopping demonstration of the machine.

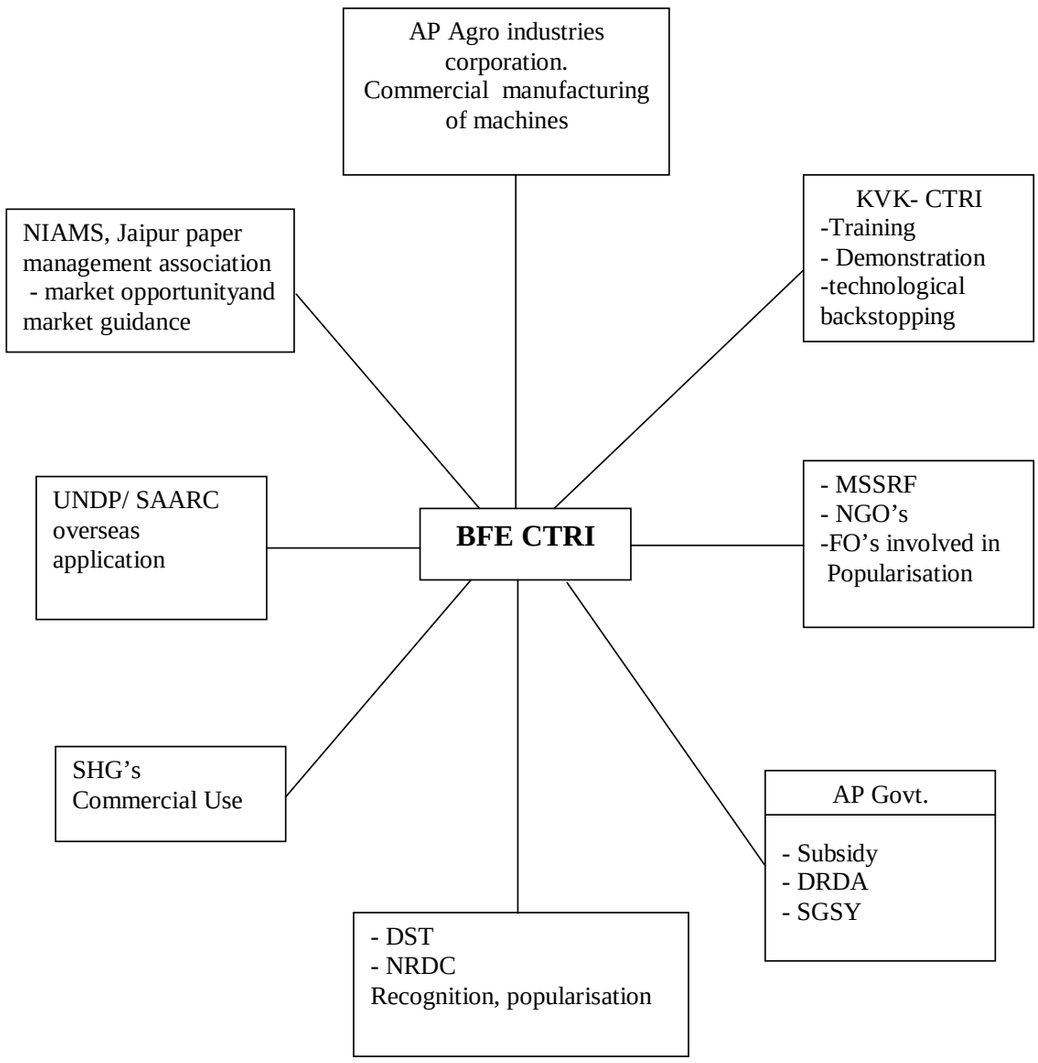
- NGOs like Abhyodhay, Harsek Parshed, Amma Society, MSSRF, etc. were involved in the popularization of the machine in their respective operational areas.

- SHGs taken up the fibre production activities.

- DST, GOI selected the machine for meritorious invention award and popularized the machine through their channels/ exhibition.

- Machine was imported by the South Asian Centres and recently to Trinidad under UNDP programme for livelihood assurance project.

- In NE Region alone, more than 60 machines are under operation and recently all the Home Science SMS of the KVKs – NE region were trained by KVK, CTRI, sponsored by Zonal Project Directorate, Zone- III.

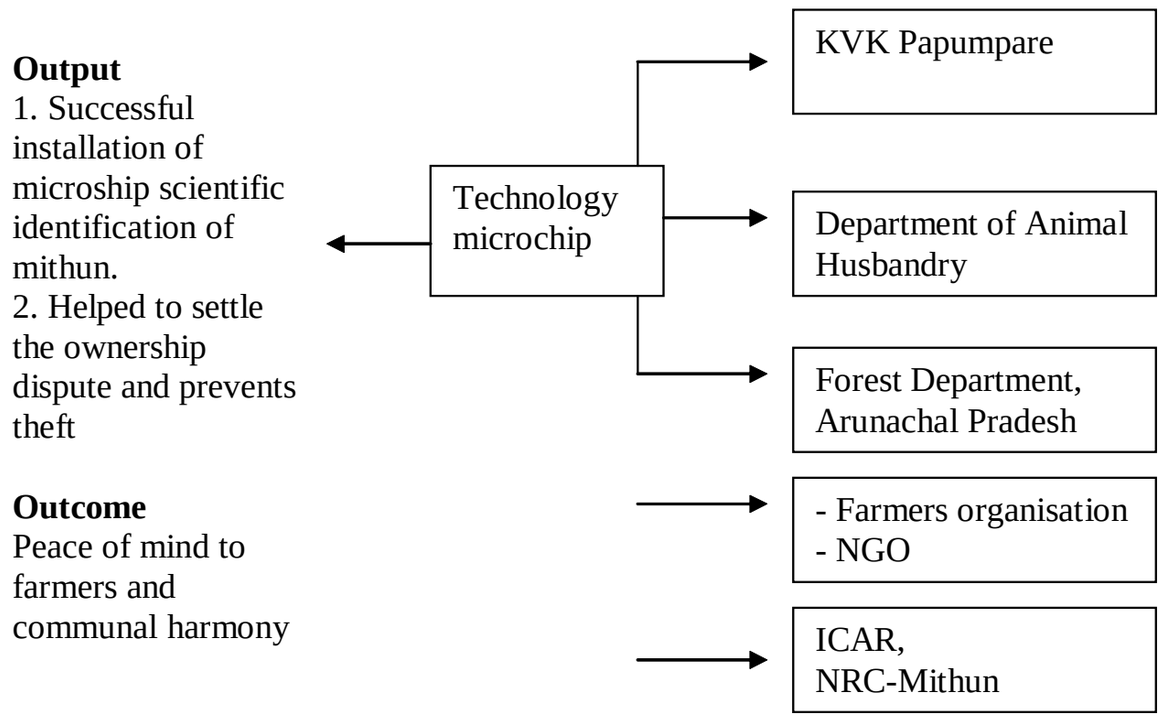


Thus, the BFE technology has been successfully commercialized for the benefit of farming community and rural women for their income generation activity using the locally available materials which are otherwise known as wastes.

CASE-2: Mithun Identification Using Microchip Installation: Arunachal Pradesh

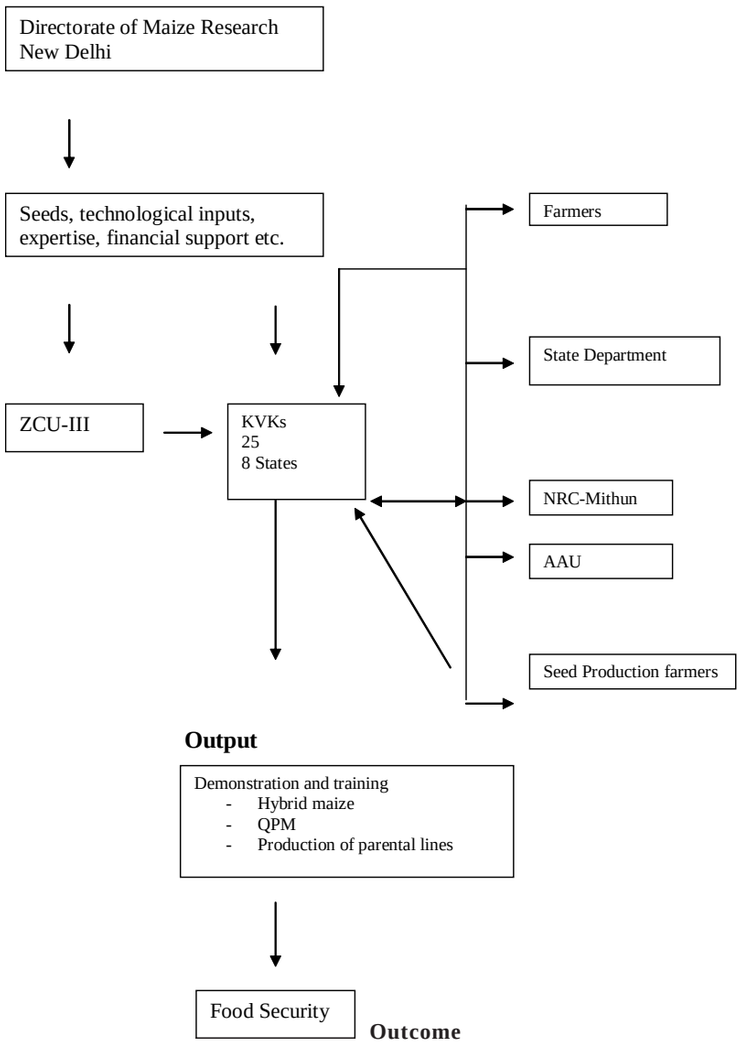
Traditionally the mithuns are identified with the identification markings made through ear cut, branding, tattooing etc. since these methods can be easily be manipulated, many times farmers are disputed over the ownership. Theft and ownership dispute is a common problem due to the lack of full proof identification practice adopted by the farmers. KVK Papumpare district has come out

with the solution of installing microchip installation on the mithuns for the scientific identification. This programme was initiated with the help of forest department of Arunachal Pradesh for technical collaboration and animal husbandry department for the field level support. The farmers organisation, local NGOs were also activiely involved in the above project. The details of the convergence , output and outcome of the programmes are given here under.



CASE- 3:

Similarly, we can site one of the successful convergence attempt made in the NE Region is the hybrid maize seed production programme where in a successful convergence of various stake holders was facilitated by Zonal Coordinating Unit, Zone-III. The partners are PD Maize, 27 KVKs distributed in 8 states, NRC-Mithun, AAU, State Department of Agriculture of respective states, farmers organisation, NGOs etc.

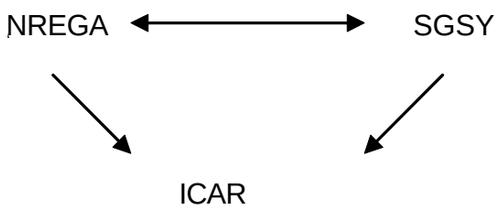


Hybrid Maize Production Programme in NE Region- A successful case of convergence

CASE-4: Convergence of NREGA and ICAR- KVK.

Ministry of Rural Development implements various schemes for employment generation and allevation of rural poverty and infrastructure development in the rural areas. The major schemes being implemented by the ministry are the National Rural Employment Gaurantee Scheme (NREGS) and the Swarnjayanti Gram Swarojgar Yojana (SGYS). After a series of high level interface meetings held between Ministry of Rural Development and Indian Council of Agricultural Research (ICAR), it has been decided that appropriate technological backstopping to the schemes of NREGS and SGSY would be provided by the Krishi Vigyan Kendras (KVKs) of ICAR at the ground level leeding to sustainable development in the rural areas. The KVKs have developed appropriate technologies for on farm and off farm activities. Initially, 50 districts have been identified on a pilot basis for technological interventions by KVKs based on the requirements of the districts.

The detail guidelines mentioning the need for convergence, parameters for convergence, strategies for NREGA (MARD) and ICAR (MOA) convergence, have been worked out. Initially, the process of convergence with ICAR is to begin with those areas of natural resource management where the KVKs have developed technical experience. The concern for quality is central to NREGA and KVK is expected to promote appropriate technologies for NREGA works. An illustrative list of NRM activities where the expertise of KVKs can be used in conjunction with the choice of works under NREGA was prepared and provided. The list includes, water conservation, ground water recharge, drought proofing, development of irrigation facility, land development, flood control and protection works etc. In addition, the value adding activities on NREGA work also proposed to be attempted through convergence with ICAR technologies.



CASE- 5:

Assuring a Livelihood Security to Tribals in East Godavari District- Convergence of KVK-CTRI, ITDA, AP Forest Department, SAU and NGO.

An inter institutional project was undertaken by CTRI, KVK-CTRI and Integrated Tribal Development Agency, East Godavari District towards farming system analysis and agricultural development in the tribal areas. It was revealed from the findings that tamarind collection and marketing was the main source of income to the tribal family. The findings further revealed that the tribals were facing the problem of declining yield of tamarind and so their income was constantly declining inspite of good demand for tamarind in the market. The senile plantation and cutting of tamarind trees were the main cause of yield decline and it was estimated that around 25,000 fresh tamarind trees to save the tribal from the approaching livelihood crisis due to declining forest produce of tamarind.

A joint action was conceived by the KVK-CTRI, ITDA, AP Forest Department, SAU and local tribal NGO to plant fresh tamarind tree saplings so that after 6 to 8 years, tamarind fruits will be available. With the help of forest department, College of Forestry and ITDA about 25,000 tamarind saplings were procured and with the community participation through local NGOs in the agency area, the afforestation drive with PK-Variety of tamarind was initiated. Within a span of three months before monsoon, all saplings were planted and at the end of third year it was reported by the forest department that about 16,000 saplings were alive and grown well. It is now beyond doubt the convergence efforts of these organisation have resulted in assuring the tribals with their livelihood source.

Conclusion:

To summarise, the efforts of different development agencies need to be successfully channelised by means of arriving at a common understanding and working out suitable implementation strategy for achieving the common goal. Our country provides wide opportunities for fruitful convergence of various extension systems operation with a common goal. Such efforts not only save our precious resources but also ensures effective utilization of various facilities created at the grass root level including the human resources and time required for achieving the target. Creating an inbuilt coordination mechanism in these agencies will help to work out fruitful convergence in the possible areas as well as its effective implementation.

Information and Communication Technology Utilization at Tamil Nadu Agricultural University

Vadivel, E[1], Anandaraja, N[2], Sriram, N[3], Muthuvel, I[4] and Shibi Sebastian[5]

Prelude

The world is in the midst of a knowledge revolution, complemented by opening up entirely new vistas in communication technologies. Recent developments in the field of Information and Communication Technologies are indeed revolutionary in nature. By definition, Information and Communication Technologies (ICT) are a diverse set of technological tools and resources to create, disseminate, store, bring value-addition and manage information with feedback. ICT, when used as a broad tool for educating the communities especially entrepreneurs, business graduates and managers, heralds the formation of a new class of society–the Knowledge Society. Knowledge thereby becomes the fundamental resource for all economic and societal developmental activities in the highly competitive and pluralistic world.

The five unique features of ICT interventions in the social transformations are

- Increasingly 'ubiquitous' connectivity along value chains
- Increasingly 'precise' applications
- Increasingly 'accessible' data and information
- Increasingly 'diverse' set of digital applications
- Increasingly 'inter-connected' tools and knowledge bases

The agriculture sector, with more than 60% population dependence, contributes only about 18 per cent of the total Gross Domestic Product (GDP), resulting in low per capita income in the farm sector. Consequently, there is a large disparity between the per capita income in the farm sector and the non-farm sector. The income levels are determined by the overall production, supported by reasonable levels of yield and prices realized by the farmers. Several constraints such as

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preponderance of small and marginal holdings accounting for about 82 per cent of total holdings, imperfect market conditions and lack of backward and forward linkages affect the income levels of farmers adversely. Information and Communication Technology (ICT) is making huge waves in all fields. Agriculture is no exception. Its potentials are huge in the wake of far spread farmlands in India. Achieving 4 percent growth in agriculture as formulated in the National Agricultural Development Project (NADP), quick and extensive methods needs to be utilized. Information and Communication technology can be utilized for quick and easy technology transfer. It can bring the best expertise to all rather than a particular locality. Tamil Nadu Agricultural University has taken up Information and Communication Technology for its transfer of technology and it is attempting to develop a new mode of link between the extension officials and the farmers. The following are the initiatives that are functioning at the Directorate of Extension Education in the university.

1. e-Agriculture Service for Accelerating Agricultural Development and Living Standards of Farmers through TNAUAGRITECH Portal

1.1. Present Technology Delivery System

In Tamil Nadu, farm technologies are transmitted to farmers through State Department of Agriculture, (Public), Private Dealers and NGO's. Still, these agencies are following the conventional extension approaches such as Mass, Group and Individual approach. Due to the fast growing economy, these approaches are not able to deliver the technologies as expected by the farming community. The existing staff in the agriculture department, Government of Tamil Nadu is not matching the growing rural population in the villages, which resulted in slow transfer of technologies and delivering of untimely information. To reach the unreached and last milestone of the farmers, a new comprehensive approach was to be evolved. There is a need to develop a dynamic website for farm entrepreneur which could help them in day-to-day decision making.

Fig. 1. Home Pageof TNAU AGRI TECH PORTAL integrating Research, Extension and User System

1.2. Need of Alternate System

Knowledge Management and Knowledge Portal are the talk of day in ICT. Analyzing the Global scenario on web delivery or portal, integrated information is not available. Agriculture means not alone the crop and its dynamics. Farming holds the integration subsidiary activities and networking

of allied enterprises. In this connotation under NADP (National Agricultural Development Project) it is planned construct and design integrated knowledge portal involving all the stakeholders in the farming profession.Apart from the standard search engine feature, web portals offer other services such as e-mail, news, stock prices, informationand entertainment. Portals provide a way for enterprises to provide a consistent look and feel with access control and procedures for multiple applications, which otherwise would have been different entities altogether.

1.3. Content in TNAU AGRITECH Portal

The TNAU AGRITECH Portal is being developed by scouting information from various trusted sources like the State Agricultural University, State Department of Agriculture, Horticulture, Engineering, Animal Husbandry and other line departments. Information is also obtained on private input dealers, marketing, export and import, KrishiVigyanKendras, indigenous technologies, schemes, food science and technology, Self Help Groups, Non Government Organizations,

entrepreneurs, agro industries and the like. The collected materials are validated with the help of subject matter specialists and the content is converted into knowledgepages. The special feature of the portal is that it has been designed to be in bilingual language ie., English and Tamil - the local language, the targeted audience being field extension officials and farmers.

The software used for this purpose include Adobe Photoshop CS as Template Designing Tool, Macromedia Dream Weaver 8 for Web Developing Tool, HTML, XHTML, ASP.net, Flash Scripts as Coding Tool and Open Software – Moodle as platform. The core areas in the portal are Agriculture, Horticulture, Agricultural Engineering, Sericulture, Forestry, Fisheries, Animal Husbandry and Marketing. The other issues covered are Crop Production, Potection, Improvement, Organic Farming, Sustainable Farming, Indigenous Farming, Soil and water management, Government Schemes, Banking, Insurance, Self Help Group and Non Government Organizations, Post Harvest Technologies, Daily events (Market Information, News Paper Clippings, Radio and TV programmes, water level in dams and streamed Audio on TNAU Community Radio), Patents, Environment and Pollution, Inputs Source, etc.

The major areas such as Weather, Soil, Water, Nutrition, Enterprises, Post Harvest Information, Biotechnology and Bio fuels are covered. Few of the specialized technologies including System of Rice Intensification (SRI), Precision Farming Systems, Good Agricultural Practices, Good Laboratory Practices andGood Manufacturing Practices. Other related information such as Availability of Input Sources, Minimal Support Prices, District wise Agricultural Action Plan and Agro linkage with other agencies.

1.4. Unique Feature of PORTAL

It also intends to set up e-connectivity in all the 60 centres of TamilNadu Agricultural University(14 KVKs(KrishiVigyan Kendra) + 2 PCCs(Plant Clinic Centres), 34 Research Centres and 10 Colleges). It is also trying to create interface mechanism between Agriculture Department, NGOs(Non Government Organization) and Farmers Association. This project aims to achieve Transfer of technology to the last milestone of the farming community, timely delivering of need based information to the farming community, Field problem diagnosis through Video Conferencing mode and giving farm advisory services.

The unique feature of PORTAL is Message Board and Ask your Expert with multimedia based dynamic network including audio and video streaming. Message board links with users to add any message they would like to share through this platform reaching to the intended audience. At the same time the user may also forward suggestions to improve portal services and corrective measures as a Feed Back. In the case of Ask Your Expert which links with Experts in the filed of farming and allied sector and ensures to provide corrective measures and implementable action plans with in a stipulated time of 24 hours. Both Message Board and Ask Your Expert also will be shared through Live Video Conferencing from HUB centre or from the clientele or users node.

Further, the portal information would like to focus on “more visuals / images with dynamics than less text and routine kind of nature”. As the research team involved in design and development perceived that generation old aspects like ploughing, weeding (manual), irrigation, application of inputs, harvesting and so on are not included in the content construction. More focus have been emphasized on science behind the facts, distinctive and pragmatic information to educate the field extension officials, farmers and stakeholders. In feature, the portal platform have strong convergence of including private partnership in the agreed aspects to reach more number of beneficiaries.

2. Dynamic Market Information Support for Agri-Horti Produces throughwww.tnau.ac.in /www. indg.in portal: Linking the Farmers with Market

2.1. Need of Market Interface Mechanism (Perishables)

India produces 150 million tonnes of fruits and vegetables. It is estimated that about 50% of the agricultural produce is available as marketable surplus. Post-harvest losses are estimated to be of the order of 5-7 per cent in food grains and 25-30 per cent in the case of fruits and vegetables. More than 72 per cent of the vegetables and fruits are wasted in the absence of proper retailing.[4]In order to reduce this wastage and also develop a direct link between the farmers and the market the State Agricultural Management & Extension Training Institute (SAMETI) & Directorate of Extension Education, Tamil Nadu Agricultural University in collaboration with C-DAC (Centre for Development of Advanced Computing), Hyderabad is operating this project.

2.2. Market Coverage and Information Reach

In Dynamic Market Information, the market rates of perishable commodities (both whole sale and retail are collected and uploaded in the website (*www.tnau.ac.in* and *www.indg.in*)on daily basis. The project covered five markets in the first phase. They were Cochin, Coimbatore, Oddanchatram, Chennai, Bangalore and Trichy. Presently in the second phase 13 markets are covered. The markets included are Madurai, Hosur, Mettupalayam, Ottanchatram, Panruti, Thalaivasal and Tirunelveli. Project Analysts are placed in the different potential marketing zones. They collect the market data and upload in the portal. As on date, 152 commodities have been added to the DMI list. The rates are ready to be viewed by 1.00 pm daily. The information is given in Tamil and English.

The additional features in the website include market profiles with photographs, tradersprofile and addresses in each markets to promotes the traders business in the market, farmers association details, best practices adopted by other successful farmers, Minimum Support Price of major commodities, regulated Markets in Tamil Nadu and KrishiVigyanKendras(Farm Science Centres) in TamilNadu. The site also provides space to access previous data for comparison.

Fig. 2. Linking the Farmers with Market

As a value added service the price details of selected commodities are sent to the farmers on trial basis to 1000 farmers through mobile on select commodities. The number of commodities and markets is limited to two to each subscriber. This is done on a pilot basis and given in free of cost.

2.3. Future plans

- Linkage with the farmers federations to promote and use of available information
- Expanding to major markets in North India like PuneKolkataan New Delhi.
- Exploring the possibility to link with GIS & GPS to provide spatial assessment for market forecast
- Popularization with partnership and reaching the un reached
- On-line trading

- The holistic marketing related information namely trends, quality preference, daily market prices, demand and supply analysis for the different produces, composition of suppliers, packaging and transport mode for different produces will be analyzed and informed to the producers, buyers and consumers through online portal www.indg.in

- Periodical publishing of market support information with regional specific inferences for different produces for the benefit of the all the stakeholders

Often farmers are exploited by the middlemen and unable to get actual benefit for their end produces. This joint initiative will facilitate the farmers and field extension officials to understand the daily prices of important markets in south India. Ultimately this would like to help the growers to mobilize the bulk commodities to get the real market prices. If the **farmers are not able to mobilize their produce individually they can organize into groups and take their commodities to the market that gives them better economic returns**.

3. Development of Expert System for Crop andAnimal HusbandryEnterprises

3.1. Exploration of Expertise Advise

Agricultural production has evolved into a complex business requiring the accumulation and integration of knowledge and information from many diverse sources. In order to remain competitive, the farmers often depend on agricultural specialties and advisors for informationondecision-making. Unfortunately, agricultural specialists' assistance is not always available when the farmer needs it. In addition, all the extension systems and transfer of technology institutions have been equipped with the connectivity and networking system without location specific technology contents for decision making and adoption. Besides, the big diversity in languages and characters in the Indian languages prevent us from sharing information. In order to solve these issues, expert system is identified as one of the powerful tool with extensive potential in agriculture.

3.2. Expert System

The expert system could be developed for decision-making and location specific technology dissemination process.An expert system is software that attempts to reproduce the performance of one or more human experts, most commonly in a specific problem domain, and is a traditional application and/or subfield of artificial intelligence. Expert systems helps in selection of crop or variety, diagnosis or identification of pests, diseases and disorders and taking valuable decisions on its management.

The project aims at development of expert systems for crop and animal enterprises facilitating instant decision-making process of the farmers through ICT enabled mechanism. The expert system will also be synergized with the existing KVK e-linkage system for its implementation. Five important crops identified , they are Paddy, Ragi, Sugarcane, Coconut and Precision Farming Technology for Banana. The animal enterprises include management of important diseases and nutritional disorder of Dairy cow, Sheep, Goat and Poultry birds.

3.3. Consortia Partnership

In order to develop location specific knowledge needs of the farming community in Tamil Nadu, Puducherry, Karnataka and Kerala the following institutes have been identified as network centres.

- National Research Centre for Women, Bhubaneswar
- Zonal Coordinating Unit, Zone VIII, Bangalore, Karnataka
- Directorate of Extension Education, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu
- Directorate of Extension Education, TANVASU, Chennai, Tamil Nadu

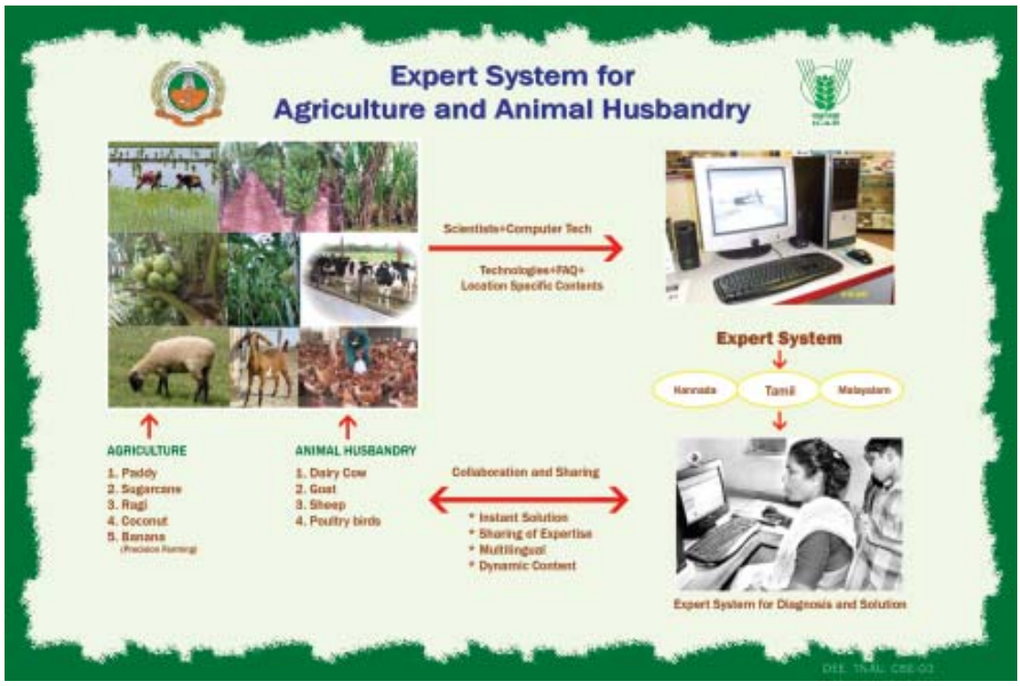

Fig. 3. Conceptual Frame Work of Expert System

3.4. Expected Outcome

For content development in multilingual the assistance of the following resource centres will be utilized.

Language	Resource Centre
Kannada	Indian Institute of Science, Bangalore
Malayalam	C- DAC, Thiruvananthapuram
Tamil	Anna University, Chennai

The major activities will include identifying location specific knowledge needs of the farming community for content generation and digitization, development of expert system in respective languages on the crops and animal enterprises, testing of validity and reliability of the expert systems at different locations both on men and women farmers before finalizing on multilingual customized mode.Presently the content for the various crops have been collected and experts are validating it.

4. Mass Awareness and outreach Module for Agricultural Research and Development

The project on **'Mobilizing Mass Media Support for Sharing Agro-Information'**is in the initiation phase and has been designed and developed with the objective to enhance the agricultural communication and awareness in the country at grass-root level by using effective communication and information tools. The capacity building will be undertaken to make the communication platform developed under the project sustainable beyond the project period enhancing visibility and adoption of agricultural technologies by farming community and entrepreneur. Latest ICT tools will be used to develop a quick and responsive interface with farmers, media and general public.

The project will be implemented in the participatory mode with active contribution from consortia partners like Indian Institute of Horticulture Research (IIHR), Central Institute for Subtropical Horticulture (CISH), Indian Institute of Vegetable Research, Varanasi (IIVR), Indian Institute Spices Research (IISR), Central Institute of Fisheries Technology (CIFT), Central Institute of Post Harvest Engineering Technology (CIPHET), TamilNaduAgricultureUniversity (TNAU)&GovindBallabh Pant University of Agriculture & Technology (GBPUA & T) and link organizations such as IGNOU, IIMC, PrasarBharati (AIR and Doordarshan) and Media groups located across the country. Directorate of Information and Publications of Agriculture, New Delhi will act as Nodal and Coordinating Agency for the implementation and monitoring of the project.

The project is focusing on documentation and dissemination of agricultural success stories in print, audio and video format for motivation of the farming community and general public at large. With the launching of online digital images library, the very effective, but hitherto neglected, pictorial communication will get an impetus. The project aims to use media as message multiplier and provides opportunity of media interaction with the scientists and farmers mutually benefiting both the stakeholders. Showcasing of agricultural technologies at regional level is another important activity to popularize the technologies ready for adoption or commercialization.

The project will establish a communication network within National Agricultural Research System by creation of small but well equipped communication units with sensitized and trained scientists/technical personnel to handle the communication efficiently and effectively. Impact assessment study will be undertaken to further refine and sharpen the communication tools for enhanced agricultural communication and awareness.

The agricultural communication platform developed under the project will be an interactive, multi-layered, quick and participatory communication system crossing economic, gender, languages and social barriers. It will ultimately lead to agrarian prosperity and inclusive agricultural growth in the country. The project plans to enhance visibility of the agricultural technologies developed by ICAR in regional and national media, regularly cover agricultural issues in print media, create sustainable information flow system, disseminate and demonstrate ICAR technologies to the farmers and masses. Success stories in the form of audio and video films will motivate the farmers to adopt ICAR Technologies.

5. *m*-Velanmai Agro Advisory Services for Improving the Livelihood status of the Farming Community of Tamil Nadu

m-velanmaiis an innovative mobile based advisory service to be initiated on public Private partnership by TamilNadu Agricultural University. Farmers can receive relevant information and advice on various topics in farming on his mobile phone. It also enables farmers to send queries specific to their land and crop to receive personalized replies from agricultural experts, on their phones. Using sensor networks, m-Velanmai Mobile Agro advisory system transfers the farmers' environment to the expert. Farmers can also send pictures of their crops and pests captured with mobile phone cameras; Sensors provide farm specific soil and crop data; Weather stations provide microclimate details. Using this data, about the farmer's environment experts guide them directly, on water, pesticide and fertilizer usage, helping them save money, effort and the environment.

The project will be integrated with existing the TNAU Agritech Portal, Dynamic Market Information, Automatic Weather Station, Agri Clinics to connect the last mile connectivity through Mobile. Cluster level associations (20 member/cluster) will be formed at Automatic Weather Station block. Five Automatic Weather Stations based clusters will be formed per district of Tamil Nadu. 28 Districts will be targeted as pilot basis. Totally 140 weather stations (Clusters) ie., 2800 farmers (Precision Farmers Associations) will be involved for this project to test the efficiency of Mobile based agro service facilitated by mobile connectivity system.

Individual Farmers farm database, which includes soil types, water quality, pH level etc., will be developed using this mobile based system. Mobile based advisory system, which includes agro advisory, pest and diseases diagnosis and recommendations, market price, information on bank loans, insurances and Government schemes will be given. One dynamic farmer / Agri Clinic owner will be trained as facilitator for each cluster who will act as local expert and promoter of the scheme. Each five cluster will get one project associate for content development that suits to mobile, giving expert advice using mobile, individual farm data base creation and training the farmers on mobile system who will be attached to TNAU centres either at KVKs or Research Stations. ELCOT, Government of Tamil Nadu, TNAU and Tata Consultancy Services will implement the project jointly. The Mobile based Agro Advisory service will be promoted to all the villages through Business model after seeing the impact this initiative. This will also help in creating a database of the farmers.

m-Velanamai mobile based advisory solution will work on a profit model so that the solution delivery becomes self sustainable with minimum government funding. Agri Clinic entrepreneurs will be empowered as service providers of the programme and will be handed over to them from second year onwards. It will be sustained by collecting nominal fees from the farming community by the agri clinic owners.

6. e-Velanmai

It is an ICT based demand driven participatory extension system to provide timely agro advisory services by TNAU scientists to the registered farmers using ICT tools (Internet, Computer, Digital Camera, Mobile phone etc.) on need and/or regular basis.It involves, farmers enrolled for the service, Expert team of Scientists formed at TNAU, Field Coordinators/SRFs to develop the capacity of farmers (Extension services), ICT tools to link farmers and Experts, Information about the agricultural problems (data) collected from farmers for advice. The other components include the technical message delivered by the experts to solve agricultural problems faced by the farmers and follow-up actions on the advices adopted by the farmers. Farmers pay a membership fee based on the farm size owned by them to avail the extension services under e-Velanmai as a mark of their participation

in the system of technology transfer.Scientists attend the farmers queries based on their call (demand) or need and hence it is demand driven for technical advice or scientific farming.

Conclusion

Information and Communication Technologies when used adequately can speed up the process of transfer of technology. The utilization of mass media, internet and the mobile can bring about considerable changes in the lives of the farmers as it transfers the current and precise technologies. Crop production and management, schemes, market rates and farmers experience provide adequate information to fulfill the farmers information needs. When this is reached at the exact time of requirement then it bears fruit. The above said efforts are towards this goal and it hopes to change the livelihood of the farmers.

Harnessing Mobile Phone Platform for Transfer of Farm Technologies

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Prelude

There is no dearth of knowledge and new technologies in agriculture, but these rarely reach farmers, especially those in developing countries. Currently, many farmers, especially in developing countries, have very limited access to information, both old and new, that may help improve their farming and livelihoods. The widespread availability and convergence of information and communication technologies (ICTs) - computers, digital networks, telecommunication, television etc in India in recent years have led to unprecedented capacity for dissemination of knowledge and information to the rural population. Over the last five years, several rural sites in India have become testing grounds for the use of Information and Communications Technologies (ICTs) for developmental ends. Project planners hope that rural information networks will allow knowledge, services, money and certain kinds of information products to flow easily across long distances, from one public access information center to another. Production and productivity in agriculture still remains a major concern in developing countries like India. The problems encountered in this activity are pests, diseases, lack of credit and market facilities.

The farmers requirement on information are related to choice of crop, seed variety, options for better crops and varieties, season and date of sowing and harvesting, cultivation practices best suited for the area, input usage, availability of inputs, market demand, transportation, etc. Information and Communication technologies have the best solutions for these problems. Internet and mobile can do wonders to reach the farmers with the necessary information. Of which mobile is fast penetrating device especially in rural areas than the internet.

1. Introduction of mobile or cellular phones

Nowadays, mobile phone is one of the most essential things of people. A mobile telephone or cellular telephone (commonly, “mobile phone” or “cell phone”) is a long-range, portable electronic device used for mobile communication. Most current mobile phones connect to a cellular network of base stations (cell sites), which is in turn interconnected to the public switched telephone network (PSTN) (the exception are satellite phones).

The technology of mobile phone is developing rapidly every day. The following are the stage wise developments that has taken place over the years.

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1.1. First Generation -1G is the name given to the first generation of mobile telephone networks. These systems used analogue circuit-switched technology, with FDMA (Frequency Division Multiple Access), and worked mainly in the 800-900 MHz frequency bands. The networks had a low traffic capacity, unreliable handover, poor voice quality and poor security.

1.2. Second Generation - 2G These mobile telephone networks were the logical next stage in the development of wireless systems after 1G, and they introduced for the first time a mobile phone system that used purely digital technology. The demands placed on the networks, particularly in the densely populated areas within cities, meant that increasingly sophisticated methods had to be employed to handle the large number of calls, and so avoid the risks of interference. Although many of the principles involved in a 1G system also apply to 2G - they both use the same cell structure - there are also differences in the way that the signals are handled, and the 1G network are not capable of providing the more advanced features of the 2G systems, such as caller identity and text messaging.

Fig:1. The various mobile generations

Source: http://www.ieeemacau.org/ieee_student/history%20of%20mobile%20phone.htm

1.3. Second Generation Enhanced - 2.5G is a generic term used to refer to a standard of wireless mobile telephone networks that lies somewhere between 2G and 3G. The development of 2.5G has been viewed as a stepping-stone towards 3G, which was prompted by the demand for better data services and access to the Internet. In the evolution of mobile communications, each generation provides a higher data rate and additional capabilities, and 2.5G is no exception as it is provides faster services than 2G, but not as fast or as advanced as the newer 3G systems.

The enhancements in 2.5G systems permit data speeds of 64-144 kbps, which enables these phones to feature web browsing, the use of navigation and navigational maps, voice mail, fax, and the sending and receiving of large email messages.

1.4. Third Generation - 3G mobile telephone networks are the latest stage in the development of wireless communications technology. Significant features of 3G systems are that they support much higher data transmission rates and offer increased capacity, which makes them suitable for high-speed data applications as well as for the traditional voice calls. In fact, 3G systems are designed to process data, and since voice signals are converted to digital data, these results in speech being dealt with in much the same way as any other form of data. Third Generation systems use packet-switching technology, which is more efficient and faster than the traditional circuit-switched systems, but they do require a somewhat different infrastructure to the 2G systems.

Compared to earlier mobile phones a 3G handset provides many new features, and the possibilities for new services are almost limitless, including many popular applications such as TV streaming, multimedia, videoconferencing, Web browsing, e-mail, paging, fax, and navigational maps. Japan was the first country to introduce a 3G system

1.5. Fourth Generation - 4G As the limitation of the 3G, people are trying to make new generation of mobile communication, this is the 4th generation. This 4G system is more reliable. Nowadays, some companies have started developing the 4G communication system, this technology can have a high uplink rate up to 200Mbps, more data can transfer in the mobile phone. So the 4G mobile can have more function such as work as the television.

2. Features and usability

In addition to the standard voice function of a telephone, current mobile phones can support many additional services such as SMS (Short Message Service) for text messaging, email, packet switching for access to the Internet, and MMS (Multimedia Messaging Service) for sending and receiving photos and video. Mobile phones do not only support voice calls; they can also send and receive data and faxes (if a computer is attached), send short messages, access WAP services (Wireless Application Protocol is an open international standard[for application layer network communications in a wireless communication environment. Its main use is to enable access to the Mobile Web from a mobile phone. A WAP browser provides all of the basic services of a computer based web browser but simplified to operate within the restrictions of a mobile phone, such as its smaller view screen), and provide full Internet access using technologies such as GPRS (General Packet Radio Services). Modern mobile phones usually have a clock, alarm, and calculator and a few games.

Most current models also have a built-in digital camera, that can have resolutions as high as 8M pixels (Samsung). Sound recording and video recording is often also possible. Sending and receiving pictures and videos is possible through MMS, and for short distances with e.g. Bluetooth. (Bluetooth is a wireless communication feature now found in many higher-end phones) Most people do not walk around with a video camera, but do carry a phone. The arrival of video camera phones is transforming the availability of video to consumers, and is helping to fuel the idea of citizen

journalism. These feature when used for development works can add value addition to the efforts of the various departments.

3. Reach of Mobile in India

India is fast booming in mobile technologies. Its subscriber bases are increasing rapidly. India's mobile subscriber base at June 2009 stands at 403.66 million. This brings the total telecom user base to 441.47 million, which includes the wireless and the wireline connections. This growth in the wireless segment is being met with a marginal decrease in the wireline segment which saw a decline of 0.15 million thus pushing the subscriber base to 37.81 million in April against 37.96 million wireline subscribers in March 2009. The tele-density (the number of people having phones per a population of 100) of the nation which increased from 36.98 in March to 37.94 at the end of April. The Rural tele-density which stood at 8% in 2008 has increased to 12 per cent in March 2009.

Rural Wireline Subscriber base stood at 11.33 million in quarter ending June 2008 as compared to 11.64 million in quarter ending March 2008. The major market being held by BSNL Number of Village Public Telephones (VPT) have increased from 5.60 lakhs in quarter ending March 2008 to 5.63 lakhs in quarter ending June 2008.The use of internet is also quite impressive. There are 11.66 million Internet subscribers at the end of June 2008 in India. Besides above, there are 75.97 million wireless data subscribers at the end of June 2008 (capable of accessing data services including internet through mobile handsets.

4. Potential tool to deliver Farm Information

The potentials for its use are many. A number of initiatives are taken by various institutes to harness its potential to their advantage. In rural areas its use is still at infancy. Mobile can be used for short message services like sending flash news on weather information, pest and disease outbreak, market rates, tips on farm practices, messages on new schemes, daily farm activities specific to crops, availability of inputs, etc.

5. Experimentations with mobile across the Globe for Agricultural Technology Delivery

The first way cell phones were used to sustain development is to deliver news about market prices. It is happening for agriculture and fishery, in Africa and Asia. The mechanism is simple: the users are usually farmers or fishermen interested in selling their products. Via SMS they receive information about prices on different markets in their area. In this way they can easily decide where to go to sell their products to maximize the earnings. Following are a few initiatives around the world.

5.1. **IFAD** is running a service of this kind in Tanzania: market spies called "shu shu shu" are scattered around the country to collect information about markets and share them via cellphones with the other members of the same organization.

5.2. The Ugandan **Brosdi** (Busoga Rural Open Source & Development Initiative) is a not for profit organization that works with government and the civil society in improving rural livelihoods. It wants to empower the civil society through knowledge sharing using ICT as a medium so that they can improve their livelihoods. The idea is the following: information and common knowledge is collected during Knowledge Sharing Forums, written, repackaged and sent once a week to the subscribers' cellphone numbers using both a mobile phone and Gmail services. The farmers record the SMS in a book, saving it for future reference. Other farmers without mobile phones at their will can access this knowledge and further freely disseminate it within the village.

5.3. The **CGIAR ICT-KM** has a pilot project focused on recognizing the value of farmer knowledge, to get farmers to value their own knowledge and ideas and find ways to share this knowledge between farmers. The main activity of the project revolved around the organizing of an International Farmers' Conference with over 50 farmers attending. The farmers, instead of being passive participants, were asked to present their situations, knowledge, experiences, ideas and skills using storytelling. Their stories were recorded in video, audio and text forms to be disseminated in various ways and will be made available on the web. Additionally, the organizers uploaded small story clips onto mobile phones and showed the farmers how to send these to other farmers via cell phones. This is to stimulate knowledge sharing and a farmer-to-farmer extension system to facilitate the spread of useful ideas, techniques and knowledge of agricultural activities.

5.4. **Grameen Foundation with Google and MTN Uganda** has launched mobile phone applications that deliver services and information that were previously unavailable to Uganda's poor and disadvantaged communities in June 2009.The five mobile phone applications provide real-time health and agricultural information and a virtual marketplace for buying and selling goods and services. The services are SMS-based and designed to work with basic mobile phones to reach the broadest possible audience. Users can access the services quickly and privately at the time of their choosing and search relevant content on-demand, like someone with access to the Internet. Mobile phone users send an SMS query and receive an automatic answer back from the database. Prices for the services are 110 Uganda shillings per request (about 5 cents), on par with sending a text message to a friend in the country. Prices for requests to the trading marketplace are double, at 220 shillings per request.

5.5. m-learning : The mobile service of agricultural information had been conducted in many provinces in China. Linking with the Internet, radio, television and other media, the agricultural science and technology and market information knowledge can be transmitted to farmer's mobile-phone through the wireless communication network which has covered the whole country, such as China Mobile, China Unicom, China Netcom and etc.

On the software side Frontline SMS, created by kiwanja, is a very useful tool to enables users to send and receive text messages with large groups of people through mobile phones. Frontline SMS is the first text messaging system created to avoid a lack of communication that can affect non-governmental organisations (NGOs) working in developing countries. By leveraging basic tools

already available to most NGOs, as computers and mobile phones, the tool enables instantaneous two-way communication on a large scale.

6. Mobile Experimentation in India

A number of initiatives have been done in India. The following are a few of the prominent ones

6.1. mKrishi : It is a mobile-based crop advisory service of Tata Consultancy Services. The application provides personalized information and expert advice to rural farmers, and runs on Tata Indicom's Code Division Multiple Access 2000 network, and it uses various applications including sensors, camera phones, and Global Positioning System technologies. Through mKrishi, farmers get answers to queries related to agriculture, such as advice on use of fertilizers, pesticides and growth hormones. It also provides up-to-date weather and market information through text messages on cell phones. Services such as assistance with crop insurance, loan services, rural yellow pages and government policy information will be included in a phased manner. The mKrishi application can be customized in farmers' local languages, both text and voice. This feature is particularly helpful for the illiterate in the agricultural community. Currently the application runs as pilot project in four villages supporting about 20,000 farmers each holding an average of three to four hectares of land. The service includes weather and soil sensors for these villages.

6.2. IFFCO Kisan Sanchar Limited (IKSL) : Bharti Airtel and the Indian Farmers Fertilizer Cooperative Limited (IFFCO) have announced the launch of a joint venture (JV) company, the IFFCO Kisan Sanchar Limited (IKSL) to leverage the power of telecom to add value to the farm sector and empower the rural farmer by giving him access to vital information that would enhance his livelihood and overall quality of life. IKSL offers products and services, specifically designed for farmers, through IFFCO societies in villages across the country. The company provides affordable mobile handsets bundled with Airtel mobile connections. Farmers will get access to a unique VAS (Value Added Services)platform that will broadcast five free voice messages on mandi (market) prices, farming techniques, weather forecasts, dairy farming, animal husbandry, rural health initiatives, and fertilizer availability, etc, on a daily basis. There will also be a dedicated helpline, manned by experts from various fields to derive answers to specific queries.

3.3. Reuters Market Light: News and information company, **Reuters** Group in October 2007, rolled out a service to bring commodity prices, crop and weather data to Indian farmers via mobile phone.

Indian mobile providers have been signing up users at more than 8 million a month and total wireless users number more than 200 million. This short messaging service costing 60 rupees ($1.50) a month, is currently available in the western state of Maharastra and has been on trial since April 2007. Information services is in either English or Marathi, the local language. In addition, after an agreement with Maharashtra's Postal Circle, the service is accessible at the nearest post office for farmers without cell phone.

6.4. Mobile for fishermen: The M S Swaminathan Research Foundation (MSSRF) manning the Village Resource Centre (VRC) at a bio-village has launched the icon-based mobile facility, a fishermen-friendly mobile facility which would provide vital information like height of sea waves and weather report. Agricultural scientist Professor, M. S Swaminathan, founder of the MSSRF, with the support of Prof Bruce Alberts, Department of Biochemistry and Biosciences, University of California (USA), launched the mobile phone which would furnish information including weather reports, local news, potential fishing zone and market price to the fishermen. It used software developed by 'Qualcomm´. The information being provided in English by the Hyderbad-based Indian National Centre for Ocean Information Services (INCOIS) to the VRC would be translated into the regional language for the onward communication to the fishermen. The mobile phones with the software facility were supplied to the fishermen.

6.5. Dynamic Market Information (DMI): Tamil Nadu Agricultural University(TNAU), Coimbatore in collaboration with Centre for Development of Advanced Computing (C-DAC), Hyderabad has developed online Dynamic Market Information (DMI) for 13 major markets of South India. It provides data for 152 perishable commodities. Apart from being online farmers are receiving price data over the mobile. The number of markets and commodities is restricted to two. This has been initiated on a pilot basis. The farmers register freely to access the data. This helps the farmers to decide the markets based on their profitability and also avoids distress sale in the local markets without understanding the market trends in the nearby markets.

7. Strategies

7.1. Policy level

Presently the service in the rural areas is concentrated by the public telecom industry. The private industry should also penetrate into the deep villages so that the quality of the service is enhanced. Common towers in rural areas could possibly be a solution which is at the hands of the high end policy makers. The cost of high end technologies, when used for developmental activities should be subsidized so that it reaches the poor and under privileged. The content delivery by SMS is limited hence better technologies like WiFi should be linked with mobile phones to access the World Wide Web.

7.2. Research and experimentation level

Utility of Voice SMS should be tapped as it provides a helping hand to the illiterates. Inclusion of technologies for local language conversion is indispensible in a country like India where language has multi colours. Rural based and agriculture related short messages should be sent by the officials of the development departments, NGOs and those involved in rural development. Provision should be made in the department policies to allocate budget and engage people to develop these messages and send them to the subscribers regularly. These may be provided on subscription basis so that revenue may be generated in a sustained manner. This creates value for the message as well as accountability. Utility of mobile is unlimited as far as farmers are concerned however since many platforms co-exist and the service quality differs, the service markets needs to be normalized.

Conclusion

The mobile industry is one of the fastest developing industries with technologies being upgraded every day. The reach of mobiles has also penetrated to the nook and corner of the country though a bit sluggish in the rural settings. However the developmental activities can be clubbed with this fast technology to reach faster and promptly to the farmers. This will enhance the capacities of the development officials as well as multiply the effects in less time. This is sure to reduce the cost over the years and make developmental efforts easier.

Associated Review - III

Sanitary and Phytosanitary Measures[1]

History of WTO-SPS

- The Bretton Wood Conference of July, 1944 at Bretton Woods, New Hampshire, proposed the creation of an International Trade Organisation (ITO) to establish rules and regulations for trade between countries.
- The ITO have complemented the other two organizations International Monetary Fund (IMF) and the International Bank for Reconstruction and Development (known informally as the World Bank)
- Only one element of the ITO survived: the General Agreement on Tariffs and Trade (GATT).
- Seven rounds of negotiations occurred under GATT before the eighth round – the Uruguay Round- concluded in 1995 with the establishment of the World Trade Organization (WTO) at the GATT's replacement.
- The GATT principles and agreements were adopted by the WTO, which was charged with the administering and extending them.
- Uruguay round (8th round of GATT negotiations).
- Land mark round held for conversion of GATT to WTO.
- Represent milestone in multilateral trading system, because for the first time agriculture and food trade included under operationally effective rules.

World Trade Organizations

Location : Geneva, Switzerland

Established : 1 January 1995

[1] An article by Dr. S. Raghuvardhan Reddy, Vice Chancellor, ANGRAU, Hyderabad, presented at the Second National Conference on KVKs held at ANGRAU, Hyderabad from November 26-27th, 2006.

Created by : Uruguay Round negotiations (1986-94)

Membership : 149 countries (on 11 December 2005)

Functions:

- Administering WTO trade agreements
- Forum for trade negotiations
- Handling trade disputes
- Monitoring national trade policies
- Technical assistance and training for developing countries
- Cooperation with other international organizations
- The World Trade Organization (WTO) is the only global international organization dealing with the rules of trade between nations.
- WTO agreements are negotiated and signed by the bulk of the world's trading nations and ratified in their parliaments.
- The goal is to help producers of goods and services, exporters, and importers conduct their business

The following are the multilateral trade agreements signed by member countries under WTO

- General Agreement on Tariffs and Trade 1994
- Agreement on Agriculture (AOA)
- **Agreement on the Application of Sanitary and Phytosanitary Measures (SPS)**
- Agreement on Textiles and Clothing

- Agreement on Technical Barriers to Trade (TBT)
- Agreement on Trade Related Investment Measures (TRIMS)
- Agreement on Implementation of Article VI of the General Agreement on Tariffs and Trade 1994
- Agreement on Implementation of Article VII of the General Agreement on Tariffs and Trade 1994
- Agreement on Pre-shipment Inspection (PSI)
- Agreement on Rules of Origin
- Agreement on Import Licensing Measures
- Agreement on Subsidies and Countervailing Measures
- Agreement on Safeguards.

History of WTO-SPS

During 1991 DG, GATT issued *Dunkel Draft, which included issues on SPS*

Significant areas completed under WTO was Sanitary (Human and Animal Health), and Phytosanitary (Plant Health) Agreement, which outlines disciplines and limits to protect human, animal and plant life and health from foreign pests, diseases and contaminants.

The agreement of SPS came into enforce from January, 1995

Regulations under the purview of the WTO-SPS Agreement include

The protection of animal or plant life or health within a territory from risks arising from the entry, establishment, or spread of pest, disease, disease-carrying organisms, or disease-causing organisms.

The protection of human or animal life or health within a territory from risks arising from additives, pesticide residues, contaminants, toxins, or disease-causing organisms in foods, beverages, or feedstuffs.

The protection of human life or health within a territory from risks arising from diseases carried by animals, plants, or products thereof, or from entry, establishment, or spread of pests.

The prevention or reduction of the risks of other damages within a territory from the entry, establishment, or spread of pests.

The Agreement on the Application of SPS contains 14 articles and three annexes

Article 1	General Provisions
Article 2	Basic Rights and Obligations
Article 3	Harmonization
Article 4	Equivalence
Article 5	Assessment of Risk and Determination of the Appropriate Level of Sanitary or Phytosanitary Protection
Article 6	Adaptation to Regional Conditions, Including Pest or Disease Free Areas and Areas of Low Pest or Disease Prevalence
Article 7	Transparency
Article 8	Control, Inspection and Approval Procedures
Article 9	Technical Assistance
Article 10	Special and Differential Treatment
Article 11	Consultations and Dispute Settlement
Article 12	Administration

Article 13 Implementation

Article 14 Final Provisions

Basic concepts – SPS agreement

The WTO-SPS Agreement creates a framework for border protection and eradication measures while facilitating free trade. The Agreement is based on the following five general principles:

- *Harmonization*-encourages the adoption of measures that conform to international standards, guidelines, and/or recommendations of international agencies.
- *Equivalence*-mutual recognition of different but equivalent measures to achieve international standards.
- *Non-discriminatory*-treating imports no differently than domestic produce.
- *Transparency*-notifying trading partners of changes in their SPS measures, especially when the measures differ from international standards.
- *Regionalization*-allows continued exports from clean (disease-free) areas of affected countries.

Ten Commandments in SPS

- Participation in relevant international organizations:OIE, IPPC and Codex Alimentarius
- Adaptation of laws, rules and standards to the terms of the SPS agreement
- Use of risk analysis studies
- Transparency of Information
- Reinforcement of export certification procedures
- Reinforcement of import inspection and quarantine procedures
- Modernization of laboratory services

- Strengthening the information, surveillance and alert service
- Modernization of procedures for registering and controlling agricultural chemicals and veterinary products
- Control and eradication of diseases and pests that hinder trade

WTO member countries are encouraged to use International Standards, guidelines and recommendations set by International Standard Setting agencies, where they exist

However, the SPS agreement

- Allows WTO member countries to set their own safety, animal & plant health standards-applied to the extent necessary.
- The regulations must be based on science.
- SPS regulations shall not be arbitrarily or unjustifiably discriminate between countries.

Milestones in evolution of Food Standards

Year	**Milestone**
Ancient Times	In Europe during middle ages, Individual Counties passed Laws Egyptians prescribed labeling from certain foods Roman had a well-organized food control systems
Early 1800s	Invention of Canning
Mid-1800s	First shipment of Bananas to Europe from Tropics
1800s	Adoption of first generation food laws and reliable methods gained credibility from food adulteration
Late 1800s	First International long-distance food transportation of frozen meat from Australia and New Zealand to UK
Early 1900s	Food Trade Associations facilitated Harmonized Standards
1903	International Diary Federation (IDF) developed International Standards for milk products

Milestones in evolution of Food Standards

During 1897-1911, standards and product descriptions for a wide variety of food were developed in the *Austro-Hungarian Empire* as the *Codex Alimentarius Austriacus*, from which the Codex Alimentarious has been named.

Year	Milestone and Trade Concerns
1945	FAO is founded with responsibilities of Food Standards
1948	WHO is founded with responsibilities covering
1949	Argentina proposes a regional Latin American Food Code
1950	Joint FAO/ WHO expert meeting on nutrition, food additives and related areas
1953	The world health assembly expressed concerns on use of chemicals in food as health problem
1954-58	Austria actively pursued the creation of a regional food code, Codex Alimentarius Europaeus, Codex Alimentarius
1960	First FAO regional conference for Europe endorsed the desirability of International Food Standards on the conference of FAO
1961	The Council of Codex Alimentarius Europaeus adopted a resolution proposing that its work on foods to be taken over by FAOThe ECE, OECD, the council of the Codex Alimentarius Europaeus established Codex AlimentariusThe FAO conference decided to establish Codex AlimentariusCommission (CAC)
1962	The joint FAO/ WHO Food Standards Conference requested the Codex Alimentarius Commission to implement a joint FAO/ WHO food standards programme
1963	The World Health Assembly approved establishment of the joint FAO/ WHO Programme on Food Standards and adopted the statues of the Codex Alimentarius Commission.

Food safety Standard setting agencies

- Codex Alimentarius Commission (CAC) is the International Food Safety Standards setting body within UN family, created in 1963 by FAO and WHO
- Main purpose: to protect health of consumers, ensuring fair practices in food trade, and promoting coordination of all food standards work undertaken by international government and non-government agencies.
- Cover all the main foods-processed/ semi-processed/ raw.
- Concern the hygienic and nutritional quality of food,
- Chemical contaminants (food additives, pesticide and veterinary drug residues, other contaminants), labeling and presentation, methods of sampling and risk analysis. CODEX standards are considered scientifically justified and are accepted as bench marks.

Animal Safety Standard setting agencies

- Its mission to guarantee the transparency of animal disease status worldwide.
- To collect, analyze and disseminate veterinary scientific information
- To provide expertise and promote international consensus for control of animal diseases.
- To guarantee the sanitary safety of world trade by developing rules for international trade in animals and animal products.

OIE has FOUR committees to develop standards viz.,

- International Animal Health Care Commission
- The Standards Commission
- The Foot and Mouth disease and other epizootics Commission
- The Fish disease Commission

Plant Safety Standard setting agencies

- PURPOSE: to secure a common and effective action to prevent the introduction/ spread of pests of plants/ plant products.
- To promote appropriate measures for their control.
- To provide information on Pest Risk Analysis (PRA) in Plant Health.
- To create standards for PRA for quarantine pests and non-quarantine pests
- SCOPE- fungi, bacteria, viruses, nematodes, insects and weeds.
- IPPC developed ISPM (International standard for Phytosanitary Measures) guidelines adopted in 1994, includes Pest categorization, economic impact and risk management.

Need to understand SPS

- For import / export of Food commodities (Raw/ semi-processed/ processed) (FOOD SAFETY)
- For import/ export of Plant(s) / Plant Materials (PLANT SAFETY)
- For import/ export of Animal(s)/ Animal Materials (ANIMAL SAFETY)

Food Safety (Food Exports and Imports)

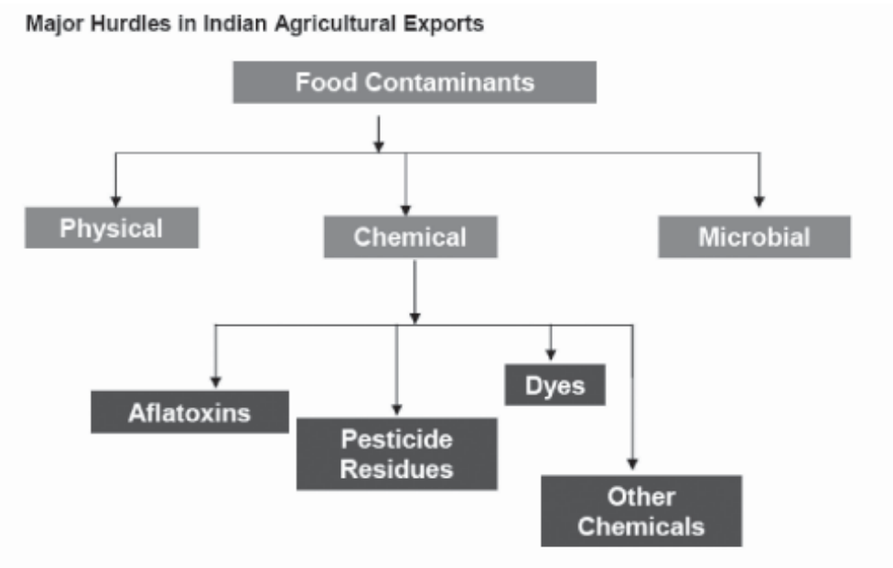
Growth in Agricultural Exports

Name of the Product	1990-91		1996-97		2000-01		2002-03		2004-05	
	Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value
Pulses	--	--	55	132	244	537	154	328	246	553
Rice-Basmati	527	440	523	1247	849	2155	772	1993	1126	2741
Rice-Other	--	--	1989	1924	682	777	2640	2175	3645	3899
Tea	202	1075	179	1037	187	1788	177	1637	194	1784
Coffee	86	253	163	1427	185	1985	188	1086	159	1008
Spices	100	233	222	1202	245	1617	267	1544	275	1794
Cashew	50	442	69	1285	89	2050	100	1700	157	2336
Fresh Fruits	--	--	--	244	--	386	--	784	--	811
Fresh Vegetables	--	--	--	334	--	457	--	954	--	813

Processed Vegetables	--	--	--	116	--	228	--	291	--	340
Processed Fruits	--	62	--	209	--	557	--	343	--	346
Meat & Preparations	--	141	--	709	--	1470	--	1714	--	1734
Marine Products	158	960	--	4007	502	6367	410	6106	380	5695
Poultry Products	--	--	--	--	--	105	--	254	--	257
TOTAL	--	6012	--	24161	--	28657	--	37266	--	39863
Share (%) In Total National Exports		18.5	--	20.0	--	14.2	--	12.7	--	11.2

Share of Agril. Exports in Total Exports from INDIA is gradually coming down over years

Year	% share of Agri. Exports in total exports (value based)
1990-91	18.49
1991-92	17.80
1993-94	18.05
1996-97	20.33
1997-98	19.09
1999-00	15.91
2000-01	14.23
2002-03	13.58
2003-04	12.70
2004-05	11.20



Indian Agricultural Products rejected / Alert Notices issued by European countries

Month & Year	Importing Country	Agricultural Product	Reasons
July, 2000	Spain	Chilli	Cypermethrin
April, 2001	Germany	Curry Powder & Chilli Powder	Ethion, cypermethrin
May, 2001	UK	Grapes	Triazophos
June, 2001	Germany	Curry Powder	Cypermethrin and dicofol
November, 2001	Germany	Curry Powder	Cypermethrin Fenvalerate Phosphamidon
	Greece	Chilli Powder & Red Chilli	Ethion, triazophos, cypermethrin, chlorpyriphos

Indian Agricultural Products rejected / Alert Notices issued by European countries

Month & Year	Importing Country	Agricultural Product	Reasons
January, 2002	Greece	Crushed Chilli & Chilli Powder	Aflatoxins
March 2002	UK	Coriander	Rat Droppings
	Italy	Chillies	Aflatoxins
August 2002	UK	Curry Powder	Ethion
	Spain	Pepper	Aflatoxins
September, 2002	Italy	Herbal Products	Heavy Metals
December 2002	UK	Curry Powder	Salmonella
	The Netherlands	Chilli Powder	Aflatoxins

Indian Agricultural Products rejected / Alert Notices issued by European countries.

Month & Year	Importing Country	Agricultural Product	Reasons
January, 2003	Italy	Shelled sesame seeds	Salmonella Spp
February, 2003	Italy	Chilli Powder	Aflatoxin
	Italy	Chilli Powder	Aflatoxin
March, 2003	UK	Extra hot chilli	Aflatoxin
	UK	Dabur Honey	Streptomycin
	Italy	Nutmeg	Aflatoxin
April, 2003	UK	Grapes	Methomyl, acephate
Jan,2004	UK	Chilli Powder	Sudan Red-I
Feb,2004	UK	Chilli Powder	Sudan Dye
Oct, 2004	UK	Chilli Powder	Sudan Dye
Nov, 2004	UK	Chilli Powder	Sudan Red-I
Jan, 2005	UK	Chilli Powder	Sudan Red-I

US FDA rejects Agricultural Products from India during October 2006

Product	Reason
Creamy Peanut Butter	Aflatoxin
Papads (pepper, garlic, red chilli, rice, moong ,etc.), Tamarind Concentrate, Basmati Rice	Filthy
Mustard oil	Unsafe add
Fenugreek, Sambar Powder, Shreded Coconut, Asafoetida Powder, Cumin whole & powder, Black Pepper	Salmonella
Whole Green Chilli	Pesticides
Fennel	Colour

US FDA rejects Agricultural Products from India during September 2006

Product	Reason
Basmati Rice, Frozen Fish, Tamarind	Filthy
Fruit Mix Jam (HL), Fennel Seeds, Ginger Garlic Paste, Lemon Crush	Unsafe Colour
Garam Masala, Sambar Powder, Rasam Powder, Chilli Powder, Coriander Powder, Red Pepper, Turmeric Powder	Salmonella
Sesame Seeds	Pesticides

Indian Veterinary Products rejected / Alert Notices issued by European countries during Jan-July 2002

Month & Year	Importing Country	Agricultural Product	Reasons
Jan,2002	Italy	Frozen Cuttle Fish	Salmonella
Jan,2002	Norway	Frozen Surumi (Fish Paste)	Virio spp.
Feb, 2002	France	Frozen Tiger Shrimps	Salmonella
April,2002	France	Frozen Cuttle Fish	Salmonella
May, 2002	Holland	Frozen Toger Shrimp	Nitrofurans
June,2002	Spain	Peeled Prawns	Bacterial inhibitor
June,2002	Greece	Frozen Cuttle Fish	Salmonella
June,2002	Holland	Headless Shellon	Nitrofurans
June,2002	Holland	Shrimps	Chloramphenicol
June,2002	Spain	Peeled Shrimps	Chloramphenicol & antibiotics
July,2002	Spain	Peeled Shrimps	Bacterial inhibitor
July,2002	Spain	Frozen Shrimps	Antibiotic residues

Indian Veterinary Products rejected / Alert Notices issued by European countries during Jan-Mar, 2003.

Month & Year	Importing Country	Agricultural Product	Reasons
Jan, 2003	Italy	Frozen Cephalopod Molluscs	E. Coli
Jan, 2003	Spain	Frozen Peeled Red Prawn	Mesophilic aerobic bacteria
Jan, 2003	Italy	Frozen dentex fillets	Vibrio spp
Feb, 2003	Italy	Frozen blanched shrimps	Bacterial inhibitors
Feb, 2003	Italy	Frozen blanched shrimps	Do
Feb, 2003	Italy	Frozen shrimps	Do
Feb, 2003	Italy	Frozen shrimps	Do
Feb, 2003	Germany	Shrimp tails	Nitrofurans
March,2003	Spain	Frozen Squid	Cadmium
March,2003	Italy	Frozen Fish Products	Aminoglycosides
March,2003	Greece	Frozen Octopus	Cadmium
March,2003	Norway	Baracuda Steaks	Vibrio spp.

In recent months Indian supermarket shelves have started displaying a variety of imported foods.

- Cheese from Switzerland
- Apples from Australia
- Kiwi fruit from New Zealand
- Biscuits from Thailand
- Chocolates from Brazil, the list is growing by the day.

These imports have been allowed as part of fulfilling India's commitment to World Trade Organization under its Agreement on Agriculture (AoA) to improve market access for foreign foods, but the monitoring at entry points for the quality checks is questionable in the absence of accredited labs for analysis of food contaminants.

Science behind the problems…..

Example: Pesticide Residues standards (MRLs/ Tolerance levels) for

ACEPHATE as per PFA (Prevention of Food Adulteration) Act and rules, 1954

ACEPHATE is registered for use as per Insecticide Act, 1969

Registered for : Cotton, Safflower

Not Registered : Chillies, Brinjal, Cabbage, Cauliflower, Apple, Castor, Mango, Tomato, Potato, Grapes, Okra, Onion, Mustard, Paddy and many other crops.

Hence, Tolerance levels/ MRLs are set for Safflower Seed, and Cotton Seed.

But, in fact the ACEPHATE is being recommended for the control of sap sucking pests in most crops. So, the immediate requirement is to REGISTER the ACEPHATE in CROPS as per the recommendation of ICAR/SAUs based on the bio-efficacy studies, and to set the MRLs on those crops.

CODEX MRLs for ACEPHATE are set for Cauliflowers, Artichoke, Broccoli, and Soybean dry

Example: Pesticide Residues standards (MRLs/ Tolerance levels) for MANGO as per PFA (prevention of Food Adulteration) Act and rules, 1954

Pesticide Registered for use as per insecticide Act, 1969 are 8. But, Tolerance levels/ MRLs are not set for most of these Pesticides on Mango/ Mango products (Raw/ semi-processed/ processed)

Pesticides	MRL	Pesticides	MRL	Pesticides	MRL	Pesticides	MRL
Ethephon		Sulphur	NR	Malathion	4.0	Diazinon	
Dimetohate	2.0	Dinocap		Hexaconazole		Tridemorph	0.05
Carbendazim	2.0	Benomyl	2.0				

Many other pesticides are recommended as per ICAR/ SAUs, are to be included as per Insecticide Act, and MRLs are to be set as per PFA Act/As per CODEX, MRLs are set for 7 pesticides. Tolerance levels for Semi-processed/ processed foods are not set, and is the urgent need to protect our food exports.

India has number of food quality regulations under various ministries, but the coordination for harmonization is questionable!

Regulation	Ministries Involved
Essential Commodities Act 1955	**Ministry of Food and Civil Supplies** *(Solvent extracted oils, De-oiled meal and edible flour control order 1967)-Mandatory inspection* **Ministry of Food Processing Industries** *(Fruit product order, 1955)-Mandatory inspection* **Ministry of Agriculture** *(Meat food product orders 1973)-Mandatory inspection*
Standards& weight measures Act 1976	**Ministry of food and civil supplies** *(SWM rules 1977) Packed food stuffs must adhere to quality declaration*
Agricultural Produce Act 1937	**Ministry of Agriculture –** *AGMARK standard for raw, semi-processed products- Mandatory for export*
Prevention of Food Adulteration (PFA) Act 1954	**Ministry of Health and Family Welfare** *(Protect customer against inferior quality of food and food adulteration*
CODEX stel 1954 (not a law)	**Ministry of Health and Family Welfare** *(endorsed by WTO under SPS and TBT)-Defacto mandatory*
Export (Quality control and inspection) Act 1963	**Ministry of commerce** *(pre-shipment inspection mandatory)*
Bureau of Indian Standards 1986	**Ministry of consumer affairs** *(HACCP 9000 certification) Voluntary Inspection*

Plant Safety Plant Quarantine

Destructive Insects and Pests Act (DIP Act)

Under the Directorate of Plant Protection, Quarantine and shortage, under Ministry of Agriculture

- Passed in India 1914 for the purpose of Quarantine
- Revised and corrected 8 times during 1930-1967
- New Plant Quarantine Order 2003

Examples of plant diseases introduced into India

Disease	Introduced from	Year
Leaf rust of Coffee	Sri Lanka	1879
Late blight of Potato	UK	1883
Flag smut of Wheat	Australia	1906
Powdery mildew of Cucurbits	Sri Lanka	1910
Downy mildew of Grapes	US & Europe	1910
Downy mildew of Maize	Java	1912
Paddy blast	S.E. Asia	1918
Black root of Crucifers	Java	1929
Powdery mildew of Rubber	Malaya	1938
Black shank of Tobacco	Holland	1938
Bunchy top of Banana	Sri Lanka	1940
Hairy root of Apple (viral)	England	1940
Wart of Potato	Netherlands	1953
Onion smut	Europe	1958
Bacterial leaf blight of Paddy	Philippines	1959
Golden nematode of Potato	Europe	1961

Examples of Insect Pests introduced into India

Name of the Insect Pest	Scientific Name
Subabul psyllid	*Heteropsylla cubana*
American Serpentine leaf miner	*Liriomyza trifolii*
Coffee berry borer	*Hypothenemus hampei*
Spiralling white fly	*Aleurodicus disperses*
Coconut mite	*Aceria quadrasticus*
San Jose Scale in Apple	
Potato tuber moth	*Phthorimaea operculella*
Cottony Cushiony Scale in Citrus	*Icerya purchasi*
White Wooly aphid in Sugar cane	*Ceratoyacuna lanigera*

Examples of Weeds introduced into India

Name of the Weed	Year
Opuntia spp.	1795
Chromelaena odorata	1800
Lantana camara	1809
Eicchornia crassipes	1895
Ageratum adenophora	1920
Mikania micrantha	1940
Salvinia molesta	1950
Parthenium hysterophorus	1950

Pests intercepted in India by NBPGR

During 1986-2003, a total of 8034 accessions of different oilseed germplasm was imported from 48 countries all over the world as per the database developed at NBPGR, New Delhi. Quarantine pests such as *Peronospora manshurica* in soybean, *Ralstonia solanacearum* in groundnut, peanut stripe virus in groundnut and soybean were intercepted. Pathogens of unknown quarantine significance viz., *Burkholderia cepacia* (Bacterium), and *Panogrolaimus spp.* (Nematode) on sunflower were also intercepted in germplasm from USA (Chakrabarty et al., 2004).

Pests intercepted in India by NBPGR

During 2003, out of 1,42,170 exotic samples of various crops on examination revealed that 621 samples were found infested with insect and mite pests including 134 with hidden infestation (Kavita Gupta et al., 2005).

Pest	Host	Source
Acanthoscelides obtectus (x)	*Phaseolus vulgaris*	Columbia
Bruchidius sp (x)	*Trifolium alexandrinum*	USA
Bruchidius atrolinwatus (x)(*)	*Vigna unguiculata*	Nigeria
Bruchus dentipes (x) (*)	*Vicia faba*	Syria
Bruchus pisorum (x)	*Pisum sativum*	Bulgaria, Eritrea
Bruchus lentis (x)	*Lens culinaris*	Syria
Callobruchus analis (x)	*V. unguiculata*	Nigeria
C. chinensis (x)	*V. faba, V. unguiculata*	Nigeria
C. Maculatus (x)	*V. unguiculata*	Nigeria

(*x*) : Pests detected through X-ray radiography
(*) : Pests not yet reported in India

New Plant Quarantine Order 2003

New Plant Quarantine Order 2003 reflects the primary plant quarantine concerns of the Government of India.

These are;

1. To prevent the introduction and spread of exotic pests that are destructive to the country by regulating the import of plants and plant products through adequate policy and statutory measures

2. To support India's agricultural exports through credible export certification.

3. To facilitate safe global trade in agriculture by assisting producers, exporters and importers and by providing technically comprehensive and credible phytosanitary certification.

Pest risk analysis plays a key role in the new Order for plant quarantine in India. A major feature of the plan is the establishment of a national pest risk analysis unit. Thirty –six commodities were selected for which a pest database is under development.

SPS Implementation Problems

Major external factors with respect to SPS measures affecting Indian Exports are

- Lack of transparency in the design and implementation in the importing country

- Stringency of measures/ inadequate use of pest risk assessment
- Lack of awareness or access to information on the part of the exporter as well as importer
- Compliance cost
- Insufficient domestic infrastructure
- Legal factors
- Insufficient access to technology
- Insufficient supply of environmental friendly inputs, prescribed chemicals

Implementation problems

If we do not comply with SPS, we face non-tariff barriers to trade

Export of fish

As per Codex Alimentarius Commision (CAC), HACCP system is mandatory for food processing units. EU banned import of Indian fish from Gujarat companies, which did not follow HACCP. To be competitive Indian seafood processors spending lot of money to implement HACCP through foreign consultancy.

Export of Peanuts

As per CAC, aflatoxin content permissible is 15 ppb, while Indian laws permit 30 ppb. But, European Commission (EC) has fixed up aflatoxin standard of 4ppb, preventing Indian exports to EU.

Implementation problems

If we do not comply with SPS, we face non-tariff barriers to trade

Export of Chilli

Chilli products rejected by Europeans countries due to pesticide residues in chilli and grapes, simply not due to that the residues are above set limits, but because of lack of limits for the pesticides on these crops as per the PFA Act of India.

Export of Milk Products

Milk from India contains lead residues, which falls under stricter regulation of western countries while cadmium is a major contaminant in western countries is not under regulations.

In India 0.2 ppm lead content is permissible, International limit is 0.02ppm.

What we need to meet the challenges……..

- Buildinb Infrastructure – in relation to Quarantine measures. Food safety and Pest risk analysis.
- National Standards – Harmonization, and setting standards for all possible contaminats in all raw/ semi-processed/ processed foods.
- Accreditation – of all quality control labs involved in export/ imports, certification, production houses, processing firms, and standard setting state labs, pest risk analysis labs.
- Coordination – between all standard setting departments/ agencies working under various ministries of holistic approach.
- Regional cooperation – multilateral cooperation with respect to SPS measures, and harmonization of standards among ASEAN, SAARC countries.
- Nodal agency – single window to provide database, information regarding all aspects related to SPS for importers, exporters, growers, processors, and all stake holders.
- Education – Education on Good Agricultural Practices (GAP), Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP) for stake holders

- Capacity building – in areas of understanding WTO, SPS, Legal issues of SPS, Food Safety, Risk Analysis, Diagnosis etc.

- Fund exploration – from WTO and World Bank from New Fund under STDR (*Standards and Trade Development Facilities*)

Role of Extension Specialists in this direction

- Training of farmers and entrepreneurs on export quality standards and phytosanitary requirements.

- Training on FAQ (Fair Average Quality) Standards- ANGRAU developed FAQs for Rice, Maize and Pulses.

- Market intelligence through information technology – Cyber extension

- Non-degree training to middle level extension functionaries to improve their Technical and Professional knowledge in skills.

- Educate the farming community and the industry, the anticipated implications of the agreements and lend a helping hand in building confidence and converting the so-called threats into opportunities in the global trade.

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