Role of ITK in Conservation Agriculture: Blending Indigenous and Scientific Knowledge

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The advent of the concept of sustainable agriculture in late eighties in Indian agricultural scenario has evoked interest on indigenous technical knowledge (ITK) that has the element of use of natural products to solve the problems pertaining to agriculture and allied activities. Indian farmers, over centuries, have learnt to grow food and to survive in difficult environments, where the rich tradition of ITK has been interwoven with the agricultural practices followed by them.

India, a country spreading over 3287.26 thousand sq. km. and inhabitated by about 1000 million people has been nurturing a tradition of very rich civilization over a period of five thousand years. India's ancient scriptures consisting of 4 Vedas, 108 Upanishads, 2 epics, Bhagwad Gita, Brahmasutras, 18 Purana, Manu Sniriti, Kautilya Shastra and Smritis as well as the teachings of innumerable sayings, proverbs and sages contain profound literature of ideas, concepts and practices which are designed to address the process of building harmonious relationship among man, animal and nature. The enhancement of the quality of life of the Indians who in great majority live in and depend on agricultural production systems would be impossible by keeping this rich tradition of ITK aside. The special features of indigenous knowledge are (World Bank, 1998):

- **Local** in that it is rooted in a particular community and situated within broader cultural traditions; it is a set of experiences generated by people living is those communities. Separating the technical from the non-technical, the rational from the non-rational could be problematic. Therefore, when transferred to other places, there is a potential risk of dislocating indigenous knowledge.
- **Tacit** knowledge and, therefore, not easily modifiable
- **Transmitted** orally, or through imitation and demonstration. Codifying it may lead to the loss of some of its properties.
- **Experiential rather than theoretical knowledge.** Experience and trial and error, tested in the rigorous laboratory of survival of local communities constantly reinforce indigenous knowledge.
- **Learned through repetition,** which is a defining characteristic of tradition even when new knowledge is added. Repetition aids is the retention and reinforcement of indigenous knowledge.
- **Constantly changing,** being produced as well as reproduced, discovered as well as lost; though it is often perceived by external observers as being somewhat static.

Indigenous Knowledge refers to the unique, traditional, local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area. Indigenous knowledge is the local knowledge - knowledge that is unique to a given culture or society. IK contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local-level decision in agriculture, health care, food preparation, education, natural resource management, and a host of their activities in rural communities (Warren, 1991). Indigenous knowledge is the information base for a society, which facilitates communication and decision-making. Indigenous information systems are dynamic, and are continually influenced by internal creativity and experimentation as well as by contact with external systems (Flavier *et al*.

1995). The term indigenous technical knowledge is often camouflaged with the belief that is associated with forthcoming happenings and the innovations made by the farmers to solve specific problems. Some of the related terms are:

- **Indigenous Knowledge (IK):** is the participants' knowledge of their temporal and social space. Indigenous knowledge as such refers not only to knowledge of indigenous peoples, but to that of any other defined community.
- **Indigenous knowledge system (IKS):** delineates a cognitive structure in which theories and perceptions of nature and culture are conceptualized. Thus it includes definitions, classifications and concepts of the physical, natural, social, economic and ideational environments. The dynamics of IKS takes place on two different levels, the cognitive and the empirical. On the empirical level, IKS are visible in institutions, artifacts and technologies.
- **Indigenous Technical Knowledge (ITK):** is specifically concerned with actual application of the thinking of the local people in various operations of agriculture and allied areas.
- **Belief:** change in behaviour of insects, animals and vegetation indicating a forthcoming event without any scientific rational but could be true in happening.
- **Innovation**: outside the arena of ITK, but scientifically based development of practices using the locally available resources to solve specific problems.

The indigenous Technical Knowledge (ITK) system has been developed by the people based on their experiences and continuous improvement through informal experimentation over centuries. These ITKs are interwoven and assimilated in the cultural life of the people. India has one of the largest collections of ancient manuscript in the world, which includes 14 sastras, 4 vedas, 4 upvedas and 6 branches of vedangas. The advent of the concept of sustainability in Indian agricultural scenario has invoked interest on indigenous technical knowledge that has the element use of natural products to solve problems pertaining to agriculture and allied activities. ITKs are based on experience, often tested over a long period of use, adapted to local culture and environment, dynamic and changing, and lays emphasis on minimizing the risks rather than maximizing the profits. ITK covers a wide range of subjects such as crop production, livestock rearing, natural resource management, food preparation, health care and many other related topics. Various aspects of agriculture and allied activities have been included in this project such as soil, water and nutrient management; crop cultivation; plant protection; farm equipment, farm power, post-harvest preservation and management; pasture and fodder management; agro-forestry; bio-diversity conservation and exploitation; animal rearing and health care; animal products preservation and management; fisheries and fish preservation; and ethnic foods and homestead management encompass ITKs. The differences between traditional knowledge system and scientific system are indicated below.

Traditional Knowledge system	Scientific System
All parts of the natural world are regarded as animate, all life forms as interdependent	Human life is generally regarded as superior, with a moral right to control other life forms
Knowledge is transmitted largely through oral media.	Knowledge is transmitted largely through the written word

Knowledge is developed and acquired through observation and practical experience	Knowledge is generally learned in a situation, which is remote from its applied context
Knowledge is holistic, intuitive, qualitative and practical	Knowledge is essentially reductionist, quantitative, analytical and theoretical.
Knowledge is generated by resource users in a diachronic (long term) time scale	Knowledge is generated largely by specialist researchers on a synchronic (short term) time scale
The nature and status of particular knowledge is influenced by socio cultural factors such as spiritual beliefs, and is communally held	The nature and status of particular knowledge is influenced oy peer review, and is held by individual specialists
Explanations behind perceived phenomena are often spiritually based on subjective	Explanation behind perceived phenomena are essentially rational and objective
Knowledge is used to make suitable decisions under variable conditions	Knowledge is used to put forward hypothesis and to verify underlying laws and constants

Diversity of Indigenous Knowledge

Indigenous knowledge systems are:

- Adaptive skills of local people usually derived from many years of experience, that have often been communicated through oral traditions and learned through family members over generations.
- Time-tested agricultural and natural resource management practices, which pave the way for sustainable agriculture.
- Strategies and techniques developed by local people to cope with the changes in the socio-cultural and environmental conditions.
- Practices that are accumulated by farmers due to constant experimentation and innovation.
- Trial-and-error problem-solving approaches by groups of people with an objective to meet the challenges they face in their local environments.
- Decision-making skills of local people that draw upon the resources they have at hand.

Characteristics of ITK

- ITK is not static but dynamic
- Exogenous knowledge and endogenous creativity brings change to ITK
- ITK is intuitive in its mode of thinking
- ITK is mainly qualitative in nature
- ITK study needs a holistic approach
- ITK, if properly tapped, can provide valuable insights into resources, processes, possibilities and problems in particular area
- ITK is recorded and transferred through oral tradition
- ITK is learned through observation and hands-on experience
- ITK forms an information base for variety
- ITK reflects local tradition

Classes of ITK in agriculture

- Climatology
- Local soil and taxonomy
- Soil fertility
- Primitive cultivar
- Inter cropping
- Agronomic practices
- Irrigation and water management
- Plant protection
- Post harvest technology and methods.

Roles of ITK

- ITK can aid development efforts
- ITK can facilitate local people's participation
- ITK is a valuable source of developing appropriate technologies

Scope of ITK analysis

- New biological and ecological insight
- Resource management
- Protected areas and conservation education
- Development planning
- Environment assessment

Process and methods of ITK analysis

A. Identification and collection of ITK : methods and techniques

1. Documentation of oral histories
2. The Delphi method
3. Agro-ecosystem analysis
   a) Mapping (ecological, agronomic, seasonal, spatial)
   b) Transect
4. Manual discriminative analysis (ask farmers to discriminate practices and find rationality)
5. Decision tree analysis
6. Use of local resource persons
7. Linguistic and historic analysis of concepts, vocabulary and key words
8. Ethnobotany
9. Critical incident analysis (farmers' seed exchanges and new variety introduction)
10. Analysis of peasants' journals and newspapers
11. Arranging competition
12. Conducting documentation workshops
13. Continuous interactions during on-farm experiments
14. Anthropological methods (investigation into the social, culture and other aspects of rural tradition)
15. Local taxonomy
16. Hear-say method
17. Crop histories
18. Survey method
19. In-depth interview of farmers.

B. Documentation

Types of documentation

1. Documenting large variety of practices without scientific validation
2. Documenting prevalent practices and comparing them with traditional ones
3. Documenting the practices/details of experimentation on a specific aspect and understanding the various linkages
4. Documenting the practices evolved to mitigate specific problems of farming or for sheer survival under conditions of ecological and economic stress
5. Documenting practices that had evolved in response to specific external interventions

Methods and Techniques

- Notes
- Photos
- Audio-recordings
- Video-recordings

C. Testing and Validation : method and techniques

1. Prepare a list of all the collected ITK practices
2. Decide the continuum for rating the rationality of ITK with specific weightages

Continuum	Weightage
Very rational	5
Rational	4
Undecided	3
Irrational	2
Very irrational	1

3. Send the list of ITK practices to experts for their opinion and judgement on each practice.
4. Calculate the weighed mean score of individual practices.
5. Select practices above mean score as rational.

Developing extension programmes to validate farmer experiments

Farmers are not passive consumers, but active problem solvers who develop for themselves most of the technology they use. For many hundreds of years before today's national agricultural research systems were set up, farmers did their own research. And, by integrating technology from different sources and continuing to adapt it on their farms, they still do so today. Indigenous knowledge systems form the basis for informal experimentation of farmers. The factors which influence farmer experimentation are:

- **Ecological**: innovations that result due to interaction among crops, soil, and climate
- **Historical**: a major happening such as crop failure or year of glut or scarcity
- **Serendipity**: a practice discovered by farmers accidentally
- **Economical**: Farmers innovate new practices taking advantage of government subsidies for flood and drought relief activities.

Validating farmer experiments is an extension process in which SMSs encourage farmers to replicate their own experiments in their own environment in order to:

- Understand experiments in the socio-cultural and agro-ecological environments
- Determine the impact of the experiments on productivity, profitability, and sustainability of the agricultural system

The various steps involved in the process of developing the extension programs are:

- Selecting "research minded" village extension workers

- Identifying "research minded" farmers who are already involved in farmer experiments; and
- Establishing programs for validating farmer experiments

The various steps involved during the process of validating farmer experiments are:

- Understand the rationale behind farmer experimentation.
- Recording the mode of conducting experiments.
- Identifying farmers' evaluation criteria.

Understanding, identifying, recording, and evaluating farmer experiments form the various stages of validating farmer experiments. It is important that extension personnel must understand the farmers' criteria when they explore indigenous approaches to experimentation.

Blending of Indigenous and Scientific Knowledge: Issues and Strategies

Agricultural research for the most part has been highly discipline-oriented in our country. Normal science generates packages, whereas resource-poor families engage in farming as a continuous performance. Research station technologies have focused primarily on attaining high yield of target crops. The introduction of modern technologies through the application of chemical fertilizers, agrochemicals, machinery, and modern methods of irrigation in developing countries was a departure from traditional agriculture and has led to pollution and land degradation. In addition, lack of relevance to small farm conditions was found to be one of several constraints in the station research technologies. Therefore, during the process of technology development, farmers' informal experimentation is usually not considered as a source of innovation. In spite of increased coordination between research and extension through periodical extension-scientific workers' conferences, it is found that farmers' innovations are not considered while conducting on-farm research trials. On-farm trials conducted by researchers and extension worker mostly concentrate on crop varietal comparison, fertilizer response, and testing of different packages of practices for different crops. In contrast, farmers experiment on alternative coping strategies to avoid extreme conditions such as droughts and floods, diversified food production techniques such as intercropping and border cropping in order to broaden their food and fodder requirements, and adjusting their sowing and harvesting periods to meet the local market demand are commonly ignored.

In many cases, agricultural researchers and extension functionaries are not aware of local classification systems of farmers regarding soils, crops, livestock, and other natural resources. A case study conducted by the International Crops Research Institute for Semi-Arid Tropics (ICRISAT) in Shirapur, a South Indian village, showed that the indigenous soil categories of farmers were more accurate than the formal system in stratifying the soils into groups for analysis and provided improved bases for indexing variations in land quality. In addition, indigenous soil types are considered better for long term sustainability of the soil structure and soil fertility. Because soil analysts in soil testing laboratories (STLs) are not familiar with the indigenous classification, their fertilizer recommendations may not fit in with the local soil categories. Another case study conducted in Chengalpattu District, Tamil Nadu State showed the indigenous classification of rice varieties is based on criteria such as water source, cropping season, crop duration, and grain quality. The village extension workers disseminate information on the seed varieties recommended by the researchers to the farmers. These extension decisions are reflected in the types of seeds made available through the seed multiplication units. Although several varieties suitable to semi-arid zones of Tamil Nadu are adapted to severe drought conditions, most of the varieties being encouraged through the agricultural extension system are suitable only in resource-rich environments

such as those with an assured supply of irrigation. The indigenous, locally adapted varieties of rice are no longer as easily available.

Farmers are mainly seen as the recipients of technical messages but not the originators of either technical knowledge or improved practice. The technical messages concentrate mostly on seed-to-seed packages of practices for different crops grown in the region. Resource conservation strategies such as watershed management, agro-forestry, and soil conservation rarely form part of the technical messages. The reasons can be enumerated as:

1. Lack of understanding of traditional agriculture which further leads to a communication gap between promoters and practitioners giving rise to myths;
2. The accomplishments of farmers often are not recognized, because they are not recorded in writing or made known; and
3. Poor involvement of farmers and their organizations in integrating, consolidating, and disseminating what is already known.

Strategies

Keeping these potential constraints in conventional transfer of technology, a conceptual framework for incorporating indigenous knowledge systems into agricultural research and extension has been developed with the following salient features:

1. Strengthening the capacities of regional research and extension organizations;
2. Building upon local people's knowledge that are acquired through various processes such as farmer-to-farmer communication, and farmer experimentation;
3. Identifying the need for extension scientist/ social scientist in an interdisciplinary regional research team;
4. Formation of a sustainable technology development consortium to bring farmers, researchers, NGOs, and extension workers together well ahead of the process of technology development;
5. Generating technological options rather than fixed technical packages;
6. Working with the existing organization and management of research and public sector extension;
7. Bringing research-extension-farmer together at all stages is practically difficult considering the existing bureaucracies and spatial as well as academic distances among the personnel belonging to these organizations. Hence, utilizing the academic knowledge gained by some extension personnel (subject matter specialists) during the process of validating farmer experiments;
8. Outlining areas that research and extension organizations need to concentrate on during the process of working with farmers.
9. Understanding that it is impractical to depend entirely on research stations for innovations considering the inadequate human resource capacity of the regional research system.

Technology Development by Incorporating ITK into Agricultural Research

Indigenous Technical Knowledge Resource Centers (ITKRC)

Establishing a National Indigenous Technical Knowledge Resource Center forms the starting point for the entire framework of incorporating indigenous knowledge systems into agricultural research and extension. The resource persons in the national indigenous knowledge systems resource center will provide training on the methodologies for recording indigenous knowledge systems. The functions of this centre are:

1. Provide a national data management function where published and unpublished information on indigenous knowledge are systematically documented for use by development practitioners;

2. Design training materials on the methodologies for recording indigenous knowledge systems for use in national training institutes and universities;
3. Establish a link between the rural people of a country who are the originators of indigenous knowledge and the development community;
4. Facilitate the active participation of rural people in the conservation, utilization, and dissemination of their specialized knowledge through *in situ* knowledge banks, involvement in research and development activities, farmer-to-farmer training, and farmer consultancies; and
5. Act as a two-way conduit between the indigenous knowledge-based informal research and development systems and formal research.

Training on ITK

Training programmes on indigenous knowledge systems are inevitable for bringing a desirable change in the attitudes of researchers and extension workers. The need for conducting training programs for extension workers on the role of indigenous knowledge in agricultural development is:

1. If the extension personnel including village extension workers and agricultural extension officers are provided training on scientific technological innovations, but have not learned to regard farmers as their colleagues, their potential to support farmers' local research efforts will be comparatively lower;
2. Training programmes on the role of ITKs in agricultural development help to remove the impression among the extension workers that research scientists are the only generators of technological innovations and their (extension workers) job is to merely transmit those innovations;
3. Information provided in these training programmes regarding local farmer organizations and their functions can stimulate ideas among extension workers for a number of viable action-programs; and
4. Extension workers can help local farmers' organizations establish and strengthen links with agencies such as government services, private organizations, commercial farms, and other farmer organizations for information and other inputs.

Training on indigenous knowledge systems should be conducted in two stages, as indicated below

Stage I : Training / workshop for the state level trainers of TTCs, ICAR Institutes and agricultural universities from various regions of the country.

Stage II : The trainers will then provide similar training for district-level extension workers, subject matter specialists of KVKs etc.

Inter-Disciplinary and Multi-Disciplinary Approach

The regional research stations are responsible for developing agricultural technologies related to disciplines such as plant breeding, agronomy, entomology, soil science, and plant pathology; but in most of the cases there is no social scientist or extension scientist working in these stations. Social scientist can play a key role in linking the research mandates with those based on farmers' perceptions. So, incorporating social scientists in an interdisciplinary research team will bring farmers' perceived needs and problems into the research agenda. Such research programmes should be carried out with following components:

- Identifying problem (s)
- Problem prioritization with active participation of the farmers, local people etc.
- Recording relevant indigenous knowledge systems *w.r.t* specific problems

- Formulating research project incorporating the indentified ITK as a major component
- Conducting Participatory On-Station Research (POSR) or On-Farm Farmers Oriented Research (OFFOR)
- Evaluating the effectiveness of the ITK including additional benefits
- Testing the research output in farmers' fields
- Technology validation
- Technology refinement (if necessary)
- Technology demonstration / popularization

On-Farm Farmer-Oriented Research (OFFOR)

Salient features

- Management, not just implementation, should be left to farmers whenever possible
- Farmer assessment is an important component of overall analysis. Measurements need to be made in order to quantitatively analyze outcomes and to diagnose reasons for observed responses
- Farmer control is particularly important for site selection, plot sizes, seed rate, planting patterns, and timing of agronomic operations
- Exploration and demonstration activities are required to stimulate awareness and interest in technological options.

Benefits

- OFFOR keeps the indigenous knowledge system of farmers as a base
- It facilitates farmer participation well ahead of the on-farm research process in order to generate a basket of technological options
- It can be taken to wider areas among a wider spectrum of farmers covering different castes and gender with minimum cost
- It has enabled researchers to get direct and first hand feed back that helps researchers to improve or modify technologies

Methods

- **Developing new research technologies based on indigenous knowledge systems**
  In Zambia, the farmers evaluation of a high-yielding hybrid maize variety and description of the positive and negative characteristics of locally-adapted open-pollinated varieties led to a more effective national maize breeding programme. Hence, during the process of technology development, scientists at the research station should conduct research by building on the acquired indigenous knowledge systems.

- **Integrating indigenous knowledge systems and existing research technologies**
  Casuarina farmers in Pillayarkuppam, Pondicherry, India, conducted informal experiments by growing legumes such as black gram or cowpea as intercrops in casuarina (a multipurpose tree) plantation. But most of them faced problems such as the shattering of legume pods and spreading of legumes between casuarina trees. The research scientists can conduct on-station research experiments with an objective to evaluate the performance of various legume varieties in casuarina fields and select certain legume varieties which are suitable for intercropping in casuarina fields. The successful combinations of casuarina and legume varieties can be taken to farmer-oriented on-farm research for its validation under farmers' field conditions. Other examples where an integrated technology can be developed by blending Indigenous knowledge systems and existing research station technologies are developing IPM strategies by blending indigenous crop pest management systems and selected

chemical pest control methods, and conducting integrated crop nutrient research to formulate crop nutrient schedules by mixing cattle, sheep manures and chemical fertilizers.

Evaluating Technological Options

Evaluating the technological options is an essential component while conducting OFFOR. The extension scientist should evaluate the performance of technological options with respect to:

1. Compatibility with agro-ecological conditions
2. Compatibility with socio-cultural environments
3. Usage of labour
4. Usage of cash
5. Profitability
6. Need for institutional support
7. Contribution to reducing risk

Finally, extension scientists with input from farmers should evaluate the technologies that have been tested during the OFFOR in terms of their contribution to:

(a) Productivity of crops and associated livestock

(b) Sustainability of the agricultural system

(c) Complexity (e.g., ease of experimentation),

(d) Labour intensity. They are expected to arrive at any one of the following decisions:

1. Drop the technological option that has been tested
2. Technological options need long-term research
3. Technological option is ready for further dissemination.

The technological options that are proved to be viable after the on-farm research should be disseminated to farmers using procedures outlined under the section, "process of disseminating sustainable agricultural technology to farmers by collaborating with research, extension and NGOs.

Subject Matter Specialists as Researchers

The Subject Matter Specialists (SMSs) working in KVKs are post-graduates or doctorate in different disciplines such as agronomy, soil science, entomology, and plant breeding. Moreover, the department of agriculture is sponsoring extension personnel to undergo post-graduate training in the specialized disciplines. The advanced knowledge they acquire during this training period along with their field experience as SMSs should be used for validating farmer experimentation. But, it was found that SMSs use to spend most of their time in conducting FLDs and preparing periodical reports to be sent to their higher authorities. In other words, the academic training acquired by the SMSs is rarely exploited. They should spend at least one day in a week on activities such as problem identification, recording relevant indigenous knowledge systems and presenting the problems and indigenous knowledge systems to the appropriate platform.

Sustainable Technology Development Consortium (STDC)

The purpose of a sustainable technology development consortium is to bring farmers, researchers, extension workers, KVKs and NGOs representatives together in order to classify the identified problems and indigenous knowledge systems and set research agendas based on them. In the consortium, research should be represented by all scientists of the research centres and agricultural universities, extension should be represented by regional-level extension workers and SMSs and NGOs by their representatives. Complementary linkages

between NGOs, researchers and extension workers encourage interaction among many sources of technical innovation to arrive at dynamic technological options.

Wrapping up

Indian agriculture is at present confronted with a number of challenges including instability of productivity and diminishing sustainability of natural resources. These issues have evoked growing interest in the study of indigenous knowledge systems that are based upon the local resources. Since, information on ITK is seldom documented, it often happens that such information are lost, if not passed on from generation to generation or protected and practiced by the local people. Hence, in today's concept of IPR regime, it is all the more imperative to document and protect our valuable ITK for posterity. In the context of agricultural sustainability, ITK is also required to be properly documented for the benefit of researchers, planners and development officials. Validation of ITK is a logical step to qualify and quantity effectiveness of the practices. Suitable modifications of the local practices, through research and development will help to develop appropriate and acceptable technologies that are more suited to our farming situations. Considering this, a Mission Mode project on Collection, Documentation and Validation of Indigenous Technical Knowledge was launched in 2000 by Indian Council of Agricultural Research (ICAR) under the National Agricultural Technology Project (NATP) with the following objectives:

- Identify, collect, classify and document ITK and its variants in different agro-climatic regions in respect of production systems, farming systems and situations;
- Catalogue and characterize the information for developing a data base;
- Ascertain the propensity of the extent and level of use of various ITKs by the farmers in the management of various farming systems;
- Validation of ITK though a quick screening method and through formal experimentation, wherever needed; and
- Evolve a mechanism to protect property rights and facilitate the process of sharing the benefit by the farming community.

For the purpose of documentation information on ITK were collected from various literatures which are available in different forms, and through voluntary disclosure by the users of ITK or through facilitators. The information on ITKs, geographical indications of the plant materials used in the ITKs through quick screening and experimentation has been documented in different volumes. It is understood that the publication have not been able to cover all the published information. Therefore, such efforts need to be made on continuous basis. These are the time tested knowledge and experiences of the peoples' accumulated experience in dealing with situations and problems in varying aspects of life and such knowledge and practices are special to particular culture. Indigenous knowledge are not primitive, left over from the past but on the contrary, are systems of finally tuned and adopted, both biologically and socially, to counter the process of what are often harsh and inimical environment and often represent hundreds, sometimes thousands of years of adaptive evolution in which vagaries of climate, the availability of land, water, the basic need of people and their animals for food, shelter and health have been amalgamated in a system which has allowed society to exist and develop in face-to-face tremendous odds. Various ITKs in agriculture, animal husbandry, fisheries and other and based activities have been in use since the human civilization by the farmers, animal owners and other practitioners. In spite of advancement in scientific knowledge in agriculture, ITK-based practices still remain in use by the vast majority of the farming community particularly in resource poor farming situations, without the knowledge of its scientific rationality. In this context, blending of indigenous knowledge with modern scientific technologies is the need of the day to support sustainable development of agriculture and allied sector in our country.