

Technology Application in Different Farm Environments

A.K. Singh¹, Lakhan Singh² and Jitendra Chauhan³

¹. Zonal Project Director, 2. PS (Agril Extn), Zonal Project Directorate, Zone-IV (ICAR), Kanpur

³. Joint Director (KVKs) and Head, RBS College, Bichpuri, Agra

aksinghcsa@yahoo.co.in

In India, transformation of agriculture could be realized with much needed interventions of National Agricultural Research System (NARS) in the form of various revolutions in agriculture and allied sectors. The benefits of transformational technologies were derived as they were efficiently utilized by the individual farmers in their local situations.

The commonly alleged observations quite often we hear that revolutions are confined to chosen areas, involving certain farmers, crops, livestock and commodities. The main reason for this is not the scarcity of agricultural knowledge, research findings and technologies, but lacking in translating them in to production accomplishments especially in location specific micro farming situations for the betterment of farming community. Therefore, it largely depend on understanding the various aspects in totality how the technologies are generated, assessed, refined, demonstrated and disseminated to integrate farming system as a whole.

Robert Chambers evolved the concept of Farmer First in 1987 which had insights of three broad categories of types of agriculture (Industrial, Green Revolution and the CDR or Complex, Diverse and Risk-prone); the pipeline approaches and methods of transfer of technology (TOT) for the uniform and controlled conditions of industrial and green revolution agriculture did not fit CDR conditions; farmers' practices seen as adaptive performance; the proposition that adoption by farmers is validation of a technology; the comparative advantages of farmers over scientists in innovating for complex systems; and many others. Farmer First was established as paradigmatically different from TOT, and vital for CDR agriculture. It became a movement.

Five years later, in 1992, Ian Scoones and John Thompson came with Beyond Farmer First concept. This stressed perspectives that broadened and complemented Farmer First: the pluralism of different knowledges; the recognition of knowledge as not a stock but a process; seeing farmers, extensionists, scientists and others as social actors; recognizing political dimensions and the significance of power relations; and elements of a new professionalism in agricultural science.

A workshop on Farmer First Revisited was held in 2007 which differed from the original Farmer First. In farmer First, it was mutual recognition of marginalized innovators, the solidarity of heretics, the sense of being a vanguard, of having a common commitment that could be transformative. In Farmer First Revisited it was seeing how far we had come, how many more domains than just farmer participation were relevant, and how rich the range of innovations had been. In Farmer First the focus was on the complexity and diversity of farming systems and the creativity of farmers. In Farmer First Revisited it was the complexity and diversity of domains of action and intervention and of relationships, and the co-creativity of many different actors.

In Farmer First concern was to move beyond the reductionism of production and productivity and to privilege the complex, diverse and risk-prone realities of the majority of farmers, focusing on participation on-farm with and by farmers. Now the universe itself is complex and diverse. Many aspects are multiple or multi; multiple stakeholders, multiple perspectives, multiple realities, multi-functional agriculture, multi-method approaches. There are concepts and domains that are new or new in emphasis like food systems, trade, market chains, value chains, innovation pathways and most of all innovation systems.

Now we have far many agencies other than public organizations and various kinds of public-private-farmers partnerships. Earlier farming was an adapting performance. Participatory approaches and processes were central. Now relationships and interactions are seen more clearly to have dimensions that are related to power, trust, transparency, virtual, grass root, peer, and advisory network. Partnerships like public-private, multi-stakeholder partnership etc, and collaborations like co-management, co-breeding, co-creation, co-evolution, co-development, etc. have emerged in present day context.

Different sets of support systems are emerging in many states like micro irrigation system in Gujarat, poly house technology in Uttarakhand, three tier model of Amul in Gujarat, mother dairy and fruit and vegetables marketing model by NDDDB, production and export of high value fruit crops in Maharashtra have been taken up with full support from state governments and private agencies.

Since the 1990s, Farmer Field Schools (FFSs) have been utilized as a vehicle of technology application in different projects of diverse sectors. A private initiative of Mahindra Shubh Labh Services Ltd. in 2001 aimed to establish franchises of Mahindra Krishi Vihar (MKV) to provide access to inputs and machinery, credit, and advisory and field supervision services.

The micro irrigation system has been taken up as a movement in Gujarat as a tool for wise usage of resources resulting in higher agricultural productivity, thus improving the livelihood and empowering farmers to participate meaningfully in the growth of the Agriculture Sector in the State.

Uttarakhand faced with factors like undulating topography, fragile environment, fragmented and small holdings, little or no irrigation facilities, poor marketing structure has launched an ambitious project to set up cluster-based 20,000 modern polyhouses to boost production of vegetables and flowers.

The polyhouses are proposed to be constructed with an area size ranging from 100 sq meter to 200 sq meter. Through this project, the government is aiming to increase four to ten times higher productivity of cash crops. The project will also provide support for capacity building of local youth and employment of local artisans in the construction of polyhouse designs.

The Amul Model structure consists of a Dairy Cooperative Society at the village level affiliated to a Milk Union at the district level which in turn is further federated into a Milk Federation at the state level. The above three-tier structure was set up in order to delegate the various functions, milk collection is done at the Village Dairy Society, Milk Procurement & Processing at the District Milk Union and Milk & Milk Products Marketing at the State Milk Federation. This helps in eliminating not only internal competition but also ensuring that economies of scale is achieved.

Madhya Pradesh became the first state in the country and perhaps the only state in India to have a private extension policy. The policy states that the private extension would aim for cost reduction, improving the efficiency of extension system and inculcating accountability in extension services.

Considering changed socio-economic perspective, climate variation, agro-climatic situations, and other institutional factors, the technology needs to be generated accordingly. Different technology application models again need to be developed to suit the micro environments. A large network of research, social, and developmental organizations are being working at field level, need close convergence for desired outcome.

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Open and Distance Learning System in Extension Education

B.S. Hansra¹ and P.K. Jain²

.1. Professor, School of Agriculture, IGNOU, New Delhi-110068

2. Assistant Professor, School of Agriculture, IGNOU, New Delhi-110068

Open and distance learning (ODL) is relatively new in the field of education. It gains prominence only in the last 25 years. This term is comprised of two terms i.e. Open Learning and Distance education. Open learning is a philosophy and Distance learning is a methodology in education. Openness and learner-centric is a basic philosophy of ODL. Flexibility and openness in entry and admission requirements, programme structure, and flexible learner support (when, where and how to study), etc. are important reasons for popularity of ODL. Distance education or distance learning, is a field of education that focuses on teaching methods and technology with the aim of delivering teaching to students who are not physically present in a traditional educational setting such as a classroom. It has been described as “a process to create and provide access to learning when the source of information and the learners are separated by time and distance, or both” (Wikipedia). Physical on-site presence of teachers and learners is also recommended in the new generation distance education particularly in technology oriented courses.

There are a number of similarities between extension education and distance education:

- Extension education deals with study of farmers problems and needs of the farmers. The subject and areas deal with the distance education is also based on the need of the society.
- Extension education has no fixed curriculum or course of study & curriculum are developed with the help of farmers based on their requirements. Similarly, in case of distance education, curriculum is developed based on the requirements of the learner and choice is given for selection of curriculum.
- Decision power is given to farmers / or learners in extension and distance education in terms of when, where, what and how to learn.
- Participation of learners is voluntary in both extension education and distance education (self pacing).
- In extension education local leaders are used for teaching and In distance learning, the locally available teacher-counselors are used for teaching.
- Learners are large & heterogeneous in both extension and distance education.
- Both are flexible in terms when, where, what and how to study.
- Extension education is more practical & intended for immediate application in the solution of problems. The programmes/ courses offered by the distance education are also need based and have immediate application for improving the livelihood.

The open and distance learning (ODL) system is successful in providing the education to the unreached. It is being employed in agriculture as well for suitable curriculum development and delivery. This paper covers the development and delivery of agricultural programmes through cost-effective and efficient ODL to educate farmers, upgrade their technical, entrepreneurial, and analytical skills.

Development of Education and Extension System: In pre-independence India, five agricultural colleges at Pune, Coimbatore, Sabour, Kanpur, Nagpur and Layallpur (Now in Pakistan) were opened in order to impart agriculture education and bring improvement in production technology. Setting of Imperial Agricultural Research Institute, Pusa (Bihar) and Imperial Council of Agricultural Research were the major initiatives for agricultural research, education and extension activities in the country. The education system has undergone lot of changes in post-independent India. The Imperial word was replaced by Indian Council of Agricultural Research (ICAR).

State Agricultural Universities (SAU) were established on the philosophy of Land - Grant College of USA. Presently, there are 48 SAUs and one Central Agricultural University (CAU). SAUs and ICAR institutes are also undertaking extension activities to transfer developed technologies to the cultivators. However, the target population to be covered by the available extension and education system has limitations in reaching out to all citizens in a geographically vast country like India, particularly those in rural and agricultural-based communities.

Need for Open and Distance Learning (ODL): Agricultural knowledge and advancement in farming practices must be brought to the farming for their adoption. Open and distance learning is a proven system of education for the un-reached. Distance education is a form of education which relies on the pedagogy/andragogy, technology and instructional systems design that are effectively incorporated in delivering education to students who are not physically “on site”. However, teachers and students can interact at a time of their own choice. The mode of interaction can be in the form of print or electronic media or technology mediated. Because of use of multi-technology, openness and flexibility, the ODL system is able to become an alternate and cost effective mode of extension education. The ODL System can provide access to extension system to reach large segment of population.

Indira Gandhi National Open University (IGNOU): IGNOU was established in 1985 in order to provide cost-effective quality education to large sections of population, including those living in remote and far-flung areas. The University at present offers 475 programmes of study to cumulative student strength of over 2.6 million through 21 School of Studies making it the largest University in the world (Anonymous, 2011).

School of Agriculture (SoA): The School of Agriculture was established in January 2005 at IGNOU and is mandated to improve and sustain productivity and quality of human life in rural areas through ODL System in agriculture and allied sectors. It aims at improving out-reach of agriculture education and extension for rural masses through academic, continuing and extension programmes. The School is playing important role in turning the rural unemployed youth to first rate agricultural entrepreneurs and agri-business managers of tomorrow. This will strengthen human resource base through quality education and generate trained manpower. It imparts knowledge and skills for life-long learning.

Technological Innovations for Improving Outreach and Effectiveness of Open and Distance Education in Agriculture: IGNOU has made an attempt to conduct the educational programmes / courses using ICTs. Few programmes offered by IGNOU have been converted in to online format using ICTs. ICTs supported education if designed and implemented well, can promote the acquisition of the knowledge and skills that will empower students for lifelong learning.

The extension and educational programmes of the IGNOU have multi-media support. The University has state of art facilities for production of audio/video programmes and their dissemination through radio and television. The University also uses interactive radio counselling as well as tele-conferencing to provide interactivity in the teaching-learning process. IGNOU is the nodal agency for running a 24-hour educational TV channel (*Gyan Darshan*) and a network of 40 FM Radio stations (*Gyan Vani*) exclusively devoted for education. The University has made a major breakthrough in distance education and training with the launch of an exclusive Educational Satellite, EDUSAT which has a wide reach to cover large sections of population with its two-way video conference facility.

National and International collaboration for development of ODL System : Distance education in agriculture is being developed and adopted in various parts of the world and different models. International agricultural research centers offer a large set of knowledge that could be used in the national systems of education. These programmes could provide valuable information and course materials through appropriate partnerships. The international education systems in distance learning should be linked with national organizations in order to strengthen knowledge access to various stakeholders of agriculture. The participation of the private sector and Non-Government Organizations (NGOs) can further complement and supplement the efforts of public sector in educating farmers and rural youth.



Evolving an Inclusive Extension System for Enhancing Rural Household Income

R.P. Singh 'Ratan'¹, A.K. Singh² and Niva Bara³

1. Director Extension Education, BAU, Ranchi-834006 (Jharkhand), 2. Zonal Project Director, Zone-II, ICAR, Kolkata-700097 (W.B.), 3. Head, Deptt. of Agril. Extension, BAU, Ranchi-834006 (Jharkhand)

deebauranchi@rediffmail.com

Emerging Innovations in Extension

The recent reforms in Indian agricultural extension systems like integrated approach, participatory planning and management, group mobilization, etc. call for major change in institutional setting. These changes should eventually lead to “learning rather than command and control” as the philosophy. However, these reforms have not produced the desired effects, implying thereby that instead of searching for outside solutions to typical micro-level problems in rural and agrarian India, the public extension must learn to look for such solutions inside the client systems and if required replicate the same to achieve the economics of scale. This requires that clients be viewed as active partners not just passive recipients of extension.

The basic approach to agricultural extension in 11th Five Year Plan involved focus on extension reach to small, marginal farmers, farm women and disadvantaged groups; strengthening and upscaling new institutional mechanism with adequate funds for extension activities, dedicated manpower at different levels and infrastructure support; focusing on demand-driven and farmer-oriented training strategies; ensuring women participation in all the trainings programmes at all levels and organizing specialized training for women trainers; introducing gender budgeting in agricultural extension programmes and sensitizing all the stakeholders in gender issues; farmer-led-extension as an instrument for participatory research and knowledge management leading to build a cadre of grass-root farmer trainers, and to facilitate commodity interest groups; agripreneurs identification and training under KVKs or agri-clinics and agri-business centres recognizing the outstanding farmers through awards; provision of adequate quality extension manpower including the private service providers (agripreneurs, input dealers, NGOs, programme producers of print and mass media, etc.) to address agricultural diversification, intensification, commercialization and sustainability issues, understanding information needs of different clients (farmers, farm women, labourers, youth, etc.) through continuous capacity building to also have skills of group formation, negotiation, conflict resolution, social mobilization, management of Common Property Resources (CPRs), use of IT, documentation of success stories and replication to improve the effectiveness of the delivery system; Integrating Research-Extension-Farmer-Market linkages to be addressed by undertaking research and extension activities through the participatory technology development mode, creating a Research-Extension-Farmer and Market coordination at State level to take necessary policy initiatives to enable and establish linkages; promoting farmer organizations around the commodity and federating them at block/district/state level and linking the economic activities and markets for collective bargaining to sustain the developmental efforts; following farming system approach explicitly by farmers’ needs through an understanding of the existing farming systems to determine the research and extension agenda and, convergence of extension services between public and private sector extension service providers on Public-Private-Partnership (PPP) mode at the district, block and village levels to improve the performance of various stakeholders.

Suggestive Model of Next Generation Agricultural Extension in India: In view of changing partnerships and proprietary claims, there is a need to bring system approach in extension and transfer of technology and to

look for an extension model that would involve various extension agencies like KVK, Agricultural Technology Management Agency (ATMA), line departments and private agencies, etc. in the district. This framework is based on the following premises:

- Core operating philosophy of next generation agricultural extension system will be guided by its classical manifestation, education, facilitation and empowerment (helping clients to help themselves).
- District will be the core planning and operating unit.
- Systems approach to link all extension service providers (ESP) at district level and below with innovation systems (formal and informal research systems), client systems and other support systems (inputs, credit, power, road, telecommunications, etc.).
- KVKs will be the main agencies to connect all the ESPs with other systems directly by ways of functional linkages or by facilitating regular interfaces, initial hand-holding in forging partnerships and also by referral/regulatory role for diagnostic and prescriptive services.
- Within the purview of the existing mandate, the KVKs will function as nodal extension agency. However, the KVKs will have flexibility to realign its mandated activities in line with the development niches of the district, and also its own strengths.

The model proposes KVKs as the basic platform at district level to spearhead extension on the premises suggested above. The backend support for KVKs is visualized in the form of National Agricultural Innovations and Knowledge Gateway. KVKs would customize the innovations and knowledge repository of this gateway to help the clients on a group approach (FIGs, CIGs, FOs, SHGs, etc.). KVKs would facilitate and help these groups to connect with the other ESPs. KVKs would use Knowledge Infomediaries (KnIMs), to be identified jointly by Panchayati Raj Institutions and KVKs as master trainers and KVK ambassadors to multiply and magnify the capacity building and other extension activities using Farmer School concept. KVKs would help connect National Agricultural Innovation and Knowledge Gateway to the future generations by forging active partnerships with schools in the district. The possible strategic options for this model are

- Decentralization/devolution/democratization
- Top-down/bottom-up/convergence approach for knowledge and innovation dissemination
- Free of cost/cost sharing/full cost recovery as fiscal considerations
- Segmentation (area/client type/commodity), targeting (customizing knowledge and innovations and costing options) and positioning (differential pricing, communication, media-mix, etc.) of ESPs.

Critical Success Factors for Next Generation Extension System in India: The following factors would be the corner stone of the next generation extension system in India.

- *Pluralism:* Acknowledge and integrate pluralism in extension (harmony and synergy among various ESPs).
- *Professionalism:* Move away from bureaucratic to more professional operating philosophies and systems. This include core values of the systems and people constituting these systems, professional identity, professional HRD and capacity building.
- *Pragmatism:* Ability to ‘think global and act local’ to consider and cater to real needs of the clients and not the greed of clients/donors.
- *Partnership:* Shift from competitor approach to strategic issue-based alliances, partnership and consortium approach.
- *Prudence:* External demands and internal responses would call for judicious and efficient use of resources to deliver the best results (outputs and outcomes).
- *Pride:* A sense of commitment, devotion, dedication, and discipline to promote pride in serving those (millions of small, marginal and landless farmers and other downtrodden sections of rural India) who strive to ensure the food security of the nation.

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Emerging Agricultural Extension Models

Prof. V. Veerabhadraiah

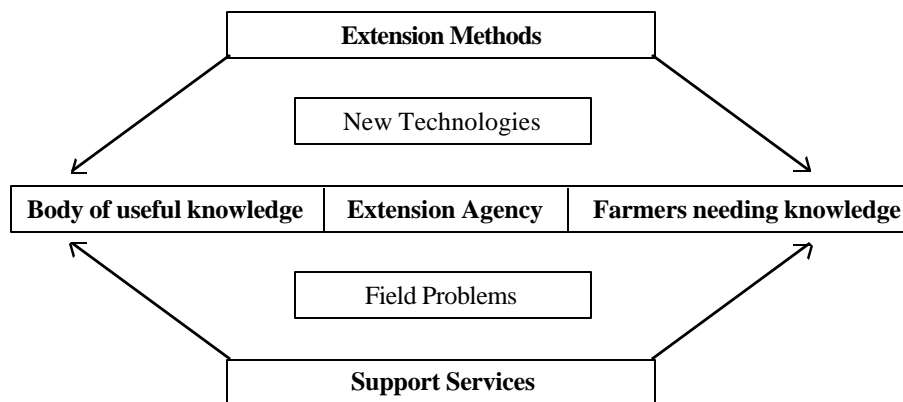
Former Director of Extension, University of Agricultural Sciences, Bangalore

Agricultural Extension is an instrument of change. It enables farmers to seek and adopt desirable changes in farming. Its focus is on technology improvements, leading to human resource development. Agriculture normally keeps changing, either slowly or rapidly. The role of agricultural extension is to make this process more purposeful. And, as the agricultural sector changes, the tasks of the agricultural extension will also change, while its basic functions remain essentially the same.

Basic Model of Extension Education: Extension is a change inducing system, which enables farmers to improve their living mainly through their own efforts. By upgrading the knowledge and skills of farmers in their occupations, Extension helps them to increase their productivity, production and their incomes.

Extension education is a system of working with farmers, their families and communities, using informal educational procedures, to relate useful, practical new knowledge to their needs and interests, thereby enabling them to make satisfactory improvements in their living (Dwarakinath, 2011).

Farmers are interested in meeting their needs and problems in order to create more satisfying situations. The extension agency helps them in this effort. Extension systems works with local farming communities to promote improvements in farm production, family life and community living. It has access to new knowledge useful to farmers. This body of new knowledge is the starting point of all extension efforts.



A Basic Model of Extension Education

Components of the Model : The basic model of Extension system consists of five components. They include: (1) a body of new and useful knowledge, (2) farming communities who need the knowledge, (3) an extension agency to link the two, (4) a set of extension educational methods and (5) infrastructure and support services.

How does extension system operate? : The main task of extension is to make available to farmers new perceptions, practices and products for which they have a need.

- It works as a system of informal education helping people to improve their living. It remains educational in its objectives, principles and methods.
- It develops informal working relationships with individuals and groups, studies their needs and problems, develops problem solving approaches in partnership with them and gets them implemented.
- It maintains links with research agency in order to ensure continuous flow of useful information and to feed back field problems for research.
- It fosters growth of the required infrastructure facilities to support development including supplies, services and marketing.
- It encourages farmers to evaluate the changes they have made to derive lessons for future application and to derive a sense of accomplishment as a motivation for further effort.
- It encourages farmers to organize themselves into groups and associations to safe safeguard and advance their interests (Dwarakinath, 2011).

Participatory Model : Non-Government Paradigms in agricultural extension : The predominant linear view of technology transfer is insufficient for addressing complex agricultural problems that exist, especially in a limited resource country like India.

The time tested models like T&V system of Extension and others are mostly top-down approaches and they are one-way paradigms. The inadequate linkages between research and extension establishments are a major weakness of development. Public sector extension systems have had limited success working with resource-poor farmers.

The NGOs (CSOs) play an increasing important role in agricultural extension in developing countries. The ability of public extension institutions is especially limited due to inadequate human resource and facilities. Due to their good linkages with resource – poor farmers and grassroots organizations the NGOs have considerable advantage. They offer some refreshing alternative programmatic approaches compared to dominant agricultural technology transfer / extension paradigm.

Participatory Features: Facilitation and networks

- The approach of NGOs is different from traditional extension models. They adopt participatory approach, progressive development and execution and operating through grassroots network.
- The participatory approach is significantly different from the predominant technology transfer paradigm. The farmer is not viewed as the “*end recipient*” as in the case of top-down technology delivery models. Likewise extension worker is not just viewed as a “*conduit*” (channel) for conveying information to farmers.
- Rather than formulating a pre-packaged prescription for farmers, more effective NGOs regard farmers are valued partners in the development process at all levels of intervention need assessment, programme development, participatory technology development, implementation and evaluation.
- More scope for articulation and participation of farmers. Engaging a local volunteer as promoter (may be called SAP - Sustainable Agriculture Promoter as in the case of AMEF in Karnataka, Andhra Pradesh and Tamil Nadu). The SAP should have willingness to serve people, how he interacts with other people and his respect for others.
- An innovative model of agricultural extension (agricultural department) is steadily evolving and maturing among NGOs. It has two importance characteristics – participatory at the grassroots level and proactive at the institutional level.
- The change agent’s role should not be reactive (conveying a designated technology to farmers for rapid adoption) but more interactive, cultivation of co-learning partnership with farmers.



Participatory Approach of Women in Agriculture: Vision 2025

U.S. Gautam¹, Alka Singh² and S.R.K.Singh³

1. Zonal Project Director, Zone VII, Jabalpur., 2. SMS (HSc.), KVK, Chhindwara,
3. Sr. Scientist (AE), ZPD Zone VII, Jabalpur

Women play a significant and crucial role in agricultural development and allied fields including in the main crop production, livestock production, horticulture, post harvest operations, agro/ social forestry, fisheries, etc. (Prasad & Singh 1992). The nature and extent of women's involvement in agriculture, no doubt, varies greatly from region to region. Even within a region, their involvement varies widely among different ecological sub-zones, farming systems, castes, classes and stages in the family cycle. But regardless of these variations, there is hardly any activity in agricultural production, except ploughing in which women are not actively involved.

Scope for Women in Agriculture : Meeting world food needs in the year 2025 will depend even more than it does now on the capabilities and resources of women. Women are responsible for generating food security for their families in many developing countries, particularly in India. Women not only process, purchase, and prepare food, but they also play a significant role in national agricultural production, producing both food and cash crops. Population growth, urbanization, and the limited potential for increasing production through the expansion of cultivated area imply that, for food needs to be met in the future, yields will have to increase. Agricultural research continues to develop new varieties with higher yields and increased tolerance to unfavorable environmental conditions, but an untapped source of productivity gains could lie in addressing gender disparities in agriculture. The women play in maintaining the three pillars of food security-food production, food access, and food utilization-*Women as Food Producers*: The sustainable production of food is the first pillar of food security. Millions of women work as farmers, farm workers, and natural resource managers. In doing so they contribute to national agricultural output, maintenance of the environment, and family food security.

Women as Gatekeepers: The second pillar of food security is making sure that household members, particularly the children, receive an adequate share of the food that is potentially available. Women act as the "gatekeepers" of their households' food security through the allocation of their own time and income.

Evidence suggests that men spend a higher proportion of their incremental income on goods for their personal consumption. By contrast, women are more likely to purchase goods for their children and for general household consumption.

The third pillar of food security-*Food Utilization*-means ensuring that the food consumed contributes to good physical and cognitive development. This entails the provision of "care," namely, paying adequate time and attention to meeting the physical, mental, and social needs of growing children and other household members. Care affects food security in two broad ways: first, through feeding practices such as breast-feeding and the preparation of nutritious foods for weaned infants and others in the family, and second, through health and hygiene practices such as the bathing of children and the washing of hands before food preparation. These caring behaviors are time-intensive. The time constraint is especially acute for female heads of households.

Multi-Dimensional Role of Women: (i) Agriculture: Sowing, transplanting, weeding, irrigation, fertilizer application, plant protection, harvesting, winnowing, storing etc.

(ii) *Domestic* : Cooking, child rearing, water collection, fuel wood gathering, household maintenance etc.

(iii) *Allied Activities* : Cattle management, fodder collection, milking etc.

Women in Decision Making in Agriculture: Women's role in agricultural operations, animal husbandry and

other economically productive activities is very significant. They contribute about 60-70 percent of the labour required for these activities thus playing a pivotal role in sustaining economy. The decision making process is an important segment of every household because it makes implementation of a plan or programme quite easy. In rural areas of the country, both husband and wife are jointly responsible for making decisions on matters like family obligations, specific housing charges and purchase of household articles. However, women's suggestions are not given due consideration in the decisions pertaining to agricultural sector and important family matters. It is because the majority of women are illiterate, has little time to know about the latest techniques of farming and restricted mobility due to several cultural taboos. At times, even the suggestions of knowledgeable rural women are ignored or are not taken seriously because men consider it disgraceful to accept the decision of women. This is because traditionally men have been major lawmakers of society. Many policies and decisions neglect women and undermine their abilities and roles. The programmes should be developed exclusively for women; to build leadership skills for managing agricultural community based development activities.

Scenario by 2025:

- The farm women will have farm management skills and capable of taking even complex decisions like shifting from subsistence farming to diversified agriculture, with stand competition from market forces improvement in work or farm efficiency etc.
- Suitable agricultural interventions will enhance production of quality food grains, vegetables and fruits. This will help in improving per capita availability of food, which will, in turn, impart food and nutritional security.
- Improved access to credit, establishment of milk cooperative and marketing will enhance the managerial abilities of farm women in dairying.
- Women will act as “vaccinators” and as manufacturers in low cost dairy and poultry feed formulations at the village level.
- Women will play a significant role in livestock management and production and will be the member of dairy cooperatives.
- Availability of time saving, work ease and efficient effective implements and tools will ease out the drudgery and enhance the working efficiency of farm women and this will leave much time for other work and income generating enterprises.
- Greater awareness will bring in reduction in malnutrition in rural areas through fortification of conventional foods with nutrient rich produce such as soybean.
- Suitable gender-specific technologies will empower the farm women.
- Availability of safe and pure drinking water will reduce the incidence of diseases which leads to malnutrition, save money and increase the working efficiency.
- Reduce losses of produce by improved storage structures and technologies will raise income of the farm women.
- Lastly, it is expected that empowerment of rural women will also facilitate in achieving the Vision 2025 of the country in terms of better livelihood support, poverty reduction, building food and nutritional security for the family and a gender balanced healthy and prosperous society.

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Human Resource Development for Sustainable Agriculture and Rural Development under Present Climate Change

B.K. Narayana Swamy

Professor of Extension and Head, Department of Distance Education, UAS, GKVK, Bangalore-560065

narayana.bks@gmail.com, narayana.bks@rediffmail.com

Climate change is a natural process and the Earth was subjected to many changes since its formation. Just as the weather changes from day to day, the climate changes over decades, centuries and millennia. But recently, the changes have become more apparent. Historical evidences suggest that the world has warmed more rapidly in the past 100 years than ever before. Climate change is one of the biggest challenges facing the world today. The problem of human induced climate change first came into force and drew the attention of the scientists and policy makers when Inter governmental Panel on Climate Change was established. The effects of global climate change are many folds and there is need to create awareness about its impact on various sectors of economy. There is an urgent need to take all necessary steps by both developed and developing countries to reduce greenhouse gases that are being let out into atmosphere. However, sustainable agriculture and rural development and climate are mutually dependent. There is a need to understand the effect of climate change on sustainable agricultural and rural development sector both at Global and as well as at regional level especially from the point of view of providing food to vulnerable section of the population. Changing climatic conditions can have the big effect on our life and our environment. The change in weather conditions can be best observed through the extreme rise in temperature, melting of glaciers and sudden rise in sea level. These changes are causing serious problems to humans and other forms of life. Sustainable agriculture and rural development in India and entire world is mostly dependent on the persisting weather conditions. The alteration in Global warming has dramatically affected sustainable agriculture and its productivity. The increase in temperature has significantly led to a change in the sustainable agricultural zones and shift in the growing seasons. On the other hand the change in the rainfall pattern is the serious threat to the sustainable agriculture and rural development, which in turn affects the country's economy and food security. The several studies conducted in different parts of the country indicated that the overall loss in the crop production in the country in the last few years due to the anticipated rise in the temperature. It is expected that in the near future India is going to face the challenges that includes unwanted pressure from the growing population, and changing scenario of world trade in sustainable agriculture. The poor are likely to be hit hardest by climate change, and that capacity to respond to climate change is lowest in developing countries and among the poorest people in those countries. It seems clear that vulnerability to climate change is closely related to poverty, as the poor are least able to respond to climatic stimuli. Furthermore, certain regions of the world are more severely affected by the effects of climate change than others. Generally speaking, vulnerability and adaptation to climate change are urgent issues among many developing countries. For this reason, there exist provisions in the United Nations Framework Convention on Climate Change (UNFCCC) to assist those countries that are thought to be most vulnerable and least able to adapt. Within the context of the Climate Change Knowledge Network (CCKN), a project on the impacts of economic changes and climate change on India's sustainable agricultural and rural development sector is being pursued jointly by the International Institute for Sustainable Development (IISD), the Centre for International Climate and Environmental Research (CICERO) and the Tata Energy Research Institute (TERI).

Interventions to overcome climate impact on sustainable Agriculture: The predominant interventions to overcome climate related impacts in rainfed areas include (1) Soil and water conservation practices (2) Agronomic

interventions (3) Nutrient management practices (4) Livestock based interventions (5) Development of alternate land use plans These interventions have a role to play in all agro-eco systems except that their order of priority changes, which basically depends on rainfall, status of natural resources like soil, water etc. Crop based interventions need to be planned based on amount and distribution of rainfall, availability and further augmentation of water resources with watershed programme. Various soil and water conservation measures for rainfed agriculture include (1) In-situ measures for rainwater management in rainfall areas. (2) Off season land treatment: (3) Conservation furrows (4) Ridges and furrows system in cotton (5) Cover cropping (6) Micro catchments for tree systems Medium term measures rain water management (7) Stone and vegetative field bunds for soil and water conservation (8) Graded line bund helps in efficient drainage. (9) Trench cum bund for soil and water conservation Long term measures for rain water management like (1) Water harvesting (2) Contour trenching for runoff collection (3) On-farm reservoirs (4) Ground water recharges structure (percolation tanks). (5) Recharge through defunct wells. These rainwater management strategies have good scope for adoption. The increasing probability of floods and droughts and other uncertainties in climate may seriously increase the vulnerability of resource-poor farmers to global climate change. In view of these climatic changes and the uncertainties in future sustainable agricultural technologies and trade scenarios, it will be very useful to have an early warning system of environmental changes and their spatial and temporal magnitude. Such a system could help in determining programmes to the potential food insecure areas and communities. Modern tools of information technology could greatly facilitate this through HRD.

Human Resource to use modern tools for rural development : The development of human resource is becoming a matter of prime concern for increasing sustainable agricultural production. It is the professional who create circumstances that can help in making things happen. Human Resource Development (HRD) is the process of enabling people to make things happen. India is liberalizing and globalizing the economy in changing climate. This has created unprecedented upsurge in the demand for accurate information. The several research and evaluation studies conducted in India revealed that utilization of human resource is far from satisfactory in different parts of the country. Five Scientific Revolutions have emerged under changing global climate in the world during this millennium like (1) Genetic Engineering and ability to use this understanding to develop new process and products. (2) Eco-technology and blending of best traditional knowledge with frontier technologies (3) Information technology and its rapid growth in the systematic assimilation and timely dissemination to the concerned. (4) Motivation techniques for efficient utilization of available technologies by ultimate users. (5) Appropriate policies to technology development, technology dissemination and technology utilization. Hence, HRD is essential for adoption of emerging scientific revolutions in changing climate. The professional competencies include knowledge, skill, attitude and values. The professional competency is required for application of modern sustainable Agricultural Production system under current agrarian issues. The competencies could enable professional to act and improve for more alternatives and increase choices. Of all the factors of sustainable agricultural production man has the highest priority and is the most significant factor of production and plays a pivotal role in areas of productivity and quality. Further, lack of attention to the nonliving factors may result in reduction of profitability to some extent but ignoring the human resource can prove to be disastrous. Hence, there is need for HRD to increase sustainable agricultural production under changing global climate.



Enhancement of Adaptive Capacity to Climate Change in Vulnerable Regions of Sundarban (WB)

A.K. Singh¹, N.J. Maitra², P. Chatterjee³, P.P. Pal⁴ and S.K. Roy⁵

1, 4 & 5. Zonal Project Directorate, Zone-II, Kolkata, 2 & 3 KVK South 24 Parganas, West Bengal

The world heritage delta, Sundarbans falls under the Complex-Diverse- Risk Prone (CDR) Agro-ecosystem consists of 102 islands of which 54 are inhabited and rest is protected forest, not open to public tapping. Although, agriculture is the mainstay of occupation for majority of the people, about 68% of the total cultivable land is low lying, mostly mono-cropped and low yielding because of excessive rainfall resulting in water logging due to impeded drainage system in monsoon. Again, scarcity of irrigation water accentuated by high salinity in soil during summer, inundation of brackish water in cultivable land and non-availability of area specific technology for effective utilization of natural resources aggravates the problem to raise second crop in Sundarbans.

Launching of the project, *National Initiative on Climate Resilient Agriculture* by ICAR and its implementation in this part of coastal zone of West Bengal provided a much sought after opportunity to work on developing appropriate strategy to cope up with the climatic aberrations as well as to enable the inhabitants of this vulnerable area to develop required expertise for a sustained livelihood. Based on baseline survey, interaction with the villagers, resources availability and occurrence of natural calamity vis-à-vis the aftermath of the calamity, five technologies were identified for its implementation in the village. Besides, soil testing was also carried out followed by programme of capacity building on a regular interval. The details of identified technologies are as follows:

Landshaping and rainwater harvesting: Landshaping by excavation of ponds in low, waterlogged & monocropped land is a viable engineering solution implemented by the KVK for creation of opportunity to harvest rain water for irrigation and fish culture and at the same time raising of the lowlands to make it suitable for multiple cropping. In this technology 1/5th portion of the low land is dug up to create a pond with a depth of 8-9 feet. The excavated earth is utilized for raising the rest of land upto 1.5 feet, 5 feet wide and 3 feet height land embankment and 5 feet wide and 4 feet height pond embankment. Fish fingerlings were supplied from the KVK fishery unit to these beneficiaries for stocking in these new ponds.

Raising (construction) of land embankment (Ail) : During kharif season, stagnation of water in low land situation inhibits vegetable cultivation and at the same time in rabi season due to delayed release of lands from kharif paddy hinders vegetable cultivation timely.

Introduction of cotton: Under the NICRA project, thrust has been given to utilize the rice fallows by introducing cotton crop (var. Surabhi). As the deep root system of cotton plant ensures little or no irrigation and is tolerant to salinity, it has been introduced in the rainfed situation of South 24 Parganas.

Ornamental fish farming : In fish culture ponds, net enclosures fixed at one side of the pond may be utilized for growing ornamental fish. The natural fish food organism present in the pond gets access into the nets through small mesh which automatically provides food for the ornamental fish.

Dual purpose poultry birds : 26 women from marginal farm families were selected to provide 20 (1:10) poultry birds (breed Nirbheek) for rearing at household level.

The technologies identified for its implementation in the project area indicated a promising trend in countering the climatic aberrations of coastal zone of West Bengal. Within a short span of time, all the technologies could be introduced among the villagers as per their resource availability, expertise gained and earlier experience to

produce encouraging results in land management as well as secondary agriculture for the benefit of the entire village. Technology wise performance is given below:

Landshaping & rainwater harvesting: In prevalent practice, only traditional (local) variety of paddy is grown in the low-lying land during *kharif* season. Second crop is not possible during *rabi-summer* season due to late release of land as well as for scarcity of irrigation water. A farmer could earn a meager sum of Rs. 4662.00 from a 0.266 ha of land. After intervention of land shaping, traditional variety of paddy is replaced by HYV paddy during *kharif* season. In *rabi-summer* season with the help of rain water so harvested in the dugout pond, raised land is used for vegetable and oil seed cultivation.

Raising (construction) of land embankment (ail) : In traditional practice, 9880 sqm of lowland is utilized for deep-water paddy cultivation yielding about 20 qt paddy during *kharif* season keeping the land fallow in *rabi*. Besides, 120 sqm area is utilized for construction of traditional *Ail* (embankment) for ownership demarcation which remains fallow for both the seasons. Average income amounting to Rs. 18,000.00 per 10000 sqm i.e. one hectare is generally obtained only from the deep-water traditional paddy throughout the year in this system of cultivation.

In this innovative *Ail* cultivation system, the total cultivable lowland area utilized for deep-water *kharif* paddy is reduced from 9880 sqm to 8680 sqm resulting to almost 2.5 qt reductions in paddy production equivalent to Rs. 2250.00. The 1200 sqm area (9880 sqm – 8680 sqm) is utilized for construction of *ail* in an area of 600 sqm and rest 600 sqm for peripheral canal.

This reduction in lowland area yields 600 sqm of *Ail* and that *Ail* enclosing the low land gives paddy-cum fish culture opportunity, thus vegetable and fish cultivation are respectively made possible. A net profit of Rs. 32,550.00 to 34,550.00 is obtained from vegetable cultivation on the 600 sqm. *Ail* land and Rs. 9,000.00 is received from the fish cultivation. So, it is observed that by sacrificing 1200 sqm (9880 sqm – 8680 sqm) lowland paddy cultivation area for constructing *Ail*, an additional net profit of Rs.41, 550.00 to Rs. 43,550.00 is achieved per year showing the profit maximization potential of the technology.

Introduction of cotton : For this intervention, 5 ha land in the project village was selected which normally remained fallow due to scarcity of irrigation water and soil salinity. An average productivity of 9.5 q/ha was achieved besides a slight drop in soil salinity following cotton cultivation. The cotton stalks also provide a source of fuel for household purpose.

Ornamental fish farming : Domestic fish culture pond are traditionally used by the local farmers for growing carps like Katla, Rohu, Mrigel, Silver carp etc. for table purpose. The surplus production is normally harvested completely in the dry months of March – May and sold in the market. The culture practice involves natural feeding by the fish on the natural fish food organism or planktons generated through monthly organic manuring. Occasional application of low cost supplementary feed is used. From a 0.13 ha of pond average profit of Rs. 25000.00 is obtained from one year of culture.

The improved practice involves the mixed culture of craps and ornamental fish. The quality parameters and feed are same for both types of fish; hence the normal management practice for fish culture followed in the pond is also applied in the improved practice. It has been observed that from a 0.13 ha pond, having six net enclosures, ornamental fish culture gives an additional profit of Rs. 5500.00 from a quarter (three month of culture).

Dual purpose poultry birds: This study documented that RIR had an average egg production of 235 number weighing average 45 gms/egg, whereas Nirbheek had 225 number and weight was 40 gms/egg. Both the bird showed similar production but only difference was that RIR had a disease incidence of 21.5% where as in this case of Nirbheek it was 13.5%. The mortality percentage was found 7.6% and 5.2% during summer and winter respectively in case of RIR whereas it was 3.1% and 2.3% in case of Nirbheek. Thus considering overall performance the study suggested to promote Nirbheek as backyard poultry farming for this agro-climatic situation as a component of climate resilient agriculture.

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