Emerging Models of Technology Application for Agri-Rural Development

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The Indian economy has its mainstay on agriculture and allied activities. Food is basic to life and wellbeing and has always been taken on the highest of all our priorities. Agriculture in India has traveled a long distance – Green revolution, White revolution, Yellow revolution, Blue revolution, Rainbow revolution to thrust on Ever Green Revolution – the stability and sustainability that we have to attain. Science and technology play a vital role in the development strategy of various section of the society. Technological empowerment and sustainable livelihood at the grass root level is very much essential at this juncture of our development. The intervention of the developments in Science and technology into the field of agriculture, industry, education and health is very much crucial particularly in rural situation. In the perspective of modern scientific intervention in the present social scenario, this 6th National Extension Education Congress on Emerging models of technology application for agri-rural development would deliberate on the following five important theme areas.

Climate change: Ground realities-

Climate change and agriculture are interrelated, both of which influence each other on a global scale. Global warming due to changes temperature, precipitation and carbon dioxide is projected to have significant impacts on conditions affecting agriculture, glacial run-off, water resources and the interaction of these elements. These conditions determine the carrying capacity of the biosphere to produce enough food for the human population and domesticated animals. The overall effect of climate change on agriculture will depend on the balance of these effects.

The vulnerability of agriculture to climate change is well acknowledged. But what is not fully appreciated is the impact this will have on Indian agriculture, more so in rain-fed (non-irrigated), practiced mostly by small and marginal farmers who will suffer the most. The crops that may be hit include, cereals, pulses and oilseeds, among others pulses, oilseeds are already in short supply and are consequently high-priced.

Nearly 80 million hectares, out of the country’s net sown area of around 143 million hectares, lack irrigation facilities and, hence, rely wholly on rain water for crop growth. Over 85 per cent of the pulses and coarse cereals, more the 75 per cent of the oilseeds and nearly 65 per cent of cotton are produced from such lands. The crop yields are quite low. Most of the rain-fed lands, moreover, are in arid and semi-arid zones where annual rainfall is meager and prolonged dry spells are quite usual even during the monsoon season. This makes crop cultivation highly risk-prone. If the quantum of rainfall in these areas drops further or its pattern undergoes any distinct, albeit unforeseeable, change in the coming years, which seems quite likely in view of climate change, crop productivity may dwindle further, adding to the woes of rain-fed farmers.

It is well known that the changes in the crop yield depend not only by the changes in rainfall but also by the changes in temperature and carbon dioxide concentration. While positive changes in these two parameters can lead to increase in crop yield, the impact of temperature increase may be negative for the tropics. Doubling of carbon dioxide concentration by 2030 will increase global average temperature by 1-3 degree centigrade an indicating a decrease in cereal production. A shift in wheat production belt can be predicted, indicating that increased temperature from global warming is likely to reduce the profit from wheat cultivation and farmers of lower latitudes to opt for maize and sorghum, better adapted to higher temperatures. In Rajasthan pearl millet output will fall by 10 to 15 per cent due to increase in temperature by 2 degree
centigrade. Acute water shortage conditions combined
with thermal stress would adversely affect wheat and
more severely rice productivity in northwest India even
under positive effects of elevated carbon dioxide level
in future. North India has already shown an increase in
minimum temperature by about one degree centigrade in
rabi season.

According to A K Singh, Deputy Director General
(Natural Resource Management) of the Indian Council
of Agricultural Research (ICAR), medium-term climate
change predications have projected the likely reduction
in crop yields due to climate change at between 4.5 and
9 per cent by 2039. The long run predictions paint a
scary picture with the crop yields anticipated to fall by
25 per cent or more by 2099. This will have a detrimental
effect on farmer’s income and purchasing power, with
obvious down-the-line repercussions.

Though the rainfall records available with the India
Meteorological Department (IMD) do not indicate any
perceptible trend of change in overall annual monsoon
rainfall of the country, noticeable changes have been
observed within certain distinct regions.

Climate change is also reflected in the increasingly
fluctuating weather cycle with unpredictable cold waves,
heat waves, floods and exceptionally heavy single-day
downpours.

The most noticeable of such events in recent years
included the country-wide drought in 2002, the heat wave
in Andhra Pradesh in May 2003, extremely cold winters
in 2002 and 2003, and prolonged dry spell in July 2004
and January 2005 in the north, unusual floods in the
Rajasthan desert in 2005, drought in the north-east in
2006, abnormal temperature in January and February
in 2007, and 23 per cent rainfall deficiency in the 2009
monsoon season. All these events took a heavy toll on
crop output.

Indeed, the silver-lining in this dismal scenario in
the National Action Plan on Climate Change, launched
in 2008, which aims at developing technologies to help
rain-fed agriculture adapt to the changing climate
patterns. At least four of the eight ‘national missions’
started under this programme will have direct or indirect
bearing on rain-fed farming. These are the missions on
sustainable agriculture, water, green India and strategic
knowledge. The ICAR-led national agricultural research
system is also conducting research on specific projects
under the umbrella programme on climate change.

Apart from the use of technological advances to
combat climate change, there has to be sound policy
framework and strong political will to achieve this
objective. State agricultural universities and regional
farm research centres too, will have to play a role in
developing local situation-specific strategies for adapting
the rain-fed centres too, will have to play a role in
the rain-fed farming to emerging climate patterns.
2. Emerging extension models: Experiences

Extension has to shift from merely communicating
techniques of know-how to do- how and from
technology transfer to technology application mode. The
earlier notion of farmer being at the receiving end has
to be substituted by farmer first not the last and
therefore, farmer participatory extension is to be
promoted and the transfer of technology (TOT) has to
be farmer-specific and demand-driven.

The technology in order to reach the clientele-
farming community from research system needs a well
organized and efficient extension mechanism/system of
technology transfer from the source of generation to
the farming community. This indispensible role of TOT
was though realized by the policy makers and the state/
the federal/central government right from the beginning,
but all said and done, in Extension, so far, the major
emphasis has been on cereal crops which resulted into
green revolution in India. Now, to have not only food
security, but also nutritional security and to make farming
a commercial business enterprise rather than farming,
we have to emphasis on diversified farming and
demand-driven and market-driven extension.

Though, it has always been said that no one method
of Extension Education can be fully effective and hence
a combination for wider impacts in less span of time yet
in actual practice, extension personnel ignore this
approach and they don’t use combination of methods.
It is being observed that basic principles and methods
of extension education are not followed by the Extension
machinery. To illustrate, the principles of planning from
below i.e. bottom-up planning, grassroot organizations
i.e. farmer participatory approach, whole family
inclusion, learning by doing etc. are often neglected and
ignored. In restructured extension systems these
principles should be rigorously followed for creating
motivation, desire for behavioral change in desirable
direction.

It is beyond the capacity of any extension system
to come out with a unified model to resolve all problems
of such a complex and diversified agricultural system
prevalent in the country. It is recognized that approaches
like farmers participation, institutional linkages, system
management approach, policy reforms, capacity building,
empowerment of farmers and farm women, use of
media and information technology and a host of other
suggestive approaches may go a long way in making extension system more vibrant. We can perceive market oriented extension system as a sub-set of overall economic development strategy as: Economic development strategy, Agricultural development strategy, Extension system and Market oriented approach.

The desired goals of Indian agriculture should include self-reliance, food security, nutritional security, conservation of biodiversity, environmental safety, risk minimization, sustainability, export orientation, growth and stability etc. The available resources at our disposal to achieve these goals include human, land, water, energy, agricultural research system, agricultural extension system, agricultural infrastructure, input delivery system, output marketing etc.

The broad agricultural activities may consist of crop production (all commodities), livestock production, agro-processing and agricultural services.

The following steps are suggested for market oriented agricultural extension strategy:

- Identify all agricultural activities which are compatible to natural and man made resources of the area.
- Short list agricultural activities which are compatible to natural and man made resources and satisfy as many as possible stipulated goals.
- Promote such short listed activities with technological and other extension support.

The agricultural development strategy in the present context must ensure adequate interface of the resource base including market infrastructure with the agricultural activities while striving to achieve set desired goals. Such an approach may ensure sustainable development of agriculture wherever market orientation is a feasible option.

What is needed is a holistic combination of verbal, written and visual methods in proper proportion to suit the targeted client groups and their suitability for them based on researches/empirical studies on effectiveness of those methods. This will be of great help in ushering into demand-driven Extension/TOT.

3. ICT enabled models of technology dissemination

The need for improved agricultural extension throughout the developing world has never been greater. Agricultural and rural development and hence rural extension continue to be in a phase of transition in this part of the world. The vulnerability of farming in the developing world to climate change, to changes in natural resources quality and lack of coping and adaptation strategies at micro and macro levels of decision making are all well documented, while globalization of commodity trade offers a mix of opportunities as well as challenges. The role of extension and support systems in this background is undergoing profound changes while no unified alternative framework has emerged.

Information and Communication Technology (ICT) is an umbrella term that includes computer hardware and software, digital broadcast and telecommunications technologies as well as digital information repositories online or offline, and includes contemporary social networking aspects, read/write interfaces on the web besides file sharing systems online. It represents a broad and continually evolving range of elements that further includes the television (TV), radio, mobile phones and the policies and laws that govern the widespread use of these media and devices. The term is often used here in its plural sense (ICTs) to mean a range of technologies instead of a single technology.

From the perspective of agricultural knowledge and information systems (AKIs), ICTs can be seen as useful in improving linkages between the research and the extension sub systems. The experience of rural telecenters in the developing world shows that ICTs can help in enabling rural development workers to gather, store, retrieve, adapt, localize and disseminate a broad range of information needed by rural families. The ICTs in extension can lead to the emergence of knowledge workers that will result in the realization of a bottom-up, demand-driven paradigm for technology generation, assessment, refinement and transfer.

Extension agent to farmer ratio in India is estimated at 1:2,000. Public agricultural extension services were criticized for being technically weak, providing insufficient coverage of and contacts with farmers. Less than one-third of the technologies generated by Agricultural Universities and ICAR institutes in India were transferred to the farmer’s field due to the lack of an appropriate extension model. Direct contact by agricultural experts with all the needed farmer clients cannot be established practically with the available technical manpower and budget in India. Hence the research challenge is to identify an effective means to provide quality and timely technical advice to all the needed farmers using the available experts and their time efficiently. Developments in ICTs offer ample opportunities to accomplish this challenge. Given the complex nature of agriculture and the challenges being faced, the use of multidisciplinary expertise is more
appropriate to address agricultural information needs to empower farming community. Rationale is that technology transfer efforts in agriculture sector must harness the huge potentials of ICT to provide better linkage between agriculture experts and farmers for timely and appropriate technical advice to enhance agricultural productivity and improve living standards of farmers in the region. The linkages between agriculture and climate are pronounced and often complex. Crops and livestock are sensitive to change in both positive and negative ways. Agricultural systems are most sensitive to extreme climatic events such as droughts, floods and hailstorms, and to seasonal variability and changing rainfall patterns. Against this backdrop, farmer adaptations are influenced by many factors, including agricultural policy, prices, technology research and development, and agricultural extension services. The poor often bear a disproportionate burden of direct damage from catastrophes and climate change as concluded by most studies in developing countries.

The role of inadequate institutional support is frequently cited in the literature as a hindrance to adaptation. For example, Adger and Kelly (1999) and Huq et al. (1999) show how institutional constraints and deficiencies affected managerial capacities to cope with anticipated natural events.

Extension pluralism is at the core of farmer adaptation strategies and ICTs can offer new advantages in enabling reliable and rapid access to expert information support which is much needed in the realization of adaptation strategies on a large scale.

Leaders in extension research have pointed out the importance of learning from the deployment of contemporary ICTs in extension. A number of pilot projects in applying ICT in rural development are in progress in many parts of the world. Only a small number of these have a bearing on agricultural information sharing and extension.

4. Gender perspectives in Agri-rural development

As Swami Vivekananda said “Just as a bird could not fly with only one wing, a nation would not march forward if women are left behind”.

Rural women in developing countries are responsible for production of more than 55% of the food grains and comprise 67% of agricultural labour force and 68% of the developing countries population. According to 2001 Census of India, there are 495 million women (48.27% of the total population) in India. Out of the total workers population, female workers comprise 22.5% of which 68.89% are marginal workers. About one third population of women (out of total population of women) are actively engaged in agricultural activities and play important role in agricultural production. It is a well known fact that women’s work remains largely invisible and under recorded. The real issue, therefore, is more serious i.e. despite their involvement in agricultural work in such a huge magnitude, they have not been actively involved in mainstream of agricultural development and there is hardly any appreciation and recognition of their extensive contribution. By and large, they have remained as “invisible workers”.

Despite their role as a backbone of food production and provision for family consumption in developing countries, women remain limited in their access to critical resources and services due to cultural, traditional and sociological factors. They need to be given access to credit, land, agricultural inputs, education, training & extension services, decision making and research and appropriate technologies.

Recognizing women’s role as farmers and producers of crops and livestock, as users of technology, as active agents in marketing, processing and storage of food and as agricultural labourers, the National Agricultural Policy (NAP) has highlighted incorporation of gender issues in agricultural development agenda.

The major reforms in Agricultural extension at the state level have also been proposed during the 10th Five year plan with ‘Mainstreaming Gender Concerns in Agriculture’ as one of the suggested reforms. Under the proposed reforms, being executed in 252 districts of the country, the States are being encouraged to prepare State Extension Work Plans (SEWP) encompassing all extension activities they propose to undertake. These Work Plans essentially include number of activities directly benefiting women farmers to an extent of 30% of total programmatic resources and benefits. The efforts are further being made to introduce the concept of ‘Gender Budgeting’ in Agriculture Sector for which a ‘Gender Budgeting Cell’ has been set up in the DAC. The core activity of the Cell will be able to add gender dimension to public programmes and policies and bring out a separate chapter on ‘Gender Perspective’ in Performance Budget and Annual Report of the Department.

Though women are involved in almost all agricultural operations, yet they have inadequate technical competency due to their limited exposure to outside world. This has compelled them to follow age old practices with low efficiency. The strategic
interventions for empowering farm women can include:
• Creating awareness, knowledge and confidence in farm women
• Rapport building with farm women by econotechnocrats
• Programme to eradicate gender biasness among rural societies
• Access to appropriate technology and financial resources
• Ownership to productive assets
• Reducing farm drudgery through income generating projects
• Generating women’s self help groups and cooperatives for their own networking and empowerment through group formation
• Enhancing organizational and social leadership skill of farm women in community action
• Building their capacity through collectivization and socio-political participation
• Providing courses through open and distance education mode.

5. Agricultural policies and support system

Many observers of rural development in recent times have commented on the frequent manifestations of unsatisfactory extension performance. Feder et al (2001) have suggested interrelated characteristics of extension systems in the developing world that jointly result in deficient performance, namely low staff morale, reduced efficiency and financial stress etc. One more such key factor is the number of clients and the vast spectrum of information/services needed to be covered by extension systems. Policy makers in the developing world have reacted to this with the deployment of more extension personnel which has continued the emphasis on a more centralized, hierarchical and top-down management systems. The requirement for combining a bottom up approach with the conventional extension process is yet to be fulfilled and the limitations on the extension process to influence issues such as credit availability, input supplies, market linkages and logistics facilitation continue without change. In effect, there has been no visible impact due to such changes within the extension system in many parts of the developing world. The NARS – the world over have concentrated on agro-climatic conditions and agricultural characterization for their R&D scheme of things. They have come to realize late that, many scientists are still in the process that, together with agro-climatic conditions, the socio-economic circumstances of the farming communities are equally important for need-based and appropriate technologies. The poor and slow spread and poor adoption and diffusion of technologies are partially because of this mismatch. The rainfed agriculture has made it more obvious, and in fact arduous.

If agricultural research has to become more and more oriented to meet the continuing growth of food needs in developing countries, it should consider strong role of social sciences in priority setting, technology assessment, recognizing role of users in dissemination and adoption, monitoring and evaluation, partnering and policy formulation. More importantly, agricultural research should not only be limited to expanding food production per capita, but should also be able to enhance ability of individual to secure and be guaranteed food security.

Most research institutions are commodity oriented rather than a systems or livelihood oriented and reductionist, not holistic. Issues linked with human resource development and lack of well designed and well maintained research facilities do also contribute to under-performance of national agricultural research systems in developing countries. To meet the socio-economic and agricultural challenges of the 21st century, the government of developing countries have to concentrate and address on the following issues:

a) Need to recognize that technological advances alone are not enough to fight hunger
b) Need for comprehensive systems
c) Need for more local people’s perspective – Farmer led research and extension
d) Need for more consideration of gender issues
e) Need to address agriculture – health relationship (Nutritional Security)
f) Need for policy, institutional and organization reform and
g) Need for innovative funding sources and public private partnership.

A range of extension initiatives from the public and private sectors that explain the way extension agenda is expanding as embodied in the concept of “extension plus” have pleaded for new experiments in extension. Pluralistic institutional arrangements are emerging and are finding wider acceptance and this is mainly because developing countries have realized the need for extension to engage in a wider range of issues beyond merely disseminating production-oriented technologies.