Bangladesh Journal of Extension Education *ISSN 1011-3916*
Volume 24, No. 1&2, 2012:13-24 *Research Article*

Issues on Indian Extension System to Combat Consequences of Climate Change

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Abstract

Agriculture is extremely vulnerable to climate change. Indian agriculture faces the dual challenge of feeding a billion people in a changing climatic and economic scenario. Even it is the main source of livelihood for almost 60% of the country's total population. The impacts of climate change on agriculture will be severely felt in India as noted by different scientists. It has been projected that under the scenario of a 2.5°C to 4.9°C temperature rise, rice yields will drop by 32%-40% and wheat yields by 41%-52%. This would cause GDP to fall by 1.8%-3.4%. India has to be concerned about the impacts of climate change due several factors. Its large population depends on climate-sensitive sectors like agriculture and forestry for livelihoods. Agriculture is facing ecological and economical challenges. The major effects can be generalized as changes in the geographical limits to agriculture, changes in crop yields and impacts on agricultural system. A range of adaptation strategies make the opportunity to improve the agriculture management in the context of climate change for sustainable development towards the climate resilient pathways. India has made significant achievement in agriculture by increasing food production by four folds during last six decades. Among many drivers to accomplish this task, the policy, research and extension support have played crucial role. Public extension played a major role in ushering green revolution in Indian agriculture. However, considering the varied agro-ecological situations under which farmers operate besides variations in the resource base of farmers, the extension system envisaged to achieve desired growth in agricultural sector has to be pluralistic in nature and hence multiplicity of extension systems are operating in India. Indian Council of Agricultural Research (ICAR) is an apex body at the national level that supports research and extension activities to evolve effective Transfer of Technology (TOT) models mainly through KVKs. The State Agricultural Universities also contemplates to develop extension models suitable to take up transfer of technology besides implementing the models evolved by ICAR system. In country like India where Agro-climatic zones widely differ besides significant variation in socio-economic status of farmers', uniform extension service is not the panacea for all the regions. It was realized that public extension system will have to be placed in new decentralized institutional arrangements which are demand driven, farmer-accountable, bottom-up and have farming system approach.

Key words: *vulnerable, adaptation, strategies, resilient pathways, pluralistic, decentralized institutional*

Indian Agriculture: Scenario, Impacts and Vulnerability Assessment Scenario

The food grain production in India has increased spectacularly due to the Green Revolution from 50 Mt in 1951 to 212 Mt in 2002 and the mean cereal productivity has increased from 500 kg per ha to almost 1800 kg per ha. The share of agricultural products in exports is also substantial with 15% of export earnings. Agricultural

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growth also has a direct impact on poverty eradication and is an important factor in employment generation. The wheat accounts for one-third of the total food grain production, while rice forms 43% of the total and is cultivated in 43 mha (million hectares), which is about 30% of the net cultivated area.

Pre Green revolution: India's Green Revolution was initiated by the 1966 commercial introduction of high yield variety (HYV) wheat and rice in India. HYV maize, bajra (pearl millet), and jowar (sorghum) were also introduced, although less prevalent. Take-up of the new crops was extremely rapid. By 1968, almost all districts in India reported some use of HYV seeds, although there remained significant heterogeneity in amount. This had a transformative effect on Indian agriculture, ending India's heavy reliance on imported grain, while population and per-capita GDP both increased dramatically. Today India is one of the largest wheat producers in the world; with yields per hectare roughly comparable to the US. It is tempting to view the Green Revolution as an ideal treatment effect for economic analysis of the impacts of new technology. Indeed there is much variation in HYV take-up across India. A common assumption used for identification, as noted by Foster and Rosenzweig (1996), is that, prior to the introduction of the new seeds, the level of technology is assumed to be the same in all areas (districts), as is implicitly assumed in empirical studies of production or profit functions based on cross-sectional data." However, this paper stresses caution in using the take-up of new technology as an exogenous treatment which is uncorrelated with past technology. At least in the case of take-up of new HYV technology in India, this assumption can be shown to be incorrect.

Green Revolution: The introduction of high-yielding varieties of seeds and the increased use of fertilizers and irrigation are known collectively as the Green Revolution, which provided the increase in production needed to make India self-sufficient in food grains, thus improving agriculture in India. Due to the rise in use of chemical pesticides and fertilizers there were many negative effects on the soil and the land such as land degradation.

Needs of Green Revolution

a) **Low Irrigation Facility:** The well irrigated and permanent irrigated area was only 17% in 1951. The major part of area was dependent on rainfall and, consequently, agriculture suffered from low level of production.
b) **Conventional and Traditional Approach:** The use of conventional inputs and absence of modern techniques further hampered the agricultural productivity.
c) **Frequent Occurrence of Famines:** Famines in India were very frequent during the period 1940s to 1970s. Further, due to higher growth rate of populations, agriculture failed to grow at the same speed.
d) **Lack of Finance (credit):** Small and marginal farmers found it very difficult to get finance and credit at cheap rate from the government and banks, hence, fell an easy prey to the money lenders.
e) **Self-sufficiency:** Due to the traditional agricultural practices, low productivity, and to feed growing population, often food grains were imported that drained away scarce foreign reserves. It was thought that with the increased production due to Green Revolution, Government can maintain buffer stock and India can achieve self-sufficiency and self-reliability.

f) **Marketising Agriculture:** Agriculture was basically for subsistence and, therefore, less amount of agricultural product was offered for sale in the market. Hence, the need was felt to encourage the farmers to increase their production and offer a greater portion of their products for sale in the market. The new methods in agriculture increased the yield of rice and wheat and this made the country attain food self sufficiency.

The Changing Nature of Indian Agriculture

Shrinking resource base: The land and water resource base for an average farm holding has declined considerably during the last five decades (Selvarajan S and Joshi P.K (2000) Socio-economic Policies in Natural Resource Management, Souvenir, International Conference on Managing Natural Resource for Sustainable Agricultural Production in the 21st Century, New Delhi). The main reason for the increasing resource degradation is the inappropriate and unscientific use of land and irrigation water. Degraded lands are either going out of cultivation or are being used for growing low value crops. Forming and sustaining farmers' groups will be crucial in achieving future agricultural growth.

Changes in demand and consumption pattern: Per capita cereal consumption for food declined somewhat over the past three decades, while the consumption of fruits, vegetables, meat, fish, eggs and dairy products increased [Kumar, P (1998) Food Demand and Supply Projections for India, Agricultural Economics, Policy Paper 1998-2001, Indian Agricultural Research Institute, New Delhi]. The demand for livestock products has been increasing rapidly during the last two decades.

Changing farming systems: The area under food grains as percentage of GCA has been declining in the Nineties, whereas the percentage share of non-food grains has been generally increasing during the same period. Area under horticultural crops (fruits, vegetables and tuber, spices and plantation crops) increased from 12.3 mha in 1991-92 to 15.0 mha in 1996-97. Farmers require a different type of support (training, problem-solving consultancy, marketing advice etc) for growing many of these crops, than simply information on technology, as was the case earlier.

Declining public investments in agriculture: Public investments in agriculture, (investments in irrigation, rural roads, rural electrification, storage, marketing, agricultural research and education, land development, co-operation etc) in real terms since mid-seventies have been declining consistently in all the states (Ramesh Chand (1999), Emerging trends and Regional Variations in Agricultural Investments and their implc0ations for Growth and Equity. Draft Project Report, NCAP. New Delhi). Farmers have to join together to put pressure on governments to invest more and have to pool together their resources to develop and maintain the necessary infrastructure. Extension may have to support farmers in this endeavour.

Extension System in India

India has made significant achievement in agriculture by increasing food production by four folds during last six decades. Among many drivers to accomplish this task, the policy, research and extension support have played crucial role. Public extension played a major role in ushering green revolution in Indian agriculture.

However, considering the varied agro-ecological situations under which farmers operate besides variations in the resource base of farmers, the extension system envisaged to achieve desired growth. Agriculture development in India is basically a state subject. But, the crucial role the agricultural sector play from the perspective of ensuring food security of its large population, the Union Government play a major role in formulating policies that has direct bearing on the growth of agricultural sector. Besides, states also formulate region specific development programmes. Similarly, Indian Council of Agricultural Research (ICAR) is an apex body at the national level that supports research and extension activities to evolve effective Transfer of Technology (TOT) models. The State Agricultural Universities also contemplates to develop extension models suitable to take up transfer of technology besides implementing the models evolved by ICAR system.

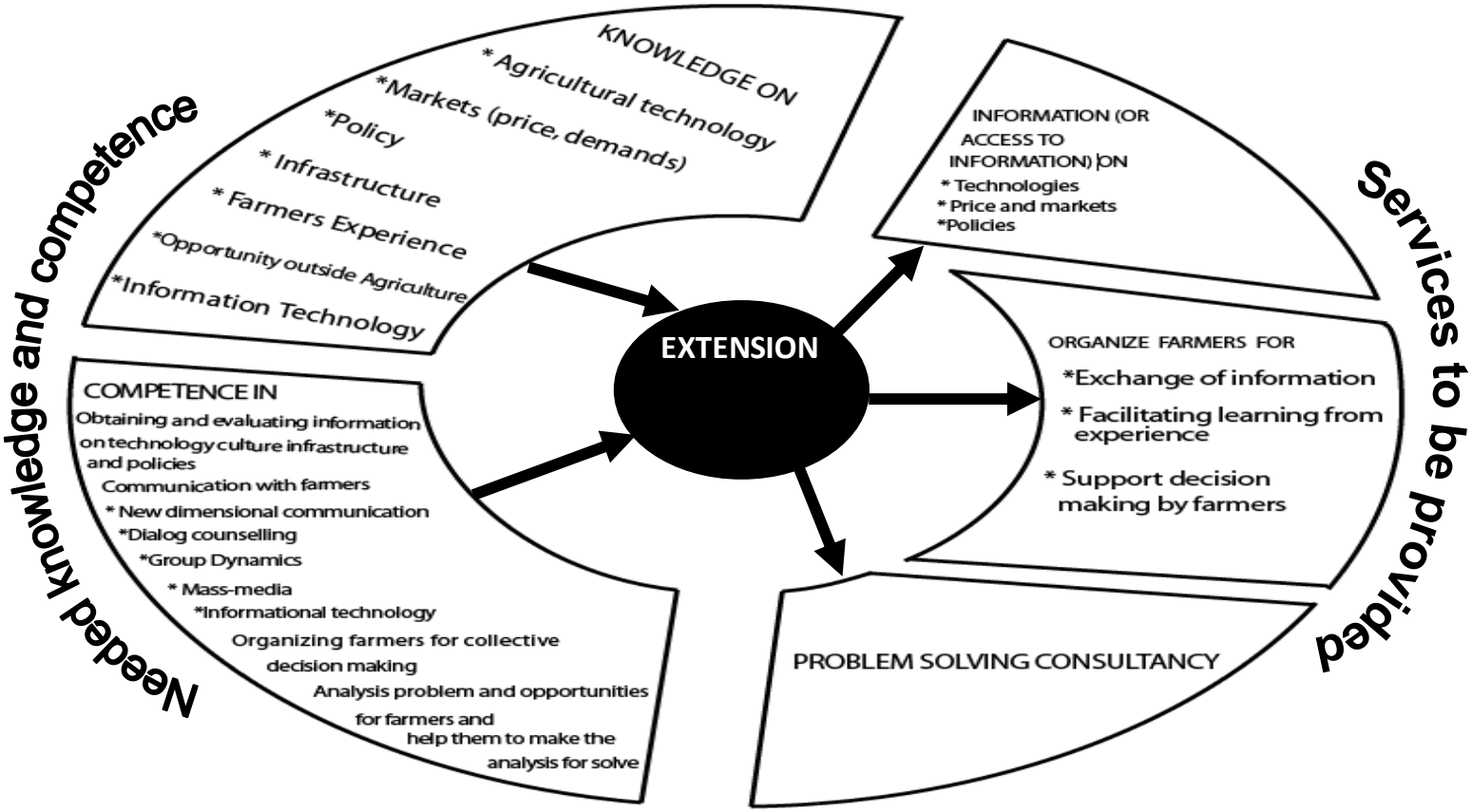
Agricultural Extension in India: The arrangements for agricultural extension in India have grown, over the last five decades, in terms of activities, organizational types and available manpower. Public sector extension, represented mainly by the State Department of Agriculture (DOA), continues to be the most important source of information for the majority of farmers. Activities of other extension agencies, be it Non-Governmental Organizations (NGOs), input agencies, mass media, research institutions or farmers associations, though increasing, are still restricted to certain regions, crops and enterprises. The performance of public sector extension is under scrutiny for quite some time and questions are being raised on its capability to deliver goods in the rapidly changing environment.

The shifting emphasis of Indian agriculture towards diversification, commercialization, sustainability and efficiency has made it necessary for the state extension organizations to critically examine their extension approaches. Department of Agriculture in several states made changes in some of their approaches towards the late 1980's as the Training and Visit System of Extension was coming to an end. But the basic issues regarding the type of support required by the farmers and the changes in extension organization needed to provide these were not addressed.

The changing needs of farmers for support from agricultural extension

Due to changing face of agriculture, farmers have to make a number of complex decisions now. Most relevant of them are as follows:

i. What technological options could be used profitably in his/her situation keeping in view the potential resource constraints in terms of land, capital, labour and knowledge?
ii. How to manage the various technologies? (e.g. how to make optimal use of new inputs in his farm?)
iii. How and when to change his farming system? (e.g. diversifying from crop production to mixed farming or vegetable or animal production)
iv. For which type of products, is there a good demand in the market?
v. What are the quality specifications he should achieve to get good value for his produce and how to achieve
vi. How, when and where to buy inputs and sell products?
vii. How to make decisions collectively on resource use and marketing?
viii. How to find quickly the most relevant and reliable knowledge and information?


Needed knowledge and competence
KNOWLEDGE ON
* Agricultural technology
*Markets (price, demands)
*Policy
* Infrastructure
* Farmers Experience
*Opportunity outside Agriculture
*Information Technology
COMPETENCE IN
Obtaining and evaluating information on technology culture infrastructure and policies
Communication with farmers
* New dimensional communication
*Dialog counselling
*Group Dynamics
* Mass-media
*Informational technology
Organizing farmers for collective decision making
Analysis problem and opportunities for farmers and help them to make the analysis for solve
EXTENSION
INFORMATION (OR ACCESS TO INFORMATION) ON
* Technologies
* Price and markets
*Policies
ORGANIZE FARMERS FOR
*Exchange of information
* Facilitating learning from experience
* Support decision making by farmers
PROBLEM SOLVING CONSULTANCY
Services to be provided

ix. What are the feasible off-farm income generation options avaialable for him and how far he could depend on them?
x. What are going to be the implications for his farming if the input subsidies are phased out and/or if the trade in agriculture is liberalized (Van den Ban (1998)?

Climate Change and Agriculture in India

India is a large country with 15 agro-climatic zones, with diverse seasons, crops and farming systems. For a majority of people in India, to this day, agriculture is the main source of livelihood. Agriculture is the most vulnerable sector to Climate Change as it is inherently sensitive to climate variability and Climate Change will leave its impacts on Indian agriculture in various direct and indirect ways. This obviously means an impact on the lives and livelihoods of millions of Indians. For instance, it is reported that about two-thirds of the sown area in the country is drought-prone and around 40 million hectares is flood-prone. The poorest people are likely to be hardest hit by the impacts of climate variability and change because they rely heavily on climate-sensitive sectors such as rainfed agriculture and fisheries. They also tend to be located geographically in more exposed or marginal areas, such as flood plains or nutrient-poor soils. The poor also are less able to respond due to limited human, institutional and financial capacity and have very limited ability to cope with climate impacts and to adapt to a changing hazard burden.

Impacts of Climate Change on agriculture: The organic carbon levels and moisture in the soil will go down while the incidence of runoff erosion will increase. The quality of the crop will also undergo change with lower levels of nitrogen and protein and an increased level of amylase content. In paddy, zinc and iron content will go down which will impact reproductive health of animals. Insect lifecycles will increase which in turn will raise the incidence of pest attacks and virulence. Other likely impacts are change in farm ecology viz. bird-insect relations, and an increase in the sea levels which will cause salinity ingression and submergence.

It is projected that due to climate change, kharif rainfall is going to increase and this might be positive for kharif crops. Further, for *kharif* crops, a one-degree rise in temperature may not have big implications for productivity. However, temperature rise in *rabi* season will impact production of wheat, a critical food-grain crop.

The impacts of climate change are already visible. A network of 15 centres of ICAR working on studying climate change has reported that apple production is declining in Himachal Pradesh due to inadequate chilling. This is also causing a shift in the growing zone to higher elevations. Similarly, in the case of marine fisheries, it has been observed that Sardines are shifting from the Arabian Sea to the Bay of Bengal, which is not their normal habitat. In fact, fisheries are the most vulnerable sector to climate change. Crops have the ability to adapt to extreme climate variability even up to, say, 4^0C while fishes and animals do not. It has also been recorded that the pest ecology of certain crops is changing due to climate change.

Impacts of agriculture on Climate Change: While climate change affects Indian farming and farmers' livelihoods adversely, the converse is also true – Indian agriculture, even if not in the same degree as the developed world's agriculture, does contribute to Climate Change. Amongst various GHGs that contribute to global

warming, carbon dioxide is released through agriculture by way of burning of fossil fuel; methane is emitted through agricultural practices like inundated paddy fields, for example; nitrous oxide through fertilizers, combustion of fossil fuels etc. Nitrous oxide has a global warming potential 296 times greater than CO2. In India, it is estimated that 28% of the GHG emissions are from agriculture; about 78% of methane and nitrous oxide emissions are also estimated to be from agriculture.

Potential of Sustainable Agriculture as Low-GHG, Resilient Farming Systems

Sustainable Agriculture can be defined as an integrated farming system (with crops, trees, livestock etc.) which is based on locally adapted agro-diverse cropping patterns and use of local resources (natural resources and natural processes), based on local knowledge, skills and innovations. This Position Paper would also like to highlight the potential of sustainable agriculture, in terms of mitigation of GHG emissions as well as adaptation to climate change. Further, sustainable agriculture holds great potential for meeting global and national food security requirements even as it leads to improvement of farmers' livelihoods through enhancing their net incomes and improving the productivity of their resources in the long run.

Food security: A question that is often posed with regard to sustainable agriculture or organic farming is whether it will be able to feed the growing population. We respond by saying that sustainable agriculture does not imply lowered yields, as experience of successful farmer's bears out on the ground. This is reinforced by an FAO report (2007) which says that "conversion of global agriculture to organic management, without converting wild lands to agriculture and without using N-fertilizers would result in a global agricultural supply of 2640 to 4380 Kcal/person/day.

Improvement in rural livelihoods: While macro-level food production and availability levels are likely to increase through sustainable agriculture, at the individual and community level too, there are bound to be improvements. As FAO notes again, access to food will increase by livelihood improvement both for farmers and agricultural workers through organic farming. Organic agriculture improves food access by increasing productivity, diversity and conservation of natural resources, by raising incomes, improving employment and by reducing risks. It has been recorded that shift to sustainable agriculture practices can reduce the outward migration from rural areas.

Sustainable agriculture also increases the Soil Organic Carbon (SOC) by incorporating organic materials into the soil. Soil can be a major source of storage of carbon, about twice as much carbon as in the atmosphere. Fertilizer use replaces soil organic matter in intensive systems, which reduces potential sequestration. Crop, tree and livestock integration with a systematic recycling of organic wastes is an integral part of sustainable agriculture. Long term studies have shown that compost application and cover crops in rotation were particularly adept at increasing soil organic matter even in comparison to no-tillage techniques. While conservation tillage is promoted elsewhere as a way of sequestration of carbondioxide, this is often done by the use of chemical herbicides and GMOs which have their own ecological implications. Agro-forestry is also a desired principle of organic farming which further adds to the potential of sustainable agriculture in carbon sequestration.

Creation of resilient systems leading to better adaptation: Extreme and unpredictable weather conditions are part of the reality of climate change even as temperature rise and changes in rainfall, changes in pest and disease incidence etc., will also be the stark reality for farmers. What the situation then requires are resilient and adaptive farming systems with the least amount of loss to the productive resources, production and the farmer.

One of the most important requirements for adaptation would be farmers' knowledge, in negotiating complex agro-ecosystems. As a philosophical approach, organic farming has always laid thrust on farmers' skills, knowledge, innovation, horizontal sharing, observations and intuition etc. Several large organic farming projects across the world have built successful institutional models for systematic support for farmers' knowledge and innovation and constant enhancement. This forms a key part of the adaptation potential of sustainable agriculture.

To address extreme weather conditions, organic farms will be better suited. The better drainage and water holding capacity of organic soils reduces the risk of drought and soil erosion, for instance. This paper notes that soils under organic management retain significantly more rainwater thanks to the "sponge properties" of organic matter. Water percolation is 15-20% more in organic systems. Water capture in organic plots was twice as high as conventional plots during torrential rains, which in turn reduces the risk of floods.

The most important component of organic systems - diversity - contributes a lot to the resilience of organic farms. Enhanced biodiversity of organic farms have several positive ecological implications - pest prevention, and similar effects on diseases, better utilization of soil nutrients and water etc.

Organic farming is also associated with decreased irrigation needs by about 30-50%. This becomes an important part of adaptation in drought conditions.

Potential of Organic Farming beyond purely agricultural technologies: Organic farming often also focuses on consumer behaviour and encourages lower ecological footprints through localized food production and consumption and reducing food miles too. This paper would like to reinforce that such farming, even though farmers adopting it are at a disadvantage due to lack of support systems in the form of extension, marketing, grassroots institutions etc., is already being practiced successfully in lakhs of acres all over the country. In large government-supported sustainable agriculture projects like Community Managed Sustainable Agriculture (CMSA) in Andhra Pradesh, where women farmers are taking a lead in implementing a large ecological farming project on more than ten lakh acres, it has been found that it is possible to scale up organic farming onto large areas, with sensitive support systems built along with people's institutions at the village level.

India's National Action Plan on Climate Change (NAPCC)

India has announced a National Action Plan on Climate Change in August 2008. The NAPCC's formulation processes were found to be very top-down and non-participatory by many analysts. The NAPCC proposes to address climate change-related issues in India through the setting up of eight inter-connected Missions: National Solar Mission; National Mission for Enhanced Energy Efficiency; National Mission on Sustainable Habitat;

National Water Mission; National Mission for Sustaining the Himalayan Ecosystem; National Mission for a "Green India"; National Mission for Sustainable Agriculture and National Mission on Strategic Knowledge for Climate Change.

The following are some of the key points that emerged as a response from civil society to the NAPCC proposals.

- **Definition required**: Sustainable Agriculture is a misnomer for what has been proposed in the NAPCC, under the name of Sustainable Agriculture and therefore, a correct, common understanding of the term is required. The current set of proposals would not lead to improving the soil health, central to sustainable agriculture, nor to cyclical models of farming, internalizing farm inputs (including crop waste) into farming systems. On the contrary, the existing suggestions would continue the conventional linear, intensive models that further the existing dependency of farmers on external agencies for everything, including for knowledge. That is one of the reasons for the current day crisis in agriculture.
- **Creating the imperative for the paradigm shift**: The NAPCC makes no mention and assessment of Green Revolution-induced climate change in India. Shying away from stating the issues with the current model of agriculture will not create the imperative for a shift to sustainable agriculture, which is a requirement both for mitigation as well as adaptation. The NAPCC should clearly specify incentives to farmers for shifting to organic farming and sustainable agriculture practices. The government should realize that the imperative to shift to sustainable agriculture is larger than climate change.
- **Policy approach**: Strategies should be evolved for a time-bound phasing out of climate change-inducing practices towards sustainable agriculture with clear targets and financial outlays. This includes a focus on the role of pasture lands, fisheries, animal husbandry (rather than the bias on crop husbandry that is present in the NAPCC) and seed banks governed by farmers' bodies as major thrust areas for adaptation. Or, when plans are made about access to information, the emphasis should not be just on information packages to farmers in a top-down manner about geo-spatial impacts of climate change, but also data on conventional vs. organic practices so that informed choices can be made by farmers.
- **Biotechnology**: On the use of biotechnology, especially genetic engineering, as part of the NAPCC, it is felt strongly that the government should focus on reducing the present subsidies to GHG-emitting practices like fertilizers rather than come up with GE seed varieties which are supposed to reduce GHGs. In fact, an assessment of the stress (in) tolerance of GE crops should be an important part of understanding the implications of Genetic Engineering as an agricultural technology in the era of climate change.
- **'Land to lab' programmatic interventions**: The NAPCC focuses too much on setting a research agenda for the NARS (National Agricultural Research System), following the old model of 'lab to land' research and not so much about programmes to be implemented immediately at the farmers' level. In the context of

climate change and adaptation, there is hardly any time to be lost and farmers' need for resilient systems cannot wait for more research in the old paradigm to be taken up. The need is for solutions discovered from the farms, assessed and validated and spread to others, especially in terms of adaptation. Alternative, horizontal extension systems with farmers' organizations at the centre are an important part of information-centred addressal of climate change. As part of the NAPCC, capacity building of agriculture scientists and extension workers on organic farming should be taken up so that they are equipped to take the message to farmers.

- **Traditional knowledge & resources**: The National Action Plan does not give adequate prominence to traditional resources and knowledge, which need to be made a cornerstone for interventions on sustainable agriculture. It was felt that popularization of traditional knowledge in addition to ever-evolving innovations in the fields of practicing organic farmers should be considered to be an important component of adaptation to climate change in agriculture. Such farmers should be identified and lessons learnt and disseminated through the extension system. There should be an emphasis on falling back on indigenous resources (seeds, animal breeds etc.), which have proven track record of adaptation to stress conditions.
- **Centre-State relations**: State governments should be involved in consultations and planning right from the beginning – it is not enough that centrally-evolved plans are imposed upon them. In fact, it is ultimately the departments of agriculture and the extension and delivery mechanisms at the state level which will directly take everything to farmers and support them to bear the consequences of climate change. For instance, seed rolling plans need to be evolved by each state, with an emphasis on revival and restoration of open-pollinated, traditional and locally-adapted varieties.
- '**Public-People' Partnership**: Similarly, it was felt that civil society and its institutions should also be involved in planning and implementation related to the NAPCC. For instance, alternative, horizontal extension systems with farmers' organizations at the centre are an important part of information dissemination and learning for adaptation to climate change..
- **Risk management**: When it comes to Risk Management, it should be acknowledged first that the existing risk management strategies and mechanisms have failed farmers badly. There is a need for complete recasting of the existing models and mechanisms. We need new mechanisms to assess damage and loss and better ways to deliver support - including weather insurance, livestock insurance and effective crop insurance.
- **Clear convergence**: The Plan should clearly spell out how it converges with other plans and missions both within the NAPCC as well as in other agencies like the Planning Commission.
- **Social safety nets**: As part of adaptation strategies, strong social security nets should be put in place for the rural households, including with a provision of minimal incomes,

pension, insurance etc., with special emphasis on the agriculture workers.

Conclusion

Climate change and agriculture are interrelated processes, both of which take place on a global scale. Climate change affects agriculture in a number of ways, including through changes in average temperatures, rainfall, and climate extremes (e.g., heat waves); changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods; and changes in sea level. The scenario of developing Indian economy is passing through a dynamic era. Agriculture constitutes the backbone of countries economy. Climate change has an enormous impact on Agriculture. Indian agriculture faces the dual challenge of feeding a billion people in an altering climatic and economic scenario. The era of Green Revolution introduce of high-yielding varieties of seeds and the increased use of fertilizers and irrigation increased the production which makes India self-sufficient in food grains, thus improving India. Within rural areas, extension services and agents should work closely with the other organizations that provide essential services to farmers and their families. Extension is only one aspect of the many economic, social and political activities that seek to produce change for the better in rural society. Side by side public extension sector played a major role in improvement of Indian agriculture. However, considering the varied agro-ecological situations the extension system envisaged to achieve desired growth. Agriculture development in India is basically a state subject. But, the crucial role the agricultural sector play from the perspective of ensuring food security of its large population, the Union Government play a pivotal role in formulating policies that has direct bearing on the growth of agricultural sector. While macro-level food production and availability levels are likely to increase through sustainable agriculture, at the individual and community level too, there are bound to be improvements. Organic agriculture improves food access by increasing productivity, diversity and conservation of natural resources, by raising incomes, improving employment and by reducing risks. In country like India with a large geographical area, where Agro-climatic zones widely differ besides significant variation in socio-economic status of farmers', uniform extension service is not the panacea for all the regions. It was realized that public extension system will have to be placed in new decentralized institutional arrangements which are demand driven, farmer-accountable, bottom-up and have farming system approach.

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