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Socio Economic Impact of Climate Resilient Technologies

Jasna, V. K., Sukanya Som, R. Roy Burman[1], R. N. Padaria and J. P. Sharma

Division of Agricultural Extension, IARI, New Delhi – 110 012

Abstract

Change in climate is likely to aggravate the problems of future food security by exerting pressure on agriculture. India is more vulnerable in view of the high population depending on agriculture, excessive pressure on natural resources and poor coping mechanisms. In India, significant negative impacts have been implied with medium-term (2010-2039) climate change, predicted to reduce yield by 4.5 to 9 per cent, which is roughly up to 1.5 per cent of GDP per year (Venkateswarlu *et al*, 2013). Rainfed agriculture which constitutes nearly 58 per cent of net cultivated area will be the most impacted. Therefore, it is of utmost importance to enhance resilience of agriculture to climate change through planned adaptation. With this background, ICAR has launched a major network project, National Initiative on Climate Resilient Agriculture (NICRA), during 2010-11 in 100 vulnerable districts to undertake strategic research on adaptation and mitigation, fill critical research gaps, demonstrate technologies on farmers' fields to cope with current climate variability and capacity building of different stakeholders. While studying the impact of climate resilient technologies in agriculture in rainfed agro-eco system, 40 per cent increase in yield of paddy and wheat, 25 per cent increase in maize yield was reported by Krishi Vigyan Kendra (KVK), Gumla in Jharkhand (Annual Report, 2013). It led to 100 per cent increase in income and considerable reduction in livestock and fish mortality. Large portion of uncultivated land is brought to cultivation in *rabi* and summer season in the district. Water storage capacity of ponds and wells, is enhanced. A pragmatic roadmap to climate resilient agriculture requires integrated emphasis on adoption of climate resilient technologies, participation of farmers, partnership and support of political and service organizations. Value orientation and perception of practitioners towards climate resilient sustainable agriculture are of also of paramount importance. This paper aims to document socio-

economic impact of climate resilient technologies and suggest strategy for up-scaling and out-scaling of these technologies.

Key words: Socio-economic impact; climate change; technologies

1. Introduction

Climate change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. The fact that climate affects development and development affects the climate has come to be known widely during recent times. For the past some decades, the gaseous composition of earth's atmosphere is undergoing a significant change, largely through increased emissions from energy, industry and agriculture sectors; widespread deforestation as well as fast changes in land use and land management practices. Left unmanaged, climate change will reverse development progress and compromise the well being of current and future generations. Impacts will be global, but much of the damage will be in developing countries, where, 11 per cent of arable land could be affected by climate change, including a reduction of about 16 per cent of agricultural GDP. The Government of India has accorded high priority on research and development to cope with climate change in agriculture sector. The Prime Minister's National Action Plan on climate change has identified Agriculture as one of the eight national missions.

1.1 How climate change impacts agriculture

Climatic changes and increasing climatic variability are likely to aggravate the problems of future food security by exerting pressure on agriculture. Countries like India are more vulnerable in view of the high population depending on agriculture, excessive pressure on natural resources and poor coping mechanisms. In India, significant negative impacts have been implied with medium-term (2010-2039) climate change, predicted to reduce yields by 4.5 to 9 per cent, depending on the magnitude and distribution of warming. Since agriculture makes up roughly 16 per cent of India's GDP, a 4.5 to 9% negative impact on production implies a cost of climate change to be roughly up to 1.5 per cent of GDP per year. The yield reduction is likely brought out by many factors including pests, weeds and diseases, loss of biodiversity, rise in sea level, saline water intrusion in coastal belts, poor quality of irrigation water, decline in soil fertility, and irregularities in onset of monsoon, heat wave, cold wave, drought, flood and cyclone. Climate change can affect the yield positively as well as negatively. Through impacting agricultural inputs like water for irrigation and availability of solar radiation, the type of crops cultivated would be determined by climate variability. Agriculture, particularly in India with nearly 60% rainfed area, has been a highly risky venture with vagaries of monsoon besides the interplay of other abiotic and biotic factors. It accelerates riskiness of agriculture with pronounced effect mainly due to two reasons, firstly rainfed agriculture is practiced on fragile, degraded and sloppy lands which are thirsty as well as hungry and prone to erosion. Secondly, the people dependent on rainfed agriculture are also less endowed

in terms of financial, physical, human and social capital limiting their capacity to adapt to the changing climate. The impact of climate change on agriculture could result in problems with food security and may threaten the livelihood activities upon which much of the population depends.

4.2 ***Need for planned adaptation***

Enhancing agricultural productivity is critical for ensuring food and nutritional security for all, particularly the resource poor small and marginal farmers who would be affected most. In the absence of planned adaptation, the consequences of long-term climate change could be severe on the livelihood security of the poor. Therefore, it is of utmost importance to enhance the resilience of Indian agriculture to climate change. Resilience is the ability of a system to absorb shocks and recover as quickly as possible to normal conditions when external environment improves. Planned adaptation is essential to increase the resilience of agricultural production to climate change. Management practices that increase agricultural production under adverse climatic conditions tend to support climate change adaptation because they increase resilience and reduce yield variability under variable climate and extreme events. The potential adaptation strategies are: developing cultivars tolerant to heat and salinity stress and resistant to flood and drought, modifying crop management practices, improving water management, adopting new farm techniques such as resource conserving technologies (RCTs), crop diversification, improving pest management, better weather forecasting and crop insurance and harnessing the indigenous technical knowledge of farmers.

The Indian Council of Agricultural Research (ICAR), New Delhi has launched a major network project entitled, National Initiative on Climate Resilient Agriculture (NICRA) during 2010-11, focusing on the process of developing district level contingency plans for all the rural districts of country with Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad as the nodal agency with an outlay of Rs.350 crores for the XI Plan. The project is implemented by Krishi Vigyan Kendras (KVKs) at district level, regionally coordinated by the Zonal Project Directorates (ZPDs) with overall planning, monitoring and coordination by CRIDA and is being implemented at large number of Research Institutes of ICAR, State Agricultural Universities and 100 KVKs

NICRA has the major objectives, to enhance the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies; to demonstrate site specific technology packages on farmers' fields for adapting to current climate risks; and to enhance the capacity building of scientists and other stakeholders in climate resilient agricultural research and its application. Both short term and long terms outputs are expected from the project in terms of new and improved varieties of crops, livestock breeds, management practices that help in adaptation and mitigation and inputs for policy making to mainstream climate resilient agriculture in the developmental planning. The overall expected outcome is

enhanced resilience of agricultural production to climate variability in vulnerable regions. The project is comprised of four components.

1. Strategic research on adaptation and mitigation
2. Technology demonstration on farmers' fields to cope with current climate variability
3. Sponsored and competitive research grants to fill critical research gaps
4. Capacity building of different stake holders.

2. Intervention Modules of Technology Demonstration

The technology demonstration component of NICRA identified climatic vulnerabilities of selected village in each of the 100 districts based on a scientific analysis of climate related problems, farmers' experiences and perceptions, and prepared and implemented, adaptation and mitigation strategies through intervention modules following a bottom-up approach. The focus of the programme is not only to demonstrate the climate resilient agriculture technologies but also to institutionalize mechanisms at the village level for continued adoption of such practice in sustainable manner. Under the technology demonstration component, interventions are generally undertaken in four modules in order to address the climatic vulnerabilities. While the specific interventions for each village would be based on the needs and requirements, and climatic vulnerability of that particular village. Availability of resources also theater a role in determining the interventions. The four modules of intervention are briefed below

2.1 Module I: Natural resources

This module consists of interventions related to in-situ moisture conservation, biomass mulching, residue incorporation instead of burning, brown and green manuring, water harvesting and recycling for supplemental irrigation, improved drainage in flood prone areas, conservation tillage, artificial ground water recharge and water saving irrigation methods.

2.2 Module II: Crop Production

This module consists of introducing drought/temperature tolerant varieties, advancement of planting dates of *Rabi* crops in areas with terminal heat stress, water saving paddy cultivation methods (SRI, aerobic, direct seeding), frost management in horticulture through fumigation, community nurseries in multiple dates for delayed monsoon, farm machinery custom hiring centers for timely completion of farm operations, location specific intercropping systems with high sustainable yield index.

2.3 Module III: Livestock and Fisheries

Major activities of this module are use of community lands for fodder production during droughts/floods, augmentation of fodder production through improved planting material, improved fodder/feed storage methods, fodder enrichment, prophylaxis, improved shelters for reducing heat stress in livestock, management of fish ponds/tanks during water scarcity and excess water and promotion of livestock as such as a climate change adaptation strategy.

2.4 Module IV: Institutional Interventions

This module consist of institutional interventions either by strengthening the existing ones or initiating new ones relating to community seed bank, fodder bank, commodity groups, custom hiring centre, collective marketing group, introduction of weather index based insurance and climate literacy through a village weather station will be part of this module.

3. Impacts Made by the Climate Resilient Technologies in Agricultural Sector

All the technologies demonstrated, yet and now, through NICRA in imparting resilience in terms of mitigation and adaptation to climate vulnerability, were studied in KVK Gumla of Jharkhand and KVK Tumkur of Karnataka. Through introduction of crop varieties tolerant to drought, temperature and flood, a noticeable increase in production was achieved by linseed variety Sekhar (63.46 %), black gram variety Uttara (64.15 %), niger variety Birsa Niger-1 (106.7 %), sweet potato variety Birsa Sakarkand-1 (88.83 %) and ragi variety GPU-28 (61.91 %) in the demonstrated fields. By adopting water saving paddy cultivation methods, aerobic rice cultivation (variety Anjali) when supplied with quality seeds and adequate fertilizer improved yield by 29.05 per cent. While in SRI method of cultivation, paddy variety Lalat and use of Cono weeder brought out 30.76 per cent increase in rice yield. Intervention aimed at location specific intercropping systems, when demonstrated in farmers' field, pronounced achievement was reported from ragi and red gram intercropping system with an enhancement in yield by 157.79 per cent. With location specific disease and pest management in red gram 53.12 per cent loss in production was eliminated. Composite fish farming as a method of management for fish ponds and tanks during water scarcity and excess water elicited 125 per cent increase in output. Maximum participation was assured in training programmes like van mahotsav (for awareness about climate change), technology weeks (demonstration on different technology) and wheat day.

The findings based on the studies about impact of demonstrated climate resilient technologies in Tumkur, reported an encouraging output on both social as well as economic aspect of the village. Through demonstration of trench cum bunding in the project site could combat climatic adversity by arresting soil erosion, where soil served as water reservoir and holds soil moisture for long time and it brought 27 per cent increase in finger millet yield. Adverse effect of water scarcity was overcame through digging of new farm ponds which resulted in 100 per cent increase in cropping intensity by providing supportive irrigation to the crops at critical stage. Construction of check dams also added similar benefits. Application of tank silt in fields helped in improvement of water holding capacity and soil productivity and 32 per cent increase in finger millet yield where it was applied. Introduction of drought tolerant medium duration finger millet var. ML-365 increased finger millet yield by 41 per cent as compared to local varieties. This variety imparted resistance to lodging and blast, which is suitable for late sowing. Maize yield increased by 21 per cent

through introduction of maize variety NAH 1137. Soil health cards were distributed to farmers based on soil testing to ensure balanced nutrient application. Provision of farm machineries and equipments assured timely planting. Through custom hiring of farm machineries human labour was saved significantly by amla de-seeder (94%), power sprayer (92%), water pumping diesel engine (90%) and trencher (90%). These studies show that within few years of implementation climate resilient technologies played a key role in transforming climate vulnerable agriculture to climate smart agriculture. It made a sea change in progress on socio economic condition of rural people. The right technologies gave an impetus to agriculture production in the era of 'uncertain agriculture'. These interventions sowed the seeds of prosperity and sustainability in agriculture. Most the interventions of NICRA seem to be promising in imparting resilience. Further step should be taken in refining the technologies and stretching the benefits of climate resilient technologies to large portion of the rural poor.

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