

## Role of Extension Services in Empowering Farmers to Adapt Climate Change

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### Introduction

Climate change is a pertinent issue affecting the livelihoods and has created the biggest threat to agricultural productivity and food security to the larger populations in developing countries. Developing countries are more vulnerable and adversely affected by the negative effects of climate variability due to their low level of adaptation measures to climate change (IFAD, 2010). Agriculture is the main source of rural households and also attached urban populations in developing countries. From ancient time, India has been dependent on monsoon, where 62 percent cropped areas are dependent on rainfall, thus climate is the major determinant of agricultural production. Additionally, the small and marginal farmers are highly affected by climate variability due to their low level of adaptive capacity. It is predicted that an average annual rainfall has declined by 86 mm from the last three decades. India is more vulnerable to climate variability, where a large population is at high risk of effects of climate change as more than half population of over 1 billion people lives in rural areas and depends on climate-sensitive sectors like agriculture, fisheries, livestock and forestry for their day to day livelihoods.

Intergovernmental Panel on Climate Change (IPCC, 2007) defined climate change as any changes in climate over a period of time, whether due to natural variability or human activities like excessive use of chemicals, loss of forests, increase in population and industrialization and burning fossil fuels, like coals oil, etc. Burning these material release Green House Gases (GHGs) into the Earth's surface, that result in increase temperature.

United Nations Framework Convention on Climate Change (UNFCCC, 2011) defined climate change as a change which is attributed directly or indirectly of human activities that

alters the compositions of the global atmosphere and natural climate variability observed over comparable time periods.

### **Impacts of climate change on agriculture**

Climate change and agriculture are interrelated or interdependent process, which takes place at global scale. Hence, any changes in climate frequency and intensity of precipitation, heat waves, and other extreme events will have negative effects on agricultural productivity either directly or indirectly; such as changes in average temperature, precipitation, rainfall pattern (decrease in number of rainy days or increase in intensity of rainfall, etc.), heat waves stress, short winter duration, etc. these are the direct effects of climate variability on agriculture. Whereas, changes in soil moisture, soil fertility, and the distribution and frequency of infestation by pests and diseases, insect diseases, changes in atmospheric carbon dioxide and ground level ozone concentrations, changes in the nutritional quality of some foods and changes in growing seasons of crops are the indirect effects of climate variability on agriculture, therefore food prices may hike.

Due to anthropogenic activities the concentration of GHGs has risen up since 19<sup>th</sup> century resulted in increase of average temperature by 0.9°C. As climate change and agriculture are inextricable links; hence climatic conditions are the biggest challenges for the food security and nutritional security as well as. Food Agriculture Organization (2018) reported that the percentage of emissions of GHGs in the atmosphere has increased; consequently the climate variability will have the adverse effects in the production of major cereal crops, which is about 20-45% in maize yields, 5-10% in wheat and 20-30% in rice crops by 2100. While, IPCC (2007) predicted that 2.5°C to 4.9° C temperature will increase by the end of 21<sup>st</sup> century, thereby rice yields will drop by 32% to 40% and Wheat yields by 41% to 52%. It is also predicted that the GDP will fall down by 1.8% to 3.4 % by 21<sup>st</sup> century. World Food Program (2018) reported that the rate of increase in crop yields per hectare is significantly slower as compared to rate of increasing population. In this scenario, India would be more exposed to the negative effects of climate change because of more than 400 million people living in the condition of extremely poverty. Therefore, the climate change could be a threat to agriculture and in achieving the goal of food and nutritional security to the larger population by 21<sup>st</sup> century.

## Adaptation to Climate Change

Adaptation to climate change is an effective measure to cope up with climate change by making changes at the rural households and communities and helps in making them able to prepare themselves and developing capacity at the farm level. It also helps to farmers to avoid projected damages and support them in dealing adverse changing climate conditions (IPCC, 2001). So, adaptation to climate change is the adjustment in natural or human systems in order to actual or expected climatic stimuli or their effects, which helps to reduce harmful effects of climate variability. It is the capacity of farmers to adapt themselves against the adverse effects of changing climate and its variability by adopting the both traditional and scientific adaptation practices. The human-induced or natural changes in climate are continuously occurring all countries are to be adversely affected; thereby all need to adapt themselves in such changing climate risks over the coming decades.

Further, the IPCC 4<sup>th</sup> Assessment report pointed out that many developing countries are more vulnerable particularly because of their relatively low adaptive capacity. Such adaptive capacity is the ability of a system to adjust with climate change and to reduce potential damages and take more advantages of available opportunities, or to cope up with the consequences of climate variability. Here, we need to enhance adaptive capacity and resilience for sustainable development.

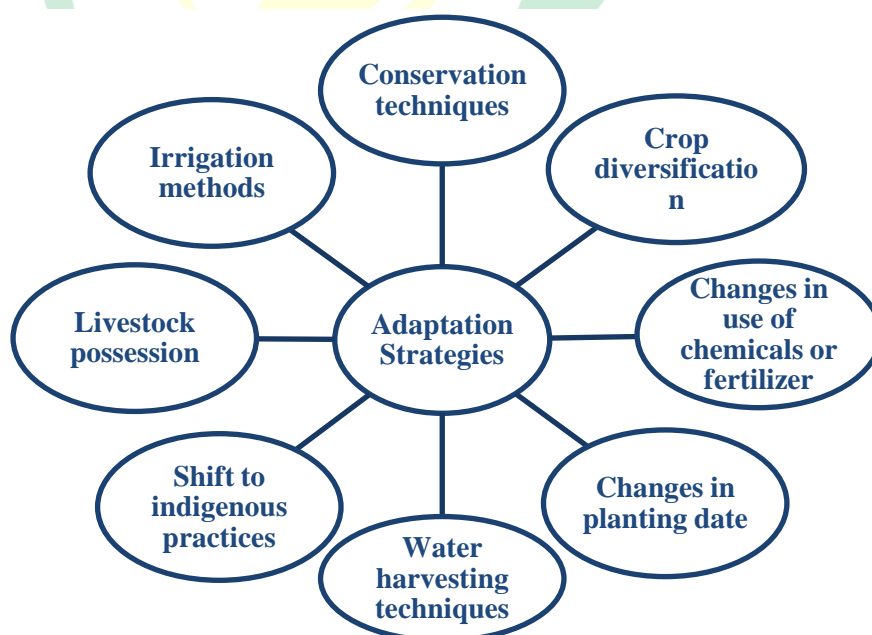


Fig: 1 Adaptation strategies to cope up climate change

Due to prevailing factors such as extreme poverty, higher dependence on rainfall, inequitable or scattered land distribution, limited access to capital and improved technology, inadequate public infrastructure such as roads and transport facilities, limited access to weather forecasting and inadequate or untimely dissemination of research or extension, etc. in order to overcome these damages to the agricultural or allied sector, adaptation strategy is one of the successful defensive measure to cope up climate variability at rural or community level. An adaptation strategy is intended to inform and assist farmers to identify their potential alternatives at farm levels. There are some adaptation strategies to cope up climate change; some of them are mentioned here.

### **Ways to ensure adaptation to cope up with climate change**

Adapting to climate change is the right measures to mitigate the negative effects of climate change by ensuring the appropriate adjustment and changes at the farm level. Agricultural production has been remaining the main income generating source to the most of rural communities. Adaptation in the agricultural sector is essential to protect the livelihoods to the small and marginal farmers and ensure food security as well as. Therefore, a better understanding of farmers' perceptions about climate change, their ongoing adaptation measures and accordingly, the decision-making process is pivotal to inform policies and promoting successful adaptation strategies for the agricultural sector.

However, despite having perceived changes in extreme temperature and rainfall patterns, still a large percentage of farmers did not make any adjustments to their farming practices to mitigate climate adverse effects. Based on various studies conducted by researchers they have found that the main factors not to adopt any adaptation practices by farmers are lack of knowledge, limited access to credit and lack of access to land, lack of information, lack of proper market linkages and limited expenditure in new heat tolerant varieties, access to crop insurance, access to extension services and information, so on.

Schlenker and Lobell (2010) suggested that farmers' awareness, expenditure in new heat-tolerant varieties, access to crop insurance, social awareness and protection programs are the some pivotal aspects to ensure the adaptation measures to climate change. Thus, policy-makers must create an enabling platform to support such adaptation practices by ensuring access to information, credit and markets, etc. and need to make effective efforts to reach



small and marginal farmers, with limited resources at farm level to mitigate the negative effects of climate change.

### **Role of extension services in ensuring adaptation to climate change**

As extension is the system which provides a single window platform to farmers, organizations and other market stakeholders to gain knowledge, get timely and accurate information and technologies and also facilitate a platform at the same time to interact with their partners engaged in research, education, agribusiness, and other relevant institutions. They assist them to develop their own technical, organizational and management skills and practices at local level, (FAO). The main responsibility of the extension agents is to disseminate approved best practices and innovations developed by scientists across the world to enhance farmer's adaptive capacity and building resilience to reduce the inimical effects of climate variability in order to increase their productivity and profitability and reducing poverty as well as. Agricultural extension services can help in establishing the linkages with various sources of farming inputs and credit facilities, providing timely and updated accurate information and most importantly, the transfer of technology and educational services in all aspects of agricultural activities to the targeted audience, those who are directly or indirectly dependent on agriculture or other allied sectors.

The rapid advancement in technology and climate change are the biggest challenges in agriculture, thereby farmers require more investment of capital in agriculture and human capacity development, improve or advance skills and knowledge for production and processing, access to markets and trade, organizing farmers producer groups and working with farmers towards sustainable natural resource management to sustain their farming. Thus, the role of agricultural extension does not only rely on the transfer of technology and enhancing farmer's productivity and profitability, but also extension agents need to work upon more in improvement of farmers' knowledge, capacity building, decision making ability, their managerial and technical skills through training, group discussion, facilitation and coaching, frontline demonstration etc. Agricultural extension has been the main conduit of addressing such challenges of farmers and to overcome rural poverty and food insecurity. Agricultural extension also supports in learning, assist farmers in problem-solving, decision making and getting farmers actively involved in the agricultural knowledge and information



system to facilitate effective policies at farm level to adapt the negative effects of climate change to sustain agriculture for development.

### **Conclusion**

Agriculture is the mainstay of Indian economy underpinning employment, food production and export, but presently this sector is facing climate stresses. The climate variability has an adverse devastating effects on agricultural food production resulted threats to food security or widespread poverty among small and marginal farmers. Adaptation to climate change is highly context specific, because it depends on the climatic, environmental, social and political conditions in the target region. It is realized that the concerning agriculture and extension policies and adaptation strategies are essential tools to adapt climate change. There are some communities which have developed various traditional or indigenous agricultural adaptation practices to cope up with changing climate conditions these practices need to be shared among communities or similar region. There is a dire need to create awareness, start a campaign in order to build resilience and adaption capacity of the small and marginal farmers for the adoption of adaptation practices regarding climate change, therefore in this context agricultural extension can play an active or effective roles.

### **References:**

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