

Climate Change and Agriculture in India: Impacts and Adaptation for Sustainable Future

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Abstract---In 21st century, Climate Change is a serious global environmental concern and its impact on the availability of numerous natural resources particularly water, which is very important for life on Earth surface. If historical CO₂ emissions from 1970 to 2014 are considered, India with 39.0 Gt is way behind the top three emitters – the USA, the EU and China. At other side, More than 50% of rural population depend upon agriculture and allied activities for their livelihood in India. Agriculture, along with fisheries and forestry, contributes 16.11 % to the Indian Gross Domestic Product (GDP). Therefore, paper considers the impact of climate change on agriculture in India. It is true that the apple growers in Himachal Pradesh to the farmers in Vidharbha (Maharashtra) and those living in endangered islands in the Sunderbans (West Bengal) are already struggling with the impacts of climate change. This Paper also describes the adaption and mitigation measures to reduce climate change impact and improve sustainable agriculture practises in India.

Keywords---Climate change, Agriculture Adaptation etc.

I. INTRODUCTION

India with its area of 3.28 million sq. km accounts for 2.4% of the world's land surface area and stands as the seventh largest country in the world. India is second most populous country in the world with above 1.3 billion which containing 17.5% of world population. The size and population of India has endowed her with excessive physical as well as economic diversity. More than 50% of rural population in India depend upon agriculture and allied activities for their livelihood. Agriculture, along with fisheries and forestry, contributes 16.11 % to the Indian Gross Domestic Product (GDP). Therefore India has concern about climate change issues because of its large population who depends upon climate sensitive activity like agriculture for their livelihood, water storage in the Himalayan glaciers which are the source of major rivers and groundwater recharge. Possible changes in temperature, precipitation and CO₂ concentration are expected to significantly impact crop growth and agricultural productivity.

II. OBJECTIVES AND METHODOLOGY

This paper provides a synthesis of available information, consider major knowledge gaps and find research that useful for farmers, communities, indigenous peoples and academics. Secondly, promotes awareness of climate change and agriculture along with adaptation measures.

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Last but not the least, paper evaluate the policy and planning action taken by government, international organization, NGOs and also provide some suggestions for sustainable agricultural growth. For these objectives, secondary data sources are used. Secondary information collected from various departments associated with climate change as well as agriculture. Limited Primary data was also used such as interview for this paper.

III. CLIMATE CHANGE IN INDIA

According to fifth Intergovernmental Panel on Climate Change (IPCC) assessment report there are several changes in weather pattern and extreme weather events. Net annual temperature in India will increase in 2030 with respect to 1970s from 1.7 to 2.2°C. The monsoon breaks days and mean and extreme precipitation during the Indian summer monsoon is expected to increase. Due to these reasons, Floods and droughts are expected to increase in India. Extreme weather events such as cyclone projections indicate that frequency of cyclone seems to decrease in 2030 with increase in intensity. The most vulnerable area by the extreme weather events are coastal (Eastern India) and hilly regions (North, North Eastern India) in India.

IV. IMPACTS OF CLIMATE CHANGE ON AGRICULTURE

Agriculture is an important economic activity for the livelihood in India which mostly depends upon monsoonal rain. In India, agriculture growth has a direct impact on poverty eradication as well as employment generation. Extreme weather condition such as flood, drought and cyclone are the potential causes of loss in agriculture productivity and production in India. Agriculture productivity is sensitive to two broad classes of climate induced effects:

- i. Direct effects from changes in temperature, precipitation or carbon dioxide concentration
- ii. Indirect effect is related to change in soil, distribution and frequency of infestation by pests and diseases.

4.1. Direct Impacts on Agriculture

The increase emission of carbon dioxide associated with rise of temperature and a warmer climate will accelerate the hydrologic cycle, fluctuating rainfall, adverse effect on running water resources. Warm air holds more moisture the normal air and it will result in an increase in evaporation of surface moisture. The combined effects of carbon dioxide, rainfall and temperature are often studied through the use of crop growth simulation models. Some modelling studies show

that a 2°C increase in temperature will result in a 17 per cent decrease in rabi crop yield (mostly in northern India) but beyond that the decrease is very high.

Climate change has a direct impact on crop evapotranspiration (ET). In arid regions of Rajasthan state an increase of 14.8 per cent in total ET demand has been projected with increase in temperature. Due to climate change, precipitation decline 5 to 25% in drought prone central India and also decline in winter rainfall in northern India. These changes implies in output of winter wheat and mustard crop in north-western India.

Recent studies at the Indian Agricultural Research Institute (IARI) show that the probability of future loss of 4 to 5 million tonnes in wheat production with every 1°C temperature increases throughout the growing period. Such studies have indicated that direct effects of global changes are relatively smaller, especially for the kharif crops. Water resources are directly related to climate and rapidly melting glaciers of Himalayas openly affect the rivers and irrigation systems in the Indo Gangetic plains and adversely impact on food production.

4.2. Indirect Impacts of Agriculture

The soil system responds to the short term changes like infiltration of rainfall and also suffers long term changes such as physical and chemical weathering due to climate change. Global climate change directly affects soil forming factors in terms of organic matter supplies, temperature regime, hydrology and the changes into the potential evapotranspiration. Both the organic matter and the carbon-nitrogen ratio will reduce in a warmer soil temperature regime. Evaporation from the soil will cause soil moisture stress which affects agricultural productivity. Enhanced temperature coupled with reduced rainfall may lead upward water movement, giving rise to accumulation of salt in upper soil layer which may reduce the soil productivity. Occurrence of pest and diseases would be more severe in India because of its tropical situation. Climate change is likely to be a reason for spread of tropical and subtropical weed species into temperate climatic area and may affect the crop interactions. It is possible that increases in temperature could spread crop diseases into new production areas and also result in higher populations of destructive pests.

V. ADAPTIVE MEASURES AND PLANNING ACTION

The strategies of adaptation are short or long-term changes to human activities that respond to the effects of change in climate. Development of new climate tolerant crop variety, use of crop mixture is key tool of adapting measures in agriculture in India to a changing climate. The rural knowledge centre should provide computer aided and internet connected information service for relevant meteorological data and sharing primitive agricultural adaptive measures world-wide. Research and development department needs to develop drought resistant crops, low cost high efficiency irrigation techniques; continuous field tracking related to climate change etc. will reduce the impact of climate change in Indian agricultural sector.

In December 2015, the historic climate change agreement under the United Nations Framework Convention on Climate Change (UNFCCC) in Paris is a landmark aims at keeping the rise in global temperatures well below 2°C, which will set the world towards a low carbon, resilient and sustainable future. Other important initiatives taken by government for climate change are:

- i. National Action Plan on Climate Change (NAPCC) includes eight missions such as solar energy; enhance energy efficiency, sustainable agriculture, sustainable habitat, water, Himalaya ecosystem, green India and strategic knowledge for climate change.
- ii. National Adaptation Fund for Climate Change (NAFCC) is meant to assist national and state level for adaptive measures of climate change.
- iii. Climate Change Action Programme (CCAP) initiates and implements of climate change related actions in the context of sustainable development.
- iv. Climate Technology Centre and Network (CTCN) facilitate the technological aspects related to Climate Change.

VI. CHALLENGES AND WAY FORWARD

Adaptive measures and policies can only provide a successful response if they are adopted in suitable situations. A variety of challenges need to be considered including land use planning, watershed management, disaster vulnerability assessment, climatic variability calculation, forecast of extreme events and manage resources to input in agriculture. Therefore, it is necessary to improve the ability of agriculture to respond to diverse demand and pressures. We need training and general education of agricultural population about climate change and also research on heat and drought tolerant, salt and pest resistant crop for achieving the sustainable agriculture goal in India.

VII. CONCLUSION

The climate change is a bitter truth and also a major concern in developing countries such as India. One of the important consequences of climate change is about changes in the quality and quantity water resources and crop productivity. Identification of suitable agronomic management practices can be a potential solution to optimize agricultural production in the changed climate. Different countries from the world agree to a common framework on climate change and a set of Sustainable Development Goals in a single year was truly a monumental achievement. Hence, adaptive measures are taken in well-timed; both as farmer's level as well as policy maker's level is important for achieving the sustainable future goal.

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