© 2018 IJSRST | Volume 4 | Issue 2 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

Effect of Climate Change on Indian Agriculture

Dr. Neeru Yadav
Assistant Professor Department of Geography Govt. P.G. College Narnaul, Haryana, India

ABSTRACT

One of the major challenges facing humankind is to provide an equitable standard of living for present and future generations: adequate food, water, energy, safe shelter and a healthy environment. But, global environmental issues such as land degradation, loss of biodiversity, stratospheric ozone depletion along with human-induced climate change, threatens our ability to meet the basic human needs. The Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change (IPCC) reaffirms that the climate is changing in ways that cannot be accounted for by natural variability and that 'global warming' is happening. Global mean temperatures have risen (0.6oC in the last century), with the last decade being the warmest on record. Climate change will, in many parts of the world, adversely affect socio-economic sectors, including water resources, agriculture, forestry, fisheries and human settlements, ecological systems and human health, especially in developing countries due to their vulnerability.

Keywords: Climate Change, Indian Agriculture, Weather Condition, Crops

I. INTRODUCTION

Vulnerability to climate change is closely related to poverty, as the poor have fewer financial and technical resources. They are heavily dependent on climate-sensitive sectors such as agriculture and forestry; they often live on marginal land and their economic structures are fragile. This is true for a developing country like India where agriculture remains the mainstay of the economy, contributing nearly 27% of the total Gross Domestic Product (GDP) and employing nearly two-thirds of the country's population. Agriculture exports account for 13 to 18% of total annual exports of the country. However, given that 62% of the cropped area is still dependent on rainfall; Indian agriculture continues to be fundamentally dependent on the weather.

Climate change will have an economic impact on agriculture, including changes in farm profitability, prices, supply, demand and trade. The magnitude and geographical distribution of such climate-induced changes may affect our ability to expand the food production as required to feed the populace. Climate change could thus have far reaching effects on the patterns of trade among nations, development and food security.

Agriculture is sensitive to short-term changes in weather and to seasonal, annual and long term variations in climate. Crop yield is the culmination of a diversified range of factors. Parameters like soil, seed, pest and diseases, fertilizers and agronomic practices exert significant influence on crop yield. The burgeoning population, along with human-induced climate change and environmental problems is increasingly proving to be a limiting factor for enhancing farm productivity and ensuring food security for the rural poor.

Agricultural productivity can be affected by climate change in two ways: first, directly, due to changes in temperature, precipitation and/or CO2 levels and second, indirectly, through changes in soil, distribution and frequency of infestation by pests, insects, diseases or weeds. Acute water shortage conditions, combined with thermal stress, could adversely affect wheat and, more severely, rice productivity in India even under the positive effects of elevated CO2 in the future. The mean temperature in India is projected to increase by 0.10 C to 0.30C in kharif (summer) and 0.30C to 0.70C in rabi (winter) by 2010 and to 0.40C to 2.00C in kharif and 1.10C to 4.50C in rabi by 2070 (IPCC, 1996). Mean rainfall is projected not to change by 2010 but may increase by 10% during rabi by 2070. At the same time, there is an increased possibility of climate extremes, such as the timing of onset of monsoon and intensities and frequencies of droughts and floods. The findings of several studies carried out in India are given in Table 1.

Crop	Scenario	Projection	References
Rice	20C rise 1.50C rise + 2 mm rainfall rise + 460 ppm CO2	0.06 - 0.075 ton / hec +12% in South India	Sinha & Swaminathan (1991) Saseendran et al (1999)
Wheat	2^0C rise + 425 ppm CO_2	-1.5 - 5.8% in sub tropical India -17-18% in tropical India -10% in Punjab, Haryana	Aggarwal & Kalra (1994) Kumar & Parikh (1998)
Maize	2^0C rise + 425 ppm CO_2	-7-12% in North India	Chatterjee (1998)

From Table-1, it is clear that most of the staple food crops in India are going to be adversely affected. For sugarcane, it was observed that for every 1°C rise in temperature, there would be a marked reduction in its yield (Chattopadhayay 2000).

II. IMPACT OF CLIMATE CHANGE ON SOIL

The soil system responds to the short-term events such as episodic infiltration of rainfall and also undergoes long-term changes such as physical and chemical weathering due to climatic change. The potential changes in the soil forming factors directly resulting from global climate change would be in the organic matter supply, temperature regimes, hydrology and changes in the potential evapotranspiration. Both the organic matter and carbon to nitrogen ratio(C: N ratio) will diminish in a warmer soil temperature regime. Drier soil conditions will suppress both root growth and decomposition of organic matter and will increase vulnerability to erosion. Increased evaporation from the soil and accelerated transpiration from the plants themselves will cause soil moisture stress.

III. IMPACT ON PESTS, DISEASES AND WEEDS

Incidence of pest and diseases would be most severe in tropical regions due to favourable climate/weather conditions, multiple cropping and availability of alternate pests throughout the year. Climate change is likely to cause a spread of tropical and subtropical weed species into temperate areas and to increase the numbers of many temperate weed species currently limited by the low temperature at high latitudes.

The above facts demand urgent measures, from the scientific community and the government. Some of the adaptation measures at the farmers' level could be:

- For short-season crops such as wheat, rice, barley, oats, and many vegetable crops, extension of the growing season may allow more crops in a year.
- Longer-season cultivars can be sown to provide a steadier yield under more variable conditions.
- Late maturing varieties and alteration of time of sowing to take advantage of the longer growing seasons needs to be adopted.
- Changes in cropping pattern (shift from rice–wheat cropping system to other favourable crop mix) may be adopted. Crop diversification in Canada and in China has been identified as an adaptive response.
- Heat and drought tolerant, pest resistant, salt tolerant varieties would be beneficial. Genetic engineering and gene mapping offer the potential for introducing a wider range of traits.
- Minimum, reduced or conservation tillage technologies, in combination with planting of cover crops and green manure crops, offer substantial possibilities to reverse existing soil organic matter, soil moisture, soil erosion, and nutrient loss to combat further losses due to climate change.
- Water resources in the semi-arid regions are expected to decrease due to climate change. Increased evaporation (resulting from higher temperature), combined with changes in precipitation characteristics (amount, variability and frequency), has the potential to affect agriculture - the predominant user of water. Better water management is required for enhancing crop productivity and ensuring food security. Generally, irrigated agriculture is less adversely affected than dry land agriculture but adding irrigation is a costly

affair as it is dependent upon the availability of water supplies.

- Added nitrogen and other fertilizers would likely be necessary to take full advantage of the CO2 effect but may have deleterious effects on humans and aquatic ecosystems.

Water and nutrient management thus, have to be redefined in various agro-ecologies to meet the future demands.

IV. STRATEGIES FOR FACING THE CHALLENGE

Specific measures can only provide a successful adaptive response if they are adopted in appropriate situations. A variety of issues need to be considered, including land-use planning, watershed management, disaster vulnerability assessment, consideration of port and rail adequacy, trade policy, and the various programmes countries use to encourage or control production, limit food prices, and manage resource inputs to agriculture.

Important strategies for improving the ability of agriculture to respond to diverse demands and pressures include:

- Improved training and general education of populations dependent on agriculture.
- Research on new variety development, incorporating various traits such as heat and drought tolerant, salt and pest resistant should be given prime importance.
- Food programmes and other social security programmes, to provide insurance against local supply changes.
- Infrastructure facilities like transportation, distribution and market need to be improved.
- Existing policies may limit efficient response to climate change. Changes in policies such as crop subsidy schemes, land tenure systems, water pricing and allocation, and international trade barriers could increase the adaptive capability of agriculture.

V. CONCLUSION

Signals of climatic change are already visible. Global climate change is going to affect major crops like rice, wheat, maize in India. Climate is the least manageable of all resources. Hence, to avert the ill effects of climate change, more attention has to be paid to other resources and technologies viz. soil, irrigation water, nutrients, crops and their management practices, to sustain the productivity and to ensure food and environmental security to the country. Adaptive measures are to be taken in a timely fashion, both at the farmers' level (backed by strong agriculture/climate research and application oriented outputs) as well as at the policy makers' level to enable the small and marginal farmers to cope with the adversities of climate change.

VI. REFERENCES

[1]. Aggarwal, P.K. and Kalra, N. (1994). Analyzing the limitations set by climatic factors, genotype, and water and nitrogen availability on productivity of wheat. II. Climatically potential yields and optimal management strategies. Field Crops Res., 38, 93-103.

[2]. Chatterjee, A. (1998). Simulating the impact of increase in Carbon Dioxide and temperature on growth and yield of Maize and Sorghum. M.Sc. thesis, Division of Environmental Sciences, Indian Agricultural Research Institute, New Delhi.

[3]. Chattopadhayay, R. (2000). Simulating the impact of climatic variability and climate change on the productivity of sugarcane. Ph.D. Thesis, Division of Environmental Sciences, Indian Agricultural Research Institute, New Delhi.

[4]. IPCC (1996). Climate Change 1995: Impacts, Adaptations and Mitigation of climate change: Scientific-Technical Analysis. Report of the Working Group II of the Intergovernmental Panel on Climate change, Cambridge University Press, London and New York.

[5]. Kumar K and Parikh J. (1998). Climate change impacts on Indian agriculture: the Ricardian approach, In Measuring the Impact of Climate Change on Indian Agriculture, edited by A Dinar, R Mendelsohn, Everson, J Parikh, A Sanghi, K Kumar, J Mckinsey and S Lonergan, Washington, DC: The World Bank [World Bank Technical Paper No 402.

[6]. Sinha S K and Swaminathan M S. (1991). Deforestation, climate change and sustainable nutrition security: a case study of India. Climatic Change 19: 201-209.

[7]. Saseendran, S.A., Singh, K.K., Rathore, L.S., Singh, S.V., Sinha, S.K. (1999). Effects of climate change on rice production in the tropical humid climate of Kerala, India. Climate Change 12:1-20.