

Climate change and its impact on Agriculture Sector in India

Jinu Joseph

Research Scholar, Department of Economics, Mar Thoma College, Thiruvalla, Kerala, India

(Received 25 July, 2020; Accepted 15 September, 2020)

ABSTRACT

In the context of the Indian economy climate change is a serious issue. Increase in the number of warm days and nights, increased frequency of deficit monsoons and heavy precipitation events, increased occurrence of temperature extremes have been observed in our country. Moreover, these trends are expected to continue over years. India is projected to experience warming above global level throughout the 21st century. The average temperature variation is projected to be 2.33 °C to 4.78 °C with a doubling in CO₂ concentrations. Climate change is likely to directly influence food production across the globe. Increase in the mean seasonal temperature of the country can reduce the duration of many crops and hence reduce the yield. This paper delivers an overview of climate change and Indian agriculture. It gives some specific attention to the impact of climate change on Indian agriculture. The paper ends with some comments on Indian agricultural policy in the era of climate change and suggest strategies and actions to mitigate the problem.

Key words : Climate change, Indian agriculture, Rainfall, Carbon dioxide, Global warming

Introduction

Climate change is one of the most defining concerns of today's world. It has greatly reshaped or in process of altering earth's ecosystems. Although climate change has been a constant process on earth, but in recent times, the pace of this variation has increased manifolds. Climate change refers to the increasing temperature of the earth due to an increased amount of carbon dioxide (CO₂) and other greenhouse gases (GHGs). Ministry of Environment and Forests, Government of India defines it as "a statistically significant variation in either the mean state of the climate or in its variability" (Hans, 2011).

Climate change as defined by Intergovernmental Panel on Climate Change (IPCC) "refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period,

typically decades or longer" (IPCC 2013). Climate changes consist of changes which happen due to internal and natural processes as well as the ones caused by external factors especially human activity induced pollution.

Climate change and weather conditions directly influence agriculture production of the country. Overall agricultural production could be augmented due to the doubling of CO₂ fertilization effect. Climate changes imposed an effect on water resources also. India will experience more seasonal variation in temperature with more warming in the winters than summers. The effect of climate change on agriculture could result in problems with food security. It may threaten the livelihood activities upon which much of the population depends.

Climate change scenarios comprises higher temperatures, changes in precipitation and higher atmospheric CO₂ concentrations. There are three ways

in which the Greenhouse Effect may be significant for agriculture sector. Firstly, higher atmospheric CO₂ concentrations can have a direct impact on the growth rate of crop production. Secondly, CO₂ induced changes of climate may influence the levels of temperature, rainfall and sunshine that can effect productivity of plant and animal. Finally, increases in sea level may leads to the loss of farmland by increasing salinity of groundwater in coastal zones.

As for climate point of view there are two major crop growing season in India. Firstly, the summer or 'kharif' crop-growing season (June - September). The major 'kharif' crops are rice, cotton, jute, groundnut, maize, sugarcane, soybean, bajra etc. The 'kharif' crops can be harvested during the autumn (October - November) or winter (December - February) months. The southwest monsoon is critical to the kharif crops. This crops accounts for more than 50 percent of the food-grain production and 65 percent of the oilseeds production in the country. Secondly, the winter or 'rabi' crop-growing season starts after the summer monsoon. Rainfall occurring at the end of the monsoon season provides irrigation water for the rabi crops. The major 'rabi' crops are wheat, mustard, barley, potato, onion, gram etc. Therefore, the summer monsoon is responsible for both kharif and rabi crops production in India.

Objective of the Study

The objective of this paper is to analyse the impact of climate change on Indian agriculture

Review of literature

Agriculture sector act as key component for the development of the Indian economy. It contributes nearly 15.7 percent to India's GDP and 10.23 percent to the total exports of our country. It also provides employment to 58.2 percent of the population. So a steady growth of agriculture sector is inevitable for progress and development of India. In India agriculture is considerably dependent on the south-west monsoon. The net irrigated area of the country is 60.9 million hectares and total net sown area of 140.3 million hectares. Large part of the net sown area is rain-fed. Indian agriculture is very sensitive to any changes in the pattern of rainfall (Aggarwal *et al.*, 2010).

Gangadhar Rao and Sinha (1994) pointed out that the wheat yields decreased due to the adverse effects of temperature during grain filling and matu-

rity stages of the growth in India.

Agronomic studies in India suggest that a temperature rise of 4 °C would cause a fall in grain yields by 25 to 40 percent (Rosenzweig and Parry, 1994). In India a +2 °C temperature change and a +7 per cent precipitation change results in 3 percent decline in farm-level net revenue annually (Kumar, 2009).

Cline William R(2007) pointed out that agricultural yield in India is going to affect seriously by climate change. South India will face decrease in crop yield in range of 15 to 25 percent but in North India it will be more than 25 percent between 2003 and 2080s. Land productivity in India declines with increase in annual average maximum temperature. By using simulations, it was predicted that climate change would cause a reduction in land productivity by 48.63 percent by 2100 (Kumar *et al.*, 2016).

Materials and Methods

The present paper is descriptive in nature and based on secondary sources collected from various books, Intergovernmental Panel on Climate Change (IPCC) Report 2001, 2007 and 2013, National and International Journals, published Government reports, publications from various websites and so on.

Results and Discussion

In India climate change has about 4 to 9 percent impact on agriculture sector each year. As agriculture contributes 15 percent to India's GDP, climate change presumably causes about 1.5 percent loss in India's GDP. In India, 64% of the population depends on agriculture for their livelihood.

Climate change affects crop production by means of direct, indirect, and socio-economic effects as described in Figure 1.

The average global surface temperature has increased by 0.74 °C since the late 19th Century and is expected to increase by 1.4 °C to 5.8 °C by 2100 (IPCC, 2007). The worldwide experiments projected 10 to 40 percent reduction in crop production in India by 2080 to 2100 due to climate change (IPCC, 2007). Wheat production are predicted to decrease by 5 to 10 percent with every increase of 1°C. The overall crop yields could drop up to 30 percent in South Asia by the mid-21st century (IPCC, 2001). Climate change will result 40 percent drop in agricultural production by the 2080s.

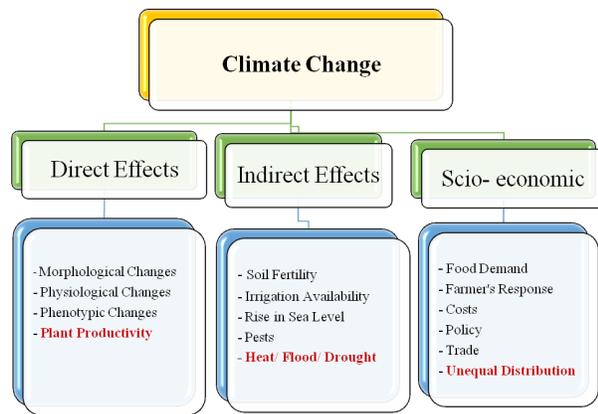


Fig. 1. Effects of Climate Change on Crop Production

The crops like rice, wheat, maize and sorghum are the worst hit by climate change. The yields of rice and wheat are likely to see about 6 to 10 per cent decrease by 2030. climate change will have a neutral or positive impact on the crops like potatoes, soybean, chickpea and mustard.

Crops like soybean and gram are likely to benefit from higher level of CO₂ in atmosphere, which supports in CO₂ fertilization. But this positive effects are unlikely to last more than 10-15 years. Mustard will experience a neutral-to-positive effect. A 1°C increase in temperature won't have much impact on agriculture yields. Though, a similar increase in temperature in eastern and central India will have an adverse impact. Production of potato will be positively impacted by elevated CO₂ concentration. The 'Kharif' crops will be affected more by rainfall variability, whereas 'Rabi' crops by minimum tem-

perature. The Wheat production is likely to be negatively impacted in Rabi season. Due to terminal heat stress with 1°C increase in temperature results in loss of 4 metric tonnes (MT) of wheat.

As per economic survey estimates, Indian economy currently faces losses of about \$9-10 billion annually due to extreme weather conditions and climate change. Of these, around 80 percent losses remain uninsured. Adaptation to climate change will need different cropping patterns and suitable inputs to compensate yield fluctuations. Policy-makers will need to consider adaptive and mitigation measures to cope with fluctuating agricultural patterns in the country. Measures may comprise the introduction of the use of alternative crops, changes to cropping patterns, technological change, use of new crop varieties, change in demand and market and promotion of irrigation activities and water conservation techniques.

Conclusion

In a situation of varying climate and weather conditions, it is necessary to introduce new varieties of crops which can withstand changing temperature and all other natural factors. In India there is an urgent need for coordinated efforts to strengthen the research to evaluate the impact of climate change on agriculture and allied activities. Agricultural production is extremely sensitive to climatic changes like changes in temperature and precipitation. This may lead to outbreaks of pests and diseases thereby dropping harvest which ultimately disturbing the

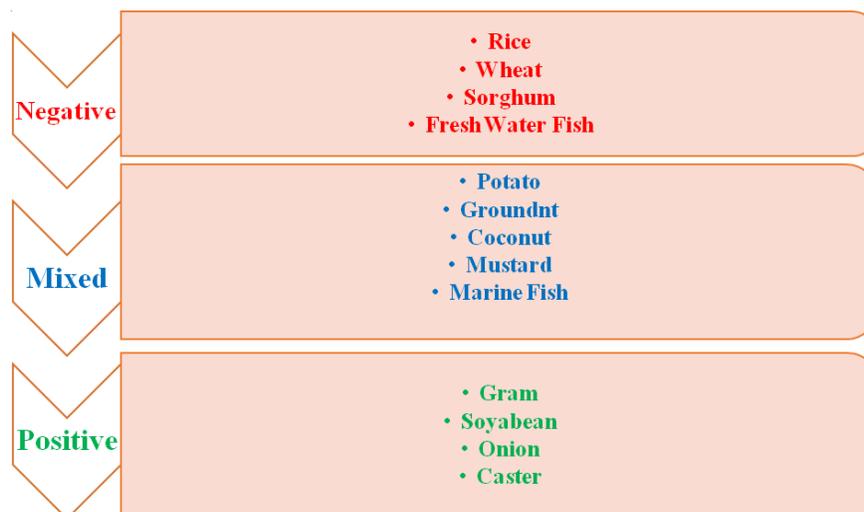


Fig. 2. Commodity Wise Impact of Climate Change

food security of the country. Coping with the effect of climate change on agriculture sector will need careful administration of resources like soil, water, forest and biodiversity.

References

- Aggarwal, P. K., Kumar, N. S. and Himanshu, P. 2010. Impacts of climate change on growth and yield of rice and wheat in the Upper Ganga Basin, 'Climate Change Impacts on Freshwater Ecosystems in the Himalayas' (CCIFEH) project, WWF Report India. 1-36.
- Arora, N.K. 2019. Impact of climate change on agriculture production and its sustainable solutions. *Environmental Sustainability*. 2 : 95-96.
- Cline, William. R. 2007. Global Warming and Agriculture: New Country Estimates Show Developing Countries Face Declines in Agricultural Productivity, Center for Global Development. : 1-4.
- Hans, V. B. 2011. Climate Change and Indian Agriculture – Implications and Reactions, Paper presented at the *National Seminar on Civic Response to Global Warming – A Sociological Perspective*, Dept of Sociology and Dept of Social Work, St Mary's College, Shirva, DK District, Karnataka (India) and Mangalore Sociology Association, August 12-13, 2011.
- IPCC (Intergovernmental Panel on Climate Change) 2001. Climate Change 2001: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Third Assessment Report of the IPCC. Cambridge University Press, Cambridge, UK. 9. IPCC (2007) Summary for Policy-makers, Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the IPCC. Cambridge University Press, Cambridge, United.
- IPCC (Intergovernmental Panel on Climate Change) 2007. Parry, ML; Canziani, of; Palutikof, JP; van der Linden, PJ; Hanson, CE (eds) Climate Change 2007: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the IPCC, Cambridge: Cambridge University Press.
- IPCC (Intergovernmental Panel on Climate Change) 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Kumar, A., Sharma, P. and Joshi, S. 2016. Assessing the Impacts of Climate Change on Land Productivity in Indian Crop Agriculture: An Evidence from Panel Data Analysis, *J. Agr. Sci. Tech.* 18 : 1-13.
- Kumar, K.S.K. 2009. Climate Sensitivity of Indian Agriculture Do Spatial Effects Matter? South Asian Network for Development and Environmental Economics (SANDEE), Working Papers, ISSN 1893-1891; 2009-WP 45.
- Kumar, R. and Gautam, H. R. 2014. Climate Change and its Impact on Agricultural Productivity in India. *Journal of Climatology & Weather Forecasting*. 2 (1) : 1-3.
- Mall, R.K., Singh, R., Gupta, A., Srinivasan, G. and Rathore, L.S. 2007. Impact of Climate Change On Indian Agriculture: A Review. From: <https://www.researchgate.net/publication/278127158>. (Retrieved on 23.07.2020)
- Naikwade, P. 2017. Impact of climate change on agricultural production in India: effect on rice productivity. *Bioscience Discovery*. 8(4) : 897-914.
- Rao, G.D. and Sinha, S.K. 1994. Impact of climatic change on simulated wheat production in India. In: C. Rosenzweig and I. Iglesias, Editors, *Implications of Climate Change for International Agriculture: Crop Modelling Study*, EPA, USA (1994), 1-10.
- Rosenzweig, C. and Parry, M. 1994. Potential impacts of climate change on world food supply. *Nature*. 367: 133-138.