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Climate Change Scenario in Indian Context

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ABSTRACT

The Indian economy is mostly agrarian-based and depends on the onset of the monsoon and its further behavior. The livelihood of people is mostly dependent on climate-sensitive natural resources like land, water and forests. The climate change impact on these natural resources affects agriculture, forests, water resources and human health. India is a vast country occupying 2.4% world's geographical area, sharing 16.2% of the global human population and 15% of the global livestock population. It is endowed with varied climates supporting rich biodiversity and highly diverse ecology. More than 60% of its population living in rural areas, where agriculture is the major concern rural economy that is the backbone of the Indian economy. The consistent impact of climate change may threaten livelihood activities, which are mostly based on agriculture providing food security. Climate change and global warming pose a significant threats to agriculture. Pest populations are strongly dependent upon temperature and humidity. It has been predicted that 10-40% losses in crop production in India with an increase in temperature 3 to 5ºC by the end of 21 century. The allied sectors of agriculture have also been affected adversely by climate change e.g., lowering production in dairy cattle, poultry and fishery. Changes in climate variables may alter the distribution of important vector species, especially malarial mosquitoes, and subsequently increase the spread of such diseases to new areas. The loss in net revenue at the farm level is estimated to range between 9% to 25% for a temperature rise of 2ºC to 3.5ºC. To minimize the adverse impact of climate change, adaptation comprises shifting the population living close to the sea side to escape the rising sea level or promote crops that can tolerate higher temperatures. To remedial measures taken to combat the adverse impact of climate change, mitigation comprises a reduction in the emissions of greenhouse gases. The government of India's expenditure on adaptation and mitigation to combating climate change impact shares 2.6% of the GDP, with agriculture, water resources, health and sanitation, forests, coastal-zone infrastructure and extreme weather events being specific areas of concern. This paper was attempted to review the climate change scenario with their present and future adaptation and mitigation efforts in India.

Keywords: *Climate change, Global warming, Natural resources, Livelihood, India.*

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INTRODUCTION

The Indian economy is mostly agrarian-based and depends on the onset of the monsoon and its different behaviour. The livelihood of the rural people is directly dependent on climate sensitive natural resources like land, water and forests. The impact of climate change on these natural resources affect the agriculture, forests, water resources and human health. India is a vast country occupying 2.4% world geographical area sharing 16.2% of the global human population and 15% of the global livestock population. It is endowed with a varied climate supporting rich biodiversity and a highly diverse ecology. More than 60% of its population living in rural areas, where agriculture is the major concern of rural economy, which is the backbone of the Indian economy. Climate change and global warming pose a significant threats to agriculture. The consistent impact of climate change may threaten livelihood activities, which are mostly based on agriculture providing food security. The Intergovernmental Panel on Climate Change (IPCC) defines climate change as a change in the state of the climate that can be identified by changes in the mean or the variability of its properties and that persists for an extended period, typically decades or longer. The current trend of global warming is the heating of global surface temperature due to the emission of greenhouse gases, over a long period of time. The global average surface temperature has increased by approximately 0.6ºC over the past century.

Further, the global average surface temperature will increase by 1.4–5.8ºC, over the end of 21 century and atmospheric carbon dioxide concentrations by 540–970 ppm over the same period. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007) has been analyzed based on observations since 1850 till 2007 under variables of changes in temperature, sea level, and snow cover in the northern hemisphere, as the warming of the earth's climate system is unequivocal. The global atmospheric concentration of carbon dioxide has increased from a pre-industrial value of about 280 ppm to 379 ppm in 2005. Multi-Model averages show that the temperature increases during 2090 - 2099 relative to 1980 - 1999 may range from 1.1 to 6.4ºC and sea level rise from 18 to 59 cm. These climatic variabilities have been projected to impact on agricultural production, freshwater availability, oceanic acidification, flooding of coastal areas and the outbreak of vector-borne & water-borne diseases. The impact of climate change concerning the vulnerability of agricultural production systems not only the physiological response of the affected plant but also the vulnerability of socio-economic systems affected by coping of agricultural production by changes in climatic variability. The adaptability of farmers in India is severely restricted by the heavy reliance on natural factors and the lack of complementary inputs and institutional support systems (IPCC, 2001; NATCOM, 2004; IPCC, 2007; NAPCC, 2008; Dhaliwal et al., 2011; Adhinarayanan, 2013; & Rao et al., 2019).

The year 2002 was a classic example to show that Indian food grain production depends on rainfall deficiency was 19% against the long period average in the country, and 29% of the area was affected due to drought. The All-India drought is declared when the rainfall deficiency for the country is more than 10% of normal and more than 20% of the country's area is affected by drought conditions. The Kharif season food grain production was adversely affected by a whopping fall of 19.1% due to All India drought during monsoon 2012. High temperature in March 2004 adversely affected crops like wheat, apple, mustard, rapeseed, linseed, potato, vegetables, pea and tea across India's State of Himachal Pradesh. The yield loss was estimated between 20% and 60% depending upon the crop. Wheat and potato harvest was advanced by 15-20 days and the flowering of apple was early by 15 days. The optimum temperature for fruit blossom and fruit set is 24ºC in the case of apple, while it experienced above 26ºC for 17 days. The entire region recorded between 2.1 and 7.9ºC higher maximum temperature against normal

across the State of Himachal Pradesh in March 2004. A decline of 39% in annual cocoa yield was noticed in 2004 compared to 2003 due to a rise in maximum temperature of the order of 1 to 3ºC from 14th January to 16th March in Central part of Kerala, India. Such trend was noticed whenever summer temperature shot up by 2 to 3ºC compared to that of a normal maximum temperature of 33 to 36.5ºC. An increase of 1-4 ºC, the grain yield reduced on average by 10% for each degree of temperature increase and annual wheat production could plunge by 4-5 million tones with every 1ºC rise in the temperature predicted in India by the end of 21 century. The loss in net revenue at the farm level is estimated to range between 9% to 25% for a temperature rise of 2ºC to 3.5ºC. It has been predicted that 10-40% losses in crop production in India with increase in temperature 3 to 5ºC by the end of 21 century (Kumar & Parikh, 1998; NATCOM, 2004; Prasad & Rana, 2006; IPCC, 2007; NAPCC, 2008; Kumar, 2010; Ninan & Bedamatta, 2012; Ranuzzi & Srivastava, 2012; Mahato, 2014; & Morya et al., 2017).

OBSERVED CLIMATE CHANGE IN INDIA

Surface Temperature

At the national level, there has been an observed increase of 0.4° C temperature in surface air over the past century. It has been also observed a warming trend among the central, west coast, interior peninsula, and northeastern India. However, cooling trend have been observed in northwestern and southern India (NATCOM, 2004; & NAPCC, 2008).

Extreme Weather Events

Concerning extreme weather events, it has been observed frequent droughts followed by less severe droughts in multi-decadal periods. An overall trend in severe storm incidence along the coastal regions has also been observed at the rate of 0.011 events per year. The states of West Bengal and Gujarat have reported increasing trends, while decreasing trend has been observed in Orissa. The analysis of rainfall observation has been shown a rising trend in the frequency of heavy rain events and decreasing trend in the frequency of moderate rainfall events over central India significantly during the decades of 1951 to 2000 (NAPCC, 2008; & Dhaliwal et al., 2011).

Melting of Himalayan Glaciers

The Himalayan glacier occupied one of the biggest sources of snow and ice and form a resource of water for rivers of the Indus, the Ganga, and the Brahmaputra. The Glacial melting may impact their long-term lean-season flows, adversely affecting the economy of water availability and hydropower generation (NAPCC, 2008; & Dhaliwal et al., 2011).

Rise in Sea Level

There has been estimated that sea level rise occurred between 1.06-1.75 mm per year based on coastal tide gauges records in the Northern India Ocean for more than 40 years. These rates are consistent with 1-2 mm per year global sea level rise estimated by the IPCC (NAPCC, 2008; & Dhaliwal et al., 2011).

Rainfall

Meanwhile regional monsoon variations recorded, there has been observed a non-significant trend of monsoon rainfall nationally. The west coast, northern Andhra Pradesh, and northwestern India have been observed trend of increasing monsoon rainfall (+10% to +12% of the normal over the last 100 years), while the eastern Madhya Pradesh, northeastern India, and some parts of Gujarat and Kerala have been observed trend of decreasing monsoon rainfall (-6% to - 8% of the normal over the last 100 years) (NAPCC, 2008; & Dhaliwal et al., 2011).

SOME PROJECTED IMPACTS OF CLIMATE CHANGE IN INDIA

Impacts on Agriculture

Indian farming is basically a monsoon-based enterprise. The climate change of variability in monsoon rainfall and temperature within a season have been adversely affected crop production. The variability in monsoon rainfall and temperature have been expected greater loss in the rabi crop. It has been estimated that,

every 1°C rise in temperature reduces wheat production by 4-5 million tons. The variability in monsoon rainfall and temperature have been significantly affected the quality of fruits, vegetables, tea, coffee, aromatic & medicinal plants and basmati rice. It has been predicted that 10-40% losses in crop production in India with rise in temperature 3 to 5°C by the end of 21 century. The allied sectors of agriculture have also been affected adversely by climate change *e.g.,* lowering production in dairy cattle, poultry and fishery (Ninan & Bedamatta, 2012; Ranuzzi & Srivastava, 2012; Mahato, 2014; & Morya et al., 2017).

Impacts on Water Resources

The variability of temperature, precipitation and humidity concerning climate change may have a significant long-term impact on the quality and quantity of water resources. While decreasing snow cover over Himalayan glacier under the impact of climate change may have adversely affected the river systems of the Ganga, the Brahmaputra and the Indus which benefited from melting snow in the lean season. It has also been projected that, the decline in total run-off for all river basins of India except Narmada and Tapti. Sabarmati and Luni basins also anticipate a decline in run-off by more than two thirds. It has been projected that, the freshwater resources near the coastal regions will suffer salt intrusion due to sea level rise (IPCC, 2007; & NATCOM, 2004).

Impacts on Surface Temperature

The simulation studies by Indian Institute of Tropical Meteorology (IITM), Pune, estimated that annual mean surface temperature is expected to raise by the end of century, ranges from 3 to 5° C with warming more pronounced in the northern parts of India. By 2070- 2099 the average temperatures across seasons are likely to range between 2.5 to 5° over different regions of India. Winter temperatures are likely to be significantly higher, ranging between 3.75 to 4.95° across the regions. The uncertainty is much higher with regard to the precipitation and by 2070-2099, the South-West monsoon precipitation is likely to increase between 9 to 27% across the regions (NATCOM, 2004; & NAPCC, 2008).

Impacts on Biodiversity

The biodiversity is highly sensitive to climatic variability. The Intergovernmental Panel on Climate Change (IPCC) has projected that the global average temperature increase during the 21st century will range from 1.4 to 4°C. The Consultative Group on International Agricultural Research (CGIAR) has been projected on the basis of distribution models of wild relatives of three staple crops of the poor, *i.e.,* peanut, cowpea and potato may have threatened 16-22 % of wild species extinction by the year of 2055. Loss of genetic diversity can have serious long-term consequences globally (Parmesan & Yohe, 2003; IPCC, 2007; & Kannan & James, 2009).

Impacts on health

The climatic variability is the major cause of disease outbreaks. Changes in climate variables may alter the distribution of important vector species, especially malarial mosquitoes, and subsequently increase the spread of such diseases to new areas. It has been projected that the transmission of malaria by mosquitoes will be more active during the year by an increase of 3.8°C in temperature and 7% in relative humidity. (IPCC, 2007; & NAPCC, 2008).

Impacts on Forests

The impact of climate change has been projected for shifting forest types, their production and dependent livelihood. The shifting forest types may have adversely affected the associated biodiversity due to the impact of changes in climatic variables (NATCOM, 2004; & Dhaliwal et al., 2011).

Impacts on Coastal Areas

A mean Sea Level Rise (SLR) of 15-38 cm is projected along India's coast by the mid-21st century and of 46-59 cm by 2100. In addition, a projected increase in the intensity of tropical cyclones poses a threat to the heavily populated coastal zones in the country (NATCOM, 2004).

STRATEGIES FOR ADAPTATION AND MITIGATION IN INDIA

To minimize the adverse impact of climate change, adaptation comprises shifting the population living close to the seaside to escape

the rising sea level or promoting crops that can tolerate higher temperatures. To remedial measures taken to combating adverse impact of climate change, mitigation comprises reduction in the emissions of greenhouse gases by promoting renewable sources of energy such as solar energy, wind energy and nuclear energy instead of burning fuel in thermal power stations. The government of India's expenditure on adaptation and mitigation to combating climate change impact shares 2.6% of the GDP, with agriculture, water resources, health and sanitation, forests, coastal-zone infrastructure and extreme weather events being specific areas of concern.

CONCLUSION

It has been concluded that floods, droughts, heat and cold waves are common worldwide due to climate change. Their adverse impact on the livelihood of farmers is tremendous. It is more so in India as our economy is more dependent on agriculture. Food security and environmental sustainability are the major focuses of global agriculture. The livelihood of the rural people is directly dependent on climate-sensitive natural resources like loud water and forests. The impact of climate change on these nature resources affects agriculture, forests, water resources and human health mitigation and adaptation policy formulation, one of the crucial inputs needed in the potential impact due to climate change on various climate-sensitive sectors. For mitigation, information would provide the required justification for decarburizing the energy systems. On the other hand, in the context of adaptation, knowledge of climate change impacts will be helpful in prioritizing the adaptation in most needed sectors and regions. There is a need to guide farmers on the projected impact of climate change and sensitize them on mitigation and adaptation options to minimize the risk in agricultural and allied sectors of rural livelihoods of India.

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REFERENCES

Adhinarayanan, R. (2013). Climate change and food security. *Development Matters*, *02*, 1-9.

Dhaliwal, L. K., Buttar, G. S., Sandhu, S. K., & Singh, S. P. (2011). Implications of climate change. *Asian Journal of Environmental Science*, 6(2), 224-229.

IPCC, (2001). Climate change 2001: The scientific basis. *https://www.ipcc.ch/ipccreports/ tar/wg1/index.htm.*

IPCC, (2007). Climate change 2007: The physical science basis. *https://www.ipcc.ch/ ipccreports/ tar/wg2/index.htm.*

Kannan, R., & James, D. A. (2009). Effects of climate change on global diversity: a review of key literature. *Tropical Ecology*, *50*, 31-39.

Kumar, K. S. K. (2010). Climate sensitivity of Indian agriculture: role of technological development and information diffusion. In : *Proceedings of National Symposium on Climate Change and Rainfed Agriculture*, 18-20 February 2010, Organized by Indian Society of Dryland Agriculture, CRIDA, Hyderabad, India. pp. 01-18.

Kumar, K. S. K., & Parikh, J. (2001). Indian agriculture and climate sensitivity. *Global Environmental Change*, *11*(2), 147- 154.

Mahato, A. (2014). Climate change and its impact on agriculture. *International Journal of Scientific and Research Publications*, *4*(4), 1- 6.

Morya, G. P., Kumar, R., Chand, S., & Gaur, S. C. (2017). Impact of climate change on rural life in India. In : Lead papers of *Proceedings of National Conference on Science for Rural India (Vol.-2),* 27-28 February 2017, Organized by Swadeshi Vigyan

Sansthanam-U.P. Chapter III of Vijnana Bharti, Deoria, India. pp. 15-20.

NAPCC, (2008). National action plan on climate change. *http://envfor.nic.in/ccd-napcc*.

NATCOM, (2004). India's initial national communication to the United Nations framework convention on climate change. Ministry of Environment and Forests, Government of India. 268 pp.

Ninan, K.N., & Bedamatta, S. (2012). Climate change, agriculture, poverty and livelihoods: a status report. Working Paper 277, *Institute of Social and Economic Change*, Bengaluru, India. 35 pp.

Parmesan, C., & Yohe, G. (2003). A globally coherent fingerprint of climate change impacts across natural systems. *Nature*, 421, 37- 42.

Prasad, R., & Rana, R. (2006). A study on maximum temperature during March 2004 and its impact on rabi crops in Himachal Pradesh. *Journal of Agrometeorology*, *8*(1), 91-99.

Ranuzzi, A., & Srivastava, R. (2012). Impact of climate change on agriculture and food security. ICRIER Policy Series No. 16.

Rao, C. S., Prasad, R. S., & Mohapatra, T. (2019). Climate change and Indian agriculture: impacts, coping strategies, programmes and policy. Technical Bulletin/Policy Document 2019, Indian Council of Agricultural Research, Ministry of Agriculture & Farmers' Welfare and Ministry of Environment, Forestry & Climate Change, Government of India, New Delhi, India. 25 pp.