

IMPACT OF CLIMATE CHANGE ON AGRICULTURE SECTOR IN INDIA

Author's Name: Dr. V. Kokila

Affiliation: Assistant Professor of Economics Department of Economics University of Madras, Chepauk, Chennai 600005, Tamil Nadu, India. Mobile No. : +91-9677569092

E-Mail I.D: kokilavedamanickam01@gmail.com

DOI No. – 08.2020-25662434

Abstract

This paper made a modest attempt to give an insight into impact of climate change on agricultural sector in India. Agriculture sector in India is defenseless to climate change. Any small changes in the climate affects the production adversely. The climate change is the long-term shift in temperature and weather patterns. The climate change can result in low crop yields and effect quality of nutrition in agricultural sector. A 2021 study estimates that the severity of heat wave and drought impact on crop production tripled over last 50 years in Europe from losses of 2.2% during 1964-1990 to losses of 7.3% in 1991-2015. It is clear that climate change and Agriculture sector has greater connectivity with each other and climate change adversely affects the productivity. This paper will be helpful to implementable policies.

Keywords: *Agriculture, Climate change and Productivity.*

INTRODUCTION

India is one of the major competitor in agriculture sector globally. Agriculture sector is serving as the primary source of livelihood to 58% of India's population. According to IBEF report of August 2022, India has the world's largest cattle herd (buffaloes), largest area planted to wheat, rice and cotton and is the largest producer of milk, pulses and spices in the world. It is the second largest producer of fruit, vegetables, tea, farmed fish, cotton, sugarcane, wheat, rice, and sugar. Agriculture sector in India holds the record of second-largest agricultural land in the world generating employment for about half of the country's population.

Now a days the major challenges facing by the growing population is equitable opportunity of standard of living like necessary nutritious food, safe drinking water, safer shelter, sustainable energy and the good environment. But, the environment worldwide is changing and lots issues faced by the population is like land degradation, deforestation, land sliding, soil erosion, loss of biodiversity, ozone layer depletion and the man-made climate change, jeopardizes the capacity to meet the basic necessities of human. According to Anish Chatterjee's report it is mentioned that 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 temperature have risen (0.6 degree C 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 resource, agriculture, forestry, fisheries and human settlements, ecological systems and human health, especially in developing countries due to their vulnerabilities.

WHAT IS CLIMATE CHANGE?

Climate change refers to long term shift in temperatures and weather patterns. These shift may be natural, but since the 1800s, human activities have been the main driver of climate change, primarily due to the burning of fossil fuels (like coal, oil, and gas) increasing heat-trapping greenhouse gas levels in the earth's atmosphere. Increasing greenhouse gas emissions from human activity act like a blanket wrapped around the earth, trapping the sun's heat and raising temperatures. Examples of greenhouse gas emissions that are causing climate change include carbon dioxide and methane.

According to the studies observation is that there is an increase in global average temperatures and change in rainfall rates during the 20th century around the world. The most imminent climatic changes in recent times is the increase in the atmospheric temperatures due to increased levels of greenhouse gases such as carbon dioxide (CO₂), methane (CH₄), ozone (O₃), nitrous oxide (N₂O) and chlorofluoro carbons (CFCs). Because of the increasing concentrations of those radiative or greenhouse gases, there is much concern about future changes in our climate and direct or indirect effect on agriculture.

CLIMATE CHANGE SCENARIO IN INDIA

India is playing a major role in global community, any divergence in the way sustainability in this region may have adverse effect on the other parts of world. It is necessary to analyze the disturbance in any part of land system will affect the entire ecosystem. According to the report of Lead Connect May 2022, more than 40% of India population will be facing water scarcity by 2050 (Made for Minds, 2022), Average temperature had already been risen by 0.7 degree Celsius during 1901-2018 (Krishnan et. al., 2020). It is expected that there is possibility of almost 4.4 degree Celsius rise in average temperature by the end of twenty first century (Krishnan et. al., 2020). Thousands of lives were killed in India and Pakistan by 2015 deadly heat waves. A phenomenon of this kind can become very frequent in this region (IPCC, 2020). There is a frightening possibility of rise in temperature by 5.3 degree Celsius in Delhi by the end of the century (IPCC, 2021). Recently, Delhi recorded more than 49 degree Celsius. Gurgaon which falls under national capital region recorded 48 degree Celsius (Mint, 2022).

IMPACT OF CLIMATE CHANGE ON AGRICULTURE SECTOR

The global food security is relies on the sufficient food production and food access, and is defined as a state when: 'all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life' (FAO, 1996). These are the following impacts of the climate change on agriculture sector:

The year 1998 was the warmest and declared as the weather-related disaster year. It caused hurricane havoc on Central America and floods in China, India and Bangladesh. Canada and New England suffered heavily due to ice storm in January while Turkey, Argentina and Paraguay suffered with floods in June 1998. In contrast huge crop losses were noticed in Maharashtra (India) due to un-seasonal and poor distribution of rainfall during 1997-98. The 1997/1998 El Nino event (The El Nino is nothing but warning of Pacific), the strongest of the last century, affected 110 millions people and cost of loss is the global economy nearly US \$ 100 billion.

It is also observed that 2003 was the year of heat and cold waves across the world. The European Union suffered to large extent due to heat wave that occurred in 2003 in summer and severe cold waves from December to January. In India Bihar, Andhra Pradesh, Orissa, Uttar Pradesh, West Bengal experienced large heat waves in summer. In some part of Jammu, Punjab, Haryana, Himachal Pradesh, Bihar, Uttar Pradesh and North Eastern States experienced unprecedented cold wave.

The crop yield loss varied between 10 and 100 % in the case of horticultural crop and seasonal crops. The fruit size and quality were also adversely affected in horticulture crops. However, temperate fruit like apple, perch, plum and cherry gave higher yield due to extreme chilling.

The damage was more in low-lying areas where cold air settled and remained for a longer time on the ground (Samra et. al. 2004).

- **Scarcity of water:** The changes in climate variables, like temperature humidity and precipitation may high impact on quality and quantity of water. River system of Brahmaputra, the Ganga, and the Indus, which benefit from melting snow in lean season, are likely to be particularly affected by the decrease in snow cover. A decline in total run-off for all river basins. Due to sea level rise, the fresh water sources near the coastal regions will suffer salt intrusion.
- **Reducing food production:** Climate change effects the food production in India and it's a threat to the growing population in terms of access to food in future. The studies by Indian Agriculture Research Institute (IARI) and other studies illustrate that there will be expected loss in Rabi crop. In every 1 degree Celsius rise in temperature will reduce the wheat production by 4 to 5 million tonnes. The quality of fruits, vegetables, and tea, coffee, aromatic and medical plants and basmathi rice will be affected if there is small changes in the temperature and rainfall. The pathogens and insect population are dependent on temperature and humidity and changes in these parameters will affect the population dynamics of insects. Some other impacts on agriculture sectors includes low yield from dairy cattle and decline in fish breeding, migration, and harvest. Global reports indicate a loss of 10-40% in crop production by 2100.
- **Increase in food price:** Due to climate change there will be a problem of food insecurity, as the food production is getting affected and reduction in yield. Food may become more expensive to people and it will affect intake of proper nutrition at quantity and the as climate change mitigation efforts increase energy prices it will affect the food price.
- **Competition for land:** The competition for land may increase as the effect of climate change there will be a changes in the soil texture, and unsuitable for production of certain crops. As land becomes unsuitable for production there will be a demand for fertilized land and competition for such land will increase in future.
- **Industries and Health:** The industries mostly located near coastal areas and river flood plains, and they are closely linked with climate sensitive resources. And the climate will also affect the health of millions of population by increasing the death rate due the heat waves, floods, storms, fire and droughts. The communicable diseases and non-communicable diseases may affect the health of the people like malaria, diarrhea and increased malnutrition.

EFFECTS OF CLIMATE CHANGES IN INDIA

The surface temperature on increased by 0.4 Degree, warming climate was observed in west coast, in central India, the interior peninsula and northeastern India, and also the cooling trends were seen in parts of south India and northwest areas. The observed heavy rainfall was in west coast, northern Andhra Pradesh and north-western India, and less rainfall was observed in eastern Madhya Pradesh, north-eastern India, Gujarat and Kerala. The drought condition was also frequent in many areas of

India, increased storms in West Bengal and Gujarat and decline storms has been observed in Orissa. And also the problems of sea level rise in was found in the north Indian Ocean, it has been between 1.06 – 1.75 mm per year over the period of 40 years. Some of the very important effects of climate change are given below:

1. **Effects of Rise in Temperature:** The increase in temperature may lead to increase in insect population their survival, development, population size and geographic range. In this such situation some insect may grow quickly (cabbage maggot, Colorado potato beetle, diamond back moth, onion maggot, European corn borer) and some insect may take time to complete the life cycle (Cicadas, Arctic moths). This may cause crop damage and shift crops geographically and pests to higher altitudes.
2. **Effects of Snow and Rainfall:** The heavy rainfall will drive out the insects from their hosts like leafhoppers, plant hoppers, thrips, cut worms etc. While others insects submerge to death like *Helicoverpa*, *Spodoptera*, *Etiella*, mealy bugs, pupae of fruit fly, rice stem borers etc.
3. **Effects of Increase in CO₂ Level:** Increase in carbon dioxide has both positive and negative effects. It has positive physiological effects through increased photosynthesis. The impact is higher on C₃ crops such a wheat, rice than on C₄ plants like maize and grasses. The direct effects of changes in CO₂ concentration will be through changes in the radiation, temperature and precipitation. Indirect effects has the effect on soil moisture and infestation by pests and diseases, and also reduces the crop duration due to increase in the temperature. Entomologists predicted more generation of insects in warm climate that increase the use of insecticides application than normal.

MEASURES FOR ADAPTATION AND MITIGATION IN INDIA

The measures taken to minimize the adverse impacts of climate change is adaptation like move the communities living close to the sea shore to manage the rising sea level. The term mitigation means to reduce the emission of greenhouse gases that cause climate change in the first place like replacing the renewable source of energy such as solar energy or wind energy or nuclear energy instead of burning fossil fuel in thermal power stations. The Government of India spends more than 2.6 % of the GDP for adaptation of climate variability. Some of the programmes adopted to reduce the impact of climate change:

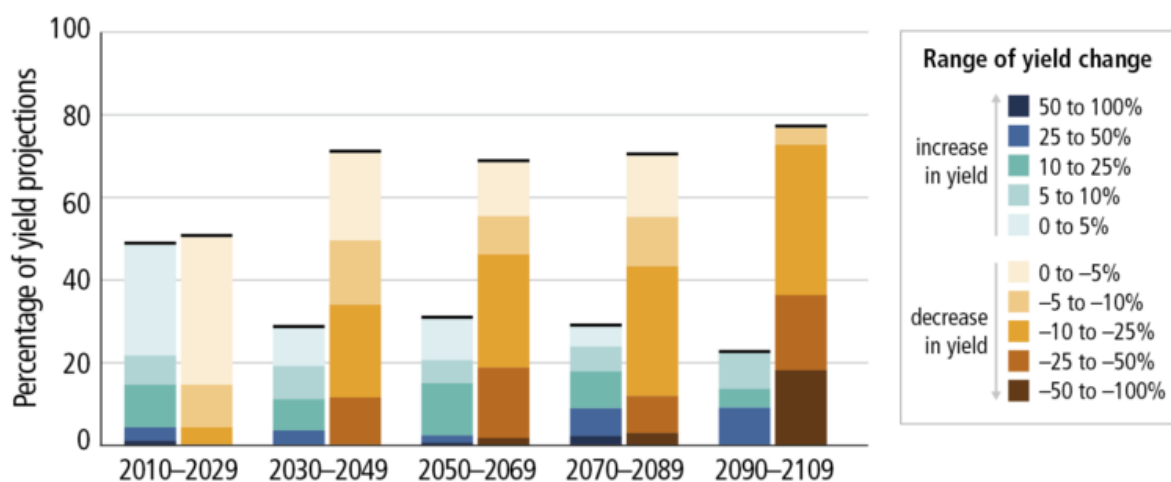
- **Crop Improvement:** This programmes address measures such a development of arid-land crops and pest management as well as capacity building workers and NGOs to support better vulnerability-reducing practices.
- **Drought Proofing:** This programmes minimizes the adverse effects of drought on production of crops and livestock, and on productivity of land, water and human resources, so as to drought proofing of the affected areas.
- **Forestry:** India has a strong and rapidly growing afforestation programme. The Forest Conservation Act of 1980 was accelerated for afforestation process. The main aim of this Act is to stop the clearing and degradation of forests through a strict, centralized control of the rights to use forestland and mandatory requirements of compensatory afforestation in case of any diversion of forestland for any non-forestry purpose.

- **Water:** The National Water Policy (2002) is the non-conventional methods for utilization of water, including inter-basin transfers, artificial recharge of groundwater, and desalination of brackish or sea water, as well as traditional water conservation practices like rainwater harvesting, including roof-top rainwater harvesting, should be practiced to increase the utilizable water resources.
- **Coastal Regions:** In coastal regions have been imposed in the area between 200 m and 500 m of the HTL (High Tide Line) while special restrictions have been imposed in the area up to 200 m to protect the sensitive coastal ecosystems and prevent their exploitation. This, simultaneously, addresses the concerns of the coastal population and their livelihood. Some specific measures taken in this regard include construction of coastal protection infrastructure and cyclone shelters, as well as plantation of coastal forests and mangroves.
- **Risk Financing:** Two risk-financing programmes support adaptation to climate impacts. The Crop Insurance Scheme supports the insurance of farmers against climate risks, and the Credit Support Mechanism facilitates the extension of credit to farmers, especially for crop failure due to climate variability.
- **Disaster Management:** This programme provides grants-in-aid to victims of weather related disasters and manages disaster relief operations. It also support proactive disaster prevention programmes, including dissemination of information and training of disaster management staff.

INDIA'S POLICY STRUCTURE RELEVANT TO GHG MITIGATION

In India there are several policy for regulatory and legislative structure that relates strongly to GHG mitigation like The Integrated Energy Policy was adopted in 2006 adopted with the goals like Promotion of energy efficiency in all sectors, emphasis on mass transport, emphasis on renewable including biofuels plantations, accelerated development of nuclear and hydropower for clean energy and focused Research and Development on several clean energy related technologies. The National Action Plan on Climate Change (NAPCC) promotes the development objectives and yielding co-benefits for addressing climate change effective. The below figure. 1 shows the impact of climate change on agricultural productivity or yield.

Figure. 1 Impact of Climate Change on Agricultural Productivity



Source: <https://www.futurelearn.com/info/courses/climate-smart-agriculture/0/steps/26565>.

Figure.1 shows the projection for different emission scenarios, for tropical and temperate regions. Many studies have considered impacts on cropping systems for scenarios where global mean temperature increase by 4 degree Celsius or more. The data are plotted in the 20 years period on horizontal axis that includes the midpoint of each future projection period.

CONCLUSION

It is clear from the above discussion that floods, drought, heat and cold waves are common happenings in worldwide due to climate change. In India people are more dependent on Agriculture but the climate change affects this sector adversely. Therefore, there should be a lots initiatives should be taken by the countries of the world in climate change and their impact on various sectors. It is important to make the industries as environment friendly to avoid the pollution and emission of greenhouse gases into the atmosphere. In this way the lifestyle of the people should also change so as not to harm the environment.

REFERENCES

1. Asian Development Bank, 2009. Addressing Climate Change in the Asia and Pacific Region.
2. Briefing Note (1), 2008, International Strategy for Disaster Reduction, Geneva, September, 2008
- International Food Policy Research Institute, 2009. Climate Change: Impact on Agriculture and Costs of Adaptation, 2009 Jamil Ahmad, Dastgir Alam and Ms. Shaukat Haseen. 2011.
3. Impact of Climate Change on Agriculture and Food Security in India Int. Jr. of Agril., Env. and Biotech. Vol. 4, No. 2 : June 2011 : 129-137
4. IPCC (Intergovernmental Panel on Climatic Change) 2006. The Economics of Climate Change: Stern Review. The Summary of conclusions. Survey of the Environment 2007, The Hindu, pp141-145.
5. IPCC (Intergovernmental Panel on Climatic Change) 2007. Climate Change: The Physical Science Basis. Extracts from the IV Assessment Report. Survey of the Environment 2007, The Hindu, pp147-155.
6. Singh. H.S. Potential Impact of Climate Change on Mangroves in India (0894-B2) Document on National Action Plan on Climate Change, India
7. Tubiello, F. N., Soussana, J. F., & Howden, S. M. 2007. [Crop and pasture response to climate change](#). Proceedings of the National Academy of Sciences, 104(50), 19686-19690.
8. Wheeler, T., & Von Braun, J. 2013. [Climate change impacts on global food security](#). Science, 341(6145), 508-513.