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# Climate Change and its Impact on Agriculture Sector in India

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## ABSTRACT

*Is climate change real? This is the question everyone is asking about climate change. Climate change has already had observable effects on the environment. Glaciers have shrunk, ice on rivers and lakes is breaking up earlier, plant and animal ranges have shifted and trees are flowering sooner. Effects that scientists had predicted in the past would result from global climate change are now occurring: loss of sea ice, accelerated sea level rise and longer, more intense heat waves. According to scientists it is acceptable if the earth's temperature rises by 1.5 degrees by the end of the century or even 2 degrees is acceptable but with current situations this target would reach by 2030 only, which is an alarming situation. Increases in sea level, rising of temperature due to global warming, greenhouse effect, growing population are all causes of climate change. If the nations did not take some measures to control all the situations then this will result in many climatic disasters to the world. Agriculture sector contributes to the major sector of the Indian economy. Government in India is taking every precaution and measure to prevent or to adapt the climatic variation for agriculture. Due to climatic variation millions of tonnes of crops are destroyed every year, which is a problematic situation like India with a huge population. In the paper, researchers discussed many problems with agriculture in India and what the government is doing to tackle them. Measure like adaptation and mitigation is also discussed in the study and how IARD is doing its work in this field.*

**Keywords:** *Adaptation, Mitigation, Climate Variation, climate change, agriculture, weather extremes.*

## I. INTRODUCTION

Climate change is really happening. The change in atmospheric temperature is causing it, from heat waves to hurricanes, from droughts to floods, extreme weather events are becoming more frequent putting lives at stake. Human activity is causing our earth's climate

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to change, the CO<sup>2</sup> emission from our cars, burning of fossil fuels, industries and power plants are heating up the planet. The most looming change in climate change is due to the sudden increase in the level of CO<sub>2</sub>, Methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) and Chlorofluorocarbons (CFCs). It already has had observable effects in the environment, glaciers are shrunk, trees are flowering sooner, ice on the river. The prediction of the scientist in the past would result from climate change is now occurring. The earth's temperature is increasing continuously & rapidly. Scientists have calculated that it is acceptable if the earth's climate increases upto 2°C in the next 80 years, but it is happening now, with the current situation, earth's temperature will touch this mark by the end of next decade. Increases in sea level, rising of temperature due to global warming, greenhouse effect, growing population are all causes of climate change<sup>3</sup>. Governments of various nations all over the world are trying to prevent further dangerous levels of climate change. Nations are trying to keep the earth's temperature below 2 degrees to prevent the planet getting warmer. Governments of various nations have signed the Paris Agreement to reduce the burning of fossil fuels and increase the share of renewable energy like energy produced by solar power, wind energy, hydro energy etc. Agriculture takes place at global level, and climate change is affecting it in several ways, like change in rainfall pattern, increase in temperature, change in pests, change in level of carbon-di-oxide, ultraviolet rays from the sun due to depletion of ozone layer, all are affecting the agriculture sector around the world. Impact of climate change on agriculture will decide the fate of future goods security for mankind. Agriculture is not only suffering from climate change but also it is one of the main drivers for it. These factors are changing the quality of the food and nutrition level and nations are constantly trying to cope-up with this situation because agriculture is an important sector and a very large number of the population is depending upon it.

## **II. CHANGE IN WEATHER AND CLIMATE EVENTS IN INDIA**

Sudden unexpected, unusual, unprecedented change in climate or weather at extreme level can include in the definition of weather extremes<sup>4</sup>. In recent times it is evident that human-induced global warming is behind the increasing periodicity of weather extremes. According to the India Meteorological Department, extreme climate change took around 1500 lives

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<sup>3</sup> What is the greenhouse effect? Available on <https://climate.nasa.gov/faq/19/what-is-the-greenhouse-effect/>. Accessed on 14 march 2020.

<sup>4</sup> Climate Change, Extreme Weather Events, and Human Health Implications in the Asia Pacific Region. Available on [https://www.jstor.org/stable/pdf/26686238.pdf?ab\\_segments=0%2Fbasic\\_SYC-5055%2Fcontrol&refreqid=search%3Ade874865771567d1ef0d16d1dda39081](https://www.jstor.org/stable/pdf/26686238.pdf?ab_segments=0%2Fbasic_SYC-5055%2Fcontrol&refreqid=search%3Ade874865771567d1ef0d16d1dda39081) Accessed on 16 march 2020 p.115.

across India in 2019<sup>5</sup>. This high impact weather includes extreme heavy rainfall, extreme drought, snowfall, dust storm, thunder storm etc affected all parts of India. IMD says Bihar was the worst affected state in the country with around 650 deaths in the same year due to extreme events. Overall India received 9% excess rainfall compared to the Long Period Average (LPA). Moreover, the monsoon season rainfall was 10% in excess last year, making it the most raining monsoon season for previous 25 years, in which Rajasthan alone recorded 40% more than average monsoon rainfall, while Maharashtra recorded 32% excess, Kerala 13% and Karnataka 23%<sup>6</sup>.

### III. HOW CLIMATE CHANGE IS AFFECTING AGRICULTURE

Among many ways there are three main ways that climate change is affecting agriculture. Firstly the CO<sub>2</sub> level, one of the main components responsible for global warming. The CO<sub>2</sub> captures the UV rays from the sun and send it to the earth which is increasing global warming<sup>7</sup>. The more the CO<sub>2</sub> level in the atmosphere the more the earth becomes hot. But on the other hand the CO<sub>2</sub> is necessary for green plants to produce food by the process of photosynthesis. Some people think the elevated CO<sub>2</sub> level is actually good for us because it will increase food production. But the real thing is that the higher level of CO<sub>2</sub> diminishes the nutrition content of the food due to the chemical process of photosynthesis plants cannot absorb the nutrition from the soil. Second Is the heat, it's hard for plants to grow in heat, heat shortens the growing season they have left and they mature faster that means they have less time to produce yield. Problems like some plants need cooling hours to grow. For example walnuts cannot grow because they don't get enough cooling hours to grow. The farmers will not be able to grow them anymore. Thirdly, increasing extremes of weather, the non-uniformity of climates is a problem for growing crops, extreme droughts, extreme heat, extreme floods are growing due to global warming, which is not beneficial for agriculture.

Agriculture is acutely connected with climate and weather. The rainfall quantity is the main factor to determine the rainy season, farming, livestock rearing and field crop production. Variable rainfall pooled with high evaporative demand and soil with low water-holding capacity and extra potential results in a high risk of water scarcity at any stage of crop production. Climate change affecting the variability in the rainfall is the primary factor which is affecting the production of crops and high yields,

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<sup>5</sup>**Extreme Weather Claimed More Than 1500 Lives Across India in 2019: IMD**

Available on <https://weather.com/en-IN/india/news/news/2020-01-07-extreme-weather-claimed-1500-lives-india-2019-imd-death-toll> (accessed on 16 march 2020).

<sup>6</sup> Supra footnote 1.

<sup>7</sup> The causes of climate change. Available on <https://climate.nasa.gov/causes/> (Accessed on 17 march 2020).

#### **IV. IMPACT ON AGRICULTURE AND FOOD PRODUCTION IN INDIA**

According to the report of Indian Agriculture and Research Institute (IARI), food production in India is very subtle to climate change<sup>8</sup>, smaller change in temperature can affect millions of tonnes of crops. Any significant change in temperature can affect the quality of food, tea, coffee, medicinal plants, vegetables etc and change in climate also affect the quantity of food which is necessary to meet the demands of the country with higher population<sup>9</sup>. Its impact is not only on the field crops, dairy cattle, fish farming, harvesting are also affected. According to IARI, even the 1oC change in temperature can destroy nearly 4-5 million tonnes of Rabi crops like wheat in a single season, since India uses wheat in very large amounts, this variation could impact food scarcity which is already there in India for a long time. Global reports show that by the end of this century, due to climate change, a total loss of 10-45% of loss in crop production is possible.

In India climate is mainly dominated by south and west monsoon, which helps in precipitation of the region. Agriculture needs both availability of irrigation and drinking water, which is important for crop production. Productivity of the crop mostly depends upon 2 broad classes-

1. Direct effect of CO<sub>2</sub> concentration in the atmosphere and change in temperature.
2. Indirect effect through change in moisture in soil and change in frequency of infestation of pests and diseases.

Wheat and Rice are the staple foods of India and they are the worst affected by climate change, any change in temperature could destroy the yield and productivity of the wheat and rice crops

The malleability of farmers in India is rigorously restricted by the heavy dependence on natural elements and the lack of institutional support systems. The loss in revenue at the farm level is estimated upto 25% for a temperature rise of 2 °C to 3.5 °C. Scientists also estimated that a 2°C rise in temperature and a 7% increase in mean precipitation would reduce revenues by 12.3% for the country as a whole<sup>10</sup>. Agriculture in the coastline regions of Gujarat,

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<sup>8</sup> Welcome to Strategies to Enhance Adaptive Capacity to Climate Change in Vulnerable Regions Available on <http://www.cca.iari.res.in/> Accessed on march 19, 2020.

<sup>9</sup> Climate change to impact Indian agri: IARI, available on <https://www.financialexpress.com/archive/climate-change-to-impact-indian-agri-iari/266207/>, accessed on march, 19 2020.

<sup>10</sup> Climate change and its Impact on Agriculture, available on <https://www.manage.gov.in/studymaterial/CCA-E.pdf> accessed on march 21, 2020.

Maharashtra, and Karnataka is found to be the most affected negatively. Small losses are also revealed for the main food-grain producing states of Haryana, Punjab and western region UP. On the other hand, Andhra Pradesh, West Bengal and Orissa are expected to benefit to a very small amount from global warming.

## **V. INDIA'S ACTION TO TACKLE THE SITUATION DEVELOPED BY CLIMATE CHANGE**

Currently India is doing everything to tackle the situation in the field of agriculture to tackle the situation created by Climate change, climate change is inevitable for recent times, in order to prevent climate change all the nations of the world has to come together and should make some reforms and treaties to tackle the common enemy, but right now respective governments of the nations need to take care of their nation by their own for near future.<sup>11</sup>

India is currently taking two measures to prevent crop production from climate change.

1. Adaption
2. Mitigation

In the context of climate change, adaption comprises the measures taken to prevent the adverse effect of climate change, for example- relocating the communities living close to the sea shore because due to the climate change the sea level is increasing drastically, and also by switching to crops which can withstand high temperature. Adaptation means to adapt the current situation created by the climate change in recent years, if in some particular area the heat is increasing continuously for some past years then the better way to tackle with this situation is to switch to crops which can withstand such high temperature like Rabi Crops<sup>12</sup>

Currently the Government is spending to adapt to climate change exceeding 2.6% of GDP with agriculture, water resources, forests, health and sanitation and extreme weather events being particular areas of concern. Different programmes like crop improvement, drought proofing, Forestry, water, coastal regions, disaster management etc

## **VI. DIFFERENT PROGRAMMES TO ADAPT CLIMATE VARIATIONS BY INDIA**

Indian government is trying continuously to tackle or to adapt the climate variations by implementing different policies and organizing different programmes to adapt the situation.

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<sup>11</sup> Climate Change Impact, Adaptation and Mitigation in Agriculture: Methodology for Assessment and Application, available on <http://www.nicra.iari.res.in/Data/Climate%20Change%20Impact,%20Adaptation%20and%20Mitigation%20Print.pdf>  
Accessed on march 20, 2020.

<sup>12</sup> Supra note 6.

1. **Crop Improvement:** Programmes address events such as growth of arid-land crops and pest management as well as capacity building of extension workers and NGOs to support better vulnerability-reducing practices.
2. **Drought Proofing:** This programme mainly focussed to minimize the adverse effects of drought on crops production, land productivity, human and water resources, so as to ultimately drought proofing the whole area. This programme also aims to promote economic development and improve the socio economic conditions of the poor.
3. **Forestry:** CAMPA, which is a strong and rapidly growing afforestation programme, according to which if a governmental or non-governmental authority if cut-down some trees for manufacture or to produce something then that authority is under obligation to plant as much as trees that were cut-down by them. This was started by the enactment of the forest Conservation Act, 1980, which aimed at stopping the clearing and deforestation of the forests through a strict and centralised manner to control the rights to use the forestland and mandatory requirements for compensatory afforestation in case of violation of laws. This was resulted in annual reforestation of 1.78 mha during 1985-1997 and now it is 1.1 mha annually
4. **Water:** The national water policy (2002) pressures that unconventional methods for utilization of water, including artificial recharge of groundwater, inter basin transfers, some traditional practices like rain water harvesting, roof-top water harvesting should be started to use as utilizable water resources.
5. **Disaster Management:** The work of the National Disaster Management is to provide aid to the victims who suffered weather related disasters and also manage disaster relief programmes it also includes the training of disaster management staff.

## **VII. POLICY STRUCTURE RELATED TO MITIGATION.**

India adopted The Integrated Energy Policy in 2006, whose main task is to promote energy efficiency in every sector, promotion for establishing renewable energy like biofuels, wind and solar energy, encourage for development of nuclear energy for clean energy, hydropower energy.

After succeeding in this India moved another step by establishing a National Action Plan on Climate Change (NAPCC). This plan identifies measures to adapt and yield benefits for addressing climate change. It also outlines the step to further advance India's development in the objective of adaptation and mitigation. There are some missions of the National Action

Plan for achieving the desired goal in the context of climate change.<sup>13</sup>

1. National Mission for Enhanced Energy Efficiency.
2. National Water Mission.
3. National Mission for a "Green India".
4. National Mission on Strategic Knowledge for Climate Change.
5. National Solar Mission.
6. National Mission on Sustainable Habitat.
7. National Mission for Sustaining the Himalayan Ecosystem.
8. National Mission for Sustainable Agriculture.

## **VIII. WHAT COULD BE DONE FOR ADOPTION OF CLIMATE VARIATIONS AGRICULTURE**

As it is discussed already, climate change is happening, now the only option left to humans is to adapt to this change. Agriculture is one of the most important sectors in the Indian economy. There could be certain things which could be done to prevent agriculture from destroying millions of tonnes of crop yield every year. The farmers could be educated for the prevention or what necessary precaution they can take to prevent the crops-

1. **How To Use Natural Resources Better:** the farmers can be educated on how they can use the limited natural resources efficiently for their benefit. Like rain water harvesting, water conservation, use of solar energy, improved drainage in flood prone areas, groundwater recharge, water saving irrigation etc.
2. **Crop Production:** In some areas of the country extreme droughts is the main problem for crop production. By introducing drought tolerance varieties they can use that extreme drought area for their benefit. Rabi crops planting dates can be advanced in terminal heat stress, methods for water saving cultivation of paddy, fumigation, community nurseries for delayed monsoon, location specific intercropping system can also be introduced with high sustainability yield index.
3. **Livestock & Fisheries:** Promotion of advanced feed storage system, preventive vaccination, advanced shelters for minimizing cold or heat stress. Management of fish tanks during water scarcity or flooding etc.

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<sup>13</sup> National Action Plan on Climate Change, Available from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2822162/#CIT2> (accessed on 20 march 2020).

4. **Institution Interference:** Institution Interference is necessary in the field of agriculture, either by strengthening the older institutions with advanced technology and crew or government can make new institutions specially to fight climate change in the field of agriculture. Institutions relating to fodder bank, seed bank, custom hiring centre. Farmers can also be educated for the weather conditions in their specific areas.

These were several techniques or interventions could be taken to prevent this climate variation impact on Indian Agriculture.

## **IX. CONCLUSION**

From the above discussions it is clear that, government and farmers together need to take many precautions, preventive methods to tackle or to fight this situation which is created by climate change or variation. Climate change is happening, many nations of the world are in their control to prevent it but everyone needs to do something in their control to prevent it. Agriculture is one of the major sectors in the Indian economy, governments are taking necessary steps to adapt the climate variations for agriculture. Increasing greenhouse gases like methane, CO<sub>2</sub>, CFCs are major responsible gases for global warming, they capture ultraviolet rays from the sun which is making earth hotter and hotter every day. According to scientist 2°C increase in temperature is acceptable till the end of this century beyond that it would be difficult for humans to survive. But according to the calculations of the scientists this mark of 2°C, due to human intervention, will be chased by the end of the next decade which is a real problem. Climate change can be seen now, extreme weather like, drought, flooding, heavy rainfall, season shifting, unprecedented weather are all outcomes of climate change. Kerala in the year of 2018 received thrice as much rainfall in one month which resulted in flooding in most parts of the state, extreme droughts in Rajasthan is also one of the outcomes of climate change.

Methods like adaptation and mitigation can be adopted as discussed before to tackle this situation. Government can also establish educational institutions for the education of farmers to make them understand how bigger this problem is and how to tackle it. Adaption is a good way to prevent crops, if there is extreme drought the farmers can produce those crops which can survive in extreme heat like Rabi crops. Mitigation is very important on other hand, as we have a limited amount of natural resources we need to use other natural resources like wind and sunlight, which are inexhaustible to create electricity, and in many other ways. The use of fossil fuels should be stopped because it releases a heavy amount of carbon dioxide in the

atmosphere, and planting trees is always useful to cool down the earth. From the agriculture point of view the farmers should be guided on the projected impact of climate change & sensitize them on probable use of adaptation and mitigation to reduce the impact of climate change.

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