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IMPACT OF CLIMATE CHANGE ON SUSTAINABLE AGRICULTURAL FOOD PRODUCTION IN INDIA

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Abstract

At present, climate change has emerged as a global issue. Climate change is not a concept related to any one country or nation, but it is a global concept which is becoming a cause of concern for the entire earth. If seen, climate change has increased the risk of floods, drought, agricultural crisis and food security, diseases, migration etc. in the whole world including India. But since a large section of India such as about 60 percent of the population is still dependent on agriculture, and is vulnerable to its impacts, it becomes very important to look at the impacts of climate change on agriculture.

According to the Global Climate Risk Index 2021, India is among the top ten countries most affected by climate change. Changing climatic conditions are affecting agriculture the most because in the long run it depends on seasonal factors like temperature, rainfall, humidity etc. Therefore, in this article we will try to know how climate change affects agriculture.

One of the most important issues of our day is climate change, which has significantly changed or is still changing the ecosystems of the planet. Although the world has always experienced some degree of climate change, in the last 100 years or so, the rate of this variation has multiplied. Since the nineteenth century, anthropogenic activities have caused an increase in average temperature of 0.9 °C, primarily as a result of greenhouse gas (GHG) releases into the atmosphere. According to projections, this rise will be 1.5 °C by 2050, or it could possibly be higher given the rate of deforestation, the rise in GHG emissions, and the pollution of the soil, water, and air. The enormous increase in temperature has led to an increase in droughts, floods, erratic precipitation patterns, heat waves, and other severe occurrences all over the world.

Therefore, this study examines many experiments at various places using various methods/models, entirely diverse climate situations, and multiple elements to discuss the impact of global climate change on agricultural productivity in the Republic of India as a whole. It will

be very useful for projecting how the future crop production of agriculture in the Republic of India would be impacted by global climate change. The potential effects of climate fluctuation and change on the production of food in India are briefly discussed in this paper.

Keywords: Climate change, Food Security, Food Production,Temperature, Rainfall, Humidity.

1.0 Introduction

Agrochemical use, animal production (for meat and other forms of revenue), exploitation of water resources, and other intensive agricultural practices have all been brought about by the population's ever-increasing demand for food. This has made things worse by causing the contamination of natural resources and the release of GHG (due to agricultural operations). Although forests serve as a sink for the rising CO2 levels, the unregulated rate of deforestation (mostly due to agriculture and development) has upset the carbon cycle's normal cycle. This has led to an increase in carbon emissions and an uneven climatic pattern, which have a significant negative influence on agricultural production and a range of other negative repercussions.

Increased desertification and nutrient-deficient soils are two effects of the high pace of land degradation brought on by climate change. As a serious global problem, the threat of land degradation is said to be growing every day. Approximately one-fourth of all land surface on the planet can now be classified as degraded, according to the Global Assessment of Land Degradation and Improvement (GLADA). 15 billion tonnes of fertile soil are lost year as a result of anthropogenic activity and climate change, and land degradation is expected to affect the livelihoods of 1.5 billion people. According to a 2017 UNEP report, 500 million hectares of agriculture have been abandoned owing to dissertification and drought, creating significant socioeconomic and environmental challenges. Land degradation is also causing mass migrations.

Floods have become more frequent and sporadic in recent years as a result of climate change. According to a report by the European Academies Science Advisory Council (EASAC), the rate at which extreme events, such as floods, have occurred over the past 10 years has grown by 50%. This is a four-fold increase over the rate seen 20 years ago. An obvious illustration of this are the severe floods that occurred in Kerala, India, in 2018. Unless and until remedial and proactive remediation measures are worked on, these floods have caused the washout of top soil and nutrients from the soil, resulting in low productivity for several years to come. Agriculture lands in coastal locations may deteriorate due to rising sea levels or a frequent occurrence of severe

rain. Salinity of soils in coastal areas has also been a consequence of this, stressing crops by reducing respiration, photosynthesis, and transpiration, which eventually jeopardizes the availability and security of food in such areas.

In addition to having a significant impact on food distribution patterns, all these climate-related disturbances would also have a negative impact on the availability and quality of food. Additionally, because food security and public health are closely linked, it will cause a vicious cycle of hunger, disease, and crime. According to the FAO, the number of people who are underweight has increased from 804 million in 2016 to 824 million in 2017, and the level of hunger around the world has been steadily rising since 2014. These studies confirmed that it will be challenging to abolish hunger by 2030, which is one of the Sustainable Development Goals (SDG) targets. In order to reduce the effects of climate variability, it is necessary to establish and adjust policies and actions. In accordance with FAO's vision of Sustainable Food and Agriculture goals, this can be accomplished by implementing a climate smart agriculture system.

2.0 Impact of climate change on Agriculture in India

2.1. Reduction in production: World agriculture is facing severe decline this century due to global warming. According to the Intergovernmental Panel on Climate Change (IPCC), the overall impact of climate change on global agriculture will be negative. Although some crops will benefit from it, the overall impact of climate change on crop productivity will be more negative than positive. India's output is likely to fall between 4.5 percent and 9 percent due to climate change between 2010-2039. According to a research, if the average temperature of the atmosphere increases by 1 degree Celsius, wheat production may reduce by 17 percent. Similarly, due to increase in temperature by 2 degree Celsius, the production of paddy is also likely to reduce by 0.75 tonnes per hectare.

2.2 Deterioration in agricultural conditions: Shifting of temperature towards higher latitudes due to climate change will adversely affect agriculture in low latitude regions. India's water sources and reserves are shrinking rapidly, due to which farmers will have to abandon traditional irrigation methods and adopt modern methods and crops that reduce water consumption. Melting of glaciers can lead to long-term reduction in the water storage area of many big rivers, which may lead to water shortage in agriculture and irrigation. According to a report, due to climate change, the quality of three-fourth of the Earth's land area has reduced due to pollution, soil erosion and drought.

2.3 Increase in average temperature: Temperatures have increased over the past several decades due to climate change. Since the beginning of industrialization, the Earth's temperature has increased by approximately 0.7 degrees Celsius. There are some plants that require a particular temperature. Increasing atmospheric temperature has an adverse effect on their production. Crops like wheat, mustard, barley and potato etc. require low temperature whereas increasing temperature is harmful for them. Similarly, due to increase in temperature, crops like maize, sorghum and paddy etc. can get damaged because due to high temperature, grains are not formed or less in these crops. Thus increase in temperature adversely affects these crops.

2.4 Change in rainfall pattern: Two-thirds of India's agricultural area is dependent on rainfall and the productivity of agriculture depends on rainfall and its quantity. Changes in the amount and patterns of rainfall affect soil erosion and soil moisture. Increase in temperature due to climate leads to decrease in rainfall due to which soil moisture gets depleted. Apart from this, the effect of increase and decrease in temperature has an impact on rainfall, due to which the possibilities of weathering and drought in the land increase. The effects of global warming have been affecting deeply for some years. Central India will experience 10 to 20 percent reduction in winter rainfall by 2050. The western semi-desert region is likely to receive above normal rainfall. Similarly, increase in temperature and decrease in rainfall in the central hilly areas can lead to reduction in tea crop.

2.5 Increase in carbon dioxide: Carbon dioxide gas contributes to about 60 percent of global warming. Due to increase in the amount of carbon dioxide and increase in temperature, it has adverse effect on trees and plants and agriculture. During the last 30-50 years, the amount of carbon dioxide has reached about 450 ppm (points per million). However, an increase in the amount of carbon dioxide is beneficial for some crops such as wheat and rice because it speeds up the process of photosynthesis and reduces losses through evaporation. But in spite of this, the yield of some major food crops like wheat has declined significantly due to increase in carbon dioxide i.e. increase in temperature.

2.6 Increase in pests and diseases: Climate change causes an increase in pests and microbes. In warm climates, the reproductive capacity of insects and mites increases, due to which the number of insects increases very much and it has a lot of side effects on agriculture. Besides, the use of pesticides to control insects and germs is also harmful for agricultural crops in some way or the other.

However, some more drought-tolerant crops have benefited from climate change. The yield of sorghum, which is used as a food grain by most of the developing world, has increased by about 0.9 percent in Western, Southern and South-Eastern Asia since the 1970s. Sub-Saharan Africa grew by 0.7 percent. But if some crops are left out, the impact of climate change on total crop productivity is negative.

3.0 Measures to reduce the effects of climate change on agriculture

According to the Food and Agriculture Organization (FAO), the world population will be around 9 billion by 2050. Due to which there will be a need to double the current food grain production to reduce the gap between supply and demand of food grains. For this, agricultural countries like India will have to take new measures from now itself. There are many ways to protect our agriculture system from the effects of climate change. By adopting which the side effects of climate change on agriculture can be reduced to some extent. Also, agriculture can be adapted to climate change by using eco-friendly methods. Some of the major measures are as follows:

3.1 By proper management of rain water: Along with the increase in the temperature of the environment, there is more need of irrigation in the crops. In such a situation, conserving land and collecting rainwater and using it for irrigation can prove to be a useful step. Through watershed management, we can store rainwater and use it for irrigation. On one hand this will help us in irrigation, on the other hand it will also prove helpful in recharging ground water.

3.2 Organic and mixed farming: Chemical farming increases green gases which are helpful in global warming. Apart from this, the use of chemical fertilizers and pesticides, on the one hand, decreases the productivity of the soil, on the other hand, harms human health through food. Therefore, more emphasis should be laid on the techniques of organic farming. Mixed (composite) farming is beneficial in place of single farming. In mixed farming, a variety of crops are produced. Due to which the possibility of being affected by climate change along with productivity becomes negligible.

3.3 Development of new technologies in crop production: Keeping in mind the serious effects of climate change, such seeds and new varieties should be developed which are suitable for the new climate. We also have to change the pattern of crops and the time of sowing their seeds. Such varieties will have to be developed which are capable of tolerating critical conditions like high temperatures, drought and floods. The threats of climate change can be tackled by mixed

farming and intercropping by coordinating and assimilating traditional knowledge and new technologies.

3.4 Climate Smart Agriculture: Concrete initiatives have been taken to develop Climate Smart Agriculture (CSA) in the country for which a national project has also been implemented. In fact, climate smart agriculture seeks to address three interrelated challenges of climate change; Increasing productivity and income, adapting to climate change and contributing to lower emissions. For example, if we talk about irrigation, popularize micro irrigation for proper use of water. Adaptation to climate change means making agriculture capable of withstanding climate change. Agricultural sectors will have to be identified with the projected impacts of climate change. Along with this, creating an environment of policies in such a way that their successful implementation reaches to local and national institutions.

4.0 Climate change and Agricultural Food production

As it affects food processing in many different ways, climate change adds another layer of stress to India's long-term food security issues. The inter-annual and intra-seasonal variability of monsoon rainfall, for example, may significantly increase as a result. Droughts are expected to become a greater problem in India's northwest, according to the World Bank (2019). For India, where a substantial portion of the population already struggles with water scarcity and relies heavily on groundwater for irrigation, the effects of climate change would be particularly severe. Wetlands in India have dried up, severely degrading ecosystems, according to Nikhil et al. (2017) who cite the drop in precipitation and droughts as causes. Indian food water needs will exceed green water resources, according to World Bank predictions, with a world mean temperature increase of 2°C over pre-industrial levels. India's food security and the production of food grains are projected to be significantly impacted by the mismatch between water demand and supply. Climate change has been proven to be particularly sensitive to two crops that are essential to Indian nutrition: wheat and rice. The development of wheat is very sensitive to temperatures above 34°C in northern India, according to research by Tripathi et al. (2020). The livelihoods of those who depend on fishing and the forest will also be negatively impacted by climate change. Landless agricultural labourers who are solely dependent on agricultural salaries have the biggest risk of losing their right of admission to food.

5.0 Climate Change on Food Security and Livelihoods

The magnitude of India's food security concerns has grown as a result of climate change. Despite the complexity of the relationship between food security and climate change, the majority of research only consider one aspect of food security, namely, food availability. This essay gives a broad overview of how the availability, accessibility, and absorption of food will be impacted by climate change in India. It concludes that maintaining food security in the face of climate change will be a formidable challenge and suggests, among other things, adopting sustainable agricultural practices, placing more of an emphasis on urban food security and public health, ensuring the security of livelihoods, and long-term relief measures in the event of natural disasters.

One of the main issues raised by climate change is food security. Food security is impacted by climate change in a variety of ways. Reduced revenues, damaged livelihoods, disrupted trade, and negative health effects are only a few of the serious social and economic effects it can have on crops, cattle, forests, fisheries, and aquaculture. It is crucial to remember that the true effects of climate change rely on both the underlying vulnerabilities and the magnitude of the climatic shock. The total effect of climate change on food security is determined by both biophysical and social vulnerabilities, according to the Food and Agriculture Organisation (2016).

Given its numerous effects on food production, climate change puts an additional strain on India's long-term food security issues. The inter-annual and intra-seasonal variability of monsoon rainfall may rise significantly as a result, to name one effect. A 4°C global mean warming will result in a 10-percent increase in annual mean monsoon intensity and a 15-percent increase in year-to-year variability in monsoon precipitation, according to World Bank estimates based on the International Energy Agency's current policy scenario and other economic models for the energy sector.The fact that Indian agriculture is still quite susceptible to monsoon fluctuation makes the country's food production extremely vulnerable to climate change.

The economic factors that cause food insecurity are amplified by climate change. The climate change-related lengthening of the agricultural growing season, increased frequency of extreme events, and the resulting increase in yield have a negative impact on the farmer's net income. Due to the small and marginal farmers that live in India's rural areas and rely on rain-fed monocropping, which only supplies a few months of food security in a typical year, this country is particularly vulnerable.

However, rural areas are not the only ones affected by climate change's effects on food access. Urban food insecurity is a serious problem since many low-income households from rural and coastal areas relocate there in search of employment opportunities. Ramachandran notes that when people are starving, there is frequently a wave of migration towards the cities that pushes entire families into urban slums.Urban food insecurity in India will become more problematic as a result of climate change. Low-income groups living in informal settlements, which are frequently situated in flood-prone and landslide-prone areas and where housing is particularly vulnerable to extreme weather events like wind and water hazards, are likely to face the highest risks related to climate change.

6.0 Conclusion

It can be said that climate change impacts the global and Indian agricultural system on a large scale. By adopting the suggestions and techniques given above, the agricultural system can be protected from the ill effects of climate change. Doing this is the need of the hour, otherwise it may have to face fatal consequences in the future. In this direction, the efforts made by the Government of India in making Indian agriculture adapted and capable of climate change are also commendable. Thus, to protect agriculture from the adverse effects of climate change, we will have to together give importance to environment friendly methods so that we can save our natural resources and make the agricultural system adaptable.

In India, low productivity is the biggest issue in agriculture. Productivity needs to be raised urgently across the board in agriculture in order to fulfil India's rising food demand. Farming practices, however, need to be reoriented to improve climate resilience considering how vulnerable Indian agriculture is to climate change. India needs to increase public investment in the creation and adoption of crop types that are more resilient to temperature and precipitation changes as well as more water- and nutrient-efficient. In order to deal with the hazards of climate change, agricultural policy should concentrate on increasing crop productivity and creating safety nets.

Strategic research is required to enhance the adaptability of Indian agriculture, including crops, herbal resource management, horticulture, livestock, and fisheries, in order to create and make use of enhanced production and threat management methods. The biggest threats to the farming communities all across the nation's ability to preserve their way of life are land degradation and climate change. In India, food insecurity resulted from a combination of all these factors that led

to a drop in agricultural productivity. To attain food security in India, significant problems with production and post-harvest management of food must be addressed, as well as the depletion and scarcity of natural resources, pollution brought on by agricultural output, food loss through food waste, and food safety.

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