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The impact of climate change on Indian agriculture

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Abstract
Climate change poses a significant threat to agriculture worldwide, and India, with its vast agricultural sector, is particularly vulnerable. The effects of climate change on Indian agriculture are manifold, ranging from altered weather patterns to changing pest and disease dynamics. This article explores these impacts and discusses potential adaptation strategies to mitigate the adverse effects on farmers and food security. Climate change is increasingly seen as the major threat to the food security and sustainability of agriculture in India. Keeping in view of the importance of this problem, we initiated a focus on 'The Impact of Climate Change on Indian Agriculture'.

Keywords: Climate change, India, agriculture

Introduction

Due to changes in climate we are experiencing droughts, unpredictable weather, sudden rains and snowfalls, constant fluctuations in temperature leading to disasters like forest fires. As before, we cannot predict the weather well enough. These changes have greatly influenced human life both positively and negatively. Since evolution, humans have continuously used nature to their advantage. The result - huge carbon dioxide content in the environment and other harmful substances in the atmosphere and water, is being depleted due to regular use of fossil fuels. Overexploitation of natural resources and not taking any significant steps to restore them to their original condition is causing great harm to the environment. Depletion of the ozone layer caused by greenhouse gases is also caused by climate change. The Indian government has not submitted an updated plan on carbon emissions at the ongoing United Nations Climate Change Conference in the UK. But India's carbon emissions will be brought to zero by 2070, Indian Government said at the conference held in Glasgow. The aim of this conference is to bring carbon emissions to net zero by 2050. India ranks third in the world in carbon dioxide emissions. China and the US are in the top two.

Due to a rapidly growing population and an economy dependent on coal and petroleum, the carbon emissions in the country are likely to increase unless comprehensive and effective measures are adopted. India's position is that industrialized countries should take a larger share in carbon emissions because these countries have more carbon emissions.

The economic progress of the countries is evident from the emission-intensity i.e. emission frequency objective. India has set a target of reducing carbon emissions by 33 to 35 percent by 2030 since 2005.

However, a reduction in carbon footprint does not necessarily mean a reduction in total carbon emissions. It would not be wrong to say that India's economic progress in the last few years has been made on the strength of fossil fuels. Fossil fuels are the largest contributor to carbon emissions in the country. The India's agriculture is dependent on monsoon. Monsoon in India has undergone several changes over the recent years, especially on account of climate change. It accounts for 18 percent of India's growth domestic product (GDP) and employs around half of its total workforce. The monsoon rains are the main source of water for 55 percent of the country's arable land. This means the rains are crucial not only for India's farmers but for its economy as a whole.

India is a large country with a diverse climate. Diverse seasons mean diverse crops and farming systems. There is a high dependency of agriculture on the monsoon rains and a close link exists between climate and water resources. Two thirds of the area is rain dependent. Add to this picture the small land holdings, poor coping mechanisms and low penetration of

risk management products. With a 0.68 degrees Celsius increase in temperature so far in India, it is expected that there will be pronounced warming in future, particularly during the post monsoon period and winter.
There will be increased frequency of floods during the monsoon and a decrease in winter precipitation with a lower number of rainy days.

Objectives

- To study the impact of climate change on Indian agriculture
- Studying the challenges of climate change impacts
- Addressing the impacts of climate change

Discussion

Most of India's agriculture is dependent on monsoon rains and climate change is causing agricultural losses. Very low or excessive rainfall is the main reason for fluctuation in agricultural production in the country. Apart from this, excessive humidity, abnormal temperature, outbreak of diseases and insects, unseasonal rain, flood, drought, hailstorm are also the reasons. Over the past few years the weather cycle has worsened to everyone's surprise. Both extreme rainfall and drought have been a bane for agriculture.
The adverse effects on agriculture caused by low rainfall in the past few years have intensified in recent times. Floods and droughts are occurring more frequently as a result of climate change and warming. Therefore, there is a fear that the loss of agriculture will increase further in the future.
The kharif crop suffers from drought, while the rabi crop compensates for the loss by unseasonal rains which damage the crops. While studying this problem, agricultural scientists found that even if the temperature rises by one degree, wheat production will decrease by four to five crore tonnes. Similarly, if the temperature rises by two degrees Celsius, the yield of rice will decrease by 0.75 tonnes per hectare.
According to the Agriculture Department, wheat production in such a situation is estimated to remain at 82 million tonnes. Climate change will also reduce fruit production. Not only the production will decrease, but their quality will also decrease. Nutrients and proteins in food will be reduced. As a result, the food will not be balanced and will have an adverse effect on human health.
On the other hand, due to the rapidly growing population, the demand for food grains is going to increase. Therefore, natural resources have to be overexploited. Even now, due to overuse of resources, the cycle of environment has been disturbed. The changes taking place in the environment will have a direct impact on agriculture. Because changes in temperature and rainfall reduce soil productivity and increase the risk of spreading insect diseases. Yields also decrease due to faster dispersal of insects.
Due to increasing pollution and overexploitation of natural resources, the environment is changing and it is bound to adversely affect agriculture and crops. Rainy days used to be more, now they are less. There has been an increase in the occurrence of more rainfall on a single day. In such a situation, it has become necessary for the farmers to be alert and it has also become necessary for the farmers to get accurate weather information on time. That is why the government has now decided to start a weather information center for farmers in every district. This center will enable farmers to get early warning of crisis and avoid or minimize losses.
Many environmental changes directly affect agriculture.
The first change is the rise in average temperature. The temperature has been increasing steadily in the last few decades. Many plant species require certain temperatures to grow. As the temperature of the environment increases, their productivity decreases drastically. For example, places where wheat, flax and potatoes are grown today will not be able to grow as temperatures rise.
Because of these crops require cold weather. A further increase in temperature may reduce the productivity of crops such as maize, sorghum and rice. Because of the process of grain formation in these crops takes place only at a certain temperature. If the temperature increases, less grain is formed and the yield decreases. If the temperature continues to rise, it will become difficult to harvest these crops. Additional warming adversely affects rainfall.
Due to less rainfall, soil moisture is reduced. If the soil temperature continues to fluctuate, the process of weathering starts. Due to warming, drought conditions occur more frequently and the process of desertification gradually begins.
Change in the amount and pattern of rainfall is also an important factor affecting crops. If there is less rain, the moisture in the soil is lost, while if there is more rain at the same time, the soil becomes infertile due to soil erosion. Rainfall has a huge impact on agriculture as a whole.
All plants in the field require a certain amount of rain to survive. Rainfall is important for agriculture, but it also needs to be timely and in the right amount.
Agriculture is also facing problems due to climate change. Increase in carbon dioxide levels in the atmosphere adversely affects plants. This change in the atmosphere is good for some places and very harmful for others. The emission of greenhouse gases is having a very adverse effect on the ozone layer in the atmosphere. Due to the emission of these gases, the ozone layer is getting thinner.
Even if this layer decreases by one percent, the amount of UV rays increases by two percent. Human life and food production are also affected to the same extent. Therefore, it has become imperative to save the ozone layer by reducing the emissions of these gases.
Farmers need to take care to avoid the effects of warming and climate change. It is necessary to create water management and irrigation facilities in the fields. Besides preventing soil erosion, water conservation is a dual-purpose way to utilize rainwater. Through catchment area development program we can capture rain water and use it for agriculture.
Moreover, it also stops soil erosion. At the same time, the stored water seeps into the soil and helps in raising the groundwater level. It is again used for agriculture. Organic and natural farming has become the need of the hour. Chemical fertilizers and pesticides have been found to reduce the productivity of the land.
Also, the toxic elements in it are included in the food chain and enter the stomach after eating, causing serious health problems. Similarly, chemical agriculture emits a large amount of greenhouse gases and thus worsens the cycle of nature. So we have to adopt organic and mixed farming in the future. Risks are reduced by using holistic farming techniques instead of monoculture.

In holistic farming, multiple crops are grown simultaneously. Even if one crop is lost due to natural calamities, the farmer can get income from other crops.

Keeping in mind the serious consequences of climate change, new methods of crop production will have to be adopted henceforth. It can be seen from the disturbed rainfall cycle that the timing of sowing will also have to be changed. The farmer must learn to overcome the crisis by combining his traditional knowledge and modern techniques.

The threat posed by climate change can be mitigated to some extent by adopting mixed farming and intercropping. Making crop insurance available to all farmers is the need of the hour. Small farmer must get the benefit of this scheme. To avoid the vicious cycle of climate change, we must first learn to use the available natural resources sparingly and judiciously. For that, the use of Indian lifestyle and traditional knowledge will be fruitful.

It has become necessary to use eco-friendly methods in agriculture in the future. By doing this we can conserve natural resources and protect the environment besides maintaining the productivity of the land.

1. Erratic Monsoon Patterns

India's agriculture heavily relies on the monsoon season for water supply. Climate change has led to unpredictable and erratic monsoon patterns, causing droughts or floods in different regions. This variability makes it challenging for farmers to plan their cropping patterns and manage water resources efficiently.

2. Rising Temperatures

Increasing temperatures due to climate change can negatively affect crop yields. High temperatures during sensitive growth stages can reduce pollination, increase heat stress in crops, and lead to wilting and reduced productivity. Crops like wheat, rice, and sugarcane are particularly vulnerable to temperature extremes.

3. Water Scarcity

With glaciers melting and precipitation patterns changing, water scarcity is becoming a pressing issue for Indian agriculture. Groundwater depletion, coupled with inefficient irrigation practices, exacerbates this problem. Farmers often resort to over-extraction of groundwater, leading to long-term degradation of water resources.

4. Shifts in Pest and Disease Dynamics

Climate change alters the geographic distribution and prevalence of pests and diseases, affecting crop health and yield. Warmer temperatures can accelerate the reproductive rates of pests, while changing rainfall patterns create favourable conditions for disease outbreaks. This necessitates the use of more pesticides and fungicides, leading to increased costs and environmental pollution.

5. Loss of Biodiversity

Climate change threatens agricultural biodiversity in India, endangering indigenous crop varieties and traditional farming practices. As farmers struggle to adapt to changing conditions, they may abandon native crops in favor of high-yielding, climate-resistant varieties, further reducing genetic diversity and resilience in the agricultural ecosystem.

6. Adaptation Strategies

To mitigate the impacts of climate change on agriculture, India needs comprehensive adaptation strategies. This includes promoting climate-resilient crop varieties, implementing efficient water management practices, improving irrigation infrastructure, and enhancing farmer education and extension services on climate-smart agriculture techniques. Additionally, policy interventions and investments in research and development are crucial for building adaptive capacity at the grassroots level.

Conclusion

In conclusion, climate change poses significant challenges to Indian agriculture, threatening food security, livelihoods, and environmental sustainability. Addressing these challenges requires concerted efforts from policymakers, researchers, farmers, and civil society to develop and implement effective adaptation and mitigation measures. By adopting climate smart agricultural practices and investing in resilient infrastructure, India can build a more sustainable and secure future for its agricultural sector.

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