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Climate Change's Impacts on Indian Agriculture and its Migration

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Abstract

Climate change affects plant disease and insect pest growth patterns, as well as crops, water, soil, animals, and pests. We require more resilient systems, decentralization, participatory research, and breeding networks in order to maintain ecosystem health and services in changing, unanticipated conditions. Simultaneously, a great number of stakeholders and scientists from domains other than plant pathology highlight the need of balancing trade-offs with other objectives. Increased variety favours land-sharing, but it is also important in land-sparing conditions (such as around the boundaries of fields), depending on the geographical and temporal scale, and hence the kind of diversity (genetic, species, species turnover, ecosystem) analyzed.

Introduction

Climate change and unpredictability are expected to increase future food security concerns by putting pressure on agriculture and jeopardizing its long-term sustainability. Long-term variations in climatic variables such as temperature, snowfall, rainfall, and wind patterns are referred to as global climate change. The earth's temperature has changed numerous times throughout history; the most immediate environmental problem is global warming, which is produced by a buildup of greenhouse gases (GHGs) in the atmosphere, including as carbon dioxide (CO2), methane (CH4), and laughing gas (N2O). Climate change has the potential to increase agricultural losses, increase the number of starving people, and alter plant disease and insect pest patterns. Agriculture and fisheries are very weather-dependent. Increases in temperature and greenhouse gas emissions (CO2) may help raise agricultural productivity in certain areas. However, specific conditions must be met in order to gain these benefits, including as nutritional levels, soil moisture, and water availability, among others. Droughts and floods with varying frequency and severity may be tough for farmers and ranchers, putting

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food safety at risk. Climate change, CO2 emissions in the atmosphere, and increasing weather frequency and severity might all have an impact on agricultural production. The effect of increased temperature on each crop is dictated by the crop's optimal temperature for growth and reproduction.

Climate Change's Impact on Indian Agriculture

Increases in greenhouse gas levels in the atmosphere fertilise C3 photosynthetically active crops, enhancing their growth and output. Rising temperatures can shorten crop duration, increase crop respiration, alter photosynthesis, affect pest population survival and distributions, and gradually develop a new equilibrium between crops and pests. They can also hasten nutrient mineralization in soils, reduce fertiliser use efficiencies, and increase evapo-transpiration. Global climate change has a significant indirect effect on agricultural land use in India due to irrigation water availability, the frequency and intensity of inter- and intra-seasonal droughts and floods, transformations of soil organic matter, soil erosion, pest profile changes, decline in arable areas due to coastal land submergence, and energy availability. The consequences on crops, water, soil, animals, pests, and diseases are listed below.

Crops

- A rise in ambient CO2 is beneficial since it leads to greater photosynthesis in a variety of crops, particularly those that use the C3 photosynthesis mechanism, such as wheat and rice, as well as reduced evaporative losses. Despite this, when air temperatures rise, yields of key cereal crops, particularly wheat, are likely to be decreased due to shorter crop growth periods, higher respiration, and/or lower rainfall/irrigation water supplies.
- Lower yields in rainfed regions due to higher agricultural water demands and variations in rainfall patterns throughout the monsoon season.

Water

Water However, by extending storage facilities, the extra water might be captured for future use. Because of the infiltration of sea water, the water balance in many places of India is expected to be disrupted, and the quality of groundwater along the coastal track is expected to be worsened.

Soil

- Why When CO2 levels are high, crop residues have a greater C:N ratio, which slows decomposition and reduces nutrient delivery.
- Increasing soil temperature will boost N mineralization, but increasing gaseous losses from processes like volatilization and denitrification would reduce its availability.

- Erosion severity, frequency, and extent may be affected by changes in rainfall volume and frequency, as well as wind strength.
- Rising sea levels may induce salt water intrusion onto coastal regions, making them unsuitable for traditional agriculture.
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Livestock

- To satisfy expected milk demand, livestock will need more water, housing, and energy as a result of global warming. Warmth stress in dairy cows is likely to worsen as a result of climate change, impairing their reproductive function. Diseases and insects
- Changes in pathogen and insect-pest increment rates
- Changes in relative abundance and efficiency of biocontrol agents
- Changes in pathogen/insect-pest host-environment interactions, including resistance loss in cultivars harbouring temperature-sensitive genes
- New illnesses/pest concerns have emerged, and the danger of migrating diseases and pests has grown.
- Varioplast effectiveness has decreased.

Mitigation of climate change in Agriculture

Climate change mitigation in agriculture is discussed below.

- The medium and long duration wheat cultivars (HD 2932 and HD 2967) generated significantly higher yields in normal, early, and late seeding conditions, however the short duration wheat cultivar HD 2285 performed well only under extreme late seeding conditions.
- Using NH4-N containing nano-zeolite increased nitrogen availability and crop growth while lowering methane emissions from rice soils. Because of the combined effect of increased growth and lower methane emission, nitrogen loaded with micro zeolite may be a feasible and ecologically acceptable source of nitrogen in rice crop development.
- A rise in temperature had a stronger negative impact on C3 (Rice) plants than it did on C4 (Maize) plants. CO2 enrichment, on the other hand, has helped to mitigate the negative impacts of increasing temperatures. Rice, rather than maize, has responded to CO2 enrichment better when cultivated at higher temperatures.

- In the face of climatic change, the System of Rice Intensification (SRI) would help preserve rice output. Water is conserved by around 20% when rice is grown using the SRI method, while yields are boosted by up to 22%.
- Identified disease-resistant varieties like ICCV 05530, ICCV 08318, ICC 11322 in chickpea and ICPL 99050, MN1 in pigeonpea, as well as pest-resistant varieties like ICPL 332WR and ICPHaRL 4989-7 in pigeonpea and ICCV 10 in chickpea that have stability toward resistance in all environments and can be used for cultivation as well as developing pest and disease resistance The activity of aminopeptidase (a receptor for Bt toxins) decreases as CO2 levels rise, meaning that Bt-transgenic crops will be less efficient in the future for pest control. This understanding will assist in the creation of disease and pest-resistant cultivars, which will help mitigate the consequences of global climate change.

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