

Impact of Climate Change on Agriculture

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INTRODUCTION

Agriculture is the foundation of the Indian economy. And in India Agriculture sector is vulnerable to climate change. According to IPCC climate change is defined as a change in the state of the climate that can be identified (e.g by using statistical tests) by changes in the mean and or the variability of its properties and that persists for an extended period ,typically decades or longer. Climate change may be due to natural internal process or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. There is direct and indirect impact of climate change related to crop, changes in the intensity and frequencies of drought, effects of microbial population, soil organic matter reduction, yield reduction, decrease of soil fertility as driven by soil erosion, etc. Agriculture is a complex system linked to climate by temperature, precipitation, solar radiation, and atmospheric gas composition. The different effects are unevenly distributed across the world and are caused by changes in temperature, rainfall and atmospheric carbon dioxide levels due to global climate change.

Direct impacts from variability of weather patterns are caused by increasing temperatures, heat waves and changes in rainfall pattern causing floods and drought, increasing atmospheric CO₂ levels by increasing crop yields due to CO₂ fertilisation but also reduced nutritional value of crops by lowering the content of micronutrients. Also there will be changes in feeding habits, movement and reproduction of insect pest and climate driven changes plant diseases and weeds which can result in reduced yields as well.

Causes of climate change

Causes of climate change can be categorized into two classes:

1) Natural causes :It includes orbital changes in earth revolution, variation, oceanic circulation, changes in position of continents and size, volcanic activity, changes in position of continents and size, volcanic activity, changes in atmospheric constituents by natural events, variations in solar activity.

2) Anthropogenic causes :It involved abnormal human activities such as deforestation, fossil fuel, combustion changes in atmospheric constituents and lastly nuclear war causing nuclear winter.

Impact of climate change on agriculture

Water is vital to plant growth, so varying precipitation patterns have a significant impact on agriculture. As over 80 per cent of total agriculture is rain-fed, projections of future precipitation changes often influence the magnitude and direction of climate impacts on crop production . The impact of global warming on regional precipitation is difficult to predict owing to strong dependencies on changes in atmospheric circulation, although there is increasing confidence in projections of a general increase in high-latitude precipitation, especially in winter, and an overall decrease in many parts of the tropics and sub-tropics (IPCC 2007). Precipitation is not the only influence on water availability. Snow and glacier melt thereby modulate the seasonal pattern of river flows and, together with groundwater, provide water when rainfall is scarce. Increasing evaporative demand owing to rising temperatures and longer growing seasons could increase crop irrigation requirements globally by between 5 and 20 per cent, or possibly more, by the 2070s or 2080s (Doll 2002; Fisher *et al.* 2006), but with large regional variations—South-East Asian irrigation requirements could increase by 15 per cent (Doll 2002).

Higher crop, grass, and forestry yield due to carbon dioxide fertilization. Carbon dioxide is removed from the atmosphere by plants during photosynthesis, (though not in quantities sufficient enough to remove everything humans emit.) In fact, greenhouse and field experiments have shown that higher levels of carbon dioxide in the atmosphere can act as a fertilizer and increase plant growth. The amount of benefit a crop receives depends on its type. Wheat, barley and rice for example benefit more from higher carbon dioxide concentrations than corn. More carbon dioxide

in the air makes the plant more efficient at absorbing the gas, and consequently it loses less water during the process, which is better for the plant's growth. With sufficient water and other nutrients, crop yields can increase significantly.

Heat waves (periods of extreme high temperature) are likely to become more frequent in the future and represent a major challenge for agriculture. Heat waves can cause heat stress in both animals and plants and have a negative impact on food production. Extreme periods of high temperature are particularly harmful for crop production if they occur when the plants are flowering – if this single, critical stage is disrupted, there may be no seeds at all. In animals, heat stress can result in lower productivity and fertility, and it can also have negative effects on the immune system, making them more prone to certain diseases.

Projected changes in climate are not limited to increases in temperature and heat waves; large changes in rainfall patterns are also expected to occur. While some regions are likely to suffer from more droughts in the future, other regions are expected to face the opposing issues of torrential rains and increased flooding. In coastal areas, rising sea levels may result in complete loss of agricultural land. Warmer climates may also lead to more problems from pests and diseases, and shifts in the geographical distribution of certain pests. For example, insects that serve as a vector for disease transmission are likely to migrate further pole-ward in the future, where livestock have so far not been exposed to these diseases.

The responses of yield to various stresses have been well defined through experimentation in many crops. Quantifying these responses, and identifying when agriculture is most vulnerable to stress, is beneficial in helping to identify the most efficient strategies for adaptation. Crop-level adaptation to climate change is expected to be key in minimising future yield losses and may

involve: changing crop cultivars, sowing time, cultivation techniques, and/or irrigation practices. Ongoing research is addressing the challenges of maintaining and/or increasing crop production under global change. Some risks to crop production from climate change and extreme weather events have been identified, and strategies suggested to help maintain production.

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