



Climate Change and Its Impact on Agriculture

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ABSTRACT

Climate change and variability are concerns of human being. The recurrent droughts and floods threaten seriously the livelihood of billions of people who depend on land for most of their needs. The global economy is adversely being influenced very frequently due to extreme events such as droughts and floods, cold and heat waves, forest fires, landslips etc. The natural calamities like earthquakes, tsunamis and volcanic eruptions, though not related to weather disasters, may change chemical composition of the atmosphere. It will, in turn, lead to weather related disasters. Increase in aerosols (atmospheric pollutants) due to emission of greenhouse gases such as Carbon Dioxide due to burning of fossil fuels, chlorofluorocarbons (CFCs), hydro chlorofluorocarbons (HCFCs), hydro fluorocarbons (HFCs), per fluorocarbons (PFCs) etc., Ozone depletion and UV-B filtered radiation, eruption of volcanoes, the “human hand” in deforestation in the form of forest fires and loss of wet lands are causal factors for weather extremes.

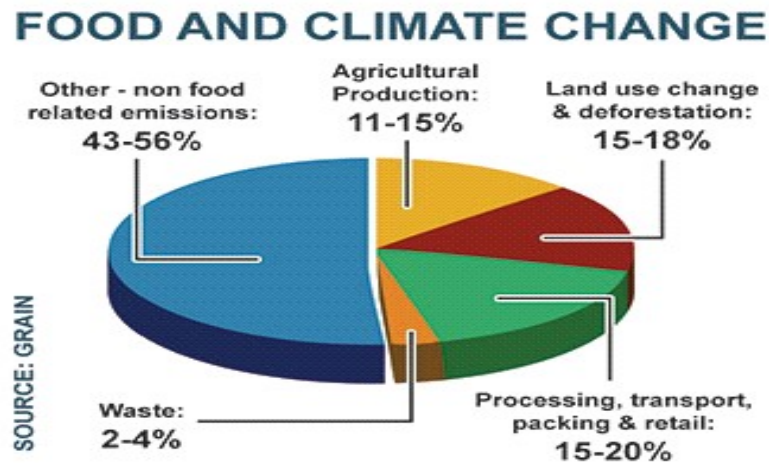
The loss of forest cover, which normally intercepts rainfall and allows it to be absorbed by the soil, causes precipitation to reach across the land eroding top soil and causes floods and droughts. Paradoxically, lack of trees also exacerbates drought in dry years by making the soil dry more quickly. Among the greenhouse gases, CO₂ is the predominant gas leading to global warming as it traps long wave radiation and emits it back to the earth surface. The global warming is nothing but heating of surface atmosphere due to emission of greenhouse gases, thereby increasing global atmospheric temperature over a long period of time. Such changes in surface air temperature and consequent adverse impact on rainfall over a long period of time are known as climate change. If these parameters show year-to-year variations or cyclic trends, it is known as climate variability.



Effects of climate change on key sectors at Global Level:

The IPCC Fourth Assessment Report of the Working Group II: Impacts, Adaptation and Vulnerability describe the likely effects of climate change, including from increases in extreme events. The effects on key sectors, in the absence of countermeasures, are summarized as follows.

- **Water:** Drought affected areas are likely to be more widely distributed. Heavier precipitation events are very likely to increase in frequency leading to higher flood risks. By mid-century, water availability is likely to decrease in mid-latitudes, in the dry tropics and in other regions supplied by melted water from mountain ranges. More than one sixth of the world's population is currently dependent on melt water from mountain ranges.
- **Food:** While some mid latitude and high latitude areas will initially benefit from higher agricultural production, for many others at lower latitudes, especially in seasonally dry and tropical regions, the increases in temperature and the frequency of droughts and floods are likely to affect crop production negatively, which could increase the number of people at risk from hunger and increased levels of displacement and migration.
- **Industry, settlement and society:** The most vulnerable industries, settlements and societies are generally those located in coastal areas and river flood plains, and those whose economies are closely linked with climate sensitive resources. This applies particularly to locations already prone to extreme weather events and especially to areas undergoing rapid urbanization. Where extreme weather events become more intense or more frequent, the economic and social costs of those events will increase.
- **Health:** The projected changes in climate are likely to alter the health status of millions of people, including increased deaths, disease and injury due to heat waves, floods, storms, fires and droughts. Increased malnutrition, diarrhea disease and malaria in some areas will increase vulnerability to extreme public health, and development goals will be threatened by long term damage to health systems from disasters.



Observed Changes in Climate and Weather Events in India:

- **Surface Temperature-** At the national level, increase of 0.4° C has been observed in surface air temperatures over the past century. A warming trend has been observed along the west coast, in central India, the interior peninsula, and north-eastern India.
- **Rainfall-** While the observed monsoon rainfall at the All India level does not show any significant trend, regional monsoon variations have been recorded. A trend of increasing monsoon seasonal rainfall has been found along the west coast, northern Andhra Pradesh, and north-western India (+10% to +12% of the normal over the last 100 years) while a trend of decreasing monsoon seasonal rainfall has been observed over eastern Madhya Pradesh, north-eastern India, and some parts of Gujarat and Kerala (-6% to - 8% of the normal over the last 100 years)
- **Extreme Weather Events-** Trends of Extreme Weather Events observed in multi-decadal periods of more frequent droughts followed by less severe droughts. There has been an overall increasing trend in severe storm incidence along the coast at the rate of 0.011 events per year. While the states of West Bengal and Gujarat have reported increasing trends, a decline has been observed in Orissa. Scientists, while analysing a daily rainfall data set, have shown (i) a rising trend in the frequency of heavy rain events, and (ii) a significant decrease in the frequency of moderate events over central India from 1951 to 2000.
- **Rise in Sea Level-** Using the records of coastal tide gauges in the north Indian Ocean for more than 40 years, Scientists have estimated that sea level rise was between 1.06-1.75 mm per year. These rates are consistent with 1-2 mm per year global sea level



rise estimates of the IPCC. Indian Summer Monsoon (ISM) intensity is projected to increase in the beginning of 2040 and by 10% by 2100.

- **Impacts on Himalayan Glaciers-** The Himalayas possess one of the largest resources of snow and ice and its glaciers form a source of water for the perennial rivers such as the Indus, the Ganga, and the Brahmaputra. Glacial melt may impact their long-term lean-sea sonflows, with adverse impacts on the economy in terms of water availability and hydropower generation.

Climate change and agriculture:

Based on some of the past experiences indicated above, impact of climate change on agriculture will be one of the major deciding factors influencing the future food security of mankind on the earth. Agriculture is not only sensitive to climate change but also one of the major drivers for climate change. Understanding the weather changes over a period of time and adjusting the management practices towards achieving better harvest are challenges to the growth of agricultural sector as a whole. The climate sensitivity of agriculture is uncertain, as there is regional variation in rainfall, temperature, crops and cropping systems, soils and management practices. The inter-annual variations in temperature and precipitation were much higher than the predicted changes in temperature and precipitation. The crop losses may increase if the predicted climate change increases the climate variability. 6 Different crops respond differently as the global warming will have a complex impact. The tropics are more dependent on agriculture as 75% of world population lives in tropics and two thirds of these people's main occupation is agriculture. With low levels of technology, wide range of pests, diseases and weeds, land degradation, unequal land distribution and rapid population growth, any impact on tropical agriculture will affect their livelihood. Rice, wheat, maize, sorghum, soybean and barley are the six major crops in the world grown in 40% cropped area, and contribute to 55% of non-meat calories and over 70% of animal feed (FAO, 2006). Consequently, any effect on these crops would adversely affect the food security.

Table 1. Impacts of climate change on agriculture

Agriculture Characteristics	Possible Impacts	Confidence
Agro-climatic conditions	• decreased precipitation in an already spring/summer moisture deficit region • increased need for irrigation with reduced water availability • overwintering of insects and diseases which have previously been killed due to harsh climate • introduction of new insects and diseases with a warmer climate	medium
Crop yields	• yield loss in some areas • yield gain in other areas with good soil moisture • increased variability in world production due to changing climate leading to increased variability in prices and income	medium
Livestock production	• reduced winter cold stress on livestock • increased heat stress in summer • increased adequate feed supplies • increased reliance on good quality water	medium
Economic impact	• increased diversification of production • reduced economic activity due to less output and reduced crop income • other sectors could increase because of diversification • effect of fewer purchased inputs by the agricultural sector on the economy of the province	medium

Demonstration of Climate Resilient Technologies to the farmers may

Be undertaken by the Extension personnel in the areas of-

- **Natural resource management:** Interventions on in-situ moisture conservation, rain water harvesting and recycling for supplemental irrigation, improved drainage in flood prone areas, conservation tillage, ground water recharge and water saving irrigation methods etc.
- **Crop Production:** Introducing drought/temperature tolerant varieties, advancement of planting dates of rabi crops in areas with terminal heat stress, water saving paddy cultivation methods (SRI, aerobic, direct seeding), frost management in horticulture through fumigation, community nurseries for delayed monsoon, custom hiring centers for farm machineries for timely planting, location specific intercropping systems with high sustainable yield index etc
- **Livestock and Fisheries:** Augmentation of fodder production during droughts/floods, improving productivity of Common Property Resources (CPRs), promotion of improved fodder/feed storage methods, preventive vaccination, improved shelters for reducing heat/cold stress, management of fish ponds/tanks during water scarcity and flooding etc.



- **Institutional Interventions:**

Institutional interventions, either by strengthening the existing ones or initiating new ones, relating to seedbank, fodder bank, custom hiring center, collective marketing, and introduction of weather index based insurance and climate literacy through a village level weather station. Extension system has to focus more on diversifying the livelihood options, changing suitable cropping patterns to adjust to the change which is occurring in the particular location, planting more drought tolerant crops, promoting increased share of non-agricultural activities and Agro-forestry practices, identifying the traditional coping strategies, improved on - farm soil & water conservation, promoting mixed cropping pattern and making provision for access to various information sources related to weather and other advisories of climate change would minimize the risks and certainty of farmers related to climate change

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