

## Climatic Hazards and Their Relation to Agricultural Production Risks

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### Introduction

Agricultural productivity of a region is dependent on several biophysical and socioeconomic factors. The key biophysical factors are: weather parameters, soil health, water resources, crops/varieties and biotic stresses. The socioeconomic factors include level of agronomic management, availability of farm inputs such as labour, fertilizers, chemicals, irrigation, rural infrastructure, institutions and government policies. Amongst all the factors responsible for productivity, weather has the over-riding impact. Weather parameters influence various dynamics of crop growth and development and account for nearly two thirds of variation in agricultural productivity.

More extreme temperature and precipitation can prevent crops from growing. Extreme events, especially floods and droughts, can harm crops and reduce yields. Dealing with drought could become a challenge in areas where summer temp are projected to increase and precipitation is projected to decrease. As water supplies are reduced, it may be more difficult to meet water demands.

In many parts of the world, weather represents one of the major uncertainties affecting the performance and management of agricultural systems. Due to global climate change, the climatic variability and the occurrence of extreme weather events is likely to increase leading to a substantial increase in agricultural risk and destabilisation of farm incomes

Climate change is a significant and long-term change in the statistical distribution of weather patterns over periods of time that range from decades to millions of years. It may be a change in the average weather conditions or a change in the distribution of weather events with respect to an average, for example, greater or fewer extreme weather events. Climate change may be limited to a specific region, or may occur across the whole Earth.

Agriculture represents a core part of the Indian economy and provides food and livelihood activities to much of the Indian population. While the magnitude of impact varies greatly by region, climate change is expected to impact on agricultural productivity and shifting cropping patterns. The impact of climate change on agriculture could result in problems with food security and may threaten the livelihood activities upon which much of the population depends. Climate change can affect crop yields (both positively and negatively), as well as the type of crops that can be grown in certain areas, by impacting agricultural inputs such as water for irrigation, amounts of solar radiation that affect plant growth, as well as the prevalence of pests. Climate induced hazards like floods, cyclones, storm surges and droughts are expected to become more frequent and severe in the near future.

### **Climatic hazards:**

A physical process or event (hydro-meteorological or oceanographic or phenomena) that can harm human health, livelihoods or natural resources. It is mainly caused by changes in climate system. The major climatic hazards are drought, Flood, Heat and Cold wave, Cyclones etc.

### **Drought**

The term drought can be defined by several ways. The condition under which crops fail to mature because of insufficient supply of water through rains. The situation in which the amount of water required for transpiration and evaporation by crop plants in a defined area exceeds the amount of available moisture in the soil. A situation of no precipitation in a rainy season for more than 15 days continuously. Such length of non-rainy days can also be called as dry spells.

### **Flood**

Years in which actual rainfall is 'above' the normal by twice the mean deviation or more is defined as years of floods or excessive rainfall. Like droughts, the definition of floods also varies one situation to another and forms one region to other.

### **Frost**

Frost is water vapour, or water in gas form, that becomes solid. Frost usually forms on objects like cars, windows, and plants that are outside in air that is saturated, or filled, with moisture. Areas that have a lot of fog often have heavy frosts.

### **Tropical cyclone**

Tropical cyclone, also called typhoon or hurricane, an intense circular storm that originates over warm tropical oceans and is characterized by low atmospheric pressure, high winds, and heavy rain. Drawing energy from the sea surface and maintaining its strength as long as it remains over warm water, a tropical cyclone generates winds that exceed 119 km (74 miles) per hour. In extreme cases winds may exceed 240 km (150 miles) per hour, and gusts may surpass 320 km (200 miles) per hour.

### **Extreme wether conditions**

#### **Heat wave**

A heat wave is a period of excessively hot weather, which may be accompanied by high humidity, especially in oceanic climate countries. While definitions vary, a heat wave is measured relative to the usual weather in the area and relative to normal temperatures for the season. Temperatures that people from a hotter climate consider normal can be termed a heat wave in a cooler area if they are outside the normal climate pattern for that area.

#### **Cold wave**

A cold wave is a rapid fall in temperature within a 24-hour period requiring substantially increased protection to agriculture, industry, commerce, and social activities. The precise criterion for a cold wave is determined by the rate at which the temperature falls, and the minimum to which it falls. This minimum temperature is dependent on the geographical region and time of year.

### **Effect of climatic hazards on agricultural production**

#### **Drought:**

Droughts are more common in arid regions occurring at least two out of every five years. Drought is a regular part of the natural cycles affecting productivity and desertification. The rainfed regions encompassing the arid, semi-arid and dry humid regions are more prone to climate variability. Drought considerably influences production, the reduction in food grain production depending upon the severity of the drought. The effects of failure of rains on decline in food production depend upon the stage and the water requirement of the crop.

Drought is certainly one of the utmost imperative stress situations causing vast impression on growth and development of crop, thus affecting its productivity. Drought stress enforces modifications in fundamental morphology, physiology and biochemical aspects in plan. Extreme drought conditions, frequently occurring due to climate change, exacerbate the

productivity of crops by causing nutrient immobilization and salt accumulation in soils making them dry, unhealthy, saline and finally infertile.

Production of pearl millet during *kharif* is reduced by 10- 30% during mild drought, 35 60% during moderate drought and 75-90% during severe droughts. Surface water availability also declined during drought years with the drought severity creating drinking water problem.

### **Flood**

Erosion and soil displacement from flooding can ruin fields and destroy crops. Erosion washes the fertile top soil away which leaves crop plants with nowhere to set roots. Sand, gravel, and rocks deposited by flood waters can smother and destroy exposed crops. Crop losses through rain damage, waterlogged soils and delays in harvesting are major effects of flood on agriculture. Floods result in siltation and sedimentation, accumulated waste, polluted water and deformed land topography. Flooding makes the soil moist which eventually make winter crops cultivation challenging. Result in washout of top soil and nutrients from the soil, resulting in low productivity for several years to come, unless and until corrective and proactive remediation strategies are not worked upon.

### **Heat wave and cold wave**

An important weather phenomenon that causes significant impact on agricultural production year after year over the northern and north eastern regions of India is the occurrence of “Western Disturbances”. The intensity, frequency and the aerial extent of these disturbances significantly influence the quantum of rainfall / snow over these regions during the *rabi* season; lean season flow of rivers and occurrence of cold wave conditions. In the process, they influence overall hydrology, the daily maximum / minimum temperatures, temperature range, bright sunshine hours and humidity. A good example of this is the severe and prolonged cold wave condition that prevailed over many parts of northern and north eastern parts of India during the winter season of 2002-03, which had considerably affected the survival and productivity of not only the seasonal crops but also the perennials (tree and horticultural). There are separate limits for defining coldness for different regions based on departures of temperature over the normal.

#### **(a) Regions with normal minimum temperature of 10°C and above:**

Cold wave conditions are said to prevail when departure of minimum temperature is 5°C to 6°C lower than normal in the region. Severe cold wave conditions

are identified when the minimum temperature departure is 7°C lower than the normal in the region.

**(b) Regions with normal minimum temperature less than 10°C:**

Cold wave conditions prevail when departure of minimum temperature is 3°C to 4°C lower than normal in the region. Severe cold wave conditions prevail when the minimum temperature departure is 5°C lower than the normal in the region. Certain stages of plant growth and development are more sensitive to low temperature than other phases with dormancy generally representing the most tolerant stage. Reproductive organs are comparatively more sensitive to chilling and freezing stress. Likewise, seedlings are more sensitive than adult plants. Limits of freezing temperatures and plant injury in general are given below:

**Light Freeze:**

-1.7 to 0.1°C – tender plants killed, with little destructive effect on other vegetation.

**Moderate Freeze:**

-3.9 to 2.2°C – wide destructive effect on most vegetation with heavy damage to fruit blossoms, tender and semi-hardy plants.

**Severe freeze:**

-4.4°C and less – severe damage to most plants. At these temperatures, the ground freezes solid, with the depth of the frozen ground dependent on the duration and severity of the freeze, soil moisture, and soil type.

Heat wave impacts crop growth and development at different levels like soil moisture uptake, root and shoot growth, photosynthesis, respiration, plant water uptake and final yield. Heat waves results in reduction of yields in warm regions due to heat stress. Heat wave competes for soil moisture by hastened evaporation, leaving almost no moisture for uptake by plants. Heat wave also causes an overall environmental degradation, which is a major factor contributing to the vulnerability of agriculture, forestry and rangelands to heat waves.

**Conclusion**

It is clear that occurrence of extreme weather events are common across the world and their impacts on world economy is tremendous. There should be a determined effort from developed and developing countries to make industrialisation environment-friendly by reducing the pumping of greenhouse gases into atmosphere. Awareness programmes on climate change and its effects on various sectors such as agriculture, health, infrastructure,

water etc and the role played by human interventions in climate change need is to be taken up on priority. Strategies on mitigation and adaptation against weather extremes have to be practiced.

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