



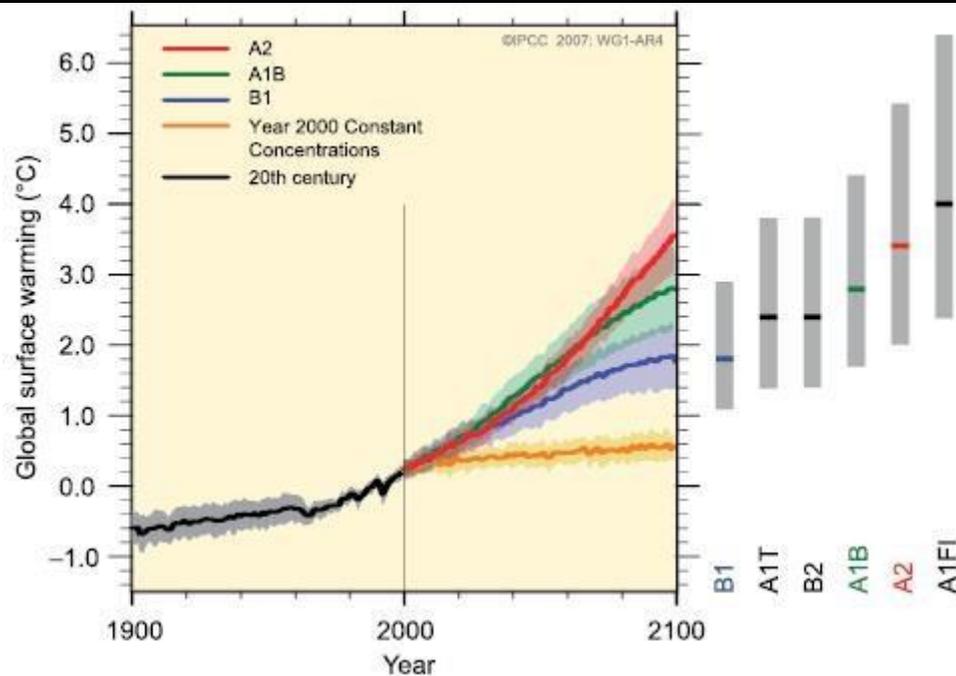
Climate Change and its Impact on Agriculture

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Abstract-climate change refers to long-term shifts in Temperatures and weather pattern. The term “weather” refers to the short-term(daily) changes in Temperatures, wind, and/or precipitation of a region (Merritts et al.1998). Climate change has affected agriculture for a long time in many ways such as quantity and quality of crops in terms of productivity, growth rates, moisture availability etc. Due to climate change whole world is struggling with the problem of food because climate change is affecting agriculture a lot. Due to increasing seasonal temperature, the crop cycle of many crops is getting shorter and the production from other crops is also getting reduced. In areas where temperatures are already close to physiological maxima for crops, warming will impact yields more immediately (IPCC,2007). Climate change can disrupt food availability, reduce access to food, and affect food quality. Climate change is having a negative impact on agriculture. Due to which food production is decreasing very much and the problem of food security has increased a lot.

INTRODUCTION

Climate change is a term used for the observed century scale rise in the average temperature of the earth’s climate system and its related effects. It is about abnormal change in the weather of a place. scientists are more than 95% certain that nearly all of global warming is caused by increasing concentrations of greenhouse gases (GHGs)and other human caused emissions. Within the earth’s atmosphere, accumulating greenhouse gases like water vapour, carbon dioxide, methane, nitrous oxide, and ozone are the gases within the atmosphere that absorb and emit heat radiation. Global warming is gauged by the increase in the average global temperature of the earth, because of increasing human activities such as industrialization, urbanization, deforestation, agriculture change, change in cropping pattern etc. Greenhouse effect is important for agriculture in three ways. First, due to increasing atmospheric carbon dioxide concentration, the growth of crops is being affected and also their rate. Secondly, due to increasing co₂, climate is changed and due to this Temperature, rainfall and sunshine alter which affect animal and plant productivity. finally, due to rise in the sea level, crop land is decreasing and the salinity of the land in the coastal area is increasing.



Greenhouse effect is a very natural process which plays a very important role in shaping the climate of earth. It produces a relatively warm and hospitable environment on earth's surface for humans and other life forms so that they can develop and prosper.

Greenhouse gases are

- Carbon dioxide (CO₂)
- Water vapour (H₂O)
- Methane (CH₄)
- Nitrous oxide (N₂O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)

The average global surface temperature has increased by 0.74 °C since the late 19th Century and is expected to increase by 1.4 °C - 5.8 °C by 2100 AD with significant regional variations (IPCC, 2007).

All the climate models have indicated that the rising trend in temperature. The precipitation pattern is also changing and rainfall is decreasing from south and southeast Asia. More intense and severe drought occurred since 1970s. Contraction in snow cover of Himalayas, rise in sea level by 0.18 to 0.59 m by the end of the century.

Weather and climate: weather is the set of meteorological conditions such as wind, rain, snow, sunshine, temperature, etc. At a particular time and place. Climate describes the overall long-term characteristics of the weather experienced at a place.

Indian scenario of climate change

The warning has been more pronounced in the northern part of India. Due to climate change, there is a lot of difference in minimum and maximum temperature of places, some place gets surplus of rainfall and some part suffers from drought. Example – Rajasthan (25mm rainfall) suffers from deficit of water. Mawsynram in Meghalaya receives the highest rainfall in India.

Climate change in India is having profound effects on India, which is ranked 4th among the list of countries most affected by climate change in 2015. India emits about 3 gigatonnes (Gt) CO₂ of greenhouses each year, about two and half tons per person, which is less than the world average. The country emits 7% of global emissions, despite having 17% of the world population. Temperature rises on the Tibetan plateau are causing Himalayan glaciers to retreat, threatening the flow rate of the Ganges, Brahmaputra, Yamuna and other major rivers. A 2007 world wide fund for nature report states that the Indus river may run dry for the same reason. Heat waves frequency and intensity are increasing in India because of climate change. Severe landslides and floods are projected to become increasingly common in such states as Assam. Climate change performance index of India ranks 8th among 63 countries which account for 92% of all GHG emissions in the year 2021.

Climate change effect on crops

Climate change includes increasing temperature, changing precipitation, and change in the concentration of CO₂, which has a great impact on the quality and quantity of crops, on their growth, photosynthesis and transpiration rates, moisture availability, change in irrigation pattern and herbicides, insecticides also affect crop growth and production which also impact the economy of the country. Crop production is highly sensitive to climate. It is affected by long-term trends in average rainfall and temperature, interannual climate variability, shocks during specific phenological stages and extreme weather events (IPCC, 2012). Some crops are more tolerant than others to certain types of stresses, and at each phenological stage, different types of stresses affect each crop species in different ways (Simpson, 2017). As climate changes, crop production strategies must change too. There will always be some uncertainty associated with modelling the complex relationships between agricultural yields and future climate scenarios. Atmosphere with higher CO₂ concentration would result in higher net photosynthetic rates (Cure & Acock 1986, Allen et al. 1987). Higher CO₂ concentration may reduce the water level so plants also reduce stomatal activities in which CO₂ and water vapour are exchanged. The reduction in transpiration could be 30% in some crop plants (Kimball 1983). Temperature alterations can take many forms: changes in average temperature; changes in daytime high and night time low temperature; and changes in the timing, intensity and duration of extremely hot or cold weather. In general, crops are most sensitive to high temperatures at the reproductive stage and grain-filling /fruit maturation stage (Hatfield et al. 2011). A key mechanism of high temperature induced floret sterility in rice is the decreased ability of the pollen grains to swell, resulting in poor thecae dehiscence (Matsui et al. 2000). Variation in solar radiation, increased maintenance respiration losses or differential effects of night vs. Day temperature on tillering, leaf-area expansion, stem elongation, grain filling, and crop phenology have been proposed as possible causes (Peng et al. 2004; Sheehy et al. 2005). In a recent climate chamber study, there was first evidence of possible genotypic variation in resistance to high night temperatures (Counce et al. 2005). High CO₂ and rising temperature affect the productivity and growth of crops.

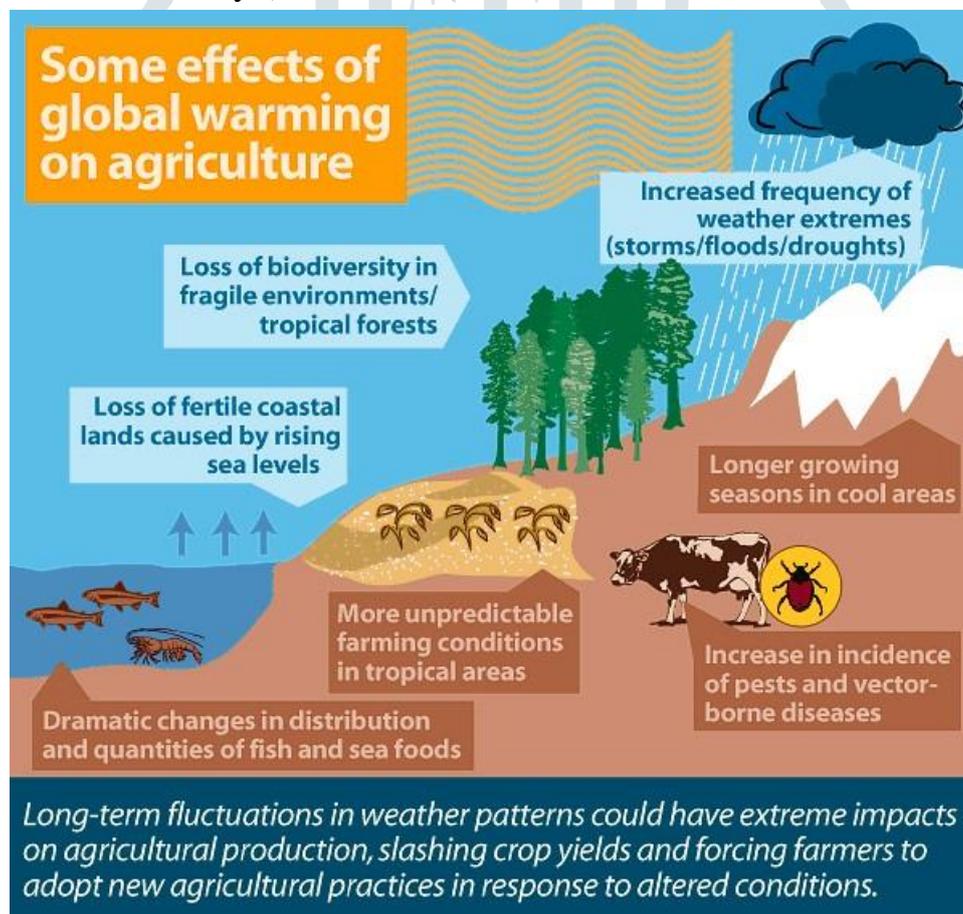
Predicted effect of climate change over next 50 years

Climatic Element	Expected Change By 2050	Confidence In Prediction	Effect on Agriculture/ Aquaculture
CO ₂	Increase From 360 Ppm To 450-600 Ppm	Very High	<ul style="list-style-type: none"> • Good for Crops • Increased Photosynthesis • Reduced Water Use
Sea Level Rise	Rise By 10-15 Cm	Very High	<ul style="list-style-type: none"> • Loss of Land • Coastal Erosion • Flooding • Salinization of Ground Water
Temperature	Rise By 1-2°C Increased Frequency of Heat Waves	High	<ul style="list-style-type: none"> • Faster, Shorter Earlier Growing Seasons • Heat Stress Risk • Increased Evapotranspiration
Precipitation	Seasonal Changes By +- 10%	Low	<ul style="list-style-type: none"> • Impacts on Drought • Risks Soil Workability • Water Logging
Storminess	Increased Wind Speeds, Especially in North. More Intense Rainfall Events	Very Low	<ul style="list-style-type: none"> • Lodging • Soil Erosion • Reduced Infiltration of Rainfall

Source: FAO publication, 2004a, 2005.

Effect of climate change on world's agriculture

Climate change is likely to directly impact on food production across the globe. Increase in the mean seasonal temperature can reduce the duration of many crops and hence reduce final yields. In areas where temperatures are already close to physiological maxima for crops, warming will impact yields more immediately (IPCC, 2007).



The agriculture of the whole world is facing a lot of trouble because of global warming. Agricultural productivity decline by 3% to 6% by 2080. Developed countries whose average temperature has come above or close to the tolerance capacity of crops, due to which the agricultural productivity predicted to decline between 10 to 25% by 2080. There are rich countries whose temperature is less than the average, due to which there is a very good and positive effect on agriculture, due to which there has been 6 to 8% decline in agricultural productivity.

Agricultural productivity and food security

Climate change further poses a challenge to food security challenges with its influence on food production, costs and security. Excessive heat or shortage of water can impede crop growth, reduce yields, and influence soil quality, and the ecosystem on which agriculture depends. The world food summit (WFS) in 1996 defined food security thus: “food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meet their dietary needs and food preferences for an active and healthy life “. food security is one of the leading concerns associated with climate change. Climate change affects food security in complex ways. It impacts crops, livestock, forestry, fisheries, and aquaculture and can cause grave social and economic consequences in the form of reduced incomes, eroded livelihoods, trade disruption and adverse health impacts. According to food and agriculture organization (2016), both biophysical and social vulnerabilities determine the net impact of climate change on food security. The number of people suffering from chronic hunger has increased from under 800 million in 1996 to 1 billion recently (UN 2009).

United nations population data and projections show the global population reaching 9.1 billion by 2050, an increase of 32% from 2010.

Even the IPCC, scarcely alarmist, says 0.5°C rise in winter temperature would reduce wheat yield by 0.45 tons per hectare in India. Rice and wheat have a total share in total food grain production in India. Any change in rice and wheat significantly impact on food security of the country. Indian agriculture had already pushed into this crisis and 2.56 lakh farmers committed suicide.

According to A K Singh, deputy director- general resource management) of Indian council of agricultural research (ICAR), medium term climate change predictions have projected the likely reduction in crop yields due to climate change between 4.5 and 9% by 2039. To reduce the impact of climate change on agriculture India will need to cope with global, national and regional level.

CLIMATE CHANGE – MITIGATION AND ADAPTATION IN AGRICULTURE

- Farmers should be guided according to climate change risks so that they can adopt their planning according to climate. They can do their planting date, their variety and growth duration and changing crop rotation according to climate change.
- Maximum funds should be provided to increase research so that they can help in adaptation and mitigation of agriculture.
- Farmers should be provided credit so that they can adopt new technology and do their farming according to climate change and environmental conditions.
- Farmers should get water/irrigation facility so that their crops can grow well and they should assist about new methods of irrigation. Example, drip irrigation, sprinkling method, mulching.
- There should be seasonal weather forecasting so that according to the weather farmers can see the effect of climate on agriculture and according to that climate farmers can grow crops there and get maximum profit from it.
- Growing a crop for a short period of time so that it matures before the onset of summer completely.

- Agriculture insurance should be provided to the farmers as much as possible.
- Proper planning of land use to ensure food security and climate change.
- Such crops should be grown which can tolerate condition like high temperature, drought and salinity.
- We have to ensure food security by improving technology, inputs and raw materials.
- We must combine an alert system for changes in pest and disease outbreaks, and the system is based on integrated pest management so that it can monitor any changes in the pest.

Conclusion

Climate change the result of global warming has started showing its result all over the world. climate change is a factor of agricultural productivity that directly affects our food security. Agriculture sector is very sensitive to climate change because climate change affects the vegetation and crops of a place. Due to increase in temperature the duration of many crops is reduced and the final yield also affected from it. Food production is also very sensitive to climate change. To deal with the impact of climate change on agriculture, we should manage soil, water and biodiversity. To deal with the impact of climate change on food production, India will have to cope globally, nationally and regionally or local level.

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