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Climate Change: The Cause and Consequences in Agriculture

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At present, climate change is the biggest challenge the world is facing. Human activities have contributed substantially to climate change by adding CO_2 and other heat trapping greenhouse gases to the atmosphere (CH_4, NO_2, SO_2 and CFC *etc.*) causing the greenhouse effect and rise in earth's surface temperature. This increased temperature impacted on the agricultural production, food supply and sustainability of the life on earth. The growth rate, competitive ability and geographical distribution of crops have been affected due to climate change.

Introduction

Climate is a major force in Earth's environmental system and even minor changes can have serious environmental consequences. Unlike past changes that occurred over long period, climate shifts or change have taken place within a few decades and are significantly affecting life on Earth in numerous ways, majorly agriculture and food supply. Climate change can influence crop productivity, agronomic practices such as irrigation, fertilization and pest management. It may also indirectly affect crop production through changes in soil fertility, organic matter and erosion. Therefore, assessing the effects of elevated CO_2 and rising temperatures is essential to develop adaptive strategies. Sustainable crop production under changing climate conditions requires improved productivity along with effective weed and pest management.

What is Climate change?

Weather is a state of atmosphere at a particular place and time as regards with heat, cloudiness, dryness, sunshine, wind, rain etc. Climate is the synthesis of weather conditions in a given area, characterized by long-term statistics for the meteorological elements in that area. Climate is the long-term weather pattern in a region, typically it is the average over 30 years weather data over a region. Climate change refers to long-term shifts in temperature and weather pattern. Climate change is the change in statistical distribution of weather pattern that lasts for an extended period of time. Climate change primarily caused due to human activities such as burning fossil fuels, deforestation and industrial processes. These activities increase greenhouse gases (like CO_2 and CH_4) in the atmosphere, leading to global warming and altering weather patterns, sea levels and ecosystems. Global warming and greenhouse effect has been resulted majorly due to climate change.

Greenhouse effect

The process of trapping of the sun's warmth in a planet's lower atmosphere by certain gases (CO_2, CH_4, N_2O and water vapour), due to the greater transparency of the atmosphere to visible radiation from the sun than to infrared radiation emitted from the planet's surface. However, an increase in these greenhouse gases due to human activities enhances the greenhouse effect, leading to global warming and climate change. The major greenhouse gases contributing for greenhouse effect are as follows.

Table 1: Contribution of Greenhouse gases to Greenhouse effect

Gas	Annual increase (%)	Contribution (%)
Carbon dioxide	1.6	40 – 50 %
Methane	1.2	20 - 25 %
CFC's	3.0	15 – 20 %
Nitrous oxide	1.0	5 – 10 %

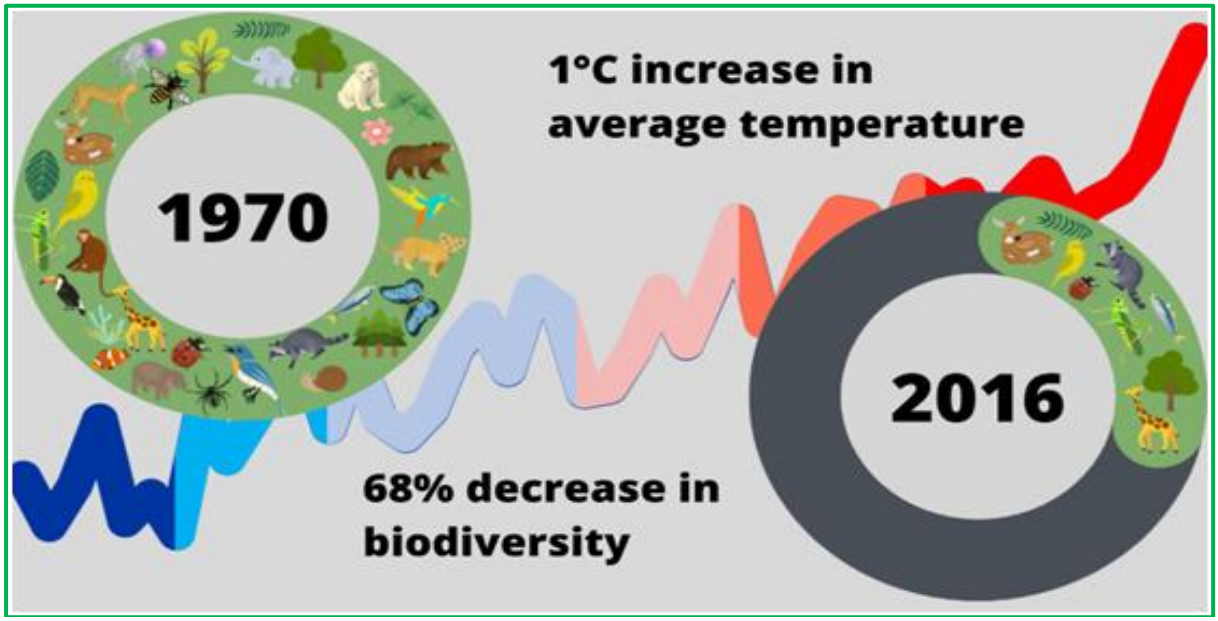

Fig1: Greenhouse effect on biodiversity

Since 1970, with increase in $1^{O}C$ of average temperature, the biodiversity has been decreasing by about 68%. It is estimated that CO_2 might increase to 800 ppm and temperature of $3.3^{0}C$ by 2080 due to climate change and greenhouse effect.

Causes for Climate change

1. **Deforestation:** In order to feed the over growing population forest land has been converted into the agricultural fields which lead to deforestation which resulted into release of CO_2 into atmosphere.
2. **Industrialization and urbanization:** Industries emit greenhouse gases such as CO_2, methane (CH_4), nitrous oxide (N_2O), and other pollutants. Rapid urban growth also increases energy consumption and emissions.
3. **Usage of vehicles:** industrialization in developed countries resulted in burning of fossil fuels which releases CO_2 into atmosphere.
4. **Burning of Crop residues:** In order to clear the land from crop residues, the residues will be burnt. This burning of crop residues and biomass lead to release of CO_2 into the atmosphere.
5. **Usage of fertilizer:** After 1964 in order to feed the over growing population external input of fertilizers is recommended. This resulted in release of N_2O into soil and atmosphere.
6. **Agricultural activities:** Due to anaerobic digestion in ruminants and non-ruminants methane gas has been emitted into the atmosphere. Due to anaerobic respiration in rice methane has been released.
7. **Aerosol spray propellants:** The cooling agents like refrigerator, air conditioner, solvents, aerosol spray, foam packaging releases chlorofluro carbons into atmosphere.

Consequences of Climate change on Agriculture

Major environmental factor which has been influenced by climate change is rainfall which resulted in erratic distribution of rainfall, alteration in CO_2 level and temperature. Increase in

CO_2 in turn resulted in increase in temperature. This resulted in increase in desertification and drought. Increase in temperature results in melting of polar ice and increase in sea level, causing flood and salinization. Increase in temperature and erratic distribution of rainfall favoured disease and pest incidence and their severity. In order to feed the over growing population, application of fertilizers to soil has been increased, but the uptake of nutrients by plant has been reduced due to flooding and salts accumulation on the surface, which resulted in reduction in yield and both the quantity of the produce and nutritional quality of the produce.

Mitigation strategies for Climate change

- Reduce deforestation and land degradation, promote afforestation and reforestation
- Improve waste management and methane capture
- Promote carbon sequestration (biochar, conservation tillage, agroforestry)
- Adopt sustainable agricultural practices
- Transition to renewable energy sources (solar, wind, hydro, biomass)
- Encourage use of electric vehicles and public transport
- Implement carbon pricing and emission regulations
- Improve energy efficiency in industries, buildings and transport

Conclusion

Global climate change significantly affects crop growth, productivity and ecosystem stability. Rising atmospheric CO_2 and change in temperature and rainfall alter plant growth, water availability and yield quality. Increased droughts, floods and pest outbreaks further threaten food security and farmer livelihoods. Climate change is a critical global issue, reducing greenhouse gas emissions along with adopting climate-resilient practices is essential for sustainable agriculture and environmental stability.

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