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Impact of Climate Change on Agriculture

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Abstracts:

The impacts of climate change on agriculture are complex and multifaceted, requiring adaptive strategies to manage risks and sustain food production in the face of changing climatic conditions.Since the impact of climate change on agriculture varies with region, the implications for food security, livelihood, and poverty reductions are marred with global inequality. Indigenous or other minority groups and small-scale producers, are often at higher risk of malnutrition, livelihood loss, rising costs and competition over resources. Adaptation options are available but often lack economic or institutional feasibility or limits on information. Climate change significantly impacts agriculture, leading to decreased crop yields, changes in farming practices, and potential shifts in agricultural zones. Rising temperatures, altered rainfall patterns, and increased frequency of extreme weather events like droughts and floods all contribute to these challenges. These effects can result in reduced crop quality, increased pest and disease outbreaks, and disruptions to traditional farming methods. In 2021, a paper which used an ensemble of 21 climate models estimated that under the most intense climate change scenario used at the time, RCP8.5, global yields of these four crops would decline by between 3–12% around 2050 and by 11–25% by the year 2100. The losses were concentrated in what are currently the major agricultural producers and exporters. For instance, even by 2050, some agricultural areas of Australia, Brazil, South Africa, Southeast China, Southern Europe and the United States would suffer production losses of mostly maize and soybeans exceeding 25%.[139] A similar finding - that some major "breadbaskets" would begin to see unequivocal effects of climate change, both positive and negative, before the year 2040 - had been established in another study from the same year.

Introductions:

The US National Research Council assessed the literature on the effects of climate change on crop yields in 2011. And provided central estimates for key crops. A meta-analysis in 2014 revealed consensus that yield is expected to decrease in the second half of the century, and with greater effect in tropical than temperate region. There is a large number of agricultural crops, but not all of them are equally important. Most climate change assessments focus on "four major crops" – maize (corn), rice, wheat and soybeans – which are consumed directly and indirectly, as animal feed (the main purpose of soybeans). The three cereals are collectively responsible for half of the total human calorie intake,and together with soybeans, they account for two thirds. Different

methods have been used to project future yields of these crops, and by 2019, the consensus was that warming would lead to aggregate declines of the four. Maize and soybean would decrease with any warming, whereas rice and wheat production might peak at 3 °C (5.4 °F) of warming.

Since it represents the worst-case scenario of continually increasing emissions with no efforts to reduce them, RCP8.5 is often considered unrealistic, and a less intense RCP4.5 scenario (which still leads to nearly 3 °C (5.4 °F) by century's end, far in excess of the Paris Agreement goals) is now usually considered a better match for the current trajectory.

It is also a C4 carbon fixation plant, meaning that it experiences little benefit from the increased CO2 levels.[8] When the results from modelling experiments comparing the combined output of latest earth system models and dedicated agricultural crop models were published in 2021, Asia is the most populous subcontinent in the world (UNO, 2015), comprising 4.5 billion people—about 60% of the total world population. Almost 70% of the total population lives in rural areas and 75% of the rural population are poor and most at risk due to climate change, particularly in arid and semi-arid regions (Yadav and Lal, 2018; Population of Asia, 2019). The population in Asia is projected to reach up to 5.2 billion by 2050, and it is, therefore, challenging to meet the food demands and ensure food security in Asia (Rao et al., 2019). In this context, Asia is the region most likely to attribute to population growth rate, and more prone to higher temperatures, drought, flooding, and rising sea level (Guo et al., 2018; Hasnat et al., 2019). In Asia, diversification in income of small and poor farmers and increasing urbanization is shocking for agricultural productivity. Asia is the home of a third of the world's population and the majority of poor families, most of which are engaged in agriculture (World Bank, 2018). We can expect diversification of adverse climate change effects on the agriculture sector due to diversity of farming and cropping systems with dependence on climate.

According to the sixth assessment report of IPCC, higher risks of flood and drought make Asian agricultural productivity highly susceptible to changing climate (IPCC, 2019). Climate change has already adversely affected economic growth and development in Asia, although there is low emission of greenhouse gasses (GHG) in this region (Gouldson et al., 2016; Ahmed et al., 2019a). Still, China and India are major contributors to global carbon dioxide emission; the share of each Asian country in cumulative global carbon dioxide emission is presented in Figures 1, 2. Although GHGs emission from the agriculture sector is lower than the others, it still has a negative impact. Emission of GHGs from different agricultural components and contribution to emissions can be found in Figure 3. However, the contribution of Asian countries in GHGs including land use changes and forestry is described in Figure 4.

Objectives of the Study

- To understand the basic concept of climate change.
- To analyze the impact of climate changes on agriculture

Methodology:

The study is based on descriptive research design. The data has been collected through secondary sources like journals, books, government reports, newspapers and various working papers. The data used in it is purely from secondary sources according to the need of this study. The secondary data has been analyzed through content analysis method.

Climate change significantly impacts agriculture in various ways, affecting crop yields, livestock health, and the sustainability of farming practices. Here are some key areas of impact:

1. Temperature Changes:
   - Crop Growth: Higher temperatures can accelerate crop maturation, potentially reducing yields. Some crops may benefit from warmer temperatures in cooler regions, while others may suffer in already warm areas.
   - Heat Stress: Livestock are vulnerable to heat stress, which can reduce fertility, milk production, and growth rates.

2. Precipitation Patterns:
   - Drought: Changes in precipitation can lead to drought, reducing water availability for irrigation and stressing crops. Drought can also affect soil health and lead to reduced yields.
   - Flooding: Increased rainfall can lead to flooding, which can destroy crops, erode soil, and damage infrastructure.

3. Pest and Disease Pressure:
   - Warmer temperatures may expand the range and increase the populations of pests and diseases, threatening crop yields and livestock health.
   - Changes in climate may also modify the life cycles of pests, potentially leading to increased occurrences of infestations.

4. Soil Quality:
   - Extreme weather events, such as heavy rainfall or drought, can degrade soil quality, reducing its fertility and its ability to retain moisture.
   - Soil erosion from rainfall can also remove the topsoil layer, which is critical for healthy crop growth.

5. Water Resources:
   - Climate change can alter the availability and quality of water resources, impacting irrigation practices and the sustainability of crop production.
   - Glacial melt and changes in snowmelt patterns can affect water supply for irrigation in many regions.

6. Carbon Dioxide Levels:
   - Increased atmospheric CO2 can enhance photosynthesis in some crops (a phenomenon known as CO2 fertilization), but this benefit may be offset by other climate stressors such as heat and water scarcity.

7. Changing Agricultural Zones:
   - Climate change can shift the suitable agricultural zones for different crops. Some regions may become less suitable for traditional crops, while others may become more favorable.

8. Food Security:

- Reduced crop yields and changing agricultural practices can threaten food security, particularly in vulnerable regions that rely heavily on agriculture for sustenance and economic stability.

- Changes in the availability and prices of food commodities can affect global markets and the economic stability of farming communities.

9. Adaptation and Mitigation Strategies:
   - Farmers may need to adopt more resilient agricultural practices, such as crop diversification, soil conservation techniques, and water-efficient irrigation systems.
   - Agricultural innovations, such as genetically modified crops that tolerate extreme conditions, could help mitigate some of the impacts

10. Economic Impacts:
   - Changes in agricultural productivity can have significant economic implications for farmers, rural communities, and national economies, particularly in regions heavily dependent on agriculture.

11. Reduced Crop Yields:
   - Climate change can shorten crop growth periods, reduce the quality of produce, and increase vulnerability to pests and diseases, all leading to lower yields.

12. Changes in Cropping Patterns:
   - Extreme weather events and shifts in climate zones can necessitate adjustments in crop choices and farming practices, potentially leading to changes in what can be grown in certain regions.

13. Increased Risk of Extreme Weather Events:
   - Droughts, floods, and other extreme weather events can severely disrupt agricultural production, impacting crop yields and livestock.

14. Changes in Water Availability and Quality:
   - Climate change can impact water resources, leading to decreased water availability and potentially affecting the quality of water used for irrigation.

Conclusions:

In conclusion, climate change poses a profound and multifaceted challenge to agriculture, affecting crop yields, livestock health, and the overall sustainability of farming systems. As temperature and precipitation patterns shift, the agricultural sector faces increased risks from droughts, floods, pests, and diseases, coupled with changes in soil quality and water availability. These challenges threaten food security, particularly in vulnerable regions, and can disrupt global food markets and local economies.

However, the agricultural community also has the potential to adapt and innovate in response to these changes. By adopting resilient practices, investing in research, and leveraging technology, farmers can mitigate some of the adverse effects of climate change. Strategies such as

crop diversification, improved soil management, and water conservation techniques are essential to build resilience in agriculture.

Ultimately, addressing the impacts of climate change on agriculture requires collaborative efforts among governments, researchers, and the farming community to develop sustainable practices and policies. By prioritizing climate resilience in agricultural planning and development, we can promote food security, protect livelihoods, and ensure the sustainability of agricultural systems for future generations.

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