



Crop Adaptation And Climate Change: Existing Issues And Future Directions

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Abstract: -

Crop yields are anticipated to be significantly impacted by climate change due to variations in temperature and water availability. Therefore, the goal of adaptation and mitigation strategies is to maintain development while attempting a gradual reversal of the effects of climate change. Several adaptation and mitigation strategies can be used to successfully combat the effects of climate change and achieve desired outcomes. These techniques can be broadly classified as resource conservation-based technologies, socioeconomic and policy interventions, and undercropping/cropping system-based technologies. These actions are discussed in order to offer practical approaches to mitigating climate change, with particular emphasis on India.

Introduction: -

Climate change is a complicated phenomenon that is subtle and ongoing, but it is very significant because of the effects it has on different kinds of vegetation that have adapted to stable or largely stable climates. The effects of climate change have gotten so bad that people are afraid that the planet's ability to function will permanently alter. With particular reference to agriculture and food production, some of the main effects of climate change, particularly in the last ten years, are: a rise in storm and flood frequency; an increase in the frequency and severity of droughts and forest fires; a gradual expansion of the growing season and frost-free intervals; a rise in disease and insect pest attacks; and the disappearance of plant and animal habitats. It is anticipated that variations in temperature and moisture brought about by climate change will have a major effect on crop yields. The distribution of pests and plant diseases may also vary with changes in climatic patterns, which could have a negative impact on agriculture. However, farming has shown to be among the human endeavors most suited to varying climatic circumstances (Mendelsohn et al., 2001). Many investments have a short payback period, and cultivars and crops can be easily modified to adapt to changing environmental conditions. These factors suggest that, under the assumption that climatic variability does not change significantly, agriculture on a global scale can most likely adapt to a moderate degree of global warming up to 2.5°C above current levels. Low-latitude (tropical and sub-tropical) crops are frequently nearing their limits.

Adaptation and mitigation through improved technologies

The two main pillars of mitigation and adaptation are (i) innovative technologies for crop production and management that mitigate and adapt to the projected climate change scenario, and (ii) strong political will and sound public policy to counteract the anticipated negative effects of climate change on agriculture. The first is through effectively controlling the direct consequences of climate change on grain crops, such as anthesis interval, reduction in duration, embryo abortion, spikelet sterility, and effects on grain number and size. The method used here is an effective combination of traditional breeding and molecular/mutation breeding through the application of biotechnological tools such as whole genome expression analysis, marker-assisted selection, and gene discovery through bioinformatics. The unintended consequences, such as a reduction in water supplies,

Crop/cropping system-based technologies

The development of varieties with variable durations that can withstand the temporary effects of change, the release of varieties that are tolerant of high temperatures, droughts, and submergence, and the evolution of varieties that respond favourably in terms of growth and yield to elevated CO₂ levels will be the main focuses of these initiatives. In addition to cultivating crops with high fertilizer and radiation efficiency, new crop varieties and those resistant to saltwater inundation and coastal salinity are required.

Resource conservation-based technologies

In situ moisture conservation, rainwater harvesting and recycling, conservation agriculture, energy-efficient crop production and irrigation, and the use of low-quality water are the main resource conservation-based technologies. The strategies that are recommended include: using GIS and remote sensing to characterize biophysical and socioeconomic resources; developing integrated watersheds; creating plans for harvesting, storing, and reusing rainwater; and contingency crop planning to reduce production loss during drought and flood years (Kapoor, 2006). In rice-wheat cropping systems, zero tillage (ZT) has successfully decreased the water requirement over one million hectares in the Indo-Gangetic Plains. Farmers can experience increased yields and lower production costs with ZT technology. Furthermore, ZT has a direct mitigating effect.

Crop	Importance	Impact on Crop Productivity
Wheat	Largest Staple food crop of Pakistan	1.9 % percent reduction in productivity
Rice	Second major food crop and economically most important item for Pakistan	3 % increase in rice growth (due to increase in precipitation)
Maize	Important livestock feed and used industrially for starch and oil	5 % reduction in productivity
Sugarcane	Cash crop gained US\$171.8million of foreign exchange	8 % reduction in productivity

Impact on plants morpho-biochemical and physiological processes

Plants are facing novel ecological circumstances that are outside of their optimal range for adaptation as a result of the rapid changes in climatic conditions. The unusual changes in temperature and rainfall patterns may make plant migration an impractical solution. Despite the fact that plants have modified their physiology to thrive in unfamiliar environments, climate change may be so harmful as to push plants over their tolerance limits [17]. Many plant species' morpho-biochemical processes are significantly impacted by abiotic stresses [18]. The responses of crops' physiology, however, suggest that they will grow faster under anticipated climatic conditions for the next few years, with minor variations in flowering and fruiting depending on the crop variety and specie [19].

Strategies to cope with this climate change

Food security is affected by changing weather patterns on a local and global scale. Food security is already threatened by climate change. Nevertheless, there had been no effort made to address this problem before. However, developing strategies for adapting to climate change is now urgent. The following techniques are required for crop adaptation to shifting climatic conditions. Several studies were carried out to comprehend how farmers manage their crops to reduce climate hazards so that their crops can adapt. Farmers in eastern Uttar Pradesh, India, have developed coping mechanisms to lessen the impact of stressful events such as temperature and rainfall. These strategies include altering the timing of sowing and harvesting, employing cultivars with short growing seasons, intercropping, altering cropping patterns, using ground water for irrigation, and agroforestry.

Conclusion:-

Unpredictable rainfall patterns and high temperatures are two important signs of climate change. Climate change is going to have an impact on the entire planet. Arid regions are more susceptible to temperature rises and drought stress. Crops are affected by climate change in both positive and negative ways, but negative effects predominate. It is difficult to eradicate agricultural production-related disequilibrium. It's unclear how much work and time would be required to resolve this problem. As a result, managing agricultural output during periods of drought and high temperatures is emphasized. New cultural practices, modified cropping patterns, and conventional and unconventional approaches to crop variety improvement would be appropriate offshoots of the fundamental transformation needed in the agriculture industry.

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