



Original Article



Sustainable Harvests: Navigating Climate Change with Climate Smart Agriculture

Puneet Kaur^{1*}, Avnee² and Baljinder Singh³

Ph.D research scholar, Department of Agronomy, Punjab Agricultural University, Ludhiana, India

Ph.D research scholar, Department of Agronomy, CSKHPKV, Palampur, HP, India, 176062

M.Sc student, Department of Soil Science, CSKHPKV, Palampur, HP, India, 176062

**Corresponding author: puneet-1905003@pau.edu*

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Abstract

In the 21st century, humanity grapples with two paramount challenges: climate change and food insecurity. The adverse impacts of climate change, including heatwaves, flash floods, droughts, and cyclones, are detrimentally affecting both lives and livelihoods. Compounding these issues are population growth and shifts in dietary patterns, amplifying the demand for food. Environmental influences on agricultural output further exacerbate the complexities faced by farmers. Traditional farming practices, under the sway of climate change, are witnessing diminished productivity, intensifying the risks for farmers and necessitating a reassessment of their methods. Climate smart agriculture provides a solution to these problems while ensuring that the world's growing population has access to enough food. It has the potential to meet the increasing demand for food while minimizing environmental impact and ensuring the sustainability of our planet's resources.

Keywords: Climate change, Climate smart agriculture, Food security, Sustainability

Climate Change

The term 'climate change' denotes the enduring alterations in Earth's climate patterns, encompassing temperature, precipitation, and wind. These changes are predominantly instigated by the emission of greenhouse gases (GHG). According to the Intergovernmental Panel on Climate Change (IPCC), "climate change" is defined as "a change in the state of the climate that can be identified by changes in the mean or the variability of its properties, and that persists for an extended period, typically decades or longer." Agriculture stands out as a significant contributor to GHG emissions (see Fig 1). It accounts for approximately 17% of global greenhouse gas emissions, primarily originating from livestock, fertilizer use, and alterations in land use (FAOSTAT, 2020). Additionally, the production and distribution of food also play a role in climate change, emitting greenhouse gases, primarily through the combustion of fossil fuels for activities such as transportation, irrigation, and processing.

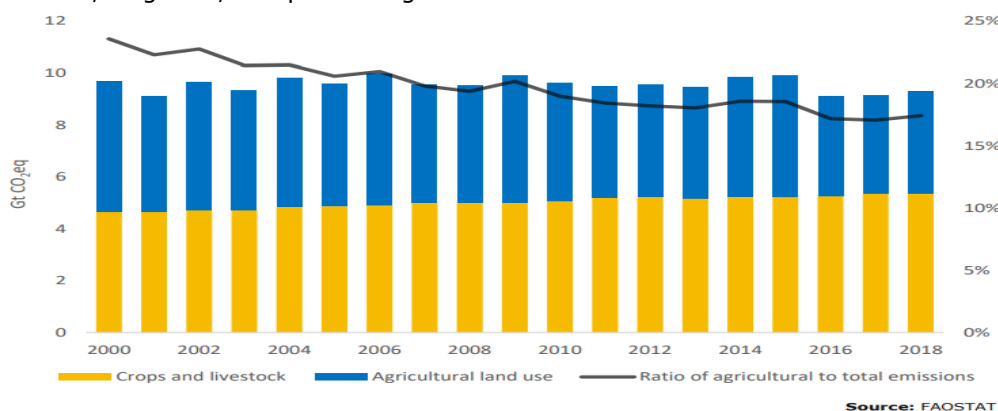


Fig 1: GHG emissions from crops and livestock and related land use, and share of agriculture in global GHG emissions from all sectors

Conversely, agriculture faces substantial repercussions from climate change, marked by alterations in rainfall patterns, escalating temperatures, and more frequent occurrences of extreme weather

events. These factors contribute to diminished crop yields and heightened food insecurity. The rising temperatures expose crops to increased heat stress, potentially resulting in reduced yields and crop failures. The expanding range of temperatures may also facilitate the migration of pests and diseases to new areas, causing damage to crops and diminishing overall yields. Furthermore, climate change induces shifts in precipitation patterns, leading to a heightened frequency and intensity of droughts, floods, and extreme weather events. This transformation adversely affects the availability and quality of water for irrigation and other agricultural purposes.

Food security under climate change

The global population is projected to approach nine billion by 2050, necessitating a 70% surge in food production (Adam, 2021). Compounding this challenge, climate change exacerbates the issue by negatively influencing agricultural productivity, resulting in food shortages and elevated food prices. The adverse effects are particularly pronounced in developing nations, where a considerable portion of the population relies on small-scale agriculture for both their sustenance and livelihoods. Implementing climate-smart agriculture practices emerges as a viable solution. By adopting sustainable farming methods, farmers can increase food production while fortifying the resilience of agricultural systems against the adverse impacts of climate change.

Climate Smart Agriculture

Climate-smart agriculture refers to an approach that aims to transform and reorient agricultural systems to effectively support food security, while also addressing the challenges posed by climate change. The goal is to make agriculture more resilient, sustainable, and adaptive to changing climatic conditions, while simultaneously reducing greenhouse gas emissions. Climate-smart agriculture integrates three main pillars:

1. **Adaptation:** This involves adjusting agricultural practices and systems to better cope with the changing climate. This can include selecting climate-resilient crop varieties, improving water management, and implementing soil conservation practices to mitigate the impacts of extreme weather events such as droughts, floods, and heatwaves.
2. **Mitigation:** Climate-smart agriculture seeks to reduce the environmental footprint of agriculture by promoting practices that contribute to lower greenhouse gas emissions. This may involve adopting more efficient use of resources, such as precision farming techniques, optimizing fertilizer application, and implementing agroforestry practices.
3. **Resilience:** Building resilience in agriculture involves enhancing the capacity of farming systems to withstand and recover from climate-related shocks. This can be achieved through diversification of crops, water harvesting techniques, and the use of advanced technologies that provide early warning systems for weather-related risks.

Climate Smart Agriculture Practices

Cultivating Climate-Resilient Crop Varieties: Growing crops that are more resistant to temperature and precipitation extremes can help farmers mitigate the impact of global warming on crop production.

Conservation Agriculture: Climate-smart conservation agriculture involves the implementation of techniques such as no-till and reduced-tillage cultivation, utilizing crop residues and cover crops to maintain continuous land coverage, and practicing crop rotation. These approaches aim to safeguard soil quality by enhancing soil health, minimizing erosion, and improving water absorption and land drainage.

Agroforestry: As a climate-smart agricultural and forestry practice, agroforestry entails cultivating trees alongside crops or livestock. Trees serve multiple purposes, providing shade and windbreaks, enhancing nutrient cycling for neighboring crops, and sequestering carbon dioxide emitted from agricultural activities. By integrating trees and shrubs into farmland, agroforestry systems enhance biodiversity and soil fertility, contributing to the creation of more resilient and productive agricultural landscapes.

Water Management: Climate-smart agriculture employs effective water management strategies, including precision irrigation, drip irrigation, and rainwater harvesting. These practices are designed to optimize water consumption efficiency and minimize adverse environmental impacts. Particularly valuable during periods of drought or unpredictable precipitation, these methods ensure that crops receive sufficient water with minimal waste, promoting sustainable and efficient agricultural water use.

Integrated Pest Management: Integrated Pest Management (IPM) stands out as a climate-smart agricultural strategy designed to address pests, weeds, and diseases with a primary focus on ecological safety. By incorporating biological, cultural, and chemical approaches, this method has proven effective in minimizing the reliance on synthetic pesticides. The implementation of IPM

strategies not only helps safeguard ecosystems but also contributes to increased biodiversity and the protection of beneficial organisms from harm.

Nutrient Management: Climatically smart nutrient management involves practices such as the application of organic fertilizers, precision fertilization, and crop rotation. These strategies aim to enhance soil fertility while concurrently mitigating nutrient runoff and reducing the greenhouse gas emissions associated with synthetic fertilizers.

Conclusion

In the face of global challenges such as climate change, food security, and resource depletion, a collective commitment to climate-smart agriculture becomes imperative. The need for a holistic strategy is driven by climate change's dual challenges of adaptation and mitigation, and the pressing need for agricultural production to rise by 70% by 2050 in order to fulfill food demand.

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