Available online at
http://currentagriculturetrends.vitalbiotech.org/

ISSN (E): 2583 – 1933

Curr. Agri.Tren.:e- Newsletter, (2025) *4*(2), 30-32

Current Agriculture Trends: e-Newsletter

Article ID: 375

Role of Horticulture in Climate Change Mitigation

Ashutosh Kumar[1]*, Abhik Patra[2], Ratul Moni Ram[3], Bhushan Kumar Singh[4], Rajendra Pratap Singh[5]

[1]SMS Horticulture Vegetables, KVK Narkatiyaganj, RPCAU Pusa Bihar
[2]SMS, Crop Production, KVK Narkatiyaganj, RPCAU Pusa Bihar
[3]SMS, Plant Protection, KVK Narkatiyaganj, RPCAU Pusa Bihar
[4]SMS, Animal Science, KVK Narkatiyaganj, RPCAU Pusa Bihar
[5]Sr. Scientist and Head, KVK Narkatiyaganj, RPCAU Pusa Bihar

Article History
Received: 21. 03.2025
Revised: 26. 03.2025
Accepted: 31. 03.2025

INTRODUCTION

Climate change represents a global dilemma of rising temperature, erratic climatic conditions, and more frequent extreme events. Horticulture is an important crop production sector dealing with fruits, vegetables, cut flowers, and ornamental crops and has extensive opportunities to lessen climate change impact. The motive behind this paper is to highlight how sustainable horticultural cropping can help fight climate change through healthy soil enhancement, water usage improvement, diversification, and carbon sequestration to offset greenhouse gas emission.

Climate change is among the most urgent global issues, affecting ecosystems, agriculture, and human livelihoods. In the quest for sustainable solutions, horticulture is a key driver in combating climate change through nature-based solutions. Horticultural practices not only help mitigate greenhouse gas emissions but also improve environmental resilience, biodiversity, and food security. Through the incorporation of sustainable cultivation practices, green infrastructure promotion, and resource utilization efficiency, horticulture provides end-to-end solutions for climate change adaptation and mitigation. Such an integrated approach places horticulture as a key driver in developing a sustainable and climate-resilient world.

Enhanced Horticultural Management for Climate Change Mitigation

Agroforestry and Perennial Cropping

The inclusion of trees and perennials in agricultural systems greatly adds to the sequestration of carbon in above-ground biomass and soil organic carbon, thereby lowering the concentration of atmospheric carbon dioxide and reducing climate change. The practice also generates microclimates, enhances soil quality, and increases biodiversity, leading to resilient agricultural production systems.

Agroforestry offers vital ecosystem functions, such as shading to reduce soil and crop temperatures, lowering evaporation and water loss. It reduces soil erosion by root holding, improves soil fertility by adding organic matter, and enhances nutrient cycling, resulting in better and more productive soils.

Organic Farming and Soil Management

Organic farming focuses on the utilization of natural inputs, minimizing or eliminating synthetic chemicals that degrade soil health and biodiversity. Organic practices increase soil organic matter, structure, and carbon sequestration by stimulating microbial activity, nutrient cycling, and soil fertility. This method results in healthier soils, resilient ecosystems, and long-term climate change mitigation.

Cover cropping

Cover cropping, crop rotation, and composting are essential organic farming practices that improve soil structure, increase soil microbial activity, and improve resilience to climate extremes. Cover crops combat soil erosion, prevent weeds, and enhance soil fertility, while crop rotation breaks pest and disease cycles, and composting adds organic matter to the soil, building long-term soil health and sustainability.

Effective Water Management

Drip irrigation, rainwater collection, and mulching maximize water use by providing water to plant roots efficiently with minimum evaporation and runoff. These methods save water resources, increase soil water retention, and promote sustainable water management in agriculture, even when water is scarce.

Conservation of water wastage by using efficient irrigation methods, rainwater harvesting, and moisture-saving practices not only saves precious water resources but also reduces energy usage related to water pumping and supply. This integrated strategy addresses climate impact by minimizing greenhouse gas emissions due to energy consumption.

Renewable Energy and Green Technologies

Solar irrigation systems and greenhouses with energy efficiency are key to minimizing greenhouse gas emissions as they use renewable energy sources. Solar irrigation uses no fossil fuel-based power, reducing carbon footprints, whereas energy-efficient greenhouses incorporate latest technologies for climate control, using less energy while increasing productivity.

The utilization of biodegradable materials and organic pesticides reduces environmental damage by eliminating chemical residues, enhancing soil health, and protecting beneficial organisms. These organic alternatives naturally decompose, avoiding soil and water pollution and providing sustainable pest and disease management.

Urban Horticulture and Green Landscaping

Green roofs, vertical agriculture, and green walls contribute notably to urban spaces by removing CO_2 from the air, enhancing air quality, and lowering urban temperatures. These new green infrastructure solutions act as insulation, save energy, and offer habitat for pollinators and wildlife, which increases urban biodiversity and climate change resilience.

Urban greening largely eliminates the urban heat island effect by reducing ambient temperatures, enhancing air quality, and addressing pollution. It also increases urban biodiversity by creating areas for pollinators, birds, and wildlife, allowing ecological balance and ensuring a healthier urban environment.

Carbon Sequestration and Greenhouse Gas Reduction in Horticulture

Perennial Crops and Trees

Horticultural crops, especially perennial species such as fruit trees, shrubs, and ornamental plants, play a crucial role in carbon sequestration the process of capturing and storing atmospheric carbon dioxide (CO_2). These plants absorb CO_2 during photosynthesis, converting it into organic matter stored in their trunks, branches, leaves, and roots. The benefits of perennial horticultural crops include:

Long-Term Carbon Storage: Unlike annuals, perennials take several years to mature, continuously sequestering carbon throughout their lives.

Soil Carbon Sequestration: The root systems of the crops build soil structure, adding organic matter and increasing soil carbon levels. This stabilizes the soil and prevents erosion, further enhancing carbon storage.

Less Soil Disturbance: Perennials are less frequently tilled compared to annuals, reducing

soil disturbance and the emission of stored carbon back into the atmosphere.

Agroforestry Systems: The inclusion of trees and shrubs in cropping systems (e.g., alley cropping, windbreaks) increases carbon storage in biomass and soil.

Examples are fruit orchards (mango, apple, citrus), nut trees (almond, walnut), and ornamental plants (bamboo, flowering shrubs). They not only sequester carbon but also generate economic returns through fruits, nuts, and landscaping value.

Urban Greening

Urban greening is the act of integrating plants into urban areas using rooftop gardens, vertical gardens, urban forests, parks, and green belts. Urban greening is a natural approach to climate change adaptation and mitigation through:

Mitigation of Urban Heat Islands (UHIs): Plants cool urban spaces by offering shade and evaporating moisture via evapotranspiration. This reduces energy demand for air conditioning, lowering electricity generation emissions.

Enhancing Air Quality: Plants remove pollutants such as particulate matter, sulfur dioxide, and nitrogen oxides from the atmosphere, improving urban air quality.

Carbon Sequestration: Urban trees and shrubs sequester CO_2 and store carbon, similar to natural forests. The high density of planting in urban parks and green spaces enhances the carbon storage capacity.

Stormwater Management: Greening in cities serves to control rainwater runoff, lessening flooding and erosion potential. Water is absorbed by plants, aiding groundwater recharge.

Increased Aesthetics and Happiness: Parks aid in mental and physical well-being by offering leisure grounds and decreasing stress.

CONCLUSION

Horticulture provides an integrated route to sustainable development and climate resilience by encouraging practices that support ecosystem services, store carbon, and adapt to climatic variability. Through the adoption of climate-smart horticultural practices, we are able to counter greenhouse gas emissions, enhance biodiversity, and guarantee long-term food security despite the uncertainties of climate. It is necessary to raise awareness, foster people's participation, and have effective policies that ensure sustainable horticulture to conserve and preserve the environment for future generations.

REFERENCES

Lal, R. (2004). Soil Carbon Sequestration Impacts on Global Climate Change and Food Security. Science, 304(5677), 1623-1627.

FAO (2020). The State of the World's Biodiversity for Food and Agriculture. Rome: FAO.

IPCC (2019). Climate Change and Land: An IPCC Special Report. Intergovernmental Panel on Climate Change.

Smith, P. et al. (2008). Greenhouse Gas Mitigation in Agriculture. Philosophical Transactions of the Royal Society B, 363(1492), 789-813.