

TREE-BASED FARMING SYSTEMS FOR BIODIVERSITY CONSERVATION

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ABSTRACT



Tree-based farming systems, commonly known as agroforestry, integrate trees with crops and livestock to enhance productivity and environmental sustainability. These systems support biodiversity by providing habitats for wildlife, conserving soil organisms, promoting pollinators, and improving ecological connectivity. Unlike monocultures, agroforestry creates diverse ecosystems that enhance carbon sequestration, nutrient cycling, water conservation, and climate regulation. Traditional agroforestry practices have long preserved genetic resources and ecological balance. This article discusses the role of tree-based farming systems in biodiversity conservation, major agroforestry models, their ecological functions, and future prospects for sustainable land management..

KEYWORDS: Agroforestry, biodiversity conservation, ecosystem services, tree-based farming, sustainable agriculture

INTRODUCTION

Biodiversity is essential for maintaining ecological stability and supporting human livelihoods. It includes the diversity of plants, animals, microorganisms and ecosystems that provide valuable services such as pollination, soil fertility, water purification and climate regulation. However, rapid deforestation, urbanization, agricultural intensification and climate change have accelerated biodiversity loss worldwide.

Modern agriculture based on monoculture systems has reduced habitat diversity and ecological resilience. Excessive use of agrochemicals and removal of trees from agricultural landscapes have negatively affected pollinators, birds and soil microorganisms. In this context, tree-based farming systems have

emerged as an effective strategy for combining agricultural production with biodiversity conservation.

Agroforestry systems integrate trees with crops and/or livestock on the same land unit. These systems create ecologically diverse landscapes that support wildlife while improving farm productivity and sustainability.

TREE-BASED FARMING SYSTEMS

1. Home Garden Systems

Home gardens are multi-layered farming systems consisting of fruit trees, vegetables, medicinal plants and shrubs around homesteads.



Biodiversity Benefits

- High plant species diversity
- Habitat for birds and pollinators
- Conservation of traditional crop varieties
- Improved soil biodiversity

Home gardens are often called “miniature forests” because of their complex vegetation structure.

2. Agri-Silviculture Systems

Agri-silviculture combines agricultural crops with tree species such as neem, teak, bamboo and poplar.



Ecological Importance

- Improved habitat diversity
- Conservation of beneficial insects
- Reduced soil erosion
- Improved soil fertility and nutrient cycling

Trees improve microclimate and create favourable conditions for biodiversity.

3. Silvo-pastoral Systems

Silvo-pastoral systems integrate trees, pasture and livestock.



Biodiversity Functions

- Conservation of grassland biodiversity
- Wildlife shelter and habitat
- Improved nutrient recycling
- Reduced pressure on natural forests

These systems improve animal welfare while supporting ecological sustainability.

ROLE OF TREE-BASED FARMING SYSTEMS IN BIODIVERSITY CONSERVATION

Habitat Creation

- Trees provide food, nesting sites and shelter for birds, insects, reptiles and mammals. Multi-layered vegetation supports diverse ecological niches.

Pollinator Conservation

- Flowering trees and shrubs provide nectar and pollen resources for bees and butterflies, which are essential for crop pollination.

Soil Biodiversity Enhancement

- Leaf litter and tree roots improve soil organic matter and support microbial communities such as fungi, bacteria and earthworms.

Landscape Connectivity

- Agroforestry systems serve as ecological corridors connecting fragmented habitats and facilitating movement of wildlife species.

Conservation of Native Species

- Traditional agroforestry systems preserve indigenous tree species and local crop varieties adapted to regional climatic conditions.

ECOSYSTEM SERVICES OF AGROFORESTRY SYSTEMS

Tree-based farming systems provide numerous ecosystem services important for environmental sustainability.

Provisioning Services

- Food and fruits
- Timber and fuelwood
- Fodder and medicinal products

Regulating Services

- Climate regulation through carbon sequestration
- Water conservation and groundwater recharge
- Soil erosion control
- Biological pest regulation

Supporting Services

- Nutrient cycling
- Pollination
- Soil formation
- Primary productivity

Cultural Services

- Traditional agroforestry systems preserve indigenous knowledge, cultural heritage and ecological traditions.

TREE-BASED FARMING SYSTEMS AND CLIMATE CHANGE

Climate change threatens biodiversity and agricultural productivity. Agroforestry systems improve resilience against climate variability while contributing to climate mitigation.

1. Carbon Sequestration

Trees absorb atmospheric carbon dioxide and store carbon in biomass and soil.

2. Climate Adaptation

Agroforestry systems:

- Improve soil moisture retention
- Moderate temperature extremes
- Reduce drought impacts
- Diversify farm income sources

Diverse farming systems are generally more resilient than monoculture agriculture.

CHALLENGES AND FUTURE PROSPECTS

Despite their advantages, adoption of tree-based farming systems faces several constraints.

Major Challenges

- Lack of awareness among farmers
- Policy and regulatory barriers
- Limited quality planting material
- Poor market infrastructure
- Land tenure issues

Future Strategies

- Promotion of native tree species
- Diversified agroforestry models
- Farmer training and extension programs
- Supportive government policies

- Research on biodiversity-friendly agroforestry systems

Community participation and integration of traditional knowledge are essential for successful biodiversity conservation.

CONCLUSION

Tree-based farming systems represent a sustainable approach for integrating agricultural production with biodiversity conservation. By combining trees with crops and livestock, agroforestry systems create ecologically diverse landscapes that support wildlife, improve soil health, conserve pollinators and enhance ecosystem resilience. These systems also contribute to climate change mitigation, restoration of degraded lands and livelihood security. Traditional agroforestry systems demonstrate that conservation and production can coexist harmoniously. Strengthening agroforestry practices through supportive policies, scientific research and farmer awareness can significantly contribute to sustainable development and environmental security.

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