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Overview of importance, problems and prospects of agroforestry crop production

Priya, Kailash Kumar, Anjali Anand, Ajay Kumar Shah, Kamal Kishor Patel and Dwarka

Priya
Ph.D., Department of Forestry, Jawaharlal Nehru Krishi Vishwa Vidyalaya, CoA, Jabalpur, Madhya Pradesh, India

Kailash Kumar
Guest Faculty, Jawaharlal Nehru Krishi Vishwa Vidyalaya, CoA, Jabalpur, Madhya Pradesh, India

Anjali Anand
Ph.D., Department of Forestry, Jawaharlal Nehru Krishi Vishwa Vidyalaya, CoA, Jabalpur, Madhya Pradesh, India

Ajay Kumar Shah
Guest Faculty, Jawaharlal Nehru Krishi Vishwa Vidyalaya, CoA, Jabalpur, Madhya Pradesh, India

Kamal Kishor Patel
Ph.D, Department of Soil Science and Agricultural Chemistry, Jawaharlal Nehru Krishi Vishwa Vidyalaya, CoA, Jabalpur, Madhya Pradesh, India

Dwarka
Guest Faculty, Department of Entomology, Jawaharlal Nehru Krishi Vishwa Vidyalaya,, CoA, Panna, Madhya Pradesh, India

Corresponding Author:
Kailash Kumar
Guest Faculty, Jawaharlal Nehru Krishi Vishwa Vidyalaya, CoA, Jabalpur, Madhya Pradesh, India

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Abstract
Agroforestry crop production is an innovative and sustainable land-use system that integrates trees, crops, and sometimes livestock, offering a holistic approach to addressing agricultural, environmental and socio-economic challenges. Its importance lies in its ability to enhance biodiversity, improve soil fertility, increase carbon sequestration and provide diversified income sources for farmers, contributing to food security and climate resilience. Despite these benefits, agroforestry faces several problems, including limited farmer awareness, land tenure complexities, inadequate policy frameworks, and technical challenges in implementation. However, the prospects for agroforestry are encouraging, as global efforts toward sustainable development and climate change mitigation continue to drive interest in this approach. Advancements in agroforestry research, improved policy support, and enhanced market access are critical to overcoming existing challenges and unlocking its potential as a cornerstone of sustainable agriculture and rural development.

Keywords: Socio-economic challenges, improve soil fertility, increase carbon sequestration, provide diversified income and agroforestry

1. Introduction

Agroforestry crop production is a sustainable agricultural practice that integrates trees, crops, and sometimes livestock within the same land management system, offering a multifaceted approach to addressing food security, environmental sustainability, and rural livelihoods. Although they were not purposefully merged, the main goal of cropping at the subsistence level in this agricultural system is the integration of trees and arable crops (Winrock, 1995) [7]. This system holds immense importance due to its ability to enhance biodiversity, improve soil fertility, mitigate climate change through carbon sequestration, and provide diverse income streams for farmers. In Central American nations, it was common for farmers to cultivate an average of 24 plant species on less than one hectare of land using agroforestry. But in Asia, the Philippines engaged in challenging and rather advanced forms of "shifting cultivation" (King, 1987) [3]. By combining forestry and agricultural practices, agroforestry reduces the vulnerability of farming systems to environmental shocks such as droughts and floods, promoting resilience and long-term productivity. Nevertheless, by the late 1800s, Myanmar had created "Taungya" teak (*Tectona grandis*) plantations, which eventually became the finest tree-planting method. It was brought to South Africa in 1857 and to India from Burma in 1890 (Hailey, 1957) [1]. The Taungya system's guiding premise was to use available jobless or landless laborers to build forest plantations wherever feasible. As compensation for their arduous work, the laborers could be allowed to cultivate the area in between the rows of tree seedlings in order to grow food crops. The methods used by this straightforward approach varied depending on the nation or region (Nair, 1993) [5]. However, the adoption of agroforestry is hindered by several challenges, including land tenure issues, lack of technical knowledge among farmers, and insufficient policy support or incentives. Despite these problems, the prospects for agroforestry crop production are promising, as increasing awareness of its benefits and the global emphasis on sustainable development have spurred interest in scaling up these practices. Innovations in agroforestry design, improved access to markets, and supportive policies can further accelerate its adoption, offering a pathway toward more sustainable and climate-resilient agricultural systems.

2. Importance of Agroforestry
2.1 Environmental Benefits
- **Biodiversity Conservation:** Agroforestry systems provide habitats for various plant and animal species, enhancing biodiversity in agricultural landscapes.
- **Soil Health Improvement:** Trees and shrubs in agroforestry systems prevent soil erosion, increase organic matter, and improve nutrient cycling.
- **Climate Change Mitigation:** Agroforestry sequesters carbon in biomass and soil, reducing greenhouse gas emissions.

2.2 Economic Advantages
- **Diversified Income:** Farmers benefit from multiple revenue streams through timber, fruits, nuts, and other non-timber products.
- **Enhanced Productivity:** Integrated systems can lead to higher overall productivity per unit area compared to monoculture systems.

2.3 Social Benefits
- **Food Security:** Agroforestry supports diversified diets and reduces vulnerability to crop failure.
- **Community Resilience:** The practice fosters social cohesion through shared resources and collaborative management.

3. Problems in Agroforestry
Nearly every habitat may benefit from agroforestry, which also offers a potential solution to widespread issues worldwide. When compared to traditional forestry or agriculture, it may be beneficial (USDA, 2014) [6]. According to a survey of US extension programs, some of the barriers to the adoption of agroforestry include the following (Jacobson and Shiba, 2013) [2]:
- Insufficiently established product marketplaces.
- Lack of technological acquaintance
- Ignorance of effective agroforestry examples
- Tree, crop, and animal competition
- Absence of obvious profit opportunities
- Insufficient demonstration locations
- Insufficient knowledge or experience
- Insufficient technological support
- Inaccessible agroforestry knowledge
- Evident annoyance
- A lack of equipment
- A lack of infrastructure
- Lack of seed or seedling sources
- Inadequate land
- Inability to pay for adoption or setup expenses, including time expenditures.

4. Prospects for Agroforestry
For instance, a study on climate change conducted by the Consultative Group on International Agricultural Research (CGIAR) program and Agriculture and Food Security (AFS) found that at least 50% of the 700 + households surveyed in East Africa had started planting trees on their farms, which was a departure from the traditional farming methods used a few decades prior (Kristjanson *et al.*, 2012) [4].

4.1 Technological Innovations: Advances in agroforestry modeling, remote sensing, and genetic improvement of tree species offer promising opportunities to optimize system design and productivity.

4.2 Policy Support: Developing clear policies, financial incentives, and subsidies can encourage farmers to adopt agroforestry practices. Examples include payment for ecosystem services and carbon credits.

4.3 Community-Driven Approaches: Empowering local communities through participatory planning and capacity-building initiatives can enhance agroforestry adoption and sustainability.

4.4 Climate Adaptation and Resilience: Agroforestry offers robust solutions for adapting to climate variability, making it a critical strategy for climate-resilient agriculture.

5. Conclusion
Agroforestry crop production holds immense potential to address critical global challenges related to food security, environmental sustainability, and rural development. Despite its benefits, widespread adoption is hindered by technical, financial, and institutional barriers. Addressing these challenges requires concerted efforts involving technological advancements, supportive policies, and active community participation. As the world faces growing pressures from climate change and population growth, agroforestry emerges as a viable pathway toward sustainable agricultural landscapes.

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