

RECENT TRENDS IN AGROFORESTRY RESEARCH AND DEVELOPMENT

Abstract

Agroforestry research focuses on combating climate change, adapting to climate change, stopping land degradation, improving water quality, and protecting biodiversity. It also addresses social problems, the role of agroforestry in jobs, business, and money, and its economic impact. National research focuses on diagnostic surveys, collection and evaluation of tree species, tree selection and improvement, development and control of agroforestry practices, economic study of agroforestry systems, environmental, abandoned land, and community land development. However, most studies do not carefully review data. Agroforestry is a sustainable and multifunctional land-use system that can address environmental and socio-economic challenges. It has been explored for its potential to enhance resilience, reduce climate-related risks, and promote adaptation. The National Agroforestry Policy of 2014 encompasses various aspects like the provision of high-quality planting material, the implementation of tree insurance schemes, and the promotion of effective marketing strategies for agroforestry goods. Agroforestry systems can double farmers' income in seven years and triple it if farmers receive compensation for carbon stored. Recent trends in agroforestry research include climate-resilient agroforestry, digital technologies, biodiversity conservation, carbon sequestration, and sustainable agriculture, market opportunities for agroforestry products, scaling up agroforestry adoption, and improving rural livelihoods.

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I. INTRODUCTION

The initiation of agroforestry research in the early 1970s was spearheaded by three institutes under the Indian Council of Agricultural Research (ICAR): the Central Arid Zone Research Institute in Jodhpur, the Central Soil and Water Conservation Research and Training Institute in Dehradun, and the Indian Grassland and Fodder Research Institute in Jhansi. India has been at the top of agroforestry studies since they started. In 1979, the first agroforestry seminar was held in Imphal. It was put on by the Indian Council of Agricultural Study in New Delhi with the help of ICRAF to collect and organize information about agroforestry study and development in India. In April 1983, the All-India Coordinated Research Project (AICRP) on Agroforestry was started by the ICAR to carry out the main ideas from the conference. The Council led a systematic study into agroforestry by coordinating a number of projects and later, by setting up the National Study Centre for Agroforestry (NRCAF) at Jhansi in 1988. The Centre was set up to help with basic, strategic and applied studies in agroforestry. USAID, UNDP, and others gave money to the agroforestry study at first to improve infrastructure and human resources. In 1997, the Director of the NRCAF became the Project Coordinator of the AICRP on Agroforestry, which is a large network of agroforestry groups that was started in 1983. The AICRP on Agroforestry has 37 centers. Of these, 25 are State Agricultural Universities (SAUs), 11 are ICAR schools, and one is an ICFRE institute. These sites cover most of the agro climates in the country. Since the early 1980s, agroforestry has helped farmers who were having trouble. The NRCAF is known all over the world for its studies, development, agroforestry database, information repository and watershed-based natural resource management. The centre conducts research on several components of agro ecosystems, including forests, fruit trees, bushes, bamboo, arable crops, meadows, animals, and fish, and investigates their interrelationships and synergistic dynamics. In India, various private organizations and non-governmental organizations (NGOs) like WIMCO, ITC, BAIF, IFFDC, West Coast Paper Mills Ltd., Hindustan Paper Mills Ltd., and National Tree Growers Cooperatives engage in the examination and promotion of agroforestry practises. In 1969, four clones of *P. deltoids* were brought over from Australia. They quickly spread, making leaseholders a lot of money. WIMCO Ltd. brought poplar agroforestry to the world and made it famous. In 1976, WIMCO began trying to get farmers to plant poplar trees. The National Agroforestry Policy of 2014 emerged as a response to various challenges, including issues related to the availability of high-quality planting material, insurance coverage for trees, regulations pertaining to the transportation and harvesting of agroforestry products, marketing strategies for such products, as well as research and extension efforts. The biggest problem with the National Agroforestry Policy for 2014 is getting it from paper to the ground so that it can help small farmers. Today, agroforestry is the current, science-based way to use the benefits of practices like these that have been around for a long time. Development and climate change programmes around the world are paying more attention to its proven role in maintaining crop yields, diversifying farm output, realizing ecosystem services, and ensuring environmental integrity in land use.

In recent years, most agroforestry research and development at the international level has focused on three main topics:

- Using agroforestry to fight climate change
- Using agroforestry to adapt to climate change
- Using agroforestry to stop land degradation and desertification in dry land
- Agroforestry to improve water quality, restore watersheds and protect biodiversity

- Social problems in Agroforestry systems (such as gender and migration)
- The role of agroforestry in jobs, business and money
- Taking improvements in agroforestry to a larger scale
- Agroforestry methods and products' value chains and certification
- Practicing agroforestry
- Using agroforestry in public policy
- The Economic Analysis of Agroforestry: Exploring the Interconnection between the Natural Environment and Society
- Societal, Economic, and Cultural Factors Influencing the Adoption of Technology in Agroforestry Systems
- Understanding the Agroforestry Landscape: Patterns, Processes, and Dynamics
- Enhancing Food and Nutritional Security through Urban and Peri-Urban Agroforestry
- Mapping Agroforestry Systems: Methods, Applications, and Implications
- Examining the Challenges, Opportunities, and Trade-Offs of Agroforestry with Perennial Crops
- Incorporating Cereals and Annual Crops into Agroforestry Systems: Benefits and Considerations

II. AT THE NATIONAL LEVEL, AGROFORESTRY RESEARCH FOCUSES ON THE FOLLOWING AREAS:

1. **Conducting A Diagnostic Survey and Assessment of Current Agroforestry Practices and the Preferences of Farmers:** Important Agroforestry practices and systems have been found in different agro climatic zones, and useful information has been gathered about the species that farmers choose
2. **Collection and Evaluation of MPTS:** The seeds of 184 promising tree species were collected and assessed. Finding the most important tree species for agroforestry studies in different agro climates. Few centres have filed their germplasm with the NBPGR.
3. **Choosing Trees and Making Them Better:** On 20 MPTS, work has been done to choose trees and make them better. Poplar spp., Eucalyptus spp., Leucaena leucocephala, Casuarina equisetifolia and Tectona grandis were the ones that made the most progress. The wood-based industry has used the better material as a raw material. The species such as Acaia spp., Ailanthus excelsa, Albizia spp., Dalbergia sissoo, Azadirachta indica, Anogeissus latifolia, Pongamia pinnata, Bamboos, Anthocephalus cadamba, Grewia optiva, Melia, Prosopis cineraria, Jatropha, Salix spp., Gmelina arborea, etc. have also gone through different stages of selection and improvement and some of them are under multilocation trials. Few species have had seed or clonal farms set up.
4. **Development and Control of Agroforestry Practices and Systems:** Through scientific interventions, traditional agroforestry practices have been improved. For different agro climatic areas, different types of agroforestry systems, such as agrisilviculture, agrihorticulture, agri-horti-silviculture, hortipastoral, silvipastoral, and specialized systems, were made. The most common methods are agrisilviculture and agrihorticulture, which are both used in most of the agroclimatic zones. Research centers have come up with different kinds of agroforestry systems, such as home gardens, block plantations, energy plantations, shelterbelts and shifting cultivation. Most of these systems that have

been developed and are suggested are only good for certain places. Also, farmers often don't like these systems because they have different tastes in species, crops and other things. Some of the systems that have been made have not gone through a full cycle with the trees, so biomass output and returns are only based on extrapolations.

5. **Economic Study of Agroforestry Systems:** Not much has been done to analyze the economics of agroforestry systems, but what has been done is limited to the B: C ratio, which doesn't show real economics. Aside from that, the study is based on extrapolation because most of the systems, except for those based on eucalyptus and poplar, have not gone through a full cycle.
6. **Environment, Waste Land and Community Land Development Through Agroforestry Interventions:** The network hasn't done much in these areas. But the watershed projects that have been used in the country for the past 60 years have given us useful information but the role of agroforestry needs to be separated.
7. Few attempts have been made to combine farming, fishing, beekeeping, lac, etc. as parts of agroforestry. Sericulture, beekeeping, lactation, animals, and fishing are all part of the plan. But most of the studies don't do a careful review of the data.
8. **Mapping of Areas and Size of Agroforestry Areas:** There were a few local attempts to map agroforestry areas, but none at the national level. In its 2013 study, FSI estimated how much land could be used for agroforestry. Also, CAFRI uses remote sensing to figure out how much agroforestry there is in each agro ecological area.
9. **Carbon Sequestration Potential and Environmental Benefits of Agroforestry Systems:** CAFRI has conducted extensive research in several agro ecological zones to assess the carbon sequestration capacity of agroforestry systems.
10. **Issues of Policy:** Concerns and problems with putting agroforestry into place have been pointed out. The National Agroforestry Policy 2014 was the result of all the work.

III. AGROFORESTRY CAN HELP FARMERS DOUBLE THEIR INCOME

Our Prime Minister wants farmers' income to be double what it was in 2015-16 by 2022-23. To reach this goal, growth would have to be much faster, and all the factors that affect farmers' incomes would have to work together in a way that makes them stronger. Agroforestry is one way that our country can meet its Nationally Determined Contributions (NDCs) and lower the amount of greenhouse gases it puts into the air by using carbon, water, and land footprints. The tests showed that an agroforestry system can more than double a farmer's income in seven years and triple it if the farmer gets paid for the carbon that the system stores. Some recent trends in agroforestry research and development:

1. **Climate-Resilient Agroforestry:** With the increasing impact of climate change on agriculture, agroforestry systems have been explored for their potential to enhance resilience. Research has focused on identifying tree species and management practices that can mitigate climate-related risks and promote adaptation in agroforestry systems.

2. **Digital Technologies in Agroforestry:** The integration of digital technologies, such as remote sensing, GIS (Geographic Information Systems) and data analytics has gained momentum in agroforestry research. These technologies help in monitoring and managing agroforestry systems more efficiently enabling better decision-making and resource optimization.
3. **Agroforestry and Biodiversity Conservation:** Researchers have been investigating the role of agroforestry in conserving biodiversity. By promoting diverse tree species in agricultural landscapes, agroforestry systems can create habitats for various wildlife, pollinators, and beneficial insects, thereby supporting ecosystem health.
4. **Carbon Sequestration and Agroforestry:** Agroforestry has been regarded as a prospective approach for the sequestration of carbon and the mitigation of climate change. Numerous investigations have been undertaken to evaluate the capacity of various agroforestry techniques in sequestering carbon and their role in mitigating the release of greenhouse gases.
5. **Agroforestry for Sustainable Agriculture:** Agroforestry systems have been explored for their capacity to improve soil health, fertility and nutrient cycling. By integrating trees with crops or livestock, agroforestry can enhance overall productivity and promote sustainable agricultural practices.
6. **Market Opportunities for Agroforestry Products:** Research has been conducted on the economic viability of agroforestry systems, including the market potential for various agroforestry products such as timber, fruits, nuts, medicinal plants, and non-timber forest products.
7. **Scaling up Agroforestry Adoption:** Efforts have been made to identify the barriers and enablers of agroforestry adoption among farmers and stakeholders. Research on policy interventions, incentives and capacity-building measures aims to promote the wider adoption of agroforestry practices.
8. **Agroforestry and Livelihoods:** Studies have explored the role of agroforestry in improving rural livelihoods, especially in developing countries. Agroforestry systems can offer diversified income streams, food security and resilience against economic shocks.

These trends indicate a growing interest in agroforestry as a sustainable and multifunctional land-use system that can address various environmental and socio-economic challenges. As interest in agroforestry has grown, the number of publications has gone from 43 per year in 1990 to 385 per year in 2018 and total of 139 countries/regions have conducted and disseminated research on the subject of agroforestry throughout the time frame spanning from 1990 to 2018. ICRAF became a member of the Consultative Group on International Agricultural Research (CGIAR) in 1991, aligning its endeavours with the overarching objectives of CGIAR. These objectives encompass the amelioration of poverty, enhancement of food security, and betterment of the environment. This helped a lot with the growth of study on agroforestry in both developed and developing countries.

REFERENCES

- [1] Dagar J C, Singh A K, Arunachalam A. 2014. Agroforestry Systems in India: Livelihood Security & Ecosystem Service. <https://vdoc.pub/documents/agroforestry-systems-in-india-livelihood-security-ecosystem-services-6minf953f3d0>
- [2] Jhariya M K, Bargali S S and Raj A. 2015. Possibilities and Perspectives of Agroforestry in Chhattisgarh, DOI: 10.5772/60841
- [3] Robert J Zomer, Deborah A Bossio, Antonio Trabucco, Li Yuanjie, Diwan C Gupta and Virendra P. Singh, Trees and Water: Smallholder Agroforestry on Irrigated Lands in Northern India
- [4] Jagdish C. Dagar and Vindhya P. Tewari. 2017. Evolution of Agroforestry as a Modern Science, http://www.arroba.com.br/portal-arroba/wp-content/uploads/2018/09/Cap_2_Evolution-of-Agroforestry.pdf
- [5] Nair PKR, Viswanath S, Lubina PA (2016) *Cinderella* agroforestry systems. *Agrofor Syst.* <https://doi.org/10.1007/s10457-016-9966-3>.
- [6] ICRAF. About Agroforestry. Available online: <http://www.worldagroforestry.org/> (accessed on 4 April 2019).