

AGROFORESTRY - ENVIRONMENT

NEWS: Recently a research paper, “**Agroforestry: the green guardian**”, was published that explores how this practice can be scaled to **support farmer livelihoods, sequester carbon, and regenerate ecosystems** across India.

WHAT'S IN THE NEWS?

About Agroforestry

- **Agroforestry** is the integrated and purposeful use of **trees and shrubs with crops and/or livestock** in spatial or temporal sequences on the same land unit.
- It merges **agriculture, forestry, and ecological sustainability**, promoting **synergistic interactions** between components.

Types of Agroforestry Systems

- **Agri-silviculture: Trees + Crops** (e.g., intercropping teak with maize or pulses).
 - Enhances soil fertility and crop yield.
- **Silvi-pastoral: Trees + Pasture/Livestock** (e.g., fodder trees like Subabul with grazing animals).
 - Supports livestock productivity and soil conservation.
- **Agri-silvi-pastoral: Trees + Crops + Livestock** (e.g., fruit trees, crops, and goats).
 - Maximizes land productivity and diversification.
- **Home gardens: Multi-layered systems near homesteads** with trees, shrubs, and crops (e.g., coconut, banana, and vegetables in Kerala).
 - Ensures food security and income.
- **Alley Cropping: Rows of trees with crops grown in alleys** (e.g., Leucaena with millets).
 - Improves soil structure and nutrient cycling.
- **Windbreaks/Shelterbelts: Trees planted to protect crops from wind** (e.g., Eucalyptus along field boundaries).
 - Reduces soil erosion and crop damage.
- **Apiculture with Trees: Beekeeping integrated with trees for pollination and honey production.**
 - Enhances biodiversity and income.

Agroforestry in India

- **Traditional Roots:** Indigenous systems like **home gardens in Kerala**, **Zabo farming in Nagaland**, and **Kheti-wadi in Rajasthan** showcase India's agroforestry legacy.
- **Current Coverage:** Agroforestry practiced on **~28.42 million ha**, which is **8.65% of India's geographical area** (FSI 2021).
 - Tree cover increased by **490,400 ha between 2011–2021**.

Best Practices in Agroforestry in India

- **Poplar-Based Agri-Silviculture in Punjab and Haryana:** Farmers integrate fast-growing **poplar trees** (*Populus deltoides*) with crops like wheat, sugarcane, and turmeric in short-rotation cycles (6–8 years).
 - Increases **soil organic carbon (SOC)** from 0.62% (monoculture) to 1.14% and sequesters 10–15 tCO₂/ha/year (ICAR, 2020).
- **Coconut-Based Homegardens in Kerala and Tamil Nadu:** Multi-layered systems combine **coconut trees** with spices (black pepper, nutmeg), fruits (banana, mango), and vegetables, ensuring year-round income.
 - Enhances biodiversity (e.g., pollinators, birds) and food security, with 80% of homesteads meeting household nutritional needs (ICAR, 2019).
- **Bamboo-Based Agroforestry in Odisha and Northeast India:** **Bamboo** (e.g., *Bambusa bambos*) is intercropped with millets, pulses, or vegetables, supporting livelihoods and land restoration.
 - **National Bamboo Mission** provides subsidies for planting and processing units.
- **Silvi-Pastoral Systems in Rajasthan's Arid Zones:** **Fodder trees** (e.g., *Prosopis cineraria*, *Acacia nilotica*) are integrated with pastures for livestock grazing, enhancing drought resilience.
 - Improves soil fertility (SOC increase by 0.5–0.8%) and provides fodder during lean periods (ICAR, 2020).
- **Farmer-Managed Natural Regeneration (FMNR) in Bundelkhand:** Farmers regenerate native tree stumps (e.g., *Anogeissus pendula*, *Butea monosperma*) on degraded farmlands, requiring minimal inputs.
 - Supported by **Sub-Mission on Agroforestry (SMAF)** and NGOs like Development Alternatives, training 10,000+ farmers.
- **Coffee and Arecanut Agroforestry in Western Ghats:** **Coffee** and **arecanut** plantations are grown under shade trees (e.g., silver oak, jackfruit), supporting biodiversity and premium markets.

- Sequesters 15–25 tCO₂/ha/year and enhances soil moisture by 20–30% (ICAR, 2021).
- **Zabo Farming in Nagaland:** Indigenous **Zabo system** integrates **trees (e.g., alder, fruit trees), rice terraces, and livestock in hilly terrains**, conserving water and soil.
 - Sequesters 10–18 tCO₂/ha/year and sustains 90% of local food needs (ICAR-NRC on Agroforestry, 2022).

Significance and Benefits of Agroforestry in India

• Economic Significance

- **Income Diversification:** Provides **multiple income sources**: timber, fruits, fuelwood, fodder, NTFPs (e.g., bamboo, medicinal plants).
 - **Teak** alone can generate ₹40–50/kg, 10× more than eucalyptus under similar conditions.
- **Timber Self-Reliance:** As per the **Indian Council on Forest Research and Education (ICFRE)**, over **93 per cent** of India’s domestic timber was produced by “**trees outside forests**”, a majority of which are agroforestry plots.
 - Reduces dependence on imported wood; India’s timber import bill was **\$2.7 billion in 2023**.
- **Support for Allied Industries:** Supplies **60% of pulpwood, 50% of fuelwood, and 11% of fodder** demand nationally.
 - Agroforestry raw material supports **paper, furniture, construction, and livestock** sectors.

• Environmental Benefits

- **Carbon Sequestration:** Agroforestry systems sequester **13.7–27.2 tCO₂/ha/year** depending on species and density.
 - Multistrata systems can contribute up to **23.94 GtCO₂e by 2050 globally**, with high profitability.
- **Reduces fertilizer dependency:** Agroforestry reduces fertilizer dependency by incorporating **nitrogen-fixing trees**, which can supply **50–100 kg of nitrogen per hectare annually**.
- **Soil Health Enhancement:** Trees improve **soil organic carbon (SOC)** and structure:

- E.g., in Punjab, SOC rose from 0.62% (monoculture) to **1.14% under poplar agroforestry**.
- **Water Management:** Tree roots increase **water infiltration**, reduce runoff.
 - Jaltol model evaluates **crop–tree water competition** to optimize species choice.
- **Biodiversity Conservation:** Agroforestry preserves **pollinators, natural pest predators, and seed dispersers**.
 - Offers habitat continuity in agricultural landscapes.
- **Social and Livelihood Benefits**
 - **Rural Employment and Skill Development:** Engages over **25,000 farmers** through CAFRI-ICRAF training.
 - **35% of trainees are women**, especially in sericulture and homestead agroforestry.
 - **Livelihood Resilience:** Trees serve as **natural insurance** against droughts, crop failures, and climate shocks.
 - Reduces seasonal migration through **year-round employment**.
 - **Nutritional and Food Security:** Fruit- and fodder-based systems enhance **diet diversity and livestock productivity**.
 - Strengthens **kitchen gardens, homesteads, and tribal food systems**.

- **SDG 2: Zero Hunger**
 - **SDG 13: Climate Action**
 - **SDG 15: Life on Land**

- **National and Global Relevance**
 - **Policy Integration:** Agroforestry supports **India's NDC targets** and several SDGs (2, 13, 15).
 - Key component of:
 - **National Agroforestry Policy (2014)**
 - **Green India Mission**
 - **Bharat Bamboo Mission, Mahatma Gandhi NREGA**

- **International Model:** India's agroforestry model adopted by **ASEAN, Nepal, Rwanda, Ethiopia**.
 - **ASEAN Guidelines on Agroforestry (2018)** inspired by India's NAP.

Government Policies and Initiatives on Agroforestry in India

- **National Agroforestry Policy (NAP), 2014:** India became the first country in the world to adopt a dedicated policy on agroforestry.
 - **Key Features:**
 - Promotes **integrated agriculture–forestry systems** on private and community lands.
 - Calls for **convergence between agriculture, environment, and rural development ministries**.
 - **Recommends:**
 - Simplifying tree **felling and transit regulations**
 - Establishing **institutional support** (e.g., CAFRI)
 - Encouraging **research–extension linkages**
 - **Outcomes:** Laid the foundation for the **Sub-Mission on Agroforestry (SMAF)**.
 - Strengthened India's role in **climate-resilient agriculture**.
 - **Inspired global policies** (ASEAN, Rwanda, Nepal, Ethiopia).
- **Sub-Mission on Agroforestry (SMAF) under National Mission for Sustainable Agriculture (NMSA)**
 - Operational Since: **2016**
 - **Objectives:**
 - Promote **tree plantation on farmland**, especially for **small and marginal farmers**.
 - Provide **incentives for seedling procurement, planting, protection, and extension**.
 - Converges with **MNREGA, RKVY, NABARD projects**.
- **All India Coordinated Research Project (AICRP) on Agroforestry:**
 - In 1983, the **Indian Council of Agricultural Research (ICAR)** was initiated as a **coordinated network of research centers** to study and develop agroforestry practices suitable for different agroclimatic zones.

- **Aim:** To investigate and improve agroforestry systems across India.
- **GROW: Greening and Restoration of Wasteland with Agroforestry:**
 - GROW, launched by **NITI Aayog**, is a national initiative aimed at **restoring degraded and underutilized lands** in India through **agroforestry-based interventions**.
 - Launched to support India's international commitments on **land restoration and climate change mitigation**.
 - The **GROW portal**, hosted on **Bhuvan**, provides pan-India access to **agroforestry suitability data at state and district levels**, facilitating informed decision-making for sustainable farming.
 - **Key Objectives**
 - **Restore 26 million hectares** of degraded land by **2030**, aligned with India's **Bonn Challenge** commitment.
 - Establish an **additional carbon sink** of **2.5 to 3 billion tonnes of CO₂ equivalent** as per India's **Nationally Determined Contributions (NDCs)** under the Paris Agreement.
 - **Technology and Tools Used**
 - **Remote Sensing and GIS:** Employed to map land suitability for agroforestry.
 - **Agroforestry Suitability Index (ASI):**
 - A scientific tool developed using **thematic datasets** (soil, rainfall, land use, etc.)
 - Helps **prioritize areas** for agroforestry implementation at **national, state, and district levels**.
- **State-Level Agroforestry Policies:**
 - **Odisha Agroforestry Policy (2025 Draft):** Targets **₹2000 Cr** investment to promote **native timber, fruit, and bamboo species**.
 - Focus on **livelihoods, carbon markets, and tribal participation**.
 - **Tamil Nadu Agroforestry Policy (2025 Draft):** Emphasizes **market-linked high-value timber** like mahogany, red sanders, and sandalwood.
 - Integrates **urban agroforestry models** and **research-extension linkage**.
 - **Punjab Crop Diversification through Agroforestry (CDAF) Scheme:** Offers **Direct Benefit Transfer (DBT)** of ₹8–10/tree planted.

- Promotes **poplar and eucalyptus plantations** for plywood industry under CAFRI guidance.
- **Legal and Regulatory Reforms:**
 - **National Transit Pass System (NTPS):** Developed by Ministry of Environment, Forest and Climate Change, envisioned as a “One Nation-One Pass” regime.
 - Aims to issue **QR-coded, digital permits** for tree transit across states.
 - Reforms under progress: **TiGram app in Kerala** uses geotagging and photo-verification to digitize permits.
 - **Indian Forest and Wood Certification Scheme (IFWCS):** Launched by the Ministry of Environment, Forests and Climate Change .
 - **Aim:** To promote **sustainable forest management and agroforestry practices** in India.
 - **Species Exemption Lists:** Over 20 fast-growing species (e.g., **bamboo, neem, subabul**) now exempt from transit/felling rules in most states.
 - However, **valuable native species** like teak, mahogany, rosewood are still regulated.

Agroforestry in Other National Missions

Mission	Agroforestry Relevance
Green India Mission	Focus on enhancing ecosystem services via agroforestry on degraded lands.
National Bamboo Mission	Encourages bamboo-based agroforestry on private and community lands.
MGNREGA	Supports tree plantation and protection activities under convergence mode.
Compensatory Afforestation Fund Act (CAMPA)	Allows agroforestry components in compensatory plantation zones.

International Partnerships & Initiatives

- **TOFI (Trees Outside Forests in India)** – MoEFCC & USAID project for carbon credits and farmer support.
- **FAO–ICRAF Collaboration** – Supports technical assistance, capacity building, and digital monitoring tools.

- **UN Decade on Ecosystem Restoration (2021–2030)** – Agroforestry recognized as a key restoration pathway.

Best Global Practices in Agroforestry

- **Payment for Ecosystem Services (PES) – Costa Rica**
 - Governments and private entities compensate farmers for ecosystem services like carbon sequestration, water purification, and biodiversity conservation through agroforestry.
- **FAO supported Farmer Field Schools (FFS) – Indonesia**
 - Community-based FFS train farmers on species selection, soil management, and market access through participatory demonstrations and digital tools.
- **Tree-Commodity Integration – Brazil (Agroforestry Cocoa Systems)**
 - Cocoa is grown with native trees (e.g., mahogany, fruit trees) in the Amazon, diversifying incomes and restoring biodiversity.
- **Farmer-Managed Natural Regeneration (FMNR) – Niger**
 - Farmers prune naturally regenerating tree stumps (e.g., *Guiera senegalensis*) to restore degraded lands, requiring minimal external inputs.

Challenges in Agroforestry in India

- **Legal and Regulatory Challenges**
 - **Stringent Tree Felling & Transit Rules:** Most states require permits for felling or transporting trees like **teak, rosewood, and sandalwood** even on **private farmland**.
 - These rules are **non-uniform** across states, causing confusion and harassment.
 - **Judicial Overhang:** The **Godavarman Case (1996)** led to a broad interpretation of “forest”, extending forest regulations to **private plantations** and restricting agroforestry expansion.
 - **Overlapping Jurisdictions:** Farmers may need clearances from **multiple departments** (forest, revenue, agriculture), discouraging tree planting.
- **Market and Economic Constraints**
 - **Lack of MSP and Formal Market Access:** Agroforestry produce (timber, bamboo, medicinal plants) is **not eligible for MSP** or regularized procurement.
 - Most sales happen via **unorganized channels** with poor price realization.

- **Inadequate Credit and Insurance:** Agroforestry is excluded from priority sector lending in many banks.
 - No customized **insurance products** to cover long gestation risks of tree crops.
- **Timber Import Dependence:** Despite domestic potential, India imports **\$2.7 billion worth of timber annually** due to legal bottlenecks and poor value chain development.
- **Technical and Extension Limitations**
 - **Data and Research Gaps:** Lack of region-specific, science-backed **tree–crop compatibility models**.
 - **Low adoption** of tools like Jaltol, AgroConnect, or biodiversity-based planning systems.
 - **Weak Farmer Outreach:** Agroforestry receives **less extension focus** than food crops.
 - Coordination between **agriculture and forest extension departments** is poor.
- **Institutional and Policy Challenges**
 - **Incomplete Implementation of NAP 2014:** Very few states (e.g., **Odisha, Tamil Nadu**) have notified state-level agroforestry policies.
 - The **Sub-Mission on Agroforestry (SMAF)** is operational but underutilized in many regions.
 - **Fragmented Institutional Architecture:** Agroforestry intersects **6+ ministries** (Agriculture, Environment, Rural Development, Panchayati Raj, Tribal Affairs, Finance), but coordination is weak.
- **Environmental and Ecological Concerns**
 - **Overuse of Exotic Monocultures:** Fast-growing species like **eucalyptus and poplar** dominate due to commercial value, but:
 - **Lower biodiversity**
 - **High water consumption**
 - Can reduce **soil fertility**
 - **Crop–Tree Competition:** Without scientific planning, deep-rooted trees can **compete with crops for water and nutrients**, especially in rainfed areas.
- **Socio-Cultural and Gender Barriers**

- **Women's Access to Resources:** Despite comprising **35% of trainees**, **women lack tree ownership rights** and decision-making roles in many agroforestry projects.
- **Low Awareness and Risk Aversion:** Many farmers perceive tree planting as **legally risky**, **slow in returns**, and **incompatible with annual farming cycles**.

Way Forward for Agroforestry in India

- **Legal and Regulatory Simplification:** Harmonize tree felling and transit rules across states through a national framework.
 - Fast-track the implementation of the *National Transit Pass System (NTPS)* with digital tools like *TiGram* to ensure transparency, reduce bureaucratic delays, and incentivize farmers to plant high-value native species.
- **Market Reforms and Support Mechanisms:** Provide **Minimum Support Price (MSP)**-like assurance or price stabilization mechanisms for **key agroforestry products** (e.g., timber, bamboo, NTFPs).
 - Strengthen **Farmer Producer Organizations (FPOs)** to aggregate, process, and market produce through formal channels.
- **Credit and Insurance Innovations:** Classify agroforestry under **priority sector lending** with customized, low-interest credit.
 - Develop **insurance schemes** that cover tree crop risks during gestation, especially for small and marginal farmers.
- **Research, Innovation, and Digital Extension:** Promote **region-specific R&D** on **tree–crop–livestock interactions** using digital tools like *AgroConnect*, *Jaltol*, and remote sensing.
 - Boost collaboration between **ICAR, CAFRI, ICRAF**, and state agriculture universities to mainstream agroforestry in **Krishi Vigyan Kendras (KVKs)** and extension services.
- **Inclusive and Gender-Sensitive Approaches:** Ensure land and tree tenure security for women.
 - Create **women-led agroforestry cooperatives** and incentivize their participation in training, marketing, and ownership through targeted policies and subsidies.
- **Ecological Sustainability through Native Diversity:** Promote **multi-species, climate-resilient agroforestry models** using indigenous species over monocultures.
 - Encourage biodiversity-based planning to balance income generation with soil health, water conservation, and carbon sequestration.
- **Strengthen Institutional Coordination and State Policies:** Operationalize *National Agroforestry Policy (NAP) 2014* effectively by encouraging all states to adopt dedicated policies.

- Create **inter-ministerial task forces** to coordinate planning and funding under NREGA, NABARD, Green India Mission, and tribal development schemes.

Conclusion

Agroforestry in India holds **immense potential** to enhance farmer livelihoods, sequester carbon, and regenerate ecosystems, but scaling it requires overcoming **legal, economic, and technical barriers** through robust policy reforms and inclusive strategies. By aligning with national and global sustainability, agroforestry can drive **climate-resilient agriculture and rural development**.

Source: <https://www.thehindu.com/opinion/open-page/agroforestry-can-transform-rural-futures/article69661729.ece>