

Whitepaper Vol. 16

Cultivating Resilience Through Sustainable Agroforestry



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Foreword

In today's rapidly evolving global landscape, climate resilience and sustainable development have become critical priorities for governments, businesses, and communities. Increasing expectations from investors, regulators, and consumers are encouraging organizations to strengthen their Environmental, Social, and Governance (ESG) commitments while building resilient and sustainable supply chains.

In this context, sustainable agroforestry has emerged as a practical and strategic solution. Agroforestry integrates trees, crops, and sustainable land management practices within the same landscape, differing from conventional agriculture that often relies on monoculture systems and intensive land use. By promoting more balanced ecosystems, agroforestry supports both environmental restoration and long-term productivity.

Agroforestry also plays an important role in climate mitigation through carbon sequestration, forest restoration, and avoided deforestation, contributing to global net-zero commitments. At the same time, it strengthens climate adaptation by improving soil health, enhancing water resilience, reducing land degradation, and supporting biodiversity conservation.

For Indonesia, sustainable agroforestry presents a significant opportunity to address climate vulnerability while supporting sustainable economic development. Beyond an environmental initiative, it represents a strategic investment in resilient supply chains, sustainable sourcing, and long-term value creation.

Through this whitepaper, *Cultivating Resilience Through Sustainable Agroforestry*, we hope to encourage collaboration among businesses, policymakers, communities, and sustainability stakeholders in advancing a more adaptive, inclusive, and sustainable future.

Lenny Hidayat

Partner, Greenwise Consulting



CHAPTER 1

Introduction: The Strategic Importance of Sustainable Agroforestry

Agroforestry is increasingly recognized as a critical land-use approach at the intersection of climate action, ecosystem restoration, and rural development. The Food and Agriculture Organization (FAO) defines agroforestry as the intentional integration of trees with crops and/or livestock in spatial or temporal arrangements, while recent academic literature further characterizes it as a structured, integrated land-use system combining woody vegetation with agricultural production (MDPI, 2024). Unlike conventional agriculture, which typically relies on monocropping and input-intensive practices, agroforestry systems are inherently diversified and multifunctional. By integrating trees into productive landscapes, agroforestry creates synergies between ecological processes and agricultural outputs, enabling more resilient and sustainable land management.

From a climate mitigation perspective, agroforestry represents a high-potential, nature-based solution. Empirical studies indicate that agroforestry systems can sequester between 0.5–5 Mg C/ha/year in aboveground biomass and 0.2–1.5 Mg C/ha/year in soils, depending on system design and local conditions (MDPI, 2024). With appropriate design and management, these systems function as effective carbon sinks, contributing meaningfully to the global carbon budget. Beyond direct sequestration, agroforestry also supports avoided emissions by reducing pressure on natural forests. By supplying timber, fuelwood, and other forest-derived products within agricultural landscapes, it minimizes the need for forest extraction and helps curb deforestation. This dual role—enhancing carbon stocks while preventing emissions—positions agroforestry as a key component of climate-smart agriculture and land-based mitigation strategies (FAO; ScienceDirect).





Equally important is the role of agroforestry in strengthening climate adaptation and resilience. The integration of trees into farming systems enhances soil health through improved nutrient cycling and organic matter accumulation, while also supporting water conservation by increasing infiltration and reducing runoff. Agroforestry systems contribute to biodiversity conservation by creating heterogeneous habitats and ecological corridors within agricultural landscapes. These ecological benefits translate into improved resilience to climate variability, including droughts and floods, by stabilizing microclimates, reducing erosion, and enhancing overall system productivity. As highlighted in multiple studies, such diversified systems are better equipped to withstand climate shocks and maintain yields compared to conventional monoculture systems (FAO; ScienceDirect, 2023).

Beyond environmental benefits, agroforestry plays a vital role in supporting rural livelihoods. By design, it generates multiple products and income streams, thereby reducing economic vulnerability for farming communities. Common benefits include the provision of food, fodder, and firewood, alongside income from timber and non-timber forest products. Additional outputs—such as medicinal products, gums and resins, ornamental plants, and materials for household items and farm tools—further enhance livelihood diversification. This multifunctionality not only improves household resilience but also contributes to broader rural development objectives by creating more stable and sustainable income sources.

In the context of global climate goals, agroforestry is gaining traction as a practical pathway to support nationally determined contributions (NDCs) and private sector net-zero commitments. As countries and corporations seek scalable solutions to decarbonize land-use systems, agroforestry offers a credible mechanism to integrate carbon sequestration, adaptation, and socio-economic co-benefits. Moreover, it is increasingly embedded within sustainable supply chain strategies, particularly for commodities such as palm oil, cocoa, and coffee, where deforestation risks and carbon footprints are under scrutiny. By promoting deforestation-free production and enhancing traceability and sustainability, agroforestry enables companies to align with evolving regulatory requirements and ESG expectations.

Overall, agroforestry represents a holistic approach to land management that simultaneously addresses climate mitigation, climate adaptation, and sustainable development. Its ability to integrate environmental integrity with economic viability makes it a cornerstone of resilient agricultural systems and a key enabler of the transition toward low-carbon, sustainable supply chains.

CHAPTER 2

Global Policy and Standards Landscape

Sustainable agroforestry has gained increasing global recognition as a critical approach to addressing interconnected challenges related to climate change, biodiversity loss, and rural livelihoods. Its relevance is reinforced by a growing ecosystem of international policy frameworks, scientific guidance, and voluntary standards that collectively shape how agroforestry is designed, implemented, and scaled. Understanding this global policy and standards landscape is essential for aligning agroforestry initiatives with internationally recognized sustainability goals and ensuring measurable impact.

1

Alignment with the United Nations Sustainable Development Goals (SDGs)



Agroforestry is strongly aligned with the United Nations Sustainable Development Goals (SDGs), which provide a comprehensive blueprint for sustainable development. By integrating trees into agricultural systems, agroforestry contributes simultaneously to multiple goals, including poverty reduction (SDG 1), zero hunger (SDG 2), climate action (SDG 13), and life on land (SDG 15).

Research highlights that agroforestry systems enhance ecosystem services, improve soil fertility, and diversify income streams for smallholder farmers, thereby supporting inclusive and sustainable development pathways. This multi-functional nature makes agroforestry a practical mechanism for operationalizing the SDGs at the landscape level.

2

Role under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement



Within the global climate policy architecture, agroforestry plays a strategic role under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. These frameworks emphasize the importance of land-based mitigation and adaptation strategies in achieving global climate targets. Agroforestry contributes to climate mitigation through carbon sequestration in biomass and soils, while also enhancing resilience to climate variability by improving water retention, reducing erosion, and stabilizing microclimates. As a result, agroforestry is increasingly incorporated into countries' Nationally Determined Contributions (NDCs) as a nature-based solution that delivers both environmental and socio-economic benefits.

3

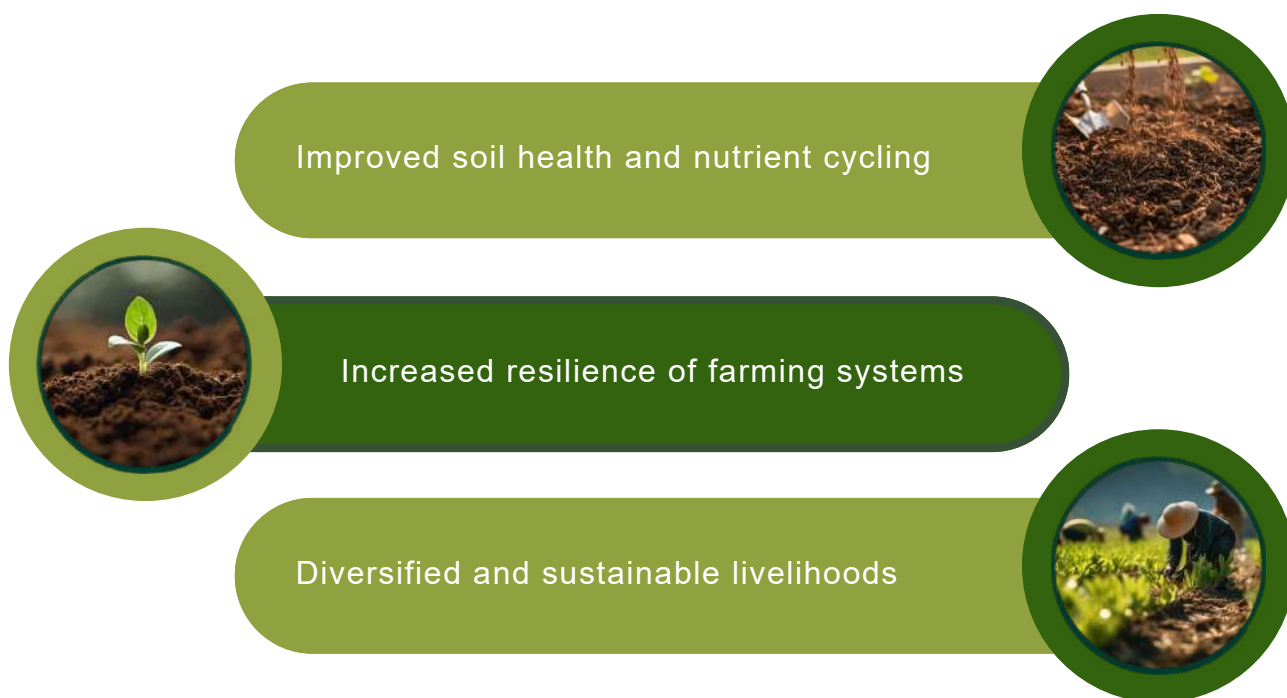
Linkages to the Food and Agriculture Organization (FAO) agroforestry guidance

Technical guidance from the Food and Agriculture Organization (FAO) further strengthens the case for agroforestry as a sustainable land-use system. FAO frameworks position agroforestry as an integrated approach that combines agriculture, forestry, and ecosystem management to optimize productivity while maintaining ecological balance.

According to FAO, agroforestry systems contribute to:



Enhanced biodiversity conservation



4

Voluntary standards (Forest Stewardship Council (FSC), Rainforest Alliance, Roundtable on Sustainable Palm Oil (RSPO))

In addition to policy frameworks and technical guidance, voluntary sustainability standards play a crucial role in translating global principles into operational practices. Certification systems such as the Forest Stewardship Council (FSC), Rainforest Alliance, and Roundtable on Sustainable Palm Oil (RSPO) provide structured criteria for sustainable land management and responsible supply chains.

The standards:



Promote environmental protection and biodiversity conservation



Ensure social safeguards and fair labor practices



Enhance traceability and transparency in global markets

Moreover, they enable private sector engagement by linking sustainability performance with market access and consumer demand. Increasingly, certification schemes are recognized as essential mechanisms for scaling agroforestry adoption and bridging the gap between policy commitments and on-the-ground implementation.

Chapter 3

INDONESIA REGULATORY AND POLICY FRAMEWORK FOR SUSTAINABLE AGROFORESTRY

Sustainable agroforestry in Indonesia is positioned as a strategic pillar to advance landscape resilience, foster a forest-based bioeconomy, and enhance the livelihoods of local communities. Looking ahead to 2026 and beyond, national strategic directions emphasize three overarching priorities: strengthening climate resilience through increased vegetation cover and carbon sequestration, accelerating the transition toward a sustainable bioeconomy, and promoting ecosystem-based welfare for communities living in and around forest areas.

As part of the forward-looking policy direction toward the 2026 strategic outlook, several key priorities are emphasized:



Landscape Resilience & Climate Mitigation

Agroforestry is recognized as a key approach to increasing vegetation cover and national carbon stocks to address climate change challenges and disaster risks.



Bioeconomy Transition

Indonesia promotes a sustainable forest-based bioeconomy that integrates sustainable forest management with multi-sector economic productivity.



Ecosystem-Based Livelihoods

A primary focus is ensuring improved welfare for forest-dependent communities through agroforestry practices that support sustainable livelihoods without degrading forest ecosystems.

In line with these strategic directions, the Government of Indonesia has articulated its commitment through various planning documents, regulations, and policy instruments, including:

1

National Medium-Term Development Plan (RPJMN) 2025–2030 (Presidential Regulation No. 12/2025)

Mandates the protection of at least 87% of designated paddy fields as Sustainable Food Agricultural Land (LP2B) to prevent land conversion.

2

National Long-Term Development Plan (RPJPN) 2025–2045 (Law No. 59/2024):

Serves as the overarching framework for Indonesia Emas 2045, emphasizing a green economy and sustainable natural resource management

3

Social Forestry Management Plan (RKPS)

Requires community groups to prepare 10-year management plans and annual work plans to ensure sustainable forest governance through agroforestry schemes.





The regulatory framework for sustainable agroforestry in Indonesia demonstrates a progressive and interconnected policy evolution, beginning from high-level spatial and forestry governance to more technical and implementation-oriented guidelines. At its foundation, Government Regulation No. 21/2021 on Spatial Planning establishes the overarching land-use structure by defining protection and cultivation zones, thereby creating the spatial basis for where agroforestry practices can be developed. This is further reinforced by Government Regulation No. 23/2021 on Forestry Administration, which enables the utilization of forest areas across various functions, formally allowing agroforestry activities within the national forestry system.

Building on this foundation, MoEF Regulation No. 7/2021 on Forestry Planning and Land Use Change provides the procedural framework for managing forest designation and land-use transitions, ensuring that agroforestry can be systematically integrated into forest planning processes. This is complemented by MoEF Regulation No. 8/2021 on Forest Management Planning, which operationalizes agroforestry within forest concession schemes, particularly through multi-business forestry licenses that allow diversified land use.

At the community level, MoEF Regulation No. 9/2021 on Social Forestry Implementation plays a critical role in granting legal access and management rights to local communities, positioning agroforestry as a key mechanism for inclusive and sustainable forest utilization. This is further strengthened by MoEF Regulation No. 23/2021 on Forest and Land Rehabilitation, which recognizes agroforestry as an effective approach for restoring degraded lands while maintaining economic productivity.

Expanding beyond rural and forest landscapes, ATR/BPN Regulation No. 14/2022 on Green Open Space Provision and Utilization introduces the concept of urban agroforestry, linking sustainable land use with urban spatial planning and green infrastructure development. Finally, the framework is complemented by Minister of Forestry Decree No. 657/2025, which provides specific technical guidelines for food-based agroforestry within social forestry areas, aligning agroforestry practices with national food security objectives.

Despite strong policy support and multi-stakeholder collaboration, further refinement is required to address emerging challenges and strengthen implementation. Key areas that require regulatory attention as part of a collaborative framework include:

1. Cross-Sectoral Regulatory Integration (Agroforestry Omnibus Framework)



Existing policies often overlap across forestry, agriculture, and rural development sectors. Required Action: Establish a Presidential-level regulation clearly defining institutional roles and responsibilities to streamline implementation and avoid administrative fragmentation.

2. Standardization and Certification of Agroforestry Products



Global market access increasingly requires proof of deforestation-free supply chains (e.g., EU Deforestation Regulation). Required Action: Develop an inclusive and affordable sustainable agroforestry verification system to enhance product competitiveness and export access.

3. Tenure Security and Legal Certainty



Land conflicts remain a major barrier to long-term investment. Required Action: Strengthen regulations on agroforestry tenure rights, including pathways to convert temporary permits into long-term management rights (e.g., up to 35 years).

4. Economic Incentives and Green Financing Mechanisms



Agroforestry is often perceived as less economically attractive than monoculture systems in the short term. Required Action: Introduce regulatory frameworks for carbon credits, carbon taxation, and payments for ecosystem services to provide direct financial incentives.

5. Protection of Genetic Resources and Traditional Knowledge



Indigenous knowledge systems are vulnerable to external appropriation. Required Action: Establish regulations to protect traditional knowledge and local plant varieties, ensuring benefit-sharing mechanisms for local communities.

6. Risk Mitigation and Forest-Based Agricultural Insurance



Climate change increases the risk of crop failure. Required Action: Develop insurance schemes specifically tailored for agroforestry systems, expanding beyond conventional agricultural insurance models.

In conclusion, while Indonesia has demonstrated strong commitment through policies and partnerships, further efforts are required to enhance implementation effectiveness and long-term sustainability. Key priorities moving forward include:

01

Strengthening Policy Coherence and Institutional Coordination

Enhancing alignment across ministries and governance levels to ensure efficient and integrated implementation.

02

Improving Economic Attractiveness and Market Integration

Expanding access to premium markets, strengthening certification systems, and scaling innovative financing mechanisms.

03

Enhancing Governance, Tenure Security, and System Resilience

Securing land rights, improving local institutional capacity, and developing risk mitigation instruments to support long-term sustainability.

CHAPTER 4

Cultivating Resilience Through Sustainable Agroforestry

Agroforestry is a way of using land that combines trees with crops and livestock. This creates landscapes that do lots of things. Agroforestry gives us benefits for the environment, the economy and people. It is a way to take care of the land that's sustainable. Agroforestry helps with biodiversity makes the soil better and absorbs carbon. At the time it helps farms produce more and makes the people who own the farms more money from different things.



In Indonesia people have been doing agroforestry for a time. It is very important for people who have farms. Agroforestry helps people in Indonesia deal with climate change have food and make a living in rural areas. We know that agroforestry systems can make people stronger by keeping their income steady giving them access, to food and making the environment better. This includes making the soil fertile and controlling water. Agroforestry does all these things for the people who practice agroforestry and for the environment.

4.1 Practical Pathways for Agroforestry Implementation in Indonesia

1 Flexible land-use systems across various sectors

Agroforestry has land-use systems that can be used in different areas, such as farming, taking care of trees, and helping rural areas. For example, in Indonesia people do something called intercropping which means they grow trees and other crops at the time. This way, agroforestry helps people make timber, food and other things from the forest at the same time in the same area. This is good because it lets people who own the land like farmers and people who make decisions like policymakers use the land in the way possible while still taking care of the environment.

Agroforestry systems can also be changed to fit the environment and the people who live there. They can be simple like growing a few things together or complicated like growing many things in layers. This helps the land deal with changes in the weather and it means people do not have to depend on just one type of crop. Agroforestry also helps make the farms more diverse which is good for the environment. Agroforestry systems, like these make the land stronger and more able to withstand problems.



2 Multiple Ways To Make Agroforestry Happen (Companies Leading The Way, Small Farmers Working Together and so on)



Agroforestry in Indonesia can be done in different ways depending on who is involved. Most of the time it is the farmers who take the lead using the knowledge they have had for a long time and doing what they need to do to make a living. They plant trees to get food, fuel and to earn money. This way of doing things helps them have food at home and also makes them some extra money, which is more than what they would get from just growing crops.

At the time companies and groups of small farmers are starting to work together to make agroforestry bigger and better especially when it comes to growing things like coffee, cocoa and timber. When companies are involved they can help the small farmers get the money and expertise they need and also help them sell their products. This makes agroforestry a stable and profitable way of farming. Some people are even trying a mix of both, where companies invest money and small farmers manage the land, which is a good way to make sure that the way we use the land is sustainable for everyone and that agroforestry keeps growing.

3 What It Takes For Agroforestry To Grow

Agroforestry in Indonesia is a thing but it needs some help to really take off. There are some problems that get in the way like it taking a long time to make money not being able to get good seeds and plants and farmers not knowing how to do it. These problems make farmers like to grow one crop because they think it will make them money faster.

To make agroforestry work we need to get a lot of people working together. We need the government to make rules that help we need to find ways to get money to farmers we need to get people to buy agroforestry products and we need to share what we know with each other. When the government, companies, non-profits and schools all work together they can help agroforestry in Indonesia really grow and become successful. Agroforestry, in Indonesia needs all these people to work to reach its full potential.



CHAPTER 5

Socio-Economic Value and Inclusive Development

Agroforestry has been widely recognized as a multifunctional land-use system that generates substantial socio-economic benefits while promoting inclusive development pathways. Within the sustainable development discourse, agroforestry represents a hybrid production model that integrates ecological sustainability with economic viability and social equity, particularly in rural and resource-dependent regions.



From an economic standpoint, agroforestry contributes significantly to household income diversification and economic resilience. By integrating trees, crops, and sometimes livestock within a single system, agroforestry reduces dependency on monoculture production and mitigates risks associated with market volatility and climate-induced crop failures. Empirical studies indicate that agroforestry adopters tend to experience more stable and, in some cases, higher cumulative incomes due to diversified revenue streams (MDPI Sustainability, 2025). Moreover, the system enables participation in emerging green markets, including certified sustainable products and ecosystem service-based schemes, thereby expanding income-generating opportunities beyond traditional agriculture.

Beyond income generation, agroforestry plays a crucial role in strengthening rural livelihoods and enhancing adaptive capacity. The integration of multiple components within agroforestry systems improves land-use efficiency and resource productivity, while simultaneously providing essential goods such as food, fuelwood, fodder, and raw materials. This multifunctionality enhances household self-sufficiency and reduces vulnerability to external shocks, including economic downturns and environmental stressors (MDPI Forests, 2022). Consequently, agroforestry can be conceptualized as a livelihood buffering mechanism that supports long-term socio-economic stability.



In the context of inclusive development, agroforestry demonstrates strong potential in empowering marginalized and underrepresented groups. Smallholder farmers, women, and indigenous communities often face structural barriers in accessing capital-intensive agricultural systems. Agroforestry, by contrast, typically requires lower initial investment and relies on locally available knowledge and resources, making it more accessible and adaptable. Furthermore, participatory agroforestry practices encourage community involvement in decision-making processes, leading to a more equitable distribution of benefits (ResearchGate, 2025). This inclusivity is particularly important in addressing rural poverty and reducing socio-economic disparities.

Agroforestry also contributes to the enhancement of social capital and institutional capacity at the community level. The collaborative nature of agroforestry practices fosters trust, collective action, and knowledge sharing among stakeholders. These interactions not only strengthen social cohesion but also facilitate the co-creation of locally appropriate solutions. Over time, such social dynamics contribute to stronger local institutions and improved governance of natural resources, which are critical for sustainable development outcomes.



Despite these benefits, it is important to acknowledge that the socio-economic potential of agroforestry is not fully realized due to several structural and systemic constraints. These include limited access to markets, inadequate policy support, insufficient technical knowledge, and weak institutional frameworks. Additionally, the long gestation period of certain agroforestry components (e.g., timber) may discourage adoption among resource-constrained farmers. This highlights a critical research and policy gap: while agroforestry is widely promoted as a sustainable solution, its scalability and inclusivity depend heavily on enabling conditions such as financial access, extension services, and supportive governance structures.



Therefore, to maximize the socio-economic and inclusive development outcomes of agroforestry, there is a need for integrated policy interventions and multi-stakeholder collaboration. This includes strengthening value chains, improving access to finance, enhancing capacity-building programs, and aligning agroforestry initiatives with broader rural development strategies. Without such systemic support, the transformative potential of agroforestry may remain underutilized.





CHAPTER 6

Implementation Challenges and Risk Factors in Agroforestry

Indonesia has strong potential to become a global leader in agroforestry. The country has large areas of suitable land, long-standing community farming traditions, and growing support through carbon market and green finance policies. However, several long-standing structural challenges continue to slow progress. This paper highlights five key challenge areas that need coordinated action from government, financial institutions, businesses, and local communities.



7.1 Land Tenure Conflicts and Overlapping Permits

One of the biggest barriers to agroforestry development in Indonesia is unclear land ownership and land-use rights. Over many years, overlapping permits for forestry, plantations, mining, and other activities have created frequent land conflicts. Between 2004 and 2014, nearly 1,400 agrarian conflicts were recorded, covering more than five million hectares. In many areas, multiple parties hold competing claims over the same land, creating uncertainty for communities, investors, and project developers.

7.2 Fragmented Governance and Inter-Agency Coordination

Agroforestry involves many sectors at once, including forestry, agriculture, environmental protection, spatial planning, rural development, and finance. Because of this, responsibility is spread across several ministries and government agencies. While each institution manages part of the issue, no single authority fully coordinates agroforestry development. This fragmented governance often results in overlapping policies, slow decision-making, and inconsistent implementation.

7.3 Technical Knowledge Gaps and Extension Limitations

Successful agroforestry systems require technical knowledge and long-term management. Farmers need to understand topics such as crop and tree interactions, soil health, water management, and market timing. However, many smallholders have limited access to training and technical assistance. Existing agricultural extension systems are often underfunded and not fully equipped to support agroforestry practices. Indonesia's diverse ecological conditions across regions also make it difficult to apply one standard approach nationwide.



7.4 Financing Barriers and Long Gestation Periods

Agroforestry systems require patience and long-term investment. Trees may take between five and twenty-five years to generate full economic returns. In contrast, most agricultural financing in Indonesia is designed for short-term crops, with loan periods of only one to three years. Banks also often require formal land certificates as collateral. As a result, many agroforestry projects struggle to access suitable financing that matches the longer production cycle of tree-based systems.



7.5 Market Access and Certification Costs

Products from sustainable agroforestry systems, such as certified timber, organic commodities, and carbon credits, can achieve premium prices in international markets. However, smallholder farmers often receive only a small share of these benefits. Much of the added value is captured by intermediaries, processors, and exporters. In addition, certification systems are often expensive and difficult to access. Many standards were developed for high-income markets and require financial resources, technical capacity, and infrastructure that remain limited in rural Indonesia. As a result, the farmers who manage the land sustainably are often the least able to benefit from premium markets.

Despite these challenges, agroforestry initiatives across Indonesia and other parts of the world have shown that many of these barriers can be addressed through the right combination of policy support, community participation, technical assistance, and innovative financing models. A growing number of projects have successfully improved farmer livelihoods, restored degraded landscapes, and created sustainable economic opportunities at the same time. The next chapter explores several best practices and successful case studies that demonstrate how agroforestry can be implemented effectively and scaled sustainably.



Chapter 7

BEST PRACTICES IN IMPLEMENTATION

Across Indonesia and globally, many agroforestry initiatives have demonstrated that environmental restoration and economic development can be achieved simultaneously. Successful practices show how integrated approaches, combining sustainable land management, and community participation, can strengthen ecosystem resilience while improving local livelihoods. This chapter highlights several best practices that offer practical lessons for scaling agroforestry more effectively and sustainably.



Governance

The success of sustainable agroforestry is not solely determined by on-the-ground practices, but by the quality of governance that underpins them. Sound governance ensures that land rights are protected, stakeholders are meaningfully engaged, and all operations are aligned with global sustainability standards. Without a strong governance foundation, agroforestry initiatives risk fragmentation and vulnerability to long-term external pressures.



Clear Land Tenure and Stakeholder Engagement

Clear land tenure is a fundamental prerequisite for any agroforestry initiative. Research in Lampung, Sumatra demonstrates that tenure security directly drives the adoption of agroforestry systems while reducing the risk of land fires (Suyanto et al., 2005). A comprehensive literature review of smallholder agroforestry systems in Indonesia affirms that tenure security, policy support, and active stakeholder engagement are key to transforming agroforestry from subsistence to commercially sustainable operations.

Best practices encompass four key elements:



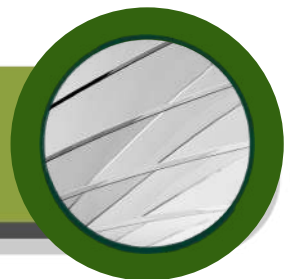
Participatory mapping using GPS and satellite imagery to accurately and verifiably document land claims.

Land registration and legalization through Agrarian Reform or Social Forestry schemes.



Application of Free, Prior and Informed Consent (FPIC) principles in accordance with UNDRIP standards to protect indigenous community rights.

Transparent, accessible, and non-discriminatory dispute resolution mechanisms





NDPE Alignment

The No Deforestation, No Peat, No Exploitation (NDPE) principle has become the global benchmark for sustainable commodity industries. Analysis of hybrid governance in commodity supply chains in Sumatra shows that effective NDPE implementation requires the democratization of institutions and the strengthening of smallholder and indigenous community voices (Pirard et al., 2015). The No Deforestation dimension requires the protection of High Conservation.

Value (HCV) and High Carbon Stock (HCS) areas prior to land planning. The No Peat dimension prohibits development on peatlands, which store approximately one-third of global soil carbon. The No Exploitation dimension ensures all workers receive fair wages, safe working conditions, and protection of women's rights throughout the value chain. NDPE alignment must be independently verified through third-party audits and reported on an annual basis.



Internal ESG Oversight

A structured internal ESG (Environmental, Social, and Governance) oversight system is the third pillar of resilient agroforestry governance. A systematic review of ESG reporting in the agribusiness sector demonstrates that companies deeply integrating ESG into strategic management achieve greater competitive advantage and reputational resilience (Gerber & Van Zyl, 2024).

Key components of an effective internal ESG system include:



Measurable operational policies and standards;



Regular internal audits covering environmental, social, and governance indicators



Appointment of an ESG Officer with adequate authority;



Safe and accessible grievance mechanisms



Integration of ESG requirements into supply chain contracts with capacity-building support for partners.

Governance Case Study: Yayasan Bambu Lingkungan Lestari (YBLL)

Yayasan Bambu Lingkungan Lestari (YBLL), or the Environmental Bamboo Foundation, is an Indonesian non-profit organization that has operated for over 30 years at the intersection of community empowerment, landscape restoration, and sustainable bamboo-based enterprise development. In its journey, YBLL has received strategic support from Greenwise Consulting in the area of green impact investing — helping YBLL identify climate funding opportunities, develop impact reporting frameworks, and strengthen its position with global ESG investors.



Gender-based community engagement

YBLL places women as primary actors through the Mama Bambu program. Approximately 532 female members from NTT communities are engaged as family-based bamboo nursery managers in their own home yards, successfully planting 1.2 million bamboo seedlings across seven districts. This model demonstrates that gender inclusion is not merely a normative agenda, but a proven and scalable operational strategy.



Sustainable Bamboo Forest System as an NDPE-aligned standard.

YBLL has developed the Sustainable Bamboo Forest System (Sistem Hutan Bambu Lestari/HBL) a community-based bamboo forestry framework with selective harvesting standards: only culms aged 3–5 years are harvested, clump density is maintained, and land burning is strictly prohibited. Furthermore, bamboo forests managed under this system can absorb up to 50 tonnes of CO₂ per hectare per year, making them a measurable climate mitigation instrument and a tangible source of community livelihood.



Data-driven ESG oversight.

YBLL shares three replicable lessons: authentic community engagement yields greater program resilience; measurable harvesting standards build international market trust; and digital data integration strengthened by Greenwise Consulting's strategic support in green impact investing unlocks access to global climate finance.



Operational

The operational dimension of sustainable agroforestry encompasses how systems are planted, managed, monitored, and adapted in the field. Sound operational practices ensure long-term productivity is achieved without compromising biodiversity, soil health, or the integrity of surrounding ecosystems

Mixed-Species Design



Mixed-species system design is the core of agroforestry that fundamentally differentiates it from monoculture. In Indonesia, complex agroforestry systems store an average of 80.05 Mg C/ha — more than twice that of simple systems at 37.30 Mg Cha (Rahman et al., 2021).

Key principles of mixed-species design include: Canopy stratification: combining tall trees, mid-level layers, and ground cover to maximize light use and suppress weeds. Functional complementarity: selection of nitrogen-fixing species such as *Gliricidia sepium* and *Leucaena leucocephala* that naturally enrich the soil. Year-round harvest diversification to stabilize income and reduce dependence on a single commodity. Integration of locally adapted native species that support wildlife and pollinators.

Soil and Biodiversity Management



Healthy soil is the foundation of long-term agroforestry productivity. A soil-based review of agroforestry's climate adaptation potential confirms that agroforestry systems promote more diverse soil fauna communities — with marked increases in microbial biomass, .

arbuscular mycorrhizal fungi (AMF) diversity, and soil enzyme activity (Rolo et al., 2023). Recommended management practices include: organic composting and mulching from litter and crop residues; avoidance of land burning; and application of minimum tillage. For biodiversity, zoning between core areas and buffer zones, along with the development of ecological corridors between land parcels, is essential to support wildlife movement and natural seed dispersal.

Digital Monitoring and MRV System

A robust Measurement, Reporting, and Verification (MRV) system is a fundamental requirement for agroforestry seeking to connect with carbon markets, certification schemes, and ESG investors. Research on Participatory MRV (PMRV) across three sites in Indonesia demonstrates that combining remote sensing with local community monitoring capacity creates a more accurate, cost-efficient, and equitable system (Boissiere et al., 2014).



Key components of a digital MRV system include: multispectral satellite imagery (such as Sentinel-2) for land cover change monitoring and biomass estimation; geotagged mobile applications for field personnel and farmers; an integrated Geographic Information System (GIS) platform; validated allometric equation-based carbon stock estimation; real-time reporting dashboards accessible to external stakeholders; and independent third-party verification supported by a complete digital audit trail.

Operational Case Study: Bamboo Cop

BambooCoop is the cooperative operational arm of YBLL, translating governance principles into field-level practice across mixed-species bamboo landscapes in East Nusa Tenggara (NTT)

Biodiversity management.

Under the Sustainable Bamboo Forest System, only mature culms aged 3–5 years are selectively harvested, preserving younger growth and maintaining clump density for sustainability.



Community-Based Monitoring.

BambooCoop encourages active participation from local communities in monitoring harvesting practices and maintaining sustainable bamboo forest management, creating stronger accountability and local ownership

Community Empowerment and Training.

Prior to harvesting activities, BambooCoop provides training and technical assistance to local communities, including sustainable harvesting techniques, bamboo quality selection, environmental stewardship, and post-harvest handling. This approach strengthens local capacity while supporting long-term livelihood resilience.

BambooCoop demonstrates that operational excellence in agroforestry is achieved through science-based harvesting standards, community-led monitoring, and transparent impact reporting offering a replicable blueprint for bamboo enterprises seeking to bridge ecological integrity with market credibility.

Chapter 8

The Way Forward for Indonesia

Agroforestry as a Bridge Between Economic Growth and Climate Targets.

Indonesia faces a dual challenge, sustaining economic growth while meeting ambitious climate commitments. Agriculture contributes approximately 13% of GDP and employs around 30% of the workforce, highlighting its central role in economic development.

Agroforestry offers a viable pathway to reconcile these competing priorities. By integrating trees with crops and livestock, agroforestry systems deliver multiple economic and environmental benefits simultaneously :



Unlike monoculture agriculture, agroforestry enhances biodiversity, soil health, and water efficiency, making it inherently more resilient to climate variability and extreme events.

Thus, agroforestry acts as a “natural bridge”, aligning Indonesia’s economic growth with its commitments under global climate frameworks such as the Paris Agreement.

Required Collaboration: Corporates, Cooperatives, Government, and Financiers

Scaling agroforestry in Indonesia requires multi stakeholder collaboration, as no single actor can drive systemic transformation alone.

Key Roles include:



Government



Develop enabling policies and incentives (e.g land tenure clarity, subsidies, carbon pricing mechanism)

Integrate agroforestry into national climate strategies (NDCs)





Corporates

01

Embed agroforestry in sustainable supply chains (e.g coffee, cocoa, palm oil alternatives)

02

Support smallholders through offtake agreements and technical assistance



Cooperatives and Local Communities



Facilitate aggregation, knowledge sharing and implementation



Preserve local ecological knowledge and ensure social inclusion



Financial Institutions and Investors

01

Provide blended finance, green bonds, and carbon financing mechanisms

02

De risk investments in agroforestry projects.

Agroforestry strengthens community resilience and fosters collective resource management, making collaboration not only beneficial but essential .



Importance of Standardized MRV and Transparency.

A critical barrier to scaling agroforestry is the lack of robust Measurement, Reporting, and Verification (MRV) systems.

Standardized MRV is essential for :



Quantifying carbon sequestration and ecosystem services



Attracting institutional investors and climate finance



Ensuring credibility in carbon markets



Monitoring social and environmental co benefits

Currently, research on ecosystem service quantification in agroforestry remains limited, highlighting the need for improved data systems and methodologies.

Transparent MRV frameworks will:

01

Enable traceability across supply chains

02

Reduce risks of greenwashing

03

Build trust among stakeholders

Digital technologies (e.g remote sensing, blockchain) can accelerate MRV standardization and scalability.



Strategic Advantage for Early Adopters

Early adopters of agroforestry stand to gain significant competitive advantages, particularly in the context of global sustainability transitions. Key advantages include :



Access to premium markets demanding deforestation free and sustainable products



Eligibility for carbon credits and climate finance



Enhanced resilience to climate shocks, reducing long term operational risks



Improved brand positioning and ESG performance

As global regulations tighten (e.g deforestation free supply chain policies), companies and regions that adopt agroforestry early will be better positioned to comply and lead.

Moreover, agroforestry provides a “future proof” land use strategy, balancing productivity with ecological integrity.



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