

# Environmental Ethics and Local Wisdom in Sustainable Agroforestry in Indonesia

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## ABSTRACT

Agroforestry is increasingly recognised as a central strategy for sustainable forest and land management in Indonesia. Its effectiveness is attributed not only to technical design but also to environmental ethics, local wisdom, and the moral and institutional frameworks that govern resource utilisation. Examining these dimensions elucidates why certain communities achieve greater success in sustaining forests and land resources.

This study used a comparative qualitative approach. It drew on literature review, conceptual analysis, and cross-case comparison of agroforestry systems in Indonesia. The analysis looked at how environmental values, traditional knowledge, and local institutions affect the ecological and social outcomes of agroforestry.

The results make it clear that communities with strong environmental values consistently adopt land use practices that effectively protect forests and land over time. In these communities, agroforestry leads to increased household income, improved food security, enhanced soil and water protection, greater biodiversity support, and better climate change adaptation. Moreover, local wisdom offers practical land management strategies, while customary institutions transform ethical values into enforceable rules and shared community responsibilities.

Overall, agroforestry produces the best results where social and ecological values are widely shared and drive both productivity and sustainability.

The findings show that sustainable forest and land management needs a shift from exploiting nature to working together with it. By focusing on environmental ethics, this research highlights the importance of ethical foundations for successful community-based agroforestry and for creating policies that fit local contexts.

**Keywords:** sustainable agroforestry; environmental ethics; local wisdom; forest and land management; watershed conservation; sustainable development

## 1. INTRODUCTION

Agroforestry is seen as a promising way to support sustainable farming in tropical countries like Indonesia. It combines trees, crops, and sometimes livestock on the same land, bringing both ecological and economic benefits. Research shows that agroforestry helps people earn a living in various ways, improves land productivity, and provides services such as soil and water conservation, improved microclimates, and stable landscapes (Rafdinal et al., 2021; Sultana & Bari, 2021). Because of this, agroforestry is viewed as both a technical solution and a path to economic and environmental sustainability.

Agroforestry has become more important as traditional farming faces more challenges. Population growth, climate change, and resource loss show the weaknesses of monoculture, which is easily affected by climate, pests, soil problems, and market changes. Agroforestry, on the other hand, is more resilient because it uses different species and land uses, spreading out risks (Paudel et al., 2022). Traditional systems such as tembawang among the Dayak people demonstrate that agroforestry has long been both an agricultural innovation and a cultural means of survival and resource management (Rafdinal et al., 2021). This means agroforestry is not just an alternative to regular farming, but a key part of building more sustainable rural areas.

Even with its promise, managing forests and land in Indonesia still faces big problems. Deforestation, land conversion, loss of biodiversity, poor soil, and unstable water systems are major issues, especially where farming expands without strong resource management. Climate problems like droughts, floods, and unpredictable rain make things worse, putting farms and rural lives at risk. Because of this, agroforestry's success is not guaranteed everywhere, due to physical or economic reasons. This raises the question of why some communities succeed with agroforestry while others do not.

Many people promote agroforestry as a complete solution that combines conservation and economic growth. This is seen as effective because it increases vegetation, improves soil, and creates better microclimates, helping restore damaged land while supporting food and income (Gifawesen et al., 2020; Legesse et al., 2019). However, this broad promotion often misses an important point: agroforestry's outcomes depend heavily on local social, cultural, and institutional factors. It should not be seen as a one-size-fits-all technical model. Instead, we need to look more closely at local ethics, norms, and governance to understand how well they work.

Past studies show that local wisdom is key to making agroforestry sustainable. Knowledge

passed down through generations helps communities adjust their management to fit local environments. These practices become more suitable and lasting (Utami & Oue, 2021). Agroforestry works not just because of what is planted or how it is arranged. It is part of a knowledge system built over time through people's connection with the land. This traditional knowledge affects which species are chosen, how and when things are planted, how resources are rotated, and how soil is protected. To fully understand agroforestry's sustainability, we must consider the cultural and mental frameworks that shape how communities see and manage their environment.

Besides local knowledge, customary institutions are also important in shaping agroforestry. These institutions control who can use land and forests, set rules for use, help share benefits, and solve conflicts (Okubo et al., 2010). In many cases, combining traditional practices with modern agroforestry has strengthened food security and helped farmers cope with environmental changes (Pancholi et al., 2023; Sudomo et al., 2023). This shows that agroforestry lasts longer when local institutions can turn community values into real rules and shared responsibilities. So, agroforestry should be seen not just as an ecological system, but also as a social system that relies on strong local institutions.

Many studies have shown the ecological and social benefits of agroforestry, especially the roles of local wisdom and customary institutions. However, there is still a gap: environmental ethics are rarely discussed directly. Most research on productivity, resilience, and ecosystem services often treats local knowledge as a practical or cultural tool rather than as part of a wider moral view of nature. But environmental ethics are crucial, as they include the moral principles that shape how people relate to the environment. Different views—such as seeing nature mainly for human use or valuing it for its own sake—suggest that environmental problems stem from both technical failures and moral attitudes. So,

sustainable agroforestry needs not only good techniques and strong institutions, but also ethical commitments that respect ecological limits, take responsibility for future generations, and value nature itself. This is the main gap this research addresses. The study examines how environmental ethics, local wisdom, and agroforestry work together to support sustainable forest and land management in Indonesia. Its new approach is to move from purely technical and ecological analysis to a social and ethical one, making environmental ethics central to resource management. The main idea is that stronger environmental ethics, local wisdom, and local institutions make it more likely that agroforestry will protect forests and land while helping households. This research contributes to debates on sustainable development and provides a basis for more locally sensitive environmental policies.

## **2. MATERIALS & METHODS**

### **2.1 Research Design**

This study used a qualitative-comparative design with an analytical-explanatory orientation. It examines the relationship between environmental ethics, local wisdom, and the implementation of agroforestry in sustainable forest and land management in Indonesia. This design was selected because the research problem concerns not only the technical performance of agroforestry, but also the normative, social, and institutional dimensions that shape community behaviour in the use of forest and land resources. Conceptually, the study departed from the assumption that the success of agroforestry is strongly conditioned by local socio-cultural contexts. These contexts include value systems, intergenerational ecological knowledge, and customary institutions that regulate human-environment relations (Okubo et al., 2010; Utami & Oue, 2021). Accordingly, the method was designed to capture not only agroforestry as a land-use system, but also the social meanings and ethical orientations that sustain it.

The research design was also integrative, combining literature-based analysis, cross-

case comparison, and normative interpretation grounded in environmental ethics. Such an approach is appropriate given the study's theoretical position that environmental crises cannot be adequately understood as purely technical failures of resource management, but must also be interpreted as consequences of moral systems that reduce nature to an instrument of human interest. In this sense, the study sought to explain how particular agroforestry practices can be understood as institutionalised expressions of environmental ethics and how such expressions contribute to the conservation of soil, water, vegetation cover, and watershed functions. Thus, the methodological strategy was directed not only toward describing land-use practices but also toward explaining the conditions under which agroforestry becomes a durable and adaptive pathway for sustainable rural landscapes (Gifawesen et al., 2020; Legesse et al., 2019; Paudel et al., 2022).

### **2.2 Scope of the Study and Case Framework**

The study focused on Indonesian agroforestry systems that demonstrate a strong relationship among local ethical orientations, customary governance, and environmental conservation. The principal unit of analysis was not the individual actor alone, but rather the community-based agroforestry system embedded in a specific socio-ecological context. This scope was chosen because agroforestry in Indonesia appears in multiple forms throughout regions, yet many of these systems share a common logic: integrating productive functions, ecological stewardship, and locally grounded norms. Consequently, the study adopted a multi-case conceptual framework in which regional agroforestry practices were treated as analytically comparable instances of community-based environmental governance.

As a comparative framework, the study used ten representative cases of agroforestry from different parts of Indonesia: tembawang in West Kalimantan, parak in West Sumatra,

talun in West Java, multistrata homegardens in Central Java, subak-agroforestry in Bali, coffee agroforestry in West Lampung, multistrata cacao systems in South Sulawesi, mamar in East Nusa Tenggara, sago groves in Papua, and ilengi in Gorontalo. These cases were selected purposively based on three criteria. First, each case had to represent an agroforestry system

documented in the scientific or technical literature. Second, each system had to display a clear relationship with local wisdom, customary rules, or inherited ecological knowledge. Third, each case had to demonstrate relevance to environmental conservation, particularly in soil protection, erosion control, water regulation, watershed stability, or landscape buffering.

**Table 1. Representative agroforestry systems and their relationship to environmental conservation in Indonesia**

Region	Agroforestry Type	Agroforestry Form	Local Wisdom	Relationship to Environmental Conservation
West Kalimantan (Dayak)	Tembawang	Multistrata forest garden resembling natural forest	Dayak customary law, restrictions on cutting certain trees, mutual cooperation	Maintains upper watershed land cover, reduces erosion and runoff, and stabilizes river discharge
West Sumatra (Minangkabau)	Parak	Mixed garden of fruit trees, timber, and food crops	Minangkabau adat and communal land management	Maintains soil and water stability in upland and hilly watersheds
West Java (Sundanese)	Talun	Rotational system of gardens, mixed gardens, and community forest	Sundanese local knowledge and inherited land management	Reduces erosion, improves infiltration, and supports rural watershed functions
Central Java	Pekarangan	Multispecies homegarden agroforestry	Homegarden tradition and household food diversification	Reduces surface runoff and increases infiltration in micro-watersheds
Bali	Subak-agroforestry	Integration of rice fields, trees, and livestock	Subak system and the philosophy of Tri Hita Karana	Regulates irrigation water distribution and maintains upstream-downstream balance
West Lampung	Coffee agroforestry	Multistrata coffee with shade trees	Coffee ethno-agronomy and farmers' local knowledge	Reduces slope erosion and river sedimentation within watersheds
South Sulawesi	Multistrata cacao	Cacao gardens with shade trees	Bugis-Makassar local wisdom	Maintains soil fertility and hydrological stability
East Nusa Tenggara	Mamar	Spring-based agroforestry	Customary rules and water-source protection	Conserves springs and stabilizes streamflow in dry watersheds
Papua	Sago grove	Natural sago agroforestry in wetlands	Sago customary knowledge and communal management	Maintains wetland hydrology and lowland river systems
Gorontalo	Ilengi	Multistrata mixed garden resembling natural forest	Gorontalo local wisdom, customary law, and mutual cooperation	Functions as an upstream buffer and protects soil and water quality

### 2.3 Data Sources and Data Collection Procedures

The study relied primarily on secondary data from the scientific literature, conceptual research notes, and documentary sources on

agroforestry systems in Indonesia, environmental ethics, local wisdom, and customary institutions. Literature was used not only as a theoretical background, but as the principal empirical basis for a cross-case analytical synthesis. These sources included journal articles, books, technical reports, and prior studies that explicitly documented agroforestry forms, ecological functions, local institutions, and normative orientations in resource management. This approach was considered methodologically appropriate because many traditional Indonesian agroforestry systems have already been described in sufficient detail to support robust comparison.

Data collection was conducted through a systematic, directed literature review. The review process focused on three interconnected domains: the ecological and socio-economic performance of agroforestry, the role of local wisdom and customary institutions in natural resource governance, and the normative relevance of environmental ethics with regard to sustainable development. The procedure involved spotting relevant references, close reading, extracting key analytical information, and organising findings into comparable thematic units. The information extracted from each source included the form of agroforestry, the types of locally embedded rules, the roles of customary institutions, the contribution of the system toward environmental conservation, and the value orientations implied in the management of land and forest resources. This procedure enabled the study to develop a coherent analytical account of how the ethical, institutional, and ecological dimensions intersect within community-based agroforestry systems.

#### **2.4 Conceptual Framework and Analytical Categories**

The study's conceptual framework was structured around the relationships among four main dimensions: environmental ethics, local wisdom, customary institutions, and agroforestry implementation. Environmental ethics was defined as the normative

orientation that determines how communities perceive and justify their relationships with nature, including orientations associated with anthropocentric, biocentric, or ecocentric perspectives. Local wisdom was understood as the body of inherited knowledge, practices, and values through which communities adaptively manage natural resources in accordance with ecological conditions. Customary institutions were defined as the official and informal rules that regulate access, use, benefit-sharing, obligations, and conflict resolution related to land and forest resources. Agroforestry implementation referred to the actual integration of trees, crops, and productive-conservation functions within a land-use system.

Within the model, the study did not operationalise variables statistically but employed interpretive analytical categories to examine cross-case patterns. These categories included resource-use restrictions, multistrata vegetation arrangements, mutual cooperation practices, protection of springs or upper watershed areas, control of soil erosion and runoff, maintenance of infiltration, and stabilisation of hydrological functions. These categories were chosen because they enabled the capture of the substantive dimensions of sustainability, namely situations in which land-use systems generate economic and social benefits while simultaneously preserving environmental health.

#### **2.5 Data Analysis**

Data were analysed using qualitative content analysis and cross-case comparison. In the first stage, the selected literature was read intensively to detect recurring themes related to agroforestry structure, environmental ethics, local knowledge, institutional governance, and environmental conservation outcomes. This stage sought to detect narrative and conceptual patterns showing that communities with stronger moral and institutional commitments to nature tend to develop increasingly sustainable forest and land management practices. In the second stage, these outcomes were compared across

cases to identify both commonalities and differences in how agroforestry systems were structured and justified. This comparative logic made it possible to explain why agroforestry succeeds in some contexts not simply because of its technical design, but because it is supported by coherent local norms and socially legitimate resource governance.

## **RESULT**

The results show that environmental ethics in community-based forest and land use is not simply an abstract moral principle, but an observable pattern embedded in local norms, inherited ecological knowledge, and socially regulated resource use. Across the literature examined, communities that maintain strong ethical orientations toward land, forests, and water resources tend to develop management systems that privilege continuity over short-term extraction. In practical terms, such orientations are manifested in restrictions on cutting certain trees, protecting upper watershed areas and springs, maintaining multistrata vegetation, and collective labour arrangements that sustain long-term land stewardship. These patterns imply that the relationship between communities and their environment is formed not solely by economic rationality, but also using shared understandings of moral obligation, ecological limits, and intergenerational responsibility.

This finding supports the study's central proposition that communities that use forests and land ethically are more likely to maintain environmental health. Environmental ethics appears to function as a normative filter that influences decisions about which species are retained, how land is used over time, and which forms of exploitation are considered legitimate or illegitimate. This result is important because it shifts the analytical focus from agroforestry as a technical land-use arrangement to agroforestry as a socially and morally conditioned practice. It also confirms that the sustainability of land management cannot be adequately explained by production logic alone.

A second major finding is that agroforestry in Indonesia can be interpreted as a practical expression of environmental ethics rather than merely a diversified agricultural strategy. The literature consistently shows that agroforestry has long been recognised as one of the most promising approaches to ecologically sustainable land management in tropical regions, as it combines trees, crops, and sometimes livestock to generate mutually reinforcing ecological and economic benefits (Rafdinal et al., 2021; Sultana & Bari, 2021). However, the present findings show that these benefits are not only products of ecological design. They are also linked to moral orientations that encourage communities to preserve vegetation cover, value ecological heterogeneity, and regulate land-use behaviour past immediate profit optimisation.

This interpretation is reinforced by the finding that agroforestry performs more effectively than monoculture systems in contexts of climate uncertainty, market instability, and land degradation because it distributes risk across multiple species and production functions (Paudel et al., 2022). Yet the findings go beyond the standard claim regarding resilience by showing that resilience itself is mediated by cultural values and local institutions. Agroforestry becomes durable not simply because it is biologically diverse, but because such diversity is socially supported, morally justified, and practically reproduced over time.

The cross-case comparison further reveals that agroforestry systems in Indonesia vary considerably in form, species composition, and historical development, yet display a common structure in which local wisdom shapes the relationship between production and conservation. Cases such as tembawang, parak, talun, pekarangan, subak-agroforestry, coffee agroforestry, multistrata cacao, mamar, sago groves, and ilengi all demonstrate that local knowledge is not peripheral to agroforestry yet foundational to its operation. In each case, inherited ecological knowledge informs species selection, spatial arrangement, water

management, regeneration practices, and the temporal sequencing of land use. This means that agroforestry's ecological effectiveness is inseparable from the knowledge systems through which communities interpret and manage local environments.

A further major finding concerns the multidimensional outcomes associated with agroforestry. Economically, agroforestry is associated with higher, more stable household income than monoculture systems due to commodity diversification and production stability. In terms of food security, agroforestry enhances year-round local food availability, improves household access to food through self-provisioning, and increases long-term food stability by decreasing the risk of crop failure amid variable climatic conditions (Duffy et al., 2022; Sudomo et al., 2023). This result is consistent with previous findings showing that diversified agroforestry systems support household nutrition, dietary variety, and resilience, rather than food insecurity.

The environmental outcomes are equally significant. The reviewed studies consistently associate agroforestry with lower erosion rates, improved soil quality, higher water retention, more stable streamflow, greater biodiversity, and increased carbon sequestration (Pan et al., 2024). Tree roots strengthen soil structure and reduce surface runoff, while increased vegetation cover improves infiltration and supports year-round water availability. Greater species diversity in agroforestry also enhances habitat quality relative to monoculture systems and supports ecosystem stability. These findings show that the environmental effectiveness of agroforestry is not limited to a single ecological function, but operates across interacting dimensions of watershed conservation, biodiversity support, and long-term landscape resilience.

Customary institutions also play a decisive role in transforming ethical orientations and local knowledge into durable collective practices. Across the reviewed literature, customary institutions regulate access to

land, determine acceptable patterns of resource use, define obligations associated with shared landscapes, and provide mechanisms for conflict resolution and social enforcement. This supports the view that sustainable agroforestry is not maintained by individual intention alone, but by collective arrangements that make conservation-oriented behaviour socially expected and morally legitimate (Okubo et al., 2010).

Taken together, the findings reveal a consistent pattern across the literature: communities with stronger environmental ethics, deeper local wisdom, and more robust customary institutions are more likely to sustain agroforestry systems that preserve forest and land functions while supporting household well-being. This pattern directly supports the study's central hypothesis and reinforces the claim that the effectiveness of agroforestry is shaped not only by technical design but by socio-ethical foundations.

## **DISCUSSION**

These results demonstrate that environmental ethics is not merely a normative background to agroforestry practice, but a central explanatory factor in understanding why certain communities are more successful than others in sustaining forests, land resources, and associated ecological functions. The synthesis of anthropocentric, biocentric, and ecocentric perspectives is particularly useful here because it helps explain why some land-use systems remain exploitative while others become conservation-oriented. The findings suggest that agroforestry systems embedded in stronger ethical commitments tend to operate closer to biocentric and ecocentric sensibilities, in which ecological continuity, intergenerational responsibility, and the intrinsic value of nature are implicitly or explicitly recognised.

The discussion also shows that agroforestry in Indonesia should be interpreted as a socio-ethical system of resource use rather than only a multifunctional technical arrangement. Previous studies have documented the ecological and economic

advantages of agroforestry, including livelihood diversification, improved land productivity, soil and water conservation, and greater resilience to climatic and market variability (Paudel et al., 2022; Rafdinal et al., 2021; Sultana & Bari, 2021). However, the present study extends these insights by demonstrating that such advantages are realised more effectively where agroforestry is embedded in cultural norms, ethical commitments, and socially legitimate modes of regulation. Recent synthesis also shows that agroforestry contributes to smallholder food security in Indonesia through diversified production, improved access, and greater stability, although impacts remain context-specific across systems and regions (Duffy et al., 2022).

One of the most important theoretical implications of the study is the clarification of how local wisdom and customary institutions mediate between environmental ethics and sustainable land-use outcomes. Local wisdom provides substantive ecological knowledge and practical guidance, while customary institutions translate that knowledge and ethical orientation into enforceable rules and collectively recognised obligations (Okubo et al., 2010; Rufaidah et al., 2024; Utami & Oue, 2021). This explains why agroforestry systems can persist across generations, even under changing economic conditions, and why they are often more effective when grounded in customary legitimacy than when introduced solely as externally designed development interventions.

The multidimensional outcomes of agroforestry also deserve emphasis. Agroforestry improves household income, stabilises livelihood sources, strengthens food security, and enhances ecological functions such as soil conservation, water retention, biodiversity support, and climate mitigation. These outcomes are highly significant because they confirm that agroforestry is not a narrowly ecological intervention, but a system whose benefits are distributed across livelihood and landscape dimensions. From a watershed perspective,

this is especially important because increased income stability and food security reduce pressures for further land expansion, while multistrata vegetation and improved soil structure reduce runoff, erosion, sedimentation, and seasonal water scarcity. Bibliometric evidence on agroforestry resilience research further indicates a growing emphasis on adaptation, family farming, and multifunctional landscapes, reinforcing the broader socio-ecological relevance of agroforestry under current climate and livelihood pressures (Gallo et al., 2024).

The broader theoretical contribution of the study lies in expanding agroforestry scholarship beyond a technical-ecological framework toward a socio-ethical framework. By placing environmental ethics at the centre of the analysis, the study offers a more comprehensive framework for understanding the long-term sustainability of agroforestry and community-based resource governance. The findings support the thesis that sustainable development requires a shift from exploitative relations toward co-evolutionary relations between humans and nature. Such a shift cannot be achieved solely through technological innovation or policy transfer; it requires moral orientations, local knowledge systems, and socially legitimate institutions that define how nature should be used, protected, and shared.

## **CONCLUSION**

This study demonstrates that the sustainability of agroforestry in Indonesia cannot be explained solely by its technical-ecological advantages, but must also be understood through the ethical, cultural, and institutional foundations that shape community relations with land, forest, and water resources. The findings show that communities whose resource use is guided by stronger environmental ethics are more likely to maintain vegetation cover, protect soil and water functions, and sustain agroforestry systems that support both ecological integrity and household well-being. In this context, local wisdom and

customary institutions function not as secondary cultural variables but as key mechanisms through which environmental ethics is translated into socially recognised rules, collective obligations, and durable land-use practices.

The study also confirms that agroforestry generates multidimensional benefits across income stability, food security, soil and water conservation, biodiversity support, and climate resilience. However, these outcomes are most durable where agroforestry is embedded in community-based moral and institutional frameworks. The main implication is that sustainable forest and land management requires more than technological promotion; it requires governance approaches that recognise the importance of ethical orientation, customary legitimacy, and locally grounded ecological knowledge. In theoretical terms, the study contributes to the existing body of knowledge by extending agroforestry analysis from a technical-ecological to a socio-ethical perspective, thereby positioning environmental ethics as a central analytical element in sustainable development research. Future studies should test these relationships through field-based and mixed-method approaches that examine how environmental ethics, institutional change, and ecological performance interact under conditions of commercialisation, climate change, and rural transformation.

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