



# Bridging local perceptions and co-creation for sustainable payment environmental services design: A framework for innovative forest financing

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## ABSTRACT

**Background:** Payment for Environmental Services (PES) has emerged as a crucial conservation instrument supporting climate change mitigation efforts in tropical regions. Although PES initiatives have been implemented in several parts of Indonesia, their distribution remains uneven, particularly in Eastern Indonesia such as Buton Island. Given the island's distinctive topography, rich biodiversity, and the presence of the North Buton Wildlife Reserve, the region holds significant potential for developing PES schemes that address ongoing threats such as illegal logging and habitat degradation. **Method:** This study explores local community perspectives in North Buton regarding future PES development, focusing on three interconnected dimensions: ecological, socio-economic, and cultural. Using a co-creation and knowledge-sharing framework to promote participatory policy design, data were collected over two months in three sub-districts North Kulisusu, West Kulisusu, and North Wakorumba through surveys with 227 respondents and complementary stakeholder interviews. **Finding:** Findings revealed that communities prioritised the preservation of spring ecosystems and the planting of multipurpose trees as future PES activities, while agricultural assistance was identified as the most preferred form of incentive. Although the local Kaago-ago ritual represents an important element of cultural identity, it does not directly align with PES objectives. **Conclusion:** These findings provide valuable input for formulating inclusive, bottom-up policies that integrate ecological resilience, socio-economic improvement, and cultural sensitivity in future PES initiatives across the North Buton Wildlife Reserve. **Novelty/Originality of this article:** This study presents a pioneering effort to design a bottom-up PES model specifically for Eastern Indonesia's unique biodiversity hotspots, a region often overlooked in environmental policy research.

**KEYWORDS:** local community perception; co-creation; climate change mitigation; North Buton Wildlife reserve; payment for environmental services (PES)

## 1. Introduction

Tropical forests with high biodiversity and substantial ecological and economic functions are among the world's most critical natural assets in supporting climate change mitigation (Bonan, 2008). Maintaining the resilience of these forests has become a global priority, particularly among international policymakers and scientific communities, to stabilise the planet's rising temperatures (Brockhaus & Angelsen, 2025). Through global cooperation under the United Nations Framework Convention on Climate Change (UNFCCC), countries have pledged collective action to mitigate global warming. The Paris

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Agreement of 2015 marked a significant milestone in this effort, uniting 194 countries and the European Union in a shared commitment to limit the increase in global temperature to well below 2.0°C, and ideally to 1.5°C, compared to pre-industrial levels (Hansen et al., 2006; Houghton et al., 2012). This agreement encompasses various sectors, including industry, transportation, energy, waste management, forestry, and land use.

In addition to emission reduction commitments, developed countries pledged financial assistance to support developing nations in implementing conservation initiatives that contribute to climate change mitigation (United Nations, 2015). Among these developing countries, Indonesia holds a vital position due to its vast tropical forest cover that stretches from the western to eastern regions of the archipelago. These forests are not only ecologically significant but also serve as the foundation for local livelihoods and cultural identities. One region of particular interest is Buton Island, located in Southeast Sulawesi. The island's ecological uniqueness stems from its position along the Wallacea Line, a biogeographical transition zone that separates the Asian and Australian faunal regions (Ali et al., 2021). This location grants Buton Island an exceptionally high level of biodiversity, characterised by the coexistence of species from both continents.

According to field research by Operation Wallacea (2002), Buton Island is home to at least 223 tropical tree species, as well as two notable endemic animals, the Maleo (*Macrocephalon maleo*) and the Anoa (*Bubalus depressicornis*). These species are recognised as protected fauna under Indonesian conservation law due to their restricted habitats within the North Buton Wildlife Reserve, a protected forest area that serves as one of the island's primary ecological sanctuaries. The reserve's forest ecosystem plays an essential role in regulating water cycles, supporting soil fertility, and sustaining the livelihoods of surrounding communities. Despite its ecological significance, the area faces ongoing environmental pressures driven primarily by human activities.

Unfortunately, land degradation continues to occur around the conservation forest area, largely due to unsustainable land use practices by local residents. According to Betahita (2024), illegal logging and forest encroachment have been reported in parts of North Buton, where community members cut and sell large trees to meet short-term economic needs. Such practices, though economically motivated, contribute to long-term ecological damage, threatening forest cover, biodiversity, and the survival of endemic species. If left unchecked, these activities could accelerate habitat loss, disrupt ecological balance, and diminish the natural resilience of the forest ecosystem.

In addressing these challenges, conservation strategies must go beyond law enforcement and adopt approaches that integrate community welfare and participation. Strengthening environmental awareness and engaging local communities in conservation-related activities are key to ensuring long-term ecological protection. One promising mechanism to achieve this balance is the Payment for Environmental Services (PES) scheme. According to Alix-Garcia et al. (2008), PES provides financial or non-financial incentives to individuals or groups who contribute to the protection and management of ecosystem services. By offering additional income opportunities, PES schemes aim to reduce deforestation rates and encourage communities to become active stewards of their natural environment. This approach shifts conservation from being an externally imposed policy to a mutually beneficial partnership between environmental and economic interests.

In the context of North Buton, PES has the potential to become a transformative conservation instrument, aligning ecological preservation with the socioeconomic needs of local residents. The communities surrounding the North Buton Wildlife Reserve rely heavily on natural resources for their livelihoods, including small-scale farming, non-timber forest product collection, and fishing. However, limited access to education, infrastructure, and economic alternatives has often driven them toward extractive practices. Therefore, introducing PES could offer a sustainable alternative that values ecosystem services such as carbon sequestration, watershed protection, and biodiversity conservation while providing direct economic benefits to local participants. Through this mechanism, conservation efforts could shift from being perceived as restrictive to being recognised as productive and inclusive.

Yet, the success of PES implementation depends not only on economic incentives but also on social acceptance and participation. Local perceptions, cultural values, and community trust play pivotal roles in shaping conservation behaviour. In many cases, the failure of PES schemes in developing countries stems from insufficient engagement with local stakeholders and a lack of understanding of their priorities. Hence, a co-creation approach becomes essential in designing PES programs that reflect local realities. Co-creation involves collaborative processes where communities, researchers, and policymakers jointly identify problems, design interventions, and evaluate outcomes. In this way, PES becomes not merely a payment mechanism but a participatory tool for empowering communities to manage their ecosystems sustainably.

The North Buton Wildlife Reserve provides an ideal setting for exploring how local perceptions and co-creation processes can inform the design of a sustainable PES framework. Integrating traditional ecological knowledge, cultural values, and local aspirations into PES planning can enhance its effectiveness and long-term legitimacy. This approach ensures that conservation initiatives do not alienate local populations but instead cultivate shared ownership and responsibility. By bridging ecological priorities with community participation, North Buton can serve as a model for other regions seeking to harmonise conservation and development goals.

Ultimately, this study underscores the importance of aligning environmental conservation with human dimensions through participatory frameworks such as co-creation. Sustainable forest management cannot be achieved through external interventions alone but requires the active engagement and empowerment of local communities. The proposed PES model for North Buton represents not only a mechanism for environmental protection but also a pathway toward social resilience, economic opportunity, and cultural continuity. By grounding conservation in collaboration and shared values, North Buton's experience may contribute valuable lessons for Indonesia's broader efforts in achieving sustainability and climate resilience.

### *1.1 Payment for environmental services (PES)*

Payment for Environmental Services (PES) has emerged as a prominent market-based conservation mechanism that establishes a direct link between ecosystem protection and economic incentives. The basic concept of PES lies in the transfer of resources from environmental service users to environmental service providers, typically in the form of financial or non-financial compensation (Fletcher & Böscher, 2017; Wunder, 2005). According to Engel et al. (2008) and Wunder et al. (2008), the providers of environmental services generally consist of local communities living in or near the target ecosystem areas, while the users are often private institutions, such as companies or industries, and sometimes government agencies that rely on the ecological benefits of those ecosystems. Fletcher and Böscher (2017) further highlight the role of intermediaries often represented by non-governmental organisations (NGOs), that facilitate coordination, negotiation, and monitoring between both parties to ensure transparency and compliance with PES agreements.

The primary aim of PES, as described by Wunder (2005), is to sustain and enhance the ecological integrity of ecosystems, contributing to long-term climate change mitigation. PES programs commonly focus on four main environmental service components: water resource protection, biodiversity conservation, carbon sequestration, and the maintenance of scenic landscapes (OECD, 2010). These services form the foundation upon which PES mechanisms operate, offering measurable environmental outcomes tied to specific conservation actions (Figure 1).

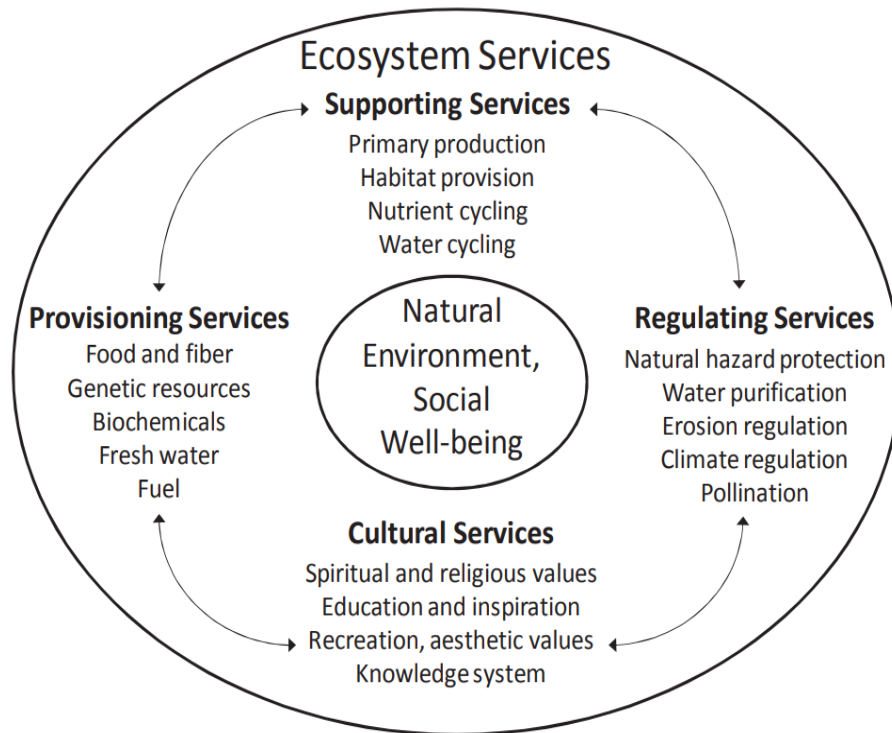


Fig. 1. Four components of environmental services (OECD, 2010)

Furthermore, Muradian et al. (2010), Pascual et al. (2014), and Wunder (2005) identify four core principles essential for the effective implementation of PES: conditionality, distributional justice, equality of access, and monitoring and verification: conditionality refers to agreed-upon conservation commitments, where benefits are received only if certain environmental performance criteria are met; distributional justice ensures that the benefits of PES are shared equitably among stakeholders; equality of access prevents discrimination or exclusion of marginalised groups; monitoring and verification involve evaluation processes to assess the effectiveness of PES interventions. These principles collectively support the credibility and sustainability of PES schemes, ensuring they function not only as economic instruments but also as tools of social inclusion and accountability. In addition, PES has been widely adopted in developing countries, particularly those with extensive forest areas in Asia and South America (Wunder, 2007). The first formal implementation of PES was in Costa Rica in 1997, where the program successfully reduced deforestation by incentivising landowners to reforest degraded areas (Pagiola, 2008). Following Costa Rica's success, numerous countries in Asia have introduced PES frameworks to integrate economic and conservation goals (Engel et al., 2008; Pagiola, 2011). However, Muradian et al. (2010) note that PES effectiveness depends on contextual factors, including ecological characteristics, local governance capacity, and socio-cultural dynamics, which vary significantly across regions. Thus, while PES provides a general model for conservation financing, its design must be adapted to local realities.

### 1.2 The role of local communities and traditional ecological knowledge (TEK)

Local communities play a central role in the implementation of PES schemes, acting as primary providers of environmental services and custodians of ecological functions (Wunder et al., 2008). The success or failure of PES initiatives largely depends on the extent of community participation and the alignment of the program with local livelihoods (Merrick, 2021). Without active involvement and perceived benefits, PES schemes risk poor compliance and long-term failure.

Community perceptions of their surrounding environment are shaped by complex interactions of geographical, socioeconomic, and cultural factors (Kosoy et al., 2007). Rural communities that depend heavily on natural resources often develop context-specific ecological knowledge and land management strategies that ensure their survival. These systems of knowledge and practice referred to as Traditional Ecological Knowledge (TEK) represent centuries of adaptive learning about the local environment (Leaf, 2022). TEK encompasses both spiritual beliefs and practical applications in land use, agriculture, and resource management.

In Indonesia, many Indigenous communities hold sacred beliefs that reinforce conservation ethics. For instance, certain Papuan tribes regard forests as ancestral domains inhabited by spiritual beings, thus restricting access and exploitation (Sopaheluwakan et al., 2023). These customary forests (*hutan adat*) have gradually gained state recognition, reflecting the alignment between cultural preservation and legal conservation frameworks (Lele, 2023). Beyond spiritual beliefs, TEK is often embedded in daily practices. Local farmers, for example, rely on traditional weather forecasting and seasonal cycles to plan planting and harvest times (Leal et al., 2021). However, much of this knowledge remains undocumented, being passed orally across generations (Eisenberg, 2019).

Corbera et al. (2007) and van Hecken & Bastiaensen (2010) argue that TEK serves as valuable social capital that enhances the legitimacy and sustainability of conservation programs such as PES. When local cultural identity and collective action are integrated into conservation frameworks, they foster a stronger sense of ownership and long-term stewardship. Consequently, communities not only engage in conservation but also help preserve cultural heritage, strengthening the socio-ecological fabric of their regions.

### *1.3 PES case studies and lessons from Buton island*

The flexibility of PES schemes allows them to be tailored to the ecological and cultural characteristics of specific regions. In tropical countries, PES programs often prioritise carbon trading, watershed management, or biodiversity protection, depending on local environmental conditions (Wunder 2005). In Indonesia, multiple PES initiatives have been implemented across the archipelago. For instance, on Kalimantan Island, PES focuses on forest environmental services, particularly through carbon sequestration and non-timber forest product (NTFP) projects. Meanwhile, in Aceh, Sumatra, PES schemes emphasise watershed protection, where companies compensate local communities for maintaining clean water sources and preventing upstream pollution (Suich et al., 2017).

Buton Island, with its abundant biodiversity and rich cultural heritage, presents a strong potential for PES application. The island lies within the Wallacea and Weber transition zones, making it home to unique endemic species such as the Anoa and Maleo bird, which are not found elsewhere (Ali & Heaney, 2021; Donnelly et al., 2021). Its varied ecosystems include tropical rainforests, mangroves, swamps, rivers, lakes, and coral reefs (Operation Wallacea, 2002). These diverse habitats have made the island a focal point for ecological research since 1995, particularly through long-term studies conducted by Operation Wallacea.

Beyond its ecological value, Buton Island is deeply rooted in historical and cultural traditions as part of the former Buton Sultanate, one of Indonesia's oldest Islamic kingdoms. Local wisdom remains evident in the community's relationship with nature for example, in the spiritual designation of sacred trees and forest patches (Song, 2018; Tenri et al., 2019). However, as North Buton communities undergo socioeconomic transition, traditional practices are increasingly eroded by modernisation and market pressures. This shift risks the loss of valuable cultural and environmental knowledge that once guided resource management. Therefore, integrating cultural and ecological conservation through PES is crucial for ensuring both environmental sustainability and cultural continuity.

#### 1.4 Socioeconomic challenges and resource conflicts

Economic necessity remains the primary driver of unsustainable resource exploitation across Indonesia's forested regions (Söllner, 2014). In Buton Island, illegal logging within protected areas, particularly the North Buton Wildlife Reserve, has contributed significantly to deforestation and ecosystem degradation (Santos de Lima et al., 2018). Many of these activities stem from subsistence needs rather than deliberate environmental destruction. Communities facing limited livelihood alternatives often resort to land clearing and shifting cultivation to sustain their families (AntaraNews, 2018).

Despite government efforts to impose sanctions, illegal logging persists due to weak enforcement, limited institutional capacity, and ongoing economic dependence on extractive practices (Tagar.id, 2019). Addressing these issues requires acknowledging the socioeconomic roots of environmental degradation. Merrick (2021) emphasises that long-term behavioural change depends on providing viable alternatives that meet economic needs while preserving ecosystem integrity. Therefore, introducing PES to the North Buton context could serve as a practical pathway to align conservation incentives with community welfare, replacing illegal extraction with sustainable livelihood models.

#### 1.5 Problem statement

Buton Island, as one of Indonesia's biodiversity-rich regions, holds significant potential to contribute to climate change mitigation efforts through sustainable forest management. Its ecological and geographical position within the Wallacea transition zone makes it an ideal location for implementing a Payment for Environmental Services (PES) framework. However, the ongoing land degradation and illegal encroachment in the North Buton Wildlife Reserve have raised serious environmental concerns. These activities not only threaten endemic species such as *Bubalus depressicornis* (Anoa) and *Macrocephalon maleo* (Maleo bird), but also undermine ecosystem stability and the well-being of local communities whose livelihoods depend on forest resources.

While PES has been introduced globally as a strategic conservation tool, its effectiveness depends heavily on context-specific socio-economic, institutional, and political factors (Muradian et al., 2010). In the North Buton context, there is a notable lack of empirical data capturing local community perceptions, awareness, and willingness to participate in PES initiatives. Understanding these perceptions is critical to ensure that future conservation policies are inclusive, locally relevant, and culturally sensitive.

Moreover, before initiating conservation programs such as PES, it is essential to assess the level of potential engagement and empowerment among local communities, who will serve as primary actors in the implementation process. According to Merrick (2021), community involvement constitutes a core determinant of PES success, influencing both environmental and social outcomes. However, local communities, particularly those in remote or economically marginalised areas, often lack access to decision-making processes and are underrepresented in policy dialogues.

Therefore, this study seeks to evaluate the extent of local community understanding and perception of PES in North Buton, providing a foundation for a more inclusive and adaptive conservation framework. By integrating their perspectives, it is expected that PES implementation can align with local realities, promoting both forest protection and economic empowerment. Through the PES approach, communities may shift from extractive practices to conservation-oriented livelihoods, obtaining financial benefits while safeguarding their ecological and cultural heritage.

#### 1.6 Research objectives, questions, and hypotheses

As an alternative approach to address illegal logging and forest degradation in the North Buton Wildlife Reserve, the PES mechanism presents a promising model that bridges conservation and livelihood improvement. PES offers an opportunity for local communities

to obtain additional income through sustainable resource management activities within buffer zones adjacent to protected areas. However, designing such schemes requires an in-depth understanding of community perspectives, needs, and local wisdom.

This study aims to assess the perceptions and preferences of local communities in North Buton regarding the future development of the PES scheme, with emphasis on ecological, socio-economic, and cultural dimensions. Furthermore to achieve the objective, the study is guided by the following research questions: what types of environmental service activities do local communities in North Buton prioritise for future PES development? what forms of intensification or incentives do communities prefer within the PES framework? what elements of local wisdom can be integrated into PES design to enhance cultural relevance and sustainability?

Then, this study is based on the following hypotheses: Communities will prioritise conservation activities that are contextually aligned with their surrounding environmental conditions. Communities will prefer cash-based incentives, as these directly address daily economic needs. North Buton communities possess rich local wisdom and traditional ecological knowledge, which can be incorporated into PES planning to strengthen both environmental and cultural outcomes.

### 1.7 Conceptual framework

This study adopts the FAO (2018) framework of co-creation and knowledge-sharing, which emphasises participatory approaches in the design and implementation of sustainable environmental programs. Co-creation integrates the views and experiences of various stakeholders particularly local communities as central elements in developing practical, inclusive, and contextually grounded conservation strategies (FAO, 2018; Agol et al., 2014). As shown in Figure 2, the conceptual model highlights the reciprocal relationship between community knowledge, stakeholder collaboration, and PES implementation. Through co-creation, the process becomes bottom-up rather than top-down, ensuring that local communities not only act as service providers but also as active participants in decision-making, monitoring, and benefit distribution (Sangha et al., 2024). This framework promotes empowerment by strengthening community capacity and institutional trust, thus increasing the long-term sustainability of PES initiatives.

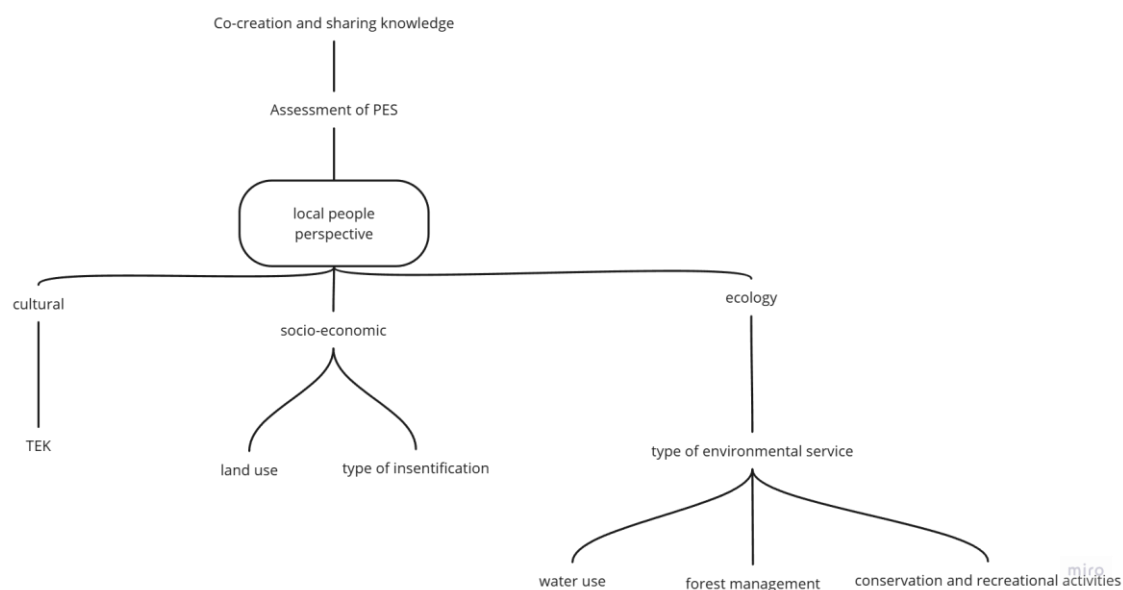


Fig. 2. Conceptual framework for assessing community perspectives on PES (Agol et al., 2014; FAO, 2018).

In this research, the assessment focuses on three key dimensions—ecological, socio-economic, and cultural, each of which represents a vital component in evaluating

community readiness and compatibility with PES principles. Ecological aspect, identifies types of activities most appropriate for sustainable environmental management, such as agroforestry, reforestation, and water conservation. Socio-Economic Aspect, examines the community's livelihood conditions, income sources, and economic dependency on natural resources. Cultural Aspect, explores traditional beliefs, local customs, and daily practices that influence the community's interaction with nature. These three dimensions serve as the foundation for developing questionnaire indicators and form the analytical structure for this study.

## 2. Methods

### 2.1 Study area selection and data collection

The research was conducted in the northern region of Buton Island, Southeast Sulawesi, specifically within North Buton Regency. The study focused on three sub-districts West Kulisusu, North Wakorumba, and North Kulisusu selected purposively for their proximity to the North Buton Wildlife Reserve (Figure 3). These areas function as buffer zones for the protected forest and are representative of communities with direct interaction with the conservation landscape.

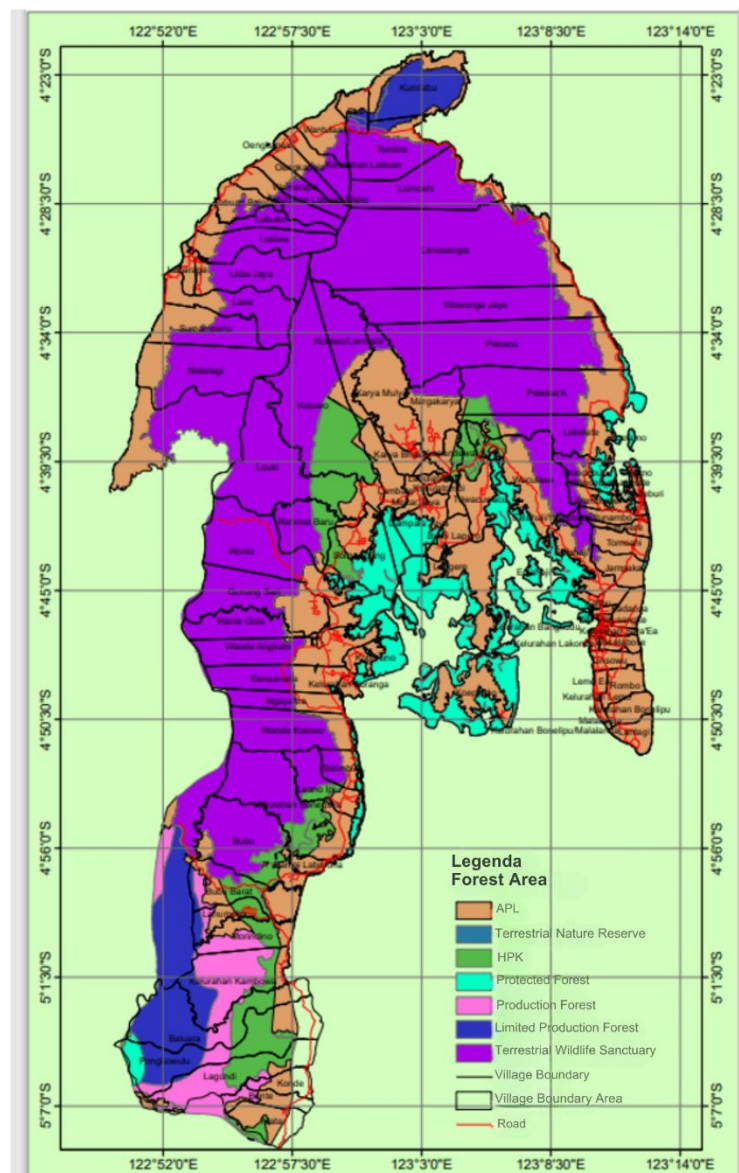


Fig. 3. Location of research area in North Buton Regency

This study utilised primary field data collected between May and July 2024. Data were gathered through community participation using structured questionnaires designed to capture perceptions, preferences, and cultural aspects related to PES development. Given the limited internet access in several remote areas of Buton, questionnaires were distributed manually in printed form and completed in Indonesian language. The instrument consisted of three main sections: respondent consent and demographic profile, ecological, socio-economic, and cultural perception questions, open-ended feedback on potential PES activities and incentives

A total of 227 respondents participated, comprising 70 from North Wakorumba, 89 from North Kulisusu, and 68 from West Kulisusu. Data from the completed questionnaires were entered manually into Microsoft Excel and analysed descriptively. Responses were visualised through pie charts and frequency distributions to illustrate category percentages. Complementing the survey, qualitative interviews were conducted using the Problem-Centred Interviewing (PCI) method (Witzel & Reiter, 2012). This approach allowed the researcher to explore participants' views in depth, particularly regarding land use conflicts, cultural rituals, and the potential of conservation-based economic activities such as ecotourism. The interviews included probing questions to elicit rich contextual insights and were audio-recorded, transcribed, and analysed qualitatively using Notta.ai to identify recurring themes such as spiritual values, forest meaning, and conservation boundaries. In addition, participatory observation was conducted to document the environmental landscape and community activities. The researcher visited sites such as springs, plantation forests, and conservation boundaries, combining field photographs and satellite imagery to support triangulation of the data obtained from questionnaires and interviews.

## *2.2 Researcher positionality and ethical considerations*

The researcher occupied a dual position: as an Indonesian citizen familiar with local socio-cultural contexts, and as an international student representing Wageningen University and Research. This dual role required navigating both national administrative procedures and academic ethical standards. Research permits were secured from the Southeast Sulawesi regional research authority, the North Buton Regent's Office, and the sub-district administrations in each study area.

Ethical considerations were strictly adhered to. Participants were informed about the confidentiality of their data and the academic purpose of the study. All data collection procedures respected local customs, traditions, and cultural sensitivities. The researcher maintained a neutral interpretive stance, ensuring that all voices particularly those from marginalised groups were represented without bias. The study acknowledges that each community possesses unique local wisdom and cultural characteristics, which are essential to understanding their perceptions of conservation and PES.

## **3. Results and Discussion**

### *3.1 Ecological aspects*

#### *3.1.1 Community priorities for PES activities*

This study assesses community perspectives in three sub-districts of North Buton, North Wakorumba, North Kulisusu, and West Kulisusu, to determine the extent of their understanding and preferences regarding the future development of Payment for Environmental Services (PES). The analysis focuses on three dimensions: ecological, socio-economic, and cultural. Survey results reveal that the local communities prioritise spring ecosystem conservation and multi-purpose tree planting as their top PES activities. Maintaining spring ecosystems was selected by 27% of respondents in North Wakorumba, 46% in North Kulisusu, and 33% in West Kulisusu.

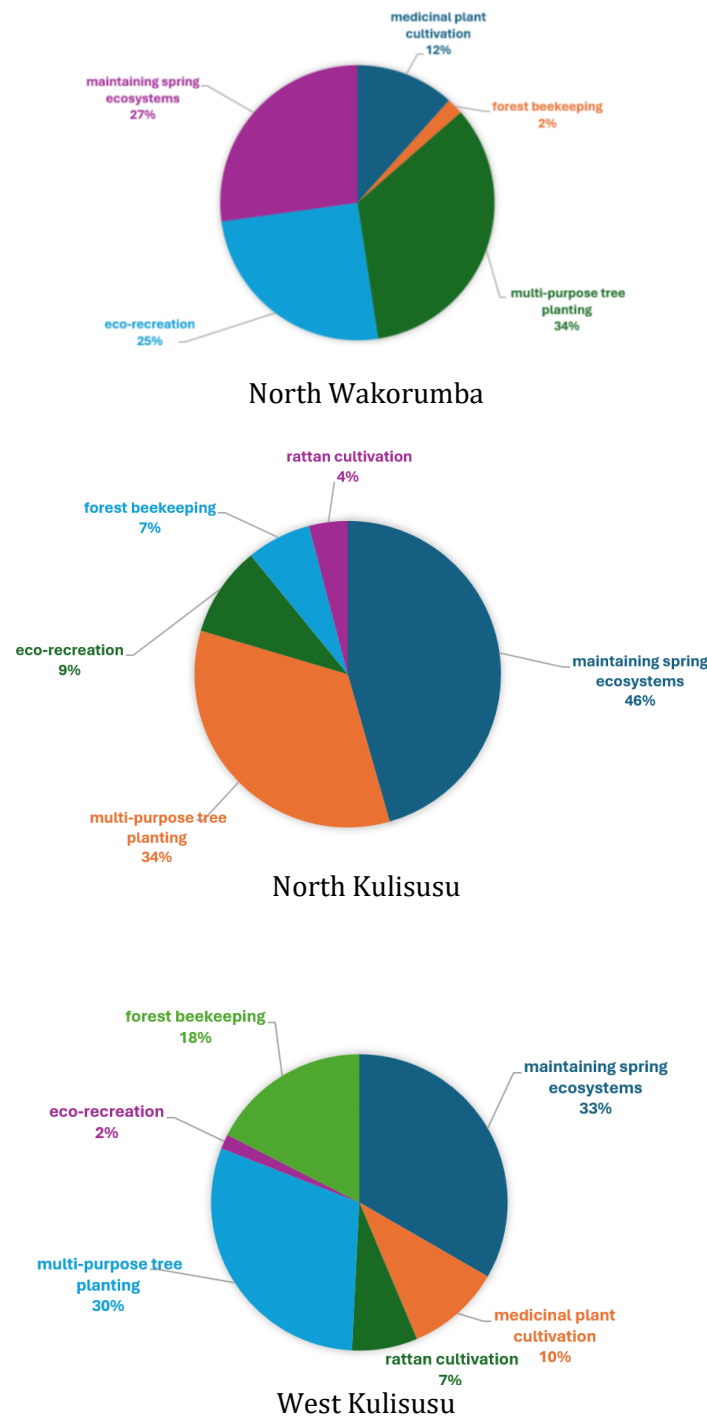


Fig. 4. Results of PES activity type selection in three sub-districts, North Buton.

Meanwhile, multi-purpose tree planting was consistently chosen by 34%, 34%, and 30% of respondents in the same respective sub-districts. Secondary preferences included eco-recreation (25% in North Wakorumba and 9% in North Kulisusu) and forest beekeeping (18% in West Kulisusu) (Figure 4.). The findings demonstrate a consistent ecological awareness across districts, reflecting that the communities’ activity preferences align closely with their surrounding environmental conditions.

### 3.1.2 Landscape context and ecological alignment

The topography of North Buton features numerous rivers and dense forests, making spring conservation a logical priority. Many rivers originate from the North Buton Wildlife Reserve, serving as vital freshwater sources for nearby villages, including Oengkapala,

where local communities rely on springs for daily water use and small-scale hydroelectricity. Satellite imagery also reveals extensive forest cover and riparian networks, suggesting strong ecological potential for water-based PES schemes. Communities' awareness of these natural systems underpins their preference for spring maintenance, reflecting a practical understanding of local hydrology and its economic and cultural value.

Simultaneously, multi-purpose tree planting was widely viewed as a sustainable land management strategy. Idle lands especially along highways and near settlements, are considered suitable for this activity. Residents suggested planting fruit-bearing trees that could provide both ecological benefits and supplemental income. This aligns with PES objectives of combining conservation and livelihood improvement. Furthermore, some respondents recognised opportunities for eco-recreation and nature-based tourism. Interviews in Lakansai Village revealed that before the 2020 pandemic, several international research groups visited to conduct forest expeditions. Such activities could evolve into eco-recreation initiatives under a PES framework, linking biodiversity conservation with local income generation.

### 3.2 Socio-economic aspects

#### 3.2.1 Land use and economic dependence

Most North Buton residents own small plantation lands adjacent to the conservation area. These lands are used primarily for subsistence farming planting seasonal crops and raising livestock. A majority of respondents indicated high dependency on their land, with 75% describing themselves as “dependent” or “very dependent” on surrounding natural resources (Figure 5).

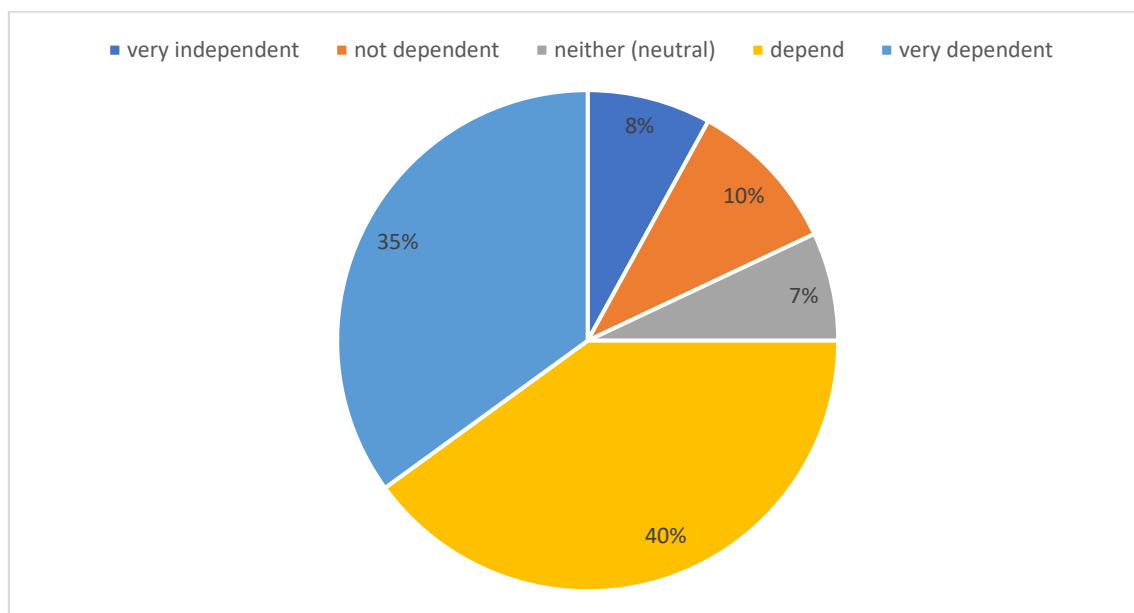


Fig. 5. Dependence on natural resources surrounding the North Buton Wildlife Reserve Forest to meet daily needs

However, productivity remains low (Figure 6). Approximately 35% earn between IDR 500,000–1,000,000 per month (€29–58), sufficient only for basic needs. Many lands remain idle after harvest, further limiting income potential. Respondents suggested integrating idle plots into agroforestry systems or fruit-tree planting, enabling continuous production and long-term income under PES support.

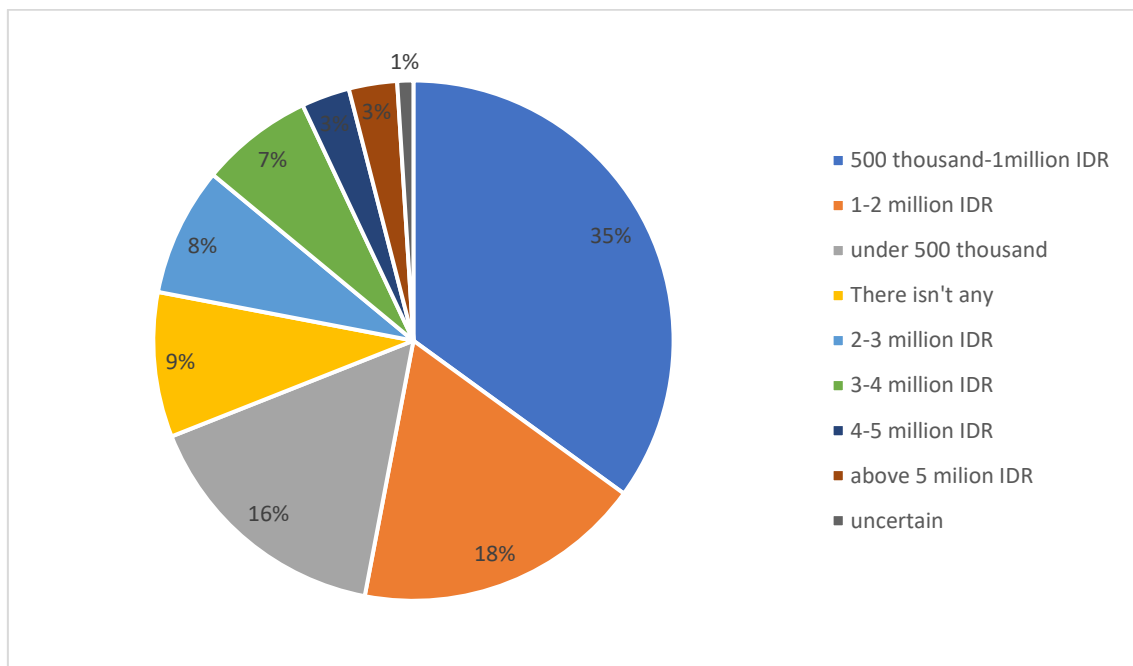


Fig. 6. The economic value of land cultivation (monthly)

### 3.2.2 Preferred types of PES incentives

Regarding preferred intensification or assistance, 49% of respondents prioritised agricultural equipment support, followed by cash incentives (25%), skills training (17%), and future savings for education or health (9%) (Figure 7.). This finding partly diverges from the initial hypothesis that cash assistance would dominate. Respondents expressed that material support such as tools would have greater long-term utility, helping them to enhance productivity while reducing operational costs.

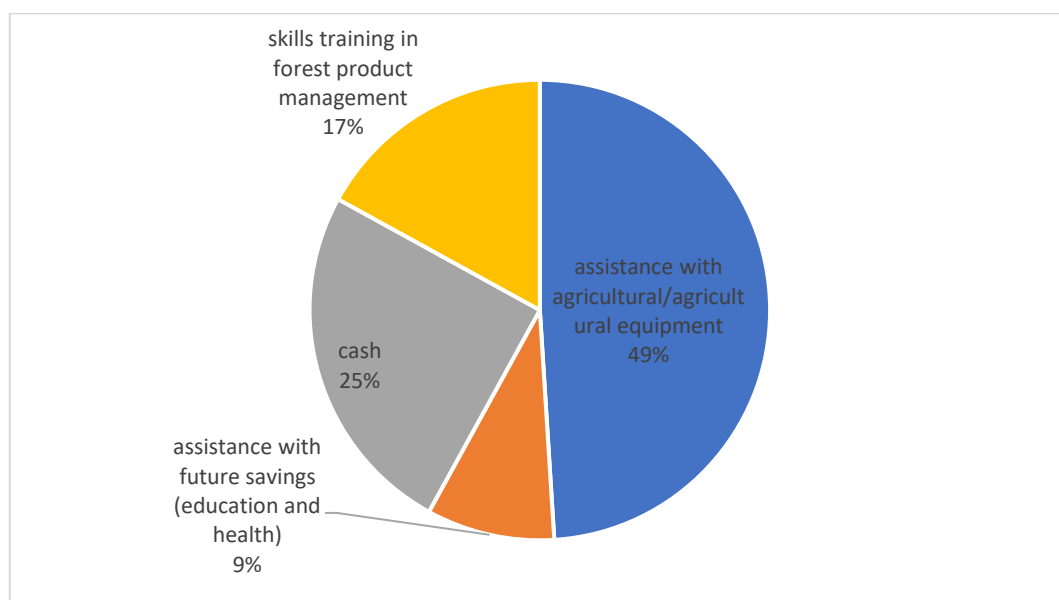


Fig. 7. Type of incentive/assistance needed

When asked about expected cash intensification amounts, most respondents indicated IDR 2–3 million/month (26%). Meanwhile 23% expected amounts above IDR 5 million/month, reflecting aspirations for economic improvement relative to current income levels. These results indicate that while cash incentives remain relevant, communities value productive and sustainable forms of assistance more highly (Figure 8.).

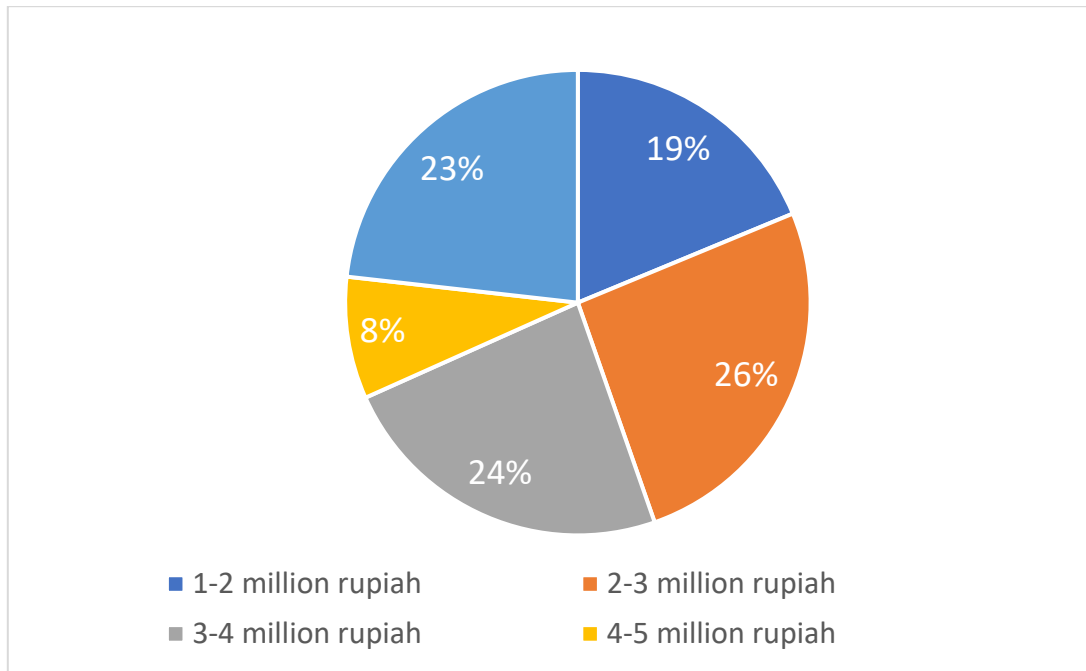


Fig. 8. Preference for the expected amount of intensification (money/monthly).

### 3.2.3 Conflict dynamics and conservation boundaries

Land use conflicts remain a significant challenge. Although boundary markers were installed by the Southeast Sulawesi Natural Resources Conservation Agency/*Balai Konservasi Sumber Daya Alam (BKSDA)*, 37% of respondents were unaware of these demarcations. Lack of boundary awareness has led to encroachment for timber extraction and coconut planting within protected zones (Figure 9.). An interview with the Head of Labelete Village revealed that disputes between villagers and Natural Resources Conservation Agency began in the early 2000s, when plantations expanded into conservation land.

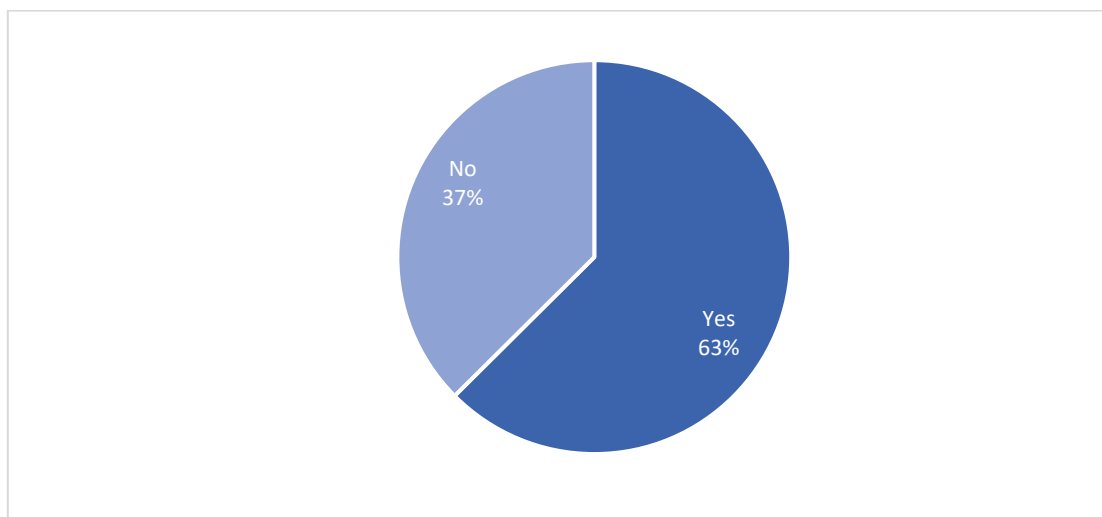


Fig. 9. Recognition and understanding of the boundaries between community land and conservation areas

Through mediation, a compromise was reached some coconut trees were removed, while others were retained under the condition that no further land clearing occur. These findings emphasise the importance of boundary awareness and participatory approaches in mitigating land conflicts through PES mechanisms. The active participation of community

members in defining these boundaries is not only a logistical necessity but also a critical step in fostering long-term trust and sustainable land management

### 3.3 Cultural aspects: Traditional ecological knowledge (TEK)

#### 3.3.1 Existence of local wisdom

Only 22% of respondents recognised any form of traditional ecological knowledge linked to conservation, specifically the Kaago-ago ritual, a ceremony of offering food and prayers to forest spirits before clearing new land (Figure 10). Although Kaago-ago represents a cultural practice rooted in respect for nature, it does not directly restrict deforestation. The ritual is performed primarily for spiritual protection, not ecological preservation.

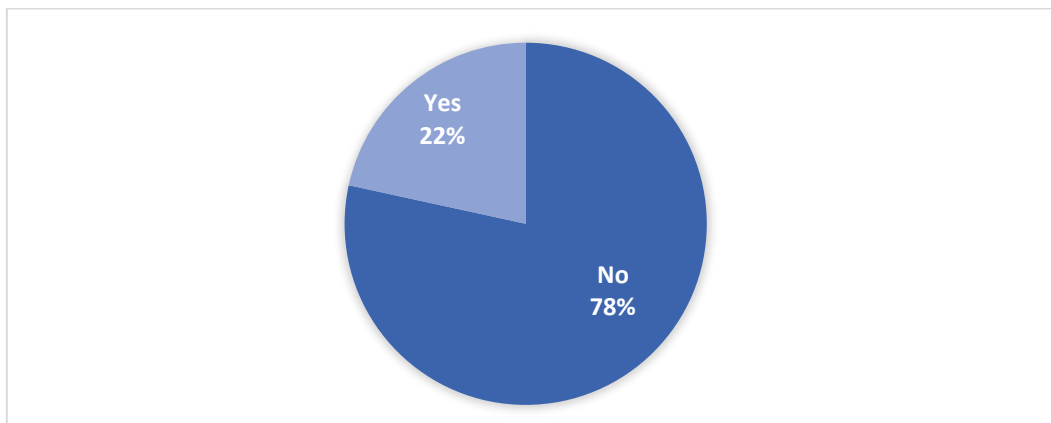


Fig. 10. The amount of knowledge about local wisdom regarding conservation initiatives.

Furthermore, based on Figure 10, it highlights a potential disconnect between deeply-rooted cultural practices and the modern scientific understanding of ecological sustainability, indicating that the 'value' placed on tradition may not directly translate into actions that prevent environmental degradation. Then, interviews with traditional leaders revealed that Kaago-ago remains sacred for older generations but is declining among youth, particularly after the adoption of organised religions that view such practices as incompatible with their faith. Despite this, 71% of respondents (27% “important,” 44% “very important”) acknowledged that preserving local wisdom remains valuable for community identity and environmental education (Figure 11.).

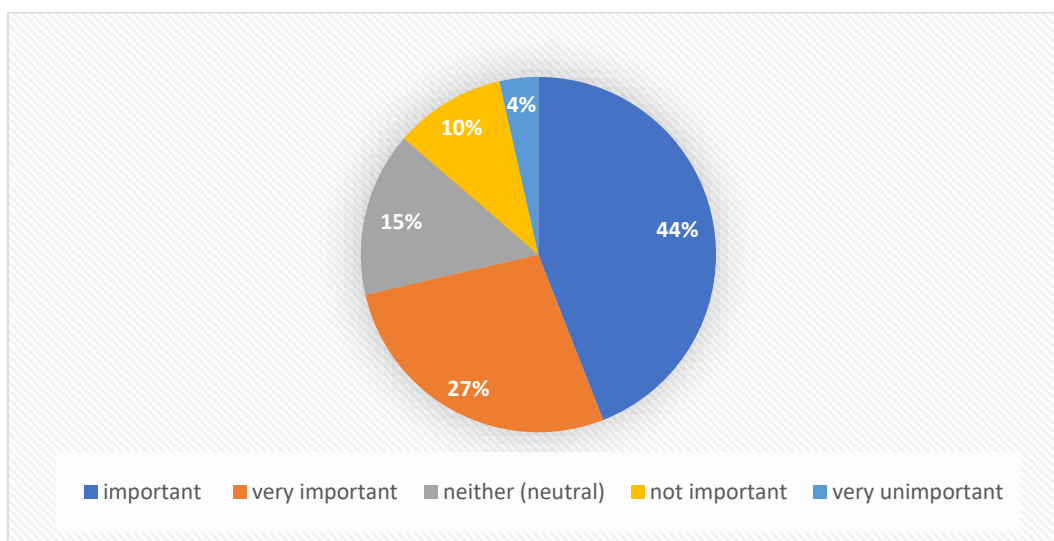


Fig. 11. The degree of importance of local wisdom.

Modernisation and migration trends have contributed to the erosion of traditional practices, leading to a gradual loss of intergenerational cultural transmission. Nonetheless, cultural values can still serve as a foundation for conservation education. Integrating traditional beliefs that emphasise respect for forests into PES awareness programs could promote behavioural change and community ownership of conservation initiatives.

### *3.4 Discussion*

This study explores the extent to which the perspectives of North Buton's indigenous communities toward the future development of Payment for Environmental Services (PES) provide insight into the interrelationship between ecological, socio-economic, and cultural dimensions. Guided by the conceptual framework of co-creation and knowledge sharing (Agol et al., 2014; FAO, 2018), the discussion highlights how local perceptions inform the types of PES activities preferred, the forms of support deemed most beneficial, and the role of traditional knowledge systems that have long shaped their environmental interaction. These perspectives offer not only reflections of community priorities but also pathways for designing PES initiatives that are participatory, inclusive, and context-specific.

#### *3.4.1 Ecological aspect and suitability of PES activities to the local landscape*

The ecological dimension focuses on identifying priority activities that the North Buton community considers most important for the PES scheme, specifically, spring ecosystem protection and multi-purpose tree planting. These priorities are deeply rooted in the community's understanding of their surrounding landscape and daily dependence on natural resources. The selection of PES activities closely reflects the geographical and ecological realities of North Buton. This supports the study's initial hypothesis that proximity to natural features, such as forests and water sources, influences community choices. The presence of numerous rivers and springs, particularly in villages like Oengkapala, North Wakorumba, shapes residents' environmental priorities. Springs are vital for drinking water, domestic needs, small-scale hydropower, and agriculture. Consistent with Wunder et al. (2008), communities prioritise spring conservation because these ecosystems underpin both ecological balance and human well-being. Protecting springs ensures water security for future generations and safeguards against seasonal droughts caused by environmental degradation.

Multi-purpose tree planting was the second most preferred PES activity, reflecting the community's pragmatic understanding of the link between ecology and livelihood. North Buton's landscape includes extensive idle land along roads and settlements, which villagers recognise as opportunities for tree-based restoration. Tree planting not only contributes to environmental improvement but also provides economic benefits through non-timber forest products (NTFPs), such as fruits, resins, and fibres (Belcher et al., 2005). When managed under agroforestry systems, these plantings can enhance soil fertility, diversify income, and reduce land degradation. Communities can select tree species suited to their local soil conditions and market demand, maximising both ecological and financial outcomes. Experience from other regions reinforces this approach. Diswandi (2017) demonstrated the effectiveness of PES models in Lombok, where local residents, in collaboration with downstream water users and companies, successfully maintained watershed sustainability through spring conservation and tree planting. The integration of PES into Lombok's regional regulation (No. 4/2007) ensured long-term institutional support. However, as shown in that case, success depends heavily on socialisation and community engagement prior to policy enforcement. Similarly, in North Buton, continuous outreach and participatory discussions will be essential to ensure clarity regarding the PES mechanism, benefit distribution, and local responsibilities.

### 3.4.2 Ecotourism potential as a complementary activity

Although ranked third in preference, eco-recreation or nature-based tourism holds considerable potential as an auxiliary PES activity. North Buton's diverse landscape, spanning coastal ecosystems, rivers, tropical forests, and hilly terrain, offers opportunities for sustainable eco-tourism that aligns with conservation goals. According to Stronza and Gordillo (2008), community-led ecotourism enhances environmental awareness while providing economic alternatives to extractive activities.

Similarly, Kiss (2004) emphasised that ecotourism fosters mutual learning, where visitors gain appreciation for ecosystems while host communities benefit economically through homestays, guiding services, and local crafts. For North Buton, small-scale eco-recreation could complement PES by generating revenue for conservation activities, strengthening local environmental education, and promoting stewardship of the North Buton Wildlife Reserve's unique biodiversity.

### 3.4.3 Socio-economic aspect

#### 3.4.3.1 Dependence on land and its economic value

The socio-economic discussion focuses on community dependence on land, preferences for intensification or assistance, and the management of boundary conflicts that often arise near conservation areas. Most North Buton households depend on agriculture and small plantations bordering protected forests. Land serves as their primary source of food, income, and identity. Daily activities revolve around cultivating seasonal crops, maintaining small gardens, or managing shifting plots. However, this reliance also produces land-use inefficiency: as some areas are left fallow or abandoned, idle lands remain underutilised. Lasco et al. (2014) suggest that such lands can be repurposed for tree planting under PES schemes, thereby transforming dormant spaces into productive, ecologically beneficial zones. Agroforestry systems combining trees, crops, and livestock could yield diversified benefits while improving soil quality and microclimate stability.

Moreover, developing value-added non-timber forest products (NTFPs) could increase local income. Marshall et al. (2006) noted that community enterprises producing modified forest goods, such as processed honey, herbal products, or dried fruits, strengthen local economies and create sustainable value chains. Integrating livestock with tree cultivation could also recycle organic waste into fertiliser, reinforcing circular production systems that support both livelihood and conservation goals.

#### 3.4.3.2 Preferences for Intensification and Assistance

Survey findings reveal a clear preference for agricultural equipment over direct cash payments as the primary form of assistance. This contradicts the study's initial hypothesis and differs from other PES cases, such as Sangha et al. (2024) in Australia, where indigenous communities prioritised cash-based incentives. The North Buton community's choice reflects a pragmatic understanding of long-term utility: tools provide tangible and lasting benefits that improve productivity and reduce dependency on external aid.

Kassie et al. (2011) demonstrated that access to agricultural tools and training directly enhances productivity and income security among smallholders. Similarly, in North Buton, equipment-based support reduces operational costs, empowers self-reliance, and strengthens local capacity to manage land efficiently. While cash transfers may be simpler to distribute, they risk being diverted to non-productive uses. Therefore, structured discussions between PES facilitators and community representatives are essential to determine the most appropriate types of tools and ensure that assistance aligns with real needs and local conditions.

### 3.4.3.3 Conflict dynamics and conservation boundaries

Conflicts over land use near conservation borders remain one of the critical challenges in North Buton. Although the Natural Resources Conservation Agency/*Balai Konservasi Sumber Daya Alam (BKSDA)*, has established official boundary markers, encroachment persists as residents seek short-term gains through illegal logging or plantation expansion. Cases such as coconut planting inside protected zones illustrate this tension. Mediation between communities and the government has resolved disputes in several instances, but prevention requires a more systemic approach.

According to Engel et al. (2008), PES can play a strategic role in mitigating such conflicts by linking economic incentives with compliance to conservation boundaries. Through participatory mapping, communities can better understand land demarcations and agree on sustainable use zones. Providing appropriate tools and training reinforces the sense of ownership and reduces the motivation to breach protected areas. Ultimately, integrating economic empowerment with education about conservation law can transform PES into a cooperative governance mechanism that strengthens trust between local people and state institutions.

### 3.4.4 Cultural aspect

#### 3.4.4.1 Existence and role of local wisdom (*Kaago-ago*)

The *Kaago-ago* tradition—an ancestral land-opening ceremony—illustrates the community's collective values and leadership structure. Although primarily associated with agricultural initiation, the ritual symbolises cooperation, respect for nature, and social harmony. Led by traditional elders, *Kaago-ago* unites participants under shared customs, fostering community solidarity that can be channelled into collective conservation efforts. However, the practice in its current form does not inherently promote conservation. It focuses on land clearing without restrictions on where or how land is opened, thereby offering limited ecological protection. Nonetheless, as Larson and Soto (2008) argue, embedding environmental principles into local governance structures can transform such traditions into conservation-supportive mechanisms. For example, incorporating guidelines that prohibit cutting ecologically significant trees during *Kaago-ago* ceremonies could align cultural practices with forest protection goals.

#### 3.4.4.2 Challenges in preserving local wisdom

Modernisation and urban migration pose serious threats to the continuity of *Kaago-ago*. As Altieri (2004) and Long and Arce (2000) highlight, globalisation often erodes traditional knowledge systems, leading younger generations to detach from ancestral customs. The fading of these traditions weakens communal identity and diminishes the cultural foundation for environmental stewardship. Revitalising *Kaago-ago* through education, storytelling, and school-based cultural programs could reconnect youth with their heritage and encourage environmental awareness rooted in cultural pride.

The integration of traditional practices into conservation frameworks has precedent in other regions. In Maluku, for instance, the *sasi* system promotes cyclical use of natural resources, alternating between “open” (*buka sasi*) and “closed” (*tutup sasi*) periods to allow ecological regeneration (Saptenno et al., 2024). The success of *sasi* demonstrates how culturally embedded governance can sustain ecosystems while preserving identity. Adapting similar principles to North Buton's context, through agreements on land use timing, tree cutting restrictions, or protected spring zones could make *Kaago-ago* a cornerstone of culturally attuned PES design.

### 3.4.5 Synthesis of cross-aspect findings

The intersection of ecological, socio-economic, and cultural dimensions reveals that the three aspects are mutually reinforcing rather than isolated. Ecological activities such as tree planting are directly tied to socio-economic preferences for equipment assistance, which in turn are influenced by cultural perceptions of land and forest as living entities. For instance, the widespread availability of idle land motivates both ecological restoration and the demand for farming tools. Similarly, viewing the forest as spiritually significant encourages restraint in land clearing and provides an ethical foundation for conservation behaviour. This synthesis underscores that effective PES design must recognise the system as a socio-ecological network where human well-being and ecosystem health are interdependent. Co-creation and knowledge sharing become not only theoretical tools but operational mechanisms that ensure PES aligns with local values, addresses livelihood needs, and strengthens community agency.

### 3.4.6 Implications for PES development plans

The findings of this study offer practical recommendations for the future implementation of PES in North Buton as follows. Ecological priorities, focus on spring conservation and multi-purpose tree planting using native species to enhance water security and biodiversity. Economic support, provide agricultural equipment and technical training as the primary incentive, fostering long-term productivity and reducing forest dependency.

Cultural integration, reframe traditional ceremonies like Kaago-ago to include conservation ethics, transforming them into educational tools for sustainability. Participatory governance, conduct inclusive socialisation and co-creation sessions between communities, Natural Resources Conservation Agency/*Balai Konservasi Sumber Daya Alam (BKSDA)*, and local authorities to establish mutual trust and transparency. Education and capacity building, integrate PES concepts into local curricula and community workshops to strengthen environmental literacy among youth and adults alike. Institutional synergy, encourage cooperation among government bodies, NGOs, and customary institutions to co-manage PES initiatives in line with local governance structures.

## 4. Conclusion

This study assessed the perspectives of local communities in North Buton regarding the potential implementation of a Payment for Environmental Services (PES) scheme as a conservation mechanism to address illegal logging and environmental degradation in the North Buton Wildlife Reserve. Grounded in a co-creation framework that emphasises participatory knowledge sharing, the research explored three key dimensions, ecological, socio-economic, and cultural, to understand how community perceptions can inform sustainable PES design. The study examined which PES activities are prioritised by communities, what forms of incentives or assistance are preferred, and how local wisdom might be integrated into future conservation initiatives.

Findings revealed that the local population prioritises maintaining spring ecosystems and planting multipurpose trees, underscoring the community's strong dependence on natural resources for daily sustenance. Regarding incentive preferences, agricultural assistance emerged as the most desirable form of support, surpassing direct monetary payments. This preference highlights the community's inclination towards long-term capacity-building measures rather than short-term financial relief. However, the study also found that existing cultural practices, particularly the Kaago-ago ritual, do not align directly with PES conservation goals, although they remain integral to local identity and social cohesion.

While these results offer valuable insights into community-based perspectives on PES, they also reflect limitations arising from limited exposure and understanding of PES

mechanisms among local residents. Community preferences may therefore mirror short-term livelihood priorities more than long-term ecological strategies. Moreover, the limited integration of traditional ecological knowledge into PES frameworks suggests a potential gap between cultural heritage and contemporary conservation policy. Without inclusive dialogue and sustained socialisation, future PES programmes risk overlooking deeper socio-cultural dynamics that underpin environmental stewardship.

This research faced several methodological constraints, including the relatively short two-month fieldwork duration, which restricted the observation of seasonal variations and long-term behavioural trends. The study area was also limited to three sub-districts, potentially constraining the representativeness of regional perspectives. Additionally, the lack of documented sources and practitioners hindered deeper exploration of how traditional practices like Kaago-ago could be effectively linked to PES design.

Future studies should adopt longitudinal approaches to examine how community perceptions and PES outcomes evolve over time. Further research should also identify suitable indigenous and economically viable tree species for agroforestry and explore policy integration between PES schemes and national conservation frameworks. Reassessing and documenting cultural traditions such as Kaago-ago could provide an entry point for embedding traditional ecological knowledge into contemporary environmental governance. Enhancing environmental education and awareness regarding PES concepts may further strengthen community engagement and support. In conclusion, this research contributes to the development of an ecologically grounded, socially equitable, and culturally responsive PES model for the North Buton Wildlife Reserve. Achieving its long-term sustainability, however, will require continuous collaboration, adaptive governance, and a deepened commitment to empowering local communities as co-creators of conservation solutions.

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### **Author Contribution**

The authors jointly contributed to all components of this study, including conceptualization, methodology, data collection, formal analysis, drafting of the original manuscript, review and editing, visualization, and project administration.

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The primary data supporting the findings of this study were collected through a field survey involving 227 respondents and are available from the corresponding author upon reasonable request. To protect the privacy and anonymity of the research participants, the raw dataset is not publicly deposited in a repository.

## Conflicts of Interest

The authors declare no conflict of interest.

## Declaration of Generative AI Use

During the preparation of this work, the author used ChatGPT (GPT-5, OpenAI) to assist in improving the flow, structure, and paragraph organization of the manuscript without altering the original content or research findings. After using this tool, the author thoroughly reviewed, verified, and edited all sections to ensure that the ideas, interpretations, and conclusions accurately reflect the author's own scholarly work. The author takes full responsibility for the content of this publication.

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