Prepublished copy

Nature Environment & Pollution Technology

This is a peer-reviewed prepublished version of the paper

ENHANCING ECONOMIC BENEFITS FROM FOREST PRESERVATION IN PAPUA, INDONESIA: A REVIEW

A. A. Awirya[*†], K. E. N. Sianipar[**], A. Kurniawan [**], I. A. Sasanti[***]

* Senior Economist, Bank Indonesia, Indonesia

** Junior Economist, Bank Indonesia, Indonesia

*** Faculty of Economics and Bussines, University of Sebelas Maret, Indonesia

† Corresponding author: I. A. Sasanti; ikaalicia69@gmail.com

ABSTRACT

The aim of this study is to demonstrate the importance of the Social Enterprise Model Canvas (SEMC), as an alternative to addressing social and ecological system challenges that describes important aspects in obtaining economic benefits from forest conservation in remote areas such as Papua. The method is carried out through Systematic Reviews and Meta-Analyses (PRISMA) and qualitative content analysis process of social services implemented in Indonesia and formulated into the required SEMC using 216 documents sourced from the Scopus Core Collection database, which consists of three types of documents: articles, reviews and book reviews. The results are: First, content analysis of environmental service payment business models in Indonesia provides insight for the government and environmental service providers. Second, the benefits scheme as part of SEMC is an important component in determining successful outcomes. Third, in special regions such as Papua which have special autonomy status, where traditional community regulations play an important role, SEMC must cover aspects of government and regional regulations. The implications of this research can be used as recommendations in determining policies related to payment for forest environmental services.

Key Words	Economic Benefit; Forest Preservation; Social Enterprise Canvas Model
DOI	https://doi.org/10.46488/NEPT.2025.v24i02.D1695 (DOI will be active only after the final publication of the paper)
Citation of the Paper	A. A. Awirya, K. E. N. Sianipar, A. Kurniawan, I. A. Sasanti, 2025. Enhancing economic benefits from forest preservation in Papua, Indonesia: a review . *Nature Environment and Pollution Technology*, 24(2), D1695. https://doi.org/10.46488/NEPT.2025.v24i02.D1695

INTRODUCTION

The growth of population and the associated demand for food and energy have led to increased exploitation of ecosystems, primarily due to forest intensification and urbanization (Schirpke et al. 2018). However, natural and semi-natural environments serve as vital reservoirs of biodiversity, which positively influence numerous ecosystem services (ES) (Reyers et al., 2012). Consequently, the degradation of these environments poses a threat to human well-being (Simonet et al. 2019). To

address the loss of biodiversity and the related ecosystem services, a key agreement from the Rio + 20 conference includes a transition towards a green economy, aimed at reducing environmental impacts while enhancing human welfare (UNEP 2024).

Emission control is an important focus for every country that ratified the Paris Agreement in April 2016. As much as 71.5% of greenhouse gas (GHG) emissions come from the energy sector (Wiatros-Motyka et al. 2023). The sector produces GtCO2e with 40% of the contribution coming specifically from the electricity sector; from the same report, it was also stated that 3.22 GtCO2e came from LULUCF (Land use, land-use change and forestry). Indonesia is ranked 11th in the world with an emission contribution of 1.59% or the equivalent of 602.59 mtCO2e (Crippa et al. 2022)and through REDD+ efforts, forest management is expected to be in harmony with steps to preserve forests and biodiversity (Simonet et al. 2019). Therefore, in the midst of Indonesia's development stages in terms of carbon trading, Presidential Regulation No. 98 of 2021 concerning Implementation of the Economic Value of Carbon to Achieve Nationally Determined Contribution Targets and Control of Greenhouse Gas Emissions in National Development (Perpres 98/2021) is a regulation fundamentals that enable the implementation of carbon economic value (NEK), so that both the government and corporations in Indonesia can develop carbon financing. This is inspired by the research results of Canadell & Raupach (2008) that forest conservation in developing countries is an effective, low-cost method for reducing GHG emissions, especially if there is potential to increase the scale of GHG emission reduction programs (Bosetti and Buchner 2009).

The role of forests in controlling emissions is considered important, both as a response to and prevention of excessive emissions in the environment, and as a form of preserving flora and fauna if managed well (Nandini, Anupama, and Pavithra 2009). So that the achievement of emission targets with reference to the Paris Agreement can be realized in a balanced manner without many economical trade-offs in the forest management transition (Saharjo 2022). On the other hand, the results of forest management efforts can contribute to specific sectors such as tourism, manufacturing industry, water and agriculture, both in the form of economic benefits received directly and indirectly towards economic growth. (Agrawal et al. 2013). On the other research finds out that the subject, named as Baduy community holds firm to its customs and culture called *pikukuh*. The Baduy community applies the concept of sustainable forest management in that local communities are directly involved in forest management activities to improve welfare and implement sustainable forests (Asteria et al. 2022). Forest preservation provides a plethora of ecological, social, economic, and global benefits. Ecologically, forests serve as critical habitats for diverse flora and fauna, contributing to biodiversity conservation and ecosystem stability. They play a pivotal role in regulating both local and global climates by sequestering carbon dioxide, mitigating climate change, and influencing weather patterns. Additionally, forests uphold soil fertility, mitigate erosion, regulate hydrological cycles, and act as natural filters for air and water purification. Socially, forests offer significant cultural, recreational, and spiritual values, supporting the livelihoods and cultural practices of indigenous communities while providing recreational opportunities for urban populations. Economically, forests are invaluable resources that provide timber, non-timber forest products, and medicinal plants, contributing to local and national economies through sustainable forestry practices. Moreover, forests support tourism, ecotourism, and nature-based recreation industries, fostering revenue generation and employment

opportunities (Rahma Febriyanti, Tri Ratnasari, and Wardhana 2022). From a global perspective, forest preservation is indispensable for achieving overarching sustainability objectives, including biodiversity conservation, climate change mitigation, and the safeguarding of crucial ecosystem services that sustain life on Earth. Overall, forest preservation is essential for maintaining ecological equilibrium, promoting human well-being, fostering sustainable development, and ensuring the resilience of the planet's ecosystems. From these points, we could see that forest preservation are having a huge impact on creating a sustainable community which leads directly to the sustainable economy growth of its specific region (Yakovleva and Subhonberdiev 2019).

In Indonesia, there's still lack of research about a forest and its preservation, especially when we're talking about the connections with the economic perspectives. Forest research in Indonesia encompasses a broad spectrum of topics aimed at understanding and managing the country's biodiverse ecosystems amidst mounting environmental challenges. Studies often focus on documenting and conserving Indonesia's rich biodiversity through species inventories, taxonomy, and ecological assessments, while also examining the effectiveness of conservation efforts in the face of deforestation threats (Patunru and Haryoko 2015). Sustainable forest management practices, including forest certification and community-based initiatives, are of paramount importance, alongside research into the impacts of logging and land-use change. Additionally, efforts to mitigate and adapt to climate change involve studying carbon sequestration, deforestation trends, and the socioeconomic implications of forest conservation policies. Fire ecology and management constitute another critical area of research, given the recurring issue of forest fires linked to land clearing and peatland degradation. Furthermore, research in Indonesia delves into the complex interplay between policy, governance, and forest management, assessing the implementation of regulations, stakeholder involvement, and land use governance frameworks. This multidisciplinary approach underscores the importance of integrating ecological, social, and economic perspectives to ensure the sustainable management and conservation of Indonesia's forests. That's why forest preservation in Indonesia yields substantial economic benefits across various sectors. The country's vast forest resources contribute significantly to its economy through timber production, non-timber forest products, and ecosystem services. Sustainable forestry practices ensure a continuous supply of timber, supporting the domestic wood industry and generating revenue from timber exports. Additionally, non-timber forest products such as rattan, rubber, and medicinal plants provide livelihood opportunities for local communities and contribute to rural economies. Forest preservation also fosters ecotourism and nature-based recreation, attracting domestic and international tourists to explore Indonesia's rich biodiversity and pristine landscapes. Furthermore, intact forests play a crucial role in regulating hydrological cycles, reducing soil erosion, and maintaining water quality, thus supporting agriculture, fisheries, and hydropower generation. Overall, forest preservation in Indonesia not only safeguards valuable natural resources but also drives economic growth, sustains livelihoods, and promotes sustainable development for present and future generations (Djafar et al. 2023).

Limited research about forest in Indonesia need to be concerned, especially since Papua is the last hope for intact Indonesian forests, forest cover decreasing in Sumatra and Kalimantan. In 2012, 38 percent of Indonesia's remaining primary forest was in Papua, which is located in the western part of Papua New Guinea, the world's second largest island, and consists of the provinces of Papua and

West Papua. Papua has one of the highest levels of biodiversity in the world, with 20,000 plant species, 602 bird species, 125 mammals and 223 reptiles. This forest is also a source of livelihood for many local communities. The rate of tree cover loss in Papua reached its peak in 2015. Since then regional leaders have started to take action. In 2015, West Papua became the first conservation province in the world and this commitment is still upheld by the current governor in 2018. He also plans to review all forestry and plantation licenses throughout West Papua Province. Meanwhile, its neighbor, Papua Province, has also designed a road map entitled Vision 2100 Papua which targets maintaining 90 percent forest cover throughout the province in line with efforts to achieve low-carbon development goals (WRI Indonesia 2021).

However, efforts to control forest sustainability have not been optimal and implemented concretely in forestry in Indonesia. So further study is needed to support the implementation of obtaining economic benefits. This study analyzes the potential economic benefits from forest use in Papua. Therefore, this study aims to analyze the development of efforts to obtain economic benefits from forest preservation, the business models that can be offered, and policy support through legal instruments. It is hoped that the benefits of this study can provide input for efforts to obtain economic benefits from forest preservation in Papua. This research also provide facts from law perspective and supporting system from financial infrastructure, to broaden the economic benefit from forest preservation perspective.

MATERIALS AND METHODS

This study is based on a qualitative method with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and content analysis guidelines to conduct a systematic review of publications reviewed by peers. A comprehensive search of studies reviewed by peers on Payment for Ecosystem Services (PES) and Social Enterprise Model Canvas (SEMC) for sustainability was conducted using online database, namely Scopus Core Collection. These two databases were searched in February 2024. The filters used were limited to the English language with no date restrictions. Search terms were also developed, reviewed, and refined to ensure that the collection covers the period before the final string was completed and executed. The research sample also included selected studies from the reference lists of PES review articles related to sustainability and sub-topics selected from the final list of studies filtered from Scopus in the previous step. Relevant sources found were then included in the screening process. The abstract review resulted in 53 articles discussing environmental service returns. All articles specifically discussed case studies of environmental service returns in Indonesia; aspects related to the 14 SEMC elements which are a reference framework that can support the formulation of compensation forms for environmental services; and the relationship between environmental service returns and REDD+.

A total of 487 peer-reviewed papers were selected for screening. After a recount before filtering out 169 duplicates, 318 papers were found eligible for full-text assessment. A further screening resulted in 101 papers that did not meet the criteria. A final screening of 1 note that did not meet completeness criteria left 216 papers deemed eligible and became the basis for a new study report (Figure 1). This study used the sample to test the concept of payment for forest ecosystem services.

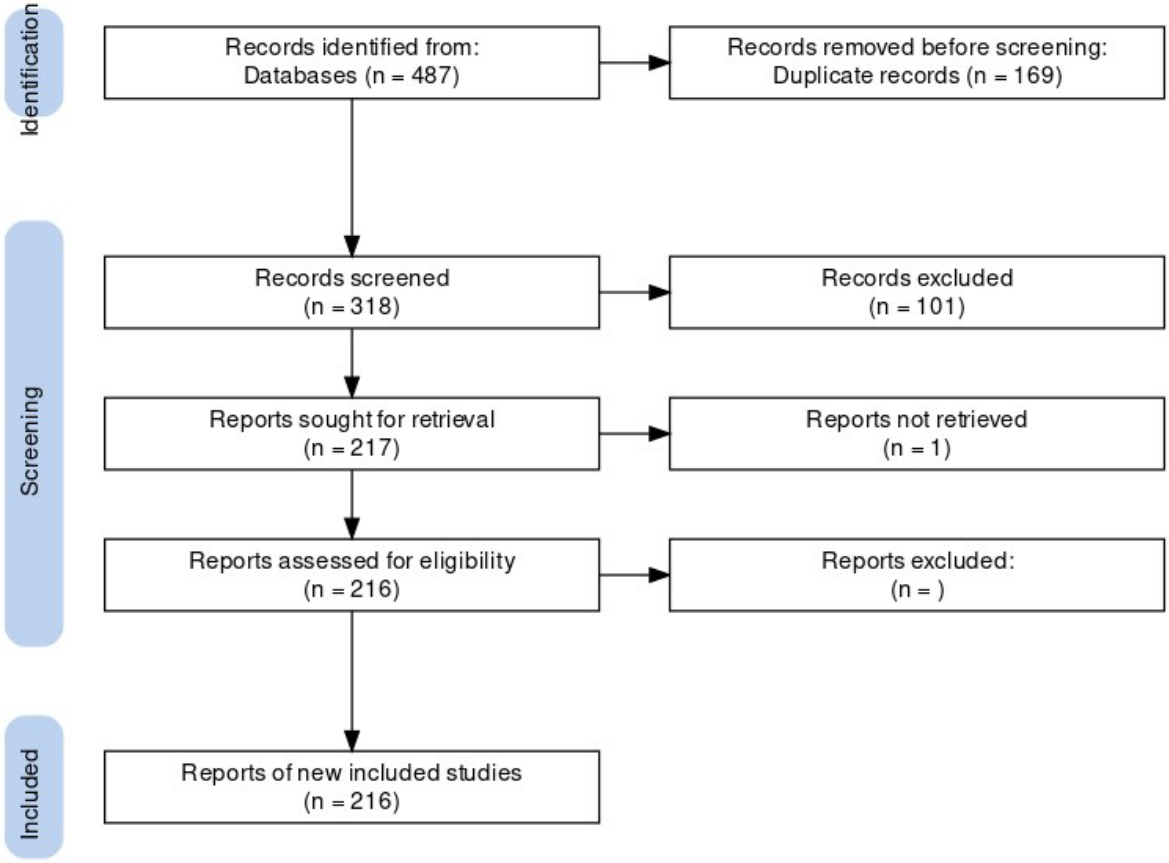


Fig. 1: Flowchart showing the process of identifying relevant studies for the review

RESULTS AND DISCUSSION

PES Practices Development in Indonesia

PES practices in Indonesia are still polarized since there are parties who believe that PES is not an optimal solution; According to some respondents, the main challenge in fulfilling contracts is threats from industry (Suich et al., 2017). PES in Indonesia, which has been implemented since 2002 in Banten (Lapeyre et al., 2015), shows how interactions between service providers and buyers of environmental services from the private sector utilize the added value of the same land so that cooperation can be formed that is mutually beneficial for service buyers who have non-climate change interests and communities who depend on land for nature conservation schemes that have climate change interests.

Table 1: PES Lombok and Lampung

Aspect	Lombok	Lampung
ES purchaser	WWF; KONSEPSI (NGO lokal)	PLN (PLTA Way Besai)
ES provider	Farmer in Rinjani area	Farmer of Sumber Jaya Village
Form of environmental service	Planting trees and maintaining springs	Preventing sedimentation by reforestation and forest conservation

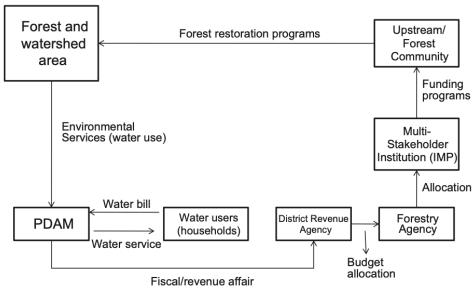
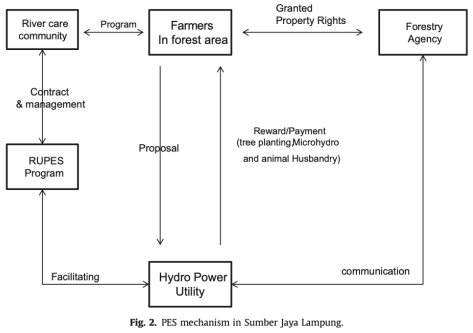
Aspect	Lombok	Lampung
PES mechanism	Farmers in upstream areas are compensated for planting forests and maintaining water sources. Financing comes from downstream water users (PDAM and local drinking water companies). Payments are included in the customer's monthly bill ('environmental services payments'). The money is managed by local government agencies to be distributed to communities that submit proposals for forest conservation programs. On the first occasion, IDR 445 million was collected. There is an increase in farmer income.  Fig. 1. PES mechanism in West Lombok.	RUPES (Rewarding Upland Poor for Environmental Services) with a tiered water turbidity (gr soil/liter water) based scheme. A 30% turbidity reduction is provided by a micro hydro turbine costing IDR 20 million. 10% turbidity reduction compensation IDR 2.5 million. Turbidity reduction 10-20% compensation IDR 5 million. Turbidity reduction 21-29% compensation IDR 7.5 million. In addition, there are revolving funds for goat farming, development of MHPs and tree seedlings.  Fig. 2. PES mechanism in Sumber Jaya Lampung.
Key issues	Forest degradation, illegal logging, unsustainable agriculture, changes in agricultural practices, decreased water discharge	Reducing sedimentation and rehabilitating deforested areas
Problems	The applicable regulations regarding regional income do not recognize income in return for environmental services; the complexity of revenue recognition resulted in PES being suspended.	Property rights over community forest's land is an example of potential conflict over access to state-owned land.
Conclusion	Current regulations do not yet facilitate incentives from local governments for environmental services. Schemes involving the private sector are easier to implement and have a higher success rate.	

Table 2: Hydrological PES in Indonesia

Location	Issues	Factors determining pay	Performance indicator	Hydrology indicator

Cidanau watershed area	Erosion of critical land	Land rehabilitation costs	Number of trees per hectare	-
Kuningan, Cirebon	Quantity and quality of forest management	Selling price of water	Development of forest conservation	-
Lombok island	Degradation of the forest's ability to produce water	Willingness to pay (WTP)	Development of forest conservation	-
Sumberjaya Lampung	River water sediment load	Sediment reduction rate	Reduction of sediment load	Sediment load

In the context of implementing PES related to water flow areas, cooperation is generally formed between regional drinking water companies and hydroelectric power plants. The compensation provided is detailed with indicators that must be achieved and the compensation burden is included in operational costs so that it can be charged to end product users (drinking water consumers) or as operational costs to increase operational efficiency (increased power plant efficiency).

PES interactions with local communities also play an important role in PES design; designs that do not take into account the configuration of local communities that depend on the PES base ecosystem can cause PES to be cost inefficient (Leimona et al., 2015).

Table 3: Fairly Efficient and Efficiently Fair PES Design in Asia

Configuration	Examples	Social – Political – Economic condition	Main environmental service	Scheme
Forests are an inseparable part of the lives of local communities	Kalahan (Philippines) and Kapuas Hulu – West Kalimantan	Indigenous people with strong ties and recognized national law for self-management of ancestral lands	(Voluntary) carbon sequestration, watershed conservation for local water companies	Payment from the company. Earmark for water bill.
Forests and agriculture are inseparable	Kulekhani (Nepal) and Bakun (Philippines)	Local communities provide forest management. Local residents invest in vegetables at high market prices with remaining forests certified as	Watershed area conservation to support electric turbine	Distribution of part of hydropower income to the community

Configuration	Examples	Social – Political – Economic condition	Main environmental service	Scheme
		ancestral areas of origin.		
Agroforests and agroforestry systems are an important part of the landscape and people's lives	Sumberjaya – Lampung, Bungo – Jambi and Cidanau – Banten	Local communities that use land are being displaced by the expansion of palm oil companies	Conservation of biodiversity	Philanthropic fund payments. Certificate for Community Forest (5 to 25 years)
The landscape has experienced severe degradation and is in the process of recovery	Singkarak – West Sumatra and Lantapan (Philippines)	Local communities cultivate food crops and rice fields for the commercial market	Voluntary carbon sequestration and watershed improvement	Incentives from power companies and local governments

PES carried out in Indonesia generally involves local farmer groups as providers of environmental services by revegetating damaged land. Intermediary institutions are an important PES component in determining PES schemes including the distribution of environmental service returns (Table 4). The ideal return (so attractive for indigenous peoples) in PES with links to indigenous communities in the scheme is to create benefits in the form of recognition of the way of life or customs of indigenous peoples in PES (Robinson et al., 2016).

Table 4. PES in Indonesia

Scheme	Province	Service seller	Service purchaser	Payment	Intermediary institution	Activity
Waterfront Cidanau	Banten	30 farmer groups	SOEs	IDR1,2 million/ha	Stakeholder groups	Trees plantation, agroforestry
Gn.Rinjani	West Nusa Tenggara	25 groups di 12 village	Private institution	IDR30 – 80 million/group	NGO	Rehabilitation and Reforestation

Scheme	Province	Service seller	Service purchaser	Payment	Intermediary institution	Activity
Aceh Carbon	Aceh	10 groups	Private institution	IDR70 – 90 million/ contract IDR1,5 – 1,6 million/ha	NGO	Planting trees, preventing logging, constructing terraces and sediment pits
Ketapang	West Kalimantan	Village	Private foundation	IDR100 million / village	NGO	Avoid planned deforestation
Merangin	Jambi	Village	Private foundation	IDR100 million / village	NGO	Avoid planned deforestation
Rimba Raya	Central Kalimantan	Konsesi lahan restorasi ekosistem	Sektor swasta			Avoid planned deforestation
Berau FCP	East Kalimantan	Village	Donor	USD25 thousand / village	NGO	Pengurangan deforestasi, rehabilitasi hutan
Kalimantan Forests & Climate Partnership	Central Kalimantan	Village	Donor	AUD1,8 million	Kalimantan Forests & Climate Partnership	Trees plantation, canal blocking

Table 5: Perception of the Benefits of PES for Aboriginal Communities

Category	Details
Human rights	Maintaining biodiversity associated with the relationship between society and the state; Formal laws and governance systems support the application of indigenous knowledge and authority
Materials	Ecosystem functions and processes run and develop with the appropriate use of fire
Aesthetics	The landscape shows the positive impact of the presence of human activities
Venue / Inheritance	Monitoring can improve efforts to defend sacred places

Category	Details
Activities and Access	The Partnership applies Aboriginal community values in efforts to prevent forest burning; Aboriginal communities still have the freedom to carry out customary laws that require burning
Spiritual	Protection of sacred sites is more guaranteed
Inspiration	Fostering enthusiasm for work and training for indigenous communities; Young children tend to stay in school so they can learn about the environment
Knowledge	Knowledge of indigenous communities in efforts to mitigate natural impacts and PES efforts fosters a sense of statehood
Existence / legacy	Involvement of the younger generation in environmental protection programs; increasing the ability to transmit knowledge to the younger generation
Social capital and cohesion	Health and wellness benefits
Identities	Sense of belonging by continuing to feel cultural authority over land belonging to indigenous communities
Occupation	Social safeguards create a premium price for carbon units from projects managed with Aboriginal communities

PES Business Model Practice in Indonesia

Governance

The regulations that were formed and the entities tasked with managing the organization (Sparviero, 2019) in the case of PES in Indonesia came from NGOs that had concerns about the degradation of local natural quality (Fauzi & Anna, 2013) as well as the beneficiaries of environmental services (Fauzi & Anna, 2013; Hendrayanto & Sudomo, 2013; Lapeyre et al., 2015).

Non-targeted stakeholders (NTS)

Stakeholders who are affected by organizational activities and partnering stakeholders are not the target beneficiaries of the social activities carried out (Sparviero, 2019). Local governments in various PES are affected by the provision of environmental services when the scheme involves the active role of government institutions/BUMD (Fauzi & Anna, 2013).

Key resources

The most important asset that ensures the business model can function (Sparviero, 2019). In the context of PES; Laws and policies related to PES mechanisms are a fundamental need in establishing PES institutions (Greiber, 2009). The involvement of local communities and regional governments is also crucial in ensuring legal certainty because it involves land ownership (Fauzi & Anna, 2013). Funding for conservation efforts also influences the quality of conservation efforts; Policy interventions at local and national levels can also increase the interest of potential fund providers and environmental service providers (Prasetyo et al., 2009).

Key activities

The most important activities that ensure the business model can function (Sparviero, 2019). The main principle in PES based on Pagiola and Platais (2002) is that environmental service providers must receive compensation for their efforts and those who benefit from providing these services must pay. So the main activities in PES are providing services and designing incentives.

Channels

The main communication media between environmental service providers, environmental service beneficiaries, and intermediary institutions can be through cooperation contracts for the procurement of environmental services, capacity building, as well as business relations and legal coordination (Sunaedi et al., 2019).

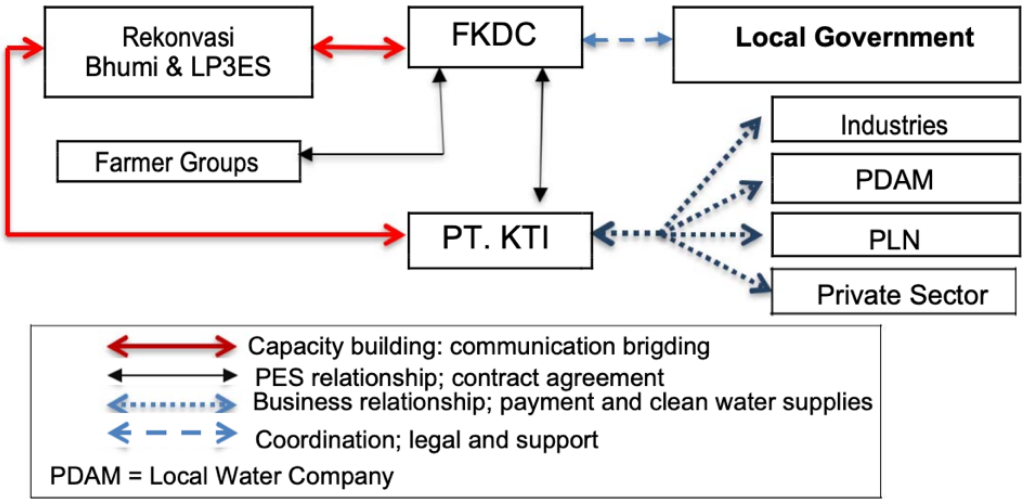


Fig. 2: PES DAS Cidanau Scheme (Sunaedi et al., 2019; Amaruzaman et al., 2017)

Customer & Beneficiaries Engagement (C&BE)

Environmental service buyers and providers have a relationship regarding the provision of incentives and contract design which is influenced by intermediary institutions (Suich et al., 2017). In practice in Cidanau, interaction even includes assessments with local communities regarding optimal PES locations as well as the transfer of information regarding local community needs for land (Sunaedi et al., 2019).

Customers & Beneficiaries (C&B)

Beneficiaries of environmental services are entities that benefit from goods and services because of providing environmental services through both active and passive consumption (Harrington et al., 2010). Suwarno et al. (2016) divides the beneficiaries of environmental services into three, namely: private (large companies, MSMEs, smallholders who employ workers), public (government institutions at various levels; global community), and RT (e.g. rice farmers, rubber farmers, local communities, rattan collector).

Social Values Proposition (SVP)

The added value of PES can be in the form of monetary benefits (Suwarno et al., 2016) which increase the welfare of environmental service providers as compensation (conditionality) for the environmental services provided. In the FCPF benefit sharing plan document in the context of the East Kalimantan Provincial Government, there are monetary benefits to cover operational costs (MRV costs, safeguards) and administrative costs as well as non-monetary benefits in the form of capacity development for the environmental services program financial management system and strengthening institutions in the provision of environmental services. Specifically, the benefits of each party at various levels are regulated in the document up to the level of indigenous communities where they receive monetary benefits for the salaries of forest protection monitoring officers as well as non-monetary benefits such as poverty alleviation programs.

Cost Structure

Tata et al. (2014) classifies the costs of PES into three types, namely transaction and negotiation costs; opportunity costs from land use according to business-as-usual; implementation costs. At the individual level the costs incurred may include monitoring costs.

Income

Suwarno et al. (2016) divides the revenues obtained by environmental service providers into two types, namely provisioning services to fulfill basic contacts and regulating services in the context of carbon absorption (i.e. valuation of potential reductions in GHG emissions).

Mission values

Big, long-term and end-state goals expected by the organization (Sparviero, 2019). In the implementation of PES in Indonesia, there are practices that are dominated by international donors aimed at nature conservation and preserving biodiversity, although in practice some companies finance PES with CSR funds which are not part of operational costs, which shows differences in companies' views on nature conservation tasks (Suich et al. , 2017).

Objectives

The short-term and practical goals to be achieved through implementing PES in Indonesia are generally measurable and gradual changes in environmental quality which have a direct influence on the sustainability of buyers of environmental services (Fauzi & Anna, 2013).

Impact measures

The size of the assessment of mission values is generally contained in PES contracts related to the size of the protected environment and the desired quality; such as deforestation rates in upstream areas monitored by stakeholders (Lapeyre et al., 2015). The achievement of the PES program's goals depends on the active and voluntary engagement of all stakeholders, guaranteeing the sustainable utilization of the environmental services it generates (Sunaedi, Hadi, and Bambang 2022).

Output measures

Environmental assessment over a shorter period of time which generally becomes a contract conditionality in providing periodic benefits; for example, the number of trees per farmer group area which is the underlying contract and changes in the number of trees on land under the supervision of the farmer group (Lapeyre et al., 2015).

PES Potential in Papua

The Ministry of Environment and Forestry (KemenLHK) database shows that in the Papua region there are five programs that are classified as climate change adaptation actions.

Table 6: KemenLHK Programs

Location	Programs	Aim of Programs	Source and Total of Funds
Jayapura Merauke	Enhancing Smallholder Benefits from REDD+ in Indonesia	Support the development of institutional and fiscal mechanisms for REDD+ that link implementation at the national and local levels	Australian Centre for International Agricultural Research USD233.227 (*sharing beneficiaries)*
Jayapura Merauke	Procurement and Utilization of Solar Cell Technology in Shipping Navigation Aids (SBNP)	Assisting the ship's navigator in determining the position and/or course of the ship and notifying the dangers and/or obstacles to navigation for the benefit of sailing safety.	Central and Regional Government Financing There is no information on the amount of funds
Papua	Support to the establishment of Indonesia REDD+ Infrastructure and Capacity: Interim Phase (finished)	Strengthened climate change mitigation and adaptation and environmental sustainability measures in targeted vulnerable	Norway – UNDP USD20,49 millions

Location	Programs	Aim of Programs	Source and Total of Funds
		provinces, sectors and communities.	

Pramudya, et al. (2023) presents data related to mapping deforestation rates using satellite imagery processed using AI in the Papua region. Based on this study, it was found that five districts with the highest reduction in forest cover area in the period 2001 to 2021 were spread across Papua Province, South Papua Province and Central Papua Province (Table 3.2.). Areas with high deforestation rates have the potential to become REDD+ locations with a PES system in the Papua region.

Table 7: Forest loss in Papua

Regency	2001 – 2007 (km^2)	2008 – 2014 (km^2)	2015 – 2021 (km^2)	Total per Regency (km^2)
Merauke	156,807	641,030	1.082,818	1.880,656
Jayapura	126,667	252,822	292,517	672,005
Boven Digoel	217,148	139,880	267,154	624,182
Yahukimo	110,783	162,850	293,800	567,432
Mimika	100,254	179,871	199,703	479,827

Business Model Recommendation in Papua

Table 8: SEMC for PES carbon-based in Papua

Aspect	Elements
Governance	MRP ; NGOs; donors and Regional Government
NTS	GTMA ; traditional groups; KPH (Forest Management Unit)
Key resources	International funding Property rights to the land that is the underlying PES
Key activities	1. REDD+ with a superior commodity approach 2. Environmentally friendly agricultural practices
Channels	1. Cooperation contract 2. Capacity building 3. Business relationships
Customer & Beneficiaries (C&B)	1. Private (smallholders such as poktan) 2. Public 3. Traditional communities (Papua Provincial Regulation No.21 of 2008)
Customer & Beneficiaries Engagement (C&BE)	1. Formulation of cooperation contracts 2. Joint assessment with indigenous communities regarding the impact of PES

Aspect	Elements
SVP	1. REDD+ contributions whose performance is recognized 2. Recognition of the rights of indigenous peoples through involvement in the PES program 3. Increasing the welfare of the PES service provider community
Mission values	1. Protection of biodiversity 2. Poverty alleviation and improvement of community welfare indicators in PES areas as well as the emergence of NTFP (non-timber forest product) businesses 3. Achieving appropriate deforestation rates within the framework of reducing GHG emissions 4. Strengthening the KPH system 5. Strengthening the role of indigenous communities in environmental management and reducing the potential for conflict over recognition of land rights
Objectives	1. Potential emission reduction of 14.1 MtCO2e* in Jayapura Regency (as one of the pilot project recommendation areas) 2. Establishment of a forest guard patrol task force 3. Obtain a climate aid package with international entities
Impact measures	1. Increase in welfare indicators (number of years of schooling, number of educational and health facilities in the PES area) 2. The amount of reduction in deforestation rates compared to the historical annual average rate in the PES area 3. The number of conflicts over land is decreasing
Output measures	1. Increase the number of people in PES areas who are employed in the provision of environmental services 2. Amount of environmental service compensation from donors 3. Construction of health and education facilities as well as development of agroforestry business potential using sustainable principles
Cost structure	1. Poktan subsidy support (opportunity cost mitigation) 2. MRV Implementation (implementation) 3. Monetary and non-monetary assistance packages for indigenous communities (transaction costs)
Income	1. Grant or international funding 2. Proceeds from sales of agroforestry commodities

*) temporary calculation in Hnya Dkening forest

Governance

Law Number 21 of 2001 concerning Special Autonomy for the Province of Papua specifically in Article 1 (g) explains that the Papuan People's Assembly is the cultural representation of indigenous Papuans (OAP) which has the authority to protect the rights of OAP. The MRP's task based on Law No. 21 of 2001 Article 20 paragraph 1 (d) is to provide advice, consideration and approval of planned

cooperation agreements made by the Government and Provincial Government with third parties that apply in Papua Province specifically regarding the protection of the rights of OAP. Ulayat rights as part of the rights of indigenous peoples over the use of land, forests and water and their contents are the main driving factor in adapting governance in SEMC to the context of the Papua region which involves representative elements of indigenous communities.

Non-targeted stakeholders

In the context of Jayapura Regency specifically, it is the GTMA (Indigenous Community Task Force) which has the role of compiling and implementing the Recognition, Protection and Empowerment of Indigenous Community programs in Jayapura Regency. GTMA which contains various stakeholder components such as academics, government officials, indigenous communities and development partners can be an appropriate intermediary institution in SEMC design in the Papuan community context. GTMA was specifically formed by the Regent of Jayapura in order to encourage efforts to measure and verify the territorial boundaries of each traditional territory; however, it can be a reference for an entity whose members come from various stakeholders (multi-perspective). The role of the division of customary territories carried out by the GTMA is also important when determining the areas protected in PES contracts and the benefits received by each customary group based on the area of land they are responsible for protecting.

Papua Province Special Regional Regulation No.21 of 2008 concerning Sustainable Forest Management in Papua Province in article 5 states that customary law communities in Papua Province have rights to natural forests in accordance with the boundaries of their respective customary territories; The existence of indigenous communities in the NTS is an example of implementing the role of indigenous communities in the PES program.

Key resources

The international donation framework (FCPF) requires beneficiaries to prepare an ER – PIN (Emission Reduction Program Ideas Note) which contains location, performance measurement and financing tenor, benefit sharing plan, leakage mitigation plan and information related to the contract as a whole. details supported by expert assessments regarding deforestation rates and carbon stocks are examples of funding program quality standards that can improve the reputation of the program and the region. International funding specifically in the PES that applies in Indonesia provides recognition of the credibility of environmental services that local communities can provide. International funding also allows excess absorption to be channeled to a wider market in the form of carbon credits.

Property rights are an important element in ensuring that PES is implemented optimally without obstacles, especially regarding the mechanism for providing returns for business carried out on land in the Papuan context that is owned by indigenous communities. The involvement of the GTMA and specifically elements of traditional elders and customary law experts in the GTMA allows the composition of the PES implementation team to have legitimacy according to customary law.

Key activities

Information given by one of the cocoa farmers in a seminar held by the DJPb Regional Office of Papua Province was that the main impetus for carrying out deforestation activities such as illegal logging is the low economic value produced by agricultural commodities for farmer groups; Cost pressures from difficult access to government subsidies are one significant obstacle. Planting sago, cocoa and coffee as superior commodities in the pilot project area can be an example of implementing a REDD+ project with an agroforestry approach that increases yield while increasing carbon absorption capacity. Rajab et al. (2016) explained that cultivating cacao in Sulawesi with a variety of shade tree cover can increase carbon stocks above and below ground up to five times without sacrificing crop yields.

Another main activity in PES is the distribution of benefits which can involve the role of traditional groups in assessing infrastructure needs that are essential in developing community welfare, such as the construction of health and education facilities. Distribution of other benefits can be done through building the capabilities of indigenous community farming groups to market commodities at earmarked prices to private partners. The distribution mechanism can adopt the FCPF framework with fiscal transfers, public service agencies, farming credit, establishment of trust funds, PES and PNPM (National Independent Community Empowerment Program). Providing this assistance also has an impact on improving the management performance of PNPM / RESPEK (Village Strategic Development Plan).

Customer & Beneficiaries (C&B)

Papua Provincial Perdasus No. 21 of 2008 plays a pivotal role in recognizing and safeguarding the land rights of indigenous peoples in Papua. This regulation underscores the importance of ensuring that the indigenous populations are the primary beneficiaries within the Sustainable Ecosystem Management and Conservation (SEMC) framework. By prioritizing the rights and needs of these communities, the Perdasus aims to empower indigenous peoples and promote their sustainable development. To achieve sustainable livelihoods for indigenous Papuans, it is imperative to implement Payment for Ecosystem Services (PES) initiatives. PES programs provide financial incentives to landowners and communities for managing their land in ways that preserve ecosystem services, such as carbon sequestration, biodiversity conservation, and water quality improvement. These initiatives can play a crucial role in mitigating the pressures that lead to land conversion for oil palm plantations, which are a significant driver of deforestation in the region. By offering alternative income sources through PES, indigenous communities can be encouraged to maintain their traditional land use practices, thereby protecting their forests and the biodiversity they harbor.

The successful implementation of PES and other sustainable development initiatives requires the active involvement of intermediary institutions and effective governance within the SEMC framework. These institutions can facilitate communication and collaboration between indigenous communities, government agencies, and private sector stakeholders. They can also help ensure that the benefits of sustainable practices are equitably distributed and that indigenous voices are heard in decision-making processes.

Moreover, the development of green job opportunities is essential for aligning economic growth with the needs of indigenous communities. Green jobs not only provide employment but also

contribute to environmental sustainability. Potential roles for indigenous Papuans within this framework may include land restoration workers who engage in reforestation and habitat rehabilitation projects, stock restoration personnel who focus on the recovery of local wildlife populations, and green construction workers who implement sustainable building practices. Additionally, tree planters involved in climate adaptation efforts can help enhance the resilience of ecosystems to climate change, while ecotourism guides can promote the rich cultural and natural heritage of Papua, generating income for local communities.

In summary, Papua Provincial Perdasus No. 21 of 2008 serves as a foundational legal framework for protecting the land rights of indigenous peoples in Papua. By integrating PES initiatives, fostering effective governance, and creating green job opportunities, it is possible to support the sustainable livelihoods of indigenous Papuans while simultaneously addressing the pressing challenges of deforestation and environmental degradation. This holistic approach not only benefits the indigenous communities but also contributes to the broader goals of environmental conservation and sustainable development in the region.

Customer & Beneficiaries Engagement (C&BE)

The establishment of cooperation agreements and dialogues regarding the effects of Payment for Ecosystem Services (PES) development on indigenous communities that depend on the region is a crucial approach to fostering meaningful engagement. This method not only acknowledges the unique relationship that these communities have with their environment but also actively involves them in the decision-making processes surrounding PES initiatives in Papua. By creating formal agreements and facilitating open dialogues, stakeholders can ensure that the voices of indigenous communities are heard and considered in the development of PES programs. This engagement is essential for several reasons. First, it helps to identify and address the specific needs, concerns, and rights of these communities, which may otherwise be overlooked in top-down approaches. Second, it promotes a sense of ownership and agency among indigenous peoples, empowering them to participate actively in the management and conservation of their natural resources.

Furthermore, these cooperation agreements can serve as a platform for knowledge exchange, where indigenous communities can share their traditional ecological knowledge and practices, which are invaluable for the effective implementation of PES initiatives. This collaboration can lead to more culturally appropriate and sustainable solutions that benefit both the environment and the livelihoods of local populations. In addition, fostering such dialogues can help build trust between indigenous communities, government agencies, and other stakeholders involved in PES development. Trust is a critical component in ensuring the long-term success of these initiatives, as it encourages collaboration and reduces potential conflicts over land use and resource management.

Overall, the establishment of cooperation agreements and dialogues is not just a procedural step; it is a fundamental strategy that enhances the inclusivity and effectiveness of PES initiatives in Papua, ultimately leading to more equitable and sustainable outcomes for indigenous communities and the ecosystems they depend on.

Social Values Proposition (SVP)

The effectiveness of the REDD+ (Reducing Emissions from Deforestation and Forest Degradation) program, particularly when bolstered by collaboration with international donors, plays a pivotal role in enhancing the program's credibility and overall impact. This enhancement is achieved through the implementation of standardized protocols that guide the execution of REDD+ initiatives, as well as the application of scientifically validated assessment techniques provided by institutions such as LVV (Land, Water, and Vegetation). These standardized protocols ensure that all participating entities adhere to a consistent framework, which not only streamlines the implementation process but also fosters transparency and accountability.

By establishing a robust framework for measuring and verifying emissions reductions, the program can effectively demonstrate its success and reliability to stakeholders, including governments, NGOs, and the private sector. This credibility is essential for attracting further investment and support from international donors, who are increasingly looking for evidence-based approaches to environmental conservation and climate change mitigation. Moreover, this strategy is particularly beneficial for environmental service providers—such as local communities and organizations engaged in forest conservation—who exceed performance expectations. By meeting or surpassing the established benchmarks, these providers can unlock greater economic benefits through the trading of carbon credit units. This market-based approach not only incentivizes high performance but also creates a financial mechanism that rewards sustainable practices, thereby promoting long-term environmental stewardship.

In addition to the economic incentives associated with carbon trading, the Payment for Ecosystem Services (PES) framework plays a crucial role in recognizing and upholding the rights of indigenous peoples. By actively involving these communities in both the development and execution phases of PES initiatives, the program ensures that their voices are heard and their traditional knowledge is integrated into conservation strategies. This participatory approach not only empowers indigenous peoples but also fosters a sense of ownership and responsibility towards the management of natural resources. Furthermore, PES contributes to poverty reduction by implementing a profit-sharing model that directs funds back into local communities. This model facilitates the allocation of resources for essential infrastructure improvements, such as better access to clean water, education, and healthcare services. By investing in the well-being of local populations, PES not only enhances their quality of life but also strengthens their capacity to engage in sustainable practices that benefit both the environment and the economy. In summary, the collaboration between REDD+ and international donors, coupled with the implementation of standardized protocols and scientifically validated assessment techniques, significantly enhances the program's credibility. This, in turn, creates economic opportunities for environmental service providers, acknowledges the rights of indigenous peoples, and contributes to poverty alleviation through targeted investments in local communities

Mission values & impact measures

The average annual release of carbon emissions into the atmosphere due to forest land degradation in Papua reaches 24.8 MtCO2e (megaton CO2 equivalent), so that a reduction in the rate of deforestation compared to the average can be a measure of achieving the mission to prevent deforestation. PES is also expected to improve the welfare of indigenous communities in forest areas

that are PES areas; so that long-term targets for the number of years of schooling, stunting rates, the number of infrastructures related to community sanitation and health facilities can be a measure of the welfare improvement mission that PES wants to achieve.

Objectives & output measures

The annual emission reduction target for Jayapura Regency as an indicator of reducing the rate of deforestation can be reduced to a measure of the annual environmental service fee in accordance with the PES contract. The number of farmer groups that function as green jobs workers as well as the effectiveness of the annual work program can be a measure.

CONCLUSIONS

An examination of the PES business model in Indonesia reveals governance deficiencies stemming from regulatory constraints and the limited involvement of indigenous communities in PES scheme design. The efficacy of PES initiatives in Indonesia hinges on the structure of benefit schemes, particularly in terms of benefits offered and mechanisms for benefit distribution. Papua stands out due to its distinctive features, including special autonomous regional regulations and the significant reliance on indigenous communities, who hold authority over forest resources. The business model could serve as a blueprint for shaping PES growth in Papua, laying the groundwork for establishing infrastructure to support carbon credit trading centered on forest resources in the region.

ACKNOWLEDGMENTS

The authors wish to thank Indonesia Bank and University of Sebelas Maret for their useful contributions.

FUNDING SOURCES

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

Agrawal, A., B. Cashore, R. Hardin, G. Shepherd, C. Benson, and D. Miller. 2013. “Economic Contributions of Forests.” *United Nations Forum on Forests. Tenth Session.* 1–132.

Asteria, Donna, Putri Alvernia, Berliana Nur Kholila, Sabarina Isma Husein, and Farha Widya Asrofani. 2022. “Forest Conservation by the Indigenous Baduy Community in the Form of Customary Law.” *Journal of Cultural Heritage Management and Sustainable Development* 14(2):175–89. doi: 10.1108/JCHMSD-12-2020-0171.

Bosetti, Valentina, and Barbara Buchner. 2009. “Data Envelopment Analysis of Different Climate Policy Scenarios.” *Ecological Economics* 68(5):1340–54. doi: 10.1016/j.ecolecon.2008.09.007.

Crippa, M., D. Guizzardi, M. Banja, E. Solazzo, M. Muntean, E. Schaaf, F. Pagani, and F. Monforti-Ferrario. 2022. *CO2 Emissions of All World Countries*.

Djafar, E. M., T. F. Widayanti, M. D. Saidi, A. M. Muin, and Ratnawati. 2023. "Forest Management to Achieve Sustainable Forestry Policy in Indonesia." *IOP Conference Series: Earth and Environmental Science* 1181(1):0–10. doi: 10.1088/1755-1315/1181/1/012021.

Nandini, N., B. S. Anupama, and S. Pavithra. 2009. "Natural Farming in Harmony with the Sustainable Ecosystem." *Nature Environment and Pollution Technology* 8(4):785–88.

Patunru, Arianto A., and Anthea Haryoko. 2015. "Forest Ownership and Management in Indonesia: Reducing Deforestation by Strengthening Communal Property Rights." (2).

Rahma Febriyanti, Annisa, Ririn Tri Ratnasari, and Akhmad Kusuma Wardhana. 2022. "The Effect of Economic Growth, Agricultural Land, and Trade Openness Moderated By Population Density on Deforestation in OIC Countries." *Quantitative Economics and Management Studies* 3(2):221–34. doi: 10.35877/454ri.qems828.

Saharjo, Bambang Hero. 2022. "Research of Indonesian Ghg Emission Assessment From Forest and Land Fires." *Journal of Tropical Silviculture* 13(1):14–22.

Schirpke, Uta, Davide Marino, Angelo Marucci, and Margherita Palmieri. 2018. "Positive Effects of Payments for Ecosystem Services on Biodiversity and Socio-Economic Development: Examples from Natura 2000 Sites in Italy." *Ecosystem Services* 34(March):96–105. doi: 10.1016/j.ecoser.2018.10.006.

Simonet, Gabriela, Julie Subervie, Driss Ezzine-De-Blas, Marina Cromberg, and Amy E. Duchelle. 2019. "Effectiveness of a REDD1 Project in Reducing Deforestation in the Brazilian Amazon." *American Journal of Agricultural Economics* 101(1):211–29. doi: 10.1093/ajae/aay028.

Sunaedi, N., S. P. Hadi, and A. N. Bambang. 2022. "Payment for Environmental Services in Indonesia: Mutually Beneficial Watershed Environmental Management Model." *Nature Environment and Pollution Technology* 21(4):1995–2004. doi: 10.46488/NEPT.2022.v21i04.054.

UNEP. 2024. *Keeping the Promise - Annual Report 2023*. doi: 10.59117/20.500.11822/44777.

Wiatros-Motyka, Małgorzata, Dave Jones, Hannah Broadbent, Nicolas Fulghum, Chelsea Bruce-Lockhart, Reynaldo Dizon, Phil Macdonald, Charles Moore, Alison Candlin, Uni Lee, Libby Copsey, Sam Hawkins, Matt Ewen, Bryony Worthington, Harry Benham, Michele Trueman, Muyi Yang, Aditya Lolla, Achmed Shahram Edianto, Paweł Czyżak, Sarah Brown, Chris Rosslowe, Richard Black, and Marion Bachelet. 2023. "Global Electricity Review 2023." (April):1–162.

WRI Indonesia. 2021. "3 Fakta Tentang Papua: Harapan Terakhir Bagi Hutan Indonesia." *Website Rumah Mitra Papua Barat*.

Yakovleva, E. A., and A. Sh Subhonberdiev. 2019. "Implementation of 'Green' Economy Principles in the Forest Sector." *IOP Conference Series: Earth and Environmental Science* 392(1):0–8. doi: 10.1088/1755-1315/392/1/012016.