# Advancing Forest Management through Collaboration between Government and Local Communities: Case Study in West Bali KPH

**Jun Ichihara[1)], Gede Sedana[2)]**

***(****Institute for Global Environmental Strategies (IGES)*

*(Dwijendra University*)

**ABSTRACT**

Indonesia's social forestry program and the establishment of Forest Management Units (Kesatuan Pengelolaan Hutan, KPH) aim to enhance sustainable forest management (SFM) through decentralized governance and community participation. This study analyzes forest management practices in the West Bali Forest Management Unit (KPH Bali Barat), focusing on Pulukan and Pendem villages in Jembrana Regency, where community forest management rights have been granted since 2017–2018. Using qualitative methods—including interviews with local leaders, social forestry groups, customary (adat) authorities, KPH officials, and other stakeholders, as well as site observations conducted from August 2024 to April 2025—the research examines institutional arrangements, socio-economic conditions, and cultural contexts shaping forest governance. Findings show that agroforestry development, ecotourism initiatives, and multi-stakeholder collaboration contribute to livelihood improvement and conservation outcomes, supported by the Balinese Hindu philosophy of *Tri Hita Karana*, which sacralizes forest spaces and reinforces community stewardship. However, limited financial resources, legal and managerial capacity gaps, and constraints on KPH authority hinder long-term sustainability. The study highlights the need for flexible governance that harmonizes cultural norms with formal regulations, strengthens KPH's intermediary role, builds community capabilities across the value chain, and expands sustainable financing mechanisms. These insights contribute to understanding how cultural values, institutional frameworks, and collaborative governance interact in advancing SFM within Indonesia's social forestry system

## 1. INTRODUCTION

Indonesia contains some of the world's most important tropical forests, which play a pivotal role in global climate mitigation and biodiversity conservation. Over recent decades, however, accelerated logging, land conversion, and plantation development have placed sustained pressure on forest ecosystems, with island-wide analyses for Borneo documenting extensive selective logging, fire, and conversion since the 1970s (Gaveau et al., 2014). The land-use

sector—especially peat fires—alongside the energy sector accounts for a significant share of Indonesia's national greenhouse gas (GHG) emissions. During the 2015 fire crisis, an estimated 2.6 million ha burned nationwide and emissions were on the order of ~1.75 Gt $CO_2$e, underscoring the scale of land-based emissions (World Bank, 2016). The Indonesian government reported that GHG emissions from peat fires in the same year were 808 Mt $CO_2$e, about 34% of national GHG emissions (Ministry of Environment and Forestry, 2018). In 2019, total GHG emissions were approximately 1.87 Gt $CO_2$e and Indonesia ranked fourth globally, reflecting combined energy- and land-use sources (Climate Watch). Indonesia also has the largest forest area in Southeast Asia, with around 120.5 million ha—about 64% of the national land area—designated as state forests; despite policy efforts, deforestation pressures and associated $CO_2$ emissions have remained salient (Ministry of Environment and Forestry, 2018).

Against this backdrop, Indonesia introduced Forest Management Units (*Kesatuan Pengelolaan Hutan*, KPH) as a decentralized forest management system and expanded social forestry (*Perhutanan Sosial*) to strengthen local stewardship while improving livelihoods (Ministry of Environment and Forestry, 2018). The Social Forestry Master Plan 2020–2045 positions local residents as central to forest management, aiming to sustain ecosystem services and reduce poverty, while the promotion of Sustainable Forest Management (SFM) has been elevated as both a domestic and international policy priority (FAO, 2016; ITTO, 1997). In practice, decentralized management centered on KPH is intended to balance objectives of local participation, livelihood improvement, and forest conservation, with recent analyses emphasizing KPH's role as a key field-level implementer (Golar et al., 2023).

Research on decentralized SFM and KPH in Indonesia is extensive, and documents obstacles in system design, governance, and local implementation. Identified challenges include legal and regulatory complexity, unclear tenure, centralized administrative cultures, and weak coordination with local governments, all of which hinder effective KPH operation (Kim et al., 2017). Additional constraints—such as limited funding, human resources, technical support, and market access—affect KPHs and social forestry groups and can undermine managerial capacity and economic sustainability on the ground (Eno, 2020; Uda et al., 2020). While the nationwide granting of community use rights under social forestry has progressed, aggregate evidence indicates that the rollout of community titles has not yet translated into nationwide deforestation reduction, highlighting implementation gaps and the need for supportive institutions and incentives (Santika et al., 2021). Trade-offs among policy goals (e.g., biodiversity conservation versus production objectives) and heterogeneous conservation effects across regions further complicate outcomes (Gaveau et al., 2014).

At the same time, studies identify enabling factors for SFM, including community-based participatory planning, capacity building for farmer groups (*Kelompok Tani Hutan*, KTH) and village organizations, and leadership by local actors (Kim et al., 2017). Public–private partnerships, multi-agency collaboration, and flexible, context-responsive implementation have also proven important; interventions such as forest certification, benefit-sharing under participatory schemes (e.g., PHBM), non-timber forest product development, and integration with regional development have supported both welfare and conservation in specific settings (Miteva et al., 2015). Traditional self-governance, culturally grounded values, and voluntary conservation by residents have been highlighted as additional success factors (Sitorus et al., 2022). Moreover, initiatives that combine climate action and community participation—such as REDD+ and mangrove restoration—offer pathways to reconcile diverse local values with conservation and livelihood objectives (Uda et al., 2020).

Building on this literature, this study examines the current conditions, institutional arrangements, and socio-economic challenges of forest management in West Bali, focusing on the West Bali Forest Management Unit (KPH Bali Barat)in Jembrana Regency, where social forestry permits underpin village-level management adjacent to state forest and where agroforestry and ecotourism activities are developing with KPH support. We analyze the interaction between administrative systems and Balinese Hindu cultural values—particularly Tri Hita Karana, which sacralizes forest spaces—and identify the social, economic, and institutional conditions that enable mutual understanding, consensus building, and cooperation between local residents and external actors. As a conceptual framework, we draw on international SFM guidance that emphasizes strengthening meso-level management systems, multi-stakeholder cooperation, and respect for cultural values—principles that align with Indonesia's forest policy architecture (FAO, 2016; ITTO, 1997).

## 2. RESEARCH METODOLOGY

### 2.1 Study area and case selection

We conducted a qualitative case study in the West Bali Forest Management Unit (KPH Bali Barat), focusing on Pulukan and Pendem villages in Jembrana Regency, Bali Province. Both villages have been formally granted community-based forest management rights under Indonesia's social forestry program since 2017, under which local residents manage village-adjacent state forest areas. Case selection considered: (i) environmental vulnerability in parts of Jembrana (e.g., flood risk); (ii) livelihood potential for agroforestry and other economic uses by local residents; (iii) strong commitment of both social forestry groups (SFGs; *Kelompok Tani Hutan*, KTH) to forest

development; and (iv) suitability as a complex sustainable forest management (SFM) case given adjacency to state forest, technical support from KPH, progress in multi-stakeholder collaboration, coexistence with traditional religious values, and ongoing regional development initiatives linked to agroforestry and ecotourism.

### 2.2 Study design and data collection

We combined documentary analysis and institutional analysis with field-based qualitative research. Fieldwork was undertaken from August 2024 to April 2025. We conducted semi-structured interviews with more than 20 informants, including village heads, leaders of social forestry groups, religious leaders of customary (adat) villages, West Bali KPH officials, and officials from the Tourism Office and Statistics Office. Interviews covered current forest management practices, perceived challenges, institutional constraints, and the state of inter-organizational cooperation. We also conducted site visits to SFG-managed areas and related facilities to observe the progress of agroforestry and the status of tourism infrastructure development. In addition, we interviewed researchers and central/provincial officialsbased in Jakarta, Yogyakarta, and Pekanbaru regarding revisions to laws and regulations related to KPH and broader sectoral trends.

## 3. RESULTS AND DISCUSSION

### Forest Management in West Bali and Local Initiatives

### 2.1 Overview of the surveyed area – forest management system and institutional framework

The subjects of this study were the West Bali Forest Management Unit (KPH Bali Barat) located in western Bali Province, Indonesia, and Jembrana Regency (Pulukan and Pendem villages) under the jurisdiction of the KPH. The West Bali Forest Management Unit was established by decision of the Ministry of Environment and Forestry based on the Indonesian Forest Law (Law No. 41/1999), Government Regulations (PP No. 6/2007, PP No. 3/2008), and the Regional Government Law (Law No. 23/2014) as part of the decentralized forest management system promoted by the Indonesian government. Its main objectives are to achieve multi-purpose forest management, such as sustainable management of state forests, collaboration with local residents and social forestry groups (Kelompok Tani Hutan: KTH, or SFG), and control of illegal logging, biodiversity conservation, and regional economic development. The West Bali KPH management area spans three regencies in western Bali, namely Jembrana, Buleleng, and Tabanan Regencies, covering a total area of about 66,763 ha as of 2024.

Pulukan and Pendem villages in Jembrana Regency are both rural areas adjacent to state forests and are highly dependent on forest resources. Jembrana has a total forest area of 41,307 ha, including protection forests (32,975 ha), production forests (2,993 ha) and conservation forests (5,339 ha), the management of which is the responsibility of KPH West Bali (Suryawan et al., 2024). Pulukan village belongs to Pekutatan District, with a village area of about 635 ha, of which about 372 ha have been designated as protection forests. As for land use, agricultural land, residential land, and public facility land are mixed, and durian-based agroforestry is being developed. The climate is tropical, with a clear division between the dry season (Apr–Sep) and the rainy season (Oct–Mar), with an average temperature of 25–29 °C. The population is approximately 4,712 (as of 2023) and consists of six sub-villages (hamlets). Among them, Arca Dwipa is the closest to the forest, with about 206 ha of forest managed by the Social Forestry Group based on the decision of the Minister of Environment and Forestry in 2017 (SK.5885/MENLHK-PSKL/PKPS/PSL.0/10/2017).

On the other hand, Pendem Village belongs to Negara District and has a location that allows access to both the town center and the wooded area. The entire village has a population of about 10,217 (as of 2023) and consists of four sub-villages. Only Dewasana is close to the forest, while the others are adjacent to the urban area of the capital of Jembrana Regency. As for forest conservation activities, conservation-oriented forestry is being promoted through reforestation/enrichment planting with non-timber forest product (NTFP) species, and 130 ha of forest are managed by the social forestry group “Puncak Mawar.” This activity was officially authorized by the Decision of the Minister of Environment and Forestry of 2018 (SK.887/MENLHK-PSKL/PKPS/PSL.0/12/2018).

Thus, since 2017, the two villages have been officially granted village forest management rights (Izin Usaha Pengelolaan Hutan Desa: IUPHD) by the Minister of Environment and Forestry, and about 206 ha of forest in Pulukan and about 130 ha in Pendem are managed by their respective social forestry groups. Ownership remains with the state, and village forests cannot be transferred or converted in use; local residents hold use and management rights under the social forestry framework. In addition, KTH in Pulukan and Pendem are developing a variety of activities—such as agroforestry, tourism resource development, and forest monitoring—with support from KPH, and these are attracting attention as local initiatives that balance sustainable forest management and residents’ welfare. In both villages, the village head and the social forestry group play leading roles, and the acquisition of forest management rights is a formal procedure that involves applying to the Governor of Bali Province (for areas in Jembrana), coordinating with the Forest and Environment Office, and formulating and mapping the use plan. As a result, a forest management

model centered on local residents is being built, and practices are underway to balance conservation and livelihood.

**Status and Challenges of the West Bali Forest Management Unit**

West Bali KPH (UPTD KPH Bali Barat) is operated under the jurisdiction of the Bali Provincial Forestry Office, and has a subordinate organization headed by the head of the KPH (Kepala KPH), as well as staff responsible for forest protection and monitoring duties such as forestry engineers, forest rangers, forest police, and social forestry personnel. As an intermediate support organization, West Bali KPH provides a variety of support to these KTH, including support for the formulation of management plans, technical advice, promotion of public–private partnerships, and training. Key activities include conservation activities such as illegal logging and fire patrols, as well as the promotion of agroforestry, ecotourism, environmental education, and biodiversity conservation (e.g., the conservation of 19 wild orchid species in the Dewasana forest area) (Dodo & Hartini, 2019). In addition to patrols to combat illegal logging and forest fires, counseling and training at the village level are also conducted. There is a shortage of personnel relative to the forest area, and legal measures (criminal procedures) for illegal logging and related offenses are entrusted to the police and prosecutors (Suryawan et al., 2024).

According to interviews with KPH officials, KPH's budget is limited to the minimum for the management and operation of offices (staff personnel costs, administrative expenses, etc.), and in recent years there has been no budget for capacity-building activities, events, or other specific projects. Due to these budget constraints, KPH is promoting cooperation with relevant stakeholders and efforts to expand collaborative activities and projects such as ecotourism, agroforestry, and capacity building. At the field level, forestry engineers and social forestry personnel are assigned to subordinate organizations, but shortages of personnel, budget, and equipment remain an issue. In addition, while the KPH philosophy previously emphasized carrying out economic activities independently and becoming financially self-sufficient, the legal amendment at the central government level—the Job Creation Law (UU Cipta Kerja; "Omnibus Law") enacted in 2020—has had a significant impact on KPH authority and economic activities in Indonesia. Specifically, implementation of the Omnibus Law has weakened the legal basis for KPH to independently carry out revenue-generating activities, and the role of KPH has tended to be limited to forest management and technical assistance. Interviews confirmed that this represented a major turning point in the operation of the system in the field of social forestry and forest governance in recent years. Therefore, in order to maintain and strengthen KPH functions, it is important to reinforce KPH budget allocations and deepen cooperation among stakeholders.

**Relevant stakeholder status**

In the survey area, a cooperative system is being formed with various actors such as KPH West Bali, village governments, customary village (adat) leaders, as well as the military, Tourism Office, and BPS-Statistics Indonesia (Jembrana Office). KPH conducts training on forest management at the village level and also advises on matching with businesses and financing. In addition, the village government allocates part of the budget necessary for forest management activities to the development of tourism infrastructure and is cooperating with the Tourism Office. The following are examples of key stakeholders related to the activities of the West Bali KPH and the surrounding forest area.

In the West Bali KPH management area, several non-governmental organizations (NGOs) and educational institutions are involved in forest conservation and community development. The main stakeholders are IDEP Selaras Bali Foundation, based in Gianyar Regency, Bali, and BASE (Bisnis Alternatif untuk Sosial dan Ekologi) in Jembrana Regency. IDEP works to strengthen the resilience of local communities through education, disaster response, and sustainable resource management. BASE Bali, on the other hand, aims to promote civic participation among young people and is committed to community development using local languages and digital media. As an example of their activities, the two organizations jointly opened a “Learning Forest” in Mendoyo District, Jembrana Regency in March 2021. This facility aims to balance forest conservation and environmental education, and serves as a learning place to raise awareness of the importance of forests among local residents. It is also positioned as a practical base for sustainable forest use models that emphasize environmental, social, economic, and cultural harmony. As part of the activities, tree planting is also carried out to coincide with World Forest Day, focusing on local native species, and a variety of tree species are planted, including Balinese nutmeg, durian, and akar wangi (vetiver).

In addition, as an example of an educational and research institution, Udayana University is also actively involved in forest management and community development in Pulukan Village. In August 2024, community service activities for residents on the “Creative Village” and agrotourism were carried out, and lectures and discussions were held by students and experts. The activity raised awareness about the maintenance of sustainable forests through local agriculture and the effective use of economic resources, and was attended by village office officials, village-run companies, and local residents. The lecture introduced strategies for creative local economies, agrotourism products, and linkages with sustainable forests.

In addition, in the West Bali KPH jurisdiction, the Indonesian National Armed Forces (Tentara Nasional Indonesia, TNI) are also actively involved in forest conservation activities as one of the

important stakeholders. In December 2024, a forest planting activity was carried out in collaboration with local residents in the management area of the Social Forestry Group (KTH) “Puncak Mawar,” located in Dewasana, Pendem Village, Jembrana Regency, under the leadership of the Jembrana District Military Command. At the event, a total of 500 saplings such as avocados, durian, mangoes, and star fruit were planted by soldiers and residents. This activity is part of the national reforestation program promoted by the TNI headquarters, which aims to preserve the natural environment, prevent floods and landslides, and reduce disaster risks such as controlling soil erosion, especially during the rainy season. At the same time, afforestation centered on fruit trees is expected to contribute to the economic interests of local residents, and cases of military cooperation in social forestry efforts aimed at balancing livelihood improvement and forest conservation were confirmed.

In this way, forest conservation in the West Bali region is supported by the collaboration of various actors such as NGOs, universities, and the military, as well as KPH and social forestry groups, and the practice of forest management through multi-actor cooperation is being developed.

**Improving livelihoods through agroforestry and other activities based on Bali’s cultural values**

In Pulukan Village, agroforestry centered on durian (Musang King cultivar) is attracting attention. Under the leadership of the village head, seedling distribution and afforestation activities using the village budget are being carried out, and in the future it is planned to promote agrotourism using orchards. Conference facilities and simple toilets have already been built around the forest, and a guidance system for external visitors is being established.

Meanwhile, the Social Forestry Group (Puncak Mawar) in Pendem Village envisions the use of forests using NTFPs and the development of meditation-based ecotourism using waterfalls. In particular, there is a strong tendency to view forest space as a spiritual and cultural resource, which is an opportunity to attract tourists and at the same time transmit the cultural values of the region. Afforestation activities are also being carried out in cooperation with the above-mentioned military.

An essential part of talking about forest management in Bali is the existence of the idea of Tri Hita Karana. This is the central idea of Balinese Hindu culture, which emphasizes the trinity of harmony between God (Parahyangan), humans (Pawongan), and nature (Palemahan), and the forest is positioned as a “sacred space.” For example, there are many water sources and temples in the forest, and it is considered “a place where no one should harm it.” If logging or pollution is discovered, it may be accompanied by purification by religious ceremonies and sanctions within

the village community. These cultural values serve as a stronger deterrent than administrative regulations and can be said to support local residents' awareness of forest conservation.

The above points that are attracting attention as a practice of social forestry in West Bali are that the inter-stakeholder collaboration model is emerging while crossing administration, economy, and culture. For example, it has been confirmed that KPH and villages have collaborated to formulate an agroforestry plan, and the village provided funds, and the results were shared with the villagers. Of course, issues remained, and some residents reported a lack of understanding of forest laws and management rules, as well as cases of illegal logging and violations of regulations. There is also a lack of skills within KTH—such as fund management, income-expenditure planning, and commodity processing—which limits the commercial use of forest resources. In addition, a certain budget is required to develop the equipment and facilities necessary for forest management, but it is currently difficult for KTH alone to secure funding, and the KPH budget is limited; therefore, continuous external support and further collaboration among stakeholders are expected to strengthen forest management.

## 4. CONCLUSION

This study investigated the current state of forest management in Pulukan Village in western Bali, Indonesia, and neighbouring areas, and clarified how local residents use and conserve forests under the social forestry system. Analysing multifaceted factors—institutional support, cultural context, stakeholder engagement, and livelihood-enhancement initiatives—in light of international guidelines on Sustainable Forest Management (SFM) led to the following key findings.

First, durian-based agroforestry in Pulukan and forest use linked to tourism assets in Pendem demonstrate the potential for livelihood-improving community forest management, consistent with social forestry objectives. Technical support and administrative cooperation from KPH Bali Barat, together with the value of forests as sacred spaces rooted in Bali's religious culture (Tri Hita Karana), supported local conservation actions from both institutional and cultural perspectives.

Second, although social-forestry groups have achieved certain results, the sustainability of management remains uncertain due to limited understanding of the legal framework, weaknesses in technical and managerial capacities, and financial constraints. Cooperation with external stakeholders exists but remains at an early stage; a more systematic and institutional foundation is needed.

Third, the implementation of socio-cultural values, namely Tri Hita Karana by village communities is an important factor in forest management in the two villages.

Taken together, practices in Pulukan and other sites reveal both the possibilities and the limitations of local governance under social forestry, and they pinpoint specific challenges for future policy design and implementation.

Policy recommendations. Based on the results of this study, we present the following four policy implications.

(1) Harmonise cultural norms and institutions. In areas such as Bali where forests have spiritual and religious value, flexible forest management is required—not a legal framework alone. System operation should explicitly recognise how concepts like Tri Hita Karana shape local norms, and promote cooperation with Adat (customary villages) in administrative rule-making and monitoring.

(2) Strengthen KPH as an intermediary support organisation. KPH should function not only as an administrative forest management unit but also as an intermediate support organisation that brokers cooperation among resident organisations, firms, governments, and cultural bodies. This requires strengthening KPH human resources, budgets, and discretion, and revisiting the allocation of authorities and support frameworks at local-government and ministeriallevels.

(3) Build community capabilities along the value chain. Beyond agronomic and silvicultural techniques, KTHs require comprehensive capacity-building programmes in product processing, marketing, tourism development, and financial management. Matching with external experts and establishing reinvestment models based on periodic business assessments should also be supported.

(4) Develop PPPs and sustainable financing schemes. Current KPH and local-government budgets are insufficient to cover infrastructure and outreach essential for forest management. A multifaceted financing approach is needed, including PPPs with companies and NGOs, reinvestment of tourism revenues into forests, and access to results-based climate finance (e.g., REDD+).

This study analysed cases in Pulukan and other locations; future research should expand in three directions. First, comparative studies across multiple regions should clarify how differences in institutional operation and cultural background affect forest management. Second, evidence-based policy recommendations require the measurement and reporting of concrete environmental and economic outcomes (e.g., changes in carbon sequestration, biodiversity

indicators, and livelihood levels). Third, further work should deepen the institutional-economics and legal-sociology analysis of social-forestry system design.

In sum, this study clarified the realities of SFM where cultural norms and institutional frameworks intersect under Indonesia's social forestry system. Practices in Pulukan demonstrate the potential of resident-led management and governance, and they identify concrete issues and directions for institutional design and support systems. To advance SFM, it is essential to design flexible systems that respect local cultures, continuously develop community capabilities, activate intermediate support organisations, and cooperate effectively with external resources.

**REFERENCES**

Bappenas (2020). Rencana Induk Perhutanan Sosial Nasional 2020–2045. Ministry of National Development Planning, Republic of Indonesia.

Climate Watch. (2024). Historical GHG Emissions. World Resources Institute. https://www.climatewatchdata.org/ghg-emissions

Dodo, Hartini S. (2019). Inventory and characteristics habitats of wild orchids in West Bali forest. Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia, 5, 1-6.

Eno, M. (2020). Institutional challenges of Forest Management Units (FMUs/KPH) in Indonesia: A review. Forest and Society, 4(2), 258-273.

FAO (2016). Guidelines on integrating climate change issues into forest policy and management planning. Food and Agriculture Organization of the United Nations.

Gaveau, D. L. A., Sloan, S., Molidena, E., Yaen, H., Sheil, D., Abram, N. K., ... & Meijaard, E. (2014). Four decades of forest persistence, clearance and logging on Borneo. PLoS ONE, 9(7), e101654.

Golar, G., Supriyanto, B., & Nugroho, B. (2023). Implementation of forest-land rehabilitation to support the enhancement of carbon stock on Indonesia's FOLU net sink 2030 strategy. IOP Conference Series: Earth and Environmental Science, 1241, 012024.

ITTO (1997). ITTO guidelines for the sustainable management of natural tropical forests. International Tropical Timber Organization.

Kim, Y. S., Kurniasih, H., & Ko, J. (2017). Managing Forest Conflicts: Perspectives of Indonesia's Forest Management Unit Directors. Forest Policy and Economics, 83, 1-11.

Ministry of Environment and Forestry (2018). Indonesia Second Biennial Update Report (BUR-2) to UNFCCC. Jakarta: Republic of Indonesia.

Miteva, D. A., Loucks, C. J., & Pattanayak, S. K. (2015). Social and Environmental Impacts of Forest Management Certification in Indonesia. Proceedings of the National Academy of Sciences, 112(14), 4643-4648.

Santika, T., Meijaard, E., Wilson, K. A., Budiharta, S., Law, E. A., Sabri, M., ... & Struebig, M. J. (2021). No aggregate deforestation reductions from rollout of community land titles in Indonesia yet. Proceedings of the National Academy of Sciences, 118(42), e2109205118.

Sitorus, S. R. P., Sitorus, S. D., & Sitorus, S. R. (2022). Living side by side with nature: evidence of self-governance in three local communities in Indonesia. Heliyon, 8(12), e11847.

Suryawan, I G. B., Suryani N. L. P., Sari, I. P., Wijaya, I W. P. A., Widharsana, I M. D. (2024) Forest Protection in the West Bali KPH area Jembrana Regency. International Journal of Judicial Law, 03(06) 38-41.

Uda, S. K., Hein, L., & Sumarga, E. (2020). Towards sustainable land use in peatland areas: A review of policies and impacts in Indonesia. Land Use Policy, 99, 104850.

World Bank (2016). Indonesia: The Cost of Fire. World Bank Group.