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RESEARCH ARTICLE

Territorializing Restoration: The Exclusion of Indigenous Agroforestry in Indonesia

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ABSTRACT

For decades, formal forest restoration initiatives in Indonesia have largely been driven by the state, companies, international donors, and NGOs. Meanwhile, despite widespread state and plantation enclosures Indigenous Dayak groups have been regenerating lands through swidden and turning them into fruit-based agroforestry for generations. Across Indonesia, traditional practices are largely excluded from the national and international restoration agenda. This paper examines forest restoration through the lens of Indigenous agroforestry, specifically through the transformations unfolding in shifting cultivation practices among the Dayak Ga'ai in Long Buang village, Bulungan District, North Kalimantan. Through a political ecology lens, the study examines the main drivers of deforestation alongside the obstacles of integration of Indigenous restoration practices. The fieldwork involved participant observation and interviews with various members of the local community. The findings reveal how local knowledge and practices can and do successfully enact forest restoration in subtle and overlooked ways, while also providing subsistence and income, as well as helping to maintain traditional land ownership and relationships to the land. However, the expansion of market-oriented oil palm plantation and state territorialization cannot be understated, which has expanded through the designation of state forests, and which continue to impact agroforestry practices. In situating our approach around the processes of territorializing forestry, the analysis shows the importance of integrating local (Indigenous land tenure and knowledge) with land reform policies at the national level aimed at solving land tenure conflicts. Only in doing so, can any reform initiative hope to support equity through rights recognition and achieve more lasting forest restoration that has become a growing international priority.

Keywords: Forest restoration, Agroforestry, Political ecology, Land tenure, Local knowledge, Dayak Ga'ai

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1. Introduction

Forest restoration has become a central pillar of contemporary environmental governance across Southeast Asia. Governments, private companies, NGOs, and international donors increasingly promote restoration through tree planting, carbon finance, and biodiversity initiatives. Yet restoration is never politically neutral. Decisions over which lands are restored, whose knowledge counts, and who benefits from restoration often reproduce longstanding inequalities in authority, tenure, and recognition.

For millennia, swidden cultivators across Southeast Asia have supported local food systems through rotational farming systems that combine cropping and fallow phases, particularly in upland regions (Cramb et al., 2009; Mizuno et al., 2013). Beyond local production, swidden systems also sustain livelihoods, social relations, and cultural identity. In many places, swidden landscapes have evolved into agroforestry systems that provide income, food, and ecological functions, including biodiversity conservation and carbon storage (de Foresta et al., 2000; Noordwijk et al., 2008, Dove, 2011; Hartoyo et al., 2016).

Across Indonesia, diverse community-based agroforestry systems have emerged from long historical interactions between farming and forest management, including *repong, tembawang, lembo, simpukng, makkalice, dusun,* and other regionally specific forms (Arifin et al., 2003; Mulyoutami et al., 2009; Hartoyo et al., 2016; Supratman & Fisher, 2023). The system discussed in this paper is found in the Bulungan regency of North Kalimantan and involves the *ledda gua'*, a fruits-based agroforestry landscape practiced by the Dayak Ga'ai in Long Buang Village, North Kalimantan.

Despite their importance, swidden and agroforestry systems across Southeast Asia face growing pressures from demographic change, commercial agriculture, state forest expansion, conservation zoning, and roads development (Cramb et al., 2009; Fox et al., 2009). Swidden cultivators are often portrayed as environmentally destructive or socially backward, even where their practices maintain biodiversity and sustain local livelihoods. Such narratives frequently obscure the dynamic relationships between fields, fallows, agroforestry, and forest regeneration.

At the same time, restoration programs have expanded rapidly across Southeast Asia. While many initiatives aim to recover forest cover, biodiversity, or carbon stocks, they increasingly also claim to support livelihoods and tenure reform. However, restoration interventions often operate through formal land categories and externally designed models that insufficiently engage existing community land-use systems. The effect undermines local agency and long term restoration outcomes.

Existing studies have examined restoration policy, ecological outcomes, and carbon governance, while other scholarship has documented swidden transitions and agroforestry livelihoods. Far less attention has been given to how contemporary restoration agendas interact with already existing Indigenous restoration systems, especially in landscapes shaped by overlapping concessions, state territorialization, and uncertain tenure. This paper aims to recenter this overall perspective, particularly by drawing from historicized and deep engagement from local community perspectives.

Meanwhile, forest restoration programs in Southeast Asia have targeted vast landscapes across the region, and have been ongoing for extended periods. These activities often aim at environmental (forest cover, biodiversity, protecting water and soil, or carbon sequestration), and more recently have paid increasing attention to crucial socio-economic goals (income generation, food security), and the political realm of rights and land tenure. Contemporary studies primarily recommend integrating forest restoration with local practice and knowledge (C. M. Barr & Sayer, 2012a; Osborne et al., 2021a) but often lack contextual and empirical analysis of the relationship between forest restoration

and community land tenure (swidden cultivation and fruit-based agroforestry practices). The implementation of forest restoration projects face challenges based on local context, including landscape and cultural factors.

This paper addresses that gap through a political ecology analysis of Long Buang Village, North Kalimantan. We examine how *ledda gua'* functions as an Indigenous restoration system, how state and market territorialization constrain community land use, and how formal restoration initiatives may simultaneously create new opportunities and new exclusions. In doing so, the paper contributes to wider debates on restoration justice and plural approaches to forest governance.

2. Territorialization, indigenous land use, and deforestation

The emergence of modern forestry regimes in Southeast Asia began when colonial states categorized lands as 'forest' in the nineteenth century, starting the expansion of the "political forest" (Peluso & Vandergeest, 2001). Post-colonial independent states extended mapping and zoning efforts, dividing territories into certain functions, such as agriculture and forestry, which involved drafting laws and regulations that delimited legal and illegal activities within forest territories. Furthermore, they established state forestry institutions to implement laws, essentially establishing counterinsurgency efforts and legitimizing the policing of forest areas, at the same time creating "legal exemptions that became customary rights" (Peluso & Vandergeest, 2001b).

Through the Ministry of Forestry, authority over forest territories continued to expand in area and scope, particularly targeting local agroforestry and swidden areas defined as underutilized and degraded (de Foresta et al., 2000; Hermosilla & Fay, 2005). One of the most popular pretexts for state territorialization is that the community-managed swidden and agroforestry practices drive deforestation (Sunderlin et al., 1997; Peluso & Vandergeest, 2001b; Barney, 2007; Dove, 2011).

State forest and land management policies in the last few decades, however, have been shown to be the main drivers of deforestation and land degradation. Between 1950–1975, focus centered on agricultural expansion, followed by the issuance of forest concession permits for industrial scale plantation and mining development between 1975–1990. In the 1990s forest management began to extend outside of state forest areas (Nawir et al., 2007). This was followed by changing political forces in Indonesia through policies of democratic decentralization, which led to an expansion of local governments attracting investment in natural resources (Barr et al., 2006). Deforestation rates have continued in various ways since. In the provinces of East and North Kalimantan, the highest deforestation rates were recorded in 2014–2015 (100,931 ha) and reached their lowest point in 2019–2020 (10,661 ha), possibly due to a decrease in available forest for conversion. In the period between 2013 and 2020, deforestation occurred mostly outside state forest areas Statistik (2024, January 15), especially due to mining permits, oil palm plantations, and agriculture. Anugrah (2024) revealed that the total deforestation rate in Indonesia between 2021–2022 reached 104,000 ha (net).

These extensive land and forest conversions have led to resistance from local community groups. To some of these groups, oil palm companies are considered beneficial for providing road access, schools, employment, involvement in contract farming, and various types of compensation (T. M. Li, 2002; Potter, 1999; Sirait, 2009). To many others, however, plantation companies at times ignored customary rights to resources because their formal lease rights superseded locally recognized rights (Sirait, 2009). As in many areas of Southeast Asia, community use of land and forests in the interior of

North Kalimantan often overlap with areas designated as state forests, and concessions can sometimes be applied in ways that local communities have little awareness about.

Throughout this history, land outside state forest also increasingly became allocated for plantation concessions (*Hak Guna Usaha,* HGU). These land use arrangements contributed to the shrinking space for swidden rice fields (*mo'*) and local agroforestry (*ledda gua*) and contributed to deforestation and land tenure conflicts. In 1990, the Forest Land use Agreement (*Tata Guna Hutan Kesepakatan* or TGHK) and Provincial Spatial Plan (*Rencana Tata Ruang Wilayah Provinsi*) policies became two basic instruments in designing and controlling the development of Forest Concession Rights (*Hak Pengelolaan Hutan* or HPH), Industrial Plantation Forests and plantation to reduce the rate of deforestation of natural forests. However, in practice, overlapping boundary conflicts between communities and local governments, private companies, and state-owned enterprises furthered deepened enclosure and dispossession (Nawir et al., 2007).

Swidden cultivation, agroforestry, and forests have thus been interrelated across a fractured and dynamic landscape, giving rise to unique relational forms of land tenure among local communities and institutional authority. In academic studies that write the landscape, the definitions of swidden, shifting, or slash-and-burn cultivation become the frameworks that also reinforce and shape policy narratives (Colfer et al., 2015). This leads to immense confusion, subversion, and conflict. Foresters might consider an activity as causing forest degradation, while agriculturalists see it as a fallow land process (W. Dressler et al., 2015). Locally, the practice can blur or interchange boundaries between traditional swidden and agroforestry. For example, Dayak Iban integrated swidden cultivation and rubber-based agroforestry for food and other needs while also fashioning their plots to connect with global export commodity opportunities (Dove, 2011). Similarly, researchers from The World Agroforestry Center (ICRAF) in Indonesia, who have focused on food-crop fields as the central component in 'shifting cultivation', redefine such systems as 'agroforestry systems', extending the concept when commercial tree or tree-borne crops take on more substantive roles (Colfer et al., 2015). Following this notion, we understand agroforestry here as systems "consisting of a large number of trees, shrubs, seasonal plants, and/or grasses. Their physical appearance and dynamics are similar to primary and secondary natural forest ecosystems" (de Foresta et al., 2000, p.3). They grow out of cultivated gardens, or on plots previously cleared and planted, and are not usually a gradual progression of an area imagined as a 'natural' forest.

Earlier studies on local or traditional agroforestry found that swidden cultivation broadly begins by the clearing of forest vegetation, followed by the planting of various food crops until they form a wood-based agroforest, which serves as an important stage in the "domestication of the forest" (Michon & Foresta, 1997). The change in practice from swidden farming to local agroforestry systems often functions as a key source of income for the community as it relayers the forest in different ways (Michon & Foresta, 1997; de Foresta et al., 2000; Roslinda et al., 2023). Indeed, agroforestry practices can contribute up to 82.74% of the source of income in West Kalimantan (Roslinda et al., 2023). For Dayak Ga'ai in Long Buang Village, North Kalimantan, swidden cultivation is called *mo'* (*ladang),* fallow is called *penggai mo',* and the fruit-based agroforestry system is called *ledda gua'.*

Meanwhile, since 1960, state forest rehabilitation programs initiated a plethora of programs, including: the national "greening" or *penghijauan* program (1961–1995), Presidential Instruction on Reforestation (*reboisasi)* and Community Forest (*Hutan Rakyat*) (1976–1999), Village Seedling Gardens (1984–2001), Development of Plantation Forests in Former Logging Areas by State Companies (Inhutani I-V) (1994–1999) and various community-based resource initiatives such as Community Forestry (*Hutan Kemasyarakatan* or HKm) (1996–2003) (Nawir et al., 2007; C. Barr et al., 2010; Fisher et al., 2023) and a

series of social forestry in more recent years (Fisher et al., 2018). Throughout the 1980s and 1990s, forest restoration or rehabilitation was funded by multilateral and bilateral donors that focused on secondary forests and logged-over areas (Nawir et al., 2007). In 2003, the Ministry of Forestry launched the National Forest and Land Rehabilitation Movement (*Gerakan Nasional Rehabilitasi Hutan dan Lahan,* GNRHL or *Gerhan*), later renamed the Special Allocation Fund–Reforestation Fund (*Dana Alokasi Khusus-Dana Rehabilitasi* or DAK-DR). However, the procedure was complicated with a year-long administrative process, shortening the duration for implementation, which was too short for adequate preparations (Nawir et al., 2007). Moreover, the cost of implementing rehabilitation activities per hectare is relatively expensive. Nawir et al. (2007) found that rehabilitation costs ranged from US$43 to US$15,221 per hectare, depending on the funding source. The lowest costs were found in government projects, while the highest costs were in projects funded by international donors. Meanwhile, government projects like *Gerhan* on community land cost around US$335 (IDR 3 million) per hectare.

Recent restoration agendas increasingly claim to integrate local participation, tenure reform, and community-based approaches (Barr & Sayer, 2012; Osborne et al., 2021; Toumbourou et al., 2024). Yet in practice, restoration interventions often remain embedded within territorial governance systems that prioritize administrative legibility, concessionary authority, and externally defined ecological objectives (Scott, 1998; Peluso & Vandergeest, 2001; Fisher et al., 2023). As a result, Indigenous agroforestry and swidden landscapes may become simultaneously valued as restoration targets while excluded as legitimate systems of land use and territorial control.

This paper examines these tensions through the case of the Dayak Ga'ai in Long Buang, North Kalimantan. Focusing on the relationship between Indigenous agroforestry, state territorialization, and restoration interventions, we analyze how restoration agendas interact with overlapping land claims, concessionary regimes, and local efforts to sustain and legitimize ledda gua' as an Indigenous restoration practice.

3. Methods

3.1. Study area: Long buang village

Long Buang Village is a predominantly Dayak Ga'ai community located in the Bulungan Regency of North Kalimantan (see Fig. 1). The total village population is 350 people with a total of 104 families, and they depend on forest products, dry field rice farming, fruit crops, hunting, and foraging. This village can be reached in 3 hours by the logging road of timber companies (PT. Inhutani Unit 2 Segah, PT. HAKAP and ITCHI), or the five-hour river route from the capital town of Bulungan (see Fig. 2).

The total area of Long Buang Village is 28,248.15 ha and most of the land area is formally designated as Production Forest (20,391.56 ha), allocated with concession licenses to two timber companies, a state-owned and a private company. The remaining forest area in the village is designated as a Protected Forest, and later included by local villagers in their proposal for a Customary Forest, covering an area of 1,097.14 ha. Finally, the Village Forest Management Institution (*Lembaga Pengelola Hutan Desa, LPHD*) secured the right to manage the Village Forest from the Ministry of Environment and Forestry in 2023, covering an area of 1,026 ha.

Outside the state forest areas is a so-called designated miscellaneous use area (*Areal Penggunaan lain, APL*) of 5,820 ha, which has also been allocated to a palm oil company through the business use right (*Hak Guna Usaha,* HGU), covering 3,054.32 ha. The remaining APL of 1,632.09 ha includes residential areas (24.57 ha), swidden areas, and fruit gardens found

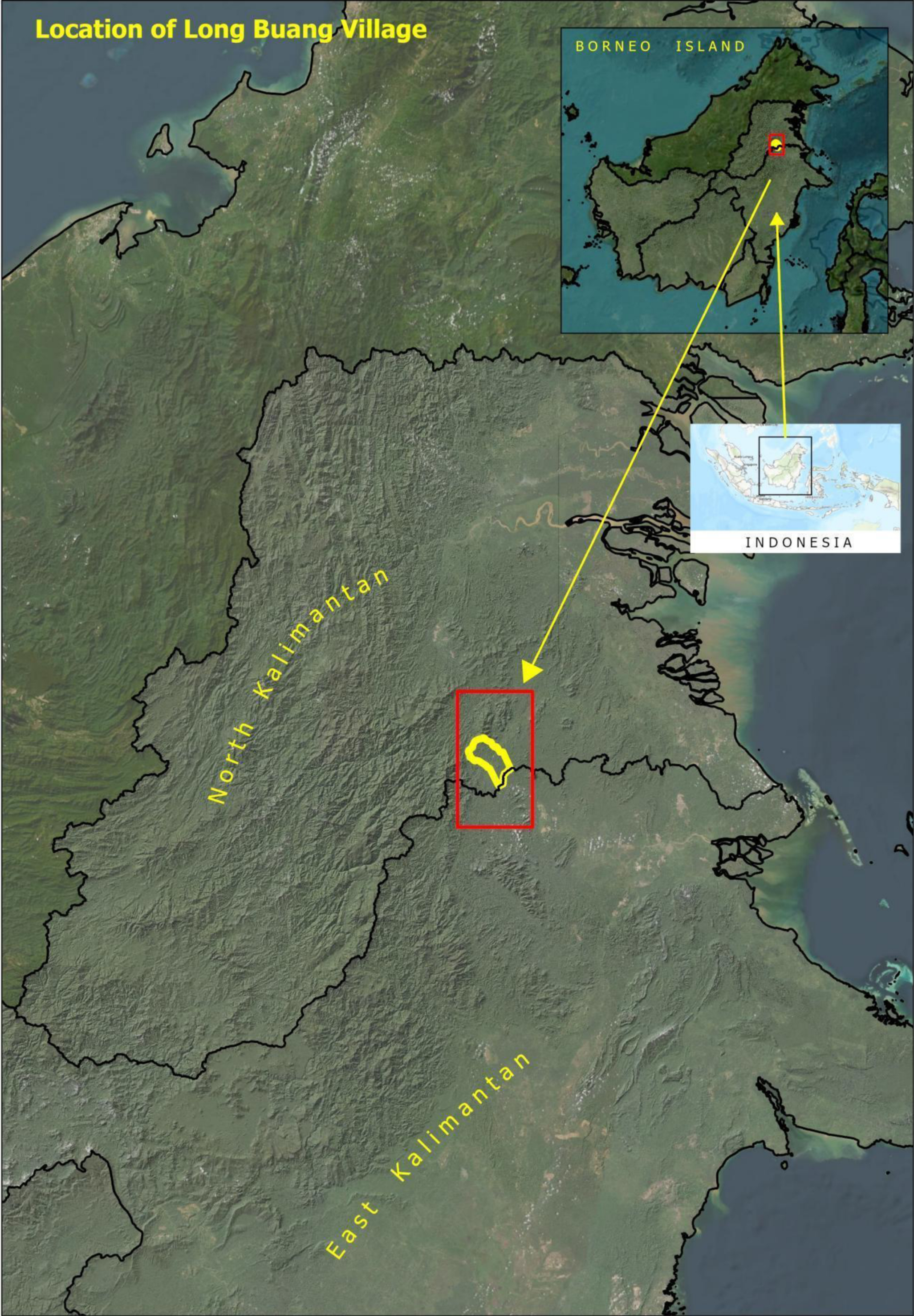

Fig. 1. Study site: Long buang village, North Kalimantan, Indonesia.

on the Pangean riverbanks. A local protection area is also reserved as customary land, extending to a total of 1,110.04 ha, and serves as a freshwater protection area. Part of this area, 267.6 hectares of forest cover, is included in the HGU, 75.71 ha of which also overlaps the villagers' swidden land and fruit gardens. This land allocation shows the dominant position of private companies. These overlapping regimes make the site especially relevant for examining how restoration, land tenure, and livelihood transitions intersect. The village was selected purposively as a critical case where Indigenous agroforestry persists amid competing restoration agenda, concessionary pressures, and land use reclassification. Rather than representing all swidden communities in Borneo, Long Buang is used to explore broader governance dynamics through a grounded case (Flyvbjerg, 2004).

3.2. Data sources

This research was conducted over two swidden farming cycles (2023–2025) from planting to harvesting, and covered several fruit seasons. The method used in this study is a combination of qualitative methods and GIS analysis to observe changes in forest cover (Preliminary data was collected in the first phase through satellite imagery). Qualitative applied participant observation to understand local land use and agroforestry practices of the Dayak Ga'ai. Interviews were conducted with as many informants as possible, including the head of the village, head of customary institution (*kepala adat*), 10 swidden cultivators, and 10 *ledda gua'* farmers. Interviews and observations were conducted during breaks while planting paddy as well as visiting old *ledda gua'* to obtain information related to swidden farming processes; *mo'* (paddy field)*, penggai mo'* (fallow)*, ledda gua'* (fruits-based agroforestry) and *kwang* (forest).

Participant observation through a participatory mapping initiative conducted by YKAN involved 40 villagers for zoning the village land use plan including the land restoration program area (see Fig. 3). Two Focus Group Discussions (FGDs) were conducted with 11 participants (9 male and 3 female).

The local terms of *ledda gua'* were detailed during observation to gardens along the Pangean Riverbank and restoration area (*kebun darat*). For more detail, the results of the sampling plots survey on these sites, like the vegetation, diversity of plants and the socio economic value obtained by villagers, can be seen in forthcoming publication in the Journal of Geographical Science (Siswandi et al., forthcoming).

In addition, because the research process coincided with the start of the restoration project using a local agroforestry system, the research team applied a participatory action research (PAR) framing by involving the community in the project to identify local concerns and follow up on their priorities. This included: (a) Technical aspects: Local agroforestry identification involving four local youths (2 female, 2 male) to identify types of fruit and wood trees. Each selected *ledda gua* owner also participated in the observation and discussion. Additionally, 15 young people were trained in the use of GPS and Avenza Map devices, who then mapped and arranged the land in the restoration area in *kebun darat* that overlapped with the HGU; and (b) non-technical aspects: Addressing legal challenges related to land use in the village that overlaps with oil palm permits.

Data analysis was conducted as follows. The observations, interviews, and FGD notes were transcribed and then categorized based on the themes identified, particularly those related to land tenure and local knowledge practices. Spatial data was analyzed with an overlay of village land use with the state forest and the palm oil permit area. This data was obtained from YKAN staff. These data were triangulated and analyzed, along with an observation of *ledda gua',* to empirically examine the plant composition, the driving factors of traditional *ledda gua'* formation along riverbanks, and distinguish them from

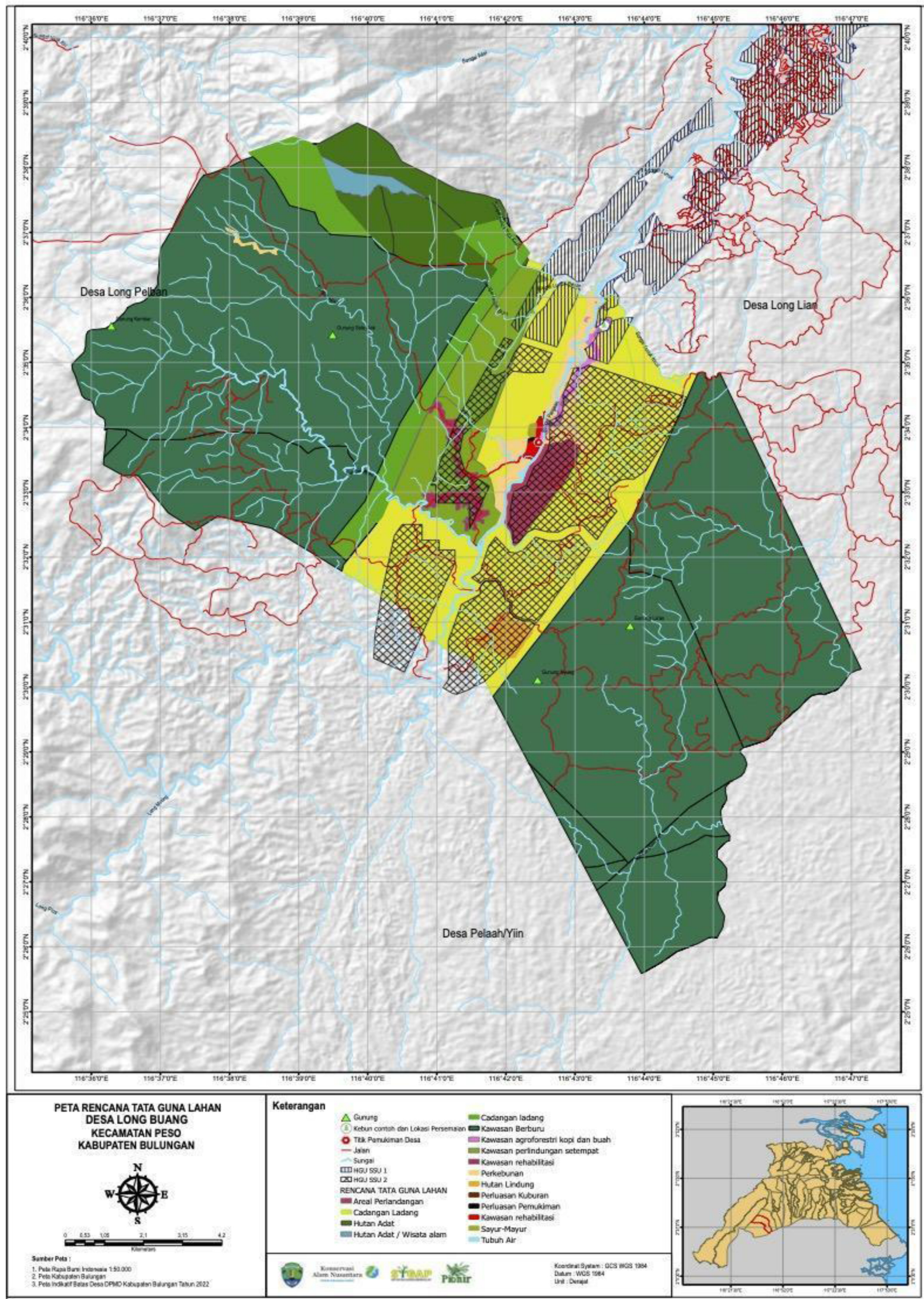

Fig. 2. Village land use (swidden land, agroforestry land and restoration area) overlapped with oil palm permit and State Forest.

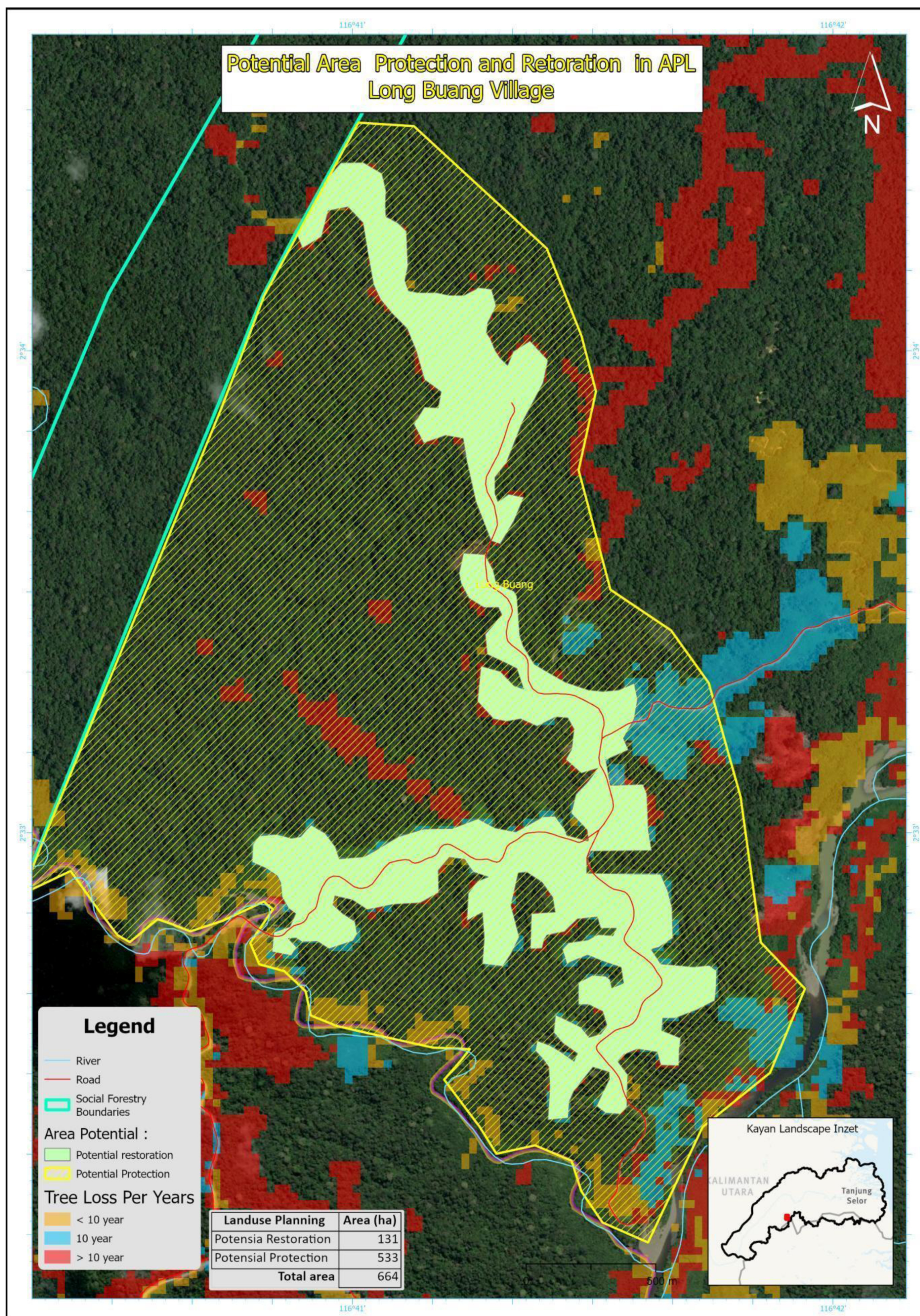

Fig. 3. Restoration program area.

NGO restoration interventions. Finally, these field findings were analyzed in conjunction with related literature and cases from elsewhere.

4. Results

4.1. State territorial categories and the fragmentation of indigenous land use

However, these locally rooted systems are increasingly constrained by state territorialization and overlapping concession regimes. Field evidence from Long Buang shows that state territorial categories have fragmented a landscape historically managed through interconnected practices of swidden cultivation (*mo'*), fallow (*penggai mo'*), fruit-based agroforestry (*ledda gua'*) and forest (*kwang*). For the Indigenous Peoples of this region, these categories are not separate land use but part of a cyclical socio-ecological system through which rice production, perennial crops, inheritance, and forest regeneration are organized across time.

The local Indigenous groups face obstacles when forest restoration initiatives are implemented. First, state territorialization has divided and undermined traditional land tenure and practices, asserting the dominance of companies that utilize the same land for industrial agriculture and timber expansion, affected by the state through changes in the legal status of land and forests. Second, the lack of legal recognition of the Indigenous land tenure limits access to land and forest, even when the local villagers have demanded formal access to their land.

4.1.1. The effects of industrial agriculture and timber expansion

State territorialization, through changing the forest's status and granting permits for logging and oil palm plantations, increases the rate of deforestation and forest degradation. Moreover, reforestation or rehabilitation programs are fragmented across several authorities: the Forestry Agency and Forest Management Unit (*KPH*) carry out reforestation inside and outside licensed areas; the Agriculture and Plantation Agency holds authority over non-state forest areas (*APL*) with or without a permit. Furthermore, the data also shows how the company significantly impacts the village area. The total village area is 28,248.15 ha, and the state forest covers 20,391.56 ha, while the village forest covers 1,026 ha. In addition, the non-state forest area (*APL*) covers 5,820 ha, and 3,054.32 ha of which is included in the palm oil permit (*HGU*). The remaining *APL* (1,632.09 ha) includes residential areas (24.57 ha), swidden areas, and fruit gardens. Finally, territorialization that divides the forest from non-forest areas, restoration and rehabilitation areas, and oil palm plantations, has yet to resolve the overlapping land access to *mo'* and *ledda gua'* in Long Buang.

When the logging company that harvested timber in the production forest area started running, they opened the road in Long Buang. The logging road provides access to the district capital and the forest, which opens up agricultural land along the logging road. The opening of logging roads created a new trend in land clearing for swidden farming alongside the road, for what they later called "*kebun darat*". The shift from riverbanks to roadside cultivation is driven by the need for swidden cultivation land. This shows that the logging expansion, which invites logging road development, helps to expand the swidden into the forested area. Moreover, this swidden area, which was formerly formally designated as Production Forest area, has changed to *APL* (i.e. no longer a State Forest area). Due to its remaining timber potential, the company was given a Timber Utilization License (*Izin Pemanfaatan Kayu, IPK*), a permit to harvest the remaining wood in the area. Subsequently, the area was assigned an *HGU* permit for oil palm plantations.

Palm oil companies sought community approval in 2008/2009 for their participation in contract farming schemes (*plasma*). This, however, is only to comply with a national condition to open a plantation. A use right permit (*HGU*) was granted to 3,054.32 hectares for 12 years on land located on both sides of the Pangean River. Initially, the company opened and planted oil palm in a 100-hectare plot but did not continue, leading to the revocation of the *Izin Usaha Perkebunan* (*IUP*), the Plantation Business Permit, in Long Buang village. However, the company still retains the *HGU* right that enables it to apply for another permit. This company also planted oil palm in downstream villages such as Long Lian[1], Peso, and Long Bia, which are extensively covered with oil palm.

4.1.2. Regulatory exclusion on indigenous agroforestry

One of the clearest examples of regulatory exclusion concerns agroforestry lands located along the Pangean riverbanks. For many households, riverbank zones have long been strategic locations for swidden cultivation and fruit-based agroforestry (*ledda gua'*) because rivers historically functioned as principal transportation corridors connecting settlements and farming sites. The river is also a source of community livelihood. The regulations that ban certification for lands on riverbanks, giving residents no legal access or recognition of the land, practices, and knowledge of the Dayak Ga'ai expressed in *ledda gua'*. This contributes to the limited access to land and planning for the development of government-assisted commodities, as well as the practice of *ledda gua'*. In early 2024, the *Pendaftaran Tanah Sistematis Lengkap (PTSL*), or the Complete and Systematic Land Registration initiative, brought a team that surveyed and measured people's lands on the Pangean riverbanks for certification. Unfortunately, the *ledda gua'* land with old fruit trees and food plants is categorized as riparian, i.e., within 100 meters from the river, hence cannot be proposed to receive a land title (certificate), similar to the inherited *ledda gua'* gardens. Meanwhile, the *ledda gua'* and *penggai mo'* lands located more than a hundred meters from the edge of the river have been included in the HGU for the palm oil company.

Interviews with farmers indicated frustration that fruit-based agroforestry lands for decades remain administratively invisible. While regulations frame riparian as ecological buffer zones, villagers understand them as a lived production landscape combining environmental stewardship, food security and inheritance. The case shows how environmental regulation can produce selective recognition when ecological protection is pursued without acknowledging historically rooted agroforestry systems already embedded in those landscapes.

4.1.3. Counter-mapping: inclusion and negotiation

In response to overlapping claims, villagers and the supporting organization engaged in participatory mapping to document land tenure area; swidden land, agroforestry sites, water source, protection zones, customary forest (Peluso, 1995; Radjawali & Pye, 2015). These exercises were valued not only as technical tools but also as political instruments for making local land use visible to state agencies and companies. Village leaders simultaneously pursued multiple recognition pathways, including Village Forest, Customary Forest, negotiation with government and oil palm companies over enclave areas within concession zones.

At the household level, the Head of Village also facilitated 200 land certificates for their homes and settlements, and a small part of the land near the settlements. Another

[1] Many Long Lian residents have started to clear forests for farming in the Production Forest where access to this location is quite far using two-wheeled vehicles.

strategy is that gardens on the side of the road and the Pangean riverbanks are proposed for partnerships with companies or other legal means, such as customary land and customary forests, after being recognized as a Customary Law Community. In 2023, with NGOs, they also proposed a Village Forest designation (a social forestry scheme) and succeeded in earning the right to manage 1,026 ha of Village Forest from the Ministry of Environment and Forestry.

However, the company holds more power regarding access to lands, so much so that the people have to come up with two options for accessing the area, all of which require a formal request to the company: legally releasing it from the plantation permit (creating an enclave) or forging a collaboration with the oil palm company. The village government, customary leader, and community representative have requested facilitation from the district government with the oil palm company. The district government, through the Bulungan Regency Agriculture and Plantation Service, helped them to meet the Head of the Regency to discuss these issues. The district government is currently facilitating negotiations between the company and the residents, but there has been no written agreement regarding partnership or exclusion from the plantation's *HGU* (permit right). Without such an agreement, the restoration program cannot be implemented in the overlapping area. At the moment, the government has revoked the company's plantation permit (IUP) while retaining its use permit (HGU), meaning the company still pays taxes to the regency. The village government also asked for a written agreement to legalize cooperation between the traditional institution/village government and the palm oil company (PT. SSU 2). At the time of the research, no results have been reported.

These strategies suggest that Indigenous land users are not passive victims of territorialization. They actively negotiate, make alliances, reinterpret, and persist within unequal governance structures, even as the terms of recognition remain externally controlled.

4.2. The practice of everyday indigenous restoration

This section shows that long before formal restoration initiatives were introduced, local communities had already practiced forms of landscape restoration through swidden-agroforestry transitions.

Ledda Gua' broadly translates as a fruit-based agroforestry system, whereby fallow lands (*penggai*) are intentionally planted with native fruits such as *durian, elai, cempedak*. Local Indigenous farmers also began cultivating coffee and cocoa for a time in the late 1980s. In the last five years, they have been planting grafted fruit trees provided by the village government through extension programs.

The formation of *ledda gua'* is closely linked to rotational swidden cultivation, an annual practice of the Dayak Ga'ai in Long Buang. They open swidden fields by clearing forests (*kwang*) or former fields (*penggai* aged 5–10 years) to plant rice, beans, sweet potatoes, bananas, and sugar cane, which are found around the field hut (*pao*). They cultivate these seasonal plants while simultaneously planting new fruit trees such as *langsat, durian,* and *cempedak*, as well as commodities like cocoa and coffee.

In the following year's rotation, to meet the need for rice, the older generation in Long Buang typically reopens fallows (*penggai mo'*) that are five years old or more that have not been planted with fruit, and are located at the Pangean riverbanks. They clear the boundary between the land overgrown with fruit trees and the *penggai* (fallow) before burning to avoid damaging fruit trees. When coffee and cocoa are less productive than expected, they cut them down and convert the land into rice fields, while also planting new fruit trees or coffee alongside the rice.

The Long Buang people practice the swidden and fruit garden system on the Pangean riverbanks due to better access by boat. There are at least two models of *ledda gua* that we observed. First, the old *ledda gua* model (30 years old or more) on the Pangean riverbanks, which is dominated by native plants such as *duku* and several types of forest *durians* combined with cocoa and coffee, which follow trends in market prices. Second, the *ledda gua* model on *Kebun Darat* beside the logging road, where native fruit trees (*green durian, elai, kapul, langsat, duku*) are mixed with grafted fruit trees obtained from outside, such as *durian (musangking, bawor, montong)*, *petai*, avocado, and commodity crops, such as pepper, cocoa, and coffee. More detail can be found in a forthcoming publication (Siswandi et al., forthcoming).

The *ledda gua'* ownership system is based on individuals who first clear forests to plant rice in *mo'* land. Afterwards, the landowner plants various local fruits and wood-producing trees, such as ironwood, *tengkawang,* and honey trees, which are not cut down during the forest clearing. These trees belong to the plot owner. As the fruit trees in the *ledda gua'* grow older and resemble a forest, the ownership system remains within the descendants of the first generation who opened and maintained the *ledda gua'*.

Currently, the *ledda gua'* on the Pangean riverbanks is jointly inherited by the second and third generations of the original owners. During the fruit season, this inherited *ledda gua'* is harvested collectively, and the harvest is divided among the children. This inherited joint ownership system of the *ledda gua'* is called *pekelwis*, and the *ledda gua'* that has been divided among the children of the first pioneers is called *kelul* (inheritance) (Peluso, 1996).The Indigenous restoration through agroforestry became a source of income and livelihood for decades. The most economically valuable and diverse of fruit trees in Long Buang (Siswandi et al., forthcoming) is in line with the recommendations proposed by agroforestry research in Kampung Birang, Berau, East Kalimantan, where the plot was said to need enrichment of species that have a high source of income (Hartoyo et al., 2016). Similarly, a study shows the advantages of the *tembawang* agroforestry in West Kalimantan as a source of income (Dibcoop and Tropenbos, 2021; Mulyoutami et al., 2024). The *ledda gua'* is also a source of food, like vegetables. Fruit-based agroforestry mixed plants such as coffee, cocoa, and plants related to traditional customs are practiced in *lembo,* West Kutai, East Kalimantan (Paulus et al., 2014). At the household level, this practice is part of an everyday strategy for diversified livelihoods that include traditional gold mining, wage labor, transport work, small trade, fishing and hunting while maintaining rice cultivation and agroforestry.

4.3. Roads, frontier expansion, and new agroforestry spaces

Road development associated with timber extraction reshaped patterns of community land use and territorial access in Long Buang. While roads facilitated commercial extraction and plantation expansion, they also enabled households to establish new swidden fields and agroforestry areas in previously less accessible forest zones. Villagers of Long Buang explained that earlier generations relied primarily on access to the land on the Pangean River where Indigenous agroforestry was thriving as a landscape restoration (Siswandi et al., forthcoming publication in Journal of Geographical Science). Meanwhile, the new roads created opportunities to open fields in more distance from the river, which is locally known as *Kebun Darat* and can be accessed by motorbike or car.

When the *Kebun Darat* was cleared for rice cultivation, the farmers also planted local fruit trees and several types of new trees, like grafted trees and *petai,* which were part of the aid seeds distributed by the village government. During the planting period, the village government also had a *sahang* (pepper) seed planting program, in which 200 seeds

were distributed to each farmer. Nevertheless, the peppers no longer grow. By processing the *penggai* (fallow) into *mo'* (by planting for the seasonal rotation), these *penggai-mo'* will slowly form a *ledda gua'* like the ones on the Pangean riverbanks.

Meanwhile, the concession permit (timber and oil palm) areas issued by regency and national government intensified uncertainty. This area for swidden rotation, fallow and agroforestry garden are enclosed within formal permits. Even where plantations were not fully developed on the ground, the legal presence of permits constrained villagers' planning and demise of the land tenure.

This finding shows that road infrastructure does not merely connect places and improved mobility and new sites for swidden cultivation. Road and permits, vice versa reorganize access for frontier expansion, reshape livelihood decisions, and redistribute power over future land use and land conflict between state, companies and villages.

4.4. NGO forest restoration initiatives

Rather than rejecting restoration, villagers attempt to negotiate and reshape it through emerging institutional arrangements.

Previously, timber company programs established nurseries on the riverbanks to be planted in the company area. The company also provided cocoa seedlings and planted them in the (former) fallow.

These lands also host the state rehabilitation programs, with mixed results. The latest program from the village government, utilizing the village budget, distributes 200 pepper plants per farmer. But none of these plants succeeded. In the last three years, the village government and the agriculture and plantation agency also provided fruit, coffee, and cocoa seeds. These seeds are distributed annually to farmers, who plant many of the seeds in former swidden fields on the riverbanks and the roadsides. In 2024, the Agriculture Agency at the regency level provided 25,000 coffee seeds, also to be planted in 25 hectares of former swidden fields on the roadsides and riverbanks. In addition to seeds, farmers are assisted with fertilizer. In the same year, when the price of cocoa reached Rp. 120,000 per kilogram, the farmers flocked to plant cocoa in former rice fields on the riverbanks.

In 2024, a restoration program also introduced by an international donor, in collaboration with a national NGO, started a forest restoration program. The Long Buang Village Government chose the fallow lands for the restoration program, on both sides of the logging road that suited the carbon requirement project. Satellite imagery analysis shows the history of forest clearing of 130 ha into former swidden fields (*penggai*) opened in 2013–2015, some of which have become fruit gardens (*ledda gua'*). Today, the former swidden fields (*Penggai mo'*) are 10 years old, have been left to grow into dense thickets, and are dominated by pioneer plants of the *Macaranga sp.* type.

However, the land (*mo'* and *penggai*) in the Pangean River and the state road, as well as the restoration program land in *Kebun Darat* overlap with the plots of oil palm plantation permits. The NGO helped overlay the village land use plan map with the palm oil company's 2014 use permit (HGU). The villagers intended to request a riverbank area that extends to one kilometer from the edge of the Pangean River for swidden farming (*mo'* and *penggai*) and gardens, including the gardens on *Kebun Darat* land (260-ha restoration area that includes 70 ha of farmers' gardens), and to be removed from the plantation permit area. This area is proposed to be a customary protection area for the village's source of clean water, food, and medicine, with a total of 800 hectares.

4.4.1. The institutional structure of the program

As a restoration program intervention by NGOs, they were required to, and pursued a free prior and informed consent (FPIC) approach. In March 2024, 68 heads of families signed an internal agreement as a form of witness by the village head and the traditional and village assembly (BPD) leaders. The villagers granted consent for cooperation under a social forestry scheme, which plans to conduct restoration through local agroforestry systems and management of locally protected areas. This agreement was then followed by a series of agreements between the village government and the donor agency, the village government with the village forest council (LPHD), and between the village forest council and member farmers. This agreement aimed to clarify the obligations of each party in the funding distribution mechanism, program implementation, and monitoring and evaluation. The collaboration lasts 3 years with a total incentive for restoration activities amounting to IDR. 30 million per hectare.

The cooperation agreement between the national NGO and the Long Buang village government was also retrofitted as an administrative support initiative to channel grant funds from donors to the Long Buang village government account. This funding was then distributed as incentive costs for land management, installing stakes, digging holes, providing local seedlings, planting, and maintenance. At the end of the year, forest farmers would then be given an incentive according to the number of target trees that have successfully grown in the first year. Other agreements have also been reached between the regency Community Empowerment and Village Government office (*DPMPD*) and the village government on the management and supervision of the restoration program incentives. These incentive funds are counted as funding from a third party that must be included in the village government budget plan.

The Long Buang village government also made an agreement with the LPHD on the roles and responsibilities of each institution in program implementation. Furthermore, LPHD also made an agreement between LPHD and farmer members about the rights and obligations of each party. The village government funded the farmer members. The LPHD Monitoring Team supervised and provided recommendations for payment of incentives for farmer members to the village government. Farmer members will be given further incentives when they complete the land management activities, prepare planting holes, provide seeds, and perform maintenance. As the funding party, the national NGO monitors, evaluates, and examines the restoration activities. The national NGO also supports farmers and LPHD with field schools and the creation of nursery facilities in the village.

4.4.2. Labor incentive, land management, seed, and tree plantation

The rehabilitation program included a plant composition of 400 trees per hectare, consisting of 280 fruit trees and 120 timber trees. Forest farmers are expected to organize the land by marking boundaries per hectare and recording wood and fruit trees previously planted. Farmer members will choose their seedlings with a minimum of 400–500 as a reserve for replanting if any plants fail to grow. The selection of species that are part of the culture and livelihood can also guarantee the success of plants in the long term, especially by considering community choices (Nawir et al., 2007).

At the end of the first year, monitoring is expected to be carried out on plants that have successfully grown, where each tree will be given an incentive of IDR. 10,000 per tree. A sustainable and long-term mechanism was developed that combines nurseries, successive planting, and product marketing and funding in the form of environmental services (Nawir et al., 2007). Environmental service rewards or incentives were evaluated to be critical, but marketing of agroforestry products and support from institutions to access markets are critical and underdeveloped. Several agroforestry models in Southeast Asia and various

parts of the world recommend closer attention to support for agroforestry profits if they want to become economically viable and sustainable in the long term (Mulyoutami et al., 2024). There is no financial support related to the development of agroforestry products and other non-timber products (Mulyoutami et al., 2024).

As a part of environmental payment services, funding from carbon programs has also proven to be unviable as a revenue source because these programs require large-scale areas and high project costs, making them again inaccessible to communities with limited land, particularly the contested legality of these lands.

5. DISCUSSION

5.1. Territorialization: state control, market expansion, and the squeeze on Indigenous landscape restoration

The Long Buang case demonstrates that exclusion from restoration is not produced solely by direct land dispossession or over conflict. It is also enacted through territorialization: the conversion of lived landscape into administratively bounded zones governed through maps, permits, and sectoral authority. Establishing a state forest is a form of political forest (Peluso & Vandergeest, 2001b). The government divided the forest in several areas like the State Forest for protection and timber companies. They also changed the legal status into Non State Forest for oil palm plantation and mining. In Long Buang, indigenous land tenures, knowledge practices are fragmented and overlapped with Production Forest, timber company, oil palm plantation, riparian buffer zones and other State zones categories.

The Dayak Ga'ai in Long Buang has long been practicing *Ledda gua'* as a knowledge system for landscape restoration. It was always an effort to build an ecosystem comprising trees that at once afford cash crops (coffee, cocoa), food (rice from shifting cultivation), vegetables, and forestry (fruit and wood trees), legacies that are closely related to their socio-cultural systems, access and use of technology, labor, and land ownership. This knowledge has developed over time in response to local environmental, economic, and socio-cultural conditions.

Throughout the early parts of this paper, we clearly explain how policies that distinguish state forest from non-state forest areas, representing a situated form of state territorialization (Peluso & Vandergeest, 2001b). This allows the state to change the status of the areas, such as relegating the status of the forest area to non-state forest (APL) and changing the logging permit (IPK) to an oil palm plantation permit. This shift contributed to widespread deforestation and forest and land degradation that squeezed in-site communities into smaller enclaves. This story is common across Indonesia, as nationwide 82.9 million hectares (63.1%) of the Forest Estate is under the authority of the Indonesian Ministry of Forestry, and furthermore, is considered either degraded or deforested (Ministry of Forestry, 2013a). Approximately 20 million hectares of the degraded forest are considered idle without a concession and hence targeted for illegal logging, land grabbing, or gazetted for oil palm plantations (Budiharta et al., 2014). This has also acted as further pretext for dispossession on the grounds of restoration (Fisher et al., 2023).

At the village level, our exposition shows how the state and companies dominate forests and land. Less discussed in this paper are the similar conditions that also unfolded in neighboring villages such as Long Lian and Peso, where swidden farming and fruit agroforestry lands continue to decrease due to forest clearing by oil palm plantations. These conditions have pushed local communities to seek out and cultivate swiddens further away from their villages. They also clear plots inside state forest areas.

Furthermore, the Long Buang community-based forest protection and restoration program is not only limited in size (only 100 ha), but also constantly faces land tenure conflicts with oil palm plantation permits. In addition, traditional agroforestry lands on the banks of the Pangean River cannot be certified due to government regulation regarding riparian zones, which further squeezes Indigenous agroforestry lands as a form of Indigenous landscape restoration.

Thus, state territorialization, through regulation and land allocation processes, combined with rapid market expansion for tree crops, not only marginalizes the practice of *ledda gua',* but also creates a vicious cycle in which communities are criminalized by the system that dispossesses them of their land.

The findings support broader scholarship showing that forest governance frequently contains a paradox: The government grants permits to companies in forested areas outside the State Forest and allocates them for oil palm plantations and other external investments on natural resources. Indonesian state regulations can provide licenses for the clearing of the remaining 'degraded' forest to be used for industrial plantations or palm oil plantations. At the same time, the government promotes forest restoration programs and forest protection. Similar practices occurred in Jambi, Sumatra, where the conversion of natural forest into HTI (Industrial Plantation Forest) and palm oil concessions was facilitated by the state under the pretext of "degraded land", even though in reality the area still had forest cover and was managed by local communities (Beckert et al., 2014).

The case study discussed herein and experience across Indonesia describes how the state facilitates companies in accessing different types of resources. Foregrounding these histories of power relations and dispossession also produces a profound policy paradox: on the one hand, the government promotes economic development programs that drive deforestation and land degradation, while on the other hand, the state also repossess supposedly degraded lands to support restoration programs that reinforce the same drivers of deforestation and degradation. A study on forest restoration in several countries in the Asia-Pacific describes this process as emerging as a result of political and patronage power (C. M. Barr & Sayer, 2012a) to sustain a legal framework that enables extractive expansion elsewhere (Fisher et al., 2023). In Long Buang, restoration initiatives coexist with concessions claims and regulatory uncertainty over lands already managed through local agroforestry. This suggests that restoration can reproduce inequality when political drivers of exclusions remain unaddressed.

5.2. Beyond the "Swidden versus Forest" binary

The study also challenges the persistent binary that positions swidden agriculture as environmentally destructive and formal restoration as environmentally beneficial. Across Southeast Asia, scholarship has long shown that swidden systems are dynamic mosaics involving cropping, fallow regeneration, biodiversity management, and livelihood security rather than simple forest clearance (Cramb et al., 2009; Dressler et al., 2017; Fox et al., 2009).

In Long Buang, State forest agencies view the Dayak Ga'ai land tenure as an agent of deforestation through the practices of a swidden agricultural system (*penggai mo'* and *ledda gua'*). These local practices and knowledge are an integrated part of the ecosystem and socio-cultural life, where land, swidden agriculture, and forests are interconnected. Former rice fields may gradually become a tree-rich production landscape combining food, market crops, inheritance assets and ecological regenerations. A parallel ecological analysis from the same landscape shows that mature *ledda gua'* systems contain complex multi-

strata canopies and diverse useful species, reinforcing their socio-ecological significance (forthcoming companion study).

What is marginalized, therefore, is not merely a farming technique but an alternative landscape logic. Swiddeners do not sharply separate agriculture, forest, livelihood, and restoration in the way policy categories often do. Similar observations have been made in studies of *tembawang, lembo, simpukng,* and other Indonesian agroforestry systems that blur boundaries between domesticated forest and cultivated land (de Foresta et al., 2000; Mulyoutami et al., 2009).

Furthermore, these practices require minimal chemical input and significantly less labor compared to an intensive monocrop plantation. Similarly, the latest research on *tembawang* (a fruit-based agroforestry system) in West Kalimantan compares the economic, ecological, and labor values, showing higher potential income from *tembawang* than rubber agroforestry or oil palm plantations on a 1-hectare scale (Mulyoutami et al., 2024).

The dismissal of *ledda gua'* as an "irregular pattern, random, and unclean garden" by so called modern and development agriculturalists reflects a transformative paradigm shift. It is symptomatic of what James Scott (1998) calls high-modernist ideology, in which the state tends to simplify complex socio-ecological realities into easily measurable and controllable categories, such as neat monocultures. In fact, the so- called "irregular pattern" within the *ledda gua'* reflects the system's biodiversity, adaptability, sustainability, and resilience.

In Kalimantan swidden agriculture practice is in decline mainly due to the expansion of agro-industrial operations, although some farmers persist with swidden because it provides livelihood, food, and culture (Santika et al., 2019; Toumbourou & Dressler, 2021; Dressler et al., 2017). Even in Busang District, East Kalimantan, Dayak Modang people who live surrounded by oil palm plantations continue to grow food crops as a livelihood strategy carried out by the most vulnerable groups of Indigenous women (Toumbourou & Dressler, 2021).

Recognizing this complexity matters because restoration policy often privileges simplified models such as tree planting targets, carbon metrics, or fixed land-cover categories. These instruments may overlook slower, socially embedded forms of regenerations already practiced by communities.

5.3. Selective recognition and the politics of legibility

The riverbank case reveals what may be termed selective recognition. Certain environmental values of riparian zones are formally recognized, while long established agroforestry tenure and livelihood functions are not. Scott (1998) famously argued that modern governance tends to simplify complex realities into administratively manageable forms. Long Buang illustrates this dynamic clearly: riverbanks become legible as buffer strips, but illegible as inhabited productive landscapes shaped through generations of stewardship.

Selective recognition also operates through institutions. Different agencies may simultaneously promote farming support, enforce riparian restrictions, encourage restoration, or regulate land certification often without coordination. The result is not simply policy contradiction but uneven recognition in which communities are asked to conserve, cultivate, and formalize land under mutually incompatible rules.

This helps explain why participatory mapping has become politically important. Counter-mapping efforts do more than record space; they challenge official representations of who uses land, how landscape functions, and what histories count (Peluso, 1995; Radjawali & Pye, 2015). In Long Buang, maps of villages' land tenure became tools for asserting continuity of use and for negotiating with state agencies and concessions holders.

Yet recognition remains conditional. Communities must translate their claims into bureaucratic formats, legal categories, and project language designed from elsewhere. This suggests that inclusion often depends less on rights alone than on the ability to become legible to govern institutions.

5.4. Rethinking inclusive restoration governance

If restoration is to be socially just and ecologically durable, it must move beyond short-term planting schemes and technocratic metrics.

Forest restoration programs in Indonesia are normally supported by the government, the private sector, and donor programs. In Long Buang, The Nature Conservancy (TNC) and *Yayasan Konservasi Alam Nusantara* (YKAN) have been implementing community-based restoration for three years, with incentive support initiatives for farmers. Sources of funding to support this type of program mostly stem from carbon finance through restoration.

Unfortunately, carbon finance often excludes farmer groups or village communities without formal legal title on their lands. In addition, restoration programs with an agroforestry model for communities tend to be smaller, around 100 ha, because the lands are used for swidden and agroforestry. This is quite different from companies with a business use permit (PBPH), which can run multiple forestry businesses (one of which is carbon trade). These companies have a legal base in the form of state permits and control thousands of hectares that meet Vera standards (minimum 1,500 ha). These legal rights and the fact that community groups control a small amount of land make them easily excluded from accessing funding from carbon finance.

The exclusion also rises when implementing restoration programs. The establishment of *ledda gua'* (agroforestry) always begins with land clearing for rice crops in the first year, and later gradually transforms the rice fields into fruit agroforestry. This differs from NGO and government interventions that carry out restoration programs on land without clearing the existing undergrowth, as per international carbon trading regulations, which require a 10-year old fallow to meet the carbon requirements. That means the community can not open the fallow for their staple food (rice). This carbon legibility is a form of exclusion on the land and practices (Hall et al., 2011) for the Indigenous. The failure to integrate and respect complex, historical, and customary land ownership systems deepening inequality (C. M. Barr & Sayer, 2012a; Osborne et al., 2012b). Restoration programs generally focus on maximizing carbon sequestration, with the social and cultural values of the land and the rights of its historical inhabitants and caretakers being either secondary or neglected.

The fact that an Indigenous practice such as *ledda gua'* is not yet recognized by the government, NGOs and donors, research institutions, or development institutions may help explain the low success rate of modern community-based restoration or rehabilitation programs (Nawir et al., 2007; C. M. Barr & Sayer, 2012b; Osborne et al., 2021b). Recognition of local land tenure rights and Indigenous knowledge practices, as well as resolution of overlapping *ledda gua'* lands, are two fundamental issues facing many local agroforestry practices in various parts of the world (DIBCoop, 2021).

The Long Buang case indicates at least four priorities. First, restoration planning should begin from existing land-use systems rather than treating local landscapes as empty or degraded spaces awaiting intervention. Community agroforestry, swidden fallows, and customary protection zones may already perform restoration functions. Second, land tenure recognition must accompany ecological objectives. Without secure rights or negotiated access, restoration incentives can deepen uncertainty rather than encourage stewardship. Third, governance should integrate cross-sectoral coordination. Forestry, land, agriculture and plantation, and environmental agencies frequently govern the same

landscapes through separate mandates, producing contradictory outcomes. Collaborative restoration often requires negotiation among actors with unequal capacities and competing interests (Toumbourou et al., 2024). Fourth, funding mechanisms should support long term community systems rather than only large, legally consolidated areas attractive to carbon or donor finance. As other studies note, restoration finance often favors actors with scale, documentation, and administrative capacity rather than those already sustaining multifunctional landscapes (Osborne et al., 2021; Barr & Sayer, 2012).

Seen this way, inclusive restoration is not simply about inviting communities into external projects. It requires restructuring how states recognize land, value ecological labor, and distribute authority over landscape futures.

6. Conclusion

There is increasing recognition in global forums and discourse that Indigenous land tenure and knowledge systems play a crucial role in forest restoration. In Long Buang, practices of *ledda gua'* that have long shaped local forest restoration show promising social and ecological results. Furthermore, they have shown to be adaptable to potential agroforestry programming. Similarity was found in other places in Kalimantan like *tembawang, lembo* and *simpukng.* The local practices, however, continue to face the legacy and continuing priority of state driven large-scale logging, mining and plantation expansion. State territorialization has undermined local land tenure, shrinking access to land and forests for local Indigenous groups, many of which they long shaped for generations.

There have been initiatives to try to innovate agroforestry systems with local land practices, but there are limits to its implementation and expansion. Retrofitting local restoration initiatives face formidable challenges, albeit as we have shown, also suggest promising outcomes when following a set of key conditions to local engagement.

These have been tried recently in carbon finance projects, particularly for reforestation activities. Nevertheless, community engagement on these initiatives are constrained by the limited control of land relative to the standard carbon requirements and high expense of carbon project registration, as well as the scale of projects. As traditional lands were historically enclosed as state forests they were then leased to timber companies or oil palm plantations. More recently international funds aimed at reforestation further exclude local communities. Meanwhile, timber companies that legally control a thousand hectares are able to sell carbon as part of their restoration initiatives. As a result, global projects discursively intending to empower local communities end up as just another reason for further dispossession and marginalization, with projects that seek out lands they can control at project scales sensible to externally driven and motivated financing schemes.

That said, local agricultural practices have been successful at developing agroforestry as embedded within a system of Indigenous knowledge, also integrating cash crops that follow market trends driven by local priorities. Thus, donor and government restoration programs could foreseeably work more closely with Indigenous systems to integrate local knowledge and practices. Policies that recognise local knowledge, for instance, would have a better chance of solving emerging land tenure conflicts and would have a greater likelihood of long term sustainability in terms of forest conservation and livelihoods.

Overall, more inclusive forest governance and policies are essential for not only meaningfully dealing with deforestation by timber companies and oil palm plantations but also restoring authority, legitimacy, and livelihoods to local communities. The question is how to go about doing it. We hope that this paper has provided some insight in how to think about reterritorializing restoration from below. In forest restoration, government and

international donors must consider the failures of previous forest rehabilitation programmes at a fundamental level, especially the legacy of land conflict and tenure issues. Only then can innovations driven by meaningful and lasting goals of sustainability be achieved.

More broadly, this study suggests that inclusive restoration cannot be measured only through hectares planted or carbon accumulated. It must also be judged by whether it expands rights, acknowledges plural ecological knowledge, and enables communities to shape the landscapes they have long sustained. Future research may compare how similar Indigenous agroforestry systems across Indonesia negotiate emerging restoration economies, carbon governance, and competing territorial claims.

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Conflict of interest

The authors declare no conflict of interest.

Author contribution

Siswandi Siswandi: Writing – review & editing, Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation. Nurhady Sirimorok: Methodology, Writing – review & editing, Supervision, Methodology: Supervision. Micah R. Fisher: Writing – review & editing, Supervision, Methodology, Conceptualization. Muhammad Alif K. Sahide: Writing – review & editing, Supervision, Methodology, Conceptualization.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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