

Actors, Access, Markets, and Values Involved in Oil Palm Expansion and Peatland Degradation in West Kalimantan, Indonesia

Ali Yansyah Abdurrahim ^{1,2,*}, Arya Hadi Dharmawan ^{2,3}, Soeryo Adiwibowo ²,
Herry Yogaswara ⁴, and Meine van Noordwijk ^{5,6,7}

AFFILIATIONS

- ¹ Research Center for Population, National Research and Innovation Agency (BRIN), Jakarta, Indonesia.
- ² Study Program of Rural Sociology, Department of Communication and Community Development Sciences of the Faculty of Human Ecology, IPB University, Bogor, Indonesia.
- ³ Center for Agrarian Studies, International Research Institute for Social, Economics, and Regional Development Studies, IPB University, Bogor, Indonesia.
- ⁴ Research Organization for Archeology, Language and Literature, National Research and Innovation Agency (BRIN), Jakarta, Indonesia.
- ⁵ Plant Production Systems, Wageningen University and Research, Wageningen, The Netherlands.
- ⁶ Agroforestry Research Group, Brawijaya University, Malang, Indonesia.
- ⁷ Centre for International Forestry Research and World Agroforestry (CIFOR-ICRAF), Bogor, Indonesia.

* Corresponding author:
ay_abdurrahim@apps.ipb.ac.id /
aliy001@brin.go.id

RECEIVED 2024-04-19

ACCEPTED 2024-12-19

COPYRIGHT © 2025 by Forest and Society. This work is licensed under a Creative Commons Attribution 4.0 International License

ABSTRACT

Despite numerous government regulations aimed at protecting Indonesia's peatlands and surrounding communities, the rapid conversion of peatlands to oil palm plantations, coupled with associated fires, continues to cause severe environmental degradation and health-threatening haze that extends to neighboring countries. This study examines the political ecology of oil palm expansion and peatland degradation in the Pelang Peat Landscape, Ketapang, West Kalimantan, focusing on the period 2000–2021. By integrating spatial analysis with qualitative methods—including active participation, in-depth interviews, group discussions, and document review—this research uncovers the dynamics of land-use change and access mechanisms. Findings reveal that oil palm expansion has resulted in significant ecological degradation, particularly in Peat Ecosystem Protection (FLEG) zones, driven by hybrid access mechanisms that combine regulation-based (legal and illegal) and structural-relational strategies, such as financial capital, political authority, identity, and informal land markets. The study also identifies "astroturfing oil palm plantations" as a strategy by large corporations posing as cooperatives to bypass regulations, exacerbating degradation. Expansion patterns are categorized into three forms—centered, spotted, and dispersed—each shaped by actor motivations and capacities. Furthermore, the analysis highlights the interplay between instrumental values (profit-driven motives) and relational values (sustainability and community well-being), which underscores broader tensions in peatland governance. Regulatory incongruence further complicates enforcement, allowing actors to exploit legal ambiguities, perpetuating the "legal, but illegal" and "illegal, but legal" phenomena. These findings underscore the urgent need for integrated governance approaches that address ecological, social, and policy challenges in peatland management.

KEYWORDS

Oil palm; Peatlands; Political ecology; Regulatory incongruence; Access mechanisms; Sustainability.

1. INTRODUCTION

Integrated landscape approaches have gained prominence as strategies to reconcile the interests of local actors, private sector, and public stakeholders from local to national and global scales (Sayer et al., 2013). However, these approaches are often critiqued for their limited attention to historical and political contexts, insufficient mechanisms to address power imbalances in resource access, and weak connections between peripheral actors and central political authorities (Blaikie, 1985, 1995, 2008; Blaikie & Brookfield, 1987; Bryant & Bailey, 1997; Forsyth, 2008; Rocheleau, 2008;

Scoones, 2009, 2015, 2016; Perreault et al., 2015; Scoones et al., 2015; Pouliot, 2016; Bernstein, 2010, 2017; Robbins, 2019; Scoones & Stirling, 2020; Svarstad & Benjaminsen, 2024). Moreover, some critics argue that the emphasis on social and governance dimensions can overshadow ecological considerations, underestimating the inherent trade-offs between social and environmental goals (Reed et al., 2021). The absence of a consistent framework for evaluating integrated landscape approaches further complicates synthesis and assessment efforts (Waeber et al., 2023).

Current theories on land-use decisions and values increasingly emphasize the interplay between individual motivations, relational dynamics, and instrumental rationality (van Noordwijk et al., 2023; Githinji et al., 2023). These frameworks incorporate multidimensional perspectives on morality (Haidt & Kesebir, 2010; Abdurrahim et al., 2023; Lusiana et al., 2023) and fundamental social constructs, including authority, equality, and market-based interactions (Fiske, 1992). Building on these theories, scholars have identified various types of power—discursive, regulatory, monetary, and compulsory—that influence access to natural resources and decision-making processes (Kemper, 2016; Leimona et al., 2017, 2024). Applying these principles to land-use governance enables a deeper understanding of the complex dynamics shaping ecological and social outcomes.

In Indonesia, home to the world's largest tropical peat ecosystem (24.67 million hectares; MoEF, 2021), the interplay of ecological, social, and economic factors is particularly evident. Despite regulatory measures such as Government Regulations (PP) No. 71/2014 and No. 57/2016, which prohibit activities that degrade peat ecosystems, large-scale land cover changes, particularly oil palm expansion, continue to threaten these landscapes (Miettinen & Liew, 2003; Hall, 2011; Hall et al., 2011; Gaveau et al., 2016, 2018, 2022; Miettinen et al., 2016; Page & Hooijer, 2016; Carmenta et al., 2017; Dohong et al., 2017; Roh et al., 2018; Uda et al., 2018; Dhandapani et al., 2019; Lilleskov et al., 2019; Saputra, 2019; Dhandapani & Evers, 2020; Dharmawan et al., 2020; Ramdani & Lounela, 2020; Astuti, 2020, 2021; Girkin et al., 2022; Omar et al., 2022). As of 2018, 98% of Indonesia's peat ecosystems across 865 Peat Hydrological Units (PHUs) were classified as degraded (MoEF, 2018). In West Kalimantan Province, this figure rises to 99%, with 96% of PHUs in Ketapang Regency, including the Pelang Peat Landscape, also categorized as degraded (MoEF, 2018). These findings underscore the urgency of addressing the systemic challenges driving peatland degradation.

2. POLITICAL ECOLOGY FRAMEWORK AND STUDY OBJECTIVES

This study adopts a political ecology approach to explore the dynamics of land-use change and resource access in the Pelang Peat Landscape. Political ecology emphasizes the interconnectedness of ecological systems and social structures, particularly the role of power, access, and values in shaping environmental outcomes (Peluso & Ribot, 2020). By analyzing land cover changes from 2000 to 2021 and the mechanisms through which actors gain access to and utilize resources, this study aims to (1) Document the forms and extent of land cover change in the Pelang Peat Landscape; and (2) Analyze the access mechanisms employed by different actors in land-use changes, focusing on their impacts on hydrology and peat ecosystem degradation.

Figure 1 provides a conceptual framework for understanding the interactions between actors, access mechanisms, and environmental values in peatland management. It highlights how ecological changes influence social systems and vice versa, creating a dynamic interplay of contestation and collaboration among stakeholders with competing values and interests.

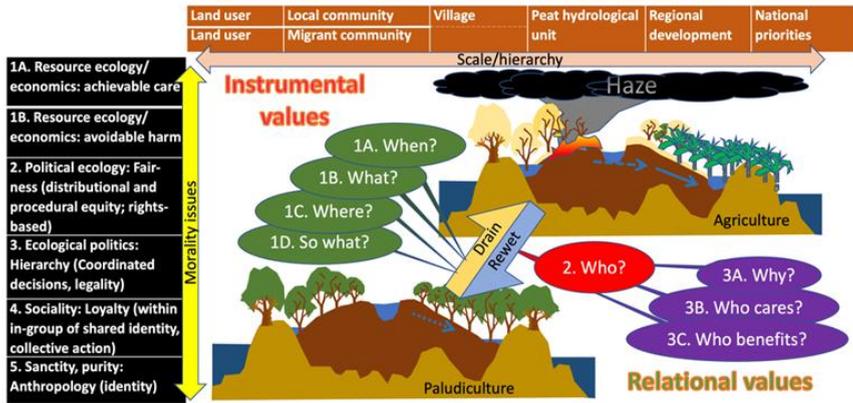


Figure 1. Visualization of the tug of war between peatland use (drainage) and restoration (rewetting) as they may apply to the stakeholders of a range of scales (horizontal axis) and classification of morality issues (vertical axis) (Abdurrahim et al., 2023).

Figure 1 illustrates the intricate interactions between actors, access mechanisms, and values in peatland management, highlighting how ecological shifts like peatland degradation intertwine with social systems comprising corporations, government agencies, local communities, and NGOs. Each stakeholder operates with distinct environmental values that shape their strategies for accessing and managing resources, subsequently influencing ecological outcomes through reinforcing or mitigating feedback loops. Corporations, driven by instrumental values, focus on profit maximization and resource extraction, utilizing formal regulatory mechanisms and financial capital to secure access. In contrast, local communities and NGOs prioritize relational values, advocating for sustainable practices, cultural preservation, and ecosystem health. Hybrid access mechanisms arise as actors navigate the interplay between formal regulations and informal networks, often exploiting regulatory gaps to achieve their objectives. This framework underscores the necessity of governance models that integrate ecological and socio-political dimensions, ensuring conservation strategies are informed by an inclusive understanding of access, power dynamics, and values.

3. SIGNIFICANCE OF THE STUDY

This study contributes to the ongoing discourse on integrated landscape approaches by linking ecological degradation with social systems and governance frameworks. By documenting land cover changes and analyzing access mechanisms, it provides critical insights into the systemic factors driving peatland degradation. The introduction of hybrid access mechanisms and values-based riding strategies offers a novel perspective on actor behavior and decision-making, enhancing the theoretical and practical understanding of peatland governance.

This introduction sets the stage for a detailed exploration of land cover changes, access mechanisms, and their ecological implications in subsequent sections. The findings aim to inform policy interventions and community-based conservation strategies, contributing to the sustainable management of Indonesia’s peat ecosystems.

4. RESEARCH METHODOLOGY

4.1 Location and time of research

This study was conducted in the Pelang Peat Landscape, located in West Kalimantan Province, Ketapang Regency. This region encompasses two Peatland Hydrological Units (PHUs): Sungai Pawan-Sungai Kepulu (64,241 ha) and Sungai Kepulu-Sungai Pesaguan (13,546 ha), which together represent two of the twenty PHUs in the regency. These PHUs have been identified as critical targets for peat ecosystem restoration (2021–2024) due to their degraded status, aligning with national priorities for peatland recovery (PMRA, 2021). Degradation indicators in the landscape include extensive land cover changes (from peat swamp forests to oil palm plantations), the widespread construction of drainage canals, and frequent fires, particularly during the dry season. Fires in 2015 and 2019 were notably severe, making Ketapang Regency the most fire-affected area in West Kalimantan and ranking fourth nationwide (Nusantara Atlas, 2024).

The Pelang Peat Landscape was selected as the study site due to its environmental challenges and its status as a focal area for the national peatland restoration program led by *Badan Restorasi Gambut dan Mangrove* (BRGM), or Peat and Mangrove Restoration Agency (PMRA). To ensure a comprehensive analysis, research was conducted across three levels: district (Ketapang Regency), landscape (Pelang Peat Landscape), and village (Sungai Pelang, Sungai Besar, Sungai Bakau, and Pematang Gadung). These villages are characterized by deep peat soils and frequent land fires, making them high-priority sites for restoration interventions. Field research was carried over three years (August 2020 to December 2023) with support from the National Research and Innovation Agency (BRIN) and Tropenbos Indonesia (TI), involving both primary and secondary data collection, as well as spatial data analysis (GIS).

4.2 Data collection, analysis, and validation

4.2.1 Data collection

The data collection, analysis, and verification for this study were guided by Blaikie's (1985) *'Chain of Explanation'* framework from the Theory of Environmental Degradation (Blaikie & Brookfield, 1987). This approach linked environmental changes to local resource use practices and external influences across multiple scales. The first stage, *Environmental Change*, focused on identifying landscape transformations, including deforestation, drainage canal construction, and biodiversity loss, through GIS-based spatial analysis of land cover changes between 2000 and 2021.

The second stage, *Resource Use Rationality*, explored the motivations and practices of various resource managers—households, institutions, and corporations. Field observations and interviews revealed how socio-economic drivers and institutional roles influenced land-use decisions, particularly the conversion of peat forests into oil palm plantations. This stage emphasized the human dimensions of environmental degradation by connecting land management practices to individual and organizational decision-making.

The final stage, *External Influences*, examined the broader policy and economic forces affecting local practices. This included analyzing legislative frameworks, donor-driven programs, and global market demands that shape resource exploitation. Together, these stages connected four scales—individuals, local communities, national policies, and the global economy—providing a comprehensive view of the interconnected drivers of environmental degradation in the Pelang Peat Landscape.

4.2.2 Data sources and methods

The study employed a combination of spatial data analysis, field observations, participatory methods, interviews, and focus group discussions (FGDs) to examine environmental changes and stakeholder interactions in the Pelang Peat Landscape. Spatial data on land cover changes, drainage canals, and fire hotspots were provided by Tropenbos Indonesia's GIS expert team, forming the foundation for analyzing environmental transformations. Field observations focused on key environmental indicators, including burned areas, drainage systems, and peat water levels, across four prioritized villages.

Participatory observation involved the lead researcher actively engaging in two key multi-stakeholder forums. At the district level, the *Sekretariat Bersama Forum Multi-Pihak Pengelolaan Sumber Daya Alam Berkelanjutan* (Sekber PSDA), established in 2020, brought together government, private sector, and civil society actors to promote sustainable resource management. At the landscape level, the *Forum Masyarakat Antar Desa Lingkungan Lestari* (Formad Lingkar), formalized in 2022, represented a collaboration of village institutions from Sungai Pelang, Sungai Besar, Sungai Bakau, and Pematang Gadung, addressing localized challenges in peatland management. These forums provided critical insights into multi-stakeholder dynamics and decision-making processes.

In-depth interviews were conducted with diverse stakeholders, including government officials at multiple levels, civil society organizations, private sector representatives (e.g., large plantation companies and cooperatives), and community members. These interviews were complemented by FGDs conducted at district (five sessions), landscape (four sessions), and village levels (three sessions per site). Using semi-structured questions, the FGDs facilitated inclusive discussions to capture diverse perspectives, ensuring a robust understanding of the social and ecological dimensions of peatland management.

4.2.3 Data analysis and validation

The study employed a rigorous process to analyze and validate qualitative and quantitative data, ensuring accuracy and relevance. Preliminary findings were cross-checked with key informants to refine interpretations, while stakeholder consultations through FGDs and workshops incorporated diverse perspectives. Expert reviews during seminars and meetings further enhanced the reliability of the results by integrating feedback from academics, practitioners, and scientists. This comprehensive approach enabled the study to effectively capture the ecological and social complexities of the Pelang Peat Landscape. By combining local knowledge, participatory methods, and spatial analysis, the research provided a robust foundation for documenting land cover changes, analyzing access mechanisms, and developing strategies for peatland restoration.

5. RESULTS

5.1 Forms of land cover changes: Oil palm plantation expansion and peat ecosystem degradation

The Pelang Peat Landscape, located in Ketapang Regency, West Kalimantan, comprises two Peat Hydrological Units (PHUs): Sungai Pawan-Sungai Kepulu (64,241 ha) and Sungai Kepulu-Sungai Pesaguan (13,546 ha), hereafter referred to as PHU PKKP, covering a total area of 79,080 ha. This landscape is divided into two primary functions: the Cultivation Function (*Fungsi Budidaya Ekosistem Gambut/FBEG*), which spans 52,261 ha (66%), and the Protection Function (*Fungsi Lindung Ekosistem*

Gambut/FLEG), covering 26,819 ha (34%) (Ketapang Regency Government, 2023). The FLEG zones, situated on the peaks of peat domes and in deep peat areas with depths greater than 3 meters, play a critical role in maintaining hydrological balance and biodiversity. These areas house endemic species and are protected under the Peat Ecosystem Protection and Management Regulations (*Perlindungan dan Pengelolaan Ekosistem Gambut*/PPEG) (Government of Indonesia, 2014, 2016).

Despite their protected status, the FLEG zones face severe degradation driven by oil palm plantation expansion, the construction of drainage canals, and frequent fires. These interconnected processes have led to significant ecological disruption, as visualized in Figure 2.

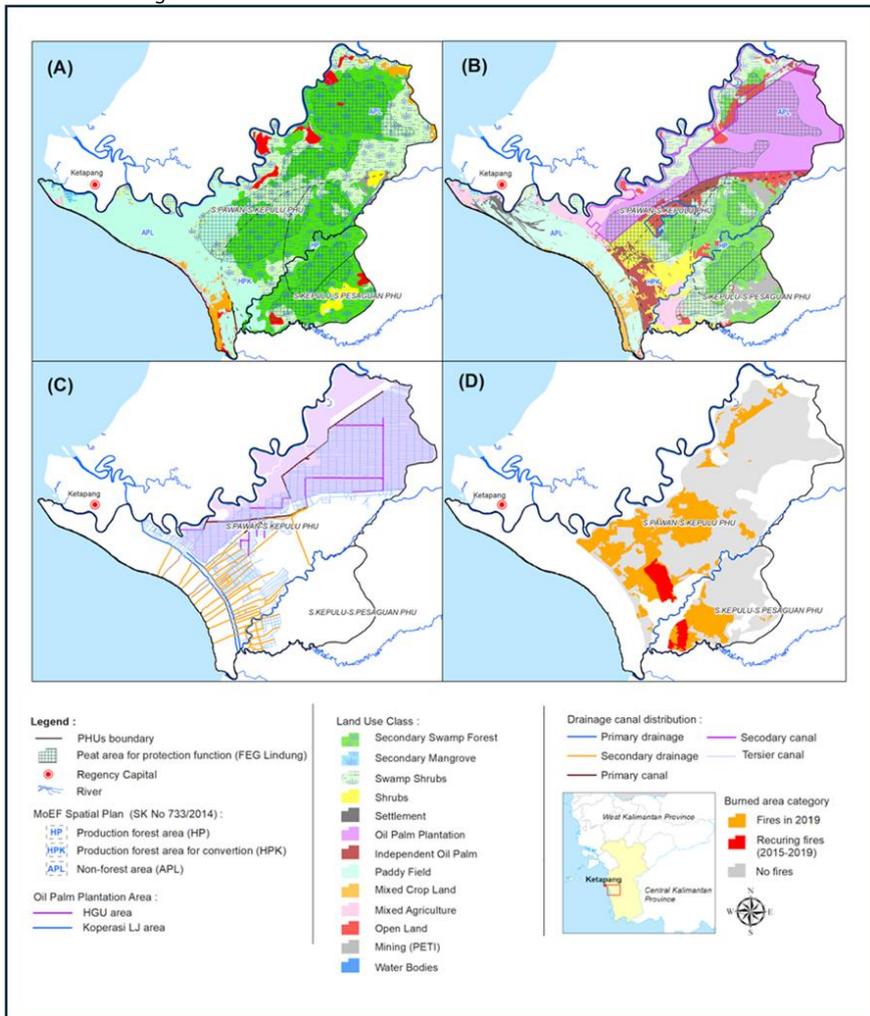


Figure 2. Upper panels: Land Use/Cover in 2000 (2A) and 2021 (2B); lower panels: Drainage Canal Distribution in PHU PKKP in 2021(2C) and Burned Area in PHU PKKP in 2021 (2D). PHU PKKP refers to the Pelang Peat Landscape, which includes the Sungai Pawan–Sungai Kepulu and Sungai Kepulu–Sungai Pesaguan PHU (Ketapang Regency Government, 2023).

5.1.1 Key findings

Spatial analysis of land cover changes between 2000 and 2021 (Figure 2A–D) reveals two critical trends: a dramatic decline in peat swamp forests and the rapid expansion of oil palm plantations. Peat swamp forests decreased by 21,529 ha (61.5%), with the most severe losses observed in the FLEG zones, where 12,293 ha (64.2%) were destroyed, underscoring the heightened vulnerability of these protected areas to land conversion. Simultaneously, oil palm plantations became the dominant land cover type by 2021, expanding to 23,153 ha, with nearly half of this growth (10,066 ha) occurring within FLEG zones, which are designated for ecological protection. These findings, summarized in Table 1, highlight the extensive conversion of land uses such as rice fields, dryland farming, and mixed gardens into oil palm plantations, reflecting a two-decade shift that prioritizes agricultural expansion over environmental conservation.

5.1.2 Forms of oil palm oil expansions

Oil palm plantation expansion in the Pelang Peat Landscape manifests in three distinct forms (Dharmawan et al., 2020), each driven by specific actor access mechanisms as detailed in Table 2. Centered expansion, dominated by large-scale corporations like PT OBB and PT OCC, involves contiguous land clearing supported by substantial capital investment and regulatory permissions. Spotted expansion, characterized by fragmented and small-scale plantations, is typically initiated by non-transmigrant villagers and local residents, with plantations scattered and less organized. Dispersed expansion, primarily driven by transmigrant farmers and independent smallholders, reflects sporadic land clearing that lacks cohesive planning and is supported by informal social networks. These expansion forms illustrate the varied strategies and resources utilized by different actors to transform the landscape, often at the expense of ecological stability.

5.1.3 Drivers of degradation: Drainage and fire

The rapid expansion of oil palm plantations in the Pelang Peat Landscape is closely tied to the construction of drainage canals (Figure 2C), which lower peat water levels to enable large-scale cultivation. This intervention leads to significant ecological consequences, including peat subsidence, as the drying of peat accelerates oxidation and increases the ecosystem's vulnerability to fires. Additionally, the disruption of water flow alters the hydrological balance of the peat dome, further exacerbating ecosystem degradation. Fires, as depicted in Figure 2D, represent another critical driver of peatland degradation. Recurrent during the dry season, many fires are deliberately set as a low-cost method for land clearing. The fire events of 2015 and 2019 were particularly catastrophic, with Ketapang Regency being the most severely affected area in West Kalimantan and the fourth largest in Indonesia (Ketapang Regency Government, 2023). These interlinked drivers—drainage and fire—create a feedback loop that perpetuates the degradation of the peat ecosystem.

5.2 Access mechanisms for oil palm expansion

The expansion of oil palm plantations in the Pelang Peat Landscape involves diverse actors—large corporations, smallholders, and cooperatives—each using distinct access mechanisms. Their strategies combine regulatory and relational approaches, often shaped by land status and governance gaps. Table 1 outlines land cover changes from 2000 to 2021. Table 2 summarizes expansion forms and access mechanisms across actor types, while Table 3 highlights actor characteristics, values, and strategies influencing peatland transformation.

Table 1. Land cover change in the Pelang Peat Landscape, period 2000 – 2021 (in ha)

| No | Land cover | FBEG (Cultivation) | | | FLEG (Protect) | | | Total | | |
|-------|---------------------------|--------------------|---------------|---------|----------------|---------------|----------|---------------|---------------|----------|
| | | 2000 | 2021 | Change | 2000 | 2021 | Change | 2000 | 2021 | Change |
| 1 | Secondary Swamp Forest | 15,868 | 6,633 | (9,235) | 19,147 | 6,854 | (12,293) | 35,015 | 13,486 | (21,529) |
| 2 | Secondary Mangrove Forest | 315 | 150 | (165) | - | - | - | 315 | 150 | (165) |
| 3 | Bush Scrub | 1,165 | 2,953 | 1,788 | - | 1,928 | 1,928 | 1,165 | 4,881 | 3,716 |
| 4 | Swamp Scrub | 14,306 | 9,889 | (4,417) | 5,747 | 4,156 | (1,591) | 20,053 | 14,045 | (6,008) |
| 5 | Settlement | 70 | 1,270 | 1,200 | - | 1 | 1 | 70 | 1,271 | 1,201 |
| 6 | Corporate Oil Palm | - | 9,175 | 9,175 | - | 10,066 | 10,066 | - | 19,241 | 19,241 |
| 7 | Independent Oil Palm | - | 2,602 | 2,602 | - | 1,309 | 1,309 | - | 3,912 | 3,912 |
| 8 | Rice Fields | 14,837 | 8,048 | (6,790) | 1,804 | - | (1,804) | 16,642 | 8,048 | (8,594) |
| 9 | Mixed Garden | 1,938 | 1,602 | (336) | - | - | - | 1,938 | 1,602 | (336) |
| 10 | Open Land | 1,892 | 1,822 | (69) | 121 | 2,196 | 2,075 | 2,013 | 4,018 | 2,006 |
| 11 | Mining (Illegal) | 446 | 2,678 | 2,231 | - | 42 | 42 | 446 | 2,719 | 2,273 |
| 11 | Dryland Farming | 479 | 4,495 | 4,016 | - | 268 | 268 | 479 | 4,762 | 4,283 |
| 12 | Water Bodies | 945 | 945 | - | - | - | - | 945 | 945 | - |
| Total | | 52,261 | 52,261 | - | 26,819 | 26,819 | - | 79,080 | 79,080 | - |

Description: Analyzed from spatial data of Ketapang Regency Government (2023)

Table 2. Forms, actors, and access mechanisms for land cover changes in FLEG of the Pelang Peat Landscape Since 2001

| Land Cover Changes | Expansion Forms | Actors | Regulation-Based Access Mechanisms (Legal/Illegal) | | Structural and Relational Access Mechanisms |
|---|---------------------|------------------------|---|---|---|
| | | | Forest Area (KH) or Non-Forest Area (APL) Regulations | PPEG Regulation | |
| Corporate oil palm plantation (Large-scale) | Centered expansion | PT OBB | Legal because it is on APL | Legal because it existed before the PPEG regulation | Authority |
| | Dispersed expansion | PT OCC | Legal because it is on APL | Legal because it existed before the PPEG regulation | Capital |
| | Dispersed expansion | Transmigrant villagers | Legal because it is on APL | Illegal because it is in FLEG | Authority |

| Land Cover Changes | Expansion Forms | Actors | Regulation-Based Access Mechanisms (Legal/Illegal) | | Structural and Relational Access Mechanisms |
|---|--------------------|----------------------------|---|-------------------------------|---|
| | | | Forest Area (KH) or Non-Forest Area (APL) Regulations | PPEG Regulation | |
| Independent smallholder oil palm plantation (Small-scale) | Spotted expansion | Non-transmigrant villagers | Legal if in APL, but illegal if in KH | Illegal because it is in FLEG | Identity |
| | | Village outsiders | Legal if in APL, but illegal if in KH | Illegal because it is in FLEG | Land market |
| Farmer cooperative oil palm plantation (Large-scale) | Centered expansion | CAA | Legal because it is on APL | Illegal because it is in FLEG | Identity |

Table 3. Actors, access, and values—related to oil palm expansion

| Actors | Characteristics | Expansion Forms | Regulation-Based Access Mechanisms (Legal/Illegal) | Structural and Relational Access Mechanisms | Values |
|--------------------------|---|---|--|--|--|
| Large-scale Corporations | Profit-driven entities with access to significant capital and political influence. | Centered expansion in areas allocated by government or large-scale permits. | Legal (on APL land, permitted under existing regulations). | Authority, capital, formal legal mechanisms. | Instrumental Values (profit, economic growth). |
| Transmigrant Farmers | Smallholders or independent entrepreneurs focusing on subsistence farming or small-scale economic gain. | Spotted or dispersed expansion, with farms often scattered in fragmented patterns. | Mixed: Legal on APL, but can become illegal in protected areas (PEF). | Authority, land market, informal social networks. | Mixed (subsistence and economic sustainability with some environmental consideration). |
| Indigenous Communities | Long-standing communities with cultural, social, and environmental ties to the land. | Tend to resist expansion in favor of preserving local ecosystems and cultural values. | Mostly informal, using traditional rights and local governance; often legal but with informal aspects. | Social networks, cultural ties, traditional authority. | Relational Values (community well-being, cultural preservation, environmental sustainability). |
| Cooperative CAA | Operates under the guise of a farmer cooperative but functions like a large-scale | Large-scale (centered expansion) with activities like deep peat | Mixed: Legal on APL, but illegal in FLEG areas (lacks proper permits). | Identity (using cooperative status to bypass legal | Instrumental Values (profit-driven expansion, |

| Actors | Characteristics | Expansion Forms | Regulation-Based Access Mechanisms (Legal/Illegal) | Structural and Relational Access Mechanisms | Values |
|--|--|---|--|---|---|
| | plantation using illegal practices. | land clearing and canal development in protected areas. | | scrutiny), informal market. | masked by cooperative identity). |
| LPHD with NGOs and Environmental Activists | Local community organizations supported by NGOs to promote sustainable forest management and environmental advocacy. | Resist oil palm expansion, support reforestation, and advocate for community-based forest management. | Legal: Using formal access permits for social forestry, supported by NGO advocacy. | NGO support, social pressure, formal governance structures. | Relational Values (environmental protection, community well-being, long-term sustainability). |

5.2.1 Company oil palm plantations (large scale)

Large-scale companies such as PT OBB and PT OCC are key players in the oil palm sector, employing centered and dispersed expansion strategies. These corporations leverage both *regulation-based mechanisms*, such as obtaining legal permits for land in APL zones, and *structural mechanisms*, including authority, capital, and political influence. However, their activities often extend into FLEG zones, violating PPEG regulations despite their official legality in certain areas.

Case Box 1 provides a comparative analysis of PT OBB and PT OCC's strategies. PT OBB utilizes government-granted authority to dominate land acquisition, while PT OCC supplements its expansion efforts with "compensation payments" to local residents, enabling it to overcome resistance and secure land access in FLEG zones.

Box Case 1: Comparing PT OBB and PT OCC Strategies and Impacts on FLEG Zones

PT OBB

PT OBB began operations in the Pelang Peat Landscape in 2007. The company primarily employs a *centered expansion* strategy, focusing on contiguous tracts of land designated as APL (non-forest areas). Its concession spans 19,391 ha, of which approximately 6,000 ha of which lie in FLEG zones. Despite being in protected areas, PT OBB's activities are considered "legal" under regulatory frameworks that predate current peat ecosystem protection regulations (PPEG). The company leverages *authority-based mechanisms*, relying on permits granted by the government and avoiding significant financial outlay for community compensation. PT OBB's dominance in land acquisition has been attributed to "the solidity of its land acquisition task force" and a lack of awareness among local residents about compensation rights. This approach has minimized local resistance but resulted in large-scale peatland degradation within FLEG zones.

PTOCC

PT OCC commenced operations in 2012, adopting a *dispersed expansion* strategy that targets smaller, scattered plots within APL and FLEG zones. The company's concession spans 7,638 ha, with approximately 3,000 ha encroaching into FLEG zones. Unlike PT OBB, PT OCC relies heavily on *capital-based mechanisms*, offering financial compensation to local residents to secure access to their lands. Compensation payments range from IDR 250,000 to IDR 300,000 per hectare for land claims verified by the company. However, PT OCC's financial strategies have also faced criticism. Funds allocated for community compensation are often reduced by intermediaries and task forces, creating tensions with local stakeholders. Despite these challenges, PT OCC's approach enables it to expand operations in a manner that appears cooperative, even as it contributes to extensive peat degradation.

Comparison and Impact

While both PT OBB and PT OCC operate under the guise of regulatory compliance, their activities highlight significant flaws in governance and enforcement mechanisms. PT OBB's reliance on government authority shields it from local opposition but exacerbates ecological damage due to its large-scale, centralized operations. Conversely, PT OCC's financial compensation fosters local acceptance but fail to mitigate its environmental impacts, particularly in FLEG zones.

Summary

The strategies of PT OBB and PT OCC reveal how corporations exploit both formal (legal

permits) and informal (financial or social influence) access mechanisms to circumvent peatland protection laws. These approaches underline the urgent need for stronger regulatory oversight and community-based governance to safeguard FLEG zones from further degradation.

5.2.2 Independent smallholder (small scale)

Independent smallholder farmers, encompassing both transmigrant and non-transmigrant villagers, contribute significantly to oil palm expansion through spotted and dispersed expansion patterns. These actors rely on access mechanisms such as *authority-based access* through government land allocation programs, and *identity and land markets*, where informal transactions facilitated by local networks grant them access to peatlands. Their activities often mirror corporate practices, with many smallholders citing corporate precedence to justify their actions. One common sentiment is: "If PT OBB and PT OCC can do it, why can't we?"

Box Case 2: CAA and Identity-Based Access Mechanisms

The Role of CAA

The Cooperative Association for Agriculture (CAA) operates under the guise of being a community-focused organization. However, its activities reveal practices more aligned with those of large-scale corporate entities. Established ostensibly to support local farmers, CAA has expanded its operations into FLEG zones (Peat Ecosystem Protection Areas), engaging in activities that conflict with environmental regulations.

Access Mechanisms

CAA employs *identity-based access mechanisms* to navigate regulatory constraints. By presenting itself as a cooperative tied to local communities, CAA gains social legitimacy, allowing it to operate in sensitive areas with reduced scrutiny. This identity-based strategy enables CAA to:

1. *Secure local support.* Cooperative membership consists of community members, retired officials, and influential figures who lend social and institutional credibility to the organization.
2. *Bypass permitting requirements.* While officially lacking plantation permits, CAA leverages its cooperative status to minimize legal oversight.
3. *Expand into protected zone.* Using informal networks and local influence, CAA conducts large-scale expansions, including canal construction for peatland drainage.

Environmental Impacts

Between 2019 and 2021, CAA cleared over 1,000 ha of peatlands, including 72 ha within orangutan habitats in FLEG zones. Its drainage canals have disrupted local hydrology, contributing to peat subsidence, increased fire risks, and loss of biodiversity. Despite these impacts, CAA has avoided significant legal consequences due to its cooperative identity and local influence.

Local Tensions and Criticism

While CAA's cooperative status facilitates its operations, it has faced criticism from environmental groups and local activists. These stakeholders argue that CAA's identity-based mechanisms exploit regulatory loopholes while prioritizing profit over sustainability. Additionally, its activities undermine genuine community-led conservation efforts, creating tensions among local actors.

Summary

CAA exemplifies how identity-based access mechanisms can be manipulated to bypass regulations and expand operations into environmentally sensitive areas. Its case highlights the importance of scrutinizing not just legal frameworks but also the social and relational dynamics that enable such expansions. Strengthening governance and ensuring accountabilities for all actors, including cooperatives, are critical for protecting FLEG zones and promoting sustainable land use.

5.2.3 Farmer cooperatives (large-scale)

Farmer cooperatives, such as Cooperative CAA, occupy a unique position between smallholders and corporate actors. These cooperatives often operate under the guise of community-driven institutions while pursuing large-scale, profit-oriented expansion. Through *identity-based access mechanisms*, CAA bypasses regulatory scrutiny and engages in extensive peatland conversion, including activities in FLEG zones. Box Case 2 illustrates how CAA exploits its cooperative identity to access protected peatlands, causing significant ecological degradation. Despite its cooperative status, CAA employs strategies that align more closely with corporate behaviors, blurring the boundaries between community-driven and commercial land use.

5.2.4 Integration of access mechanisms and values

The interplay of access mechanisms and values is critical to understanding the dynamics of oil palm expansion in the Pelang Peat Landscape. Large-scale corporations prioritize *instrumental values*, focusing on economic growth and profit, while smallholders and cooperatives often blend subsistence goals with opportunistic land-use practices. Together, these actors shape the trajectory of peatland transformation, highlighting the need for nuanced governance approaches that address both formal and informal access mechanisms.

5.3 Community-based conservation and livelihoods: The village forest program

Recognizing that the Pelang Peat Landscape has experienced significant degradation driven by oil palm expansion, drainage canals, and recurrent fires. In response, community-based initiatives such as the Village Forest Program (Hutan Desa) have been introduced, aiming to restore ecosystems while supporting local livelihoods. Facilitated by NGOs like Flora and Fauna Indonesia (FFI), International Animal Rescue Indonesia (IARI), and Tropenbos Indonesia (TI), these programs foster collaboration with local communities to address environmental challenges.

5.3.1 Community access and governance

The Village Forest Program grants formal legal access to local communities for managing forest areas, based on decrees issued by the Ministry of Environment and Forestry. In the Pelang Peat Landscape, communities in Sungai Pelang, Sungai Besar, and Pematang Gadung have been entrusted with a total of 14,066 hectares of forest management rights for 35 years. These allocations include 540 hectares for Sungai Pelang, 6,522 hectares for Sungai Besar, and 7,004 hectares for Pematang Gadung. Although these areas are classified as Production Forests (*Hutan Produksi*), their management prioritizes the protection of FLEG zones (Peat Ecosystem Protection Areas), with a focus on ecological preservation rather than resource exploitation.

5.3.2 Key activities and outcomes

The Village Forest Program integrates sustainable, community-based forest management practices that harmonize environmental conservation with economic development. Key activities include promoting peat-friendly agriculture to minimize environmental damage, establishing integrated fisheries and livestock systems that align with conservation goals, and supporting ecotourism as an alternative income source while raising awareness about peatland preservation. Additionally, the program mobilizes community patrols to monitor and prevent illegal activities such as logging, mining, and wildlife poaching. By offering alternative sustainable livelihood alternatives, the initiative reduces local dependency on environmentally destructive practices like oil palm cultivation, fostering a sustainable pathway for development.

5.3.3 Restoration and conservation

In addition to fostering community-driven livelihood activities, the Village Forest Program places significant emphasis on ecological restoration through reforestation and peatland rehabilitation. These efforts are critical for maintaining the hydrological balance of peat ecosystems, enhancing biodiversity, and safeguarding habitats from further degradation. By preserving wet peatlands and discouraging land clearing, the program also mitigates fire risks that threaten both ecological and human systems. The integration of these restoration activities into community management plans not only addresses environmental degradation but also strengthens the ecological resilience of the Pelang Peat Landscape, ensuring sustainable benefits for both the environment and local communities (van Noordwijk et al., 2020; Abdurrahim et al., 2021; Langston et al. 2023).

5.3.4 Social and relational mechanisms

Building on Ribot and Peluso's theory of access (2003), the Village Forest Program employs a blend of legal, social, and relational mechanisms to secure forest management rights and promote peat ecosystem conservation. Legal access mechanisms, such as Village Forest licenses, grant communities the authority to manage forest areas and exclude external actors like palm oil companies from encroaching on their territories. Social and physical control is exercised through community patrols, supported by the Village Forest Management Institution (LPHD), which enforces land-use regulations and prevents unauthorized access. Furthermore, collaborations with NGOs provide essential technical expertise, capacity-building, and policy advocacy, strengthening sustainable forest management governance. By aligning legal frameworks with community-driven governance and NGO support, the program effectively safeguards peat ecosystems while empowering local communities to actively participate in conservation efforts. This integrated strategy addresses both ecological degradation and social equity, presenting a scalable model for sustainable peatland management (Peluso & Ribot, 2020).

5.4 Integration of findings into broader discussion

The findings of this study illuminate the complex interplay between actors, access mechanisms, and values that drive land-use decisions and environmental outcomes within the Pelang Peat Landscape. The substantial reduction of peat swamp forests and the concurrent expansion of oil palm plantations highlight the ecological vulnerability of peat ecosystems to unsustainable practices. This transformation extends beyond ecological degradation, reflecting deeper sociopolitical dynamics where actors navigate formal and informal mechanisms to access and exploit resources. The significant loss of FLEG zones, despite their protected status, underscores systemic failures in regulatory enforcement, intensifying the degradation process.

The diverse strategies employed by actors further complicate governance. Large corporations leverage financial resources and political connections for expansive operations, while smallholder farmers rely on social networks and informal land markets. Cooperatives, such as CAA, demonstrate a dual strategy that blends legal and illegal mechanisms, effectively challenging governance efforts and regulatory coherence. These dynamics, as detailed in Table 3, reveal the multidimensional strategies actors use to secure access and benefits. Meanwhile, the Village Forest Program offers a hopeful countermeasure, empowering communities with formal management rights and fostering sustainable practices. By integrating ecological restoration with livelihood improvement, this program illustrates a viable pathway for balancing conservation with socio-economic development.

6. DISCUSSION

6.1 Land cover transformation and peatland degradation

The transformation of the Pelang Peat Landscape from a forest-dominated ecosystem in 2000 to an oil palm-dominated mosaic in 2021 represents a rapid, large-scale, and ecologically significant shift in land use. As depicted in Figure 2A and Figure 2B, this transformation highlights the intense pressure on peat ecosystems due to agricultural expansion, particularly for oil palm cultivation. This land-use change has been accompanied by the construction of extensive drainage canals (Figure 2C) and recurrent fires (Figure 2D), forming what is collectively described as the ‘peatland degradation triad’ (Dohong et al., 2017; MoEF, 2018). These interconnected processes—expansion, drainage, and fire—act in a feedback loop, each exacerbating the other, accelerating peatland degradation, and compromising both ecological integrity and hydrological balance.

6.1.1 *The extent of land cover change*

Spatial analysis and Table 1 illustrate the dramatic land cover changes in the Pelang Peat Landscape between 2000 and 2021. Peat swamp forests—a vital component of the landscape—declined by 21,529 ha (61.5%). This loss is particularly alarming in the FLEG zones, where 12,293 ha (64.2%) of peat swamp forests were converted, despite their designation for protection. These findings underscore the vulnerability of protected zones to agricultural encroachment and weak enforcement of conservation regulations.

Oil palm plantations, by contrast, experienced the most significant expansion, increasing from negligible levels in 2000 to 23,153 ha by 2021. Table 1 reveals that nearly half of these plantations (10,066 ha) are located in FLEG zones, areas critical for maintaining ecosystem services such as carbon storage and water regulation. The conversion of these ecologically sensitive zones highlights the challenges of balancing agricultural development with conservation goals.

6.1.2 *Drainage canals and hydrological disruption*

Drainage canal construction is a key enabler of oil palm plantation development on peatlands, as shown in Figure 2C. These canals lower the water table, allowing large-scale cultivation but causing severe ecological consequences. Drainage accelerates peat oxidation, releasing substantial amounts of carbon dioxide and other greenhouse gases into the atmosphere, contributing to climate change (Dhandapani et al., 2019; Temmink et al., 2023).

The hydrological disruption caused by these canals extends beyond individual plantations, affecting the broader landscape. Peatlands are interconnected hydrological systems; therefore, draining one area can destabilize water levels across

the region. This systemic disruption undermines the ability of peat ecosystems to sustain themselves and recover from disturbances, compounding the degradation process. Table 1 further indicates that rice fields, mixed gardens, and scrubland in both FBEG and FLEG zones were extensively converted into oil palm plantations, with drainage canals facilitating this shift.

6.1.3 Fires as catalysts of degradation

Fires, depicted in Figure 2D, are another critical driver of peatland degradation. Frequently used as a low-cost method for clearing land, fires are particularly common among smallholders and underfunded companies. However, the ecological and social costs are immense. Peatland fires release significant amounts of carbon dioxide, particulate matter, and other pollutants, contributing to regional haze events that pose severe health risks (Marlier et al., 2015).

The frequency and intensity of fires in the Pelang Peat Landscape have escalated over the past two decades, with catastrophic events in 2015 and 2019. These years saw Ketapang Regency recording the highest incidence of fires in West Kalimantan, with the region ranking fourth nationwide for fire-affected areas (Ketapang Regency Government, 2023). Fires not only exacerbate degradation but also hinder restoration efforts, as recurring damage makes recovery increasingly difficult. Table 1 highlights how areas previously classified as secondary swamp forests and scrubland are now among the most fire-prone, further accelerating land conversion and ecosystem loss.

6.1.4 The feedback loop of the degradation triad

The interconnected processes of land conversion, drainage, and fire create a self-reinforcing feedback loop. Oil palm expansion necessitates drainage, which dries out the peat, increasing its susceptibility to fires. Fires, in turn, destroy the organic structure of the peat, reducing its capacity to retain water and further exacerbating drainage. This vicious cycle accelerates degradation, making peatlands increasingly uninhabitable for native flora and fauna while diminishing their ability to provide essential ecosystem services.

For example, Table 1 shows that secondary swamp forests in FLEG zones declined by 12,293 ha, while corporate oil palm plantations expanded by 10,066 ha. This direct replacement of ecologically critical zones demonstrates how economic drivers like oil palm cultivation overpower environmental safeguards, perpetuating the degradation triad. The systemic nature of these processes demands integrated management approaches that address the interrelated drivers of degradation to effectively conserve and restore peat ecosystems.

6.2 Hybrid access mechanisms and regulatory incongruence

The degradation of the Pelang Peat Landscape is intricately tied to hybrid access mechanisms, which reflect the dynamic interplay between formal regulatory frameworks and informal structural-relational mechanisms. This extension of Ribot and Peluso's (2003) theory of access provides a nuanced perspective on how various actors navigate and exploit the regulatory landscape, particularly in contexts of regulatory incongruence. Regulatory incongruence, where conflicting or ambiguous legal frameworks coexist, creates openings for actors to maneuver within legal loopholes, enabling land-use practices that drive peatland degradation.

6.2.1 The role of hybrid access mechanisms

The hybrid nature of access mechanisms in the Pelang Peat Landscape emerges from the combination of formal, regulation-based approaches and informal mechanisms rooted in social relations, financial capital, and identity. Corporate actors like PT OBB

and PT OCC exemplify this duality by relying on formal permits to establish plantations in non-forest (APL) zones while leveraging authority and financial resources to secure operations in legally protected FLEG zones. This strategy enables them to justify expansion within a framework of legality, even when environmental regulations are violated.

For cooperatives such as CAA, hybrid mechanisms are more identity-driven. Presenting themselves as community-focused organizations, they gain social legitimacy while bypassing rigorous regulatory oversight. Box Case 2 illustrates how CAA exploits its cooperative status to operate in FLEG zones, engaging in activities like land clearing and canal construction, which violate conservation laws. This duality highlights the ways in which identity and relational legitimacy can act as informal mechanisms that complement formal access pathways.

Independent smallholders also engage in hybrid mechanisms, often relying on informal land markets and social networks to access peatlands. These informal transactions, while locally accepted, frequently occur outside the purview of formal governance structures. This is particularly evident in Table 2, where independent smallholders use dispersed and spotted expansion strategies that blend social legitimacy with regulatory circumvention, complicating efforts to monitor and enforce land-use policies.

6.2.2 Regulatory incongruence and its impacts

Regulatory incongruence amplifies the effectiveness of hybrid access mechanisms by creating opportunities for actors to exploit overlaps and gaps in legal frameworks, as highlighted in Table 3. This dynamic allows actors to operate in ways that are simultaneously legal and illegal depending on the regulation in question. For instance, corporate entities may hold valid permits to operate in APL zones under forest area regulations (KH) but violate peat ecosystem protection regulations (PPEG) by expanding into FLEG zones. Similarly, independent farmers conducting activities on APL land may act legally under one framework but become illegal when their operations encroach upon PEF (Protected Environmental Function) zones.

This duality complicates governance and enforcement, enabling actors to justify exploitative practices while evading comprehensive legal accountability. This duality, often described as “legal, but illegal” or “illegal, but legal,” underscores the limitations of governance structures that fail to harmonize overlapping legal mandates. The exploitation of regulatory gaps not only undermines conservation objectives but also normalizes practices that degrade ecosystems.

The phenomenon of astroturfing, where corporations operate under the guise of cooperatives, further complicates governance. By leveraging their cooperative identity, corporations like CAA gain access to peatlands in a manner that evades regulatory scrutiny while maintaining a veneer of social legitimacy. This highlights the importance of Box Case 1, which contrasts corporate strategies with those of cooperatives to demonstrate how hybrid mechanisms manifest across different actor groups.

6.2.3 Implications for governance

The reliance on hybrid access mechanisms underscores the need for comprehensive regulatory reforms. Current governance systems often prioritize formal compliance without addressing the informal mechanisms that enable actors to bypass restrictions. This imbalance allows hybrid mechanisms to flourish, perpetuating peatland degradation. For instance: (1) Drainage canals constructed by corporate actors are often permitted under agricultural development policies but conflict with conservation mandates aimed at maintaining hydrological balance (Figure 2C); (2) Fires used by smallholders and cooperatives for land clearing exploit weak enforcement of fire

prevention laws, particularly in remote areas where governance capacity is limited (Figure 2D).

The persistence of these practices demonstrates that addressing regulatory incongruence is critical to mitigating hybrid access mechanisms. Aligning overlapping legal frameworks and strengthening enforcement mechanisms are essential steps toward achieving sustainable peatland management.

6.3 Forms of oil palm expansion

The classification of oil palm expansion into *centered*, *spotted*, and *dispersed* forms (Dharmawan, 2020) offers critical insights into the dynamics of land-use change in the Pelang Peat Landscape. Each form reflects distinct spatial patterns and operational strategies employed by different actors, revealing the socio-economic and regulatory contexts that shape their actions. This typology not only provides a structured framework for analyzing the expansion but also addresses the study's second objective: examining the access mechanisms actors employ in transforming land cover and hydrological systems.

6.3.1 Centered expansion: Large-scale, corporate dominance

Centered expansion, characterized by large-scale, contiguous land acquisition, is predominantly driven by corporate actors such as PT OBB and PT OCC. These corporations rely heavily on regulation-based access mechanisms, obtaining permits to operate in non-forest (APL) areas under the forest area (KH) regulatory regime. However, as shown in Table 2, their operations often extend into protected FLEG zones, facilitated by authority-based mechanisms such as political influence and capital resources.

This form of expansion reflects a high degree of planning and resource mobilization, allowing corporations to clear vast tracts of land efficiently. While centered expansion aligns with broader development goals, its ecological impacts are severe. The construction of drainage canals and large-scale clearing activities disrupt hydrological systems, exacerbating peatland degradation. Figure 2C highlights how canal networks, integral to centered expansion, lower water tables and accelerate peat oxidation, contributing to long-term environmental decline.

6.3.2 Spotted expansion: Independent smallholders and fragmentation

Spotted expansion is characterized by smaller, scattered plantations typically developed by independent smallholders and non-transmigrant villagers. Unlike centered expansion, spotted expansion involves minimal planning and lower levels of investment. These actors rely on a mix of formal and informal access mechanisms, including land markets, social networks, and identity-based legitimacy, as detailed in Table 3.

This expansion form often involves piecemeal land clearing, creating a mosaic of plantations interspersed with other land uses. The lack of cohesive planning makes monitoring and enforcement challenging, particularly in areas where informal land transactions dominate. Box Case 1 provides an example of how spotted expansion operates within regulatory ambiguities, allowing smallholders to circumvent restrictions while contributing to the degradation triad.

6.3.3 Dispersed expansion: adaptability and fragmentation

Dispersed expansion, the most prominent pattern in the Pelang Peat Landscape, illustrates fragmented land-use practices driven by socio-economic adaptability and limited resources. This form is common among transmigrant farmers and independent smallholders who spread their activities over wide areas, adapting to shifting market

dynamics and changing government policies. Dispersed expansion exemplifies a hybrid access mechanism, where actors navigate between formal permits and informal arrangements to gain land access.

The fragmentation inherent in dispersed expansion poses significant challenges for sustainable land management. As shown in Table 1, land cover changes associated with dispersed expansion often involve the conversion of mixed gardens, dryland farms, and rice fields into oil palm plantations. This shift disrupts traditional land-use practices, intensifies the ecological burden on peatlands, and complicates restoration efforts.

6.4 Value-driven strategies in peatland management

Building on the theory of access (Ribot & Peluso, 2003), this study introduces the concept of value-driven strategies, which examines how actors align their access mechanisms with their underlying values—either instrumental values prioritizing economic gain or relational values emphasizing sustainability and community well-being. This perspective provides a nuanced understanding of how motivations shape land-use decisions, regulatory interactions, and environmental outcomes. By integrating this framework into the analysis of oil palm expansion, the study advances the theoretical discourse on actor behavior and peatland management.

6.4.1 Instrumental values: profit and economic growth

Corporations, particularly large-scale entities like PT OBB and PT OCC, exemplify instrumental values-driven strategies by prioritizing economic growth and profit through the strategic use of regulatory loopholes, political influence, and financial capital. These actions are closely associated with centered expansion, which involves clearing contiguous tracts of land, often facilitated by government approval or tacit endorsement. As detailed in Table 3, corporations leverage regulation-based access mechanisms (e.g., permits in APL zones) while simultaneously violating conservation regulations to encroach upon FLEG zones, leading to severe ecological impacts such as deforestation, drainage, and fires (Figures 2A–D). Moreover, some corporations engage in deceptive tactics, such as astroturfing, to disguise profit-driven motives under the guise of cooperative identities (Box Case 2). These strategies highlight the role of hybrid access mechanisms in enabling corporations to circumvent scrutiny and regulatory oversight, further exacerbating ecosystem degradation.

6.4.2 Relational values: Environmental and social stewardship

Local communities, environmental NGOs, and cooperative institutions focused on sustainability embody relational value-driven strategies, prioritizing ecological preservation, cultural heritage, and community well-being over economic exploitation. Their efforts center on resisting degradation and advancing proactive restoration. Supported by NGOs such as Tropenbos Indonesia and FFI, communities leverage legal frameworks like the Village Forest (Hutan Desa) program to secure access to peatland resources for conservation (see Box Case 3), effectively countering corporate encroachment. Additionally, these actors employ mechanisms such as traditional authority and collaborative governance to advocate for environmental stewardship. Strategies include community-based patrolling, ecological restoration, and sustainable livelihood programs, which not only mitigate degradation but also foster a balance between ecological preservation and community development. Community champions have also emerged as key agents of change in peatland restoration, mobilizing local knowledge and social legitimacy to protect ecosystem services and support relational values of care and responsibility (Abdurrahim et al., 2022).

6.4.3 Value-driven strategies in a contested landscape

The interplay between instrumental and relational values highlights the contested dynamics of peatland governance, where value-driven strategies emerge as actors navigate shifting regulatory and socio-economic landscapes. Corporations exemplify instrumental adaptation by aligning their strategies with permissive policies and exploiting regulatory incongruence through hybrid access mechanisms, allowing them to operate in ambiguous "legal but illegal" or "illegal but legal" scenarios (Table 3). Conversely, NGOs and local communities adopt relational adaptation, advocating for stricter conservation measures and enhanced policy enforcement. Through media campaigns, legal challenges, and grassroots mobilization, these actors counterbalance corporate exploitation, reinforcing sustainable practices and ecological stewardship. This dynamic underscores the tension between profit-driven expansion and conservation-focused resilience within peatland governance.

6.5 Ecological and governance implications

6.5.1 Ecological consequences of oil palm expansion

The ecological impacts of oil palm expansion in the Pelang Peat Landscape are severe, particularly in the FLEG zones, which hold critical ecological and hydrological significance. The construction of drainage canals (Figure 2C) lowers water tables to facilitate plantation development but disrupts the hydrological balance, leading to peat subsidence, oxidation, and significant carbon emissions, making Indonesia a major global emitter due to peatland degradation (MoEF, 2018). Fires, frequently used for low-cost land clearing (Figure 2D), exacerbate degradation by releasing vast amounts of carbon dioxide and pollutants, contributing to regional haze crises, as seen in the catastrophic events of 2015 and 2019, while also depleting the peat's organic structure, hindering restoration efforts. The loss of 61.5% of peat swamp forests (21,529 ha) between 2000 and 2021 (Table 1) has resulted in significant biodiversity loss, threatening habitats for endemic and protected species, further underscoring the long-term ecological costs of oil palm expansion and the pressing need for sustainable peatland management.

6.5.2 Governance challenges: Hybrid access mechanisms and regulatory incongruence

The study highlights governance failures as a key driver of ecological degradation in the Pelang Peat Landscape, particularly through hybrid access mechanisms and regulatory incongruence. Hybrid access mechanisms enable actors such as corporations, cooperatives, and smallholders to combine formal regulatory pathways with informal structural-relational strategies to gain access to peatlands (Table 3). Corporations leverage financial capital and regulatory permissions to expand plantations, while cooperatives and smallholders utilize identity-based and social network mechanisms to bypass formal restrictions, operating within legal gray areas that blur compliance and violation lines (Box Case 1, Box Case 2). Regulatory incongruence further exacerbates governance challenges, as conflicting frameworks like the Forest Area (KH) and Peat Ecosystem Protection and Management (PPEG) regulations create legal ambiguities, allowing actors to exploit overlapping jurisdictions and loopholes. This incongruence results in activities deemed "legal, but illegal" or "illegal, but legal" (Peluso & Ribot, 2020), undermining conservation efforts and facilitating encroachment into protected FLEG zones.

6.5.3 Persistence of the peatland degradation triad

The persistence of the peatland degradation triad—oil palm expansion, drainage, and fire—despite regulatory interventions underscores systemic governance failures driven by weak enforcement, economic incentives, and fragmented policy responses. Limited monitoring resources and enforcement capacity allow illegal activities, such as corporations disguising operations under "astroturfing" cooperatives—organizations that appear community-led but are in fact corporate-controlled, to persist unchecked (Box Case 2). High global demand for palm oil generates strong economic incentives for actors to prioritize profit over conservation, while the absence of viable alternative livelihoods perpetuates local reliance on environmentally destructive oil palm cultivation. Furthermore, fragmented policy approaches treat drainage, fire, and land-use changes as isolated issues, neglecting their interconnected nature and preventing comprehensive solutions to the systemic challenges driving peatland degradation. Without systemic policy integration and enforcement, this self-reinforcing cycle is likely to persist.

6.6 Policy implications

6.6.1 Integrated landscape governance

Policy frameworks must integrate ecological, social, and economic dimensions to address the interconnected drivers of peatland degradation. This approach is essential to addressing regulatory incongruence, as overlapping jurisdictional challenges in frameworks like FLEG and PPEG create ambiguities that allow exploitation of peatlands (Page & Hooijer, 2016; Peluso & Ribot, 2020). Strengthening coherence through unified policy instruments can enhance conservation efforts and reduce hybrid access mechanisms, where actors exploit legal loopholes to gain access to sensitive areas (Dhandapani & Evers, 2020).

6.6.2 Enhanced enforcement and monitoring

Weak enforcement has been a persistent issue in peatland governance, enabling illegal activities and undermining regulatory frameworks (Gaveau et al., 2018; MoEF, 2018). Building local enforcement capacity and utilizing satellite-based monitoring systems can significantly improve oversight. Additionally, fostering community participation in monitoring and reporting violations can empower local stakeholders and strengthen governance mechanisms (Gaveau et al., 2022).

6.6.3 Sustainable livelihood alternatives

Economic reliance on oil palm cultivation is a key driver of peatland degradation (Ramdani & Lounela, 2020; Astuti, 2021). Policies should incentivize sustainable livelihoods through mechanisms like carbon credits, eco-certifications, and alternative income sources. These initiatives can provide economic stability for communities while reducing reliance on environmentally destructive practices and encouraging long-term conservation (Lilleskov et al., 2019; Dharmawan et al., 2020).

6.6.4 Targeted restoration programs

Restoration efforts must prioritize hydrological restoration by blocking drainage canals and rewetting peatlands to reduce subsidence and carbon emissions (Page & Hooijer, 2016; MoEF, 2018). Public-private partnerships can play a key role in funding restoration projects and ensuring corporate accountability (Dhandapani et al., 2019). Such programs also support biodiversity recovery in degraded peatlands, which are critical habitats for endemic species (Gaveau et al., 2016). In addition, empowering community champions—local actors with social legitimacy and ecological knowledge—can enhance restoration effectiveness by bridging scientific interventions with

grassroots stewardship (Abdurrahim et al., 2022).

6.6.5 Fire management and prevention

Fires continue to be a major contributor to peatland degradation, releasing significant carbon emissions and pollutants (Dohong et al., 2017; Uda et al., 2018). Comprehensive fire management policies should incorporate early warning systems, firebreak construction, and community-based prevention programs. These strategies can mitigate fire risks, protect the ecological integrity of peatlands, and reduce public health crises caused by haze (Girkin et al., 2022).

6.6.6 Global market accountability

The global demand for palm oil is a significant driver of peatland degradation (Gaveau et al., 2018; Ramdani & Lounela, 2020). International trade policies should enforce sustainability criteria for palm oil imports to incentivize responsible practices among producers. Such policies can discourage environmentally harmful expansion and align economic incentives with sustainable development goals, promoting conservation of vital peatland ecosystems (Miettinen et al., 2016).

7. CONCLUSIONS AND SUGGESTIONS

This study highlights the rapid transformation of the Pelang Peat Landscape from forest-dominated ecosystems in 2000 to oil palm-dominated mosaics by 2021. This shift, driven by oil palm expansion, drainage canal construction, and recurrent fires, exemplifies the 'peatland degradation triad.' These interconnected processes not only degrade ecological and hydrological systems but also highlight significant governance challenges. The findings reveal a 61.5% reduction in peat swamp forests, with protected FLEG zones experiencing the highest losses (64.2%). These ecological impacts are compounded by hybrid access mechanisms, where actors navigate formal regulatory pathways and informal networks to exploit peatlands, often exacerbating regulatory incongruence and undermining conservation efforts.

By categorizing oil palm expansion into centered, spotted, and dispersed forms, the study provides a nuanced understanding of land-use dynamics. Furthermore, the introduction of values-driven strategies offer a novel lens to analyze how actors' motivations—whether driven by instrumental values (e.g. profit) or relational values (e.g., community and environmental stewardship)—shape land-use decisions. Corporations primarily adopt instrumental strategies, leveraging regulatory loopholes for large-scale expansion, while communities and NGOs emphasize relational values, resisting exploitation through collaborative networks and sustainable practices. This framework not only advances the theory of access but also underscores the contested nature of peatland governance.

The persistence of the degradation triad despite regulatory interventions underscores the urgent need for stronger, more cohesive governance structures. Policies must address regulatory incongruence, enhance enforcement mechanisms, and incentivize sustainable practices. Expanding community-based conservation initiatives, such as social forestry programs, can provide a model for balancing ecological preservation with local livelihoods. Future research should focus on the long-term ecological and socio-economic impacts of peatland degradation, the role of hybrid access mechanisms across scales, and the integration of climate mitigation strategies into peatland restoration efforts. Balancing economic development with sustainable land management is critical to ensuring the ecological and socio-economic resilience of Indonesia's peatlands.

The policy recommendations outlined in this study highlight the critical need for an integrated and multi-level approach to peatland management. Aligning fragmented regulations can reduce ambiguities and strengthen conservation frameworks, while enhanced enforcement mechanisms and monitoring systems will address weak governance and prevent further illegal exploitation. Additionally, prioritizing sustainable livelihood alternatives and restoration programs offers a path to simultaneously support local economies and ecological recovery. The integration of fire management and global market accountability ensures that both local and international stakeholders share responsibility for sustainable peatland management. These comprehensive and actionable policies provide a foundation for balancing economic interests with ecological preservation, fostering the resilience of peatlands against future threats while aligning with global climate goals.

Author contributions: AYA, AHD, SA, HY, MvN conceived and designed the research; AYA collected and analyzed the data; AYA and MvN wrote the first draft; all contributed to the manuscript as submitted.

Competing Interests: The authors declare that they have no known competitors' financial interests or personal relationships that could (or appear to) influence the work reported in this paper.

Acknowledgments: This study is part of the Degree by Research Program (DBR) of BRIN and Bogor Agricultural University (IPB University), funded by the National Research and Innovation Agency (BRIN), Indonesia; and the Scenario Evaluation for Sustainable Agroforestry Management Program (SESAM), funded by the Interdisciplinary Research and Education Fund (INREF) of Wageningen University and Research (WUR), the Netherlands and Tropenbos Indonesia (TI), Indonesia. The authors thank BRIN, IPB University, WUR, and TI, especially Mr. Kasuma Wijaya (GIS staff), who helped create and compile the map in Figure 2.

REFERENCES

- Abdurrahim, A. Y., Farida, F., van Noordwijk, M., Yogaswara, H., Adiwibowo, S., Dharmawan, A. H., & Sari, R. R. (2021). Collective action in lake management (CALM): An Indonesian stocktake. *IOP Conference Series: Earth and Environmental Science*, 789, 012039. <https://doi.org/10.1088/1755-1315/789/1/012039>
- Abdurrahim, A. Y., Adhuri, D. S., Ross, H., & Phelan, A. (2022). Community champions of ecosystem services: The role of local agency in protecting Indonesian coral reefs. *Frontiers in Ecology and Evolution*, 10, 868218. <https://doi.org/10.3389/fevo.2022.868218>
- Abdurrahim, A. Y., Dharmawan, A. H., Adiwibowo, S., Yogaswara, H., & van Noordwijk, M. (2023). Relational and instrumental values of tropical peat landscapes: Morality and political ecology in Indonesia. *Current Opinion in Environmental Sustainability*, 64, 101318. <https://doi.org/10.1016/j.cosust.2023.101318>
- Astuti, R. (2020). Fixing flammable Forest: The scalar politics of peatland governance and restoration in Indonesia. *Asia Pacific Viewpoint*, 61(2), 283-300. <https://doi.org/10.1111/apv.12267>
- Astuti, R. (2021). Governing the ungovernable: The politics of disciplining pulpwood and palm oil plantations in Indonesia's tropical peatland. *Geoforum*, 124, 381-391. <https://doi.org/10.1016/j.geoforum.2021.03.004>
- Bernstein, H. (2010). *Class dynamics of agrarian change*. Kumarian Press.
- Bernstein, H. (2017). Food sovereignty via the 'peasant way': a sceptical view. In

- Edelman, M. (Ed.), *Critical perspectives on food sovereignty* (pp. 131-164). Routledge.
- Blaikie, P. (1985). *The political economy of soil erosion in developing countries*. Routledge.
- Blaikie, P., & Brookfield, H. (1987). *Land degradation and society*. Routledge.
- Blaikie, P. (1995). Changing environments or changing views? A political ecology for developing countries. *Geography*, 80(3), 203–214. <https://doi.org/10.1080/20436564.1995.12452497>
- Blaikie, P. (2008). Epilogue: Towards a future for political ecology that works. *Geoforum*, 39(2), 765–772. <https://doi.org/10.1016/j.geoforum.2007.07.004>
- Bryant, R. L., & Bailey, S. (1997). *Third world political ecology*. Psychology Press.
- Carmenta, R., Zabala, A., Daeli, W., & Phelps, J. (2017). Perceptions across scales of governance and the Indonesian peatland fires. *Global Environmental Change*, 46, 50–59. <https://doi.org/10.1016/j.gloenvcha.2017.08.001>
- Dhandapani, S., Ritz, K., Evers, S., & Sjögersten, S. (2019). Environmental impacts as affected by different oil palm cropping systems in tropical peatlands. *Agriculture, Ecosystems & Environment*, 276, 8–20. <https://doi.org/10.1016/j.agee.2019.02.012>
- Dhandapani, S., & Evers, S. (2020). Oil palm “slash-and-burn” practice increases post-fire greenhouse gas emissions and nutrient concentrations in burnt regions of an agricultural tropical peatland. *Science of The Total Environment*, 742, 140648. <https://doi.org/10.1016/j.scitotenv.2020.140648>
- Dharmawan, A. H., Mardiyarningsih, D. I., Komarudin, H., Ghazoul, J., Pacheco, P., & Rahmadian, F. (2020). Dynamics of rural economy: A socio-economic understanding of oil palm expansion and landscape changes in East Kalimantan, Indonesia. *Land*, 9(7), 213. <https://doi.org/10.3390/land9070213>
- Dohong, A., Aziz, A., & Dargusch, P. (2017). A review of the drivers of tropical peatland degradation in South-East Asia. *Land Use Policy*, 69, 349–360. <https://doi.org/10.1016/j.landusepol.2017.09.035>
- Fiske, A. P. (1992). The four elementary forms of sociality: Framework for a unified theory of social relations. *Psychological Review*, 99(4), 689–723. <https://psycnet.apa.org/doi/10.1037/0033-295X.99.4.689>
- Forsyth, T. (2008). Political ecology and the epistemology of social justice. *Geoforum*, 39(2), 756–764. <https://doi.org/10.1016/j.geoforum.2006.12.005>
- Gaveau, D. L., Sheil, D., Husnayaen, Salim, M. A., Arjasakusuma, S., Ancrenaz, M., ... & Meijaard, E. (2016). Rapid conversions and avoided deforestation: examining four decades of industrial plantation expansion in Borneo. *Scientific reports*, 6(1), 32017. <https://doi.org/10.1038/srep32017>
- Gaveau, D. L., Locatelli, B., Salim, M. A., Yaen, H., Pacheco, P., & Sheil, D. (2019). Rise and fall of forest loss and industrial plantations in Borneo (2000–2017). *Conservation Letters*, 12(3), e12622. <https://doi.org/10.1111/conl.12622>
- Gaveau, D. L., Locatelli, B., Salim, M. A., Husnayaen, Manurung, T., Descals, A., ... & Sheil, D. (2022). Slowing deforestation in Indonesia follows declining oil palm expansion and lower oil prices. *PLoS One*, 17(3), e0266178. <https://doi.org/10.1371/journal.pone.0266178>
- Girkin, N. T., Cooper, H. V., Ledger, M. J., O'Reilly, P., Thornton, S. A., Åkesson, C. M., ... & Roucoux, K. H. (2022). Tropical peatlands in the Anthropocene: the present and the future. *Anthropocene*, 40, 100354. <https://doi.org/10.1016/j.ancene.2022.100354>
- Githinji, M., van Noordwijk, M., Muthuri, C., Speelman, E. N., & Hofstede, G. J. (2023). Farmer land-use decision-making from an instrumental and relational

- perspective. *Current Opinion in Environmental Sustainability*, 63, 101303. <https://doi.org/10.1016/j.cosust.2023.101303>
- Government of Indonesia. (2014). *Government Regulation No. 71 of 2014 on Protection and Management of Peat Ecosystems* [Government Regulation]. Retrieved from <https://peraturan.bpk.go.id/Details/5513/pp-no-71-tahun-2014>
- Government of Indonesia. (2016). *Government Regulation No. 57 of 2016 amending Government Regulation No. 71 of 2014 on Protection and Management of Peat Ecosystems* [Government Regulation]. <https://peraturan.bpk.go.id/Details/5778/pp-no-57-tahun-2016>
- Haidt, J., & Kesebir, S. (2010). Morality. In S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), *Handbook of social psychology* (5th Edition). John Wiley & Sons, Inc.
- Hall, D. (2011). Land grabs, land control, and Southeast Asian crop booms. *The Journal of Peasant Studies*, 38(4), 837–857. <https://doi.org/10.1080/03066150.2011.607706>
- Hall, D., Li, T. M., & Hirsch, P. (2011). *Powers of exclusion: Land dilemmas in Southeast Asia*. NUS Press.
- Kemper, T. (2016). *Elementary forms of social relations: Status, power and reference groups*. Routledge.
- Ketapang Regency Government. (2023). *Masterplan Pencegahan Kebakaran Hutan dan Lahan Berbasis Tata Kelola Gambut di Kesatuan Hidrologis Gambut (KHG) Sungai Pawan–Sungai Kepulu dan Sungai Kepulu–Sungai Pesaguan Kabupaten Ketapang, Provinsi Kalimantan Barat*. Ketapang Regency Government.
- Langston, J. D., Mendham, D. S., & Sakuntaladewi, N. (2023). Dreaming of wetscapes: Waking to the realities of restoration. *Ambio*, 53(2), 351–362. <https://doi.org/10.1007/s13280-023-01956-8>
- Leimona, B., van Noordwijk, M., Mithöfer, D., & Cerutti, P. (2017). Environmentally and socially responsible global production and trade of timber and tree crop commodities: Certification as a transient issue-attention cycle response to ecological and social issues. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 13(1), 497–502. <https://doi.org/10.1080/21513732.2018.1469596>
- Leimona, B., Mithöfer, D., Wibawa, G., & van Noordwijk, M. (2024). Sustainability certification: Multiple values of nature coexist in value chain transformations toward a common but differentiated responsibility. *Current Opinion in Environmental Sustainability*, 66, 101393. <https://doi.org/10.1016/j.cosust.2023.101393>
- Lusiana, B., Slingerland, M., Miccolis, A., Khasanah, N., Leimona, B., & van Noordwijk, M. (2023). Oil palm production, instrumental and relational values: The public relations battle for hearts, heads, and hands along the value chain. *Current Opinion in Environmental Sustainability*, 64, 101321. <https://doi.org/10.1016/j.cosust.2023.101321>
- Miettinen, J., & Liew, S. C. (2003). Connection between fire and land cover change in Riau province, Sumatra from 1998 to 2002. In *IGARSS 2003. 2003 IEEE International Geoscience and Remote Sensing Symposium. Proceedings (IEEE Cat. No. 03CH37477)* (Vol. 4, pp. 2496-2498). IEEE.
- Miettinen, J., & Liew, S. C. (2010). Status of peatland degradation and development in Sumatra and Kalimantan. *Ambio*, 39(5–6), 394–401. <https://doi.org/10.1007/s13280-010-0051-2>
- Miettinen, J., Shi, C., & Liew, S. C. (2016). Land cover distribution in the peatlands of Peninsular Malaysia, Sumatra and Borneo in 2015 with changes since 1990. *Global Ecology and Conservation*, 6, 67–78. <https://doi.org/10.1016/j.gecco.2016.05.001>

- 016.02.004
- Ministry of Environment and Forestry (MoEF). (2018). *PPKL-MoEF Decree No. 40 of 2018 concerning Determination of Peat Ecosystem Damage Status*. Ministry of Environment and Forestry. Accessed from <http://pkgppkl.menlhk.go.id/v0/keputusan-dirjen-ppkl-nomor-sk-40-tahun-2018-penetapan-status-kerusakan-ekosistem-gambut/>
- Ministry of Environment and Forestry (MoEF). (2021). *Corrective action on peatland protection and management in Indonesia: Toward sustainable peatland management 2019–2020*. Ministry of Environment and Forestry. Accessed from <http://pkgppkl.menlhk.go.id/v0/en/corrective-action-on-peatland-protection-and-management-in-indonesia-2019-2020/>.
- Nusantara Atlas. (2024). *Location and evidence-based stories linking deforestation and fire alerts*. Nusantara Atlas. Accessed from <https://map.nusantara-atlas.org>
- Omar, M. S., Ifandi, E., Sukri, R. S., Kalaitzidis, S., Christanis, K., Lai, D. T. C., ... & Tsikouras, B. (2022). Peatlands in Southeast Asia: A comprehensive geological review. *Earth-Science Reviews*, *232*, 104149. <https://doi.org/10.1016/j.earscirev.2022.104149>
- Page, S. E., & Hooijer, A. (2016). In the line of fire: The peatlands of Southeast Asia. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *371*(1696), 20150176. <https://doi.org/10.1098/rstb.2015.0176>
- Peluso, N. L., & Ribot, J. (2020). Postscript: A theory of access revisited. *Society & Natural Resources*, *33*(2), 300–306. <https://doi.org/10.1080/08941920.2019.1709929>
- Perreault, T. A., Bridge, G., & McCarthy, J. (Eds.). (2015). *The Routledge handbook of political ecology*. Routledge.
- Peatland and Mangrove Restoration Agency (PMRA). (2021). *Rencana Tindakan Tahunan Restorasi Ekosistem Gambut di Kalimantan Barat 2021 –2024*. Peatland and Mangrove Restoration Agency (PMRA).
- Pouliot, V. (2016). *International pecking orders: The politics and practice of multilateral diplomacy*. Cambridge University Press.
- Ramdani, R., & Lounela, A. (2020). Palm oil expansion in tropical peatland: Distrust between advocacy and service environmental NGOs. *Forest Policy and Economics*, *118*, 102242. <https://doi.org/10.1016/j.forpol.2020.102242>
- Reed, J., Kusters, K., Barlow, J., Balinga, M., Borah, J. R., Carmenta, R., ... & Sunderland, T. (2021). Re-integrating ecology into integrated landscape approaches. *Landscape Ecology*, *36*(8), 2395–2407. <https://doi.org/10.1007/s10980-021-01268-w>
- Ribot, J., & Peluso, N. (2003). A theory of access. *Rural Sociology*, *68*(2), 153–181. <https://doi.org/10.1111/j.1549-0831.2003.tb00133.x>
- Robbins, P. (2019). *Political ecology: A critical introduction* (3rd ed.). John Wiley & Sons.
- Rocheleau, D. E. (2008). Political ecology in the key of policy: From chains of explanation to webs of relation. *Geoforum*, *39*(2), 716–727. <https://doi.org/10.1016/j.geoforum.2007.02.005>
- Roh, Y., Kim, S., Han, S. H., Lee, J., & Son, Y. (2018). Rewetting strategies for the drained tropical peatlands in Indonesia. *Korean Journal of Environmental Biology*, *36*(1), 33–42. <https://doi.org/10.11626/KJEB.2018.36.1.033>
- Saputra, E. (2019). Beyond fires and deforestation: Tackling land subsidence in peatland areas, a case study from Riau, Indonesia. *Land*, *8*(5), 76. <https://doi.org/10.3390/land8050076>
- Sayer, J., Sunderland, T., Ghazoul, J., Pfund, J. L., Sheil, D., Meijaard, E., ... & Buck, L. E. (2013). Ten principles for a landscape approach to reconciling agriculture,

- conservation, and other competing land uses. *Proceedings of the national academy of sciences*, 110(21), 8349-8356. <https://doi.org/10.1073/pnas.1210595110>
- Schlager, E., & Ostrom, E. (1992). Property-rights regimes and natural resources: A conceptual analysis. *Land Economics*, 68(3), 249-262. <https://doi.org/10.2307/3146375>
- Scoones, I. (2009). Livelihoods perspectives and rural development. *Journal of Peasant Studies*, 36(1), 171-196. <https://doi.org/10.1080/03066150902820503>
- Scoones, I. (2015). *Sustainable livelihoods and rural development*. Practical Action Publishing.
- Scoones, I., Leach, M., & Newell, P. (2015). *The politics of green transformations*. Routledge. <https://doi.org/10.4324/9781315747378>
- Scoones, I. (2016). The politics of sustainability and development. *Annual Review of Environment and Resources*, 41(1), 293-319. <https://doi.org/10.1146/annurev-environ-110615-090039>
- Scoones, I., & Stirling, A. (2020). *Uncertainty and the politics of transformation*. In *The politics of uncertainty: Challenges of transformation*. Routledge.
- Svarstad, H., & Benjaminsen, T. A. (2024). Political ecology and the power of sociology. In Overdevest, C. (Ed.), *Elgar encyclopedia of environmental sociology* (pp. 447-453). Edward Elgar Publishing. <https://doi.org/10.4337/9781803921044.ch79>
- Temmink, R. J., Robroek, B. J., van Dijk, G., Koks, A. H., Käärmelahti, S. A., Barthelmes, A., ... & Smolders, A. J. (2023). Wetscapes: Restoring and maintaining peatland landscapes for sustainable futures. *Ambio*, 52(9), 1519-1528. <https://doi.org/10.1007/s13280-023-01875-8>
- Uda, S., Schouten, G., & Hein, L. (2018). The institutional fit of peatland governance in Indonesia. *Land Use Policy*, 99, 103006. <https://doi.org/10.1016/j.landusepol.2018.03.031>
- van Noordwijk, M., Speelman, E., Hofstede, G. J., Farida, A., Abdurrahim, A. Y., Miccolis, A., ... & Teuling, A. J. (2020). Sustainable agroforestry landscape management: Changing the game. *Land*, 9(8), 243. <https://doi.org/10.3390/land9080243>
- van Noordwijk, M., Leimona, B., Amaruzaman, S., Pascual, U., Minang, P. A., & Prabhu, R. (2023). Five levels of internalizing environmental externalities: Decision-making based on instrumental and relational values of nature. *Current Opinion in Environmental Sustainability*, 63, 101299. <https://doi.org/10.1016/j.cosust.2023.101299>
- Waeber, P. O., Carmenta, R., Carmona, N. E., Garcia, C. A., Falk, T., Fellay, A., ... & Kleinschroth, F. (2023). Structuring the complexity of integrated landscape approaches into selectable, scalable, and measurable attributes. *Environmental Science & Policy*, 147, 67-77. <https://doi.org/10.1016/j.envsci.2023.06.003>