TAY JUHANA FOUNDATION

TJF RESEARCH BRIEF

Hydrosocial Territories: Traditional Water Management for Sustainable Coconut Agriculture on Tropical Coastal Peatlands

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Key Findings

1. Traditional *parit* systems constitute dynamic hydrosocial territories that co-produce people, tidal water flows, and peat for sustainable coconut agriculture with low emissions.

2. Modernization and climate pressures have re-territorialized *parit* from lived socio-cultural landscapes into fragmented agricultural infrastructure.

3. Recognising and scaling smallholder hydrosocial territories rather than replacing them offers a just and effective pathway for inclusive peatland sustainability.

Introduction

The eastern coast of Sumatra Island consists of extensive wetland ecosystems shaped by its lowland topography. This natural setting has compelled human societies to adapt their agricultural practices to the hydrological conditions. Historical records show that wetland agriculture dates back to the Sriwijaya Kingdom (7th century CE), when coconut (*ñīyur*), areca nut, sugar palm, and sago were cultivated successfully in these environments (Cœdès, 1930). This heritage persisted and intensified during Dutch colonial rule in the 19th century, when coconut became a major export commodity known locally as "green gold" (Heersink, 1994). In Indragiri Hilir Regency (Riau Province), large-scale traditional coconut cultivation expanded rapidly in response to demand from the East Indies trade network in Singapore (Cerepak, 2020). Migration of Banjar and Bugis communities, driven by inter-tribal conflicts, further populated the peat-dominated landscape and established coconut-based livelihoods (**Figure 1**).

Traditional systems rely on shallow water infrastructure, locally known as '*parit*.' These *parit* serve as artificial or natural canals and water channels that act as the lifeline of the local community. This infrastructure regulates water levels for coconut production in coastal and riparian peatlands influenced by tidal dynamics. These *parit* networks form the backbone of agricultural life and have earned Indragiri Hilir the designation "the land of a thousand canals." Far beyond infrastructure, the *parit* system constitutes a community-based water management practice embedded in local knowledge, cultural identity, and human–environment relations. It has evolved into a distinct hydrosocial territory—a relational space co-produced by people, water flows, peat soils, and governance arrangements (Boelens et al., 2016).

However, this territory faces rapid transformations driven by two main pressures: the marginalisation of

smallholder coconut farming within national policy priorities and climate-induced subsidence that alters hydrology, increases flooding risk, and reduces productivity. These changes demand social adaptation to protect the livelihoods of communities dependent on coconut in this fragile ecosystem. Understanding these dialectic shifts is essential for enhancing sustainability and resilience. Examining governance in practice, particularly how responsibilities for parit maintenance are distributed among communities, local governments, external interventions, and national peatland agendas—reveals the challenges arising from fragmented and dynamic institutional landscapes. As these arrangements evolve, so do expectations regarding who should manage, maintain, and finance the parit system to preserve Indonesia's coconut heritage within the hydrosocial context of peatland management.

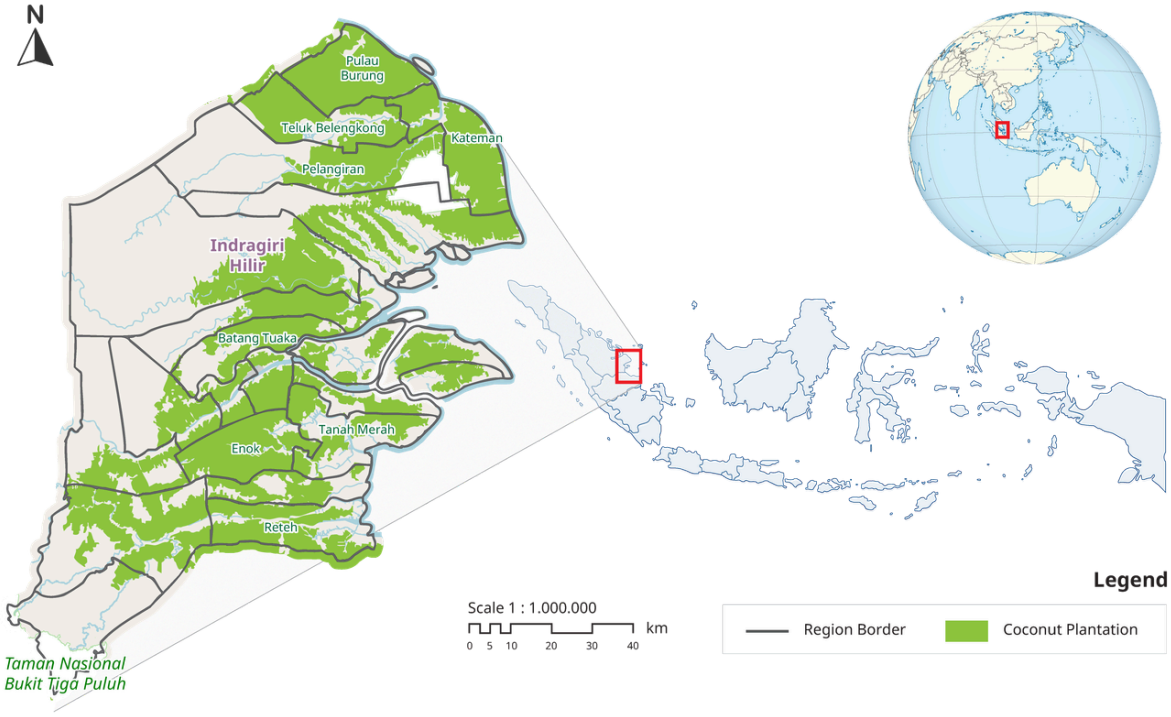

Figure 1. The map of the distribution of coconut plantations in Indragiri Hilir.
Source: TJF Documentation (2025)

Characteristics and Challenges of Wetland Agriculture

Although the hydrosocial territory framework has been applied extensively to peatland governance in Indonesia, a critical gap persists regarding traditional smallholder coconut systems. Most studies focus on impact on large scale agriculture concession on peatland, large-scale restoration projects, or government-led

rewetting initiatives. These works highlight contestation between drainage for export crops and ecological restoration but largely overlook how community-managed *parit* systems on coastal peatlands generate resilient, low-emission hydrosocial territories that sustain coconut production while minimising subsidence and carbon loss. Addressing this gap is essential for developing inclusive peatland policies that recognise and scale existing adaptive practices rather than replacing them.

Sustainable agricultural use of peatlands depends fundamentally on water regulation to support crop productivity and prevent environmental degradation (Ritzema et al., 1998; Wijedasa et al., 2017). To understand water governance in practice, it is necessary to examine the spaces where management is enacted. The concept of hydrosocial territories offers a robust analytical lens:

Figure 2. *Parit* in Indragiri Hilir.
Source: TJF Documentation (2023)

it views water governance as a relational process shaped by interactions among water flows, infrastructure, social relations, and institutions. Hydrosocial territories are socially, naturally, and politically constructed networks—rather than fixed physical spaces—that are continuously (re)produced through human practices, hydraulic technologies, biophysical elements, and cultural-political arrangements (Boelens et al., 2016). They operate across scales as dynamic assemblages linking actors, materials, and processes (Flaminio et al., 2022). In this framing, water is not a neutral resource but a site of ongoing political, cultural, and ecological contestation over definition, control, and benefit. The *parit* system in Indragiri Hilir exemplifies such a territory: water channels, peat soils, farming practices, and governance are co-produced and sustained through community labour, tidal knowledge, and adaptive rules.

Contested Imaginaries of the Territory

Contested imaginaries lie at the core of the hydrosocial territory concept. Rather than beginning as a fixed physical space, a territory originates as a mental vision or storyline about what water is, what the landscape should become, and how society, nature, technology, and power should be organised.

In peatland agriculture these imaginaries are sharply polarised because peatlands are living, water-saturated carbon stores whose

identity is redefined by water management. The dominant imaginary promoted by large-scale agribusiness concessions views tropical peat as underutilised and suboptimal land that nonetheless has high potential, provided it is drained to support either high-value crops or rice as the staple food. This vision materialises through extensive canal networks that lower water tables dramatically. The Mega Rice Project (1990s) provides a cautionary lesson: its open-drainage canals system severed peat-dome hydrology, leading to widespread degradation and unproductivity (Horton et al., 2021; Houterman & Ritzema, 2009).

In parallel, the ecological/restoration imaginary re-envisions the same peatland as a wet carbon sink best managed through rewetting and paludiculture (wet-adapted crops such as sago or certain fruits). In contrast, the traditional coconut imaginary —held by smallholder communities—treats coastal and riparian peatlands as tidal-influenced systems best regulated by *parit* connected to natural rivers rather than upland peat domes (which require greater technical and financial investment). Farmers imagine the *parit* as a controlled drainage and nutrient-delivery network bounded by river and tidal hydrology (**Figure 3**). These imaginaries clash most visibly. In some cases, oil-palm concessions impose drainage territories with closed-system water management that disrupts neighbouring traditional coconut systems. At the same time, government restoration programmes introduce rewetting mandates that sometimes conflict with established tidal management practices. The coconut parit territory thus stands as a living alternative, challenging both extractivist drainage and full-rewetting models while offering a pathway for sustainable peatland agriculture that integrates livelihood security with hydrological integrity.

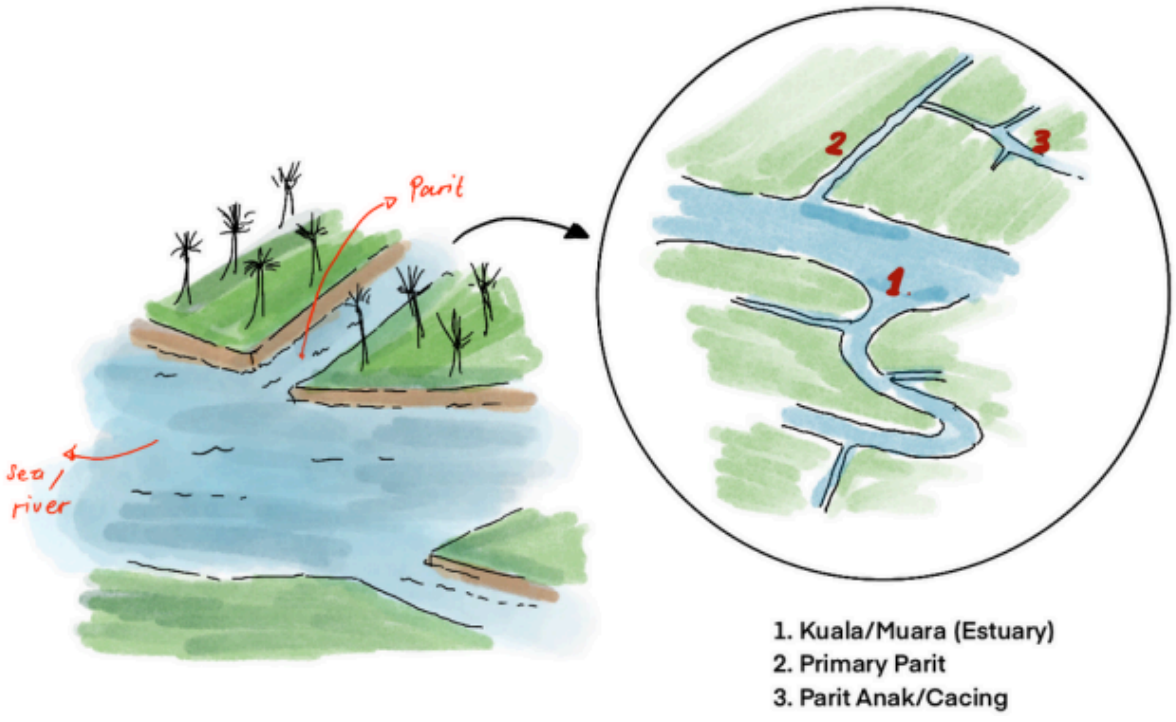

Figure 3. *Parit* and its characteristics.
Source: Developed by author (2025)

Territorial Pluralism

Territorial pluralism is pronounced in peatland landscapes because an entire peat hydrological unit functions as a single interconnected system that can simultaneously host multiple, overlapping hydrosocial territories. In Indragiri Hilir, the same coastal and riparian peatlands accommodate at least three distinct territories alongside the traditional coconut systems: corporate drained territories (large concessions with its own primary and secondary canal networks optimised for monoculture), adjacent smallholder territories (often combining monoculture coconut plantations with intercropping, managed at smaller scales), and government-designated restoration territories under the Peatland and Mangrove Restoration Agency (BRGM). These territories share identical peat hydrology and tidal influences yet operate under entirely different rules, boundaries, and water-control technologies. This classic territorial pluralism underscores how competing water practices within the same hydrological unit generate conflict over agricultural productivity, particularly for capital-poor smallholders.

Power and Inclusion/Exclusion in Agricultural Water Territories

Power relations and processes of inclusion/exclusion are enacted primarily through control of drainage infrastructure and legal recognition of water rights. In large concession territory (often with national or foreign capital) secure long-term concessions and build primary and secondary canals that effectively govern the large area of hydrology's system, including areas outside their legal boundaries. This "governmentalization of territory" includes smallholders and communities into a drained logic whether they want it or not. Many smallholders become outgrowers or are tolerated on the edges, but they are excluded from decision-making about canal design and water levels.

Figure 4. A farmer showing the water level on his farm. Source: TJF Documentation (2026)

In traditional coconut systems, everyday governance centres on the figure of the *Wakil Parit* (canal representative), who occupies the central position in everyday water management and dispute resolution. The *Wakil Parit* is the person who opens the *parit*, but the position is passed down through generations, primarily through primarily through kinship and familial ties.

Historically, this role arose alongside the construction of new waterways, with authority frequently passing down through kinship and familial ties. However this arrangement has begun to shift. Today, the *Wakil Parit* is selected through *musyawarah*, a collective deliberation process attended by landholders farming along the *parit* to reach a consensus decision by mutual agreement. This shift reflects broader social and institutional changes that influence how authority and responsibility are negotiated in peatland landscapes. We also discovered that in the current village institutional hierarchy, *Wakil Parit* holds a role similar to that of the RT (*Rukun Tetangga*) or Neighbourhood Unit. In several locations, communities have formally merged the title "*Wakil Parit*" with that of RT head.

Interestingly, while the position of *Wakil Parit* still exists today, that perceptions of this role have shifted. All *Wakil Parit* interlocutors expressed dissatisfaction with their current position. This sentiment is expressed in the following interview excerpt:

> ***Wakil parit* are elected through musyawarah and are officially registered with the *kelurahan* administration.**
>
> *– Pak Apul (Interview, July 2025)*

Figure 5. *Parit* in one of the *perkampungan*.
Source: TJF Documentation (2025)

These changes in governance and responsibility are inextricably linked to longer-term shifts in how people perceive and inhabit the *parit* landscape. Oral histories show that *parit* systems in Indragiri Hilir existed long before formal state formation. For earlier generations, *parit* were more than just agricultural infrastructure; they were also living spaces. Farmers who opened new *parit* built houses along them, and these waterways eventually became the center of *perkampungan* (settlements). Interlocutors recalled that governance during this period was embedded in a larger social and moral landscape: in addition to the *Wakil Parit*, there was a *Penghulu* who held the highest position of authority and functioned similarly to a village leader today. Each *parit* also had its own *surau*, which served

as a hub for religious and social activities. In this configuration, the *parit* shaped not only water management practices but also settlement patterns, leadership structures, and communal life.

Multi-Scalar and Dynamic Processes

Hydrosocial territories in peatland agriculture are inherently multi-scalar and dynamic because local water management practices connect directly to global markets, climate variability, and national policy frameworks. In tropical peatlands, these connections are particularly pronounced, as decisions made in individual *parit* systems influence not only farm productivity but also regional hydrology and global carbon cycles. The failure of the Mega Rice Project in the 1990s continues to shape national perceptions of peatland agriculture. Although the project focused primarily on deep inland peat rather than coastal smallholder systems, its collapse reinforced a dominant narrative that agricultural use of peatlands is inherently unsustainable.

This historical legacy has indirectly stigmatised smallholder coconut cultivation despite its fundamentally different shallow water management approach (Horton et al., 2021). In contemporary Indonesia, water-level regulation is being enforced to maintain peatland water tables at −40 cm or higher while permitting limited agricultural production. However, these measures are enforced mainly on large-scale concessions, with far less support extended to traditional smallholder territories. Nevertheless, the policy shift has contributed to a broader transition toward fire-free practices across peatlands (Fawzi et al., 2024), significantly reducing transboundary haze during El Niño dry seasons.

At the same time, smallholders experience these scalar dynamics most acutely through climate change. Greater variability in rainfall and tidal patterns disrupts pollination and water balance, triggering a condition locally termed '*ngetrek*.' This phenomenon, known scientifically as premature button shedding or excessive nut drop, occurs when coconut palms produce numerous female flowers (buttons) that abort before developing into mature fruit. Yield losses can reach 70–90 % in a single season even when the palms appear healthy. The condition is closely linked to unstable water tables and nutrient imbalances common under changing hydrological regimes in coastal peatlands.

Figure 6. *Kelapa 'ngetrek'* due to water imbalance.
Source: TJF Documentation (2023)

Figure 7. Farmer-made *tanggul* and water gate.
Source: TJF Documentation (2025 (Above) & 2026 (Below))

Land subsidence and sea-level rise further exacerbate vulnerability by increasing flooding frequency and severity in coastal plantations. Farmers often respond by constructing '*tanggul*' (embankments), yet the financial costs and the limited authority of the *Wakil Parit* mean that only some territories can implement effective adaptation measures. Many communities must therefore rely on external support from regional coconut processing companies or government programmes (Saputra, 2019). These processes highlight the continuous re-territorialization of hydrosocial territories in Indragiri Hilir. Local practices, national restoration agendas, and global environmental change interact to reshape both the physical landscape and the social relations that sustain it. Recognising the multi-scalar nature of these territories is essential for developing inclusive peatland policies that build upon, rather than marginalise, the adaptive capacities of smallholder coconut systems.

Re-Territorialization and Adaptation toward Sustainability

Historically, *parit* systems served as the primary spatial axis for socio-economic life in coastal peatland communities. They functioned not only as water regulation channels but also as the main transport routes for moving copra and other agricultural products to trading centres. Because livelihoods depended directly on the functionality of these waterways, their maintenance represented a shared responsibility deeply intertwined with daily mobility, residence, and social interaction.

The communities emphasised that parit were maintained through collective practices rather than formal regulations, sustained by their role as routes of access, connection, and livelihood security. Processes of modernisation, particularly the pursuit of improved access to education, healthcare, and road-based transportation, encouraged households to relocate closer to village centres and main roads. This spatial shift did not reflect a perception of *parit*-side life as backward. Rather, it mirrored changing aspirations and evolving infrastructure priorities that altered how space is valued and inhabited. As a consequence, the cultural meaning of the

Figure 8. *Parit* as routes of access.
Source: TJF Documentation (2025)

parit has been fundamentally transformed. What was once a multifaceted living landscape—integrating residence, sociality, religion, and economy—has been redefined primarily as agricultural space.

Today, when farmers refer to *parit*, they typically mean '*kebun*' (plantation) rather than '*perkampungan*' (settlement). This transformation carries significant implications for governance. As the *parit* shifts from a lived landscape to a predominantly productive space, practices of care have become narrower, more individualised, and increasingly burdensome. Governance has moved from managing a shared socio-ecological domain to maintaining agricultural infrastructure alone, even though the ecological and hydrological interdependence of the system remains unchanged. As climate change and land subsidence intensify, this narrowing of responsibility has contributed to the abandonment of many plantations.

Beyond these socio-cultural changes, transformations in parit governance are also evident in the physical reconfiguration of the landscape. Originally constructed as discrete, independent channels carefully designed to regulate water inflow and outflow according to seasonal cycles and tidal rhythms, many *parit* were merged starting in the 1980s to improve accessibility and shorten travel distances between farms and settlements. While this reconfiguration addressed emerging mobility needs, it produced unintended hydrological consequences. The merging of channels altered water circulation patterns, reducing outflow and causing persistent waterlogging in agricultural plots. This disruption of established water cycles has increased vulnerability in the peatland environment.

These modifications have introduced new forms of risk. Persistent water retention, combined with ongoing subsidence and rising water levels, has heightened the need for infrastructure such as *tanggul* to protect *kebun*. What began as a responsive, adaptive hydrosocial system has evolved into a more rigid infrastructure requiring constant intervention.

These changes reflect a broader process of re-territorialization within the peatland landscape. Although the *parit* have not

disappeared, their significance and function have been reconfigured through shifting relationships among water circulation, authority structures, and everyday living and farming practices. As settlement patterns moved away from the waterways and *parit* came to be understood primarily as agricultural infrastructure, the social meanings and collective responsibilities attached to them have gradually narrowed. Governance, which once encompassed an integrated lived landscape linking water management, residence, religious life, and social authority, has been re-territorialized into a more technical and fragmented domain. In this process, the *Wakil Parit* continues to occupy a central position but now operates within new institutional hierarchies with responsibilities that often exceed their authority and capacity. Taken together, these transformations demonstrate why *parit* systems must be understood as dynamic hydrosocial territories rather than neutral technological infrastructure.

The ongoing reconfiguration of *parit* illustrates how water, space, and social relations are continuously co-produced (Krause & Strang, 2016). Changes in water flows reshape patterns of care, vulnerability, and governance, while evolving social priorities and development logics reshape the hydrological landscape. In this light, *parit* emerge as contested territories in which ecological processes, embodied practices, and political authority are constantly negotiated. Understanding them through the hydrosocial territory framework reveals that current governance challenges are not technical management failures but the outcome of long-term hydrosocial transformations that have redefined what the *parit* are, for whom they exist, and how they should be governed. Recognising and supporting these adaptive smallholder territories offers a promising foundation for more inclusive and sustainable peatland management in Indonesia.

Figure 9. *Parit* as hydrosocial territories supporting livelihoods.
Source: TJF Documentation (2023)

Conclusion

Territorial pluralism is pronounced in peatland landscapes because an entire peat hydrological unit functions as a single interconnected system that can simultaneously host multiple, overlapping hydrosocial territories. In Indragiri Hilir, the same coastal and riparian peatlands accommodate at least three distinct territories alongside the traditional coconut systems: corporate water management territories (large concessions with its own primary and secondary canal networks optimised for monoculture in inland areas), adjacent smallholder territories (often mixed coconut plots managed at smaller scales), and government-designated restoration territories under the Peatland and Mangrove Restoration Agency (BRGM). These territories share identical peat hydrology and tidal influences yet operate under entirely different rules, boundaries, and water-control technologies. This classic territorial pluralism underscores how competing water practices within the same hydrological unit generate conflict over agricultural productivity, particularly for capital-poor smallholders.

Furthermore, effective governance of these territories requires more than technical interventions such as embankment construction. It demands recognition of the *parit* as a living socio-ecological landscape and the strengthening of collective responsibility. A multi-stakeholder approach that fosters genuine dialogue among smallholders, *Wakil Parit*, local governments, and restoration agencies can shift governance from fragmented, reactive measures toward coordinated, long-term care for water flows and community livelihoods. Hybrid governance models that combine public, private, and community roles have proven essential for peatland restoration elsewhere in Indonesia and offer a promising pathway for Indragiri Hilir.

Understanding *parit* systems as dynamic hydrosocial territories explains why purely infrastructural solutions remain insufficient. These systems are continuously (re)produced through interactions among water, people, institutions, and ecological processes. As Indonesia advances its national peatland restoration agenda, recognising and actively supporting existing smallholder hydrosocial territories—rather than replacing them—offers the most just and effective pathway toward sustainable peatland management. This approach not only preserves Indonesia's coconut heritage but also contributes to global efforts to balance carbon storage, biodiversity conservation, and rural livelihoods in vulnerable tropical peatland ecosystems.

Figure 10. *Parit* as the reservoir canal under integrated water management (*Trio Tata Air*) in corporate territories. Source: TJF Documentation (2020)

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Tay Juhana Foundation (TJF) is a nonprofit organization dedicated to promote the advocacy of the conversion and cultivation of suboptimal lands into productive lands, through the most environmentally, economically, and socially sustainable manner.

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