Eduvest – Journal of Universal Studies
Volume 5 Number 10, October, 2025
p- ISSN 2775-3735- e-ISSN 2775-3727

Conservation-Compatible Oil Palm Development: Integrating High Conservation Value (HCV) Safeguards in Mandailing Natal, Indonesia

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ABSTRACT

The global palm oil industry faces increasing pressure to eliminate deforestation from its supply chains, driven by international commitments such as the European Union Deforestation Regulation (EUDR), Roundtable on Sustainable Palm Oil (RSPO) standards, and Indonesia's Forest and Other Land Use (FOLU) Net Sink 2030 commitment. These frameworks require effective mechanisms to identify and safeguard ecologically and socially valuable landscapes within agricultural frontiers. Integrating High Conservation Value (HCV) principles into land use planning is therefore critical to balancing commodity production, biodiversity conservation, and community rights. This study analyzes how oil palm development in Mandailing Natal, North Sumatra, can align with High Conservation Value (HCV) protection. Using a 2024 district-wide ABKT-HCS (High Conservation Value and High Carbon Stock) assessment and scenario modeling, the study examines forest encroachment, institutional fragmentation, and policy gaps undermining sustainable land use. Although more than half of the district is legally defined as forest, rapid plantation expansion—driven by smallholder pressures, tenure insecurity, and weak inter-agency coordination—continues to erode ecological integrity and cultural landscapes. Scenario analysis shows that improving yields through Good Agricultural Practices (GAP) and participatory zoning can enhance productivity without new deforestation. The paper recommends integrating ABKT spatial data into formal land-use planning, institutionalizing Free, Prior, and Informed Consent (FPIC), and implementing community-based monitoring. These strategies support a jurisdictional sustainability transition consistent with Indonesia's FOLU Net Sink 2030 objective.

KEYWORDS *ABKT, conservation, deforestation, High Conservation Value (HCV), Indonesia, land use planning, Mandailing Natal, oil palm, smallholders, sustainable agriculture*

INTRODUCTION

The global palm oil sector operates within an increasingly stringent regulatory landscape shaped by deforestation-free supply chain commitments, sustainability certification standards, and climate mitigation obligations. The European Union Deforestation Regulation (EUDR), effective from 2025, mandates traceability and due diligence to ensure commodities—including palm oil—are not linked to deforestation or forest degradation after December 2020 (European Commission, 2023). Similarly, the Roundtable on Sustainable Palm Oil (RSPO) has strengthened its criteria to prohibit development in High Conservation Value (HCV) and High Carbon Stock (HCS) areas, reflecting growing consumer and investor demands for environmentally responsible sourcing (RSPO, 2018). At the national level, Indonesia—the

world's largest palm oil producer—has committed to achieving a Forest and Other Land Use (FOLU) Net Sink by 2030, requiring the cessation of deforestation in production landscapes and the restoration of degraded ecosystems (Ministry of Environment and Forestry Indonesia, 2021). These converging pressures necessitate the integration of robust conservation safeguards within subnational land use governance systems, particularly in commodity-producing regions where ecological values intersect with economic development priorities.

Mandailing Natal (Madina) District, located in North Sumatra Province, has emerged as a significant frontier in Indonesia's rapidly expanding oil palm sector. As of 2022, the district encompassed more than 165,000 hectares of plantation land, reflecting a growth trajectory driven by both large-scale estates and smallholder-based cultivation systems (Hatfield Indonesia, 2025a). This expansion has generated considerable economic benefits, particularly in terms of employment, rural livelihoods, and contributions to regional development. However, it has also precipitated substantial ecological and socio-cultural trade-offs, notably in the form of biodiversity loss, forest encroachment, and the marginalization of local resource access and customary land rights.

The High Conservation Value (HCV) framework offers a structured approach to identifying and managing landscapes of exceptional environmental, social, or cultural significance within agricultural production zones. Originally developed for forest certification, the HCV concept has been adapted to commodity agriculture, particularly in tropical contexts where plantation expansion threatens biodiversity, ecosystem services, and community welfare (Jennings et al., 2003). The framework encompasses six categories: HCV 1 (areas with concentrations of biological diversity); HCV 2 (landscape-level ecosystems and mosaics); HCV 3 (rare, threatened, or endangered ecosystems); HCV 4 (areas providing critical ecosystem services); HCV 5 (areas fundamental to meeting basic needs of local communities); and HCV 6 (areas critical to local communities' traditional cultural identity) (Brown et al., 2013). When integrated into land use planning and management systems, HCV assessments serve as decision-support tools that enable sustainable intensification—enhancing agricultural productivity on existing lands while protecting irreplaceable ecological and social values. In Mandailing Natal, where high forest cover, endemic species richness, and strong indigenous presence converge with expanding palm oil frontiers, HCV integration is both necessary and urgent. However, the effectiveness of HCV principles depends critically on their institutionalization within formal governance structures, including spatial planning instruments, licensing procedures, and enforcement mechanisms—an integration that remains incomplete in many Indonesian districts (Moeliono et al., 2017).

The imperative for sustainable oil palm development in Madina lies in achieving a complex balance: enhancing agricultural productivity and economic inclusion while safeguarding ecological integrity and cultural heritage. Within this context, the High Conservation Value (HCV) framework provides a critical instrument for reconciling production with conservation. The HCV approach identifies landscapes and ecosystems of exceptional environmental, social, or cultural significance that require special management or protection within agricultural zones. Madina—characterized by high forest cover, endemic species richness, and a strong presence of indigenous and local communities—exemplifies the type of multifunctional landscape where such integration is both necessary and urgent (Hatfield Indonesia, 2025a).

In response to these challenges, a comprehensive HCV and High Carbon Stock (HCS) assessment—known locally as ABKT (Area Bernilai Konservasi Tinggi)—was undertaken across the district in 2024. Spanning approximately 653,200 hectares, this assessment mapped the distribution of multiple HCV types, including HCV 1 (biodiversity), HCV 3 (rare and endangered ecosystems), HCV 5 (areas critical to local community livelihoods), and HCV 6 (zones of cultural and spiritual importance) (Hatfield Indonesia, 2025b). Additionally, the study identified HCV 4 areas that provide essential ecosystem services such as watershed protection and erosion control, which are foundational for sustainable agriculture and climate resilience.

Scenario modeling conducted under the Targeted Scenario Analysis (TSA) framework further reinforces the potential for a conservation-compatible trajectory. The models demonstrate that by adopting Good Agricultural Practices (GAP)—including the use of certified seedlings, improved soil fertility management, and efficient harvesting techniques—smallholders in the district could potentially double their yields to 8 tonnes of crude palm oil (CPO) per hectare per year without the need for further forest clearance. These projections align with Indonesia's national commitments under the Forest and Other Land Use (FOLU) Net Sink 2030 roadmap and support ongoing landscape restoration initiatives such as the Food Systems, Land Use and Restoration (FOLUR) program (Hatfield Indonesia, 2025c).

Despite the ecological potential and policy frameworks in place, land governance in Mandailing Natal remains fragmented. Although over 54% of the district has been legally designated for forest functions—including protected, production, and conservation forest categories—land use dynamics on the ground often contradict planning intentions (Bappeda Kab. Mandailing Natal, 2016). Weak enforcement, institutional misalignment, and the absence of binding mechanisms to incorporate HCV data into formal spatial planning have allowed plantation expansion to continue in environmentally sensitive and socially contested areas.

This article investigates the extent to which High Conservation Value principles have been integrated into oil palm governance in Mandailing Natal and explores the institutional, spatial, and policy-related challenges that impede this process. Through spatial analysis, field-based assessments, and scenario modeling, the study offers empirically grounded insights into the governance conditions required to reconcile oil palm development with landscape-level conservation. The study aims to: (1) assess the current state of HCV integration in district-level land use planning and plantation licensing systems; (2) identify key institutional, regulatory, and capacity-related barriers to effective HCV implementation; and (3) propose actionable pathways for strengthening conservation governance in oil palm landscapes. The findings contribute to broader scholarship on jurisdictional sustainability, multi-level environmental governance, and the operationalization of conservation science in commodity production frontiers. Practically, the research informs policy reform at the district level, supports Indonesia's commitments under the FOLU Net Sink 2030 framework, and provides replicable lessons for other palm oil-producing regions navigating similar governance challenges.

METHOD

This study employs a multi-method qualitative approach combining document analysis, geospatial assessment, stakeholder engagement, and scenario modeling to evaluate the

integration of High Conservation Value (HCV) areas into oil palm development planning in Mandailing Natal, North Sumatra.

First, a comprehensive policy and document analysis was conducted using primary sources such as the 2024 ABKT-HCS (*Area Bernilai Konservasi Tinggi*–High Carbon Stock) technical assessment reports, the district's Spatial Plan (RTRW 2021–2026), and relevant regulatory frameworks at the national and provincial levels. Secondary sources—including academic literature, NGO reports, and relevant government guidelines—were also reviewed to assess the alignment between legal instruments and conservation targets.

Second, the study integrated geospatial overlay techniques using ABKT-HCS maps and district land use data to identify the spatial overlap between current oil palm plantations, forest zones, and HCV areas (categories 1 through 6). Geospatial analysis was conducted using GIS software to quantify the extent of encroachment, identify patterns of land use conflict, and assess the proximity of plantations to environmentally sensitive or community-valued areas.

Third, field-based data were collected through stakeholder consultations carried out between 2023 and 2024 in key subdistricts (Siabu, Ranto Baek, Ulu Pungkut, and Kotanopan). These consultations included participatory mapping sessions with local communities, interviews with smallholder farmers, discussions with representatives from district government agencies (Bappeda, ATR/BPN, Forestry Office, Agriculture Office), and input from NGOs and extension workers. The aim was to capture local perceptions of land tenure, customary practices, plantation expansion drivers, and institutional barriers to sustainable development.

Fourth, the study applied a Targeted Scenario Analysis (TSA) approach to model the trade-offs and synergies between oil palm productivity and forest conservation. The scenarios projected yield outcomes under different management regimes (business-as-usual vs. full GAP adoption) while factoring in constraints such as land suitability, terrain, and socio-ecological risks. The TSA results were used to assess the feasibility of achieving productivity gains without further encroachment into HCV zones.

Lastly, an institutional gap analysis was performed to examine coordination challenges among agencies involved in spatial planning, permitting, land registration, and agricultural extension. This involved mapping out mandates, examining overlaps, and identifying points of regulatory or operational disconnect that affect the effectiveness of HCV integration in the palm oil sector. The triangulation of these methods ensures the robustness of the findings and allows for a comprehensive understanding of both the structural and operational dynamics influencing conservation-compatible oil palm development in the district.

RESULT AND DISCUSSION

Institutional, Spatial, and Policy Barriers to Effective HCV Integration

Despite significant progress in ecological assessment and policy planning, several critical gaps continue to impede the effective integration of High Conservation Value (HCV) management into oil palm landscape governance in Mandailing Natal. These gaps exist across four domains: regulatory framework, spatial planning alignment, institutional coordination, and incentive structures for sustainable practices. Addressing these issues is essential to transition from fragmented land use decisions to an integrated, conservation-compatible oil palm sector.

Regulatory and Legal Gaps

One of the fundamental challenges lies in the absence of a binding regulatory mechanism to integrate HCV/ABKT findings into land use decision-making processes. Although the 2024 ABKT-HCS assessment provides detailed spatial delineations of HCV 1–6 areas, its outputs have not yet been codified within any formal planning or licensing instruments. This gap is further compounded by regulatory inconsistencies across national, provincial, and district levels. For example, while national forestry regulations (e.g., Ministry of Environment and Forestry Regulation No. P.5/KSDAE/2017) outline technical guidelines for ABKT identification, there is no legal requirement for district governments or land agencies to enforce these zones in non-state forest areas (APL). Consequently, HCV protections in community-managed landscapes fall into a legal grey area.

Moreover, Free, Prior, and Informed Consent (FPIC)—a principle fundamental to the recognition of HCV 5 and 6—has not been institutionalized in plantation licensing or spatial plan revision processes at the district level (Colchester et al., 2015). Without FPIC, community-designated conservation areas remain invisible in formal planning, and customary rights are systematically excluded from development decisions (GEF, 2024).

Spatial Planning and Zoning Disconnect

The Mandailing Natal Spatial Plan (RTRW 2021–2026) designates extensive areas for plantation expansion, notably for oil palm cultivation. However, the spatial plan does not incorporate ecological sensitivity data or conservation zoning, such as those derived from the High Conservation Value (HCV) and High Carbon Stock (HCS) assessments, including the ABKT survey conducted in 2024. While the RTRW identifies general forest classifications—such as production forest, protected forest, and nature reserves—it does not operationalize fine-scale conservation maps. This omission creates a disconnection between land allocation processes and environmental safeguards.

This lack of spatial congruence has resulted in several tangible problems:

1. Permitting in ecologically sensitive areas: Oil palm development continues to be permitted adjacent to or within mapped HCV zones, including areas with high biodiversity (HCV 1), landscape-scale ecological corridors (HCV 2), and community watershed areas (HCV 4). Without recognition of these zones in legal planning documents, ecological degradation is allowed to proceed unchecked.
2. Limited public access to conservation data: Smallholder communities remain largely unaware of the location and boundaries of protected or conservation-priority zones. This is due to the absence of publicly disseminated or village-level visualization tools that communicate HCV or ABKT mapping outcomes. As a result, land clearing and new planting decisions are made without reference to conservation guidelines or legal exclusion zones.
3. Overlooking cumulative impacts: Because spatial planning operates on a sectoral or plot-by-plot basis, the cumulative ecological impact of scattered plantation developments across the district is not adequately assessed. This impairs the district's ability to conduct landscape-level conservation planning that considers habitat connectivity, watershed stability, and long-term ecological thresholds.

In addition to district-level planning limitations, the One Map Policy (Kebijakan Satu Peta)—Indonesia's national initiative to harmonize geospatial datasets—has yet to be fully

localized in Mandailing Natal. While the policy aims to reduce overlapping claims and integrate thematic maps, including forest use and tenure boundaries, its implementation at the district level is hampered by limited technical capacity, lack of integration with HCV maps, and weak institutional coordination (Abidin et al., 2021; Shahab, 2016). As a result, district agencies continue to rely on fragmented or outdated base maps, leading to inconsistencies in plantation permitting, land certification, and conservation zone enforcement (Bretz, 2017; Permatasari et al., 2024).

Moreover, the failure to incorporate HCV and ABKT outputs into the One Map datasets constrains the ability of district planners to identify and exclude vulnerable areas from future development. This undermines broader national commitments under the FOLU Net Sink 2030 roadmap and contradicts the objectives of the Strategic Environmental Assessment (SEA) that informs North Sumatra's provincial land use planning.

Institutional Fragmentation and Governance Inefficiencies

Land governance in Mandailing Natal is characterized by fragmented institutional structures, where multiple government agencies hold overlapping responsibilities related to conservation, spatial planning, land allocation, and oil palm development. This fragmentation leads to inefficiencies in implementing High Conservation Value (HCV) protections, especially in areas undergoing oil palm expansion.

1. Forestry Office (*Dinas Kehutanan*): Responsible for managing state-designated forest areas, including protection and limited production forests. However, its authority does not extend to non-forest areas (*Areal Penggunaan Lain* or APL), where much of the oil palm expansion and HCV 5 and 6 values are located, limiting its capacity to enforce conservation in these zones (Daulay et al., 2023).
2. Agriculture Office (*Dinas Pertanian dan Perkebunan*): Supports agricultural productivity and provides technical guidance to oil palm growers. Yet, it often lacks access to HCV maps or ABKT data, hindering its ability to guide plantation expansion away from sensitive ecological or community areas (van Dick et al., 2015).
3. Land Agency (ATR/BPN – *Agraria dan Tata Ruang/Badan Pertanahan Nasional*): Oversees land registration and issuance of location permits for plantation development. In the absence of integrated data systems, it may issue permits overlapping with HCV areas, including zones vital to communities, without prior ecological or social screening (LANDac, 2017).
4. Bappeda (Regional Development Planning Agency): Coordinates the district's long-term development strategy and spatial planning. However, it often operates without updated ecological data, such as recent ABKT-HCS findings, leading to zoning decisions that may conflict with conservation priorities or customary land use (Daulay et al., 2023).
5. OPD (*Organisasi Perangkat Daerah* – Local Government Working Units): Various OPDs implement development projects and manage local budgets. Their initiatives, such as infrastructure development, may proceed in ecologically sensitive areas without proper conservation safeguards due to lack of coordination with land management and permitting authorities (van Dick et al., 2015).

Gaps in Smallholder Support and Incentive Structures

In Mandailing Natal, smallholders constitute nearly half of oil palm producers, yet they are largely excluded from sustainability initiatives such as the Roundtable on Sustainable Palm Oil (RSPO) certification. This exclusion stems from several challenges:

1. Limited Awareness and Knowledge: Many smallholders lack understanding of High Conservation Value (HCV) concepts and sustainable agricultural practices.
2. Financial Constraints: Access to finance and certified inputs is limited, making it difficult for smallholders to invest in sustainable practices (Aisyah et al., 2021).
3. Weak Market Linkages: There is a lack of strong connections between smallholders and sustainable supply chains, reducing incentives to adopt environmentally friendly practices (van Dick et al., 2015).
4. Insufficient Extension Services: Government extension support is often inadequate, leading to low confidence among smallholders in adopting new practices.

Consequently, smallholders have little motivation to avoid planting in HCV areas and may unknowingly contribute to the degradation of critical ecosystems and cultural sites. Currently, there are no dedicated financial mechanisms at the district level—such as Payment for Ecosystem Services (PES), reforestation subsidies, or conservation-linked microfinance—to reward conservation-compatible practices (Suich et al., 2017).

National programs like the Village Fund and Social Forestry are not well-aligned with the realities of oil palm landscapes. These programs often overlook opportunities for integrated agroforestry or replanting incentives for farmers willing to preserve HCV patches, further widening the gap between sustainability policy rhetoric and actionable support on the ground (Daulay et al., 2023).

Monitoring and Adaptive Management Deficiency

Effective governance of High Conservation Value (HCV) areas requires an adaptive monitoring system—one that continuously tracks the condition of conservation values, identifies emerging threats, and informs responsive management decisions. In Mandailing Natal, such systems are either underdeveloped or entirely absent. Conservation assessments, including the 2024 ABKT-HCS, are often treated as stand-alone reports without institutional follow-up mechanisms or integration into policy instruments.

There are several critical weaknesses in the current approach. First, there is no centralized HCV monitoring database that links spatial HCV data with plantation licensing or land-use permit systems, making it difficult for district agencies to assess compliance or monitor encroachment trends (Colchester et al., 2015). Second, periodic condition reviews of HCV areas are rarely conducted, even as land cover and land use patterns continue to shift due to plantation expansion and infrastructure development. Third, monitoring results are not systematically used to inform planning adjustments or permit revocation, indicating a lack of feedback loops that are central to adaptive management frameworks (Colchester et al., 2015; GEF, 2024).

Of particular concern is the monitoring of HCV 5 and HCV 6, which depend heavily on the active involvement of local communities. These values—linked to subsistence needs, spiritual sites, and cultural practices—are not tracked through participatory or community-

based methods. This oversight contributes to the silent erosion of social and cultural values, and the exclusion of indigenous knowledge from planning decisions. Research has shown that participatory monitoring, which engages local stakeholders in data collection and verification, enhances both the legitimacy and sustainability of conservation outcomes.

The absence of an adaptive monitoring system in Mandailing Natal not only weakens HCV governance but also limits the district's ability to meet national and international sustainability standards. Strengthening community-based monitoring and establishing institutional pathways to feed monitoring data into planning, licensing, and enforcement decisions will be essential for ensuring long-term conservation impact.

Discussions

The empirical findings from Mandailing Natal highlight persistent governance gaps that are common in tropical commodity frontiers where economic development intersects with ecological conservation. This case illustrates how the institutionalization of High Conservation Value (HCV) safeguards within subnational land use planning is shaped not only by the availability of spatial data or ecological assessments but also by regulatory coherence, political will, and the inclusiveness of policy implementation mechanisms.

Bridging the Gap Between Technical Assessments and Legal Instruments

While the ABKT-HCS assessment provides a robust technical foundation for conservation zoning, its lack of formal legal recognition undermines its utility in guiding land use decisions. This aligns with previous scholarship noting that environmental assessments in the Global South often function as advisory rather than prescriptive tools unless supported by legal mandates (Carter et al., 2020. The absence of binding regulation, particularly in areas designated as APL (non-state forest), reflects a broader trend of fragmented environmental governance where ecological data are decoupled from decision-making frameworks (Larson & Ribot, 2007).

Comparative cases from East Kalimantan and Riau have shown that integrating HCV into the district RTRW and licensing systems—through tools such as Peraturan Bupati or Local Action Plans—can enhance regulatory clarity and enable monitoring of spatial compliance (Moeliono et al., 2017). Mandailing Natal's path forward likely depends on its ability to adopt similar regulatory mechanisms while adapting them to the unique landscape-level and socio-cultural context of North Sumatra.

Jurisdictional Approaches and Multi-Level Governance

The fragmentation observed among district agencies in Mandailing Natal underscores the challenges of multi-level governance in decentralized political systems. Institutional misalignment—manifested through overlapping mandates and inconsistent data access—creates conditions where conservation and production policies are pursued in parallel but rarely converge (Treviño et al., 2017). This reinforces calls in the literature for "jurisdictional approaches" that unify conservation, spatial planning, and commodity regulation under a common governance framework (Boyd et al., 2018; Stickler et al., 2018).

Such approaches require empowered coordinating bodies (e.g., a district-level task force), formal integration of spatial datasets across agencies, and clear operational roles anchored in law. Evidence from jurisdictions such as Siak in Riau and West Kalimantan's

Ketapang district shows that when district governments lead sustainability integration, including HCV recognition and enforcement, improved outcomes can follow—especially when backed by provincial and national alignment (Fishman et al., 2022).

Equity and Inclusion in Conservation-Oriented Land Use

The exclusion of smallholders from sustainability schemes and the invisibility of HCV 5 and 6 in licensing processes reflect deeper issues of procedural and distributional justice. Previous studies have highlighted that land use planning processes often fail to engage indigenous and local communities in a meaningful way, particularly in the identification and governance of culturally significant landscapes (Myers et al., 2018). In Mandailing Natal, the absence of institutionalized Free, Prior, and Informed Consent (FPIC) mechanisms reinforces this marginalization and undermines the legitimacy of conservation decisions.

To build inclusive governance, participatory mapping and village-based conservation zoning—methods increasingly applied in social forestry and REDD+ programs—can be adapted to HCV implementation. Furthermore, the establishment of incentive mechanisms, such as Payments for Ecosystem Services (PES) tied to agroforestry or community conservation efforts, can enhance equity while aligning farmer behavior with conservation goals (Wunder et al., 2020).

Toward Adaptive and Participatory Monitoring

The current absence of adaptive monitoring systems in Mandailing Natal is emblematic of a broader implementation gap in conservation governance. Research consistently shows that monitoring not only improves policy feedback loops but also enables communities to detect and respond to ecological threats (Danielsen et al., 2009). However, when monitoring is externally driven or not linked to policy cycles, it often fails to influence decisions or sustain community engagement.

Building on frameworks for participatory environmental monitoring, district governments could establish community-based HCV observer networks, supported by NGOs and equipped with basic GPS and reporting tools. Institutionalizing these efforts through integration with licensing reviews and enforcement actions would close the loop between assessment, implementation, and adaptive management.

CONCLUSION

The integration of High Conservation Value (HCV) safeguards into oil palm development in Mandailing Natal remains limited by legal ambiguities, fragmented institutions, and exclusionary governance that excludes smallholder perspectives and undervalues community-defined HCV 5 and HCV 6 areas. Despite the technical strengths of ABKT-HCS assessments, their influence in spatial planning and licensing remains weak due to the absence of binding regulations and poor inter-agency coordination. Advancing toward a conservation-compatible palm oil sector requires institutionalizing ABKT-HCS outputs in land use planning, strengthening community participation through Free, Prior, and Informed Consent (FPIC), and creating incentive schemes and adaptive monitoring systems that empower smallholders. Future research should focus on evaluating the long-term socio-ecological outcomes of participatory HCV governance models and their effectiveness in reconciling production targets with conservation and equity goals.

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