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Potential Land Extensification And Expansion In Private Oil Palm Plantations In Indonesia

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ABSTRACT

The expansion of private oil palm plantations in Indonesia remains a critical issue due to the country's position as the world's largest crude palm oil (CPO) producer, with production reaching 48.23 million tonnes in 2023. This study aims to analyze the potential, constraints, and strategic opportunities for plantation extensification, particularly through the utilization of marginal lands (S2 and S3) and corporate expansion strategies such as mergers, acquisitions, and partnership schemes. A systematic literature review was conducted by synthesizing peer-reviewed journals, government statistics, and institutional reports selected based on inclusion and exclusion criteria to capture current dynamics of oil palm development in Indonesia. The findings indicate that the availability of highly suitable agricultural land (S1) is increasingly limited, encouraging companies to explore alternative strategies such as the optimization of degraded and idle lands, strengthening smallholder partnership schemes (plasma), and implementing replanting programs such as Peremajaan Sawit Rakyat (PSR). However, these opportunities are constrained by stricter environmental governance, land-use regulations, and increasing global sustainability requirements. The review further shows that S2 and S3 lands present significant biophysical limitations, including high soil acidity, poor drainage, and aluminium toxicity, which increase production costs and require advanced agronomic management. Socio-economic challenges such as land conflicts and unequal benefit distribution also continue to affect plantation expansion outcomes. This study concludes that Indonesia's palm oil development is gradually shifting from land extensification toward productivity intensification. This transition highlights the need for stronger sustainability governance through ISPO and RSPO certification systems, improved environmental management practices, and more inclusive stakeholder engagement to ensure that plantation development remains economically viable, environmentally responsible, and socially equitable.

Keywords:, ***Oil palm expansion, Marginal land, Sustainability***

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INTRODUCTION

Indonesia occupies a dominant position in the global vegetable oil market as the world's leading producer of crude palm oil (CPO). According to data from the Directorate General of Plantations (Ditjenbun, 2024), Indonesia's total oil palm planted area reached approximately 15.08 million hectares by the end of 2023, with total CPO production amounting to 48.23 million tonnes, accounting for roughly 58% of global palm oil supply. The commodity contributes significantly to state revenue, with export earnings reaching USD 28.7 billion in 2023, representing about 13.5% of Indonesia's total non-oil and gas export value (BPS, 2024).

Within this landscape, private plantation companies (Perkebunan Besar Swasta/PBS) play a dominant role, controlling approximately 55.3% of the total planted area (Ditjenbun, 2024). These companies have comparative advantages in capital, technology, and market access, enabling higher productivity and large-scale operations. However, the expansion of private plantations is increasingly constrained by limited availability of high-quality land, stricter environmental regulations, and rising global sustainability standards that emphasize deforestation-free and traceable production systems.

Recent literature indicates a structural shift in plantation expansion strategies from land-based extensification toward more complex approaches, including land optimization, corporate restructuring, and productivity intensification. In this context, marginal lands classified as S2 (moderately suitable) and S3 (marginally suitable) under FAO classification have become increasingly important. However, these lands present serious biophysical constraints such as soil acidity, aluminium toxicity, poor drainage, and erosion risk, which reduce productivity and increase production costs.

Despite extensive studies on palm oil expansion, there remains a gap in integrating land suitability constraints, corporate expansion strategies, and sustainability governance within a single analytical framework. Previous studies tend to focus separately on environmental impacts, socio-economic consequences, or agronomic feasibility, without comprehensively synthesizing strategic pathways for private plantation development.

Beyond biophysical constraints, oil palm expansion also generates significant socio-economic and environmental impacts. Studies report deforestation, carbon emissions, land conflicts, and livelihood changes in plantation regions (e.g., Amalia et al., 2019; Suryadi et al.,

2020; Rahayu et al., 2023). These findings highlight the dual challenge of maintaining economic competitiveness while ensuring environmental and social sustainability in the palm oil sector.

Therefore, this study aims to provide a systematic review of land extensification and expansion strategies in Indonesia's private oil palm sector, focusing on land suitability dynamics (S2–S3), corporate growth strategies, and sustainability governance frameworks. The novelty of this study lies in its integrated synthesis of biophysical, managerial, and sustainability dimensions to formulate more holistic development pathways for the palm oil industry.

METHODS

This study employed a systematic literature review (SLR) approach to examine the dynamics of land extensification and expansion in Indonesia's private oil palm plantation sector. The review synthesized scientific articles, government statistical publications, institutional reports, and policy documents published between 2012 and 2025. Data sources were obtained from the Directorate General of Plantations (Ditjenbun), the Central Statistics Agency (BPS), the Indonesian Palm Oil Association (GAPKI), and the Indonesian Oil Palm Research Institute (PPKS), as well as indexed academic databases including Google Scholar, Scopus, and SINTA. The use of multiple validated databases was intended to ensure data triangulation and improve the reliability of the review outcomes.

The literature selection followed a structured PRISMA-like process consisting of identification, screening, eligibility assessment, and final inclusion. Keywords used in the search process included "oil palm expansion," "land extensification," "land suitability," "private plantation companies," "sustainable palm oil," "peatland conversion," "oil palm acquisition," and "socio-economic impacts of plantations." Boolean operators (AND/OR) were applied to refine the search strategy and improve relevance of retrieved studies.

The inclusion criteria required that each source address at least one of the following themes: land extensification and plantation expansion, land suitability and biophysical constraints, environmental governance and sustainability, socio-economic impacts, plantation productivity, or corporate takeover and acquisition strategies. Studies were further screened

based on methodological clarity, empirical strength, and relevance to the Indonesian oil palm context. From an initial pool of collected literature, 15 peer-reviewed and high-relevance studies were selected as the final dataset for analysis.

The selected literature was analyzed using a thematic descriptive-qualitative synthesis approach, in which data were coded and grouped according to key themes. Patterns, similarities, and differences across studies were then interpreted to identify challenges, opportunities, and policy implications related to plantation expansion. Comparative analysis was also conducted to examine variations in environmental, economic, and social dimensions. To enhance validity, official statistical data were used for triangulation.

Despite the systematic approach, this study is limited by its reliance on secondary data and the absence of primary field verification, which may influence interpretation consistency across studies with different methodological designs. Nevertheless, the SLR framework provides a comprehensive and structured understanding of oil palm plantation extensification in Indonesia.

RESULTS AND DISCUSSION

3.1 Development of Oil Palm Plantations in Indonesia

Indonesia's oil palm sector has expanded at a historically unprecedented rate since the late 1980s. Total planted area grew from approximately 1.2 million hectares in 1990 to 15.08 million hectares in 2023 (Ditjenbun, 2024). This growth was driven by global vegetable oil demand, supportive government policies, and investment inflows.

The structural composition of plantation ownership shows a clear dominance of private companies, which control approximately 55.3% of total planted area, indicating a gradual shift toward corporate-led agribusiness governance**.** Table 1 shows the distribution of oil palm plantation area in Indonesia in 2023.

Table 1. Oil Palm Plantation Area by Ownership Category in Indonesia (2023)

Province	Smallholder (ha)	State Estate (ha)	Private Estate (ha)	Total (ha)
Riau	1,345,612	187,450	1,357,204	2,890,266
Central Kalimantan	628,312	142,180	1,190,543	1,961,035
North Sumatra	602,418	311,204	874,339	1,787,961

West Kalimantan	431,756	98,240	968,112	1,498,108
South Sumatra	482,315	234,108	717,849	1,434,272
Others	1,842,103	589,304	2,085,951	4,517,358
TOTAL	5,332,516	1,562,486	7,193,998	15,089,000

The private sector's 47.7% share of planted area translates into an even higher proportion of CPO production due to superior productivity. GAPKI (2024) reported that private estates achieve average fresh fruit bunch (FFB) yields of approximately 18.2 tonnes/ha/year, compared to 14.9 tonnes/ha/year for smallholders.

This productivity gap reflects structural differences in access to improved planting materials, agronomic input intensity, and management efficiency, which reinforce the comparative advantage of private estates.

3.2 Land Suitability and the Challenge of Marginal Land

Under the FAO land evaluation framework adapted for Indonesian conditions (Sys et al., 1993; Mubekti, 2012), oil palm land suitability is classified into four categories: S1 (highly suitable), S2 (moderately suitable), S3 (marginally suitable), and N (not suitable). Each category carries distinct agronomic and economic implications.

As accessible S1 land has been progressively occupied, development pressure has shifted substantially toward S2 and S3 classifications. Mubekti's (2012) evaluation of Kampar Regency a major oil palm district in Riau found that approximately 67% of remaining developable land was classified S2 or S3, with the remainder being S1 or N. This pattern is broadly replicated across Sumatra and Kalimantan (IOPRI, 2023). Table 2 summarizes the key limiting factors and management requirements for each suitability class.

Table 2. Land Suitability Classification, Limiting Factors, and Management Requirements for Oil Palm

Class	Description	Limiting Factors	Management Requirements
S1	Highly Suitable	Minimal constraints	Standard GAP and routine fertilization
S2	Moderately Suitable	Moderate soil acidity, poor drainage, moderate aluminum	Liming, drainage improvement, intensified fertilization

		toxicity	
S3	Marginally Suitable	High acidity, severe aluminum toxicity, steep slopes, low CEC	Intensive liming, terracing, major drainage systems
N	Not Suitable	Extreme constraints	Development not recommended

Source: Adapted from Mubekti (2012); FAO (1976); IOPRI (2023)

Cultivation on S2 and S3 lands substantially elevates production costs. IOPRI (2023) estimates that investment costs for S2 land development average 15–25% higher than S1, rising to 35–55% for S3 lands due to mandatory soil amelioration, drainage infrastructure, and more intensive fertilization regimes. Despite these costs, S2 and S3 lands represent the primary frontier for future expansion given the near-exhaustion of accessible S1 areas outside legally protected forests.

This indicates that marginal land development is increasingly economically inefficient compared to previously exploited S1 land, thereby reducing the attractiveness of pure land expansion strategies.

3.3 Is Expansion Still Feasible? Regulatory and Market Context

The feasibility of further land-based expansion must be evaluated against a tightening regulatory and market environment. Several policy instruments have materially constrained the pace of new land opening. Presidential Regulation No. 59 of 2019 established a temporary moratorium on new oil palm permits on primary forests and peatlands, subsequently extended and strengthened through the 2021 Presidential Instruction (Inpres No. 6/2021). The Indonesian Sustainable Palm Oil (ISPO) certification, now mandatory for all plantation operators under Perpres No. 44/2020, requires compliance with environmental, social, and governance standards that add compliance costs and procedural complexity to any new development.

On the demand side, the European Union Deforestation Regulation (EUDR), which entered into force in June 2023 and applies to palm oil products from December 2024 onward, requires importers to verify that commodities are not associated with deforestation post-December 2020. This regulation has significant implications for Indonesian exporters: the EU absorbs approximately 11.7% of Indonesian CPO exports (GAPKI, 2024), and compliance failure risks market exclusion. Similar due-diligence frameworks are emerging in the United Kingdom and Japan.

Within these constraints, viable expansion pathways for private companies include: (1) development of genuinely idle or degraded non-forest land with clear legal title; (2) plasma partnership schemes with surrounding communities; (3) intensification of existing planted areas; (4) participation in the national Smallholder Oil Palm Replanting Program (PSR); and (5) acquisition or takeover of existing plantation concessions. Of these, corporate acquisitions have become increasingly prominent as a growth mechanism in the post-moratorium environment, discussed in detail in Section 3.5.

3.4 Environmental, Social, and Economic Dimensions of Expansion

The environmental consequences of large-scale oil palm expansion are extensively documented. Amalia et al. (2019) found that between 2001 and 2016, oil palm expansion in Riau Province was responsible for the conversion of approximately 1.2 million hectares of forest, contributing substantially to regional greenhouse gas emissions. Fitzherbert et al. (2008) demonstrated that oil palm monocultures support significantly lower biodiversity than the primary or secondary forests they replace, with particular impact on specialist forest-interior species. Peatland drainage for plantation development creates chronic fire risk: the 2015 fire season, which affected approximately 2.6 million hectares of Indonesian land and peatland, caused estimated economic losses of USD 16.1 billion (World Bank, 2016).

Socially, expansion has driven complex transformations in rural communities. Suryadi et al. (2020), in their study of Pelalawan Regency, found that oil palm expansion reconfigured subsistence agricultural communities into market-dependent wage workers and smallholder producers, with mixed welfare outcomes. While average household incomes increased, economic inequality widened: landowners and plasma participants captured disproportionate gains relative to landless laborers. Agrarian conflicts arising from contested land tenure, overlapping concession boundaries, and inadequate compensation were documented as persistent features of the expansion frontier. Rahayu et al. (2023) similarly found that communities in Batahan District, North Sumatra experienced both infrastructure improvements and river pollution from poorly managed palm oil mill effluent (POME), illustrating the dual character of plantation presence.

Economically, the oil palm sector generates substantial national-level benefits. In 2023, Indonesia's palm oil-related export revenues totaled USD 28.7 billion (BPS, 2024), and the

sector directly employs an estimated 4.2 million plantation workers, with an additional 12 million people engaged in related supply chain activities (GAPKI, 2024). The sector contributes approximately 3.5% of national GDP and is the principal source of regional income for provinces such as Riau, South Kalimantan, and Central Kalimantan. Table 3 summarizes key economic indicators of the Indonesian palm oil sector.

Table 3. Key Economic Indicators of Indonesia's Palm Oil Sector (2021–2023)

Indicator	2021	2022	2023
CPO Production (million tonnes)	46.89	46.73	48.23
Export Volume (million tonnes)	33.67	30.98	32.14
Export Value (USD billion)	22.97	39.07	28.70
Plantation Area (million ha)	14.60	14.90	15.09
Direct Employment (million persons)	4.05	4.10	4.20
Contribution to Non-Oil & Gas Exports (%)	13.2	13.8	13.5

Source: BPS (2024); GAPKI (2024); Ditjenbun (2024)

3.5 Takeover and Acquisition as a Strategic Growth Mechanism

In the context of diminishing opportunities for greenfield development, corporate acquisitions and takeovers have emerged as a preferred expansion strategy for Indonesian private plantation companies. An acquisition enables a company to rapidly obtain planted area, operational infrastructure (roads, mills, worker housing), business permits, and Land Use Rights (HGU) without incurring the time and cost associated with establishing a plantation from scratch. A mature plantation acquisition may reduce time-to-production by five to seven years compared to greenfield development on equivalent land (IOPRI, 2023).

Common acquisition modalities in the Indonesian palm oil sector include: (i) share purchase of a plantation holding company; (ii) asset purchase of specific land parcels or mill facilities; (iii) merger of plantation companies; and (iv) assumption of distressed debt leading to operational takeover. The latter has been particularly active during periods of CPO price depression, when undercapitalized operators face financial insolvency.

However, acquisitions carry significant risk if preceded by inadequate due diligence. Key risk categories include: unresolved agrarian conflicts inherited from the prior operator; encumbered or overlapping HGU boundaries; aging stands with declining FFB yields; deferred

maintenance on roads and mills; undisclosed environmental liabilities (particularly on peatland concessions); and labor disputes. The due diligence process for a plantation acquisition of substantive scale (>5,000 ha) typically encompasses legal title verification, environmental compliance audit, agronomic assessment of stand age and condition, financial liability review, and social conflict mapping. Hasbullah et al. (2025) note that monitoring and evaluation capacity is a decisive factor in the post-acquisition integration phase.

Table 4 provides a comparative assessment of expansion modalities available to private plantation companies, illustrating the trade-offs between greenfield development, marginal land utilization, plasma partnerships, and corporate acquisition.

Table 4. Comparative Assessment of Expansion Modalities for Private Oil Palm Plantations

Aspect	Greenfield (S1)	Marginal Land (S2/S3)	Plasma Partnership	Acquisition/Takeover
Land Availability	Very Limited	Moderate	Moderate	Available
Capital Requirement	High	Very High	Low–Medium	High
Time to Production	4–6 years	5–7 years	4–6 years	Immediate–2 years
Regulatory Risk	Very High	High	Medium	Low–Medium
Social Conflict Risk	High	High	Low	Medium
Environmental Risk	Very High	High	Medium	Low
Productivity Potential	High	Medium–Low	Medium	High

3.6 Smallholder Replanting Program (PSR) as an Intensification Pathway

A strategic alternative to area-based expansion is the intensification of existing plantings through replanting with high-yielding certified materials. Indonesia's national Smallholder Oil Palm Replanting Program (Program Peremajaan Sawit Rakyat/PSR), launched in 2017 and administered through the Oil Palm Plantation Fund Management Agency

(BPDPKS), targets the replacement of approximately 2.8 million hectares of aging, low-yielding smallholder stands many of which utilize unregistered or non-certified planting materials yielding as little as 9–11 tonnes FFB/ha/year.

Hasbullah et al. (2025) conducted a comprehensive literature review of PSR implementation across seven provinces, finding that replanted smallholder plots achieved average yield improvements of 45–65% within five years of replanting, reaching 16–19 tonnes FFB/ha/year with certified seed. However, the program faces persistent implementation bottlenecks: as of December 2023, cumulative replanted area totaled approximately 244,000 hectares less than 9% of the target (BPDPKS, 2024). Key constraints include lengthy administrative processes for land legality verification, limited access to bridging finance during the unproductive replanting period, and logistical challenges in seed distribution to remote areas. Qodriyatun (2023) notes that many smallholders remain reluctant to enroll due to the 3–4 year income gap during plant establishment.

Private plantation companies can play a catalytic role in PSR implementation through their plasma network management systems, providing certified seed, agronomic extension services, and FFB purchase guarantees to plasma smallholders participating in the replanting program. This represents a commercially viable strategy for companies to expand their effective CPO supply base without expanding their own planted area.

3.7 Toward Sustainable Plantation Development: Strategic Pathways

The evidence reviewed strongly suggests that the dominant paradigm of extensive land-based growth must give way to an intensification-centered model for the Indonesian private oil palm sector. This transition is driven simultaneously by resource constraints (declining prime land), regulatory pressures (moratorium, ISPO/RSPO, EUDR), and market imperatives (sustainability premiums). Several strategic pathways merit priority consideration.

First, precision agronomy and digital farm management offer substantial yield gains on existing planted areas. Sensor-based soil nutrient monitoring, GPS-guided fertilizer application, and remote sensing for early pest-disease detection have been shown to reduce input costs by 12–18% while maintaining or improving FFB yields in pilot programs across Riau and North Sumatra (PPKS, 2023). Second, certification under ISPO and RSPO while imposing compliance costs yields market access advantages and increasingly attracts sustainability-

linked financing at favorable interest rates. As of early 2025, approximately 4.2 million hectares of Indonesian oil palm are RSPO certified and 3.8 million hectares hold ISPO certification (RSPO, 2025; ISPO Secretariat, 2025).

Third, landscape-level approaches that integrate plantation operations within wider land use planning frameworks including the maintenance of high-conservation value (HCV) areas, riparian buffer zones, and community forest management zones reduce ecological footprint while building social license to operate. Companies investing in community development, transparent grievance mechanisms, and fair plasma arrangements demonstrate lower incidences of agrarian conflict and higher operational continuity (Suryadi et al., 2020).

The integration of these pathways into a coherent corporate sustainability strategy is illustrated schematically in Figure 1.

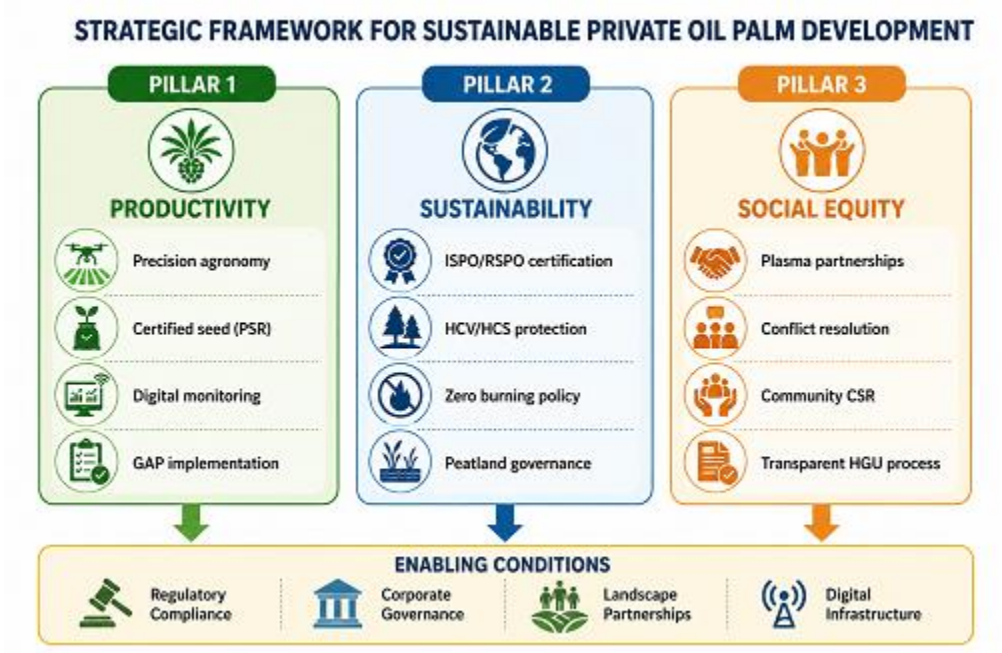

Figure 1. Three-pillar strategic framework for sustainable private oil palm plantation development

CONCLUSION AND IMPLICATIONS

This review demonstrates that while land extensification and expansion of private oil palm plantations in Indonesia remain technically and economically feasible, the structural

frontier of expansion has fundamentally shifted from S1 land toward intensification and strategic restructuring. The era of expansive greenfield development on prime (S1) land is largely concluded; future growth must be achieved through a combination of intensification on existing planted areas, strategic corporate acquisitions, and the carefully managed development of marginal (S2/S3) lands under enhanced agronomic and environmental protocols.

The biophysical constraints of S2 and S3 lands, including soil acidity, aluminium toxicity, poor drainage, and erosion susceptibility, present substantial but manageable challenges. However, their successful utilization requires significantly higher capital intensity and precision-based agronomic intervention, making them less efficient than S1-based expansion. Corporate acquisitions offer a resource-efficient pathway to rapid capacity expansion, but introduce inherited legal, environmental, and social risks that necessitate rigorous due diligence and post-acquisition integration mechanisms.

The broader development trajectory of the sector must now be anchored in three integrated pillars: productivity enhancement through technology adoption; environmental sustainability through certification and ecosystem protection; and social equity through inclusive plasma partnerships, transparent land governance, and community engagement. These pillars function as mutually reinforcing requirements for long-term competitiveness in global sustainability-driven markets.

The implications extend beyond the plantation sector. For policymakers, the findings highlight the need for accelerated PSR implementation, improved land tenure clarity, and spatial planning that prioritizes truly available marginal land while avoiding ecological and social conflict zones. For researchers, priority areas include agronomic optimization of S2/S3 lands, conflict early-warning systems, and EUDR compliance cost assessment. For private sector actors, future competitiveness will increasingly depend on productivity efficiency, sustainability credibility, and social legitimacy rather than physical land expansion.

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