



OIL PALM SMALLHOLDERS’ READINESS FOR SUSTAINABLE PRACTICES: BARRIERS, ENABLERS, AND POLICY IMPLICATIONS

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ARTICLE INFO	ABSTRACT
Article History: Received: 9 April 2025 Revised: 19 April 2026 Accepted: 14 June 2026 Published: 15 July 2026 Keywords: <i>Biodiversity loss, certification, oil palm smallholder, socioeconomic, sustainable practice</i>	The oil palm sector is a cornerstone of tropical economies but faces growing sustainability challenges, including deforestation and social inequity. This study examines the readiness of oil palm smallholders to adopt sustainable practices, with particular emphasis on independent smallholders, who manage a substantial share of Malaysia’s cultivated area. A scoping review approach was employed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses framework to systematically identify and analyse relevant literature from two major databases, resulting in the screening of 303 records and the inclusion of 15 primary studies published between 2015 and 2025. The findings reveal pronounced disparities in sustainability adoption: Organised smallholders achieve near-universal certification under the Malaysian Sustainable Palm Oil scheme while independent smallholders exhibit significantly lower participation rates. Key barriers include insecure land tenure, high compliance costs relative to uncertain economic returns, and limited access to technical support and extension services. These constraints are further compounded by structural and institutional limitations, which reduce smallholders’ capacity to transition to sustainable practices. The study highlights the need for more inclusive, context-sensitive policy interventions, including strengthening land tenure systems, expanding access to blended financing mechanisms, and enhancing capacity-building within existing supply chains. Advancing these measures is critical to improving environmental outcomes while ensuring equitable and sustainable development within the oil palm sector.

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Introduction

The oil palm sector is fundamental to tropical economies, especially in Malaysia and Indonesia, which together account for the bulk of global output. Malaysia and Indonesia contributed 26% and 57% of the world’s production, respectively, as of 2023 (U.S. Department of Agriculture, Foreign Agricultural Service, 2024). In Malaysia, the sector is a crucial economic engine, contributing 2.97% to the national Growth Domestic Product (GDP) and

facilitating rural development and employment by hundreds of thousands of individuals (Kementerian Perlindungan & Komoditi, 2024).

Despite its economic importance, the rapid expansion of oil palm production has drawn harsh criticism worldwide for its negative social and environmental impacts. Primary issues encompass extensive deforestation, biodiversity loss, and greenhouse gas emissions, as well as socioeconomic challenges such as land-use

disputes and the displacement of indigenous communities (Vijay *et al.*, 2016; Austin *et al.*, 2017; Li *et al.*, 2020). As a result, the industry encounters increasing demand to harmonise economic development with environmental conservation and social justice.

Smallholders are pivotal to this sustainable shift as they oversee a significant share of the oil palm cultivated areas (Euler *et al.*, 2016; Meijaard *et al.*, 2018). In Malaysia, Independent Smallholders (ISH) comprise more than 30% of the cultivated area (Zakaria *et al.*, 2022). Nonetheless, the acceptance of sustainability remains inconsistent. Although large estates and Organised Smallholders (OSH) receive institutional support, independent smallholders (ISH) frequently face substantial limitations that hinder their advancement toward sustainable certification.

The Roundtable on Sustainable Palm Oil (RSPO) serves as a principal global certifying authority that advocates measures to minimise emissions and enhance yields (Meijaard *et al.*, 2018). RSPO accreditation has demonstrated the capacity to bolster economic resilience and alleviate poverty among smallholders by facilitating access to premium markets and superior agricultural inputs (Brako *et al.*, 2021). Nevertheless, those without prior experience with structured schemes are frequently unable to access RSPO due to the high compliance costs and the need for external facilitators (de Vos *et al.*, 2023).

In line with global initiatives, Malaysia introduced the Malaysian Sustainable Palm Oil (MSPO) accreditation in 2013, which became compulsory for all producers on January 1, 2020. MSPO seeks to standardise sustainability throughout the supply chain and tackle both domestic and international issues related to labour rights and deforestation (Aziz *et al.*, 2016; Rahmat *et al.*, 2021). Given the requirements, smallholders in Johor, Sabah, and Sarawak face greater challenges in adhering to these criteria than corporate entities (MSPO, 2022).

Smallholders are typically classified as Organised Smallholders (OSH) and Independent

Smallholders (ISH). Structured support from state and federal agencies, including FELDA, FELCRA, RISDA, and SALCRA helps organised smallholders achieve certification (Siti-Dina *et al.*, 2023; MPOB, 2024). Conversely, independent smallholders operate their farms autonomously and often lack the financial and technical resources to traverse the institutional gaps of certification (Pacheco *et al.*, 2020).

Failing to shift has serious environmental repercussions. Research demonstrates that converting natural forests to oil palm monocultures will reduce species richness by 43% to 61%, endangering emblematic species such as the *orang utan* and the Sumatran tiger (Meijaard *et al.*, 2018; James *et al.*, 2023). Moreover, replanting cycles in unsustainable plantations may lead to prolonged soil deterioration and reduced ecosystem resilience (Ashton-Butt *et al.*, 2019). Mitigating these externalities is essential to prevent international trade barriers, including the European Parliament's limitations on palm-derived biofuels (Rahmat *et al.*, 2022).

Various obstacles hinder the willingness of independent smallholders to embrace sustainable methods. Financial constraints are critical, as the costs of certified inputs and audit fees are often high without subsidies or price premiums (Lim *et al.*, 2021). Moreover, numerous independent smallholders face persistent land tenure challenges, which are essential for obtaining both MSPO and RSPO certification (de Vos *et al.*, 2023).

In addition, adoption is impeded by knowledge disparities. Independent smallholders are frequently unable to access information on Good Agricultural Practices (GAP) that could enhance yields and mitigate environmental damage due to fragmented extension services (Nurfatriani *et al.*, 2019; Siregar *et al.*, 2024). Addressing these disparities requires targeted interventions that account for the unique socioeconomic conditions of smallholders rather than a one-size-fits-all regulatory framework (Siti-Dina *et al.*, 2023).

An effective shift to sustainability requires coordination among multiple stakeholders. Harmonising government regulations with business sustainability mandates is crucial to establishing a more inclusive supply chain (Pacheco *et al.*, 2020). Through the provision of targeted support, including financial incentives, technical training, and administrative assistance for land legality, the industry can enable smallholders to assume pivotal roles in the global sustainable development agenda (Zakaria *et al.*, 2022; Erwiningsih, 2023).

This study employs a scoping review to assess smallholders' readiness to adopt sustainable practices within the oil palm value chain. This research aims to clarify the dynamics of smallholder behaviour by identifying key facilitators such as institutional support and market access, alongside obstacles like regulatory misalignment and capital constraints. The findings intend to guide future policy initiatives to improve the sector.

Materials and Methods

This analysis employs the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, a widely recognised standard for guiding systematic literature reviews. Adhering to publication guidelines is essential for helping researchers assess the accuracy and rigour of a review while ensuring that all relevant information is appropriately included. The research follows the six-stage methodology proposed by Arksey and O'Malley (2005).

The initial stage of this methodology involved defining research questions to identify the specific factors and structural barriers influencing smallholder readiness for sustainable adoption. The second phase focused on identifying relevant previous research by systematically searching academic databases for studies specifically addressing oil palm sustainability and smallholder certification.

In addition, the study selection was conducted in the third stage, where predefined

inclusion and exclusion criteria were applied to the initial 303 records to ensure only peer-reviewed, high-quality evidence was retained. Data charting followed the selection process, involving the extraction of key variables and thematic results from the 15 included studies into a structured analytical framework.

Besides, the fifth stage consisted of summarising and reporting the findings, with a specific focus on categorising the identified enablers and barriers to sustainability within the Malaysian context. Lastly, the methodology concluded with a consultation phase, where preliminary findings were shared with academic peers to validate the thematic analysis and ensure the practical relevance of the policy implications. Figure 1 presents the results of the PRISMA-based selection process utilised in the scoping review.

Identification

The process of selecting relevant literature for this study was conducted in three main stages. The first stage entailed identifying keywords and their associated synonyms, drawing on thesauri, dictionaries, encyclopaedias, and previous studies. Once the full set of relevant terms was determined, search strings were developed for use in the Scopus and Web of Science (WoS) databases. This initial phase of the systematic review yielded 303 papers from the two databases.

Screening

This stage involved screening, during which studies were included or excluded based on predefined criteria. In the initial screening, duplicate records were removed. Of the articles retrieved from both databases, 96 were screened and eight were excluded according to the established inclusion and exclusion criteria. Additionally, 48 articles were discarded due to duplication. Table 1 shows the search terms and strings applied in database queries while Table 2 shows the criteria for study selection.

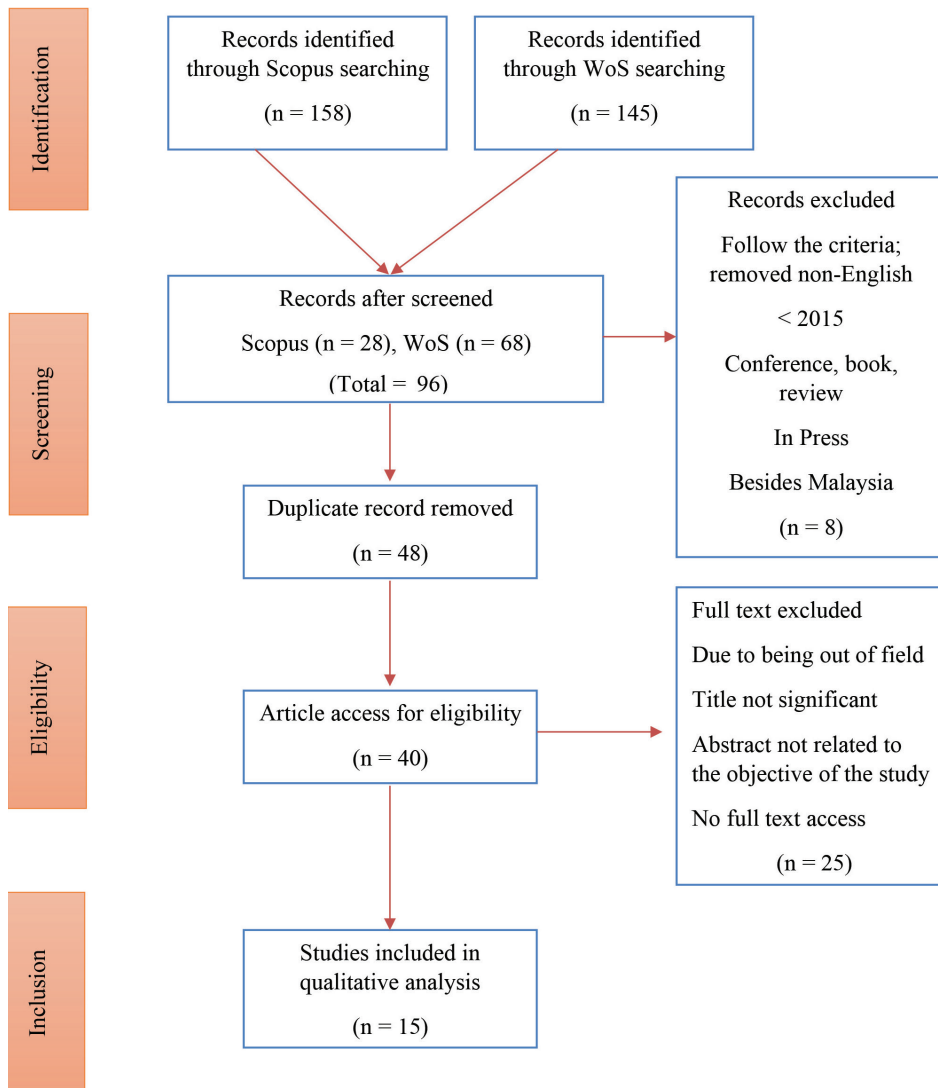


Figure 1: PRISMA-based flow diagram showing the steps of the research selection process

Source: Adapted from the methodology of Moher *et al.* (2015)

Table 1: Search terms and strings applied in database queries

Scopus	TITLE-ABS-KEY ((“challenge*” OR “barrier*” OR “obstacle*” OR “issue*” OR “complication*”) AND (“sustainability” OR “sustainable practice*” OR “sustainable agriculture” OR “sustainable farming”) AND (“smallholder*” OR “smallholder*” OR “small-scale smallholder*”) AND (“oil palm” OR “oil palm”))
Web of Science	ALL= ((“challenge*” OR “barrier*” OR “obstacle*” OR “issue*” OR “complication*”) AND (“sustainability” OR “sustainable practice*” OR “sustainable agriculture” OR “sustainable farming”) AND (“smallholder*” OR “smallholder*” OR “small-scale smallholder*”) AND (“oil palm” OR “oil palm”))

Table 2: Criteria for study selection

Criteria	Inclusion	Exclusion
Language	English	Non-English
Timeline/years	2015–2025	< 2015
Literature type	Journal (Article)	Conference, book, review
Publication stage	Final	In press
Subject area	Social science	Medical, public health, environmental science, engineering, geography, other non-social science studies
Country	Malaysia	Besides Malaysia

Eligibility

The third step, the eligibility phase, involved shortlisting 40 articles for detailed review. During this stage, the titles and key content of each article were carefully examined to ensure they met the inclusion criteria and aligned with the research objectives. Consequently, 25 articles were excluded for failing to satisfy the eligibility requirements. Reasons for exclusion included being outside the scope of the study, having minimally relevant titles, containing abstracts that did not correspond with the research aims, or lacking access to full-text, empirically grounded content. Ultimately, 15 articles were retained for the subsequent review.

A total of 303 records were identified from Scopus (158) and Web of Science (145). The qualitative analysis was based on 15 studies that met the established criteria. This systematic approach ensures transparency and rigour in identifying relevant literature on the readiness of oil palm smallholders in Malaysia to adopt sustainable practices.

Results

Enablers and Barriers to Sustainable Practice Adoption

Table 3 summarises key studies analysing the enablers and barriers to sustainable oil palm production among smallholders. The literature highlights a multidimensional set of factors influencing adoption, spanning financial,

institutional, policy, environmental, and socio-demographic dimensions. Collectively, these studies demonstrate that sustainability adoption is not driven by a single factor but rather by the interaction of structural and behavioural elements.

Numerous studies highlight the significance of certification programs such as RSPO and MSPO in promoting sustainability adoption through financial incentives and regulatory frameworks (Meijaard *et al.*, 2018; Rahmat *et al.*, 2021). Economic constraints continue to pose a substantial challenge, with smallholders frequently facing difficulties with certification and market access costs (Zakaria *et al.*, 2022; Lim *et al.*, 2023). Institutional barriers such as insufficient land tenure security and regulatory misalignment impede sustainability initiatives (Cramb & McCarthy, 2016; Pacheco *et al.*, 2020).

Certification programs such as MSPO serve as key enablers through structured regulatory frameworks (Meijaard *et al.*, 2018). As shown in Figure 2, the multi-stage audit and surveillance process presents a significant procedural barrier for independent smallholders lacking external facilitators (Aziz *et al.*, 2016).

The study identifies that the complexity of the certification process itself acts as a barrier to adoption. Figure 2 outlines the multi-stage audit and surveillance cycle required for MSPO compliance. The analysis finds that, for ISH,

Table 3: Charting the data

Authors	Variables/ Enablers	Discussion	Sub-theme	Theme
Aziz <i>et al.</i> (2016)	Certification benefits, environmental compliance	Analyses the impact of certification programs on enhancing smallholders' access to sustainable markets	Compliance incentives	Environmental policy impact
Cramb and McCarthy (2016)	Institutional support, land tenure security	Examines the difficulties faced by independent smallholders in fulfilling sustainability criteria	Smallholder challenges	Institutional barriers to sustainability
Erwiningsih <i>et al.</i> (2023)	Stakeholder collaboration, sustainability programs	Examines the functions of multi-stakeholder partnerships in promoting the adoption of sustainability practices	Stakeholder engagement	Collaborative sustainability models
Lim <i>et al.</i> (2021)	Cost of certification, smallholder profitability	The financial implications of sustainability certifications for smallholders are examined	Economic barriers	Financial barriers to sustainability
Meijaard <i>et al.</i> (2018)	Financial incentives, RSPO certification	Analyses the impact of certification on the enhancement of sustainability practices	Certification programs	Sustainable oil palm production
Pacheco <i>et al.</i> (2020)	Regulatory alignment, governance	Discusses the misalignment between government regulations and corporate sustainability standards	Policy and governance	Sustainability governance
Rahmat <i>et al.</i> (2021)	MSPO certification, policy framework	Assesses the effectiveness of MSPO certification in promoting sustainable oil palm production	Certification policies	National sustainability initiatives
Siregar <i>et al.</i> (2024)	Sustainable practices, replanting strategies	Investigates the productivity challenges faced by smallholders and the initiatives for sustainable replanting	Replanting strategies	Agricultural sustainability
Siti-Dina <i>et al.</i> (2023)	Social barriers, demographic factors	Examines the influence of social and educational factors on smallholders' engagement in sustainability initiatives	Socioeconomic factors	Social sustainability challenges
Zakaria <i>et al.</i> (2022)	Economic benefits, financial limitations	Examines financial constraints as an obstacle to the adoption of sustainability practices	Economic factors	Financial sustainability

de Vos <i>et al.</i> (2023)	Land legality, group organisation, external facilitators, certification cost	Former scheme smallholders with defined land and organisational structures are more likely to obtain certification	Certification challenges and support	RSPO certification for independent smallholders
Hendrawan and Musshoff (2024)	Subsidy amount, group registration, demographics, risk attitude	Increased subsidies and group-based initiatives enhance the propensity to replant	Replanting program preferences	Replanting subsidy design
Irawan and Syakir (2019)	Smallholder experience, expenditure, smallholder group membership, extension services	Smallholder groups and access to extension services are crucial for climate change adaptation.	Adaptation strategies and support	Climate change adaptation among smallholders
Sham <i>et al.</i> (2024)	Fertiliser cost, nutrient leaching, social acceptance, rural development	Biofertiliser reduces costs, enhances yield, and promotes sustainability	Socioeconomic benefits of innovation	Biochemical fertiliser for sustainability
Nurfatriani <i>et al.</i> (2019)	CPO fund, land legality, loan subsidy, smallholder database	CPO fund should support replanting, clarify land rights, subsidise loans, and improve databases	Financial incentives and policy reform	Optimising CPO fund for sustainable replanting

Note: Author's analysis and compilation

the lack of a designated facilitator to navigate these procedural steps often leads to compliance fatigue, in which the administrative burden outweighs the perceived benefits of entering the sustainable market. Besides, the MSPO certification process incurs additional costs per unit and per hectare, potentially reducing profitability despite yield improvements (Lim *et al.*, 2021; 2023). Awareness of MSPO is low, particularly among independent smallholders, with a certification rate of only 31% at the end of 2020 (Norzalina *et al.*, 2022).

Research indicates that higher adoption of sustainable practices is positively correlated with improved awareness, underscoring the need for targeted educational activities to encourage compliance (Norzalina *et al.*, 2022). MSPO certification offers various advantages for

smallholders, including higher yields, improved pricing for Fresh Fruit Bunches (FFB), enhanced market positioning for oil palm products, and greater operational efficiency. Moreover, MSPO aligns with governmental efforts to promote sustainable oil palm production in Malaysia (Aziz *et al.*, 2016). Smallholders frequently face limited resources that hinder the implementation of Best Management Practices (BMPs), thereby limiting productivity and progress toward sustainability objectives (Suharyanti *et al.*, 2024).

Furthermore, knowledge transfer and capacity-building initiatives are recognised as vital factors in shaping smallholders' decision-making processes (Jelsma *et al.*, 2017). Market-based mechanisms, including premium pricing and enhanced market incentives, promote



Figure 2: MSPO certification process
Source: <https://www.kebalresources.com.my/malaysian-sustainable-palm-oil-certification>

sustainable practices (Schoneveld *et al.*, 2019). Besides, environmental compliance and governance frameworks influence smallholders' capacity to adopt sustainable practices in their operations (Aziz *et al.*, 2016). Social and demographic factors such as education and community engagement significantly influence participation in sustainability initiatives (Siti-Dina *et al.*, 2023). Collectively, these studies illustrate how financial, institutional, policy, and social dimensions influence the sustainability practices of oil palm smallholders.

Disparities between Independent and Organised Smallholders

Independent Smallholders (ISH) in Malaysia's oil palm sector face more severe challenges in implementing sustainable practices than Organised Smallholders (OSH), resulting in significant differences in certification rates, including under the Malaysian Sustainable Palm Oil (MSPO) scheme. Although OSH achieved nearly universal compliance, ISH remained at only 31% by the end of 2020 (Norzalina *et al.*, 2022; MPOB, 2024). The primary factor contributing to this considerable disadvantage

is the operational isolation of ISH, which restricts their access to centralised resources, established market connections, subsidised inputs, and structured technical support that OSH can readily obtain through programs such as FELDA or FELCRA (Siti-Dina *et al.*, 2023; MPOB, 2024). ISH encounters multiple interconnected structural, financial, and knowledge-related barriers that hinder their participation in sustainability projects, including certification requirements (Meijaard *et al.*, 2018; Siti-Dina *et al.*, 2023). The vulnerability of ISH is attributable to multiple compounding factors, particularly the prevalence of insecure land ownership. Certification programs such as the Roundtable on Sustainable Oil Palm (RSPO) require documented land rights as a fundamental requirement. Many ISH cannot meet this criterion due to their contested or informal land holdings, thereby excluding them from certification pathways (Cramb & McCarthy, 2016; de Vos *et al.*, 2023).

The findings reveal a significant disparity in sustainability adoption levels. As illustrated in Figure 3 while independent smallholders (ISH) manage a substantial 14.5% of the total planted area, their readiness lags significantly behind organised groups. This gap highlights critical research findings: Organised smallholders benefit from centralised management, whereas

the fragmented nature of ISH remains a primary hurdle to national sustainability targets.

Financial Constraints and Market Access Challenges

Significant financial limitations further obstruct progress because, without access to the subsidised pathways or group economies of scale that OSH enjoys, the high costs of sustainable inputs, new technologies, and certification compliance would be unaffordable (Lim *et al.*, 2021; Zakaria *et al.*, 2022). The issues worsen due to a widespread lack of technical knowledge and awareness of sustainable farming practices and the genuine benefits of certification, which limits ISH's capacity to initiate transitions independently (Meijaard *et al.*, 2018). The ongoing difference between sustainability standards in the public and private sectors complicates compliance, resulting in burdensome requirements that disproportionately affect ISH with limited resources and inadequate support systems (Pacheco *et al.*, 2020).

A central finding of this study is that financial constraints are not merely internal budget issues but are linked to global environmental risks. When smallholders cannot afford the high costs of sustainable certification, they may resort to land expansion to maintain livelihoods. Figure 4 contextualises this at the global level, showing

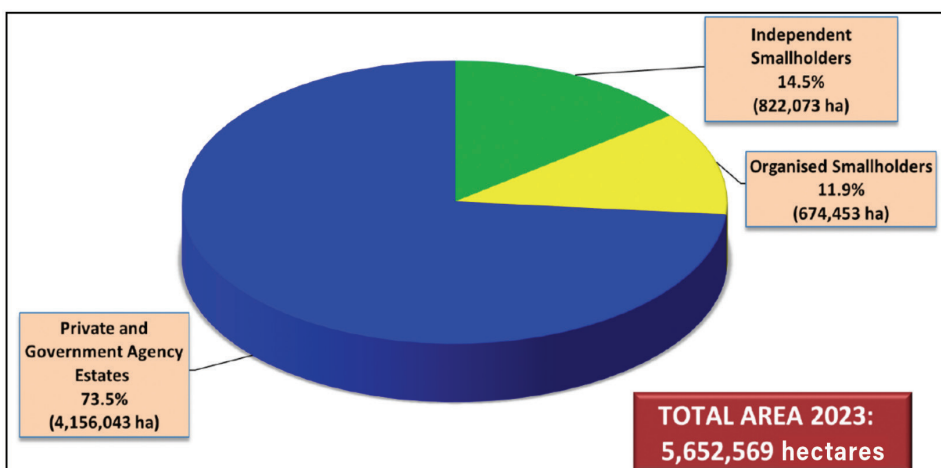


Figure 3: Distribution of oil palm planted area by category in Malaysia
Source: MPOB (2024)

that local financial barriers directly correlate with biodiversity threats in oil palm-producing regions, making financial support a necessity for environmental preservation.

Figure 4 illustrates the global distribution of oil palm cultivation and its potential threats to biodiversity-rich areas. Panel (a) pinpoints areas with a high concentration of unique terrestrial vertebrates. These regions are home to many species found nowhere else. Panel (b) demonstrates the global extent of oil palm cultivation, darker colours indicating countries where a larger percentage of land is used for oil palm production. Panel (c) highlights areas suitable for oil palm cultivation, both in forested and non-forested regions. Panel (d) focuses on Southeast Asia, revealing the intensity of oil palm cultivation within countries and provinces.

Current policy initiatives often fail to adequately account for ISH's unique socioeconomic conditions, leading to interventions that are either inaccessible or ineffective (Pacheco *et al.*, 2020). The combined impact of land insecurity, financial difficulties, knowledge gaps, and policy misalignment often results in sustainability initiatives that

unintentionally marginalise ISH rather than empowering them. Their inclusion is a matter of both equity and necessity, since ISH's substantial contribution to oil palm production means that addressing their heightened concerns is essential to achieve genuine sector-wide environmental and social improvement (Euler *et al.*, 2016; Meijaard *et al.*, 2018).

Discussion

According to the analysis, there is a crucial institutional-financial nexus that manifests as a self-sustaining tension, trapping independent smallholders in unsustainable cycles due to structural gaps and financial limitations. Since unresolved land tenure insecurity disqualifies smallholders from the very government subsidies aimed at reducing those costs, the high cost of certification acts as an overwhelming barrier, suggesting that financial limitations are symptoms of deeper institutional failures rather than isolated economic events (Lim *et al.*, 2021; Zakaria *et al.*, 2022). The differential in participation rates demonstrates that organised smallholders survive through a centralised management system that addresses these

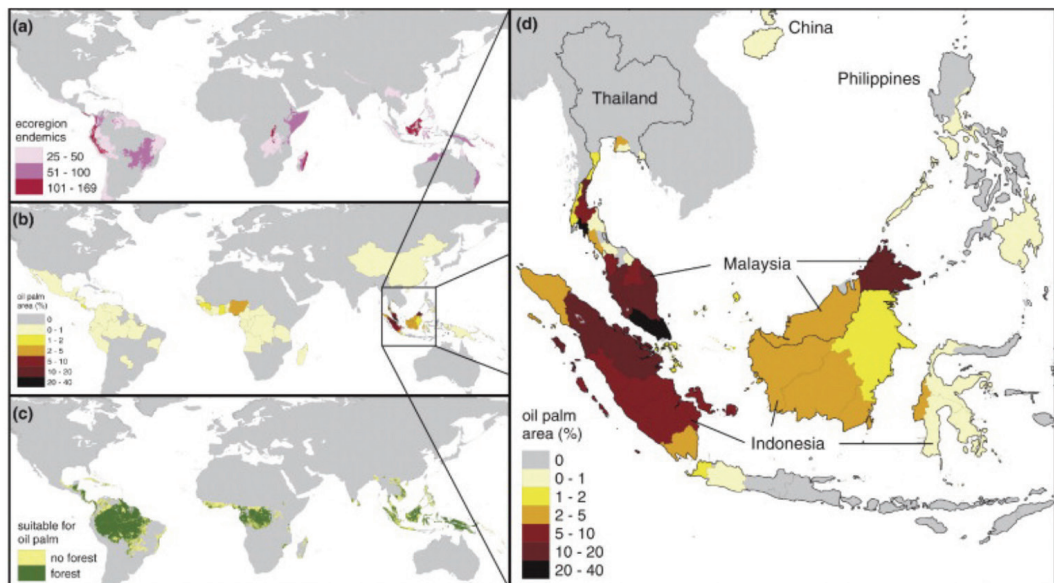


Figure 4: Oil Palm is grown globally and their potential threats to biodiversity

Source: Fitzherbert *et al.* (2008)

deficiencies, whereas independent smallholders remain isolated due to decentralised extension services that do not effectively communicate cost-efficient, sustainable practices (Nurfatriani *et al.*, 2019; Siregar *et al.*, 2024).

The global distribution of oil palm farming largely overlaps with high-priority biodiversity hotspots in Figure 4, demonstrating the ecological consequences of this readiness gap that extend beyond national boundaries. Monoculture conversion reduces species richness among amphibians, reptiles, and birds by up to 61%, a direct consequence of habitat fragmentation, as local institutional failures in Malaysia hinder the implementation of sustainable methods (James *et al.*, 2023; Manhães *et al.*, 2024). These places remain highly vulnerable to further soil and ecosystem degradation during replanting cycles in the absence of action, indicating that the policy stalemate over smallholder support is an environmental emergency rather than just a socioeconomic problem. Smallholders unintentionally contribute to a global decline in ecosystem resilience by prioritising short-term survival over long-term stewardship.

A Triad Intervention Model that concurrently targets land, finance, and knowledge through a single policy framework is proposed to overcome these interconnected structural limitations. To obtain the legal standing necessary for certification entry, digital land cadastre efficiency must be given top priority. Meanwhile, blended finance methods and results-based funding that connect subsidies to measurable sustainability outcomes must be used to lessen the financial burden. Additionally, as shown in the certification process flow in Figure 2, technical support should be decentralised by leveraging manufacturers' market power to offer direct agronomic training and input finance within existing supply chains (Pacheco *et al.*, 2020).

Although this study offers a thorough analysis through a systematic scoping review, it is constrained by its reliance on secondary data, which limits its ability to capture smallholders' real-time behavioural responses and decision-

making processes. Therefore, longitudinal primary studies should be used in future research to examine how smallholders respond to these new integrated policies as they are implemented. Additionally, although the Malaysian setting offers a strong case study, the suggested Triad Model must be modified to account for local political and ecological realities, given the different institutional frameworks in other significant producing regions such as Indonesia, Colombia, and Nigeria. To successfully transform independent smallholders from sustainability liabilities to active stewardship partners, a coordinated, multi-stakeholder effort is necessary. This effort should address land access, high costs, and knowledge deficits as a single, unified challenge, rather than as isolated variables.

Conclusions

This study emphasises how, despite the expansion of sustainable frameworks in the oil palm industry, a complex and interconnected set of institutional, financial, and knowledge-based constraints continues to limit the readiness of independent smallholders in Malaysia. The results show a notable difference in certification performance, indicating that the shift to sustainable practices is driven by institutional enablers such as land tenure security and access to centralised support, rather than personal willingness alone.

By tackling the “institutional-financial connection” through integrated land-finance-support mechanisms, authorities can target the underlying socioeconomic motivations of non-compliance rather than just technical mandates. The transformation of independent smallholders from sustainability liabilities to active stewardship partners is contingent upon shifting the policy focus to inclusive, results-based funding and decentralised technical assistance through supply chain partnerships. In addition to meeting national certification goals, this shift is necessary to protect rural livelihoods and provide a fair contribution to environmental resilience worldwide.

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Author Contributions Statement

FHAP carried out the research, wrote, and revised the article. MK conceptualised the central research idea and guided the preparation of the scoping review paper. SH, NHAH, and AAA acted as double-checkers and supervised research progress; MK anchored the review, revisions, and approved the article submission.

Conflict of Interest Statement

The authors agree that this research was conducted in the absence of any self-benefits, commercial, or financial conflicts.

Ethical Conduct

All information communicated in this article does not need ethical approval for research or informed consent because human or animal subjects were not involved.

Declaration of AI-usage

During the preparation of this work, the authors used AI tools to improve grammar and clarity. In using the AI-tools, the authors reviewed and edited the content as needed and bear full responsibility for the content of this manuscript.

References

Abdul Aziz, M. F., Kuntom, A., & Nik Ibrahim, N. A. (2016). Pelaksanaan skim pensijilan Minyak Sawit Mampan Malaysia (MSPO) untuk pekebun kecil persendirian di Malaysia. In *Prosiding Persidangan Kebangsaan Pekebun Kecil Sawit* (pp. 172–175).

Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology*, 8(1), 19–32. <https://doi.org/10.1080/1364557032000119616>

Ashton-Butt, A., Willcock, S., Purnomo, D., Suhardi, Aryawan, A. A. K., Wahyuningsih, R., Naim, M., Poppy, G. M., Caliman, J.-P., Peh, K. S. H., & Snaddon, J. L. (2019). Replanting of first-cycle oil palm results in a second wave of biodiversity loss. *Ecology and Evolution*, 9(11), 6433–6443. <https://doi.org/10.1002/ece3.5218>

Austin, K. G., Mosnier, A., Pirker, J., McCallum, I., Fritz, S., & Kasibhatla, P. S. (2017). Shifting patterns of oil palm driven deforestation in Indonesia and implications for zero-deforestation commitments. *Land Use Policy*, 69, 41–48. <https://doi.org/10.1016/j.landusepol.2017.08.036>

Ayompe, L. M., Nkongho, R. N., Wandum, L. M., Orang, B. O., Fiaboe, K. K. M., Tambasi, E. E., Kettunen, M., & Egoh, B. N. (2024). Complexities of sustainable oil palm production by smallholders in sub-Saharan Africa. *Sustainable Development*, 32(1), 529–541. <https://doi.org/10.1002/sd.2674>

Bausano, G., Masiero, M., Migliavacca, M., Pettenella, D., & Rougieux, P. (2023). Food, biofuels or cosmetics? Land-use, deforestation and CO₂ emissions embodied in the oil palm consumption of four European countries: A biophysical accounting approach. *Agricultural and Food Economics*, 11(1), 35. <https://doi.org/10.1186/s40100-023-00268-5>

Botterill-James, T., Yates, L. A., Buettel, J. C., & Brook, B. W. (2024). The future of Southeast Asia's biodiversity: A crisis with a hopeful alternative. *Biological Conservation*, 296, 110641. <https://doi.org/10.1016/j.biocon.2024.110641>

- Brako, D. E., Richard, A., & Alexandros, G. (2020). Do voluntary certification standards improve yields and wellbeing? Evidence from oil palm and cocoa smallholders in Ghana. *International Journal of Agricultural Sustainability*, 19(1), 16–39. <https://doi.org/10.1080/14735903.2020.1807893>
- Brandão, F., Schoneveld, G., Pacheco, P., Vieira, I., Piraux, M., & Mota, D. (2021). The challenge of reconciling conservation and development in the tropics: Lessons from Brazil's oil palm governance model. *World Development*, 139, 105268. <https://doi.org/10.1016/j.worlddev.2020.105268>
- Chiriaco, M. V., Galli, N., Santini, M., & Rulli, M. C. (2024). Deforestation and greenhouse gas emissions could arise when replacing oil palm with other vegetable oils. *Science of the Total Environment*, 914, 169486. <https://doi.org/10.1016/j.scitotenv.2023.169486>
- Cramb, R., & McCarthy, J. F. (Eds.). (2016). *The oil palm complex: Smallholders, agribusiness and the state in Indonesia and Malaysia*. NUS Press. <https://doi.org/10.2307/j.ctv1xz0km>
- de Vos, R. E., Suwarno, A., Slingerland, M., van der Meer, P. J., & Lucey, J. M. (2023). Pre-certification conditions of independent oil palm smallholders in Indonesia: Assessing prospects for RSPO certification. *Land Use Policy*, 130, 106660. <https://doi.org/10.1016/j.landusepol.2023.106660>
- Erwiningsih, W. (2023). Analyzing drivers and mitigation of deforestation for oil palm expansion in Indonesia, 2000–2020. *International Journal of Sustainable Development and Planning*, 18(11), 3657–3664. <https://doi.org/10.18280/ijstdp.181132>
- Euler, M., Schwarze, S., Siregar, H., & Qaim, M. (2016). Oil palm expansion among smallholder smallholders in Sumatra, Indonesia. *Journal of Agricultural Economics*, 67(3), 658–676. <https://doi.org/10.1111/1477-9552.12163>
- Hendrawan, D., & Musshoff, O. (2024). Risky for the income, useful for the environment: Predicting smallholders' intention to adopt oil palm agroforestry using an extended theory of planned behaviour. *Journal of Cleaner Production*, 475, 143692. <https://doi.org/10.1016/j.jclepro.2024.143692>
- Irawan, A., & Syakir, M. (2019). Determinants of oil palm smallholder smallholders' adaptation strategy to climate change in Bengkulu, Indonesia. *Revista de Economia e Sociologia Rural*, 57(3). <https://doi.org/10.1590/1806-9479.2019.186452>
- Jelsma, I., Schoneveld, G. C., Zoomers, A., & van Westen, A. C. M. (2017). Unpacking Indonesia's independent oil palm smallholders: An actor-disaggregated approach to identifying environmental and social performance challenges. *Land Use Policy*, 69, 281–297. <https://doi.org/10.1016/j.landusepol.2017.08.012>
- Kementerian Perladangan dan Komoditi. (2024). *KDNK mengikut komoditi*. https://www.kpk.gov.my/kpk/images/mp_i_statistik/Pocket_Stats/2023/poket-stats-2023-full/index.html#page/20
- Kikuchi, T., Seidel, D., Ehbrecht, M., Zemp, D. C., Brambach, F., Irawan, B., Sundawati, L., Hölscher, D., Kreft, H., & Paterno, G. B. (2024). Combining planting trees and natural regeneration promotes long-term structural complexity in oil palm landscapes. *Forest Ecology and Management*, 569, 122182. <https://doi.org/10.1016/j.foreco.2024.122182>
- Li, Z., de Tombeur, F., Linden, C. V., Cornelis, J.-T., & Delvaux, B. (2020). Soil microaggregates store phytoliths in a sandy loam. *Geoderma*, 360, 114037. <https://doi.org/10.1016/j.geoderma.2019.114037>
- Lim, C. H., Cheah, Z. H., Lee, X. H., How, B. S., Ng, W. P. Q., Ngan, S. L., Lim, S., & Lam, H. L. (2021). Harvesting and evacuation route optimisation model for fresh fruit bunch in the oil palm plantation site. *Journal of*

- Cleaner Production*, 307, 127238. <https://doi.org/10.1016/j.jclepro.2021.127238>
- Lim, F. C. W., Sharifuddin, J., & Sinden, A. (2023). Impact of MSPO certification on profit among oil palm growers in Malaysia. *The Planter*, 99(1173), 789–804. <https://doi.org/10.56333/tp.2023.030>
- Malaysian Palm Oil Board. (2022). *Overview of the Malaysian oil palm industry in 2023*. <https://bepi.mpob.gov.my/images/overview/Overview2023.pdf>
- Malaysian Palm Oil Board. (2024). *Oil palm planted area 2023*. https://bepi.mpob.gov.my/images/area/2023/Area_summary2023.pdf
- Malaysian Sustainable Palm Oil. (2022). *Overview of the revised MSPO standards*. <https://mspo.org.my/mspo-blogs/overview-of-revised-mspo-standards-ms25302022>
- Manhães, A. P., Rocha, F., Souza, T., Marques, K., Juen, L., Montag, L., & Coutinho, B. (2024). Social and biological impact of oil palm (*Elaeis guineensis* Jacq.) plantations in the eastern Brazilian Amazon. *Research Square*. <https://doi.org/10.21203/rs.3.rs-3898287/v1>
- Meijaard, E., Garcia-Ulloa, J., Sheil, D., Wich, S. A., Carlson, K. M., Juffe-Bignoli, D., & Brooks, T. M. (2018). *Oil palm and biodiversity: A situation analysis by the IUCN Oil Palm Task Force*. IUCN. <https://doi.org/10.2305/IUCN.CH.2018.11.en>
- Meijaard, E., Morgans, C., Husnayaen, Abram, N. K., & Ancrenaz, M. (2017). *An impact analysis of RSPO certification on Borneo forest cover and orangutan populations*. Borneo Futures. https://www.researchgate.net/publication/313927667_An_impact_analysis_of_RSPO_certification_on_Borneo_forest_cover_and_orangutan_populations
- Nurfatriani, F., Ramawati, Sari, G. K., & Komarudin, H. (2019). Optimization of crude oil palm fund to support smallholder oil palm replanting in reducing deforestation in Indonesia. *Sustainability*, 11(18), 4914. <https://doi.org/10.3390/su11184914>
- Pacheco, P., Schoneveld, G., Dermawan, A., Komarudin, H., & Djama, M. (2020). Governing sustainable oil palm supply: Disconnects, complementarities, and antagonisms between state regulations and private standards. *Regulation & Governance*, 14(3), 568–598. <https://doi.org/10.1111/rego.12220>
- Pulighe, G. (2023). Navigating the path to sustainable oil palm cultivation: Addressing nexus challenges and solutions. *Research on World Agricultural Economy*, 4(2), 13–17. <https://doi.org/10.36956/rwae.v4i2.835>
- Putri, E. I. K., Dharmawan, A. H., Hospes, O., Yulian, B. E., Amalia, R., Mardiyansih, D. I., Kinseng, R. A., Tonny, F., Pramudya, E. P., Rahmadian, F., & Suradiredja, D. Y. (2022). The oil palm governance: Challenges of sustainability policy in Indonesia. *Sustainability*, 14(3), 1820. <https://doi.org/10.3390/su14031820>
- Rahmat, S. R., Mat Yasin, S., Mad' Atari, M. F., & Tayeb, A. (2021). Seeking for sustainability: Actor's perspective on the Malaysian Sustainable Oil Palm Certification Scheme (MSPO). *Malaysian Journal of Society and Space*, 17(2), 65–78. <https://doi.org/10.17576/geo-2021-1702-06>
- Rosyidy, M. K., & Frimawaty, E. (2024). Spatiotemporal analysis of oil palm land clearing. *Global Journal of Environmental Science and Management*, 10(2), 821–836. <https://doi.org/10.22035/gjesm.2024.02.25>
- Roundtable on Sustainable Palm Oil. (2024). *Supporting smallholders: Improving livelihoods through sustainable practices*. <https://rspo.org/as-an-organisation/support-smallholders/>
- Schmidt, J., & De Rosa, M. (2020). Certified oil palm reduces greenhouse gas emissions compared to non-certified. *Journal of Cleaner Production*, 277, 124045. <https://doi.org/10.1016/j.jclepro.2020.124045>

- Schoneveld, G. C., van der Haar, S., Ekowati, D., Andrianto, A., Komarudin, H., Okarda, B., Jelsma, I., & Pacheco, P. (2019). Certification, good agricultural practice, and smallholder heterogeneity: Differentiated pathways for resolving compliance gaps in the Indonesian oil palm sector. *Global Environmental Change*, 57, 101933. <https://doi.org/10.1016/j.gloenvcha.2019.101933>
- Senior, M. J. M., Hamer, K. C., Bottrell, S., Edwards, D., Fayle, T., Lucey, J., Mayhew, P., Newton, R., Peh, K., Sheldon, F., Stewart, C., Styring, A., Thom, M., Woodcock, P., & Hill, J. (2013). Trait-dependent declines of species following conversion of rain forest to oil palm plantations. *Biodiversity and Conservation*, 22, 253–268. <https://doi.org/10.1007/s10531-012-0419-7>
- Sham, I. N., Yap, C. K., Nulit, R., Peng, S. H. T., & Chai, E. W. (2024). The need to develop a cost-effective novel biochemical fertilizer to control leaching problems for sustainable oil palm production: A short note on special reference to the socio-economic aspect. *Pakistan Journal of Life and Social Sciences*, 22(2), 5250–5262. <https://doi.org/10.57239/PJLSS-2024-22.2.00392>
- Siregar, A. A., Halimatussadiah, A., Moeis, F. R., Anky, W. A. K., & Nainggolan, D. (2024). The oil palm replanting imperative: Are smallholder willing to participate? *Forest Policy and Economics*, 169, 103362. <https://doi.org/10.1016/j.forpol.2024.103362>
- Siti-Dina, R. P., Er, A. C., & Cheah, W. Y. (2023). Social issues and challenges among oil palm smallholder smallholders in Malaysia: Systematic literature review. *Sustainability*, 15(4), 3123. <https://doi.org/10.3390/su15043123>
- Suharyanti, N. A., Mizuno, K., & Nurfalalah, L. (2024). Intensification model of smallholder oil palm plantation to achieving sustainability and prosperity, Riau Province, Indonesia. *IOP Conference Series: Earth and Environmental Science*, 1308(1), 012031. <https://doi.org/10.1088/1755-1315/1308/1/012031>
- U.S. Department of Agriculture, Foreign Agricultural Service. (2024). *Top producing countries*. <https://fas.usda.gov/data/production/commodity/4243000>
- Vijay, V., Pimm, S. L., Jenkins, C. N., & Smith, S. J. (2016). The impacts of oil palm on recent deforestation and biodiversity loss. *PLOS ONE*, 11(7), e0159668. <https://doi.org/10.1371/journal.pone.0159668>
- Zakaria, Z., Rahim, A. R. A., & Aman, Z. (2022). The future of oil palm smallholders toward greater sustainability: A systematic literature review. *Pertanika Journal of Social Sciences and Humanities*, 30(1), 283–306. <https://doi.org/10.47836/pjssh.30.1.15>