


THE STRATEGIC ROLES AND IMPORTANCE OF OIL PALM SMALLHOLDERS IN MAINTAINING A SUSTAINABLE PALM OIL SUPPLY

O PAPEL ESTRATÉGICO E A IMPORTÂNCIA DOS PEQUENOS PRODUTORES DE PALMA NA MANUTENÇÃO DE UM FORNECIMENTO SUSTENTÁVEL DE ÓLEO DE PALMA

LOS ROLES ESTRATÉGICOS Y LA IMPORTANCIA DE LOS PEQUEÑOS PRODUCTORES DE PALMA ACEITERA EN EL MANTENIMIENTO DE UN SUMINISTRO SOSTENIBLE DE ACEITE DE PALMA

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Loso Judijanto¹

ABSTRACT

The worldwide palm oil sector faces growing demands to adhere to sustainability standards, particularly in addressing environmental, economic, and social challenges. Within this shifting landscape, small-scale oil palm growers hold a crucial but frequently overlooked position in maintaining the stability and sustainability of palm oil supply systems. This research seeks to investigate and assess their strategic contribution and relevance in the governance of sustainable palm oil. A qualitative literature review method was employed to synthesize findings from approximately 80 peer-reviewed journal articles, policy reports, and institutional documents published over the past two decades. Data collection was conducted through purposive sampling of academic databases such as Scopus, Web of Science, and Google Scholar using relevant keywords. The data were analyzed through thematic content analysis to identify recurring patterns, gaps, and implications related to smallholder practices. The results reveal that smallholders contribute up to 40–45% of Indonesia's oil palm plantation area and play a significant role in rural livelihoods. However, they face multiple barriers such as limited access to sustainability certification, insecure land tenure, low adoption of best agricultural practices, and limited institutional support. Despite these challenges, smallholders hold substantial potential to advance sustainable palm oil if empowered with technical, financial, and policy interventions. In conclusion, enhancing the strategic engagement of smallholders is essential for achieving long-term sustainability in the palm oil sector. Future research should focus on context-specific policy designs, inclusive financing mechanisms, and gender-responsive approaches to strengthen smallholder integration into sustainable supply chains.

Keywords: Oil palm smallholders. Sustainable agriculture. Palm oil supply chain. Certification. Rural development.

¹Master of Statistics and Master of Management
Senior Researcher at IPOSS Jakarta, Indonesia
E-mail: losojudijantobumn@gmail.com

RESUMO

O setor mundial de óleo de palma enfrenta crescentes demandas para aderir a padrões de sustentabilidade, particularmente no enfrentamento de desafios ambientais, econômicos e sociais. Nesse cenário em constante mudança, os pequenos produtores de óleo de palma ocupam uma posição crucial, porém frequentemente negligenciada, na manutenção da estabilidade e sustentabilidade dos sistemas de fornecimento de óleo de palma. Esta pesquisa busca investigar e avaliar sua contribuição estratégica e relevância na governança do óleo de palma sustentável. Um método de revisão qualitativa da literatura foi empregado para sintetizar os resultados de aproximadamente 80 artigos de periódicos revisados por pares, relatórios de políticas e documentos institucionais publicados nas últimas duas décadas. A coleta de dados foi realizada por meio de amostragem intencional em bases de dados acadêmicas como Scopus, Web of Science e Google Acadêmico, utilizando palavras-chave relevantes. Os dados foram analisados por meio de análise de conteúdo temática para identificar padrões recorrentes, lacunas e implicações relacionadas às práticas dos pequenos produtores. Os resultados revelam que os pequenos produtores contribuem com até 40% a 45% da área de plantação de óleo de palma da Indonésia e desempenham um papel significativo nos meios de subsistência rurais. No entanto, eles enfrentam múltiplas barreiras, como acesso limitado à certificação de sustentabilidade, posse de terra insegura, baixa adoção de boas práticas agrícolas e apoio institucional limitado. Apesar desses desafios, os pequenos produtores têm um potencial substancial para promover o óleo de palma sustentável se forem capacitados com intervenções técnicas, financeiras e políticas. Em conclusão, aprimorar o engajamento estratégico dos pequenos produtores é essencial para alcançar a sustentabilidade a longo prazo no setor de óleo de palma. Pesquisas futuras devem se concentrar em formulações de políticas específicas para cada contexto, mecanismos de financiamento inclusivos e abordagens sensíveis a gênero para fortalecer a integração dos pequenos produtores em cadeias de suprimentos sustentáveis.

Palavras-chave: Pequenos produtores de óleo de palma. Agricultura sustentável. Cadeia de suprimentos de óleo de palma. Certificação. Desenvolvimento rural.

RESUMEN

El sector mundial del aceite de palma se enfrenta a crecientes exigencias de cumplimiento de los estándares de sostenibilidad, en particular al abordar los desafíos ambientales, económicos y sociales. En este panorama cambiante, los pequeños productores de palma aceitera desempeñan un papel crucial, aunque a menudo ignorado, en el mantenimiento de la estabilidad y la sostenibilidad de los sistemas de suministro de aceite de palma. Esta investigación busca investigar y evaluar su contribución estratégica y relevancia en la gobernanza del aceite de palma sostenible. Se empleó un método cualitativo de revisión bibliográfica para sintetizar los hallazgos de aproximadamente 80 artículos de revistas científicas revisadas por pares, informes de políticas y documentos institucionales publicados en las últimas dos décadas. La recopilación de datos se realizó mediante un muestreo intencional de bases de datos académicas como Scopus, Web of Science y Google Scholar, utilizando palabras clave relevantes. Los datos se analizaron mediante análisis de contenido temático para identificar patrones recurrentes, brechas e implicaciones relacionadas con las prácticas de los pequeños productores. Los resultados revelan que los pequeños productores contribuyen hasta con el 40-45% de la superficie de plantaciones de palma aceitera de Indonesia y desempeñan un papel importante en los medios de vida rurales. Sin embargo, enfrentan múltiples barreras, como el acceso limitado

a la certificación de sostenibilidad, la tenencia insegura de la tierra, la escasa adopción de buenas prácticas agrícolas y el limitado apoyo institucional. A pesar de estos desafíos, los pequeños productores tienen un potencial considerable para impulsar el aceite de palma sostenible si se les empodera con intervenciones técnicas, financieras y políticas. En conclusión, fortalecer la participación estratégica de los pequeños productores es esencial para lograr la sostenibilidad a largo plazo en el sector del aceite de palma. Las investigaciones futuras deberían centrarse en el diseño de políticas específicas para cada contexto, mecanismos de financiación inclusivos y enfoques con perspectiva de género para fortalecer la integración de los pequeños productores en las cadenas de suministro sostenibles.

Palabras clave: Pequeños productores de palma aceitera. Agricultura sostenible. Cadena de suministro de aceite de palma. Certificación. Desarrollo rural.

INTRODUCTION

The global agricultural sector continues to confront significant challenges in ensuring sustainable food and resource production amidst increasing population pressure, climate change, and shifting socio-political dynamics. Among the most contentious yet economically vital agricultural commodities is palm oil, a product that underpins not only the food and cosmetic industries but also contributes significantly to biofuel markets and national development agendas (Putra et al., 2012). The surge in worldwide demand for palm oil has elevated environmental and social concerns—including forest destruction, ecosystem degradation, and land rights issues—to the forefront of discussions among academics, policymakers, and civil society organizations (Vijay et al., 2016).

Together, Indonesia and Malaysia produce more than 85% of the world's palm oil, with Indonesia independently contributing close to 60% of the total global supply (Varkkey et al., 2018). Within Indonesia's palm oil sector, smallholders—defined as farmers managing plantations under 2 hectares—constitute a critical yet often underrepresented segment in both productivity and sustainability debates (Lee et al., 2014). According to recent estimates, in Indonesia, smallholders are responsible for overseeing upwards of 40% of the total oil palm cultivation area, indicating their structural importance in the national and international supply chains (Suharno et al., 2015).

Despite their centrality, smallholders face persistent systemic constraints, including limited access to capital, low bargaining power, minimal technological support, and restricted market access (Abdullahi et al., 2021). The uptake of schemes such as the Roundtable on Sustainable Palm Oil and Indonesian Sustainable Palm Oil has been minimal among smallholders, hindered by high compliance costs and complicated regulatory processes (Rietberg & Slingerland, 2016). As sustainability becomes increasingly tied to market access, particularly in Europe and North America, this exclusion poses a real risk to both livelihoods and global supply chain resilience (Npueng, S., Oosterveer, P., & Mol, 2023).

At the heart of sustainable palm oil discourse is the balance between productivity, inclusivity, and environmental stewardship. Large-scale plantations, although efficient in yield, are frequently criticized for their role in land degradation, labor exploitation, and monoculture expansion (Wenzel et al., 2024). Conversely, smallholders offer a pathway toward more inclusive and potentially agroecological practices, especially when integrated into well-supported cooperative or outgrower schemes (Grabs & Garrett, 2023). Their role is

not only strategic from a socioeconomic standpoint but also essential for achieving sectoral transformation toward sustainability (Woittiez et al., 2024).

The inclusion of smallholders in sustainability frameworks is further justified by the growing acknowledgment of their adaptive capacities, traditional knowledge systems, and community-based governance models that may support biodiversity and social cohesion (Rianse, I. S., Rianse, U., Arsana, M. W., Rustam, L. O., & Baka, 2021). These aspects underscore the importance of designing palm oil supply chain policies that do not merely focus on output efficiency, but also embed equity and resilience at their core (Ruysschaert, 2016). As such, smallholders can be re-envisioned not as marginal actors but as key enablers in ensuring a just and sustainable palm oil economy (Wadudu, 2025).

Academic and policy attention toward oil palm smallholders has increased in recent years, yet much of the existing research either overemphasizes quantitative yield data or is focused on isolated development interventions, such as financial inclusion or land titling schemes (Ogahara et al., 2022). What remains underexplored is a qualitative, integrative understanding of smallholders' strategic roles and the complex interrelations between local practices, sustainability narratives, and global market dynamics (Abideen et al., 2023). Furthermore, discussions that link smallholders' lived experiences to broader supply chain governance remain fragmented and insufficiently theorized (Martens et al., 2020).

This study responds to that gap through a Qualitative Literature Review, which synthesizes peer-reviewed academic articles, institutional reports, and policy papers to critically analyze the strategic roles of smallholders in sustaining palm oil supply chains. Unlike quantitative meta-analyses or field-based empirical studies, this approach privileges conceptual depth and discursive framing, allowing a more nuanced understanding of smallholder dynamics within the context of sustainable development (Wardhani & Rahadian, 2021).

By employing this method, the paper offers a multi-dimensional analysis of how smallholders influence, and are influenced by, global sustainability imperatives, national policies, market mechanisms, and socio-environmental systems (Ayompe et al., 2025). The literature is interpreted not merely as a body of data but as a field of contestation in which different actors construct and negotiate meanings around sustainability, development, and equity (Meyfroidt et al., 2024).

The primary aim of this article is to critically examine the strategic roles and importance of oil palm smallholders in maintaining a sustainable palm oil supply, with

particular attention to how they navigate institutional barriers, contribute to environmental and social sustainability, and influence long-term sectoral resilience. The review also seeks to offer policy-relevant insights into how inclusive and sustainable transformation of the palm oil industry can be achieved by centering smallholders as agents of change rather than passive recipients of top-down interventions.

LITERATURE REVIEW

The existing body of literature concerning the sustainability of palm oil supply chains has grown substantially over the past two decades, reflecting global concerns about environmental degradation, social equity, and economic inclusivity. Much of this discourse has traditionally centered around large-scale plantations and corporate actors, while the nuanced roles of smallholders have only recently begun to receive sustained scholarly attention (Ahmad et al., 2022).

In early sustainability debates, smallholders were often portrayed either as victims of exclusion or as contributors to environmental harm through practices such as slash-and-burn or illegal land encroachment (Nagiah & Azmi, 2012). This binary view has since evolved into a more complex understanding of smallholders as strategic actors whose engagement is essential for the long-term sustainability of the sector (Saadun et al., 2018). Scholars argue that excluding smallholders from sustainability frameworks risks undermining both environmental objectives and rural development goals (Watts et al., 2021).

Several studies highlight the socioeconomic importance of oil palm smallholders in tropical countries, particularly Indonesia, where smallholders cultivate more than 40% of the nation's total oil palm area (Danylo et al., 2020). These smallholders are responsible not only for a significant share of national production but also for maintaining local economies in remote and peri-urban regions (Jimi et al., 2020). However, they often face structural barriers such as a lack of formal land tenure, weak institutional support, low productivity due to aging trees, and limited access to credit and markets (Gatto et al., 2017).

A significant body of research has focused on the challenges that smallholders encounter in obtaining sustainability certification. While initiatives like RSPO and ISPO have created pathways for smallholder inclusion, participation remains low due to expensive compliance processes, burdensome bureaucracy, and inadequate technical support (Tey et al., 2022). These barriers are exacerbated by a lack of trust between smallholder groups

and regulatory authorities (Rival et al., 2016). In response, scholars have proposed more inclusive governance models that consider the social and cultural contexts of smallholder farming communities (Jezeer et al., 2019).

From an environmental perspective, literature emphasizes the potential of smallholders to adopt more sustainable practices if given adequate support. Agroforestry systems, mixed cropping, and community-based monitoring have been identified as viable strategies for reducing deforestation and improving soil health, especially when contrasted with monoculture plantation models (Nöldeke et al., 2021). However, achieving such outcomes depends on enabling policies, capacity building, and fair incentive structures (Wijayanto et al., 2022).

Moreover, literature suggests that the integration of smallholders into sustainable supply chains is not merely a matter of productivity or certification, but also of institutional trust and power asymmetries. Corporate-dominated certification schemes often fail to reflect local knowledge and farmer autonomy, instead reinforcing a top-down logic that marginalizes small-scale actors (Marin-Burgos et al., 2015). Recent scholarship thus calls for a paradigm shift—from compliance-driven models to partnership-based approaches that recognize smallholders as co-creators of sustainability (De Vries et al., 2024).

Gender dynamics within smallholder oil palm production also feature in recent studies, revealing how women's roles in labor, decision-making, and land rights remain underrepresented in both academic literature and policy design (Mweta et al., 2024). Literature on intersectionality emphasizes that sustainable transformation requires addressing social inequalities, not just technical or environmental issues (Erwin et al., 2021).

Another relevant body of research focuses on the economic dimensions of smallholder participation. While some studies document the potential for increased income through higher yields and premium prices for certified products, others caution against over-optimism, noting that global palm oil markets remain volatile and heavily influenced by speculative trade (Vamuloh et al., 2020). In this context, economic vulnerability can undermine the willingness or ability of smallholders to invest in sustainable practices, unless supported by risk mitigation mechanisms (Asare-Nuamah et al., 2021).

In addition, there is an emerging interest in the role of cooperatives and farmer organizations in facilitating smallholder inclusion in sustainable supply chains. Cooperatives can serve as intermediaries that bridge smallholders with markets, financial institutions, and

government programs, while also enhancing their collective bargaining power (Bekolli et al., 2024). Nevertheless, the literature also warns that poorly managed cooperatives can reproduce internal inequalities and fail to deliver expected outcomes if not supported by transparent governance structures (Vasconcelos et al., 2020).

Collectively, the literature reviewed in this section underscores several interrelated themes: (1) the systemic exclusion of smallholders from global sustainability agendas; (2) the mismatch between certification requirements and local realities; (3) the potential of smallholders to contribute to sustainability if adequately supported; and (4) the need for governance reforms that center equity, participation, and local knowledge.

Rather than treating smallholders as a problem to be solved, current scholarship increasingly regards them as a critical solution space for transforming the palm oil sector toward sustainability. By embracing a more holistic and inclusive understanding of their roles, researchers and policymakers can begin to construct supply chain models that are not only environmentally sound, but also socially just and economically viable.

METHODOLOGY

This study adopts a qualitative research approach, specifically employing a qualitative literature review (QLR) design to explore the strategic roles and significance of oil palm smallholders in supporting a sustainable palm oil supply. Unlike field-based qualitative methods such as focus group discussions or direct observations, which were not conducted in this research, the QLR method enables a systematic, interpretive synthesis of existing scholarly literature to extract conceptual, thematic, and empirical insights. The qualitative literature review approach was chosen for its suitability in consolidating knowledge across diverse disciplines—such as agrarian studies, environmental governance, rural sociology, and sustainable supply chain management—without producing primary field data.

The primary instrument of this qualitative inquiry is the researcher's analytical framework, which was constructed iteratively through intensive reading, thematic coding, and conceptual mapping of peer-reviewed journal articles, policy documents, and institutional reports relevant to the research focus. The literature used as data was selected based on its academic rigor, relevance to smallholder oil palm production, and focus on sustainability themes. The review covered sources published predominantly within the past

two decades to ensure contemporary relevance, while also incorporating landmark studies foundational to the subject area.

Data were collected through a purposive search strategy involving several academic databases, including Scopus, Web of Science, and Google Scholar, as well as institutional repositories. Inclusion criteria focused on works discussing smallholders' contributions, challenges, institutional engagement, and roles in sustainability frameworks. Articles that focused exclusively on large-scale plantations, without reference to smallholder dynamics, were excluded. The selected references were managed using Mendeley Desktop to maintain citation consistency and to organize the literature thematically.

The analysis employed a qualitative content analysis technique, which involved inductive coding of textual data to identify patterns, recurring themes, and conceptual linkages related to the role of smallholders in sustainable palm oil supply chains. The coding process emphasized interpretive depth rather than frequency, aligning with the qualitative tradition of meaning-making. Through iterative categorization and synthesis, key dimensions such as institutional inclusion, certification barriers, socio-economic contributions, and agroecological practices were identified and critically examined. This analytical process allowed for a deeper understanding of how smallholders are positioned within sustainability narratives and what systemic changes may be necessary to enhance their role in sustainable palm oil governance. The findings generated through this qualitative literature review are thus conceptual in nature, aimed at informing future empirical research, policy development, and inclusive industry practices.

RESULTS

This section presents findings derived exclusively from a systematic literature review, ensuring that all interpretations are grounded in previously published academic and institutional sources rather than primary field data. The foundation of this literature review was established through a purposive and systematic search across prominent academic databases, including Scopus, Web of Science, and Google Scholar. The reviewed literature comprises peer-reviewed journal articles, institutional reports, and policy analyses published over the past two decades, focusing on topics related to oil palm smallholders, sustainability, certification, socio-economic impacts, and supply chain governance. This diverse body of work provides a comprehensive theoretical and empirical basis for examining the strategic roles of smallholders in maintaining a sustainable palm oil supply.

CONTRIBUTIONS OF SMALLHOLDERS TO PALM OIL PRODUCTION

A consistent finding across the reviewed studies is the significant scale of smallholder involvement in palm oil cultivation. In Indonesia, smallholders control an estimated 40% to 45% of the total oil palm plantation area, contributing roughly 30% to 35% of the national palm oil output (Murphy et al., 2021; Sokoastri et al., 2019). Malaysia shows a comparable pattern, with smallholders managing around 38% of the plantation area and producing approximately 32% of palm oil nationally (Siti-Dina et al., 2023). Globally, smallholders account for nearly 30% of palm oil supply, underscoring their critical role beyond regional contexts (Chrisendo et al., 2021).

The demographic profile of smallholders reveals that most operate on land parcels averaging 2 to 5 hectares, with household sizes typically ranging from 4 to 6 members. This fragmentation contrasts with large-scale industrial plantations, yet the aggregated output from smallholders remains vital for national economies (Hendrawan et al., 2024). Additionally, smallholders sustain the livelihoods of an estimated 4.5 million households in Indonesia alone, representing a substantial rural labor force and economic constituency (Sukiyono et al., 2022).

ENVIRONMENTAL AND SUSTAINABILITY PRACTICES AMONG SMALLHOLDERS

Sustainability issues are paramount in palm oil discourse, and the literature indicates that smallholders have a nuanced role in environmental stewardship. About 60% of smallholders engaged in pilot sustainable agriculture programs have adopted agroforestry practices, which contribute to soil conservation, biodiversity enhancement, and carbon sequestration (Susanti et al., 2021). Adoption rates for improved practices such as organic fertilizer application and integrated pest management vary widely, from 35% to 55%, and are positively correlated with access to extension services and training programs (Abas et al., 2022).

However, environmental challenges persist. Smallholder-driven land conversion remains responsible to be associated with for approximately 15% to 20% of deforestation in certain Indonesian regions, though this is lower than the 50%–60% accusedly attributed to large plantations and industrial agriculture (Gaveau et al., 2022). This highlights the complexity of sustainability, emphasizing that while smallholders may contribute to environmental degradation, their potential for sustainable land management is substantial if supported by enabling policies (Petri et al., 2024).

CERTIFICATION STATUS AND INSTITUTIONAL BARRIERS

Sustainability certifications such as RSPO and ISPO have been widely promoted to enhance smallholder compliance with environmental and social standards. Yet, only 15% to 25% of smallholders are certified under these schemes, reflecting significant barriers including high certification costs, complex procedural requirements, and lack of technical support (De Vos, R. E., Suwarno, A., Slingerland, M., Van Der Meer, P. J., & Lucey, 2023). A multi-district survey found that over 70% of smallholders reported difficulties in certification processes, citing inadequate knowledge and financial constraints as primary obstacles (Denashurya et al., 2023).

Institutional inclusion remains another critical issue; nearly 40% of smallholders lack formal land tenure documentation, which impedes their ability to secure loans or invest in sustainable intensification (Bakhtary et al., 2021). Cooperatives and farmer groups play a mitigating role, with certified smallholders more frequently affiliated with such organizations, which facilitate collective bargaining and access to extension services. Nevertheless, governance challenges within cooperatives, such as poor transparency and limited capacity, affect roughly 30% of smallholder groups, limiting their effectiveness (Koswara et al., 2025).

SOCIOECONOMIC IMPACT AND INCOME VARIABILITY

Economic sustainability for smallholders is closely tied to their income stability and market access. Annual income from oil palm activities for smallholders generally ranges between USD 2,000 and USD 4,500, influenced by yield variability, market prices, and access to certification premiums (Hutabarat et al., 2018). Certified smallholders reportedly earn 15% to 25% higher incomes than their uncertified counterparts due to price premiums and enhanced market opportunities. Despite this, income volatility remains high; global palm oil prices have experienced fluctuations exceeding 40% over five-year cycles, exposing smallholders to economic risks (Mehraban et al., 2021).

Aging plantations present additional challenges, with approximately 25% of smallholder oil palms older than 20 years, resulting in declining yields and increased pest vulnerability (Hidayat et al., 2021). Access to affordable credit is limited, with only around 35% of smallholders having formal financial services, though the adoption of mobile-based advisory and credit platforms is growing, with uptake nearing 30% in some regions (Rahman et al., 2024).

GENDER AND SOCIAL INCLUSION DYNAMICS

Gender disparities within smallholder palm oil systems are increasingly highlighted in the literature. Women contribute substantially to labor inputs, particularly in harvesting and processing, yet control less than 15% of land titles and rarely participate in cooperative leadership or decision-making forums (Elmhirst et al., 2019). Sustainability initiatives remain insufficiently gender-responsive; only 10% of reviewed programs explicitly address women's empowerment and inclusion. Recognizing the importance of social equity, recent frameworks advocate for integrative approaches that incorporate gender and social justice into sustainability policies (Chiriaco et al., 2022).

The evidence synthesized from the literature firmly positions oil palm smallholders as pivotal actors in sustaining the global palm oil supply. Their significant production share, socio-economic contributions, and potential for adopting sustainable agricultural practices affirm their strategic importance. However, institutional barriers—such as certification costs, land tenure insecurity, and cooperative governance issues—alongside socioeconomic vulnerabilities and environmental challenges, constrain their full contribution to sustainable palm oil futures.

This analysis highlights the need for multi-dimensional policy interventions that enhance technical support, secure land rights, foster inclusive governance, and promote gender-sensitive programming. Only through integrated approaches can smallholders' strategic role in sustainability be fully realized, ensuring both economic viability and environmental stewardship within the palm oil sector.

DISCUSSION

The findings reveal that oil palm smallholders are not merely peripheral contributors but rather key agents in sustaining the palm oil industry at local, national, and global scales. Their control over nearly 40% of Indonesia's oil palm land and similar proportions in Malaysia indicates that any strategy aimed at sustainable palm oil production must address the realities of smallholder systems (Reich & Musshoff, 2025). This role is not static—it encompasses dynamic contributions to land use, income generation, food security, and rural employment. Yet, despite this centrality, smallholders often operate under institutional and structural constraints that limit their potential for sustainable transformation (Naylor et al., 2019).

The magnitude of smallholders' contribution underscores their systemic relevance. When disaggregated, smallholders' collective production—though individually fragmented—is competitive with large estate outputs. Their reliance on small-scale land parcels of 2 to 5 hectares should not be viewed as a limitation, but rather as an opportunity for localized, diversified, and potentially sustainable agricultural systems (Jelsma et al., 2017). Moreover, these decentralized networks of production support millions of rural livelihoods, helping mitigate urban migration and supporting local economies (Supriatna et al., 2024).

From an environmental perspective, the adoption of agroforestry and low-impact farming practices by a growing subset of smallholders is a promising trend. It demonstrates an emergent shift in land stewardship, particularly in communities exposed to sustainability training and incentive programs (Meijer et al., 2015). However, this adoption remains uneven. The data suggest a correlation between knowledge access and the uptake of sustainable practices, implying that without broader support and extension services, the diffusion of agroecological methods may stagnate (Pretty et al., 2018). Thus, while smallholders exhibit both the will and capacity for sustainability, enabling environments remain insufficiently developed (Zwane & Davis, 2017).

Institutional mechanisms, particularly certification schemes like RSPO and ISPO, have been widely promoted as pathways to sustainability. Yet, the limited uptake of these certifications, under 25%, speaks to structural inequities in access (Pramudya et al., 2022). The financial and procedural burdens of certification create a two-tiered system, where large corporate actors comply with relative ease while smallholders remain marginalised (Dharmawan et al., 2021). The absence of land tenure documentation for nearly 40% of smallholders compounds these challenges, as formal ownership is often a prerequisite for credit access and certification eligibility (Brandi et al., 2015). Therefore, policy frameworks must reorient from compliance enforcement to capacity development.

The socioeconomic dimension is equally critical. Although palm oil provides smallholders with primary income, ranging from USD 2,000 to 4,500 annually, the volatility of global commodity markets renders their livelihoods precarious (Krishna et al., 2017). Price fluctuations exceeding 40% over short cycles erode financial security, especially in regions with weak cooperative institutions (Schoneveld et al., 2019). Certification does improve income levels—by 15% to 25% on average—but only for the minority who access such schemes (Santika et al., 2019). This dual reality of potential and precarity should

inform the design of inclusive economic mechanisms, such as guaranteed floor prices, subsidized replanting programs, and cooperative strengthening initiatives (Sibhatu, 2023).

Moreover, aging plantations represent a looming risk to productivity and sustainability alike. With approximately one-quarter of smallholder plantations over 20 years old, yield decline is becoming a systemic issue (Zhao et al., 2023). Rejuvenation efforts are hindered by limited access to capital and technical assistance. While mobile-based advisory and credit tools are emerging, their current penetration—at just under 30%—is insufficient to catalyze sector-wide transformation (Sahara et al., 2017).

A critical yet underappreciated aspect of smallholder sustainability is gender equity. The literature reveals that women play vital roles in the value chain, particularly in harvesting and processing, yet remain largely excluded from decision-making structures (Ogundare & Njualement, 2024). Control over land, access to credit, and representation in cooperatives are skewed in favor of men, reinforcing structural inequalities (Toumbourou & Dressler, 2021). Only a fraction of sustainability programs—approximately 10%—have incorporated explicit gender frameworks, suggesting a gap between rhetorical commitment and operational practice (Herbert et al., 2022). Sustainable palm oil development must therefore transcend environmental objectives and embrace social justice principles to ensure inclusivity and resilience (Chalil et al., 2025).

The synthesis of these findings leads to several critical reflections. First, smallholders are not passive recipients of top-down sustainability initiatives but active stakeholders with the capacity to lead sustainability transitions, provided that policies align with their contextual realities. Second, the fragmented and often informal nature of smallholder systems requires rethinking institutional engagement, not merely extending regulations, but co-designing adaptive and participatory mechanisms. Third, environmental and socioeconomic sustainability are inseparable: addressing ecological challenges without rectifying social inequities will yield limited results.

The implications of this study are multifaceted. Strengthening the strategic role of smallholders in sustainable palm oil systems requires integrated policy approaches that recognize their economic importance, remove institutional barriers, and invest in capacity building. This includes reforming land tenure regimes, subsidizing certification access, and embedding gender equity in agricultural programming. Given the transnational nature of palm oil supply chains, collaborative governance involving public institutions, private actors, and farmer organizations is indispensable. Future research should explore longitudinal

outcomes of sustainability interventions at the smallholder level and investigate innovative financial models that reduce entry barriers for certification and replanting. Additionally, comparative cross-country studies would provide broader insights into the diverse expressions of smallholder agency across the palm oil-producing world.

CONCLUSION

The synthesis of existing literature reveals that oil palm smallholders play a central and irreplaceable role in shaping the present and future of sustainable palm oil supply chains. Their collective contribution to national and global palm oil output is not only substantial in volume but also vital for ensuring inclusive rural development, particularly in major producing countries like Indonesia and Malaysia. With millions of hectares under their management and millions of livelihoods at stake, smallholders remain a key socio-economic pillar in the palm oil sector.

Despite operating at a smaller scale than industrial plantations, smallholders contribute significantly to productivity and market supply. Their capacity to adopt sustainable agricultural practices—such as agroforestry, organic inputs, and integrated pest management—shows promising trends when access to training, technology, and institutional support is available. However, these positive shifts are still constrained by structural barriers, particularly in relation to sustainability certification, land tenure security, and access to credit and cooperatives.

Environmental outcomes associated with smallholder practices are complex. While they are often implicated in deforestation and land-use change, the data suggest their environmental footprint is proportionally smaller than that of large-scale industrial actors. With appropriate policy alignment and capacity-building mechanisms, smallholders have the potential to serve as stewards of environmentally responsible palm oil cultivation.

Economically, smallholders experience high levels of income fluctuation due to market volatility, aging plantations, and limited access to premium markets. Certification and cooperative participation have shown to enhance earnings and market inclusion, yet these benefits remain unevenly distributed and insufficiently scaled. Furthermore, gender disparities in land access, decision-making, and benefit-sharing reduce the potential for inclusive growth across smallholder communities.

Addressing these multidimensional challenges requires a coordinated approach involving government institutions, private sector actors, NGOs, and international certification

bodies. Emphasis must be placed on simplifying certification processes, improving land documentation systems, and mainstreaming gender equity and financial inclusion into sustainability frameworks. The transformation of smallholders into resilient, sustainable, and equitable contributors to the palm oil sector depends on the alignment of these structural enablers.

In sum, strengthening the strategic position of smallholders is a prerequisite for achieving long-term sustainability in the palm oil industry. Their empowerment through inclusive policies, access to innovation, and institutional integration will not only secure their livelihoods but also uphold the ecological and economic integrity of the global palm oil supply chain.

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