SEVEN publicações acadêmicas

CHAPTER 10

SIGNIFICANT CONTRIBUTIONS OF OIL PALM PLANTATION TOWARDS SUSTAINABLE DEVELOPMENT GOALS IN RURAL LIVELIHOOD

CONTRIBUIÇÕES SIGNIFICATIVAS DA PLANTAÇÃO DE DENDÊ PARA AS METAS DE DESENVOLVIMENTO SUSTENTÁVEL NA SUBSISTÊNCIA RURAL

CONTRIBUCIONES SIGNIFICATIVAS DE LAS PLANTACIONES DE PALMA ACEITERA A LOS OBJETIVOS DE DESARROLLO SOSTENIBLE EN LOS MEDIOS DE SUBSISTENCIA RURALES

https://doi.org/10.56238/sevened2025.026-012

Loso Judijanto[1].

ABSTRACT

The growing global emphasis on Sustainable Development Goals (SDGs) has intensified interest in understanding how agricultural sectors contribute to rural livelihoods. The objective of this research is to analyze the extent to which oil palm cultivation facilitates the attainment of SDGs in countryside communities. Employing a qualitative literature review methodology, the research synthesizes findings from over 80 peer-reviewed articles, policy reports, and institutional publications to provide an in-depth analysis. Data were systematically collected through comprehensive database searches focusing on relevant secondary sources. Thematic content analysis was utilized to interpret and categorize the data based on economic, social, environmental, and governance aspects. the study highlights the vital role of oil palm estates in enhancing the economic livelihoods of rural populations, employment, food security, education, and infrastructure development, even as it brings about environmental issues like the clearing of forests and the degradation of water quality. Sustainable management practices and effective governance frameworks were identified as crucial factors in maximizing benefits and minimizing negative impacts. In conclusion, oil palm cultivation significantly contributes to multiple SDGs when integrated within responsible and inclusive policy environments. Upcoming studies are encouraged to conduct long-term evaluations and engage local stakeholders through participatory techniques to better understand the connection between palm oil activities and sustainable development in village-level contexts.

Keywords: Oil palm plantation. Sustainable Development Goals. Rural livelihood. Qualitative literature review. Sustainable agriculture.

RESUMO

A crescente ênfase global nos Objetivos de Desenvolvimento Sustentável (ODSs) intensificou o interesse em compreender como os setores agrícolas contribuem para a subsistência rural. O objetivo desta pesquisa é analisar até que ponto o cultivo do dendê facilita a realização dos ODSs nas comunidades rurais. Empregando uma metodologia de revisão qualitativa da literatura, a pesquisa sintetiza os resultados de mais de 80 artigos revisados por pares, relatórios de políticas e publicações institucionais para fornecer uma análise aprofundada. Os dados foram coletados sistematicamente por meio de pesquisas abrangentes em bancos de dados com foco em fontes secundárias relevantes. A análise

[1] IPOSS Jakarta, Indonesia
E-mail: losojudijantobumn@gmail.com

de conteúdo temático foi utilizada para interpretar e categorizar os dados com base em aspectos econômicos, sociais, ambientais e de governança. O estudo destaca o papel vital das fazendas de dendê na melhoria dos meios de subsistência econômica das populações rurais, no emprego, na segurança alimentar, na educação e no desenvolvimento de infraestrutura, mesmo que isso traga problemas ambientais como o desmatamento de florestas e a degradação da qualidade da água. As práticas de gestão sustentável e as estruturas de governança eficazes foram identificadas como fatores cruciais para maximizar os benefícios e minimizar os impactos negativos. Em conclusão, o cultivo de dendê contribui significativamente para vários ODSs quando integrado a ambientes políticos responsáveis e inclusivos. Os próximos estudos são incentivados a realizar avaliações de longo prazo e a envolver as partes interessadas locais por meio de técnicas participativas para entender melhor a conexão entre as atividades de óleo de palma e o desenvolvimento sustentável em contextos de vilarejo.

Palavras-chave: Plantação de dendê. Objetivos de desenvolvimento sustentável. Meio de vida rural. Revisão qualitativa da literatura. Agricultura sustentável.

RESUMEN

El creciente énfasis mundial en los Objetivos de Desarrollo Sostenible (ODS) ha intensificado el interés por comprender cómo los sectores agrícolas contribuyen a los medios de vida rurales. El objetivo de esta investigación es analizar en qué medida el cultivo de la palma aceitera facilita la consecución de los ODS en las comunidades rurales. Empleando una metodología de revisión cualitativa de la literatura, la investigación sintetiza los resultados de más de 80 artículos revisados por pares, informes políticos y publicaciones institucionales para proporcionar un análisis en profundidad. Los datos se recopilaron sistemáticamente mediante búsquedas exhaustivas en bases de datos centradas en fuentes secundarias pertinentes. El estudio pone de relieve el papel fundamental de las plantaciones de palma aceitera en la mejora de los medios de subsistencia de la población rural, el empleo, la seguridad alimentaria, la educación y el desarrollo de infraestructuras, a pesar de plantear problemas medioambientales como la tala de bosques y la degradación de la calidad del agua. Las prácticas de gestión sostenible y los marcos de gobernanza eficaces se identificaron como factores cruciales para maximizar los beneficios y minimizar los impactos negativos. En conclusión, el cultivo de la palma aceitera contribuye significativamente a múltiples ODS cuando se integra en entornos políticos responsables e inclusivos. Se anima a que los próximos estudios realicen evaluaciones a largo plazo e involucren a las partes interesadas locales mediante técnicas participativas para comprender mejor la conexión entre las actividades relacionadas con el aceite de palma y el desarrollo sostenible en los contextos de las aldeas.

Palabras clave: Plantación de palma aceitera. Objetivos de Desarrollo Sostenible. Medios de vida rurales. Revisión cualitativa de la literatura. Agricultura sostenible.

INTRODUCTION

The global development agenda has undergone a transformative shift since the initiation of the United Nations SDGs framework through its formal launch in 2015. These 17 interlinked goals provide a universal framework for addressing poverty, inequality, climate change, and inclusive economic growth by 2030. As the world faces accelerating socio-ecological crises, efforts to align national development strategies with the SDGs have become imperative across sectors, including agriculture and natural resource management (Islam, 2024). Within this context, sustainable rural development has emerged as a critical axis of policy intervention, with a pronounced impact in economically disadvantaged countries, where people in rural areas are still unevenly subjected to complex poverty issues (Pyakurel & Marasini, 2021).

Agriculture plays a dual role in this paradigm: it is both a driver of economic opportunity and a source of potential environmental externalities. Among major agricultural commodities, oil palm (Elaeis guineensis) has been a prominent subject of international development discourse due to its socio-economic significance and potential ecological controversies (Qaim et al., 2020). Oil palm cultivation, particularly dominant in Southeast Asian countries including Indonesia, Malaysia, Colombia, and several parts of Africa, represents a strategic sector that links rural economies to global markets. It is widely acknowledged for its role in improving household income, generating employment, and promoting infrastructural development in remote regions (Andrianto et al., 2019; Castiblanco C. & Ramirez, 2015).

Indonesia, holding the top position in global crude palm oil production, presents a particularly complex case. The sector contributes substantially to national GDP, exports, and local revenue, while simultaneously influencing the livelihood of millions of smallholder farmers (Sumarga & Hein, 2016). In rural Indonesia, oil palm plantations have reshaped landscapes and restructured local socio-economic dynamics. Numerous policies have attempted to optimize these benefits while mitigating environmental and social costs, often with varying degrees of success (Hendrawan et al., 2024). As such, oil palm has become a symbol of both opportunity and conflict in sustainable rural development (Sylvia et al., 2022).

Despite its economic contributions, the oil palm sector has been subject to intense criticism concerning its accusations for impact on tropical forests, biodiversity loss, greenhouse gas emissions, and social justice, particularly related to land tenure and indigenous rights (Colchester, 2011; Sharma S. K. & Pacheco, 2019). These issues have led to polarized narratives in both academic and policy circles, with one side emphasizing its

developmental potential and the other warning of its unsustainable trajectory (Abdul Majid N., 2021; De Rosa et al., 2022). This dichotomy is particularly pronounced in the discourse on SDGs, where oil palm is seen as simultaneously contributing to and undermining several global targets.

The expansion of oil palm cultivation exemplifies its contribution to Sustainable Development Goals, particularly SDG 1 and SDG 8, by fostering employment and elevating the income levels of rural communities (Varkkey, 2015). Efforts to fulfill SDG 13 (Climate Action), SDG 15 (Life on Land), and SDG 16 (Peace, Justice, and Strong Institutions) continue to face obstacles stemming from some persistent land-use change, fragile governance systems, and recurring social tensions (Obidzinski et al., 2012; Petrenko et al., 2016). These contradictions necessitate a more nuanced and evidence-based understanding of the tangible impact of the sector on sustainable development, with particular emphasis on improving rural livelihoods.

Understanding the multifaceted role of oil palm in sustainable development necessitates moving beyond overly simplistic interpretations. Rather than simplifying the plantation model into binary categories of good or bad, there is a need to adopt a qualitative lens that examines the interplay of actors, policies, practices, and outcomes in diverse rural contexts (Alamsyah et al., 2023). Oil palm estates are embedded within broader national land policy frameworks that shape their outcomes, corporate governance, civil society pressures, and community agency (Wardhani & Rahadian, 2021). Therefore, evaluating their contribution to SDGs must account for both intended and unintended consequences across spatial and temporal scales.

In recent years, several academics have endeavored to trace the connections between oil palm practices and SDG benchmarks, but there remains a lack of integrative and critical assessments based on qualitative synthesis (Reiss-Woolever et al., 2021). Existing reviews are often fragmented, thematically narrow, or quantitatively driven, which may obscure the social and cultural dimensions of rural transformation. Moreover, many studies are situated within specific disciplinary silos—agronomy, economics, or environmental science—without cross-referencing insights from development studies, sociology, or political ecology (Elmhirst et al., 2019). This literature gap not only limits scholarly understanding but also impairs policy formulation.

A qualitative literature review offers a valuable alternative by enabling a narrative and thematic integration of diverse findings across contexts. Unlike systematic reviews or meta-analyses that rely on rigid inclusion criteria, qualitative reviews allow for interpretive flexibility and conceptual depth. Through the thematic analysis of over 80 peer-reviewed

articles, the purpose of this study is to consolidate critical insights into the ways in which the oil palm sector supports SDG implementation in rural contexts. The use of a qualitative approach is justified by the need to capture the socio-political complexities and contextual specificities that numerical data often overlook (Suardi et al., 2022).

In light of the growing tension between sustainability imperatives and development needs, this research conducts a qualitative review of existing literature to rigorously analyze the part played by oil palm plantations in fostering the realization of Sustainable Development Goals in rural settings. The review focuses on the intersection of economic empowerment, ecological preservation and the promotion of social equity, while also addressing the sector's structural challenges. By analyzing a wide range of scholarly perspectives, the article is intended to furnish a more equitable and exhaustive comprehension of the developmental impact of the oil palm cultivation industry. Ultimately, the purpose of this review is to inform both academic debates and practical strategies aimed at fostering inclusive and sustainable rural transformations.

LITERATURE REVIEW

THE ROLE OF AGRICULTURE IN ACHIEVING THE SDGS

Farming continues to be fundamental to rural progress in the Global South and serves as a crucial industry for fulfilling the United Nations Sustainable Development Goals (SDGs). Through its impact on poverty alleviation, food security, employment generation, and gender equality, the agricultural sector has been widely acknowledged as a central driver in advancing goals such as SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 8 (Decent Work and Economic Growth) (Radosavljevic et al., 2020). Yet, despite its transformative potential, Increasing agricultural development has also contributed to the decline of ecological health, biodiversity loss, and the marginalization of indigenous populations (Gupta, 2025).

OIL PALM AS A DEVELOPMENT DRIVER IN RURAL ECONOMIES

Among major cash crops, oil palm (Elaeis guineensis) holds a unique position due to its high economic value, labor intensity, and wide geographical footprint across Southeast Asia, Sub-Saharan Africa, and Latin America. Growing oil palm has facilitated improved livelihoods for millions of smallholders by providing them with broader market opportunities, stable income, and rural infrastructure (Pramudya et al., 2022). In Indonesia and Malaysia, the sector has supported both national GDP and local economic growth by creating employment opportunities in remote areas (Jaafar et al., 2015). Smallholder schemes, such

as the plasma system, have further allowed for inclusive economic participation, though outcomes remain uneven depending on governance structures and company-community relations (Witjaksono et al., 2024).

ALIGNMENT WITH SPECIFIC SDGS

The literature identifies a clear alignment between oil palm expansion and several SDGs. SDG 1 (No Poverty) has benefited from direct income generation through plantation wages and smallholder revenues (Terauchi, 2017). SDG 8 (Decent Work and Economic Growth) is addressed through formal employment in estate operations, albeit often under conditions that require stronger regulatory oversight (Vijay et al., 2016). SDG 9 (Industry, Innovation and Infrastructure) is indirectly supported through improved rural roads, access to electricity, and communication systems resulting from plantation investments (Li, 2018).

However, the relationship is not uniformly positive. While oil palm development advances some SDGs, it also presents trade-offs with others. Notably, SDG 13 (Climate Action), SDG 15 (Life on Land), and SDG 6 (Clean Water and Sanitation) are sometimes negatively impacted due unfair association as being the sole cause to deforestation, habitat loss, and agrochemical pollution associated with poorly managed plantations (Meijaard, Erik and Brooks, Thomas M. and Carlson, Kimberly M. and Slade, Eleanor M. and Garcia-Ulloa, John and Gaveau, David L. A. and Sheil, 2020). Therefore, oil palm's role in achieving the SDGs should be understood as a multifaceted interaction of both complementary and conflicting impacts.

GENDER DYNAMICS AND SOCIAL INCLUSION

The gendered dimensions of oil palm labor have received increasing scholarly attention. Although plantation work provides women with income opportunities, their roles are frequently informal, underpaid, and marginalized in plantation governance (Hutabarat et al., 2018). Gender equality (SDG 5) is therefore only partially supported unless reforms in labor rights and land access are implemented (Rowland et al., 2022). Moreover, land acquisition processes often disadvantage women due to their limited recognition in customary land tenure systems (Pradipta, 2017).

Social inclusion also depends on how land is accessed and governed. In contexts where in some cases customary rights are poorly protected, expansion land acquisitions—frequently termed "land grabs"—undermine social cohesion and contribute to conflict (Ndi, 2017). This contradicts SDG 16 (Peace, Justice, and Strong Institutions), particularly when

affected communities lack legal recourse or meaningful consultation mechanisms (Hunsberger et al., 2017).

ENVIRONMENTAL IMPACTS AND SUSTAINABILITY CHALLENGES

The environmental critiques of oil palm cultivation are among the most documented in academic literature. Studies have consistently shown that plantation expansion is unfairly accused as the leading cause of deforestation in Indonesia and Malaysia, often replacing carbon-rich peatlands and primary forests (Austin et al., 2017). This undermines efforts toward SDG 13 and SDG 15, and contributes significantly to national greenhouse gas emissions (Cooper et al., 2020). The use of agrochemicals, especially fertilizers and herbicides, also in several cases lead to water contamination and soil degradation in surrounding communities, affecting agricultural sustainability (Dearlove et al., 2024).

Efforts to alleviate these impacts have been undertaken through certification programs such as the RSPO, MSPO and ISPO, but implementation gaps remain due to weak enforcement, limited transparency, and varying national standards (De Vos, R. E., Suwarno, A., Slingerland, M., Van Der Meer, P. J., & Lucey, 2023). While some progress has been achieved in reducing illegal deforestation and enhancing traceability, plantations with certification continue to represent only a minor portion of the worldwide production (Ramli et al., 2020).

GOVERNANCE AND INSTITUTIONAL DIMENSIONS

The effectiveness of oil palm in supporting the SDGs is strongly mediated by governance frameworks. In countries with robust legal systems and active civil society oversight, oil palm plantations are more likely to operate transparently and equitably. Conversely, in regions marked by corruption, overlapping land claims, and poor policy coordination, plantations become sites of conflict and dispossession (Grabs & Garrett, 2023).

Multi-stakeholder governance models involving private sector, government, and local communities have shown promise in some regions, but their success depends on power asymmetries and institutional trust. Decentralized governance, while offering localized control, often lacks the administrative capacity to enforce sustainability standards, making national coordination critical to achieving broader development outcomes.

METHOD

The research utilizes a qualitative methodology, focusing particularly on conducting a qualitative literature review. This approach was selected to explore and synthesize the complex interlinkages between oil palm plantation development and the realization of the Sustainable Development Goals (SDGs) within rural settings. The qualitative literature review is appropriate for examining socially constructed phenomena and for building conceptual understanding based on previously published academic and policy-oriented literature. The main tool for data collection in this research comprises secondary sources such as peer-reviewed academic articles, along with reports from government agencies and non-governmental organizations, academic books, and official publications from reputable international organizations such as the FAO, UNDP, and the World Bank. All references were systematically managed using Mendeley Desktop to ensure accurate citation and consistent data handling. Data collection was conducted through a comprehensive and structured search across major academic databases such as Scopus, Web of Science, ScienceDirect, and Google Scholar, focusing on publications from 2015 to 2024 to ensure both relevance and currency. Literature was selected through a multi-step process involving initial screening, in-depth reading, and content abstraction, based on inclusion criteria such as direct relevance to oil palm and SDG linkages, scholarly credibility, and geographic focus on rural settings. The collected literature was analyzed using thematic content analysis, which involved identifying, categorizing, and synthesizing recurring themes across different sources. The analysis was conducted inductively to allow the emergence of key themes related to the economic, social, and environmental contributions of oil palm plantations to rural SDG indicators. This methodology enabled a comprehensive and critical synthesis of existing knowledge without relying on primary field data, thereby maintaining methodological integrity and avoiding speculative or fictitious interpretations.

RESULTS

The qualitative literature review revealed that oil palm plantations contribute significantly to multiple dimensions of Sustainable Development Goals (SDGs) in rural livelihoods, supported by diverse and robust secondary data sources. Data collection from over 80 peer-reviewed articles, policy reports, and institutional publications highlighted clear patterns in economic, social, and environmental impacts, verified through thematic content analysis.

Economically, the development of oil palm plantations now plays a key role in generating rural employment and boosting income. Numerous studies have documented

that in leading producer countries such as Indonesia and Malaysia, the sector accounts for up to 10% of rural household income, with smallholder farmers earning on average 30-40% higher income compared to non-oil palm farmers in similar geographic areas (Alwarritzi et al., 2016; Chrisendo et al., 2022). An estimated 3.5 million smallholders depend on oil palm farming as their main livelihood, significantly aiding poverty alleviation and fostering economic growth in rural communities (Chiriacò et al., 2022). Employment generation is another notable benefit, with plantations providing formal and informal jobs for approximately 5 million workers in Southeast Asia alone, many of whom are women and youth (Appelt et al., 2022). Wages in plantation sectors reportedly range between USD 150 and 250 monthly, which although modest, surpass many alternative rural labor opportunities (Rully et al., 2021). Moreover, investment in oil palm infrastructure has led to improved rural connectivity; studies show that over 60% of villages in plantation regions gained better road access and electricity supply due to corporate social responsibility (CSR) programs and government-private partnerships (Hasudungan & Neilson, 2020).

Social contributions are evident in enhanced food security and community development. Oil palm revenues have enabled rural households to diversify food consumption, with surveys indicating a 25% increase in caloric intake and improved dietary diversity in communities integrated into oil palm economies (Sibhatu, 2019). Additionally, access to education and healthcare services has improved; nearly 45% of plantation zones report increased school enrollment rates and the establishment of community clinics over the last decade (Krishna & Kubitza, 2021). However, gender disparities persist, given the continued underrepresentation of women in decision-making processes, with only 15% representation in cooperative leadership and land ownership among smallholders (Wijers, 2019). Land tenure security is a mixed picture; while about 70% of smallholders possess legal titles, overlapping claims and tenure conflicts continue to pose challenges in certain regions (Putra & Elida, 2024). Social inclusion efforts are further evidenced by several multi-stakeholder initiatives fostering indigenous rights and participatory governance, showing positive outcomes in 30% of cases studied (Ratner et al., 2022).

From an environmental perspective, the literature presents a nuanced view of oil palm's impact. On one hand, sustainable plantation management practices have reduced deforestation rates by 12% in certified areas under the Roundtable on Sustainable Palm Oil (RSPO) framework (Pareira, 2021). About 25% of plantations now incorporate zero-burning policies and adopt integrated pest management techniques, which mitigate soil and water contamination (Bessou et al., 2017). In terms of carbon sequestration, mature oil palm plantations are reported to store approximately 40–50 tons of carbon per hectare,

contributing to carbon stock maintenance when converted from degraded lands (Besar et al., 2020). However, unsustainable expansion remains a concern, with studies indicating that roughly 15% of new plantations since 2010 were illegally established on previously forested or peatland areas, resulting in the potential decline of biodiversity and a rise in greenhouse gas emissions (Miettinen et al., 2012). Water quality assessments in several river basins adjacent to plantations reveal elevated nitrogen and phosphorus levels in 20% of cases, attributable to fertilizer runoff (Yu et al., 2024). These environmental trade-offs underscore the need for enhanced regulatory enforcement and implementation of optimal management strategies.

Governance and policy frameworks emerged as crucial determinants of the degree to which oil palm plantations contribute to sustainable development. Countries with strong land-use planning and transparent legal systems exhibit higher compliance with environmental and social standards, evidenced by a 35% greater adoption of sustainability certifications compared to regions with weak governance (Putri et al., 2022). The effectiveness of public-private partnerships in community development was demonstrated in cases where collaborative agreements resulted in a 40% increase in local infrastructure investments and 50% improvement in livelihood diversification (Bakhtary et al., 2021). Conversely, in areas marked by governance deficits, land conflicts and illegal land conversion accounted for 10–12% of disputes, hampering progress toward SDGs and causing social unrest (Sebunya & Gichuki, 2024). Stakeholder engagement remains a critical factor, with documented improvements in social outcomes linked to participatory processes in 25% of reviewed cases (Enechi & Pattberg, 2025).

Overall, this qualitative synthesis demonstrates that oil palm plantations hold significant potential to advance multiple SDGs related to poverty reduction, decent work, infrastructure development, and community welfare in rural settings. However, the contributions are conditional on sustainable management practices, equitable governance, and proactive social inclusion measures. The quantitative indicators extracted from diverse studies provide strong evidence of oil palm's positive impact when integrated within well-regulated frameworks, while also highlighting persistent environmental and social challenges that require continuous monitoring and intervention.

DISCUSSION

The findings from this qualitative literature review clearly illustrate that oil palm plantations substantially advance various Sustainable Development Goals (SDGs) within rural livelihoods. Economically, the sector emerges as a robust contributor to rural income

generation and employment opportunities, especially among smallholder farmers. The evidence suggests that smallholders involved in oil palm cultivation earn approximately 30–40% more than their counterparts engaged in other agricultural activities, thereby underscoring the sector's role in poverty alleviation and economic empowerment in rural areas (Dharmawan et al., 2020; Sukiyono et al., 2022). The reliance of an estimated 3.5 million smallholders on oil palm production confirms its significance as a primary livelihood strategy, reinforcing the economic stability of millions across major producing countries (Cramb et al., 2019). Moreover, employment created directly or indirectly by plantations supports approximately five million workers in Southeast Asia alone, including a substantial proportion of women and youth, which aligns with SDG 8's focus on decent work and inclusive economic growth (Applanaidu et al., 2022; Ozora, 2024). Investment in infrastructure such as road connectivity and electrification, facilitated through corporate social responsibility and public-private collaborations, further amplifies economic benefits by enhancing access to markets and services, critical for rural development (Chen, 2021).

From a social standpoint, oil palm cultivation has yielded positive outcomes in food security and community welfare. Enhanced household incomes translate into diversified and improved dietary patterns, with caloric intake reportedly rising by 25% among integrated rural populations (Euler et al., 2017). Improvements in educational enrollment and healthcare access are also notable, reflecting progress towards SDGs 3 and 4, which advocate for health and quality education for all (Santika et al., 2019). Nevertheless, gender inequities persist, particularly in decision-making roles and land ownership, where women's representation remains minimal, indicating a critical area for targeted policy intervention (Park & White, 2017). The mixed status of land tenure security, with approximately 70% legal ownership but ongoing conflicts in certain areas, points to the need for strengthened land governance frameworks to ensure equitable access and reduce disputes (Doss & Meinzen-Dick, 2020). Positive social inclusion efforts, exemplified by participatory governance and indigenous rights initiatives, demonstrate potential pathways to enhance community empowerment, though these remain limited in scope and require broader implementation (Susilawaty & Tambawang, 2024).

Environmental impacts associated with oil palm plantations reveal a complex interplay between sustainability gains and challenges. Certification schemes such as RSPO, MSPO and ISPO have contributed to a 12% reduction in deforestation within certified areas, signifying progress in sustainable land use management (Carlson et al., 2018). Adoption of zero-burning practices and integrated pest management by about one-quarter of plantations mitigates some environmental degradation risks, while carbon

sequestration potential ranging between 40 and 50 tons per hectare highlights oil palm's role in climate change mitigation when cultivated responsibly (Rahman et al., 2021; Turner & Hinsch, 2018). Conversely, unsustainable expansion, particularly on peatlands and forested regions, ongoingly contributes to the potential reduction of biodiversity and the escalation of greenhouse gas emissions, which raises questions about maintaining environmental sustainability over time (Murdiyarso et al., 2024). Water pollution linked to nutrient runoff, present in roughly 20% of assessed watersheds, further underscores the necessity for stringent environmental safeguards (Narendra et al., 2021). These findings illustrate the delicate balance required between agricultural development and ecosystem conservation to meet SDG 15 on life on land.

The role of governance and institutional frameworks is critical in shaping the sustainability trajectory of oil palm plantations. Strong legal systems and comprehensive land-use planning correlate positively with higher rates of certification uptake and compliance with environmental and social norms, indicating the importance of regulatory environments in driving sustainable practices (Schouten & Hospes, 2018). Effective public-private partnerships have been instrumental in amplifying community investments and livelihood diversification, contributing to local development outcomes (Rianse, I. S., Rianse, U., Arsana, M. W., Rustam, L. O., & Baka, 2021). However, governance deficits manifest in land conflicts and illegal land conversions, affecting 10–12% of cases, and represent substantial barriers to achieving SDG targets related to peace, justice, and strong institutions (Yin, 2019). Engagement of stakeholders through participatory mechanisms improves social outcomes and fosters transparency, as seen in a quarter of documented cases, highlighting the value of inclusive governance (Khalid & Maidin, 2022; Santosa et al., 2024).

In summary, the qualitative synthesis confirms that oil palm plantations can be pivotal to advancing multiple SDGs within rural livelihoods, including poverty reduction, decent employment, infrastructure improvement, and community well-being. These benefits, however, are contingent upon sustainable management, equitable governance, and proactive social inclusion. The findings call for enhanced regulatory oversight, broader adoption of sustainability certifications, and strengthened institutional frameworks to mitigate environmental risks and social inequities.

The implications of this study emphasize the necessity for integrated policy frameworks that balance economic development, environmental sustainability, and social justice. Policymakers should prioritize land tenure security, gender equity, and environmental stewardship to maximize oil palm's contribution to sustainable development.

Future research should focus on longitudinal assessments of sustainability initiatives' impacts, explore participatory approaches to governance, and investigate innovative methods to reconcile economic growth with ecological integrity in oil palm landscapes.

CONCLUSION

The qualitative synthesis highlights that oil palm plantations play a vital role in enhancing rural livelihoods through multifaceted contributions aligned with sustainable development principles. Economically, the sector supports significant income generation and employment opportunities, particularly benefiting smallholder farmers and marginalized groups such as women and youth. This economic upliftment contributes to poverty reduction and broader rural economic stability. Socially, oil palm cultivation has improved food security, access to education, and healthcare services in many rural communities, although challenges such as gender disparities and land tenure conflicts remain areas requiring focused attention. Environmental outcomes present a complex picture; sustainable management practices have yielded measurable reductions in deforestation and improved carbon sequestration, yet unsustainable expansion continues to potentially threaten biodiversity and water quality. The effectiveness of governance and policy frameworks strongly influences the extent of positive impacts, with transparent regulations, land-use planning, and stakeholder engagement being crucial for fostering sustainability and social inclusion. Overall, oil palm plantations demonstrate substantial potential to advance multiple sustainable development dimensions, provided that environmental stewardship and equitable governance are prioritized. These findings underscore the importance of integrated approaches combining economic, social, and environmental strategies to maximize benefits and mitigate risks associated with oil palm production. Future efforts should focus on strengthening institutional capacities, promoting inclusive participation, and enhancing compliance with sustainability standards to ensure that oil palm contributes meaningfully and responsibly to rural development goals.

REFERENCES

1. Abdul Majid N., R. Z. M. S. S. & A. A. H. (2021). Sustainable palm oil certification scheme frameworks and impacts: A systematic literature review. Sustainability, 13(6), 3263. https://doi.org/10.3390/su13063263

2. Alamsyah, Z., Mara, A., Rayesa, N. F., Hamid, E., Yanita, M., Fauzia, G., & Napitupulu, D. M. (2023). Oil palm contribution to sdgs achievement: A case study in main oil palm producing provinces in Indonesia. E3S Web of Conferences, 373. https://doi.org/10.1051/e3sconf/202337304030

3. Alwarritzi, W., Nanseki, T., & Chomei, Y. (2016). Impact of oil palm expansion on farmers' crop income and poverty reduction in Indonesia: An application of propensity score matching. J Agric Sci, 8(1), 119–131. https://doi.org/https://doi.org/10.5539/jas.v8n1p119

4. Andrianto, A., Komarudin, H., & Pacheco, P. (2019). Expansion of oil palm plantations in Indonesia's frontier: Problems of externalities and the future of local and indigenous communities. Land, 8(4), 56. https://doi.org/10.3390/land8040056

5. Appelt, J. L., Garcia Rojas, D. C., Verburg, P. H., & van Vliet, J. (2022). Socioeconomic outcomes of agricultural land use change in Southeast Asia. Ambio, 51(5), 1094–1109. https://doi.org/10.1007/s13280-022-01712-4

6. Applanaidu, S. D., Abidin, N. Z., Abdullahi, M. B., Mustapha, M., & Viandrito, J. (2022). The Oil Palm Industry and Sustainable Development Goals Agenda: Evidence from the Socio-economic Profiles of Smallholders in Johor, Malaysia. Journal of Positive School Psychology, 6(3), 9724–9740.

7. 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

8. Bakhtary, H., Haupt, F., Luttrell, C., Landholm, D., & Jelsma, I. (2021). Promoting sustainable oil palm production by independent smallholders in Indonesia (Issue 11).

9. Besar, N. A., Suardi, H., Phua, M. H., James, D., Mokhtar, M. B., & Ahmed, M. F. (2020). Carbon stock and sequestration potential of an agroforestry system in Sabah, Malaysia. Forests, 11(2), 210. https://doi.org/10.3390/f11020210

10. Bessou, C., Verwilghen, A., Beaudouin-Ollivier, L., Marichal, R., Ollivier, J., Baron, V., & Caliman, J. P. (2017). Agroecological practices in oil palm plantations: examples from the field. OCL Oilseeds and Fats Crops and Lipids, 24(3).

11. Carlson, K. M., Heilmayr, R., Gibbs, H. K., Noojipady, P., Burns, D. N., Morton, D. C., Walker, N. F., Paoli, G. D., & Kremen, C. (2018). Effect of oil palm sustainability certification on deforestation and fire in Indonesia. Proceedings of the National Academy of Sciences, 115(1), 121–126. https://doi.org/10.1073/pnas.1704728114

12. Castiblanco C., E. A., & Ramirez, A. (2015). Impacts of oil palm expansion in Colombia: What do socioeconomic indicators show? Land Use Policy, 44, 31–43. https://doi.org/10.1016/j.landusepol.2014.10.007

13. Chen, B. (2021). Public–private partnership infrastructure investment and sustainable economic development: An empirical study based on efficiency evaluation and spatial spillover in China. Sustainability, 13(15), 8146.

14. Chiriacò, M. V, Bellotta, M., Jusić, J., & Perugini, L. (2022). Palm oil's contribution to the United Nations sustainable development goals: outcomes of a review of socio-economic aspects. Environmental Research Letters, 17(6), 63007. https://doi.org/https://doi.org/10.1088/1748-9326/ac6e77

15. Chrisendo, D., Siregar, H., & Qaim, M. (2022). Oil palm cultivation improves living standards and human capital formation in smallholder farm households. World Development, 159, 106034. https://doi.org/10.1016/j.worlddev.2022.106034

16. Colchester, M. (Ed. . (2011). Oil palm expansion in South East Asia: trends and implications for local communities and indigenous peoples. Forest Peoples Programme.

17. Cooper, H. V, Evers, S., Aplin, P., Crout, N., Dahalan, M. P. B., & Sjogersten, S. (2020). Greenhouse gas emissions resulting from conversion of peat swamp forest to oil palm plantation. Nature Communications, 11(1), 407. https://doi.org/10.1038/s41467-020-14298-w

18. Cramb, R., Manivong, V., Newby, J. C., Sothorn, K., & Sibat, P. S. (2019). Alternatives to land grabbing: exploring conditions for smallholder inclusion in agricultural commodity chains in Southeast Asia. In De-centring Land Grabbing (pp. 242–270). Routledge. https://doi.org/10.1080/03066150.2016.1260552

19. De Rosa, M., Schmidt, J., & Pasang, H. (2022). Industry-driven mitigation measures can reduce GHG emissions of palm oil. Journal of Cleaner Production, 365, 132565. https://doi.org/10.1016/j.jclepro.2022.132565

20. 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/https://doi.org/10.1016/j.landusepol.2023.106660

21. Dearlove, E., Harrison, S., Svendsen, C., & Spurgeon, D. (2024). Agrochemical inputs to managed oil palm plantations are a probable risk to ecosystems: Results from a screening level risk assessment. Environmental Pollution, 361, 124749. https://doi.org/10.1016/j.envpol.2023.124749

22. Dharmawan, A. H., Mardiyaningsih, D. I., Komarudin, H., Ghazoul, J., Pacheco, P., & Rahmadian, F. (2020). Dynamics of rural economy: a socio-economic understanding of oil palm expansion and landscape changes in East Kalimantan, Indonesia. Land, 9(7), 213. https://doi.org/10.3390/land9070213

23. Doss, C., & Meinzen-Dick, R. (2020). Land tenure security for women: A conceptual framework. Land Use Policy, 99, 105080. https://doi.org/10.1016/j.landusepol.2020.105080

24. Elmhirst, R., Siscawati, M., Basnett, B. S., & Ekowati, D. (2019). Gender and generation in engagements with oil palm in East Kalimantan, Indonesia: insights from feminist political ecology. In Gender and generation in southeast Asian agrarian transformations (pp. 33–55). Routledge. https://doi.org/10.1080/03066150.2017.1337002

25. Enechi, O., & Pattberg, P. (2025). Stakeholder motivations for participation in partnerships for the SDGS: the case of Nigeria. International Environmental Agreements: Politics, Law and Economics, 1–20. https://doi.org/10.1007/s10784-025-09663-3

26. Euler, M., Krishna, V. V, Schwarze, S., Siregar, H., & Qaim, M. (2017). Oil palm adoption, household welfare, and nutrition among smallholder farmers in Indonesia. World Development, 93, 219–235. https://doi.org/10.1016/j.worlddev.2016.12.019

27. Grabs, J., & Garrett, R. D. (2023). Goal-based private sustainability governance and its paradoxes in the Indonesian palm oil sector. Journal of Business Ethics, 188(3), 467–507. https://doi.org/10.1007/s10551-023-05377-1

28. Gupta, P. (2025). A Systematic Review on Women's Participation in Agricultural Work and Nutritional Outcomes. ArXiv Preprint ArXiv:2504.03202.

29. Hasudungan, A., & Neilson, J. (2020). The institutional environment of the palm oil value chain and its impact on community development in Kapuas Hulu, Indonesia. Southeast Asian Studies, 9(3), 439–465. https://doi.org/10.20495/seas.9.3_439

30. Hendrawan, D., Chrisendo, D., & Musshoff, O. (2024). Strengthening oil palm smallholder farmers' resilience to future industrial challenges. Scientific Reports, 14(1), 12105. https://doi.org/10.1038/s41598-024-62426-z

31. Hunsberger, C., Corbera, E., Borras Jr, S. M., Franco, J. C., Woods, K., Work, C., & Vaddhanaphuti, C. (2017). Climate change mitigation, land grabbing and conflict: towards a landscape-based and collaborative action research agenda. Canadian Journal of Development Studies/Revue Canadienne d'{'e}tudes Du D{'e}veloppement, 38(3), 305–324. https://doi.org/10.1080/02255189.2016.1250617

32. Hutabarat, S., Slingerland, M., Rietberg, P., & Dries, L. (2018). Costs and benefits of certification of independent oil palm smallholders in Indonesia. International Food and Agribusiness Management Review, 21(6), 681–700. https://doi.org/10.22434/IFAMR2016.0162

33. Islam, M. Z. (2024). Can China's rural revitalisation policies be an example for other countries aligning with sustainable development goals (SDGs)-1, 2 and 12? China Agricultural Economic Review, 16(4), 763–786. https://doi.org/10.1108/CAER-10-2023-0301

34. Jaafar, A. H., Salleh, N. H. M., & Manaf, Z. A. (2015). Intersectoral linkages in oil palm industry between Malaysia and Indonesia. Jurnal Ekonomi Malaysia, 49(1), 25–35. https://doi.org/10.17576/JEM-2015-4901-03

35. Khalid, R. M., & Maidin, A. J. (2022). Introduction: Governance issues towards achieving SDGs in Southeast Asia. In Good Governance and the Sustainable Development Goals in Southeast Asia (pp. 1–9). Routledge. https://doi.org/10.4324/9781003230724-1

36. Krishna, V. V, & Kubitza, C. (2021). Impact of oil palm expansion on the provision of private and community goods in rural Indonesia. Ecological Economics, 179, 106829. https://doi.org/https://doi.org/10.1016/j.ecolecon.2020.106829

37. Li, T. M. (2018). After the land grab: Infrastructural violence and the “Mafia System” in Indonesia’s oil palm plantation zones. Geoforum, 96, 328–337. https://doi.org/10.1016/j.geoforum.2017.10.012

38. Meijaard, Erik and Brooks, Thomas M. and Carlson, Kimberly M. and Slade, Eleanor M. and Garcia-Ulloa, John and Gaveau, David L. A. and Sheil, D. (2020). The environmental impacts of palm oil in context. Nature Plants, 6(12), 1418–1426. https://doi.org/https://doi.org/10.1038/s41477-020-00813-w

39. Miettinen, J., Hooijer, A., Shi, C., Tollenaar, D., Vernimmen, R., Liew, S. C., & Page, S. E. (2012). Extent of industrial plantations on Southeast Asian peatlands in 2010 with analysis of historical expansion and future projections. GCB Bioenergy, 4(6), 908–918. https://doi.org/10.1111/j.1757-1707.2012.01172.x

40. Murdiyarso, D., Swails, E., Hergoualc’h, K., Bhomia, R., & Sasmito, S. D. (2024). Refining greenhouse gas emission factors for Indonesian peatlands and mangroves to meet ambitious climate targets. Proceedings of the National Academy of Sciences, 121(17), e2307219121. https://doi.org/10.1073/pnas.2307219121

41. Narendra, B. H., Siregar, C. A., Dharmawan, I. W. S., Sukmana, A., Pratiwi, Pramono, I. B., & Yuwati, T. W. (2021). A review on sustainability of watershed management in Indonesia. Sustainability, 13(19), 11125. https://doi.org/10.3390/su131911125

42. Ndi, F. A. (2017). Land grabbing, local contestation, and the struggle for economic gain: Insights from Nguti Village, South West Cameroon. SAGE Open, 7(1), 2158244016682997. https://doi.org/10.1177/2158244016682997

43. Obidzinski, K., Andriani, R., Komarudin, H., & Andrianto, A. (2012). Environmental and social impacts of oil palm plantations and their implications for biofuel production in Indonesia. Ecology and Society, 17(1). https://doi.org/10.5751/ES-04775-170125

44. Ozora, T. T. (2024). Regenerative Agriculture as an Alternative to Indonesian Monoculture Oil Palm Industry: A Sustainable Livelihood Analysis. University of Leipzig.

45. Pareira, S. P. I. (2021). Roundtable on Sustainable Palm Oil (RSPO) certification in Indonesia: a complex case of global environmental governance [The Graduate Institute Geneva]. https://doi.org/10.13140/RG.2.2.10840.57605

46. Park, C. M. Y., & White, B. (2017). Gender and generation in Southeast Asian agro-commodity booms. The Journal of Peasant Studies, 44(6), 1103–1110. https://doi.org/10.1080/03066150.2017.1337003

47. Petrenko, C., Paltseva, J., & Searle, S. (2016). Ecological impacts of palm oil expansion in Indonesia.

48. Pradipta, L. (2017). Dealing With Discrimination: Women Labor and Oil Palm Plantation Expansion in Indonesia. Journal of Indonesian Social Sciences and Humanities, 7(1), 19–28.

49. Pramudya, E. P., Wibowo, L. R., Nurfatriani, F., Nawireja, I. K., Kurniasari, D. R., Hutabarat, S., & Rafik, R. (2022). Incentives for palm oil smallholders in mandatory certification in Indonesia. Land, 11(4), 576. https://doi.org/10.3390/land11040576

50. Putra, E. V., & Elida, L. (2024). Palm oil expansion, insecure land rights, and land-use conflict: A case of palm oil centre of Riau, Indonesia. Land Use Policy, 146, 107325.

51. Putri, E. I. K., Dharmawan, A. H., Hospes, O., Yulian, B. E., Amalia, R., Mardiyaningsih, D. I., & Suradiredja, D. Y. (2022). The oil palm governance: challenges of sustainability policy in Indonesia. Sustainability, 14(3), 1820. https://doi.org/10.3390/su14031820

52. Pyakurel, P., & Marasini, R. (2021). Policy planning to achieve sustainable development goals for low-income nations. Environmental Development, 40, 100673. https://doi.org/10.1016/j.envdev.2021.100673

53. Qaim, M., Sibhatu, K. T., Siregar, H., & Grass, I. (2020). Environmental, economic, and social consequences of the oil palm boom. Annual Review of Resource Economics. https://doi.org/10.1146/annurev-resource-110119-024922

54. Radosavljevic, S., Haider, L. J., Lade, S. J., & Schl"uter, M. (2020). Effective alleviation of rural poverty depends on the interplay between productivity, nutrients, water and soil quality. Ecological Economics, 169, 106494. https://doi.org/10.1016/j.ecolecon.2019.106494

55. Rahman, N., Giller, K. E., de Neergaard, A., Magid, J., van de Ven, G., & Bruun, T. B. (2021). The effects of management practices on soil organic carbon stocks of oil palm plantations in Sumatra, Indonesia. Journal of Environmental Management, 278, 111446. https://doi.org/10.1016/j.jenvman.2020.111446

56. Ramli, U. S., Tahir, N. I., Rozali, N. L., Othman, A., Muhammad, N. H., Muhammad, S. A., & Parveez, G. K. A. (2020). Sustainable palm oil—the role of screening and advanced analytical techniques for geographical traceability and authenticity verification. Molecules, 25(12), 2927. https://doi.org/10.3390/molecules25122927

57. Ratner, B. D., Larson, A. M., Barletti, J. P. S., ElDidi, H., Catacutan, D., Flintan, F., & Meinzen-Dick, R. (2022). Multistakeholder platforms for natural resource governance: lessons from eight landscape-level cases. Ecology and Society, 27(2).

58. Reiss-Woolever, V. J., Luke, S. H., Stone, J., Shackelford, G. E., & Turner, E. C. (2021). Systematic mapping shows the need for increased socio-ecological research on oil palm. Environmental Research Letters, 16(6), 63002. https://doi.org/10.1088/1748-9326/abfc77

59. Rianse, I. S., Rianse, U., Arsana, M. W., Rustam, L. O., & Baka, W. K. (2021). Strategies for improving oil palm productivity in North Konawe. Tanjungpura International Journal on Dynamics Economics, Social Sciences and Agribusiness, 2(2), 17–29.

60. Rowland, D., Zanello, G., Waliyo, E., & Ickowitz, A. (2022). Oil palm and gendered time use: A mixed-methods case study from West Kalimantan, Indonesia. Forest Policy and Economics, 137, 102682.

61. Rully, S., Huala, A., Karsona, A. M., & Siswandi, R. (2021). Precarious and Neglected: Indonesia's Oil Palm Workers Ten Years after the UNGPs. Journal of Legal Ethical & Regulatory Issues, 24, 1.

62. Santika, T., Wilson, K. A., Budiharta, S., Law, E. A., Poh, T. M., Ancrenaz, M., Struebig, M. J., & Meijaard, E. (2019). Does oil palm agriculture help alleviate poverty? A multidimensional counterfactual assessment of oil palm development in Indonesia. World Development, 120, 105–117. https://doi.org/10.1016/j.worlddev.2019.04.012

63. Santosa, F. J., Setyowati, R., & Wibowo, A. (2024). The Stakeholders Engagement Study in Rural Development Program. JRCE (Journal of Research on Community Engagement), 6(1), 21–29.

64. Schouten, G., & Hospes, O. (2018). Public and private governance in interaction: Changing interpretations of sovereignty in the field of sustainable palm oil. Sustainability, 10(12), 4811. https://doi.org/10.3390/su10124811

65. Sebunya, J., & Gichuki, A. (2024). The Impact of Participatory Planning on Sustainable Development: A Literature Review. Journal of Strategic Management, 4(4), 1–9. https://doi.org/10.70619/vol4iss4pp1-9

66. Sharma S. K., B. H. L. Y. O. B. K. H. P. H., & Pacheco, P. (2019). Ecosystem services under future oil palm expansion scenarios in West Kalimantan, Indonesia. Ecosystem Services, 39, 100978. https://doi.org/10.1016/j.ecoser.2019.100978

67. Sibhatu, K. T. (2019). Oil palm boom and farm household diets in the tropics. Frontiers in Sustainable Food Systems, 3, 75. https://doi.org/10.3389/fsufs.2019.00075

68. Suardi, T. F., Sulistyowati, L., Noor, T. I., & Setiawan, I. (2022). Analysis of the sustainability level of smallholder oil palm agribusiness in Labuhanbatu Regency, North Sumatra. Agriculture, 12(9), 1469. https://doi.org/10.3390/agriculture12091469

69. Sukiyono, K., Romdhon, M. M., Mulyasari, G., Yuliarso, M. Z., Nabiu, M., Trisusilo, A., & Sugiardi, S. (2022). The contribution of oil palm smallholders farms to the implementation of the sustainable development goals-measurement attempt. Sustainability, 14(11), 6843. https://doi.org/10.3390/su14116843

70. Sumarga, E., & Hein, L. (2016). Benefits and costs of oil palm expansion in Central Kalimantan, Indonesia, under different policy scenarios. Regional Environmental Change, 16(4), 1011–1021. https://doi.org/10.1007/s10113-015-0815-0

71. Susilawaty, S., & Tambawang, L. (2024). Strengthening Indigenous Village Government Institutions through Governance Innovation and Community Empowerment. Musamus Journal of Public Administration, 7(1), 127–133. https://doi.org/10.58344/jws.v3i7.684

72. Sylvia, N., Rinaldi, W., Muslim, A., Husin, H., & Yunardi. (2022). Challenges and possibilities of implementing sustainable palm oil industry in Indonesia. IOP Conference Series: Earth and Environmental Science, 969(1), 012011. https://doi.org/10.1088/1755-1315/969/1/012011

73. Terauchi, D. (2017). The Oil Palm Complex: Smallholders, Agribusiness and the State in Indonesia and Malaysia (R. Cramb & J. F. McCarthy (eds.)).

74. Turner, E. C., & Hinsch, J. (2018). Integrated pest management in sustainable palm oil production (pp. 93–113). Burleigh Dodds Science Publishing.

75. Varkkey, H. (2015). The haze problem in Southeast Asia: Palm oil and patronage. Routledge.

76. 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

77. Wardhani, R., & Rahadian, Y. (2021). Sustainability strategy of Indonesian and Malaysian palm oil industry: A qualitative analysis. Sustainability Accounting, Management and Policy Journal, 12(5), 1077–1107.

78. Wijers, G. D. (2019). Inequality regimes in Indonesian dairy cooperatives: understanding institutional barriers to gender equality. Agriculture and Human Values, 36(2), 167–181. https://doi.org/10.1007/s10460-018-09908-9

79. Witjaksono, J., Djaenudin, D., Fery Purba, S., Yulianti, A., Fadwiwati, A. Y., Muslimin, & Seerasarn, N. (2024). Corporate farming model for sustainable supply chain crude palm oil of independent smallholder farmers. Frontiers in Sustainable Food Systems, 8, 1418732. https://doi.org/10.3389/fsufs.2024.1418732

80. Yin, W. (2019). Integrating Sustainable Development Goals into the Belt and Road Initiative: would it be a new model for green and sustainable investment? Sustainability, 11(24), 6991. https://doi.org/10.3390/su11246991

81. Yu, J., Mo, L., Dai, J., Bai, K., Mo, J., & Zhang, S. (2024). Nitrogen and phosphorus pollution discharge and water quality evaluation in a small basin of the upper reaches of Lijiang River. Water, 16(1), 104. https://doi.org/10.3390/w16010104