

Research Article

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Beyond Certification: Sustainable Palm Oil as an Integrated Pathway to the Sustainable Development Goals in Indonesia

Loso Judijanto

IPOSS Jakarta, Indonesia

ABSTRACT

Indonesia's palm oil sector occupies a paradoxical position in sustainable development. It generates rural income, employment, export earnings, industrial value added, and renewable-energy opportunities, yet its expansion and production systems have also been associated with deforestation, peat degradation, greenhouse-gas emissions, biodiversity loss, land conflicts, labour vulnerabilities, and unequal access to sustainable markets. This qualitative literature review examines which Sustainable Development Goals (SDGs) can be meaningfully addressed by sustainable palm oil and identifies the systemic challenges that must be resolved to achieve such sustainability comprehensively and durably in Indonesia. Rather than equating sustainability with certification, the review conceptualizes sustainable palm oil as a multidimensional system-level outcome encompassing inclusive livelihoods, environmental integrity, decent work and gender justice, circular low-carbon production, traceability, and credible governance. Recent peer-reviewed literature published predominantly during 2020–2026 is synthesised thematically across the palm-oil value chain. The findings suggest particularly strong potential contributions to SDGs 1, 5, 6, 7, 8, 9, 10, 12, 13, 15, 16, and 17, with important conditional linkages to SDGs 2, 3, and 4. However, synergies are not automatic: certification costs, insecure land tenure, replanting constraints, yield gaps, labour vulnerabilities, traceability deficiencies, ecosystem degradation, and fragmented governance can transform apparent sustainability solutions into new trade-offs. The article proposes a six-pillar transformation architecture combining sustainable landscapes, inclusive smallholder productivity, social justice, circular industry, accountable traceability, and coherent governance.

*Corresponding author

Loso Judijanto, IPOSS Jakarta, Indonesia.

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Introduction

Palm oil is one of the clearest examples of why sustainable development cannot be understood through a simple choice between economic growth and environmental protection. Indonesia's palm-oil economy is embedded simultaneously in rural livelihoods, agricultural transformation, land-use change, manufacturing, international trade, food systems, energy policy, and regional development. Oil palm has supported structural transformation in agricultural regions and generated income opportunities for farmers and workers, while smallholder participation has become increasingly important in the national production system [1,2].

At the same time, the historical expansion of oil-palm cultivation has contributed to profound land-use changes, including conversion of forest and peat landscapes, making the commodity a central component of debates concerning climate change, biodiversity, social justice, and responsible global supply chains [3,4].

The fundamental analytical challenge is therefore not whether palm oil is intrinsically “good” or “bad” for sustainable development.

Such a binary framing overlooks substantial variation in production location, land history, farm structure, agricultural practices, labour arrangements, processing technologies, governance institutions, and supply-chain relationships. A hectare of oil palm established by converting carbon-rich peat forest, for example, has fundamentally different sustainability implications from productivity improvements on an existing smallholder plantation accompanied by forest protection. Likewise, a certified supply chain that unintentionally excludes independent smallholders raises different development questions from one that provides farmers with technical assistance, legal support, affordable certification, and secure market access [5,6].

This distinction is particularly important because recent studies demonstrate genuine socioeconomic benefits associated with oil-palm cultivation while simultaneously identifying significant heterogeneity. Oil-palm adoption has been associated in particular settings with higher household living standards, asset accumulation, diversification, and investments in human capital [7].

Yet higher income does not automatically imply improved outcomes across every dimension of well-being. Changes in cropping systems influence household nutrition, food purchasing, labour allocation, and gender relations, while distributional effects differ among smallholders, plantation labourers, women, local communities, and other social groups [8-11].

The environmental record is similarly heterogeneous. Indonesia experienced substantial oil-palm-related forest conversion during earlier periods of rapid expansion, although recent reductions in deforestation have coincided with slower expansion and changing commodity-market conditions.

At landscape scale, evidence from Sumatra shows that profitability gains associated with transitions towards intensive monocultures can coincide with losses in biodiversity and ecosystem multifunctionality, highlighting an important ecological-economic trade-off [12].

Peat conversion imposes an additional climate penalty: direct measurements show very high greenhouse-gas emissions following conversion of peat swamp forest to oil palm, reinforcing the case for treating peat protection as a non-negotiable boundary of sustainable production [13].

Scenario research indicates that satisfying future demand through business-as-usual spatial expansion could continue generating severe environmental costs, whereas redirecting development towards lower-environmental-value lands, increasing productivity on existing plantations, protecting forests and peatlands, and improving processing practices can considerably alter the sector's ecological footprint [14].

Thus, the relevant sustainability question concerns the configuration of the production system rather than the commodity alone.

The Sustainable Development Goals (SDGs) offer a useful framework for evaluating these multiple dimensions, but they must be applied cautiously. Palm oil has been associated with potential contributions to poverty reduction, employment, infrastructure, rural development, renewable energy, and other objectives, while the same sector can undermine goals related to water, climate, terrestrial ecosystems, equality, or institutional justice when sustainability safeguards are weak [15,16].

Moreover, sustainability interventions themselves may generate trade-offs. Intensification can increase farmer incomes and reduce the amount of new land required for a given output, but excessive fertiliser or pesticide use can increase pollution. Stronger traceability can improve environmental accountability but may exclude poorly documented farmers. Biodiesel can strengthen energy security but its climate contribution depends on land-use history and life-cycle emissions. Certification can improve standards but may remain inaccessible to those farmers with the least financial, organisational, or legal capacity.

Consequently, this article treats SDGs as an interconnected system of goals rather than a checklist of icons. Contemporary research on SDG interactions demonstrates that progress towards one target can either reinforce or constrain another, and that indirect relationships can be as consequential as direct ones [17-20].

The appropriate question is therefore not simply "Which SDGs does palm oil support?" but rather: through what mechanisms, under which conditions, for whom, and with what potential trade-offs can sustainable palm oil contribute to particular SDG targets? The urgency of this question is reinforced by changes in Indonesian and international sustainability governance. Indonesia's Presidential Regulation No. 16 of 2025 replaced the previous 2020 ISPO framework and defines Indonesian Sustainable Palm Oil across oil-palm plantations, downstream industries, and palm-oil-based bioenergy [21].

This regulatory development is conceptually significant because sustainability governance is increasingly expected to cover the value chain rather than plantation management alone. At the international level, the European Union Deforestation Regulation (EUDR) further emphasises legality, geolocation, and deforestation-free sourcing, creating incentives for improved traceability while raising concerns about the capacity of poorly documented smallholders to meet increasingly demanding market requirements [22].

Recent evidence makes the inclusion problem particularly visible. find that independent smallholders contributed approximately one-third of production in the regions they examined but accounted for only a small share of supply to certified mills. The study identifies "passive exclusion": independent farmers were not necessarily expelled following certification, but structural market access, spatial patterns, producer capacity, and buyer behavior restricted their participation. Chandra et al [23].

similarly find that corporate zero-deforestation commitments have limited reach among Indonesian smallholders, particularly independent producers, with low awareness, weak bottom-up traceability, limited capacity building, and little price differentiation.

These findings demonstrate why tightening sustainability requirements without simultaneously building producer capability can produce an environmental-governance system that is formally stronger yet socially less inclusive Eggen et al [24].

reach a complementary conclusion from a transdisciplinary assessment of zero-deforestation supply chains: independent smallholders remain underrepresented, and equitable participation requires coordinated mapping, land-rights support, technical assistance, and economic incentives rather than traceability demands alone.

This review therefore has three objectives. First, it identifies the SDGs and SDG targets to which genuinely sustainable palm oil can contribute through economic, social, environmental, technological, and institutional pathways. Second, it synthesizes the interconnected challenges preventing comprehensive, holistic, and durable sustainable palm oil in Indonesia. Third, it develops an integrated transformation and policy framework capable of converting potential SDG trade-offs into synergies.

The central proposition is that certified palm oil and sustainable palm oil are not synonymous. Certification is one important governance instrument. Sustainable palm oil is the broader system-level outcome that should result when environmental integrity, economically viable and inclusive production, decent work, gender justice, land and community rights, circular resource use, traceability, responsible downstream processing, and credible governance operate together. Accordingly, SDG contributions should be judged from substantive outcomes rather than certification status alone.

Literature Review

Sustainable Development Goals and the Logic of Interlinkages

The 2030 Agenda was deliberately constructed around the principle that economic prosperity, social inclusion, and environmental integrity are interdependent. Yet policy implementation frequently fragments the agenda into separate sectoral goals. This fragmentation can obscure causal chains in which intervention in one sector changes outcomes elsewhere. SDG-interlinkage

research therefore distinguishes positive synergies, enabling relationships, neutral interactions, and trade-offs among goals and targets.

Luttikhuis and Wiebe argue that responsible innovation should be examined against both its positive and negative interactions with the SDGs rather than assessed through a single intended outcome. Similarly demonstrate recurring patterns of SDG interlinkages that can help identify strategic entry points for implementation. This approach is highly relevant to palm oil because the sector connects land, agriculture, poverty, employment, industrialization, water, energy, ecosystems, climate, institutions, and trade.

For this article, the relationship between sustainable palm oil and the SDGs is conceptualised as a causal sequence. A sustainability intervention first changes a production or governance mechanism, which produces an immediate economic, social, or environmental outcome; that outcome can then contribute to an SDG target while also generating spillovers or trade-offs that may require a complementary policy response. This framework avoids simplistic claims that the existence of palm oil automatically fulfils a particular SDG and instead asks whether a specific change in the palm-oil system produces outcomes consistent with relevant targets.

Sustainable Palm Oil beyond Certification

Certification is among the most visible sustainability interventions in the palm-oil sector. The Roundtable on Sustainable Palm Oil (RSPO), the Indonesian Sustainable Palm Oil (ISPO) system, and corporate sourcing standards seek to improve aspects of plantation management, legality, traceability, environmental protection, and social responsibility. However, research demonstrates that sustainability governance involves complex interactions among private standards, state regulation, corporate commitments, and producer capabilities [25,27].

Oliphant and Simon question whether the private benefits of certification are consistently sufficient to justify its costs for individual smallholders. Studies of smallholder certification reinforce this distinction. Apriani et al identify land legality, organisational capacity, knowledge, finance, and compliance costs as persistent barriers. de Vos et al [28,30].

while show that collective and jurisdictional mechanisms can reduce certification costs through economies of scale. Irawan et al find that independent producers often face difficulties understanding and financing certification requirements and frequently depend on external facilitation. Watts et al show that many independent farmers enter the pre-certification process with significant deficits in documentation and capacity [31,32].

More recent evidence adds a design perspective: farm-management training and cash premiums increase smallholders' stated willingness to adopt certification, suggesting that standards are more likely to be inclusive when requirements are paired with tangible capability building and incentives. These findings imply that certification can be an instrument for sustainable development only when embedded in broader enabling institutions. Denashurya et al likewise show that adoption of sustainable agricultural practices and ISPO compliance depend on farmer knowledge, institutional support, and perceived benefits. At a broader level, Supriatna et al find multidimensional weaknesses across economic, ecological, social, institutional, and technological aspects of Indonesian smallholder sustainability. Smallholders are also

heterogeneous in their capacity to absorb shocks: Indonesian evidence identifies distinct resilience profiles and finds that some independent and older local farmers are among the least resilient groups, strengthening the case for differentiated rather than uniform support packages [33,36].

Consequently, sustainable palm oil is defined here through six dimensions, (1) inclusive economic and livelihood sustainability, (2) decent work, gender equality, and rights, (3) environmental and landscape integrity, (4) climate mitigation, resource efficiency, and circularity, (5) traceable and accountable supply chains and (6) coherent institutions, markets, and partnerships. Treating these dimensions jointly prevents improvements in one domain from being mistaken for whole-system sustainability when material harms persist elsewhere in the value chain.

The Indonesian Palm-Oil System from Upstream to Downstream

An upstream-to-downstream perspective is essential because sustainability outcomes emerge through interconnected stages. Upstream production involves land allocation, planting materials, cultivation, fertiliser and pesticide management, harvesting, labour, smallholder organisation, replanting, and conservation. Productivity varies substantially among farms, and spatial heterogeneity reflects differences in infrastructure, knowledge, farm history, land status, and market access [37,38].

Modelling of Indonesian production further indicates that substantial yield gaps create scope for climate-smart intensification on existing plantations; under a scenario that combines yield-gap closure with tightly limited expansion excluding fragile ecosystems, considerably less forest and peatland would be placed at risk than under historical yield and land-use trends [39]. This potential, however, depends on land-use safeguards that prevent productivity gains from inducing rebound expansion.

Midstream processes involve collectors, traders, cooperatives, mills, and complex fresh-fruit-bunch sourcing relationships. These relationships can make farm-to-mill traceability difficult, particularly for independent smallholders selling through intermediaries. Ekaputri et al and Chandra et al show that mill structure, sourcing geography, contractual arrangements, and information gaps strongly condition producer participation in higher-standard supply chains.

Downstream stages include refining, oleochemicals, food and non-food manufacturing, biodiesel, biomass use, and other forms of bioenergy. Sustainability therefore extends beyond the plantation gate. Mill effluent, energy use, methane emissions, refining efficiency, and life-cycle greenhouse-gas emissions affect whether downstream industrialization supports or undermines environmental objectives. Research on palm oil mill effluent (POME) demonstrates substantial potential for methane capture and biogas production, although economic, technological, infrastructural, and regulatory barriers constrain widespread adoption [40-42].

Life-cycle analysis also cautions against treating palm-based bioenergy as automatically low-carbon. Plantation-stage emissions and land-use history can dominate environmental impacts, while improvements in mill efficiency, methane capture, and feedstock use can materially improve performance [43-44].

Measurement-based greenhouse-gas budgets from Indonesian oil-palm plantations further show that plantation age and prior land use materially affect the climate balance of palm-oil biodiesel, challenging generic assumptions of carbon neutrality. Research on sludge palm oil and mill-based biodiesel illustrates opportunities for circularity and rural energy provision when waste streams displace higher-impact fuels. Thus, downstream sustainability is a matter of verified life-cycle performance rather than product labels [45,46].

Governance, Rights, and the Political Economy of Sustainability

Land governance is foundational because unresolved tenure problems affect environmental compliance, certification, finance, social conflict, and farmer investment. Astuti et al. demonstrate how spatial mapping can expose illegal plantations while simultaneously creating politically difficult choices over legalisation, restoration, business interests, and smallholder livelihoods. Afrizal, Putra and Elida show how insecure land documentation in Riau can be manipulated in processes of plantation expansion, increasing conflict vulnerability [47,48].

Broader conflict research demonstrates that the problem is not simply the absence of formal rules. Berenschot et al. identify institutional collusion and weak grievance resolution in numerous oil-palm conflicts, while Berenschot and Dhiaulhaq describe processes through which communities can become effectively “rightless” despite nominal legal protections [49,50].

Grasse quantitatively connects oil-palm expansion and commodity incentives with resource conflict, illustrating how concentrated economic gains and diffuse externalities can destabilize land relations. Afrizal et al. further show that even sustainability-oriented grievance systems can provide unequal access to justice. Labour and gender relations similarly challenge narrow sustainability definitions. Goestoro documents barriers faced by plantation workers seeking remedies for poor working conditions [51-53].

Sinaga emphasises intersectional dimensions of land and bioeconomy relations, demonstrating how gender, class, and other social hierarchies shape participation in palm-oil landscapes. Household-level studies also show that oil palm changes labour allocation between women and men, with outcomes that cannot be inferred from household income alone [54].

Finally, palm-oil sustainability is increasingly embedded in international regulatory politics. Kettunen and Pratiwi illustrate how EU–Indonesia palm-oil debates have been shaped by competing environmental, trade, development, and sovereignty narratives. A sustainable strategy therefore requires Indonesia not simply to respond defensively to international requirements, but to build domestic sustainability institutions that simultaneously improve environmental outcomes, farmer inclusion, market acceptance, and national value creation [55].

Method

Research Design

This study employs a qualitative literature review, specifically an integrative and narrative form of evidence synthesis. It is explicitly not a Systematic Literature Review (SLR). The purpose is to interpret and integrate heterogeneous knowledge from sustainability science, agricultural economics, development studies, environmental science, political economy, governance, gender studies, industrial ecology, and energy research rather than to produce an exhaustive inventory of all publications.

Integrative reviews are appropriate when a research problem crosses disciplinary boundaries and includes different empirical designs, theoretical perspectives, and units of analysis [57,58].

Barry, Merkebu and Varpio similarly emphasise that rigorous state-of-the-art literature synthesis involves purposeful question formulation, literature identification, critical interpretation, synthesis, and transparent communication rather than relying exclusively on procedural standardisation [56].

Accordingly, this review does not claim exhaustive database coverage, statistical representativeness of the literature universe, formal risk-of-bias scoring, meta-analysis, PRISMA-based article screening, or systematic-review registration. Those procedures would imply an SLR design that is inconsistent with the interpretive objective of the present article.

Literature Identification

The literature base was developed purposively and iteratively around the research questions and conceptual categories identified in the preceding section. Peer-reviewed journal articles published predominantly from 2020 to 2026 were prioritised. Literature was identified through combinations of thematic searches involving Sustainable Development Goals, sustainable palm oil, oil-palm smallholders, Indonesia, certification, ISPO, RSPO, deforestation, land tenure, replanting, productivity, gender, labour, traceability, POME, bioenergy, circular economy, and sustainability governance. Priority was given to peer-reviewed studies from established international journals, Indonesian empirical studies, comparative research with direct relevance to Indonesia, and theoretical literature necessary for analysing SDG interlinkages. Backward and forward citation tracing was used conceptually to connect newer evidence with related studies. Policy documents were used only to establish current institutional context and were not counted as part of the peer-reviewed journal evidence base.

Analytical Procedure

The review proceeded through two levels of thematic synthesis. First-cycle coding organised the literature around seven attributes: value-chain stage, principal stakeholder, sustainability dimension, relevant SDG, documented positive outcome, documented constraint or adverse effect, and enabling institutional condition. These attributes provided a consistent basis for comparing heterogeneous evidence across disciplines and scales.

Second-cycle synthesis grouped the evidence into four broader analytical categories: SDG contribution pathways, systemic sustainability bottlenecks, synergies and trade-offs among SDGs, and policy and governance leverage points. These categories structured the presentation of results and the subsequent policy synthesis.

The review deliberately incorporated evidence reporting positive, negative, mixed, and heterogeneous outcomes. This contrastive reading strategy is important because a literature review that selects only environmental damages or only development benefits would reproduce polarised palm-oil narratives rather than explain the conditions determining sustainability. The unit of interpretation was also differentiated. Evidence concerning a farm or household was not automatically generalised to the landscape or national scale. Similarly, an environmental benefit at a mill was not automatically interpreted as whole-value-chain sustainability. The analytical framework therefore distinguishes farm, household, labour, supply-chain, landscape, industrial, and institutional outcomes.

Limitations

The qualitative approach necessarily involves interpretive judgement. The literature contains different definitions of smallholders, diverse geographic settings, heterogeneous indicators, varying causal identification strategies, and uneven coverage of labour, gender, biodiversity, and downstream processing. Moreover, sustainability standards and international market rules are evolving rapidly. Consequently, this review seeks analytical comprehensiveness rather than numerical estimation of a single aggregate “palm-oil sustainability effect.”

Results

Sustainable Palm Oil as a Multi-SDG Development Pathway

The literature supports a central finding: sustainable palm oil has the potential to contribute to many SDGs, but the contribution originates from specific sustainability practices rather than from production volume itself. The strongest pathways involve SDGs 1, 5, 6, 7, 8, 9, 10, 12, 13, 15, 16, and 17, while SDGs 2, 3, and 4 are important but generally more conditional.

SDG 1, SDG 8 and SDG 10: Livelihoods, Employment, and Inclusive Prosperity

Oil-palm cultivation can contribute to poverty reduction and economic opportunity through farm income, wage employment, rural demand, and agricultural commercialization. Mehraban et al. find improvements in living standards and changes in risk exposure among Indonesian oil-palm smallholders, while Chrisendo, Siregar and Qaim connect oil palm with wider structural transformation in agricultural communities. Chrisendo, Siregar and Qaim further find associations with household living standards and investments in human capital.

However, the distributional qualifier is critical. Certification does not deliver uniform poverty effects. Santika et al. [59] demonstrate that effects on village well-being and poverty vary according to livelihood characteristics and local conditions. Sukiyono et al. similarly find differentiated performance when smallholder palm oil is assessed against multiple SDGs. Therefore, SDG 1 is best addressed when productivity improvements are combined with equitable market participation, secure land access, risk management, and social protection.

SDG 8 requires an even more demanding interpretation because “employment” and “decent work” are not equivalent. Plantation work may generate income but remain precarious when employment is temporary, occupational safeguards are weak, or workers face practical barriers to legal remedies. A sustainable palm-oil strategy must consequently measure employment quality alongside employment quantity. SDG 10 is strongly linked to how sustainability upgrading distributes benefits and costs. The recent evidence on certified mill markets is revealing: independent smallholders may be structurally underrepresented even without explicit exclusion. Similarly, zero-deforestation commitments may cover supply regions without effectively transmitting information, incentives, or assistance to independent producers. Sustainable-market access therefore becomes an inequality issue when compliance capacity differs systematically across producer groups.

SDG 2, SDG 3 and SDG 4: Food, Health, and Human Capabilities

The relationship between oil palm and food security is indirect and context dependent. Higher cash income can increase food purchasing power and dietary diversity, but commercialization may also alter subsistence production, food prices, and labour

allocation. Chrisendo et al find that agricultural transformation affects nutrition through income and household mechanisms, whereas comparative work by Tabe-Ojong, Alamsyah and Sibhatu suggests that oil-palm households can exhibit more diverse diets without a simple, universal improvement in food-security indicators.

SDG 3 is relevant through occupational health, pesticide exposure, smoke and fire, water contamination, and living conditions in plantation landscapes. Consequently, environmental management and labour standards should be understood jointly rather than treated as unrelated sustainability domains.

SDG 4 enters through farmer capabilities and household investments in education. Extension, agronomic knowledge, financial literacy, certification literacy, and digital traceability skills determine whether smallholders can participate effectively in sustainability transitions. Research on replanting consistently identifies knowledge and training constraints, while household evidence suggests that increased agricultural income can support human-capital formation under favourable conditions [60].

SDG 5: Gender Equality

Gender equality cannot be inferred from aggregate household income. Oil palm changes the organisation of labour and control over economic resources. Mehraban et al. find that oil-palm cultivation can reduce some women’s agricultural labour requirements while simultaneously reallocating time towards domestic and care responsibilities, potentially weakening involvement in income-generating activities. Rowland et al. likewise demonstrate that gendered time-use effects vary with production arrangements and household circumstances.

These findings imply that sustainable palm oil should incorporate women’s access to land documentation, farmer-group membership, training, certification, finance, leadership, occupational protection, and income control. Sinaga’s intersectional analysis further demonstrates why land relations cannot be treated as gender neutral. SDG 5 is therefore not a peripheral social addition; it affects whether the economic benefits of sustainability upgrading are distributed equitably.

SDG 6: Water and Pollution Management

Water provides one of the clearest examples of how plantation-level environmental practices affect wider landscapes. Asmara and Randhir show that oil-palm development can modify hydrological processes and influence sediment and nutrient loads in Indonesian watersheds. Soil management and agrochemical use also affect nutrient dynamics and possible contaminant pathways. Field experimentation provides an important management counterpoint: mechanical rather than herbicide-based weeding can reduce nutrient leaching, while reduced fertilisation combined with mechanical weeding has been shown to maintain yields while improving ecosystem multifunctionality and profitability in a mature industrial plantation [61-64].

These findings indicate that SDG 6 depends not only on avoiding new land conversion but also on improving within-plantation management. Riparian protection offers an important but qualified solution. Studies demonstrate that buffers can increase habitat heterogeneity and support ecological functions, although mature oil-palm buffers do not consistently reproduce the ecological value of natural or restored forest vegetation. At the broader plantation-landscape scale, strategically configured set-asides can improve

biodiversity, above-ground carbon storage, and nutrient cycling more efficiently than uniform allocation, demonstrating that the spatial design of conservation areas matters as much as their nominal area. Experimental evidence also indicates that restoring understory and riparian vegetation in established Indonesian oil-palm plantations need not increase measured greenhouse-gas fluxes, strengthening the case for ecological restoration within productive landscapes.

SDG 6 contributions therefore require protection and restoration of riparian zones, responsible fertiliser and pesticide use, effective POME treatment, and watershed-level monitoring [65-68].

SDG 7 and SDG 9: Renewable Energy, Innovation, and Industrial Upgrading

Palm-oil processing produces substantial biomass and wastewater streams. POME is particularly important because untreated effluent can become a significant source of methane, while captured methane can be converted to renewable energy. Foong, Chong and Ng and Nasrin et al demonstrate substantial potential for biogas generation and utilisation but emphasise barriers related to investment, mill scale, infrastructure, technical operation, and market arrangements. Sodri and Septriana similarly identify techno-economic and environmental opportunities for POME-based power generation. Circular strategies can also transform low-value residues into energy products. Gourich et al for example, demonstrate life-cycle benefits from converting sludge palm oil into biodiesel for rural electrification under specified conditions. Such interventions connect SDG 7 with SDG 9 by turning environmental liabilities into opportunities for industrial innovation. Yet this pathway must be evaluated through life-cycle performance. Wahyono et al. show that plantation-stage impacts significantly influence the environmental profile of Indonesian palm biodiesel, while Paminto, Karuniasa and Frimawaty [69] similarly underline the importance of life-cycle assessment. Measurement-based evidence indicates that the age of the plantation and the land-use history of the feedstock can materially alter estimated greenhouse-gas savings. De Rosa, Schmidt and Pasang demonstrate that mitigation measures at industry level can materially reduce greenhouse-gas emissions. Consequently, “bioenergy” is not synonymous with “sustainable energy”: its contribution depends on feedstock history, processing efficiency, methane management, and avoided emissions.

SDG 12: Responsible Consumption and Production

SDG 12 is the point at which farm management, traceability, certification, resource efficiency, and downstream circularity converge. Sustainable production requires knowing where fresh fruit bunches originate, whether the production is legal and deforestation-free, how chemicals and waste are managed, and how sustainability claims are verified.

Nevertheless, traceability systems can become socially regressive when they merely identify non-compliant farmers without resolving why those farmers lack documentation or capacity. Apriani et al. Watts et al. and de Vos et al consistently identify limited financial, organisational, and legal capacity among independent smallholders. Thus, responsible production requires both accountability and capability.

SDG 13 and SDG 15: Climate and Terrestrial Ecosystems

The strongest environmental case for sustainable palm oil rests not on making expansion “slightly better” but on changing the development model from forest- and peat-converting expansion

towards productivity improvement on existing land, protection of high-value ecosystems, restoration, and low-emission processing. This shift places avoided conversion and ecological restoration ahead of marginal improvements to new expansion and makes land-use history central to environmental assessment. Gaveau et al. document the historical relationship between oil-palm expansion and forest loss as well as the more recent decline in deforestation associated with slower expansion and changing economic conditions. Xin, Sun and Hansen demonstrate through scenario analysis that future palm-oil demand can produce dramatically different environmental outcomes depending on where and how expansion or intensification occurs. This distinction is particularly important on peat, where direct field measurements show that conversion of peat swamp forest to oil palm produces a large and persistent greenhouse-gas burden. Conversely, climate-smart intensification scenarios suggest that closing part of the yield gap on existing plantations, if combined with strict protection of fragile ecosystems, can reduce pressure on forests and peatlands compared with historical development trajectories. Replanting and yield-gap closure are therefore potentially powerful leverage points. Monzon et al. identify substantial agronomic yield gaps in smallholder plantations. Petri et al. show that replanting ageing palms could improve productivity but is constrained by finance, high-quality seedlings, knowledge, documentation, and the income gap during immature years. Siregar et al find that formal land documentation and programme characteristics affect smallholders’ willingness to participate in replanting, while Hendrawan and Musshoff show that farmers respond differently to subsidy-programme attributes [70,71].

Fosch et al provide particularly relevant SDG evidence, finding that replanting unproductive plantations with smallholder systems can improve multiple sustainable-development outcomes compared with leaving degraded or unproductive plantation systems in place. Jelsma et al further demonstrate the importance of collective organisation and long-term institutional support in smallholder replanting and resilience [72,73].

However, productivity improvement is not automatically land sparing. Higher profitability can incentivize additional expansion unless spatial planning, forest protection, and enforcement restrict conversion. Li therefore argues for strategies that improve smallholder livelihoods without requiring further deforestation. Sustainable intensification should consequently be defined as. Accordingly, this review defines sustainable intensification as higher productivity on existing legitimate agricultural land combined with enforceable no-expansion safeguards, restoration and conservation, and inclusive farmer support. This definition makes land-use safeguards an integral part of intensification rather than an optional environmental add-on.

SDG 16 and SDG 17: Institutions, Justice, and Partnerships

Sustainable palm oil ultimately depends on institutions capable of defining and enforcing rights. Land insecurity can obstruct investment, certification, replanting, and conflict resolution simultaneously. Astuti et al. show that even improved spatial information creates political dilemmas where plantations overlap legally designated forest areas. Afrizal, Putra and Elida demonstrate how insecure local land documentation increases vulnerability to dispossession and conflict. Berenschot et al. Berenschot and Dhiaulhaq and Grasse collectively illustrate the institutional importance of transparent land allocation, accountable government, grievance mechanisms, and accessible justice. Afrizal et al. show that private sustainability governance does

not automatically resolve these institutional problems because access to grievance mechanisms can itself be unequal. SDG 17 therefore becomes important because no single actor can produce sustainable palm oil independently. Governments control land administration and enforcement; companies control significant processing and procurement infrastructure; farmers manage millions of hectares; certification organisations establish standards; banks influence investment; civil-society organisations provide monitoring and facilitation; and international buyers create demand conditions. Sustainable palm oil is therefore intrinsically a partnership and governance challenge.

Figure 1: The Value-Chain Logic of SDG Contributions

Figure 1 should be read as the basic causal map of the article. It emphasises that SDG outcomes emerge throughout the chain rather than at the plantation stage alone. Upstream interventions affect livelihoods and landscapes, midstream actors determine traceability and market inclusion, downstream processes shape circularity and life-cycle emissions, while governance conditions influence every stage.

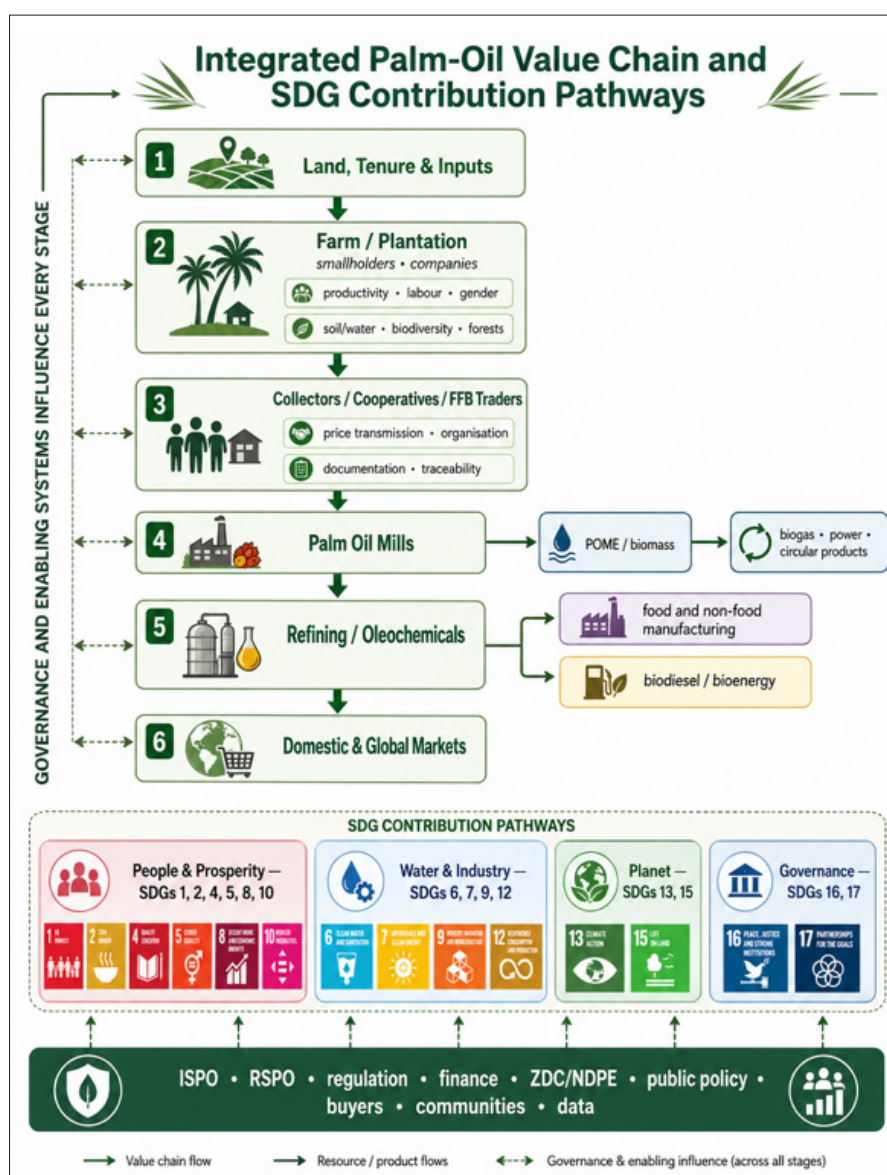


Figure 1: Integrated Palm-Oil Value Chain and SDG Contribution Pathways

Figure 1: highlights why the same commodity can generate contradictory sustainability outcomes. For example, a productive farm may contribute to income and employment while degrading water or biodiversity if environmental management is weak. Conversely, rigorous environmental sourcing requirements may protect forests while excluding farmers who lack documentation. Sustainable palm oil therefore requires coordination across the vertical value chain and the horizontal landscape rather than optimisation of a single stage.

Systemic Challenges to Achieving Sustainable Palm Oil

Land Legality and Tenure Insecurity

Land legality is one of the most consequential cross-cutting constraints because it connects social justice, finance, environmental regulation, and market access. A farmer lacking recognised documentation may be unable to qualify for replanting support or certification; without replanting, productivity declines; lower productivity weakens income and savings; limited income further

reduces the ability to finance mapping, certification, or improved practices. Astuti et al. demonstrate that mapping illegal plantations can improve governance visibility but does not itself solve the underlying political problem. Different categories of illegality require differentiated policy responses. Treating a poorly documented smallholder in the same manner as a large plantation established through extensive forest conversion could produce inequitable outcomes, whereas blanket legalisation could weaken environmental safeguards. Land conflict also affects SDG 16 directly. Afrizal, Putra and Elida show that locally recognised documentation may provide less effective protection than farmers assume. Berenschot et al. identify widespread difficulties in resolving corporate-community disputes, while Berenschot and Dhiaulhaq emphasise how legal and political processes can systematically disadvantage affected communities.

Smallholder Productivity and Replanting

A second systemic challenge is the productivity gap between many independent smallholders and better-managed plantations. Monzon et al. show that agronomic management explains significant yield variation, while Sibhatu et al. demonstrate substantial spatial heterogeneity. Low productivity increases economic vulnerability and may also increase pressure for expansion when households seek additional land to compensate for low output.

Replanting provides an obvious technical solution but creates a financial transition problem. Farmers must remove old trees and wait several years for new palms to reach productive maturity. Petri et al. Siregar et al. and Hendrawan and Musshoff demonstrate that replanting participation depends on financing, farmer preferences, legal eligibility, planting material, knowledge, and income security during the immature period. Collective action matters because farmer organisations can aggregate demand for seedlings, extension, finance, certification, and marketing. Jelsma et al. show that collective institutions can strengthen long-term resilience, but organisations require durable institutional support rather than short project cycles.

Certification Costs, Capacity, and Unequal Participation

Certification remains difficult for many independent smallholders. Apriani et al. document dependence on outside organisations for preparation and compliance. Watts et al. identify multiple interacting barriers, while de Vos et al. demonstrate that pre-certification conditions vary substantially. Oliphant and Simon further question the private financial attractiveness of certification where farmers bear costs without assured premiums. Irawan et al. show that cost reductions become possible when certification is organised collectively and institutionally rather than farmer by farmer. This suggests a major policy principle: if society and downstream markets demand public environmental benefits from certification, it is economically questionable to expect smallholders to bear the full compliance cost privately. The 2025 findings of Ekaputri et al. intensify this concern. Independent smallholders can be underrepresented in certified mill markets even without explicit discriminatory exclusion. Structural proximity, existing contracts, certification capacity, and buyer behaviour matter. Sustainable supply-chain governance therefore needs inclusion metrics in addition to environmental compliance metrics.

Traceability without Capability

Deforestation-free supply chains require traceability, but traceability is not simply a technological problem. It requires reliable farm boundaries, legal identity, production records, mill sourcing information, intermediary transparency, and interoperable databases. Chandra et al. find that many independent smallholders

remain poorly informed about zero-deforestation commitments even when they operate geographically within the sourcing areas of firms that have such commitments. Bottom-up traceability and specialised capacity building remain limited. This evidence implies that geolocation systems and digital platforms will have limited transformational value if producers do not understand requirements or lack the legal and financial capacity to comply.

Labour Vulnerability and Social Sustainability

A sustainability model focused predominantly on forests and carbon risks neglecting labour. Goestoro demonstrates that plantation workers can face practical and institutional barriers in obtaining remedies for poor working conditions. Social sustainability therefore requires enforceable indicators for contracts, wages, occupational health and safety, social security, freedom of association, gender protection, grievance access, and prevention of forced or child labour. The issue also intersects with gender. Women may participate as formal workers, casual workers, unpaid family labourers, or household members whose time is affected indirectly by plantation production. Mehraban et al. Rowland et al. and Sinaga collectively indicate that sustainability assessment should identify who performs labour, who receives income, who controls land, and who participates in decisions [53,54].

Environmental Degradation beyond Deforestation

Deforestation is a critical indicator but not a complete environmental metric. Sustainability also requires attention to peat, water, soil, biodiversity, fire, fertiliser, pesticides, and ecological connectivity. Grass et al. show that land-use transitions towards intensive smallholder monocultures can increase profitability while reducing biodiversity and ecosystem multifunctionality, illustrating why economic and ecological performance must be evaluated jointly. Asmara and Randhir demonstrate watershed consequences of land-use change, while Thompson-Morrison et al. document soil nutrient and contaminant concerns. Formaglio et al. show that weed-control strategy can materially affect nutrient leaching, and Iddris et al. demonstrate that reduced fertilisation and mechanical weeding can improve multifunctionality and profit while maintaining yields under the conditions studied. Pashkevich et al. show that plantation riparian buffers can provide some ecological benefits but that their performance is inconsistent, while Mullin et al. demonstrate the biodiversity value of riparian reserves within oil-palm-dominated landscapes. Bicknell et al. further show that optimally configured set-asides can improve multiple ecological outcomes, reinforcing the value of landscape design in addition to farm-level compliance. Landscape-restoration evidence adds an important complement: tree islands embedded in oil-palm landscapes can increase biodiversity and ecosystem functioning without reducing landscape-scale oil-palm yield, although such enrichment cannot substitute for protecting remaining forests. At smallholder level, environmental-efficiency analysis also indicates scope to reduce biodiversity loss while maintaining or increasing output, and identifies payments for ecosystem services as a potentially viable incentive mechanism. The implication is that zero deforestation should be considered a minimum requirement, not a complete environmental definition of sustainability. A credible environmental standard must therefore evaluate within-plantation management and landscape condition alongside forest-conversion outcomes [74,75].

Circularity and Uneven Technology Adoption

POME methane capture is technologically well understood, yet adoption is uneven. Nasrin et al. and Foong, Chong and Ng identify investment and utilisation barriers, while Sodri and Septiana show

that project feasibility depends on specific techno-economic parameters.

This creates a classic infrastructure-coordination problem. A mill can capture biogas, but value depends on whether electricity can be sold, gas can be used internally, nearby demand exists, or other products can be developed. Policy therefore needs to move from requiring “waste treatment” towards enabling resource recovery and industrial symbiosis.

Governance Fragmentation

Public and private sustainability systems have historically overlapped without perfect alignment. Brandi shows that interactions between public and private governance can involve both competition and complementarity. Choiruzzad, Tyson and Varkkey identify ambiguities in the development of Indonesian sustainability certification, while Grabs and Garrett reveal paradoxes in goal-based private governance.

Indonesia’s revised ISPO framework offers an opportunity to strengthen integration by extending sustainability beyond plantations to downstream industry and bioenergy. Yet broader coverage will produce meaningful outcomes only where institutional capacity, monitoring, transparency, incentives, and enforcement develop correspondingly.

SDG Synergies and Trade-Offs

Figure 2 summarizes why individual sustainability interventions should not be evaluated through a single intended benefit. Each intervention may simultaneously create synergies and new risks.

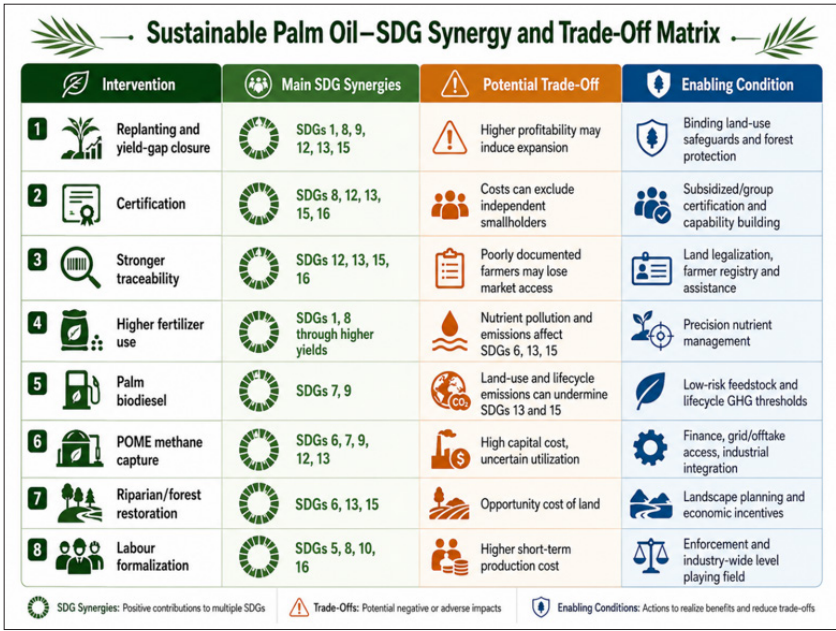


Figure 2: Sustainable Palm Oil–SDG Synergy and Trade-Off Matrix

Figure 2: demonstrates that “win-win” outcomes rarely arise from a technology or standard in isolation. Sustainable development requires policy packages. Replanting must be connected to forest protection; traceability to legalisation; certification to financial assistance; intensification to precision agronomy; bioenergy to life-cycle criteria; and labour protection to effective enforcement. The relevant unit of policy is therefore an intervention package rather than a single instrument.

Reinforcing Sustainability Bottlenecks

The literature also reveals circular causality. Smallholder constraints do not occur independently; they reinforce one another. Figure 3 illustrates one of the most important feedback loops.

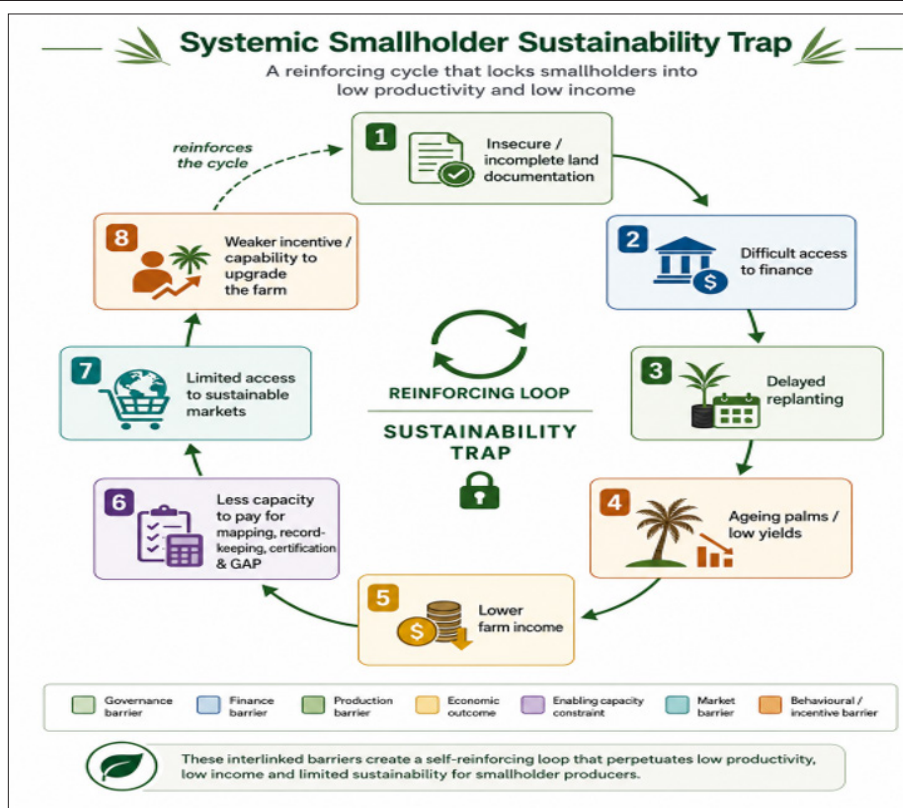


Figure 3: Systemic Smallholder Sustainability Trap

This feedback structure explains why isolated training or one-off certification subsidies often produce limited transformation. Breaking the cycle requires simultaneous interventions in land administration, farmer organisation, finance, replanting, extension, traceability, and market access. The most important policy implication is that smallholder sustainability is not merely a behavioural problem; it is an institutional coordination problem.

Discussion and Analysis

What Does It Mean for Sustainable Palm Oil to Address the SDGs?

The literature supports a more precise formulation than the claim that “palm oil contributes to the SDGs.” Palm oil production can generate development benefits, but the magnitude, beneficiaries, environmental costs, and durability of those benefits vary substantially. Sustainable palm oil should therefore be said to contribute to specific SDG targets when particular sustainability conditions are satisfied. This distinction has three analytical implications. First, commodity production is not an SDG outcome: higher crude-palm-oil output may increase value added but says nothing by itself about poverty distribution, labour quality, deforestation, or water quality. Second, certification is not an outcome either; it can increase the probability that particular practices are followed, but impacts remain heterogeneous and access to certification is uneven. Third, sustainability must be evaluated simultaneously across multiple dimensions because environmental gains achieved through farmer exclusion may undermine social SDGs, economic gains based on ecosystem conversion undermine environmental SDGs, and renewable-energy gains based on high life-cycle emissions may provide only nominal climate benefits.

The resulting conceptual relationship can be stated in three linked propositions. Certification is a governance instrument, whereas sustainable palm oil is a multidimensional system-level outcome.

SDG contribution is the wider societal consequence of that outcome and remains conditional on implementation quality, distributional effects, and the durability of environmental and institutional safeguards. This framework also helps reconcile polarised academic and policy narratives. The evidence demonstrating household economic benefits is not logically incompatible with evidence demonstrating environmental degradation or land conflict. Both can be true because they refer to different dimensions, locations, actors, and time periods. The policy problem is therefore to redesign the system so that development benefits become less dependent on ecological degradation and unequal power relations.

Transformation 1: From Expansion-Led Growth to Sustainable Intensification and Restoration

Indonesia’s palm-oil development historically relied partly on area expansion. A sustainable future requires a structural transition towards higher productivity on already cultivated legitimate land, replanting of ageing plantations, rehabilitation of degraded areas, protection of forests and peat, and restoration of ecologically important zones. The transition therefore concerns not only agronomic technique but also the spatial and institutional basis on which future production growth occurs. This strategy responds to evidence showing that substantial development gains can be achieved by improving existing plantations. Climate-smart intensification modelling indicates that closing yield gaps while excluding fragile ecosystems from expansion can substantially reduce prospective forest, peatland, and greenhouse-gas impacts relative to historical development trajectories. However, the rebound risk must be recognised: productivity improvement increases returns to oil palm and can encourage expansion. Moreover, landscape evidence shows that profitability and ecological multifunctionality can remain in tension even within smallholder-dominated production landscapes. Accordingly, sustainable intensification requires enforceable spatial constraints, monitoring, and conservation incentives. The

policy package should combine high-quality planting material, agronomic extension, farmer credit, income support during immature replanting years, nutrient optimisation, farm mapping, and enforceable protection of forests, peatlands, and riparian areas. Conservation and productivity should therefore be designed as complements.

Transformation 2: From Compliance Burden to Smallholder Capability

Current sustainability regimes frequently frame smallholders as subjects required to “comply.” The evidence suggests a more productive framing: smallholders should be treated as economic actors whose capability to comply must be developed. This capability perspective shifts policy attention from detecting non-compliance alone to removing the legal, financial, organisational, and informational constraints that produce it.

Apriani et al Watts et al de Vos et al. and Ekaputri et al. collectively demonstrate that farmer participation depends on structures outside the farm itself. These include legal documentation, proximity to certified buyers, cooperatives, access to technical assistance, finance, and market incentives. A smallholder-first transition would therefore combine land-status resolution, affordable mapping, farmer registration, collective certification, replanting finance, extension, digital literacy, and transparent market incentives. Irawan et al. demonstrate that economies of scale can reduce sustainability-assurance costs, strengthening the rationale for group and jurisdictional approaches. Recent choice-experiment evidence also indicates that training and cash premiums can increase smallholders’ willingness to adopt certification, while resilience research suggests that support should be differentiated across producer groups rather than designed for an assumed ‘average’ smallholder. This also changes the economic logic of certification. Forest conservation, traceability, biodiversity protection, and lower emissions generate benefits extending beyond the individual farmer. Requiring low-income farmers to finance all monitoring and compliance costs privately is unlikely to produce socially optimal outcomes. Public funding, downstream supply-chain finance, development finance, and results-based incentives should therefore share the transition cost.

Transformation 3: From Employment Creation to Decent Work and Gender Justice

Palm oil’s contribution to SDG 8 is frequently justified by employment generation. The literature indicates that this is insufficient. Decent work requires employment security, adequate remuneration, safe working conditions, social protection, freedom of association, and accessible grievance mechanisms. Goestoro demonstrates barriers to worker remedies, while gender research shows that women’s economic position cannot be assessed using household-level income alone social sustainability indicators should therefore become as measurable as environmental indicators. Government and certification systems should require transparent reporting on workforce composition, contract status, occupational accidents, protective equipment, wages, social-security registration, grievance outcomes, and gender-disaggregated participation. Companies should also recognize informal and unpaid labour contributions in plantation households. The gender dimension additionally requires targeted access for women to training, land documentation, farmer-group leadership, finance, and sustainability incentives. Without these measures, a transition may improve environmental compliance while reproducing pre-existing economic hierarchies.

Transformation 4: From Waste Management to Circular Low-Carbon Industry

A downstream transformation is equally important. POME, empty fruit bunches, fibres, shells, and other residues should no longer be treated only as waste-management liabilities. They are potential inputs into renewable energy, fertilisers, materials, and integrated biorefinery systems.

The literature on POME indicates significant potential for methane capture and biogas. Because methane has a high warming potential, capturing it can create an especially valuable climate intervention while simultaneously improving waste management. De Rosa, Schmidt and Pasang reinforce the broader point that processing-stage mitigation can materially lower palm-oil greenhouse-gas intensity [41-44].

However, government policy should avoid technology mandates without viable utilisation models. A digester that captures methane but lacks productive gas use or reliable electricity offtake may generate poor economics. Policy needs differentiated instruments for grid-connected mills, remote mills, industrial clusters, and facilities near transport-fuel or thermal-energy demand. Life-cycle assessment should also become routine for palm-based bioenergy. Wahyono et al. Meijide et al. and Paminto, Karuniasa and Frimawaty illustrate how land-use history, plantation-stage emissions, and other upstream conditions determine final performance. Sustainable bioenergy policy should reward verified emissions reductions rather than treating all palm-derived fuels as equally sustainable.

Transformation 5: From Fragmented Traceability to Interoperable Accountability

Traceability is becoming a central condition of access to higher-standard markets. Yet creating multiple disconnected databases may increase compliance costs without producing reliable accountability. An effective national traceability architecture should connect farm identity, geospatial boundaries, land status, farmer organisations, intermediaries, FFB transactions, mill sourcing, certification status, and environmental-risk information. The objective should be interoperability, not simply digitization. Chandra et al. demonstrate why bottom-up information flows matter. A downstream company may possess a zero-deforestation commitment, but that commitment has little behavioural effect if farmers do not know it exists. Traceability should therefore be a two-way system: products move downstream while information, incentives, training, and compliance assistance move upstream. Privacy and fairness also require attention. A national database capable of identifying “high-risk” farms creates power. Producers need transparent rules concerning data access, correction mechanisms, appeal rights, and consequences of classification. Traceability must support accountable governance rather than simply surveillance.

Transformation 6: From Fragmented Standards to Coherent Polycentric Governance

Palm-oil sustainability cannot realistically be governed by a single institution. A polycentric architecture is therefore inevitable: state regulation, ISPO, RSPO, corporate NDPE policies, banks, international buyers, local governments, civil society, and farmer organisations will continue to coexist. The goal should not necessarily be to eliminate institutional diversity but to improve functional coherence. Brandi demonstrates that public and private governance can become complementary when roles are appropriately aligned. Grabs and Garrett caution, however, that goal-based private governance can generate paradoxes when

ambitious commitments are disconnected from implementation realities. Indonesia's revised ISPO architecture creates an opportunity to organise sustainability across plantations, downstream processing, and bioenergy. This should be accompanied by clearer outcome indicators, stronger auditor accountability, public transparency, consistent enforcement, and accessible mechanisms for grievances.

International regulatory relations also require cooperative governance. Kettunen and Pratiwi show that EU–Indonesia palm-oil relations are shaped by competing narratives. Indonesia has an interest in ensuring that deforestation-free trade rules do not merely become external trade barriers, while importing markets have an interest in credible environmental assurance. Cooperation should focus on interoperability of traceability systems, recognition of credible legal data, technical assistance, and mechanisms preventing smallholder exclusion.

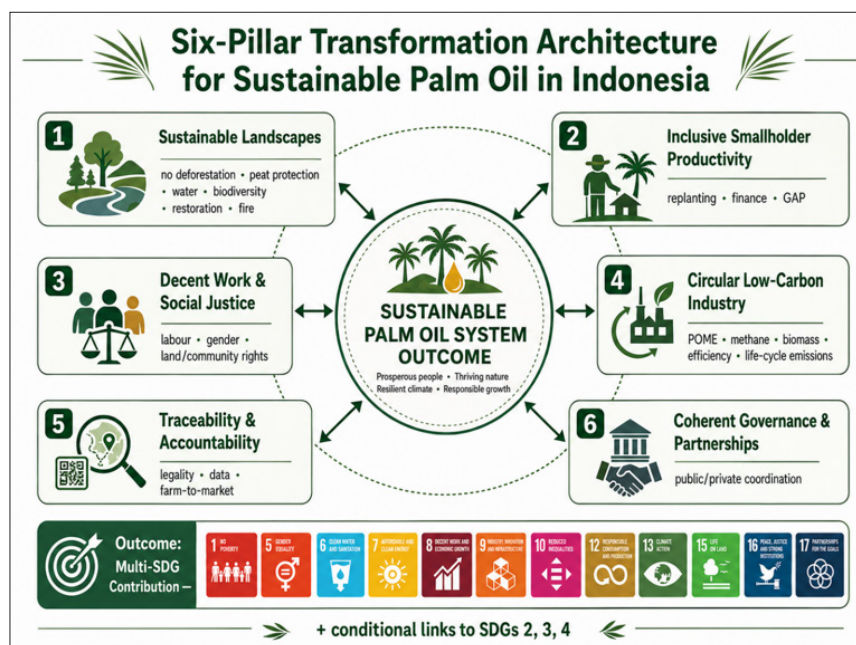


Figure 4: Six-Pillar Transformation Architecture

Figure 4 consolidates the discussion into an integrated model. Sustainable palm oil is located at the centre as the result of interactions among six transformations rather than as an automatic product of any single certification scheme.

Figure 4: Six-Pillar Transformation Architecture for Sustainable Palm Oil in Indonesia

The architecture clarifies the article's central proposition. None of the pillars is sufficient on its own. High smallholder productivity without landscape protection can accelerate expansion; environmental protection without social inclusion can marginalize farmers; traceability without land reform can formalize exclusion; circular processing without sustainable feedstock can still have a high life-cycle footprint; and certification without accountable institutions cannot guarantee justice. Comprehensive sustainable palm oil therefore exists only where these pillars reinforce each other.

An Integrated Policy Architecture

The synthesis suggests that policy sequencing should distinguish short-, medium-, and long-term interventions. Sequencing is necessary because immediate inclusion and compliance bottlenecks must be resolved while longer-horizon landscape restoration, technological upgrading, and institutional reform are built in parallel.

Short-term priorities

First, government should accelerate resolution of smallholder land documentation and create differentiated pathways for legitimate smallholders facing administrative deficiencies. Land-status resolution should be connected directly to farmer registries, replanting eligibility, and traceability. Second, replanting support

should combine finance with income-bridging mechanisms, high-quality seedlings, extension, and legally enforceable no-expansion conditions. A loan or subsidy alone cannot solve the transition problem documented by Petri et al Siregar et al and Hendrawan and Musshoff. Third, farmer organisations should be strengthened as sustainability service platforms. Cooperatives and producer groups can aggregate extension, mapping, certification, credit, and marketing rather than functioning only as administrative requirements. Fourth, high-impact industrial mitigation opportunities, especially POME methane capture where technically feasible, should be accelerated. Fifth, labour and gender safeguards should be incorporated into routine monitoring with measurable indicators rather than qualitative commitments alone.

Medium-Term Priorities

Indonesia should build an interoperable farm-to-market traceability backbone. Such a system should integrate existing public and private datasets rather than impose repeated data entry on farmers. Certification support should increasingly adopt group, landscape, and jurisdictional approaches where these can credibly reduce transaction costs without weakening standards. The evidence on certification costs and market participation suggests that individual-farmer approaches alone will not produce inclusion at the required scale. Life-cycle sustainability metrics should also be applied downstream. Bioenergy policies should include greenhouse-gas performance thresholds, methane management, and feedstock-risk criteria. At landscape scale, jurisdictions should link forest monitoring with farm productivity, fire prevention, watershed protection, restoration, and smallholder development. This would help move sustainability governance beyond the boundaries of certified concessions.

Long-Term Priorities

The long-term objective should be a climate-resilient and economically competitive palm-oil economy in which output growth is progressively decoupled from ecosystem conversion. This requires restoration of degraded peat and riparian zones, improved landscape connectivity, higher productivity on existing legal plantations, technologically advanced low-emission processing, and diversified rural economies. Indonesia should also move from compliance-based sustainability assessment towards outcome-based sustainability accounting. A national indicator set could track productivity per hectare on existing plantations, smallholder income and income stability, women's participation and control over economic resources, decent-work compliance, the share of smallholders with resolved land documentation, and the proportion of fresh fruit bunches traceable to farm. Environmental and governance indicators should additionally cover deforestation and peat-conversion rates, water quality, methane captured per tonne of fresh fruit bunches, life-cycle greenhouse-gas intensity, biodiversity and restoration outcomes, independent-smallholder access to certified or verified sustainable markets, and grievance-resolution performance. Together, these indicators would enable policymakers to distinguish substantive sustainability improvements from growth in certification numbers alone.

Conclusion and Policy Recommendations

This qualitative literature review demonstrates that sustainable palm oil can make meaningful contributions to a broad range of Sustainable Development Goals, but those contributions are conditional on how the sector is organised. The strongest direct pathways concern SDG 1 (No Poverty), SDG 5 (Gender Equality), SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), SDG 10 (Reduced Inequalities), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), SDG 15 (Life on Land), SDG 16 (Peace, Justice and Strong Institutions), and SDG 17 (Partnerships for the Goals). Important but more conditional relationships also exist with SDGs 2, 3, and 4. The evidence does not support treating these contributions as automatic consequences of producing palm oil. Instead, the magnitude and direction of SDG impacts depend on land-use history, productivity, farm organisation, labour conditions, gender relations, environmental management, processing technology, traceability, market structure, and institutional quality. A particularly important conclusion is that certification should not be equated with sustainable palm oil. Certification remains valuable as a standard-setting, verification, learning, and market-governance instrument. However, research on certification reveals heterogeneous poverty effects, high compliance costs, legal and organisational barriers, unequal market participation, and substantial dependence on external facilitation. Sustainable palm oil must therefore be evaluated using substantive environmental and social outcomes. Smallholders are at the centre of the transformation challenge. Policies that increase sustainability requirements without solving farmer documentation, finance, agronomic capacity, replanting, organisation, and market-access problems risk creating a two-tier sector: sophisticated sustainable supply chains serving high-standard markets alongside excluded producers selling into less demanding channels. Recent evidence on the limited reach of zero-deforestation commitments makes this risk especially clear. Replanting and yield-gap closure emerge as major leverage points because they can simultaneously increase income and reduce the amount of additional land required for production. However, they are sustainable only where coupled with enforceable forest and peat protection. The appropriate policy

is therefore not intensification alone but sustainable intensification with land safeguards. Similarly, traceability should be paired with legalisation and capability building. Digital farm maps cannot substitute for land governance, and identifying non-compliance does not resolve its causes. Indonesia should establish an interoperable traceability infrastructure that reduces rather than multiplies administrative burdens and allows sustainability information, technical support, and incentives to travel upstream.

Social sustainability requires an equivalent transformation. Employment generation must evolve into decent work, and household welfare analysis must evolve into attention to gendered distribution, workers' rights, community rights, and access to justice. Strong environmental performance cannot compensate for exploitative labour or unresolved dispossession. Downstream, the expansion of ISPO's policy scope offers an opportunity to incorporate circular and life-cycle principles into national palm-oil sustainability. POME methane capture, biomass valorisation, industrial efficiency, and low-carbon energy can strengthen contributions to SDGs 6, 7, 9, 12, and 13, but sustainability claims should depend on verified life-cycle outcomes. The policy implication is a six-pillar transformation encompassing sustainable landscapes; inclusive smallholder productivity; decent work and social justice; circular low-carbon industry; traceability and accountability; and coherent governance and partnerships. These pillars must be implemented together because weaknesses in one dimension can neutralize improvements in another. Ultimately, Indonesia does not face a simple choice between palm oil and sustainable development. The relevant choice is between different development trajectories for an already economically and socially important sector. A trajectory built on continued ecological conversion, fragmented governance, unequal compliance capacity, and narrow certification metrics will struggle to align with the SDGs. By contrast, a trajectory that improves existing-land productivity, secures farmer and community rights, internalises environmental costs, protects forests and peat, creates decent work, closes traceability gaps, valorises waste, and distributes the costs and benefits of sustainability fairly can reposition palm oil from a source of persistent development trade-offs towards an integrated platform for advancing multiple SDGs. The long-term measure of success should therefore not be how much "sustainable palm oil" is claimed or certified, but whether the palm-oil economy produces measurable improvements in human well-being without eroding the ecological and institutional foundations on which future well-being depends. This outcome-based criterion is more demanding than certification coverage, but it is also more consistent with the integrated logic of the SDGs.

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