



From Mandatory Certification to Value-Chain Transformation: Reassessing Indonesia's ISPO Architecture for Global Market Legitimacy, Smallholder Inclusion, Ecological Integrity, and National Resilience

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ABSTRACT

Indonesia's Sustainable Palm Oil (ISPO) system is undergoing a fundamental transition from plantation-oriented certification toward an integrated sustainability architecture covering plantations, downstream palm-oil industries, and palm-based bioenergy. This qualitative literature review synthesizes peer-reviewed research published during 2020–2026 to examine whether this expanded architecture can reconcile global market legitimacy, smallholder inclusion, productivity improvement, ecological integrity, industrial upgrading, and national resilience. The literature indicates that certification can contribute to better environmental management, traceability, and selected socioeconomic outcomes, but certification alone does not guarantee substantive sustainability. Smallholder participation remains constrained by land legality, transaction costs, organisational capacity, finance, information asymmetry, and uneven incentives. Productivity improvement and replanting can reduce incentives for land expansion, although rebound effects require complementary land-use governance. Environmental outcomes depend increasingly on landscape-scale safeguards addressing deforestation, peatlands, biodiversity, water systems, and greenhouse-gas emissions

INTRODUCTION

Palm oil occupies an unusual position in contemporary sustainability debates. It is simultaneously one of the world's most productive vegetable-oil crops, a major contributor to rural livelihoods and export earnings, an important input into food and industrial products, and a feedstock for renewable energy. At the same time, historical expansion of oil-palm cultivation has been associated with forest conversion, peatland degradation, greenhouse-gas emissions, biodiversity loss, land conflicts, and contested changes in rural livelihoods. These multiple roles explain why sustainability governance in the palm-oil sector cannot be reduced to a single environmental criterion or a single certification label. It involves interactions among agricultural productivity, land governance, social inclusion, supply-chain transparency, international trade, industrial policy, and energy security (Qaim et al., 2020; Meijaard et al., 2020; Yu et al., 2024).

Indonesia lies at the centre of these debates because of the scale and diversity of its palm-oil economy. Industrial estates coexist with plasma schemes, organised farmers, and large numbers of independent smallholders. Fresh fruit bunches pass through mills before crude palm oil and palm-kernel products are processed by refineries and increasingly diversified downstream industries. Palm oil also supports an expanding bioenergy system. Consequently, sustainability problems originating at farm level can propagate through processing and trade, while downstream market requirements can influence production practices far upstream. A governance arrangement restricted to individual plantations therefore risks overlooking important interactions across the chain.

The Indonesian Sustainable Palm Oil certification system was developed to embed national legal and sustainability requirements into palm-oil production. Earlier studies nevertheless identified institutional ambiguity, uneven implementation capability, incomplete incentives, and difficulties involving independent smallholders. Researchers also noted that certification outcomes depend substantially on pre-existing farm characteristics, institutional support, the credibility of auditing, market incentives, and the wider regulatory environment (Choiruzzad et al., 2021; Watts et al., 2021; Dharmawan et al., 2021; Grabs and Garrett, 2023).

A major regulatory change occurred in March 2025. Presidential Regulation No. 16/2025 replaced Presidential Regulation No. 44/2020 and defined ISPO as a system covering oil-palm plantation businesses, downstream palm-oil industries, and palm-oil bioenergy businesses. The regulation explicitly links the system to social, economic, and environmental viability, improved market acceptance, and sustainability throughout the supply chain (Republic of Indonesia, 2025a). This change is analytically significant because ISPO can no longer be understood only as a plantation-certification instrument.

The wider architecture has subsequently been operationalised through sector-specific regulations. Minister of Agriculture Regulation No. 33/2025 regulates plantation-sector ISPO certification and includes provisions on principles and criteria, certification procedures, supervision, financing

facilitation, and incentives for smallholders (Republic of Indonesia, 2025b). Minister of Industry Regulation No. 38/2025 covers downstream palm-oil industries and became effective on 3 May 2026 (Republic of Indonesia, 2025c). Minister of Energy and Mineral Resources Regulation No. 3/2026 extends implementation into palm-based bioenergy and explicitly includes feedstock traceability, chain-of-custody arrangements such as segregation or mass balance, environmental management, and periodic certification oversight (Republic of Indonesia, 2026).

This transformation occurs while sustainability-related market requirements are also changing internationally. Palm oil is among the commodities covered by the European Union Deforestation Regulation (EUDR). Under the currently published implementation schedule, the regulation applies to large and medium operators from 30 December 2026 and to most micro and small operators from 30 June 2027 (European Commission, 2026a). The EUDR places legal responsibilities primarily on relevant operators and traders placing covered products on or exporting them from the EU market. Smallholders located outside the EU who do not themselves place products directly on the EU market may nevertheless be required by buyers to supply information such as production-plot geolocation (European Commission, 2026b).

This distinction is critical. ISPO certification cannot simply be described as equivalent to EUDR compliance. The two instruments have different legal bases, subjects of obligation, procedures, and compliance mechanisms. A more useful question concerns **interoperability**: whether information and assurance produced under national sustainability governance can lower information gaps, facilitate supply-chain due diligence, and demonstrate credible sustainability performance without unnecessarily duplicating administrative costs (Gilbert, 2024; Kettunen and Pratiwi, 2025).

The literature also reveals a second challenge. Certification frequently encounters the greatest obstacles among producers with the fewest resources. Independent smallholders may face incomplete land documentation, limited access to extension services, certification fees, group-organisation requirements, unstable market incentives, limited bargaining power, and difficulties maintaining detailed farm records. A standard designed to improve sustainability could therefore inadvertently produce exclusion unless certification requirements are accompanied by institutional and financial support (Apriani et al., 2020; Watts et al., 2021; Pramudya et al., 2022; Ogahara et al., 2022; de Vos et al., 2023; Ekaputri et al., 2025; Erdi et al., 2026).

A third challenge concerns the relationship between productivity and conservation. Indonesia can increase palm-oil output either through additional land, through improved productivity on existing plantations, or through combinations of both. Research increasingly supports replanting and agronomic improvement as important pathways for closing yield gaps, particularly among smallholders. Yet productivity increases do not automatically produce land sparing. Higher profitability could also encourage further expansion unless accompanied by effective land-use rules and environmental safeguards (Monzon et al., 2021; Monzon et al., 2023; Zhao et al., 2023; Li, 2024).

A fourth challenge concerns the downstream economy. Sustainability cannot stop at the mill gate if future palm-oil development increasingly involves refining, oleochemicals, biomass valorisation, waste treatment, biodiesel, renewable fuels, and other downstream products. Circular-economy technologies can recover energy and materials from residues such as palm-oil mill effluent (POME), while digital technologies may improve supply-chain monitoring. However, industrial upgrading can also shift rather than eliminate environmental burdens if feedstock expansion, energy demand, emissions, or waste are not addressed across the complete life cycle (Nasution et al., 2020; Abdul-Hamid et al., 2022; Suksaroj et al., 2023).

Against this background, the article asks six related questions. First, how does the post-2025 architecture reposition ISPO from plantation compliance toward value-chain governance? Second, what does recent literature indicate about the contribution and limitations of sustainability certification for global market legitimacy and traceability? Third, what conditions determine smallholder inclusion? Fourth, how can productivity improvement and replanting interact with ecological objectives? Fifth, what sustainability implications arise from downstreaming and palm-based bioenergy? Sixth, what integrated governance architecture could reconcile these multiple objectives?

The article contributes by treating ISPO not merely as a certification label but as a potential **sustainability infrastructure** linking legal status, information, agricultural upgrading, environmental safeguards, social legitimacy, industrial transformation, and resilience. This framing enables the analysis to distinguish between three outcomes that are often conflated: **formal compliance, credible market assurance, and substantive sustainability performance**.

LITERATURE REVIEW

1. Sustainability Certification as Public, Private, and Hybrid Governance

Sustainability certification has become an important form of transnational commodity governance. Its attraction arises partly from its ability to translate broad concepts such as sustainable production, legality, environmental protection, and social responsibility into principles, criteria, indicators, audits, and traceable transactions. However, certification systems differ considerably in institutional design. Some are private and voluntary; others are state-led and mandatory; still others combine governmental requirements with market-based incentives.

Palm oil demonstrates this institutional plurality particularly clearly. Private schemes such as the Roundtable on Sustainable Palm Oil (RSPO) interact with national regulatory schemes such as ISPO. Evidence from Indonesia shows that certification can affect management practices and certain environmental or socioeconomic outcomes, but effects are heterogeneous and strongly dependent on where certification occurs, which producers participate, what baseline conditions prevail, and how certification is enforced (Lee et al., 2020; Heilmayr et al., 2020; Santika et al., 2021).

Lee et al. (2020), for example, illustrate the importance of considering environmental and development trade-offs rather than assuming that certification creates uniformly positive outcomes. Heilmayr et al. (2020) further

highlight the possibility that environmental benefits inside certified production systems can interact with changes outside certified boundaries. These findings indicate that certification should be understood as one component of broader landscape and market governance rather than as an autonomous solution.

Evidence concerning welfare is similarly nuanced. Santika et al. (2021) found that relationships between sustainability certification and village-level well-being vary according to context and pre-certification conditions. Such results caution against judging certification solely from adoption rates. The relevant question is whether certification changes behaviour, reduces environmental risk, increases opportunities for producers, and improves accountability relative to plausible counterfactual conditions.

More recent research emphasises the paradoxes of goal-based sustainability governance. Standards must be sufficiently stringent to produce credibility while sufficiently accessible to attract and retain diverse producers. Requirements that are easy to satisfy can weaken legitimacy; requirements that are costly or administratively complex can exclude less-resourced producers. Grabs and Garrett (2023) therefore show why implementation institutions and incentive structures are as important as formal standards.

ISPO adds another dimension because its mandatory and state-based character differentiates it from voluntary private certification. Choiruzzad et al. (2021) identify institutional ambiguities in earlier ISPO arrangements, including questions concerning the allocation of authority and relationships among governance levels. The post-2025 expansion potentially addresses part of the earlier fragmentation by embedding plantations, downstream industries, and bioenergy within a common umbrella, but it also increases coordination requirements among ministries, auditors, firms, farmers, and information systems.

At the jurisdictional level, sustainability governance increasingly seeks to move beyond farm-by-farm certification. Bahrudin et al. (2024) show how jurisdictional initiatives can potentially scale sustainability interventions but also depend on political pathways, institutional alignment, and local implementation. Purnomo et al. (2025) similarly argue for system-level approaches that connect jurisdictional dynamics and theories of change. These perspectives are especially relevant to ISPO because many sustainability outcomes – forest protection, land legality, infrastructure, fire prevention, and farmer support – cannot be produced by individual certificates alone.

2. Global Market Legitimacy, EUDR, and Traceability

Certification systems perform at least two market-related functions. First, they communicate claims about how a commodity was produced. Second, they can reduce information asymmetry by requiring records, audits, and chain-of-custody controls. These functions become more important when importing markets increasingly require verifiable evidence about product origin.

The EUDR illustrates this shift from broad sustainability claims toward specific due-diligence requirements. The European Commission describes palm oil as one of the commodities within scope and requires relevant operators to demonstrate that covered products meet regulatory requirements, including

those related to deforestation (European Commission, 2026a). This creates new importance for origin information, plot-level data, chain-of-custody records, and communication between upstream suppliers and downstream actors.

Gilbert (2024) interprets the EUDR as an important development in commodity-related environmental regulation while also drawing attention to implementation challenges. Kettunen and Pratiwi (2025) show that EU-Indonesia palm-oil relations involve competing policy narratives and bargaining contexts, which makes technical interoperability and evidence-based engagement particularly important.

From an Indonesian perspective, an effective strategy therefore does not require assuming that a domestic certificate substitutes for foreign legal obligations. Instead, traceability systems developed for ISPO may become useful infrastructure if data are accurate, auditable, interoperable, and accessible to legitimate supply-chain actors. The distinction between **certification equivalence** and **data interoperability** is fundamental: the former assumes that two institutional regimes are interchangeable, while the latter recognises their differences but seeks to make information transferable.

The environmental credibility of certification also depends on life-cycle and sourcing performance. Schmidt and Weidema (2026), in a comparative life-cycle assessment differentiating palm-oil production by certification and producer characteristics, reinforce the need to evaluate environmental performance empirically rather than treating all certified supply as homogeneous. This is particularly relevant as downstream industries increasingly seek measurable carbon and environmental attributes in addition to legal certification.

3. Smallholders and the Inclusiveness Challenge

Independent smallholders constitute one of the most difficult tests of sustainable palm-oil governance. Apriani et al. (2020) show that smallholder certification is shaped by institutional support and local conditions rather than by farmer motivation alone. Watts et al. (2021) identify multiple barriers facing smallholders attempting to obtain sustainable palm-oil certification, while Dharmawan et al. (2021) emphasise agrarian, structural, and cultural constraints that shape readiness for implementation.

The economics of participation are equally important. Oliphant and Simon (2022) analyse whether certification is economically worthwhile from a smallholder perspective, illustrating the importance of transaction costs and benefits. Pramudya et al. (2022) emphasise incentives under mandatory certification and argue that financial and non-financial support must be aligned with the practical constraints faced by farmers. A major review by Ogahara et al. (2022) concludes that evidence of positive impacts from smallholder sustainability initiatives remains limited and uneven, while significant implementation and knowledge gaps persist.

Pre-certification conditions also matter. De Vos et al. (2023) show that independent smallholders may enter certification pathways with very different levels of legal documentation, organisational readiness, agronomic practice, and information. Irawan et al. (2024) subsequently demonstrate the importance of

reducing the costs involved in scaling sustainability standards. Renner et al. (2024) find that certification can be associated with economic and farm-management effects, but outcomes depend on implementation and cannot simply be generalised to all producers. Reich and Musshoff (2025) likewise identify the practical pathway to certification as a central issue rather than treating certification as a binary condition. Recent evidence also shows uneven participation of independent versus contract smallholders in certified mill markets and persistent policy-level barriers to accelerated certification (Ekaputri et al., 2025; Erdi et al., 2026).

The central implication is that mandatory certification needs a differentiated implementation strategy. Producers operating with professional administrative teams and established land records face very different compliance costs from farmers managing a few hectares with incomplete documentation. Uniform criteria can coexist with differentiated support mechanisms, including cooperative organisation, technical assistance, digital services, legal facilitation, transition finance, and group-based auditing.

4. Productivity, Replanting, and Sustainable Intensification

Sustainable intensification is important because the environmental footprint of palm oil depends partly on how much output can be produced from land already under cultivation. Monzon et al. (2021) argue that climate-smart intensification can contribute to higher yields without relying solely on further land expansion. Subsequent field-level research demonstrates that agronomic management explains substantial variation in smallholder yield gaps (Monzon et al., 2023).

Closing these gaps requires more than fertiliser. Planting material, palm age, harvesting frequency, nutrient management, water conditions, farmer knowledge, access to inputs, and market incentives all matter. At the same time, a substantial area of ageing or low-productivity plantation requires replanting. Zhao et al. (2023) identify replanting and yield improvement as important strategies for sustaining production, while Jelsma et al. (2024) demonstrate the significance of collective action and institutional resilience during long-term smallholder cultivation.

Replanting creates an especially difficult income problem. Farmers must bear establishment expenditure and lose mature-palm revenue while new trees develop. Petri et al. (2024) therefore identify finance, uncertainty, institutional arrangements, and farmer circumstances as recurrent challenges. Hendrawan and Musshoff (2024) show that the design of replanting subsidies matters to farmer preferences, while Siregar et al. (2024) demonstrate that willingness to participate cannot be assumed simply because replanting is agronomically desirable.

Fosch et al. (2023) link replanting of unproductive smallholder plantations to broader Sustainable Development Goal outcomes, a connection also supported by recent empirical analysis of smallholder palm oil and the SDGs (Sukiyono et al., 2024). Hendrawan et al. (2024) similarly emphasise resilience to future industrial challenges, whereas Li (2024) frames the policy problem explicitly as securing smallholder livelihoods without additional deforestation. These

findings connect productivity policy directly with conservation and social policy rather than treating it as a purely agronomic intervention.

5. Environmental Integrity Beyond Farm Certification

The environmental literature demonstrates why plantation-level compliance must be embedded in landscape-level governance. Meijaard et al. (2020) show that environmental impacts of palm oil depend substantially on land-use history, previous ecosystem type, production practices, and comparative alternatives. Gaveau et al. (2022) report that declining Indonesian deforestation coincided with lower oil-palm expansion and commodity-market conditions, demonstrating that land-use change is influenced by both policy and economic drivers. Xu et al. (2022), however, show that recent expansion has continued to occur into carbon-rich forests in some contexts, underscoring persistent risk. Recent research further shows that water and peatland management remain material components of plantation sustainability, including watershed impacts and the climate-mitigation potential of rewetting degraded peat plantations (Asmara and Randhir, 2024; Novita et al., 2024).

Biodiversity outcomes also require more refined strategies than simply separating plantations from protected forests. Fleiss et al. (2023) show that zero-deforestation approaches must consider biodiversity in grassy and dry forest ecosystems as well as conventional humid-forest definitions. Zemp et al. (2023) demonstrate that tree islands within oil-palm landscapes can enhance biodiversity and ecosystem functioning, while Iddris et al. (2023) find that mechanical weeding can improve ecosystem multifunctionality and economic performance relative to more chemically intensive management.

Landscape configuration and riparian protection are also relevant. Rojas-Castillo et al. (2023) show that forest buffer strips can reduce adverse effects on stream communities, while Azhar et al. (2023) demonstrate that the spatial disturbance associated with replanting can have biodiversity implications that vary with production structure. Fire risk further illustrates the importance of landscape context: Santika et al. (2020) find that fires in Kalimantan are influenced by interactions among climate variation, land type, and village livelihoods. Local and landscape characteristics also shape natural-enemy communities in Indonesian oil-palm plantations, reinforcing the need for biodiversity management at multiple spatial scales (Rizali et al., 2024).

6. Social Sustainability and Access to Justice

Palm-oil sustainability has an important social dimension because changes in land use redistribute opportunities, risks, and authority. Toumbourou and Dressler (2021) document differentiated gendered livelihood responses in an oil-palm enclave, showing why household-level impacts should not be assumed to be uniform.

Land conflict is an even more fundamental governance challenge. Berenschot et al. (2022) examine contentious politics surrounding palm-oil expansion and show how formal institutions interact with local activism and political relationships. Afrizal et al. (2023), evaluating the capacity of RSPO grievance arrangements to address palm-oil conflicts, identify unequal access to justice as an important concern. Berenschot et al. (2024) further analyse the role of corporations in contentious land politics, while Berenschot and Dhiaulhaq

(2025) examine mechanisms through which land dispossession and effective “rightlessness” can emerge.

These studies indicate that certification cannot substitute for land governance, procedural justice, and credible conflict-resolution mechanisms. A producer could satisfy numerous technical criteria while underlying tenure disputes remain unresolved. Consequently, social legitimacy requires mechanisms through which affected communities can access information, challenge decisions, pursue grievances, and obtain remedies.

7. Downstreaming, Circular Economy, and Bioenergy

Industrial upgrading creates another frontier for sustainability governance. Nasution et al. (2020) compare treatment technologies for palm-oil mill effluent within the context of sustainability standards, illustrating how environmental performance depends on technology choices as well as certification. POME can be treated as waste, but it can also become an energy resource when methane is captured and converted to biogas.

Circular-economy approaches extend this logic. Abdul-Hamid et al. (2022) link Industry 4.0, circular-economy practices, and sustainability in the palm-oil sector. Suksaroj et al. (2023) examine co-digestion pathways for organic residues, while Sodri and Septriana (2022) evaluate techno-economic and environmental dimensions of biogas generation from POME. These technologies can simultaneously reduce untreated organic loads, lower methane emissions, and generate useful energy under suitable operating conditions.

Supply-chain management is equally important. Hafiz et al. (2022) demonstrate how supply-chain disruptions exposed vulnerabilities in sustainable palm-oil management. Adwiyah et al. (2023) analyse sustainable supply-chain performance through the triple-bottom-line perspective, while El Hathat et al. (2023) explore blockchain-based approaches to greenhouse-gas information in palm-oil supply chains. Digital technologies can strengthen information integrity, but they do not automatically guarantee accurate input data or equitable participation.

Palm-based biodiesel links these issues directly to national energy policy. Mayandi and Suharjito (2024) demonstrate the importance of balancing biodiesel feedstock requirements with food, export, and production considerations. Their systems perspective is valuable because expanded bioenergy demand cannot be evaluated independently of land availability, productivity, food-industry demand, export markets, and environmental constraints.

METHODOLOGY

1. Research Design

This study employs a **qualitative literature review (QLR)**. It is deliberately designed as an interpretive and thematic synthesis rather than a systematic literature review. The objective is not to claim exhaustive retrieval of every publication, estimate a pooled effect size, or construct a PRISMA-based evidence inventory. Instead, the review integrates recent literature across several bodies of scholarship that are usually examined separately: certification governance, international market requirements, smallholder inclusion, agronomic intensification, replanting, biodiversity and deforestation, land conflicts, circular economy, and bioenergy.

A qualitative approach is particularly appropriate because the core research problem is integrative. Many relevant studies have different units of analysis, including farms, villages, companies, landscapes, supply chains, certification organisations, and policy institutions. Their outcomes are also heterogeneous, covering yields, household welfare, forest loss, biodiversity, transaction costs, legal compliance, conflict, and emissions. Converting these heterogeneous outcomes into a single quantitative effect would obscure rather than clarify the institutional relationships examined here.

2. Literature Boundary and Retrieval Logic

The principal literature window covers **January 2020 to September 2026**, consistent with the requirement to prioritise recent peer-reviewed research. Publications were selected purposively according to their relevance to one or more of the analytical domains. Peer-reviewed journal research formed the principal evidence base, while official Indonesian legal instruments and current European Commission materials were used to establish the contemporary regulatory context. Legal and policy materials are therefore not counted toward the minimum number of journal references.

The thematic retrieval logic used combinations of concepts including *Indonesian Sustainable Palm Oil, ISPO, RSPO, palm oil certification, smallholder certification, oil palm productivity, replanting, traceability, deforestation, biodiversity, peatland, land conflict, circular economy, POME, biodiesel, bioenergy, and EUDR*. Citation chaining was used to connect closely related empirical and conceptual studies.

No numerical statement is made regarding the total universe of publications identified or excluded because the study does not employ a systematic screening protocol. This is intentional. The research is a QLR and should not be interpreted as an SLR, bibliometric review, or meta-analysis.

3. Inclusion Logic

Four principal considerations guided literature inclusion. First, studies needed to address the Indonesian palm-oil sector directly or provide evidence clearly relevant to its value-chain sustainability challenges. Second, preference was given to empirical studies, high-quality reviews, and conceptual analyses published in reputable journals. Third, the evidence set deliberately included both supportive and critical findings regarding certification to avoid treating sustainability standards as either inherently effective or inherently ineffective.

Fourth, studies were selected to represent interacting scales ranging from plot and household to jurisdiction, supply chain, and international market.

This approach permits analytical triangulation. For example, smallholder certification can be examined simultaneously from farm economics research, institutional analysis, land-governance research, and sustainability-governance scholarship. Similarly, biodiesel can be analysed alongside life-cycle impacts, feedstock availability, circular-economy opportunities, and national resilience.

4. Thematic Analysis

The analysis proceeded in four conceptual stages. First, the literature was coded according to major substantive topics. Second, related codes were consolidated into broader themes. Third, relationships and tensions across themes were examined—for example, traceability versus inclusion, intensification versus expansion risk, and bioenergy growth versus feedstock pressure. Fourth, the themes were integrated into an **ISPO Sustainability-Resilience Framework**.

Nine core themes emerged: regulatory architecture; global market legitimacy; traceability and data; smallholder inclusion; productivity and replanting; ecological integrity; social sustainability; downstreaming and circular economy; and bioenergy/national resilience. Together, these themes provide the analytical structure for the results and discussion and enable cross-theme comparison of implementation conditions and outcomes.

Particular attention was paid to contradictory evidence. A certification programme may generate benefits in one institutional context while producing weak outcomes in another. Such variation was treated as analytically important because it helps identify enabling conditions.

5. Limitations of the Review

Three limitations should be recognised. First, the QLR is interpretive and purposive rather than exhaustive. Second, causal evidence specifically evaluating the post-2025 ISPO architecture is not yet available because implementation is recent. Much of the empirical certification literature therefore concerns earlier ISPO arrangements, RSPO, or related palm-oil sustainability interventions. Third, regulatory and international-market requirements are evolving rapidly. Current legal descriptions in this paper should therefore be understood as reflecting the regulatory position available up to September 2026.

RESULT

1. Theme 1: ISPO Is Moving from Plantation Certification toward Value-Chain Governance

The most consequential finding is institutional. Indonesia's new ISPO framework formally widens the object of sustainability governance. Whereas previous public discussion frequently treated ISPO primarily as a plantation certificate, the post-2025 architecture explicitly brings plantation businesses, downstream industries, and palm-based bioenergy under the same national sustainability umbrella (Republic of Indonesia, 2025a). This broader scope creates a common policy umbrella for sustainability assurance across previously separated segments of the palm-oil value chain.

This transition alters the meaning of certification. Under a plantation-centred model, the core question is whether a plantation follows prescribed requirements. Under value-chain governance, the question becomes whether sustainability information and controls can travel across multiple transformations of the commodity. Fresh fruit bunches may move through collectors and mills; crude oil may be combined, refined, fractionated, or transformed into industrial products; part of the supply may enter biodiesel or other bioenergy pathways. Traceability therefore becomes a relational property of the chain rather than a document held by an individual farm.

As illustrated in Figure 1, the institutional evolution of ISPO can be interpreted as a transition from a predominantly plantation-oriented assurance model toward an integrated governance architecture connecting production, processing, downstream industries, bioenergy, and domestic and international markets. The figure highlights the widening governance scope and the need to maintain continuity of sustainability information as palm products move across successive value-chain stages.

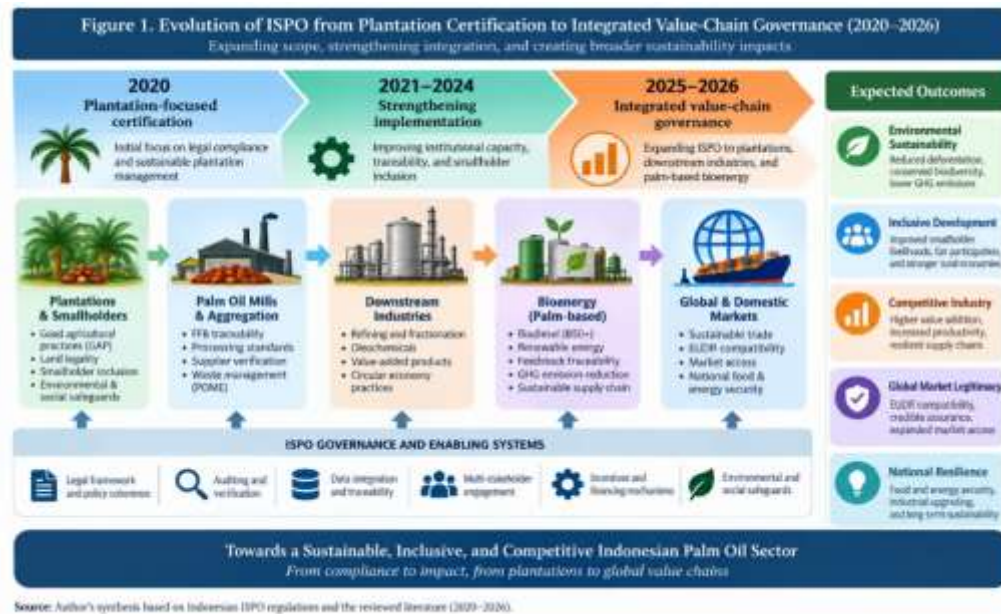


Figure 1. Evolution of ISPO from Plantation Certification to Integrated Value-Chain Governance

Source: Author's synthesis based on Indonesian ISPO regulations and the reviewed literature.

Figure 1 emphasises that expanding the scope of certification also expands the coordination problem. Agricultural authorities, industrial regulators, energy institutions, certification bodies, local governments, farmers, mills, and downstream firms must generate compatible information. Consequently, institutional integration is not achieved merely by placing several sectors within a single presidential regulation. It depends on whether implementation rules, audit procedures, databases, and incentives function coherently.

2. Theme 2: International Legitimacy Depends More on Credible Evidence than on the Label Alone

The literature does not support an assumption that possession of a sustainability certificate automatically produces international market legitimacy. Market acceptance depends on the credibility, transparency, enforcement, and relevance of the evidence produced. Certification can facilitate assurance, but buyers and importing jurisdictions may impose additional legal obligations.

The EUDR demonstrates this distinction clearly. Its requirements apply according to specific supply-chain roles under EU law, and due diligence remains the responsibility of relevant actors defined by the regulation (European Commission, 2026b). An ISPO certificate may contribute useful information on legality, traceability, or sustainable production, but it is not in itself a legal replacement for an EUDR due-diligence statement.

This suggests that the most productive objective for ISPO is interoperability rather than claimed equivalence. If ISPO data systems can generate reliable land identifiers, plot information, supply-chain records, legality documentation, and auditable sustainability evidence, actors may avoid duplicating data collection for multiple markets. If the systems remain

fragmented or difficult to verify, certification could coexist with additional market-specific compliance burdens.

The result is a shift from “certificate recognition” toward “evidence portability”. This concept is particularly important for smallholders because multiple parallel documentation systems create disproportionately high compliance costs.

3. Theme 3: Traceability Is the Operational Backbone of the Expanded Architecture

Once certification expands downstream, traceability becomes indispensable. The physical commodity may change ownership and form several times. A credible system must therefore establish rules for linking product volumes and sustainability claims to verified upstream sources.

The literature on sustainable supply-chain management and digital technology demonstrates significant potential. Adwiyah et al. (2023) highlight the importance of economic, environmental, and social performance across the palm-oil chain. El Hathat et al. (2023) illustrate the potential role of blockchain-enabled technologies in emissions information, while Hafiz et al. (2022) show how disruptions reveal weaknesses in supply-chain resilience.

Yet digitisation does not eliminate underlying governance problems. A blockchain can preserve data once entered but cannot guarantee that the original land boundary, farm identity, or production record was correct. Effective traceability therefore requires trusted first-mile data, reliable farmer registration, plot mapping, legitimate land documentation, transparent aggregation rules, and credible auditing.

Figure 2 conceptualises traceability not as a stand-alone digital application but as an information architecture connecting farm-level legality and production data with physical commodity flows and downstream sustainability claims. It also identifies the assurance functions that must operate across every stage, including data governance, auditability, interoperability, grievance handling, and corrective action.



Figure 2. Proposed ISPO Traceability and Sustainability Assurance Architecture
Source: Author's Synthesis

The figure also shows why “One Data” or integrated data ambitions matter. A plot may otherwise appear under different names or identifiers in agricultural, land, certification, and supply-chain databases. Interoperability need not mean that all information is placed in a single database. Rather, authorised systems require common identifiers, compatibility rules, quality controls, and clear responsibilities for correcting errors.

4. Theme 4: Smallholders Are the Critical Test of ISPO Inclusiveness

The reviewed literature consistently identifies smallholder inclusion as a central challenge. Barriers are not simply informational. They are structural. Farmers may be asked to demonstrate legality even where land administration has historically been incomplete. They may need farm records without having previously used formal record-keeping. They may need to join groups, change agronomic practices, finance audits, or wait for uncertain benefits (Apriani et al., 2020; Watts et al., 2021; Dharmawan et al., 2021; Oliphant and Simon, 2022). Mandatory certification can address one weakness of voluntary systems—the risk that only already capable producers participate—but it cannot eliminate capacity differences. If compliance becomes compulsory while support remains insufficient, the result can be delayed certification, informal marketing, or exclusion from preferred supply chains.

Pramudya et al. (2022) therefore place incentives at the centre of mandatory certification. De Vos et al. (2023) demonstrate the diversity of pre-certification conditions, while Irawan et al. (2024) show the importance of reducing certification costs. Renner et al. (2024) and Reich and Musshoff (2025) further indicate that economic benefits and practical pathways matter for sustained participation.

A more inclusive model would bundle certification with services farmers already value: assistance with land documentation, farmer-group strengthening, improved planting material, extension, access to replanting finance, better harvesting practices, digital record systems, and improved market relationships. Under this interpretation, certification becomes an entry point for upgrading rather than a final inspection imposed after farmers have independently solved every constraint.

5. Theme 5: Productivity and Replanting Can Support Conservation – but Only with Safeguards

The literature provides strong justification for combining sustainability certification with productivity policy. Monzon et al. (2023) show that agronomic management explains substantial yield gaps in smallholder systems. Replanting also offers opportunities to replace ageing or low-yielding palms with better material and improved management.

However, the transition is economically difficult. Replanting temporarily removes the farmer’s productive asset and therefore requires both establishment finance and livelihood support. Collective institutions can help coordinate finance, planting material, technical services, and marketing, as demonstrated by Jelsma et al. (2024). Petri et al. (2024), Hendrawan and Musshoff (2024), and Siregar et al. (2024) reinforce the importance of programme design and farmer willingness.

The environmental argument for productivity improvement is strongest when additional production substitutes for expansion. Monzon et al. (2021), Fosch et al. (2023), Li (2024), and Dalheimer et al. (2024) collectively indicate that yield improvement, replanting, farmer welfare, and biodiversity cannot be considered independently.

A rebound risk nevertheless exists. If higher yields increase profitability and land conversion remains possible, intensification could potentially increase rather than reduce incentives to expand. Certification should therefore connect replanting support with land-use safeguards and clear restrictions on expansion into environmentally sensitive areas.

6. Theme 6: Ecological Integrity Requires Landscape-Level Outcomes

The environmental literature challenges a narrow compliance model. A plantation can satisfy many management requirements while important environmental impacts occur outside its boundaries. Deforestation, fire, hydrological change, habitat fragmentation, and river impacts operate at larger spatial scales.

Gaveau et al. (2022) demonstrate that reduced deforestation in Indonesia occurred alongside slower plantation expansion and lower palm-oil prices, illustrating the interaction between governance and economic conditions. Xu et al. (2022) nevertheless show that conversion of carbon-rich forest remains a concern. The implication is that certification should be evaluated against observable land-use outcomes rather than simply the presence of management plans. Evidence on peatland rewetting and watershed impacts further supports outcome-based monitoring beyond plot-level compliance (Novita et al., 2024; Asmara and Randhir, 2024).

Research also shows that biodiversity can be improved within production landscapes. Zemp et al. (2023) demonstrate the value of tree islands; Rojas-Castillo et al. (2023) highlight forest buffers around streams; and Iddris et al. (2023) show that management choices such as mechanical weeding can simultaneously influence ecological functions and profitability. Azhar et al. (2023) further demonstrate that replanting patterns create spatial disturbance that matters for biodiversity. Research on natural enemies similarly indicates that plantation management should account for both local habitat conditions and wider landscape structure (Rizali et al., 2024).

These findings support a hierarchy of intervention: avoid conversion of high-value ecosystems; protect remaining forest and riparian features; restore strategically important habitat; improve plantation management; and monitor landscape outcomes. Certification can formalise parts of this hierarchy but should not reduce ecological integrity to audit documentation.

7. Theme 7: Social Legitimacy Requires Rights and Effective Remedies

The social literature demonstrates that certification must address both livelihoods and rights. Sustainable production cannot be defined exclusively by income improvement if land rights, labour conditions, participation, or access to justice remain unresolved.

Toumbourou and Dressler (2021) show that livelihood effects can differ by gender and household position. Berenschot et al. (2022) reveal how palm-oil expansion can become embedded in contentious political relationships. Afrizal

et al. (2023) demonstrate that the existence of a grievance mechanism does not automatically imply equal ability to use it.

Recent work by Berenschot et al. (2024) and Berenschot and Dhiaulhaq (2025) further indicates that corporate-community land conflicts can persist where formal legal processes, local power relations, and access to remedies are uneven. Certification therefore requires not only grievance procedures but also transparent information, procedural independence, protection from retaliation, reasonable costs, and credible remedial outcomes.

This has implications for land legality within ISPO. Resolving land status is important for sustainable governance, but legality programmes should distinguish between deliberate encroachment, administrative incompleteness, overlapping historical claims, and structural weaknesses in land registration. Otherwise, formalisation processes risk reproducing existing inequalities.

8. Theme 8: Downstreaming Can Increase Value, but Sustainability Must Follow the Commodity

Indonesia's downstream strategy creates opportunities to capture a greater share of value from domestic processing. Refining, oleochemicals, specialty fats, biomaterials, and other derivatives diversify the economic role of palm oil. The post-2025 ISPO architecture is therefore significant because downstream facilities are no longer conceptually disconnected from sustainability certification.

Yet downstreaming changes rather than eliminates environmental impacts. Industrial facilities use energy and water and generate emissions and residues. Sustainable industrialisation therefore requires cleaner processing, resource efficiency, renewable energy, credible sourcing, and circular utilisation of by-products.

POME is a useful example. Conventional treatment can release methane, a potent greenhouse gas, whereas anaerobic digestion with capture can transform methane into useful energy. Nasution et al. (2020), Suksaroj et al. (2023), and Sodri and Septriana (2022) demonstrate the environmental and techno-economic relevance of improved treatment and biogas generation.

Industry 4.0 approaches can further support resource monitoring and supply-chain transparency. Abdul-Hamid et al. (2022) identify complementarities between digitalisation and circular-economy strategies, but technological adoption should be viewed as an enabling mechanism rather than sustainability in itself.

9. Theme 9: Bioenergy Expands the Sustainability-Resilience Nexus

Including bioenergy under ISPO expands certification into a strategically important but potentially contested domain. Palm-based biodiesel can reduce dependence on petroleum imports and create domestic demand for agricultural production. At the same time, high feedstock demand can interact with food uses, export markets, land use, and commodity prices.

Minister of Energy and Mineral Resources Regulation No. 3/2026 makes traceability an explicit principle for palm-based bioenergy certification and provides for segregated or mass-balance chain-of-custody models (Republic of

Indonesia, 2026). This represents an important institutional link between renewable-energy policy and sustainable commodity governance.

Mayandi and Suharjito (2024) show why a systems perspective is required when allocating production among food, energy, and export uses. The central sustainability question is not simply whether palm biodiesel is renewable. It concerns the life-cycle characteristics of the feedstock, land-use consequences, emissions from cultivation and processing, alternative uses, and whether increasing demand is supplied through higher productivity or additional expansion.

DISCUSSION

1. From Certificate Issuance to Outcome-Based Sustainability

The synthesis suggests that the central strategic issue is not whether certification should exist but what certification is expected to accomplish. If implementation is evaluated primarily through the number of certificates issued, administrative progress can be mistaken for environmental or social improvement.

A more demanding approach distinguishes three levels of performance: formal compliance, credible assurance, and substantive sustainability. This distinction provides a structured basis for separating documentary conformity from verifiable environmental, social, and economic outcomes.

The first is **formal compliance**: whether actors possess required licences, documentation, procedures, and certificates. The second is **credible assurance**: whether certification data and audits are sufficiently reliable for buyers, regulators, communities, and other stakeholders to trust the associated claims. The third is **substantive sustainability**: whether observable outcomes improve – for example, lower deforestation risk, improved environmental management, secure livelihoods, reduced conflicts, increased productivity without expansion, or lower emissions.

These levels are related but not identical. Formal compliance is often necessary for credible assurance, yet it can become symbolic when verification is weak. Credible assurance can facilitate markets but does not guarantee that every relevant social or environmental outcome has improved. The new ISPO architecture therefore has an opportunity to move toward measurable outcome indicators alongside process compliance.

2. Interoperability Is More Useful than Seeking Simple Equivalence

Global market legitimacy represents one of the most difficult governance challenges because Indonesian producers operate under domestic law while international buyers may face separate obligations. Trying to make one system legally substitute for every importing jurisdiction would be unrealistic.

The more feasible strategy is to create an ISPO information architecture capable of producing high-quality evidence reusable for multiple legitimate purposes. If a farmer's plot has a verified identifier, accurate geolocation, clear legal status, and traceable transaction history, the same core information could support national certification, buyer sustainability programmes, corporate reporting, and aspects of market due diligence.

This does not eliminate EUDR obligations. Under current European Commission guidance, relevant EU operators retain their own due-diligence responsibilities (European Commission, 2026b). However, better upstream information can reduce duplication and transaction costs.

The distinction has diplomatic as well as technical implications. Kettunen and Pratiwi (2025) highlight the importance of policy discourse in EU–Indonesia palm-oil relations. Building interoperability around transparent data and measurable results offers a potentially more practical route than framing every difference as a binary choice between domestic and foreign standards.

3. The Smallholder Inclusion Paradox

Mandatory certification contains an inherent paradox. Universality is one of its strengths because sustainability expectations should not apply only to firms voluntarily seeking premium markets. Yet universal requirements encounter highly unequal capabilities.

This produces a possible vicious cycle. Farmers with incomplete land documents or limited finance struggle to certify. Buyers seeking lower compliance risk may then prefer already traceable suppliers. Marginalised producers lose access to preferred markets, weakening their ability to finance improvements and making future certification even harder.

The reverse – a virtuous cycle – is also possible. Certification can provide a platform through which farmers receive legal assistance, organisational support, extension, finance, improved planting material, and market connections. Better yields and stronger farmer organisations can increase income and make sustainability practices more affordable. This interpretation is consistent with research emphasising incentives, pre-certification readiness, cost reduction, and farmer resilience (Pramudya et al., 2022; de Vos et al., 2023; Irawan et al., 2024; Hendrawan et al., 2024). Newer evidence on certified mill markets and ISPO implementation further supports the need to address structural access, land legality, finance, and policy capacity alongside farmer-level incentives (Ekaputri et al., 2025; Erdi et al., 2026).

Certification policy should therefore differentiate between **standards** and **pathways to meet standards**. Environmental and social requirements need not be weakened for smallholders, but the time, finance, technical assistance, grouping mechanisms, and administrative support provided to achieve them may legitimately differ.

4. Linking Certification, Replanting, and Farmer Upgrading

The literature strongly suggests that certification programmes should not operate separately from replanting. Farmers are more likely to perceive sustainability requirements as valuable when they are linked to productivity and income.

Replanting represents a rare opportunity to reset the production system for several decades. It allows farmers to adopt certified planting material, redesign field access, protect riparian areas, introduce record systems, improve fertilisation practices, and establish mapped farm boundaries. Integrating certification preparation at this point is likely to be less costly than attempting to correct every deficiency after new plantations mature.

Financing remains critical. A programme covering planting costs but ignoring temporary livelihood loss may still have low participation. Findings from Petri et al. (2024), Hendrawan and Musshoff (2024), and Siregar et al. (2024) indicate that farmer decisions reflect risk and household circumstances, not simply agronomic return.

The environmental condition is equally important: productivity improvements should be accompanied by credible non-expansion safeguards. Otherwise, profitable intensification could create a rebound effect.

5. Ecological Integrity Requires Moving from Plot to Landscape

Sustainability standards traditionally focus on auditable management units. Ecosystems, however, do not follow concession or farm boundaries. Rivers connect multiple properties; wildlife crosses plantations; fire spreads through landscapes; peatland hydrology operates across drainage networks.

A future-oriented ISPO architecture should therefore integrate farm certification with jurisdictional environmental monitoring. Satellite-derived land-cover data, fire alerts, peatland information, riparian mapping, and biodiversity indicators could complement field audits. Such systems would allow certification bodies and policymakers to test whether formal compliance corresponds with actual landscape change.

The reviewed environmental literature supports this broader approach. Tree islands, riparian buffers, mechanical weed management, and better spatial design can improve ecosystem functioning inside productive landscapes (Zemp et al., 2023; Iddris et al., 2023; Rojas-Castillo et al., 2023). The implication is not that plantations become substitutes for natural forest, but that environmental performance within already established agricultural landscapes can still be substantially improved. Recent evidence on natural-enemy communities likewise indicates that both local and landscape characteristics influence ecological functions in Indonesian oil-palm systems (Rizali et al., 2024).

6. Social Sustainability Needs Procedural Indicators

Environmental indicators are often easier to measure than social legitimacy. Forest cover can increasingly be observed remotely, whereas coercion, unequal bargaining, or ineffective grievance procedures require institutional evaluation.

A stronger ISPO approach would therefore monitor procedural indicators in addition to the existence of policies. Questions should include whether communities receive understandable information, whether grievances are acknowledged within specified periods, whether complainants can participate safely, whether outcomes are documented, and whether remedies are implemented.

The land-conflict literature demonstrates why this matters. Rules that exist formally may be inaccessible in practice because affected groups face legal costs, documentation barriers, local power asymmetries, or delays (Afrizal et al., 2023; Berenschot et al., 2024). Thus, social sustainability should evaluate both the availability and the accessibility of institutions.

7. Circular Economy Should Become Part of the Certification Logic

Expanding ISPO downstream creates an opportunity to integrate circularity into sustainability criteria. Palm-oil processing produces significant biomass and liquid residues. Rather than treating these solely as disposal liabilities, circular systems can recover energy, nutrients, fibres, chemicals, and other useful outputs.

POME-to-biogas is among the clearest examples. Methane capture can convert a waste-management challenge into renewable energy and simultaneously reduce uncontrolled methane emissions. Empty fruit bunches, shells, fibres, and other residues likewise offer pathways for energy or material recovery.

However, circularity claims require life-cycle assessment. A process may valorise one waste stream while consuming substantial energy or generating another environmental burden. Sustainability standards should therefore reward verified resource-efficiency improvements rather than simply the presence of a waste-utilisation project.

8. Bioenergy Requires a Food-Energy-Land-Carbon Framework

The inclusion of bioenergy within ISPO is conceptually important because it permits a single sustainability framework to follow feedstock from plantation through processing to an energy product. Nevertheless, energy-security objectives can generate strong demand signals, making sustainability safeguards more rather than less important.

Four dimensions should be considered simultaneously. Treating food, energy, land, and carbon as a coupled system helps prevent sustainability costs from being shifted from one policy objective to another.

First, food: palm oil remains a major edible-oil commodity and industrial input. Second, energy: biodiesel and related fuels can contribute to reducing fossil-fuel dependence. Third, land: higher feedstock demand can translate into expansion unless productivity and allocation are carefully managed. Fourth, carbon: life-cycle benefits depend strongly on land-use history, methane management, processing energy, logistics, and other emissions.

The appropriate question is therefore not whether palm-based bioenergy is inherently sustainable or unsustainable. Sustainability varies according to production pathway. Certification should distinguish lower-risk feedstock from pathways involving forest or peat conversion and should progressively incorporate measurable life-cycle information.

9. An Integrated ISPO Sustainability-Resilience Framework

The synthesis allows the nine themes to be consolidated into a single conceptual model. Their interactions are visualised in Figure 3 to show how foundational enablers connect implementation pathways with system-level sustainability and resilience outcomes.

Figure 3 proposes an Integrated ISPO Sustainability-Resilience Framework in which governance and traceability constitute the institutional foundation, farmer and industrial transformation constitute the implementation pathways, and sustainability, competitiveness, inclusion, and resilience constitute the intended outcomes. This organisation makes explicit that no single

pathway is sufficient in isolation and that progress depends on mutually reinforcing governance, economic, social, and environmental conditions.



Figure 3. Integrated ISPO Sustainability-Resilience Framework
Source: Author's synthesis of the reviewed literature.

Figure 3 rejects a linear interpretation in which certification automatically leads to sustainability. Instead, legal compliance and verification form the foundation upon which other interventions operate. Smallholder inclusion and productivity are connected because farmers need economic capacity to maintain environmental standards. Ecological integrity constrains how productivity and downstream expansion can occur. Circularity and bioenergy shape resource efficiency and resilience. Market legitimacy emerges as an outcome of credible performance and evidence rather than simply the existence of a national standard.

10. Strategic Trade-offs

The value of an integrated framework becomes clearer when considering trade-offs. These are not necessarily zero-sum relationships, but they become problematic if one objective is pursued while ignoring another.

Figure 4 summarises six strategic tensions emerging from the literature and identifies governance responses capable of converting several apparent trade-offs into potential complementarities. The visual links each tension to its principal sustainability risk and to an integrative response intended to convert trade-offs into complementarities.



Figure 4. Strategic Trade-Offs in ISPO Implementation
Source: Author's Synthesis

Figure 4 shows that the central policy challenge is one of institutional complementarity. Certification is more effective when paired with agricultural extension; traceability is more inclusive when paired with farmer support; intensification is more environmentally beneficial when paired with land controls; and bioenergy is more credible when paired with life-cycle and feedstock safeguards. The figure therefore frames the identified tensions as governance design problems that can be mitigated through coordinated, evidence-based implementation.

11. Implications for Key Actors

For government institutions, the principal implication is that ISPO should be governed as a cross-sector system rather than as several adjacent certification programmes. Inter-ministerial coordination is particularly important for shared identifiers, data standards, audit quality, smallholder assistance, and reporting. For certification bodies, credibility depends on auditor competence and independence. Expanding the certification object downstream and into bioenergy increases technical complexity, requiring expertise in agriculture, industrial processing, chain of custody, environmental management, and energy systems.

For mills and large companies, smallholder traceability should be treated as supplier-development infrastructure. Firms often possess stronger administrative and digital capability than individual farmers and can reduce transaction costs through group mapping, record systems, extension, and support for certification.

For farmer organisations, certification creates potential value when collective institutions can lower audit and training costs, improve bargaining, coordinate replanting, and manage information. Collective action identified in the literature therefore has both economic and sustainability functions.

For international buyers, ISPO information can be most useful when evaluated at the level of verifiable data and actual sustainability outcomes rather than simply accepted or rejected as a single undifferentiated label. This evidence-oriented approach would allow procurement decisions to focus on the quality, traceability, and relevance of sustainability information rather than on certification status alone.

CONCLUSIONS AND RECOMMENDATIONS

Indonesia's post-2025 ISPO architecture represents a significant conceptual expansion of national palm-oil sustainability governance. Presidential Regulation No. 16/2025 explicitly moves the system beyond plantation businesses to include downstream palm-oil industries and palm-based bioenergy, while subsequent ministerial regulations provide sector-specific implementation arrangements. This creates the institutional basis for sustainability governance extending from production through processing and energy use.

The literature reviewed in this article nevertheless indicates that expanding the formal scope of certification is only the beginning. Certification outcomes vary because producers, landscapes, institutions, and markets differ. Research published since 2020 shows that certification can support improved practices and selected environmental or socioeconomic outcomes, but impacts are not automatic and should not be inferred solely from certificate ownership. Smallholder inclusion emerges as perhaps the most important implementation challenge. Land documentation, certification costs, organisational capability, finance, record keeping, and limited incentives can prevent farmers from participating effectively. The strongest response is not to abandon sustainability requirements but to integrate certification with land facilitation, farmer organisations, agricultural extension, replanting support, transition finance, and accessible digital systems.

Productivity improvement and replanting constitute a second strategic opportunity. Closing agronomic yield gaps can improve livelihoods and support future production without automatically increasing land requirements. Yet intensification contributes to conservation only where expansion into forests and other environmentally sensitive areas is constrained. Productivity policies and land-use governance must therefore operate together.

Environmental integrity likewise requires movement beyond the individual certified farm. Deforestation, peat degradation, biodiversity loss, fire, hydrological impacts, and habitat fragmentation are landscape-scale processes. Evidence on tree islands, riparian buffers, alternative weed management, peatland rewetting, and spatial plantation design indicates that already-established production landscapes can be ecologically improved, while protection of remaining natural ecosystems remains indispensable.

The inclusion of downstream industries and bioenergy further broadens the sustainability agenda. Circular-economy strategies, methane capture, residue utilisation, cleaner production, and industrial digitalisation can transform environmental liabilities into resources. However, downstream value creation must not simply transfer environmental burdens from plantations to processing facilities. Similarly, palm-based bioenergy can contribute to domestic energy resilience only when feedstock expansion, food uses, land requirements, and life-cycle emissions are addressed together.

Internationally, traceability is increasingly important as importing markets strengthen deforestation and due-diligence requirements. ISPO should therefore not be positioned as an automatic substitute for external legal obligations. Its greater strategic value lies in generating credible, interoperable evidence on legality, farm location, chain of custody, environmental safeguards, and sustainability performance.

The principal conclusion is that the future credibility of ISPO depends on whether it can evolve from a certificate-centred system into an outcome-oriented sustainability infrastructure. Such an infrastructure requires legal clarity, credible auditing, interoperable data, smallholder support, replanting and productivity programmes, environmental monitoring, accessible grievance mechanisms, cleaner downstream production, and life-cycle safeguards for bioenergy.

Under these conditions, market legitimacy, farmer inclusion, ecological integrity, economic value addition, and national resilience need not be treated as competing objectives. They can become mutually reinforcing components of a coherent palm-oil development strategy. Conversely, if these enabling conditions remain fragmented, the expansion of formal certification alone is unlikely to resolve the fundamental sustainability challenges identified throughout the recent literature.

Future research should therefore prioritise longitudinal evaluation of the post-2025 architecture. Particularly important questions include whether smallholder certification rates increase alongside genuine livelihood gains; whether integrated data systems reduce compliance costs; whether certified supply chains demonstrate lower deforestation and emissions risk; whether downstream certification improves life-cycle performance; and whether the bioenergy component can reconcile energy objectives with food, land, and carbon constraints. Such evidence will ultimately determine whether Indonesia's expanded ISPO architecture becomes primarily a regulatory compliance system or a genuine mechanism of value-chain transformation.

FURTHER STUDY

This research still has its limitations, so further studies on the topic 'From Mandatory Certification to Value-Chain Transformation: Reassessing Indonesia's ISPO Architecture for Global Market Legitimacy, Smallholder Inclusion, Ecological Integrity, and National Resilience' are needed to improve this study and add insight for both the writers and readers.

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