Account and Financial Management Journal e-ISSN: 2456-3374
Volume 11 Issue 09 September 2026, Page No.- 4707-4731
DOI: 10.47191/afmj/v11i9.02, Impact Factor: 8.167

From Resilience Architecture to Implementation Friction: Integrating PSPK 1, ISO 22301, and GRC across Indonesia's Palm Oil Value Chain- A Review

Loso Judijanto
IPOSS Jakarta, Indonesia
https://orcid.org/0009-0007-7766-0647

ABSTRACT: Indonesia's palm oil sector provides an unusually demanding setting in which to examine the gap between formally coherent resilience frameworks and their practical implementation. Sustainability-related financial disclosure, certification, deforestation-free supply-chain requirements, business continuity, governance, risk and compliance (GRC), energy policy, and financial decision-making increasingly converge within a value chain characterized by heterogeneous smallholders, intermediated fresh fruit bunch transactions, contested land legality, uneven data quality, and asymmetric organizational capabilities. This qualitative literature review examines these interactions using the Indonesian palm oil sector as a sectoral use case rather than as a primary empirical case study. The synthesis identifies implementation friction as the central mechanism explaining why individually rational standards and management systems can generate difficult cross-system interfaces. Nine thematic findings reveal friction arising from regulatory layering, traceability, land legality, smallholder inclusion, physical continuity, financial translation, financing asymmetry, domestic energy policy, and assurance. The article develops a Palm Oil Resilience Implementation Architecture (PORIA) that connects regulatory alignment, identity and provenance, value-chain risk translation, financial materiality, transition financing, continuity testing, governance, assurance, and adaptive learning. The study argues that resilience depends less on adding further standards than on improving interoperability among institutions, information systems, actors, financial resources, and operational dependencies. The framework offers implications for palm oil companies, mills, smallholders, financial institutions, regulators, and assurance providers.

KEYWORDS: Palm Oil; Indonesia; Organizational Resilience; Financial Resilience; PSPK 1; IFRS S1; ISO 22301; Integrated GRC; Smallholders; Supply-Chain Traceability.
JEL Classification: G32; G34; M41; Q13; Q56

1. INTRODUCTION

1.1 Palm Oil as an Economic, Social, Environmental and Strategic System

Palm oil is simultaneously an agricultural commodity, an industrial feedstock, a rural-development mechanism, an export product, and an increasingly important component of Indonesia's domestic energy strategy. This multidimensional role explains why discussions of palm oil rarely fit comfortably within a single disciplinary frame. Economic studies emphasize income generation, employment, rural transformation, and household welfare, whereas environmental research focuses on deforestation, biodiversity loss, greenhouse-gas emissions, peatland degradation, and land-use change. Social and governance research adds land conflict, labor conditions, certification, community relations, and institutional legitimacy to an already complex agenda. Consequently, the Indonesian palm oil sector should be understood as an interconnected socio-economic and ecological system rather than merely as a plantation industry (Qaim et al., 2020; Mehraban et al., 2021; Santika et al., 2021; Gaveau et al., 2022).

This complexity is especially significant because the benefits and costs of palm oil are distributed unevenly. Oil palm cultivation can raise smallholder living standards and provide opportunities for income diversification, yet production systems differ substantially in productivity, legality, organizational capacity, access to finance, exposure to markets, and environmental performance. Smallholders should therefore not be treated as a homogeneous group. Independent farmers, former scheme farmers, plasma farmers, relatively commercial farmers, and vulnerable livelihood-oriented producers can face very different capacities to absorb regulatory and market change (Mehraban et al., 2021; Watts et al., 2021; de Vos et al., 2023; Hendrawan, Chrisendo and Musshoff, 2024).

Recent evidence reinforces this heterogeneity. Smallholder yields can remain substantially below attainable levels because agronomic practices, harvesting frequency, input availability, labor, roads, market access, and institutional arrangements interact in ways that cannot be corrected simply through technical recommendations. Monzon et al. (2023) show that agronomy explains important components of Indonesian smallholder yield gaps, while de Vos et al. (2023) demonstrate that harvesting decisions are also influenced by economic and institutional considerations. These findings are important for resilience because an intervention that appears efficient at plantation level may fail where households lack cash, labor, transport, organizational capacity, or incentives to implement it.

The environmental dimension creates another set of trade-offs. Historical oil palm expansion has contributed to forest conversion, while periods of slowing expansion have coincided with reduced deforestation; nevertheless, continuing demand and changing commodity prices mean that governance remains important for preventing renewed pressure on forests (Gaveau et al., 2022). At the same time, environmental performance is not predetermined solely by farm size. Dalheimer et al. (2024) demonstrate scope for improving smallholder biodiversity performance while maintaining production, suggesting that sustainability policy should focus not only on excluding problematic production but on improving production systems themselves.

1.2 A Convergence of Regulatory and Strategic Pressures

The practical importance of these issues is increasing because several sustainability, trade, reporting, certification, and energy-policy developments are converging over a short period. Indonesia’s PSPK 1 on general requirements for disclosure of sustainability-related financial information and PSPK 2 on climate-related disclosure become effective on 1 January 2027. The standards are convergent with the IFRS Sustainability Disclosure Standards and therefore bring sustainability-related risks and opportunities closer to mainstream financial reporting, governance, strategy, risk management, and performance measurement (IAI, 2025; IFRS Foundation, 2023).

Indonesia has simultaneously strengthened its national palm-oil sustainability architecture. Presidential Regulation No. 16 of 2025 establishes a broader Indonesian Sustainable Palm Oil (ISPO) certification system that explicitly encompasses oil palm plantations, downstream palm industries, and palm-based bioenergy. This expansion is conceptually important because sustainability governance can no longer be understood primarily as an upstream plantation certification problem; information, risk, control, and assurance increasingly need to travel across plantations, mills, refiners, downstream manufacturers, and bioenergy operations (Government of the Republic of Indonesia, 2025; Purnomo et al., 2025).

International market regulation adds another layer. The European Union Deforestation Regulation (EUDR) requires covered commodities, including palm oil and specified derived products, to satisfy deforestation-free and legality-related requirements supported by due diligence and geolocation information. Following the 2025 legislative amendment, the Regulation is scheduled to apply from 30 December 2026 for large and medium-sized operators and from 30 June 2027 for most micro and small operators. Although many Indonesian smallholders may not export directly to Europe, compliance expectations can cascade upstream through traders, refiners, mills, financing arrangements, procurement policies, and multinational buyer requirements; research also cautions that complex traceability rules can impose disproportionate transaction costs and equity risks on smaller producers (European Commission, 2026; Gilbert, 2024; McDermott et al., 2025).

A fourth pressure comes from domestic energy policy. Indonesia formally launched its B50 biodiesel mandate in July 2026, deepening the connection between palm oil and national energy security. This creates benefits associated with domestic feedstock utilization and reduced dependence on imported diesel, but it also strengthens competition among export, food, oleochemical, and energy uses of palm-based feedstocks. Bank Indonesia’s scenario analysis indicates that the benefits of higher biodiesel blending should be considered together with fiscal, trade, productivity, and land-use consequences, so the resilience problem operates across multiple levels rather than within the energy sector alone (Ministry of Energy and Mineral Resources, 2026; Ridhwan et al., 2025).

These overlapping developments make Indonesia’s palm oil sector an unusually suitable setting for examining implementation complexity. Certification research already indicates that standards are embedded in political and institutional contexts rather than implemented mechanically. ISPO has historically displayed governance ambiguity and contested authority, while private zero-deforestation initiatives have had to coexist with national policy priorities and competing expectations concerning economic development, sovereignty, inclusion, and environmental protection (Choiruzzad, Tyson and Varkkey, 2021; Dermawan, Hospes and Termeer, 2022; Putri et al., 2022; Grabs and Garrett, 2023; Kettunen and Pratiwi, 2025).

1.3 From Resilience Architecture to Implementation Friction

A growing management literature provides well-developed conceptual tools for organizational resilience, enterprise risk management, business continuity, management control, sustainability reporting, and data-driven decision-making. Organizational resilience is commonly understood as involving anticipation, coping, adaptation, and learning rather than simply returning to a pre-shock state. Business continuity provides more specific mechanisms for protecting and recovering critical activities, while enterprise risk management connects uncertainty with objectives, governance and response priorities (Duchek, 2020; Hillmann and Guenther, 2021; Galaitsi et al., 2023; Steen, Haug and Patriarca, 2024).

However, an architecture that appears internally coherent at firm level becomes more difficult when applied to a fragmented commodity chain. The reporting company may not own the farms producing its feedstock. A mill may purchase through intermediaries and therefore have incomplete visibility of the ultimate production plot. A sustainability team may identify a deforestation or legality exposure that a finance team cannot reliably quantify. A bank may require certification that an otherwise productive smallholder cannot afford to obtain. A downstream buyer may require geolocation information that does not itself resolve ambiguous tenure. A continuity plan may protect a company-owned plantation while overlooking dependence on third-party fresh fruit bunches. These are not merely failures of individual standards; they are failures occurring at the interfaces between systems and actors.

This article introduces **implementation friction** as a conceptual device for understanding these failures. Implementation friction refers to the organizational, institutional, informational, financial, or operational resistance that arises when formally desirable sustainability and resilience objectives must be converted into coordinated action among actors possessing unequal authority, resources, information, incentives, and capabilities. The concept differs from simple non-compliance because actors may genuinely attempt to comply yet encounter structural barriers that make simultaneous implementation difficult or costly.

The Indonesian smallholder literature strongly supports this interpretation. Independent farmers can face challenges involving land legality, business documentation, farmer organization, audit cost, recurring certification expenses, training, access to finance, and dependence on external facilitators. Certification therefore often favors farmers who already possess advantageous institutional histories, clearer land rights, stronger organizations, or buyer relationships (Apriani et al., 2020; Watts et al., 2021; Pramudya et al., 2022; de Vos et al., 2023; Wibowo et al., 2023). More recent evidence also demonstrates unequal participation by independent and contract smallholders in certified mill markets, reinforcing concern that upgrading supply-chain standards may benefit actors differently even without explicit exclusion (Ekaputri et al., 2025).

1.4 Research Gap, Questions and Objectives

Three research gaps emerge from these literatures. First, sustainability disclosure, certification, traceability, ERM, business continuity, management accounting, and sustainable finance are usually examined as separate systems. Their simultaneous implementation across a commodity value chain is less well understood. Second, much resilience scholarship remains organization-centric, whereas many palm-oil risks originate outside formal corporate boundaries. Third, the distribution of implementation costs receives insufficient attention. Traceability, legalization, certification, assurance, replanting, climate adaptation, continuity buffers, and data infrastructure all require resources, but the actor required to provide information is not necessarily the actor best positioned to pay for producing it (Wahid et al., 2024; Irawan et al., 2024).

The first research question is therefore: **What implementation complexities arise when PSPK 1, sustainability certification, business continuity, integrated GRC, and financial decision-making interact across Indonesia’s palm oil value chain?** The second asks: **How do regulatory fragmentation, traceability limitations, land-legality issues, smallholder heterogeneity, data asymmetry, and operational dependencies interact to create resilience gaps?** The third asks: **How can finance translate sustainability, continuity, and supply-chain risks into economically actionable decisions without transferring disproportionate implementation costs to weaker actors?** The fourth asks: **How do PSPK 1, expanded ISPO, EUDR-related requirements, and domestic biodiesel demand reshape the balance among sustainability, inclusion, competitiveness, and resilience?** Finally, the fifth asks: **What integrated implementation architecture could move the sector from fragmented compliance toward adaptive value-chain resilience?**

The article addresses these questions through a qualitative literature review and develops a **Palm Oil Resilience Implementation Architecture (PORIA)**. Its contribution is not another sustainability standard. Rather, it identifies the interfaces at which otherwise sensible standards encounter friction and proposes mechanisms for connecting obligations, information, operational dependencies, financing, governance, and assurance.

2. LITERATURE REVIEW

2.1 Organizational Resilience and the Move toward Value-Chain Resilience

Organizational resilience has evolved from a narrow recovery-oriented concept toward a capability perspective. Duchek (2020) distinguishes anticipation, coping and adaptation, highlighting that resilient organizations must prepare before disruption, respond during disruption, and learn afterward. Hillmann and Guenther (2021) likewise demonstrate that resilience is multidimensional and combines capacities, processes and outcomes. Galaitsi et al. (2023) further distinguish organizational resilience from operational resilience and business continuity, while Steen, Haug and Patriarca (2024) emphasize their complementarities.

The palm-oil context illustrates why this perspective must be extended beyond firm boundaries. A refinery cannot be resilient if critical mills stop producing; a mill cannot maintain throughput if plantation supply fails; and smallholders cannot maintain income if transport, mill access, market demand, or payment channels are disrupted. Supply-chain resilience research demonstrates that severe disturbances propagate across interconnected networks and that survivability depends on visibility, redundancy, flexibility, collaboration, and the capacity to reconfigure flows rather than simply optimize individual facilities (Ivanov, 2020; Ivanov and Dolgui, 2020; El Baz and Ruel, 2021).

Digital technologies can improve visibility and modeling, but they do not remove structural dependencies. Spieske and Birkel (2021) show how Industry 4.0 technologies can support resilience, while Ivanov and Dolgui (2021) conceptualize digital supply-chain twins as tools for disruption-risk analysis. Yet such technologies are useful only when the underlying data are trustworthy and when organizations understand the relationships being modeled. In palm oil, a digital record of an incorrect supplier identity can make inaccurate information easier to transmit rather than making the supply chain genuinely traceable.

Value-chain resilience therefore concerns the ability of an interconnected set of actors to maintain strategically important functions while adapting to environmental, regulatory, financial, and market change. This definition is particularly appropriate for palm oil because the supply chain combines biological production cycles, perishable fresh fruit bunches, capital-intensive milling, complex derivatives, smallholder livelihoods, export markets, and increasingly important bioenergy demand. Recent palm-oil systems research likewise emphasizes multi-stakeholder coordination and adaptive, jurisdictional approaches when sustainability objectives have to be reconciled with livelihood and production goals (Purnomo et al., 2025; Ayompe et al., 2025).

2.2 Implementation Friction, Institutional Complexity and Governance Paradoxes

Institutional complexity arises when organizations face multiple expectations that cannot easily be satisfied through a single organizational response. Palm-oil companies may simultaneously respond to national certification, private buyer commitments, investor expectations, international market rules, land legislation, local government practices, community demands, and financial-sector standards. These expectations overlap but differ in authority, scope, terminology, evidence requirements, and underlying values, creating a coordination problem that is increasingly recognized in system-level and jurisdictional approaches to sustainable palm oil (Grabs and Garrett, 2023; Purnomo et al., 2025).

The ISPO literature illustrates this problem particularly well. Choiruzzad, Tyson and Varkkey (2021) describe internal incoherence and governance rescaling associated with Indonesia's sustainability certification architecture. Putri et al. (2022) identify policy and governance challenges involving regulatory coordination and sustainability implementation. Dermawan, Hospes and Termeer (2022) show how corporate zero-deforestation strategies have been adjusted in response to the Indonesian state, illustrating that companies do not implement private environmental commitments in an institutional vacuum.

Grabs and Garrett (2023) advance the argument by identifying paradoxes within goal-based sustainability governance. Private commitments can simultaneously create demands for cooperation and competition, environmental improvement and economic performance, inclusion and exclusion, or transparency and strategic discretion. These paradoxes are not temporary inconveniences that can always be "solved." They frequently require ongoing management of competing objectives.

This provides an important foundation for implementation friction. A regulation may be logically coherent within its own institutional framework while becoming difficult when combined with other requirements. For example, strict traceability can improve environmental accountability but increase sourcing costs. Excluding insufficiently documented suppliers can improve short-term compliance but worsen smallholder inclusion. Relaxing documentation requirements can increase inclusion while weakening assurance. Higher domestic biodiesel demand can strengthen national energy resilience while increasing pressure on feedstock allocation. The issue is not that one objective is necessarily wrong; rather, objectives interact.

Kettunen and Pratiwi (2025) show that palm-oil policy relations between Indonesia and the European Union are similarly embedded in divergent narratives, bargaining positions, sovereignty concerns, and sustainability objectives. This political context matters because regulatory implementation is partly a process of translating broad international and national ambitions into actions at mills, farms, and transactions. Recent EUDR equity scholarship reinforces this point by distinguishing procedural, distributive, and recognitional risks that can arise at different stages of unilateral value-chain policy design and implementation (McDermott et al., 2025).

2.3 PSPK 1, IFRS S1 and Financial Materiality in Palm Oil

Sustainability reporting is increasingly moving toward stronger connections with financial decision-making. The contemporary literature nevertheless reveals unresolved debates about who sustainability reporting is for, what constitutes material information, how financial materiality differs from impact materiality, and whether international convergence is feasible (Christensen, Hail and Leuz, 2021;

Baumüller and Sopp, 2022; Abhayawansa, 2022; Stolowy and Paugam, 2023; Wagenhofer, 2024).

For palm-oil companies, these debates become operational because many sustainability risks have identifiable financial pathways. A land-legality problem can become a sourcing or certification problem. A sourcing problem can become a market-access problem. Physical climate damage can reduce yields and mill utilization. Fire can create interruption, restoration, health, legal and reputational costs. Replanting delays can reduce future feedstock availability. Sustainability requirements can increase compliance expenditures, segregated inventory costs, supplier-development costs, and assurance expenditures.

PSPK 1 therefore has potential importance far beyond external reporting. By connecting sustainability-related risks and opportunities with prospects, strategy, governance, risk management, and performance, it can encourage firms to make causal pathways explicit. This would mean asking not only whether a supplier is certified but whether certification status affects procurement flexibility, revenue, customer concentration, working capital, insurance, cost of capital, or investment requirements.

Yet information comparability is not automatic. Suhardjo, Akroyd and Suparman (2024) show substantial variation among ESG assessments of Indonesian palm-oil companies, demonstrating that identical corporate sustainability realities can be interpreted differently depending on methodology. More broadly, sustainability-reporting literature warns that formalized metrics do not remove judgement from materiality assessment (Wagenhofer, 2024; Suhardjo et al., 2026). The implementation challenge for PSPK 1 is consequently not merely collecting more ESG data, but creating sufficiently traceable and decision-useful links among sustainability conditions, operational dependencies, and financial consequences.

2.4 Certification, Legality and the Smallholder Inclusion Problem

Certification is one of the most extensively studied sustainability interventions in palm oil, yet the literature demonstrates that participation is structurally uneven. Apriani et al. (2020) find that Indonesian independent smallholders often rely heavily on external organizational support to obtain non-state certification and that direct financial benefits can matter for continued participation. Watts et al. (2021) similarly identify significant challenges and emphasize the structural disadvantages experienced by independent farmers. Recent synthesis work further argues that smallholder sustainability requires combinations of stakeholder collaboration, adaptive management, capacity building, and innovative financing rather than certification in isolation (Ayompe et al., 2025).

Land and business legality are particularly important because certification can require documentation that smallholders do not always possess. Pramudya et al. (2022) identify legal, managerial and financial challenges affecting mandatory certification and argue that incentives are needed alongside regulatory requirements. de Vos et al. (2023) find that certified independent groups frequently have favorable pre-certification conditions, including clearer land rights and prior organization, while more weakly organized farmers remain dependent on external facilitators.

These findings reveal a selection problem. Certification success among relatively prepared groups cannot automatically be interpreted as evidence that certification is easily scalable to less prepared populations. The farmers who most need support may also be those who face the greatest barriers to entering formal sustainability systems. Reich and Musshoff (2025) reinforce this conclusion by showing that training, economic incentives, and individual behavioral factors influence willingness to adopt certification.

Wibowo et al. (2023) similarly demonstrate the significance of incentives in accelerating certification. Credit access, marketability, and economic benefits can influence participation, while institutionalization of incentives helps move sustainability from a normative requirement toward an economically viable choice. This observation is important for the present article because implementation friction is likely to increase when the costs of compliance are immediate but expected benefits are uncertain or delayed.

Certification also produces uneven market participation. Ekaputri et al. (2025) find that independent smallholders are underrepresented in certified mill supply compared with contract smallholders. Their findings do not simply imply active exclusion; they reveal that structural access, buyer behavior, land legality and existing supply relationships shape participation. This is critical for resilience because sustainability upgrading may restructure supply networks even when no formal rule explicitly excludes smallholders.

2.5 Land Legality, Spatial Transparency and Traceability

Traceability is often described as a technical requirement, yet in palm oil it is inseparable from legal and institutional questions. A supply chain can establish where a farm is located without resolving whether the producer has recognized rights to cultivate that land. Conversely, a farmer may possess locally accepted documents that do not correspond neatly with the documentary form expected by certification or international due-diligence systems.

Astuti et al. (2022) illustrate this problem through Indonesia's One Map Policy. Improved spatial visibility can reveal previously obscured plantation activity in areas legally classified as state forest. Greater transparency is desirable from a governance perspective, but it also creates difficult questions concerning enforcement, legalization, livelihoods, historical administrative failures, and differences between large-scale and smallholder production. Transparency therefore generates governance obligations rather than automatically resolving them.

This is a fundamental implementation issue for EUDR-related traceability. Geolocation can establish production location; satellite analysis can examine historical land cover; supplier databases can connect transactions with farms; but none of these technologies independently determines whether a contested legal claim is legitimate. Traceability systems therefore require institutional interoperability with land administration, plantation registration, certification, procurement, and grievance mechanisms. This distinction is particularly important because EUDR compliance can modernize commodity traceability while also creating disproportionate costs for smallholders and intermediaries if implementation support is weak (Gilbert, 2024; McDermott et al., 2025).

The same problem appears in multi-tier sourcing. Mills may receive fresh fruit bunches through traders or intermediaries whose commercial role includes aggregation, transport, finance and market access. Eliminating intermediaries may not be practical where they provide functions that farmer organizations or mills cannot easily replace. The challenge is therefore to improve traceability through the intermediary layer rather than assuming that the layer itself is necessarily illegitimate.

Irawan et al. (2024) show that certification costs can be reduced through improved design and shared support for independent smallholders. Their findings suggest a broader lesson: traceability infrastructure should be conceptualized as a shared value-chain capability rather than as a cost assigned separately to each farmer. If every smallholder must individually procure expensive data, verification, and auditing services, the system may be technically demanding but economically non-scalable.

2.6 Replanting, Productivity and Financial Resilience

Oil palm replanting is a particularly useful example of implementation friction because the long-term sustainability logic is clear while the short-term household economics are difficult. Aging palms reduce productivity and eventually require replacement. Replanting provides an opportunity to improve planting material, agronomy, productivity, and environmental management, but farmers must bear establishment costs while losing mature-crop income during the immature period.

Petri et al. (2024) identify finance, inputs, knowledge and planting material as major replanting constraints. Hendrawan and Musshoff (2024) demonstrate that subsidy design influences willingness to participate and that higher support and group-based registration can increase farmer acceptance. These findings imply that replanting policy cannot be evaluated solely by technical agronomic benefits; it must be designed around farmer liquidity and income continuity.

Hendrawan, Chrisendo and Musshoff (2024) provide an even broader resilience perspective by identifying several distinct types of smallholder resilience. Vulnerability differs according to economic, human, social, physical and other livelihood resources. A uniform requirement may therefore create very different burdens across households. This heterogeneity suggests that transition finance should be differentiated rather than assuming identical capacity to adopt new requirements.

Productivity improvement can reduce some of these tensions. Monzon et al. (2023) demonstrate substantial yield gaps and identify agronomic pathways for improvement, while de Vos et al. (2023) show that harvesting practices are affected by economic and supply-chain conditions. Sustainable intensification therefore depends on coordination. Advice to harvest more frequently is of limited value when transport, labor or mill access make more frequent harvests uneconomic.

The welfare literature reinforces the importance of treating resilience dynamically. Mehraban et al. (2021) show that oil palm cultivation can increase living standards and reduce household exposure to downside economic risk partly through labor reallocation and off-farm activities. Policies that unintentionally undermine these risk-management strategies may therefore weaken household resilience even while improving a particular sustainability metric.

2.7 Physical Climate, Peatland and Operational Continuity Risk

Palm oil is a biological production system and is therefore exposed to rainfall variability, temperature, flooding, drought, pests, disease, road conditions, and fire. These risks affect production before they appear in financial accounts, while mills add their own dependencies on electricity, water, machinery, labor, road access, and minimum feedstock volume. Long-run evidence from Indonesian oil-palm systems shows that water stress and atmospheric demand materially affect yield variation and can disrupt mill operations, while improved plant nutrition has only limited capacity to offset water-related losses (Wandri et al., 2025).

Astuti (2021) demonstrates the political and institutional complexity surrounding peatland governance and fire-related regulatory interventions. The study illustrates an important point for resilience analysis: physical risk cannot be separated cleanly from governance risk because prevention and adaptation depend on compliance, incentives, land management, enforcement, and stakeholder behavior.

Smallholder social conditions can also influence operational resilience. Mulyasari et al. (2023) identify social sustainability concerns including worker welfare, safety, price volatility and changing policy requirements. Supriatna et al. (2024) similarly find that smallholder sustainability is multidimensional, incorporating economic, environmental, social, institutional and technological factors. Operational continuity therefore cannot be understood purely as whether machinery continues to function.

ISO 22301 offers a useful discipline for structuring this problem through business impact analysis, critical activities, dependencies, continuity strategies, exercises, and continual improvement. However, conventional corporate BIA can be too narrow for palm oil if it focuses only on company-owned activities. A mill dependent on thousands of third-party farmers needs to understand the resilience of its broader feedstock catchment, including critical external supply clusters, roads, bridges, collection points, intermediaries, farmer liquidity, and alternative sourcing capacity (ISO, 2019, 2024; Galaitsi et al., 2023; Steen, Haug and Patriarca, 2024).

2.8 Integrated GRC and the Governance of Cross-System Interfaces

Enterprise risk management seeks to connect risk information with organizational objectives rather than manage exposures in isolation. Anton and Afloarei Nucu (2020) identify integration and strategic alignment as important themes in the ERM literature, while Malik, Zaman and Buckby (2020) demonstrate the governance relevance of risk committees. More recent case evidence shows that ERM can contribute to resilience when risk governance, culture, tools and strategic awareness evolve together (Monazzam and Crawford, 2024).

Palm-oil implementation requires this logic to extend across multiple systems. A sustainability risk may be monitored by ESG teams, classified by risk functions, managed operationally by procurement or plantations, documented for certification, reviewed by legal personnel, modeled financially, and eventually disclosed under PSPK 1. If those functions use incompatible definitions, the organization may appear well governed within each silo while remaining poorly integrated overall.

Integrated GRC provides one possible governance architecture for resolving this problem. Wibowo et al. (2022) demonstrate the role of integrated GRC and combined assurance in an Indonesian institutional setting. Common taxonomies, risk ownership, escalation, controls, compliance mapping and coordinated assurance can reduce duplication and gaps. However, integrated GRC should not be mistaken for a software implementation. Data systems support integration only after responsibilities and definitions are clarified.

2.9 Finance as an Implementation Integrator

Finance is uniquely positioned within resilience implementation because nearly every sustainability or continuity intervention eventually requires a resource decision. Traceability systems require investment. Certification creates direct and recurring costs. Replanting requires capital and household income support. Climate adaptation competes for capital expenditure. Maintaining inventory or redundant suppliers affects working capital. Segregated certified supply may create additional logistics costs. Assurance requires documentation and professional services.

Management-accounting research shows that finance functions are increasingly expected to combine data analytics, business partnering, strategy and control rather than merely produce historical accounts (Bhimani, 2020; Möller, Schäffer and Verbeeten, 2020; Andreassen, 2020). Yet information quality remains fundamental. Knauer, Nikiforow and Wagener (2020) demonstrate that system and data quality affect management-accounting information quality, reinforcing the importance of reliable sustainability data before it is integrated into financial models.

Management-control systems can also support resilience. Weber, Pedell and Rötzel (2024) show that controls contribute to both stability and adaptation. The challenge is to avoid excessively rigid controls that prevent learning while retaining sufficient discipline for accountability and assurance. In palm oil, this means that supplier-risk processes should permit escalation and improvement rather than defaulting automatically to supplier exclusion.

Sustainable finance research in Indonesia directly exposes the implementation gap. Wahid et al. (2024) identify disconnects among financial-sector policy, smallholder access to finance, certification, traceability and replanting. Their analysis suggests that finance can become either an accelerator or a constraint. Banks can reward improved sustainability, but financing rules can also exclude farmers whose inability to document legality is partly the product of historical institutional weakness.

Abu Afifa, Nguyen and Bui (2024) provide complementary ASEAN evidence that sustainable management-accounting practices can support sustainable risk-management processes. The implication is that finance should not wait until sustainability risks have already caused financial losses. It should participate in defining the economic pathways through which environmental, social, legal and operational conditions affect future cash flows and resilience.

2.10 Integrative Theoretical Framework

Five theoretical lenses guide the synthesis. **Institutional complexity** explains simultaneous pressures from different rule systems. **Paradox theory** explains why sustainability, inclusion, competitiveness and sovereignty objectives may remain in persistent tension. **Organizational information-processing theory** explains why increasingly complex environments require richer information-sharing and coordination capacity. **Dynamic capabilities and resilience theory** explains anticipation, coping, adaptation and reconfiguration. Finally, a **network-governance perspective** explains why neither information nor authority is concentrated within a single organization.

Strategic uncertainty literature provides a complementary insight. Packard and Clark (2020) argue that uncertainties differ in the extent to which additional information can mitigate them, while Stanton and Roelich (2021) show that decisions under deep uncertainty frequently require robust and adaptive approaches rather than optimization around a single forecast. This is directly relevant to palm oil because climate, regulation, market access, land governance and future feedstock demand may interact in ways that cannot be represented reliably through one probability distribution.

Together, these theories produce the article's central proposition: value-chain resilience is constrained not merely by deficiencies within individual organizations, but by implementation friction at the interfaces connecting institutions, data, actors, operational dependencies, and financial resources. This interface-centered proposition shifts analytical attention from whether a formal framework exists to whether its information, responsibilities, incentives, and resource requirements can be translated coherently across organizational boundaries.

Figure 1 places the emerging policy environment around this proposition. The figure should be read as a convergence map rather than a regulatory hierarchy; no single requirement replaces another, and their simultaneous implementation increases the information-processing burden on the value chain.

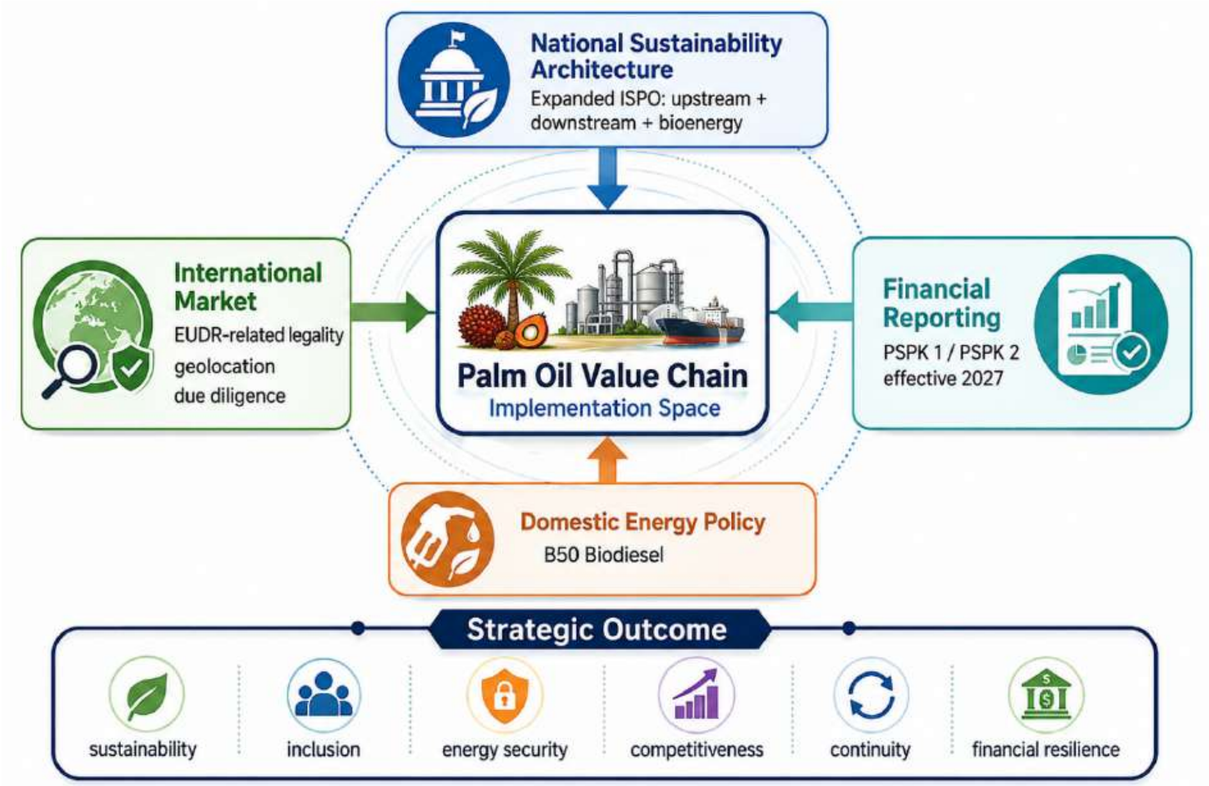

Figure 1. The 2025–2027 Convergence of Sustainability, Trade, Energy and Reporting Pressures in Indonesian Palm Oil
Source: Author synthesis based on the literature and current institutional frameworks.

Figure 1 demonstrates why implementation cannot be organized as a series of unrelated compliance projects. ISPO influences certification and supply-chain governance; EUDR-related requirements increase provenance and legality demands; PSPK 1 converts sustainability risks into potentially financially material information; and B50 changes domestic demand for palm-based feedstock. The relevant managerial question is therefore how these systems interact, not merely whether each system is individually satisfied.

3. METHOD

3.1 Qualitative Literature Review Design

This article adopts an integrative qualitative literature review rather than a Systematic Literature Review. The methodological objective is conceptual synthesis across literatures that employ different terminology, units of analysis and research traditions. Integrative reviews are appropriate where the aim is to build theory by connecting previously fragmented knowledge rather than estimate an aggregate effect or claim exhaustive retrieval of a predefined evidence universe (Elsbach and van Knippenberg, 2020; Post et al., 2020).

This distinction is especially important for the present study because relevant knowledge is dispersed across accounting, sustainability reporting, agricultural economics, land governance, certification, supply-chain management, business continuity, risk management, management accounting, development studies and palm-oil sector research. A narrow systematic search based on one disciplinary vocabulary could exclude relevant evidence from other domains. The article therefore uses a concept-centric rather than database-count-centric synthesis.

Lubbe, ten Ham-Baloyi and Smit (2020) emphasize the usefulness of integrative review approaches for synthesizing heterogeneous evidence into new conceptual understanding. Following that logic, this review prioritizes theoretical relevance, explanatory value, empirical credibility and cross-domain connections. It does not use PRISMA reporting, does not calculate pooled effect sizes, and does not present study frequencies as statistically representative of the entire literature.

3.2 Indonesia's Palm Oil Sector as a Sectoral Use Case

The Indonesian palm-oil sector is employed as a **sectoral use case**, not as a primary empirical case study. No original interviews, survey responses or field observations were collected for this article. All empirical observations are derived from published research and authoritative institutional sources.

The use-case logic allows the article to test the conceptual problem of implementation friction against a sector in which several difficult interfaces are highly visible. These include firm–smallholder relationships, certification–legality interfaces, geolocation–tenure interfaces, sustainability–finance connections, mill–farm continuity dependencies, public–private governance interactions, and domestic–international policy tensions.

The analytical value chain spans smallholders and company estates, farmer groups and cooperatives, intermediaries and collectors, mills, refineries, downstream processors, bioenergy producers, exporters, buyers, financial institutions, assurance providers and regulators. This broad scope deliberately avoids assuming that resilience can be understood by observing a single listed palm-oil company.

3.3 Literature Identification and Analytical Scope

The principal journal evidence base consists of publications from 2020 to August 2026, with emphasis on peer-reviewed sources in reputable international and regional journals. Search themes included oil palm smallholders, palm-oil certification, ISPO, RSPO, legality, land tenure, traceability, EUDR, deforestation, sustainability finance, replanting, yield gaps, resilience, business continuity, enterprise risk management, GRC, sustainability reporting, materiality, management accounting and supply-chain resilience.

Authoritative institutional materials were used separately for current regulatory facts concerning PSPK 1/2, IFRS S1, ISO 22301, Indonesian ISPO regulation, EUDR implementation, and biodiesel policy. These materials provide the formal policy context but were not counted as peer-reviewed journal articles.

Selection was iterative and purposive. Sources were included where they clarified one or more of four analytical issues: the nature of a specific implementation friction; the actors affected by that friction; the operational or financial consequences of the friction; or mechanisms capable of reducing friction.

3.4 Analytical Procedure

The literature was coded at three levels. The first level identified **friction categories**, including regulation, legality, traceability, data quality, certification, finance, continuity, climate, assurance, incentives and organizational capability. The second level identified the **actor interface** at which the friction occurred, such as smallholder–mill, mill–buyer, company–regulator, company–financier, sustainability–finance, or national–international governance.

The third level mapped each friction through a consequence chain: **implementation condition → operational consequence → financial consequence → resilience implication**. For example, uncertain land legality can reduce certification eligibility; reduced eligibility can limit participation in particular supply chains; reduced market access can affect revenue and financing; and these financial constraints can reduce capacity to invest in farm improvement.

These mappings were compared across literatures and consolidated into nine higher-order thematic findings. The findings were then synthesized into the proposed Palm Oil Resilience Implementation Architecture.

3.5 Review Rigor and Limitations

Analytical rigor was pursued through theoretical and source triangulation. Palm-specific empirical studies were compared with wider resilience, risk, finance and reporting literatures. Studies showing favorable outcomes of certification or oil-palm cultivation were considered alongside research documenting exclusion, governance conflict and uneven benefits. The approach therefore avoids treating either sustainability regulation or palm-oil development as unambiguously beneficial or harmful.

The principal limitation is interpretive selection. Because this is not an SLR, the evidence base is not claimed to be exhaustive. A second limitation is that PSPK 1 has not yet generated a large post-implementation literature because its effective date is 2027. The discussion of PSPK 1 is consequently prospective and informed by IFRS sustainability-reporting scholarship, Indonesian accounting evidence and sectoral risk characteristics. A third limitation is the heterogeneity of Indonesia's palm-oil regions, firms and farmers, which means that the proposed framework should be treated as analytically transferable rather than mechanically uniform.

4. RESULTS

4.1 Theme One: Regulatory Layering Creates Cross-System Compliance Friction

The first thematic finding is that Indonesia’s palm-oil problem is no longer a shortage of sustainability frameworks. Rather, organizations face multiple systems that address different dimensions of the same underlying value chain. ISPO concerns sustainable palm-oil certification; PSPK 1 concerns sustainability-related financial information; ISO 22301 concerns continuity capability; EUDR-related requirements concern deforestation-free and lawful market access; integrated GRC concerns ownership, compliance, control and assurance; private buyer requirements may add NDPE or certification expectations.

The coexistence of these systems is not inherently dysfunctional. Different frameworks legitimately perform different functions. The problem arises when terminology, data definitions, evidence, organizational ownership or timelines are not interoperable. A land issue might be recorded as a certification nonconformity by one team, a legal risk by another, a sourcing risk by procurement, a sustainability risk by ESG personnel and a financial exposure by finance. Without a common mapping, management can receive several reports describing the same exposure as if they were unrelated.

Existing governance research suggests that palm-oil sustainability has repeatedly encountered institutional fragmentation. ISPO’s evolution has involved state-transformation and authority issues, while corporate zero-deforestation initiatives have faced tensions with state policy and economic-development priorities (Choiruzzad, Tyson and Varkkey, 2021; Dermawan, Hospes and Termeer, 2022). Putri et al. (2022) likewise identify weaknesses in coordination across levels of governance.

The expanded 2025 ISPO framework potentially improves coherence by extending certification across downstream and bioenergy activities. Yet expansion also increases implementation scope. More organizations, products, transactions and supply relationships enter the sustainability information architecture. The implementation challenge therefore changes from “whether certification exists” to “whether sustainability information can travel accurately and economically across the chain.”

Grabs and Garrett (2023) show why this interaction should not be interpreted as a purely technical problem. Sustainability governance creates persistent paradoxes involving environmental goals, commercial realities and multi-actor coordination. Kettunen and Pratiwi (2025) similarly show that international palm-oil policy is embedded in competing narratives and bargaining positions. Regulatory interoperability consequently requires both technical mapping and institutional negotiation.

4.2 Theme Two: Traceability Is an Institutional Capability before It Is a Technology

The second theme challenges a common assumption that traceability problems can be solved principally through digital systems. Digital platforms, geolocation, satellite imagery and transaction databases can significantly improve visibility, but they cannot independently solve incorrect identities, incomplete land records, informal supplier relationships, disputed boundaries or weak organizational incentives.

The palm-oil supply chain is structurally difficult to trace because fresh fruit bunches from different origins may be aggregated before milling. Independent smallholders may sell through intermediaries, and intermediaries can combine production from several farmers. The same intermediary may provide transport, informal credit, price information and immediate market access. Eliminating this layer without replacing those functions could therefore reduce farmer resilience even if it simplifies tracing.

Research on certification demonstrates that organization and documentation are central. de Vos et al. (2023) find that farmer groups with stronger pre-existing organization and legality are better positioned for certification. Apriani et al. (2020) similarly show that external organizational support can be decisive. Watts et al. (2021) identify structural barriers faced by independent farmers.

Traceability therefore requires an **institutional chain of custody**, not merely a digital chain of custody. Farmer identity, plot identity, land status, harvest transactions, intermediary relationships, and mill receipts must be sufficiently aligned to create confidence in provenance. If any of these stages is weak, technology can record uncertainty but cannot remove it.

Figure 2 conceptualizes these friction points across the value chain.

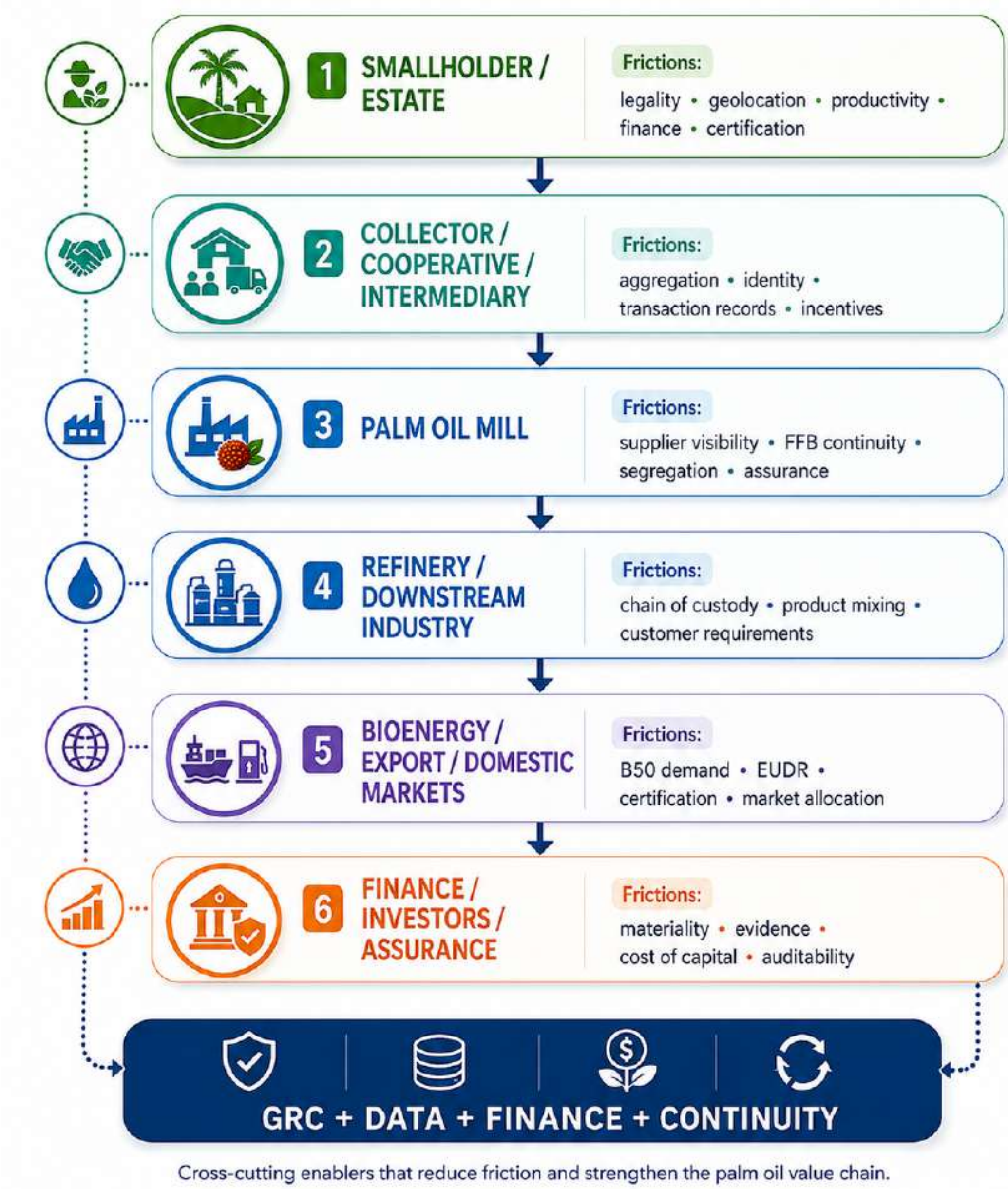

Figure 2. Implementation Friction across the Indonesian Palm Oil Value Chain

Source: Author synthesis based on Apriani et al. (2020), Watts et al. (2021), de Vos et al. (2023), Grabs and Garrett (2023), Irawan et al. (2024), and Ekaputri et al. (2025).

Figure 2 shows that traceability weakness is not localized at farm level. The integrity of information depends on every transfer point. A farmer can possess accurate geolocation data while an aggregation process later breaks provenance. Conversely, a sophisticated refinery traceability platform cannot compensate fully for unidentified upstream production. Resilience therefore depends on strengthening interfaces rather than assigning traceability responsibility to a single actor.

4.3 Theme Three: Land Legality Is a Hidden Financial and Continuity Risk

The third theme is that land legality is usually framed as a certification or regulatory issue, but it also has financial and operational consequences. A farmer unable to establish acceptable legality may face certification difficulty. Certification difficulty can restrict access to certain buyers or finance. Reduced market and financing access can constrain replanting or farm improvement. At scale, these constraints can affect the future supply base of mills and downstream processors.

Astuti et al. (2022) demonstrate that improved spatial mapping can render previously obscured illegal plantation areas visible. This creates a governance opportunity but also exposes historical discrepancies between land use and legal classification. The implementation challenge is especially difficult where local social legitimacy, historical administrative practice and formal legal classification diverge.

Pramudya et al. (2022) similarly identify land and business legality as major constraints to smallholder certification. de Vos et al. (2023) show that clearer land rights give former scheme farmers an advantage in certification compared with other independent producers. Certification systems can therefore reproduce historical differences in institutional access.

This interaction means that legality should appear in financial risk registers. A procurement portfolio containing high proportions of legally uncertain supply can create a future sourcing-cost risk. Management may need to finance supplier legalization, restructure sourcing, increase certified purchases, or replace supply. Each response has cash-flow and margin consequences.

Land conflict also creates continuity risk. Disputes can interrupt harvesting, road access, plantation operations, community relations or investment. Astuti (2021) demonstrates how environmental governance over plantation landscapes can become politically contested, reinforcing the idea that regulatory and operational risks frequently interact rather than remain separable.

The transmission mechanism can be summarized as a reinforcing pathway in which land uncertainty weakens legal evidence, which in turn can complicate certification and due diligence, restrict market or financing access, and reduce investment capacity. As investment capacity deteriorates, operational vulnerability can increase and ultimately become a financial-resilience problem; the pathway can also operate in reverse when stronger legality, traceability, and financing reinforce productive investment.

Recognizing this pathway is crucial for PSPK 1. If land-related sustainability risk could reasonably affect sourcing, cash flows, financing or strategic prospects, the issue is not merely a legal compliance matter; it becomes part of financially relevant sustainability information.

4.4 Theme Four: Smallholder Inclusion Is the Critical Resilience Bottleneck

The fourth theme is that smallholder inclusion is not peripheral to resilience. Independent producers represent a structurally important component of Indonesian palm-oil supply, but their implementation capabilities vary significantly. Treating them as passive compliance subjects can therefore create fragility across the broader sector.

Certification studies consistently identify barriers involving costs, legality, organization and knowledge. Apriani et al. (2020) show the importance of external support and economic incentives. Watts et al. (2021) emphasize structural disadvantages. Pramudya et al. (2022) identify legal, managerial and financial constraints. de Vos et al. (2023) show that successful certified groups frequently benefit from favorable initial conditions, while Wibowo et al. (2023) demonstrate that appropriate incentives can accelerate certification.

More recent research suggests that these barriers can translate into uneven market participation. Ekaputri et al. (2025) demonstrate that independent farmers are considerably less represented in certified-mill supply than contract smallholders. This result is important because exclusion may be structural rather than explicit. A mill may not intentionally reject independent farmers; instead, its sourcing geography, supplier-management system and certification model may already favor more organized producers.

Reich and Musshoff (2025) add a behavioral dimension. Their research suggests that training and cash premiums can increase willingness to adopt certification and that farmer risk preferences matter. Compliance design must consequently recognize that a standard creates both technical obligations and a farmer investment decision.

The smallholder resilience literature reinforces the need for differentiation. Hendrawan, Chrisendo and Musshoff (2024) identify multiple resilience profiles, demonstrating that some households possess substantially fewer resources for adaptation than others. A fixed compliance cost therefore has regressive effects: the same monetary requirement absorbs a larger share of income and liquidity for a vulnerable farmer.

This finding has a major policy implication. Supplier exclusion may improve short-term corporate compliance but create longer-term sectoral problems. Excluded farmers do not disappear. They may sell into less regulated channels where environmental and social improvements become harder to influence. A resilience-oriented system should therefore distinguish between **unwilling non-compliance** and **capacity-constrained non-compliance**, using improvement pathways where credible.

4.5 Theme Five: Replanting Demonstrates the Tension between Long-Term Resilience and Short-Term Liquidity

Replanting provides one of the clearest examples of temporal implementation friction. From a long-term perspective, replacing overaged palms is necessary for productivity, farm viability and feedstock security. From a short-term household perspective, replanting destroys an existing income-generating asset before its replacement begins producing.

Petri et al. (2024) identify the principal barriers as finance, knowledge, planting material and implementation capability. Hendrawan and Musshoff (2024) show empirically that farmers respond to subsidy design. The problem is therefore not lack of recognition that replanting is beneficial; it is a mismatch between long-term economic value and short-term liquidity.

The issue extends beyond farmers. Mills dependent on aging smallholder plantations face future feedstock risk. If large numbers of farmers postpone replanting, current mill utilization may remain stable while future supply deteriorates. From a corporate resilience perspective, smallholder replanting can therefore be interpreted partly as a supply-security investment.

Monzon et al. (2023) show that management improvements can reduce yield gaps on existing land, strengthening the argument that productivity is also a sustainability strategy. Dalheimer et al. (2024) further demonstrate the possibility of combining environmental improvement with continued smallholder production. These findings reduce the false choice between production and sustainability, but they do not eliminate financing constraints.

Finance should consequently evaluate replanting through several simultaneous lenses: farmer livelihood continuity, future FFB supply, productivity, biodiversity opportunity, land-expansion pressure, and creditworthiness. A narrowly agricultural subsidy perspective captures only part of this value.

4.6 Theme Six: Physical and Operational Risks Cascade across the Chain

The sixth theme is that palm-oil continuity risks are strongly interconnected. Drought or flooding reduces plantation output; lower production reduces FFB deliveries; lower deliveries reduce mill utilization; underutilized mills raise unit processing costs; reduced CPO production affects refinery supply; and downstream shortages can change inventory and working-capital requirements.

Fresh fruit bunch perishability makes timing especially important. de Vos et al. (2023) show that harvesting frequency reflects both agronomic and economic conditions. Roads, labor, plantation accessibility, FFB prices and transport costs influence harvesting practices. Continuity planning must therefore include infrastructure and market coordination rather than focusing narrowly on catastrophic events.

Peat and fire risk demonstrate even broader cascading effects. Fire can affect production, worker safety, transport, air quality, community relations, regulatory compliance, reputation and insurance. Astuti (2021) shows that governance responses themselves can generate resistance and implementation difficulty. Thus physical resilience cannot be separated from institutional capability.

ISO 22301-based business impact analysis could improve this situation if adapted to value-chain realities. Instead of identifying only internal critical processes, mills should identify critical supplier clusters, roads, collection points, power systems, water supplies, skilled labor, information systems and minimum throughput requirements. Refineries should understand critical mill concentrations and transport dependencies.

The central financial addition should be **financial endurance time**. Recovery time answers how quickly an operation can resume. Financial endurance time asks how long the business or supplier can absorb the disruption before liquidity becomes critical. For a smallholder household, this period may be very short; for a large integrated company, it may be substantially longer. Continuity planning that ignores this asymmetry will overestimate value-chain resilience.

4.7 Theme Seven: Sustainability Information Frequently Stops before Becoming Financial Information

The seventh theme is the persistence of a translation gap. Sustainability teams can produce detailed indicators concerning emissions, certification, land, suppliers, biodiversity or social performance, but those metrics do not automatically enter budgeting, scenario analysis, valuation or capital allocation.

This problem is consistent with broader sustainability-reporting literature. Christensen, Hail and Leuz (2021) show that sustainability reporting has multiple economic and institutional functions, while materiality research demonstrates that significant judgement is required to determine which sustainability information affects financial prospects (Abhayawansa, 2022; Baumüller and Sopp, 2022; Wagenhofer, 2024).

In palm oil, financial translation can be made more explicit. Traceability failure can be expressed as revenue-at-risk from particular customers. Legalization programs can be compared with replacement-sourcing costs. Replanting programs can be modeled against future mill utilization. Climate adaptation can be compared against expected production disruption. Certification costs can be evaluated against market access, premiums, customer retention and financing conditions.

Suhardjo, Akroyd and Suparman (2024) show that ESG score disparity complicates external interpretation of palm-oil sustainability. This finding strengthens the case for internally coherent financial pathways. Rather than relying on aggregate ESG scores as substitutes for risk analysis, organizations should identify the operational conditions underlying those scores and model their financial consequences.

PSPK 1 provides a mechanism for institutionalizing this practice. Its strategic value will be greatest when sustainability-related financial disclosure is generated from the same underlying risk and planning architecture used by management, rather than through a parallel annual reporting process.

4.8 Theme Eight: Finance Can Reduce or Amplify Implementation Inequality

The eighth finding is that finance plays a distributional role. A lender that requires certification, land legality and detailed sustainability information may encourage improved practices. However, the same requirements can make credit inaccessible to farmers who need financing precisely to become compliant.

Wahid et al. (2024) identify several disconnects in sustainable palm-oil financing, including smallholder access, certification, replanting and policy design. Their findings suggest that sustainable finance should include transition mechanisms rather than rely only on exclusionary screening. This creates an important distinction between **sustainable-asset finance** and **sustainability-transition finance**. The first allocates capital to actors already satisfying a sustainability threshold. The second finances credible movement toward that threshold. Palm-oil resilience requires both. Without transition finance, high-performing actors become easier to finance while structurally weaker actors remain locked outside the system.

Irawan et al. (2024) demonstrate how certification costs can be reduced through shared institutional support. Similar logic can be extended to geolocation, legality verification and farmer-data infrastructure. If downstream firms benefit financially from traceable supply, there is an economic rationale for cost sharing rather than requiring every farmer to finance the entire information infrastructure independently. Management-accounting scholarship provides the decision tools needed to evaluate such arrangements. Finance can compare the cost of supplier development with alternative-sourcing costs, disruption losses, revenue-at-risk and financing consequences (Knauer, Nikiforow and Wagener, 2020; Weber, Pedell and Rötzel, 2024; Abu Afifa, Nguyen and Bui, 2024).

4.9 Theme Nine: Domestic Energy Security Creates a New Layer of Resilience Trade-offs

Indonesia's B50 policy makes palm oil part of an energy-resilience strategy as well as an agricultural and trade system. This changes the demand structure facing the sector. Greater domestic biodiesel absorption can strengthen energy sovereignty and reduce diesel-import dependence, but it also increases the strategic importance of sustained feedstock productivity.

The resulting resilience trade-off is multi-level. A policy that improves national fuel security can alter CPO allocation, export volumes, fiscal requirements and incentives for production. If higher feedstock demand is met primarily through area expansion rather than productivity improvement, environmental risks may increase. If export availability falls significantly, trade and foreign-exchange consequences may emerge.

This reinforces the importance of smallholder productivity and replanting. The ability to satisfy food, export, industrial and energy demand without renewed land pressure depends partly on increasing production from existing plantations. Monzon et al. (2023), Petri et al. (2024), and Hendrawan and Musshoff (2024) therefore become relevant not only to agricultural policy but also to energy and macroeconomic resilience.

The nine themes can be summarized through an implementation-friction matrix. Figure 3 makes the propagation logic explicit by linking each friction to its primary manifestation and financial pathway rather than treating the frictions as isolated compliance deficiencies.

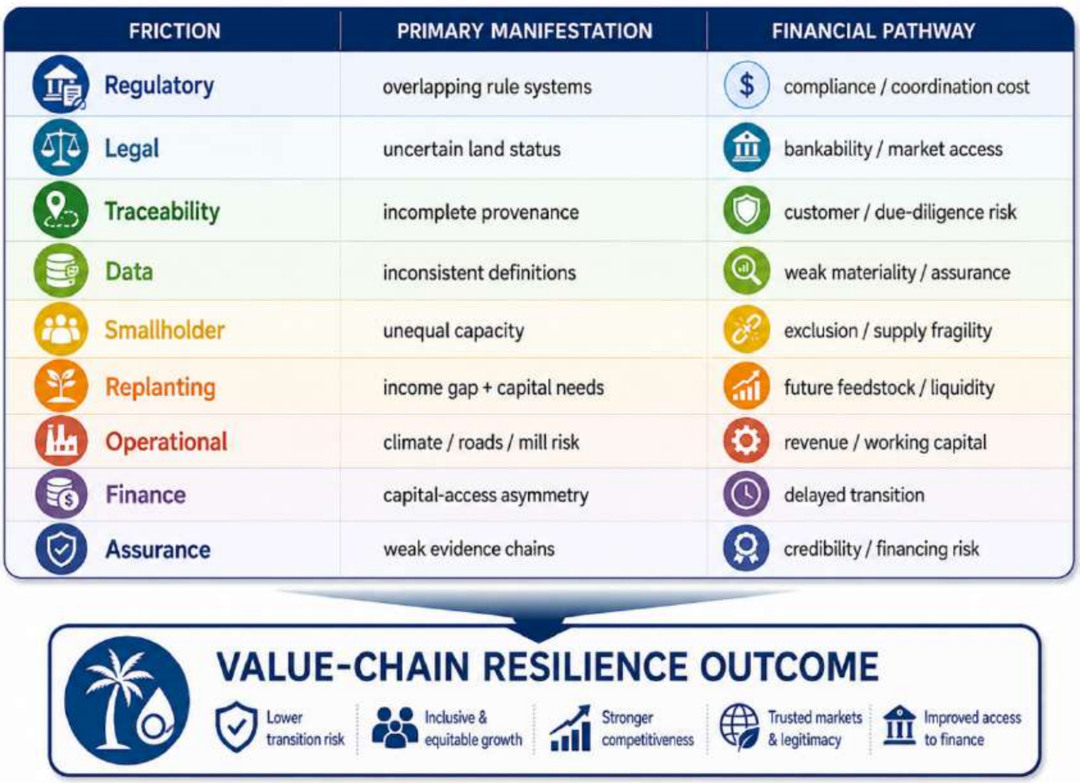

Figure 3. Implementation Friction Matrix for Indonesian Palm Oil

Source: Author synthesis.

Figure 3 illustrates that individual frictions rarely remain within their original category. A legal problem can become a financing problem, a financing problem can delay replanting, delayed replanting can become a future supply problem, and a supply problem can become a financial-reporting concern. Implementation complexity is therefore generated through **friction propagation**.

5. DISCUSSION AND ANALYSIS

5.1 Answering RQ1: Implementation Complexity Arises at the Interfaces

The first research question asked what happens when sustainability disclosure, certification, continuity, GRC and finance are implemented together. The evidence indicates that difficulty does not primarily arise because the frameworks are conceptually incompatible. It arises because their implementation boundaries differ.

PSPK 1 begins from the reporting entity but requires management to understand sustainability-related dependencies and effects relevant to its prospects. ISO 22301 begins with critical activities and continuity. ISPO certifies defined activities and supply-chain elements. EUDR-related due diligence emphasizes provenance and legality. GRC focuses on ownership, controls and compliance. Finance focuses on economically consequential decisions.

A single risk can therefore travel through several systems. Consider an independent farmer operating on land with uncertain documentation. Procurement may classify the farmer as a sourcing risk; certification personnel may identify a compliance gap; legal staff may identify tenure uncertainty; sustainability staff may classify deforestation or social risk; risk management may classify supplier concentration; finance may model replacement-sourcing costs; assurance staff may question evidence reliability. The underlying condition is one, but the organizational representations are multiple.

Implementation complexity is reduced when those representations are mapped rather than eliminated. Different professions need different analytical views, but the organization should know that those views refer to the same underlying exposure. Integrated GRC therefore becomes an interoperability architecture rather than an attempt to make every function use identical methods (Anton and Afloarei Nucu, 2020; Wibowo et al., 2022; Monazzam and Crawford, 2024).

5.2 Answering RQ2: Legal, Data, Financial and Institutional Frictions Reinforce One Another

The second research question concerns interaction among frictions. Palm-oil evidence demonstrates that constraints are frequently mutually reinforcing.

Land documentation illustrates the pattern. Weak documentation reduces certification eligibility. Lack of certification can limit access to improved buyers or finance. Weak finance delays replanting and productivity improvements. Low productivity reduces farmer surplus available for investment. Continued dependence on informal channels can further limit data generation and formalization. The system therefore exhibits feedback.

The reverse process is also possible. Farmer organization can reduce transaction cost. Organized farmers can be easier to train and certify. Certification can improve data. Better data can improve bankability and buyer confidence. Finance can support replanting and productivity. Greater productivity can improve economic resilience. The same interfaces can consequently produce either reinforcing vulnerability or reinforcing resilience.

This explains why isolated interventions frequently disappoint. Providing geolocation without solving land documentation addresses only one step. Providing credit without improving farmer organization may raise administrative cost. Requiring certification without financing creates exclusion pressure. Improving yields without stable market access may not improve household resilience.

The findings from Apriani et al. (2020), Watts et al. (2021), de Vos et al. (2023), Wibowo et al. (2023), Petri et al. (2024), Hendrawan and Musshoff (2024), Irawan et al. (2024), Ekaputri et al. (2025), and Ayompe et al. (2025) collectively suggest that the appropriate unit of intervention is frequently the interface package rather than the individual requirement. Coordinated packages that combine organization, legality, technical assistance, market incentives, and financing are more consistent with the interdependent character of the barriers identified across the literature.

5.3 Answering RQ3: Finance Must Become a Translator and a Burden Allocator

The third research question asked how finance can create economically actionable resilience without transferring disproportionate costs to weaker actors. The answer requires a broader conception of finance.

The traditional response to sustainability risk is often screening: identify unacceptable suppliers and exclude them. Screening remains necessary where risks are severe or actors refuse credible improvement. However, screening is incomplete where non-compliance reflects capacity limitations rather than deliberate misconduct.

Finance can support a differentiated response by comparing the economics of three alternatives: **retain and improve**, **replace**, or **exit**. Retain-and-improve includes supplier development, legalization, traceability support, certification, productivity programs or transition finance. Replacement involves identifying alternative supply and associated logistics or price premiums. Exit means accepting reduced market participation or supply capacity. Once alternatives are expressed financially, exclusion ceases to be an automatic default.

The distribution of costs must also be explicit. A downstream company may receive most of the market-access benefit created by upstream geolocation; a bank may benefit from improved borrower data; a farmer may receive productivity benefits from better agronomy. Efficient implementation should therefore allocate costs partly according to benefits and capacity to pay.

This logic is supported by Wahid et al. (2024), who identify gaps between sustainable-finance ambition and smallholder financing reality. It is also consistent with Irawan et al. (2024), whose certification-cost analysis demonstrates the importance of cost-reduction mechanisms.

Figure 4 shows the resulting pathway from land conditions to financial resilience.

Figure 4. From Land Legality to Financial Resilience: The Traceability–Materiality Transmission Pathway

Source: Author synthesis.

Figure 4 demonstrates that traceability should not be evaluated solely as an administrative expense. If improved provenance increases access to markets and finance, it becomes productive infrastructure. However, that infrastructure creates resilience only when farmers can participate in it. A technically rigorous system that excludes the upstream producers required for long-term supply may improve compliance while weakening value-chain resilience.

5.4 Answering RQ4: Regulatory and Energy Convergence Creates Both Opportunity and Stress

The fourth research question examines the simultaneous effects of PSPK 1, expanded ISPO, EUDR-related requirements, and B50. The convergence creates an unusual opportunity for Indonesia to build more interoperable systems because multiple policy agendas now require overlapping information concerning land, production, suppliers, sustainability, risk, and performance. Indonesia-specific systems research similarly indicates that jurisdictional and multi-stakeholder approaches can help reconcile deforestation, certification, intensification, and livelihood objectives, although the resulting trade-offs cannot be eliminated entirely (Purnomo et al., 2025).

The same convergence can create implementation overload. A company may face simultaneous investment requirements for traceability, ISPO certification, PSPK readiness, climate-risk assessment, continuity planning, bioenergy capacity, digital infrastructure and assurance. Smaller firms, mills and farmer organizations face even greater relative burdens.

The appropriate policy response is therefore not merely simplification in the sense of lowering standards. It is interoperability: the same validated farm identity should be reusable across certification, traceability, financing, and procurement; the same land evidence should not need to be recreated independently for multiple systems; materiality assessments should draw from ERM rather than duplicate them; and business-continuity scenarios should reuse climate and supply assumptions developed for sustainability analysis. Such interoperability should also be assessed through an equity lens because unilateral value-chain policies can distribute procedural and economic burdens unevenly across actors (McDermott et al., 2025; Purnomo et al., 2025).

This principle also applies to assurance. A control over supplier identity can potentially support ISPO, procurement, EUDR-related traceability, PSPK reporting and lender due diligence. Combined assurance can therefore reduce total compliance cost when evidence is designed for reuse.

5.5 Answering RQ5: Toward a Palm Oil Resilience Implementation Architecture

The fifth research question asks what an integrated implementation architecture would look like. The literature synthesis produces eight mutually reinforcing layers.

The first is **Align Obligations**. Organizations should map the requirements of PSPK 1, PSPK 2, ISPO, customer commitments, international-market requirements, GRC and continuity systems to a common process map.

The second is **Establish Identity, Legality and Provenance**. Farm identity, supplier identity, geolocation, land evidence and FFB transactions should become the foundation of upstream data architecture.

The third is **Translate Risk across the Value Chain**. Sustainability conditions should be connected with operational dependencies, affected customers, critical mills, suppliers and strategic objectives.

The fourth is **Financialize Material Consequences**. Finance should translate significant risks into revenue-at-risk, margin, working capital, liquidity, capital expenditure, impairment, financing and cost-of-capital implications where practicable.

The fifth is **Allocate Transition and Resilience Resources**. Management should determine how certification, legalization, traceability, replanting, productivity and adaptation will be financed and how costs should be shared.

The sixth is **Test Continuity**. BIA and scenario exercises should incorporate critical external suppliers and financial endurance rather than focus solely on internal operational recovery.

The seventh is **Assure and Escalate**. Data controls, internal audit, certification assurance, external assurance and board escalation should be coordinated around material risks.

The eighth is **Learn and Reconfigure**. Incidents, certification failures, supplier outcomes, regulatory changes and assurance findings should update assumptions and resource priorities.

These elements form the Palm Oil Resilience Implementation Architecture shown in Figure 5. The sequence should be interpreted as iterative rather than mechanically linear, because assurance findings, disruptions, financing constraints, and regulatory changes can require organizations to revisit earlier layers of the architecture.

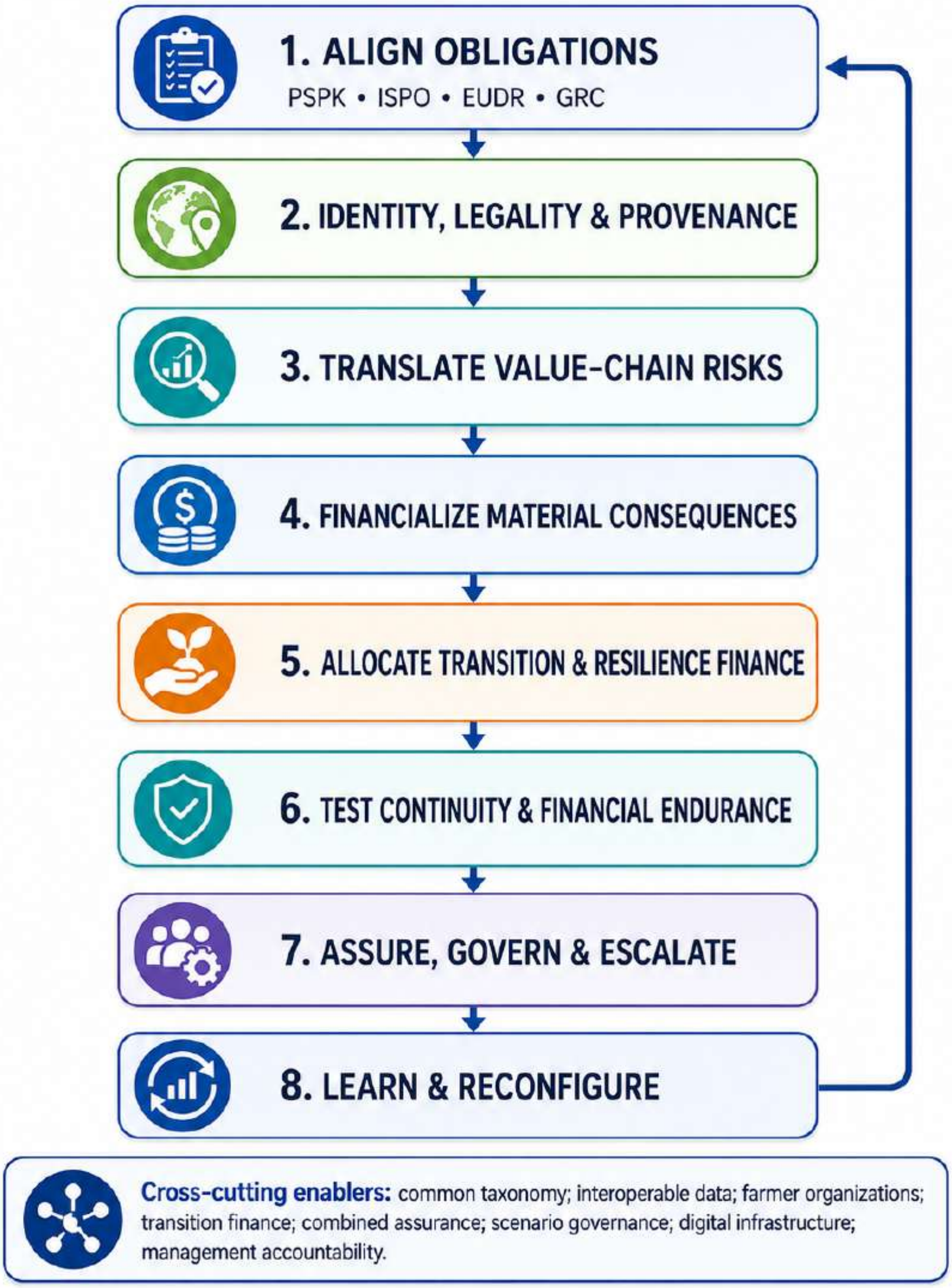

Figure 5. Palm Oil Resilience Implementation Architecture (PORIA)
Source: Author synthesis.

PORIA differs from a conventional compliance framework in three respects. First, its unit of analysis is the value-chain interface rather than the individual rule. Second, finance appears before final assurance because implementation requires resource allocation, not merely reporting. Third, learning returns to regulatory alignment and sourcing architecture, making the framework adaptive rather than static.

5.6 Theoretical Implications

The first theoretical implication concerns the scale of resilience. Organizational resilience research often assumes that the firm is the relevant unit of adaptation. Palm oil demonstrates that a company's resilience can depend substantially on external actors possessing much lower resources and formal capability. Resilience should therefore be conceptualized partly as an **interorganizational capability**.

Second, the article contributes the concept of **implementation friction**. Institutional complexity explains multiple institutional demands, but implementation friction emphasizes where those demands become costly or difficult to operationalize. Friction can occur because of inconsistent data definitions, unequal financing capacity, incompatible timelines, unclear legal evidence, or conflicting incentives even when the formal objectives are broadly aligned.

Third, the study adds a distributional dimension to resilience. An architecture may be technically efficient at company level while transferring costs to farmers. If that transfer weakens supplier viability, the result may be lower system resilience. Resilience analysis should therefore examine not only aggregate implementation costs but **who carries them**.

Fourth, the study connects sustainability-related financial reporting with continuity and supply-chain governance. PSPK 1 can become more than an external disclosure requirement when materiality assessment identifies the financial consequences of supplier legality, certification, productivity, climate risk, and traceability. The reporting architecture can therefore help expose hidden operational dependencies.

Fifth, PORIA complements dynamic-capabilities theory. Sensing requires traceable and interpretable information; seizing requires finance and decision rights; transformation requires supplier development, replanting, system redesign and organizational learning. Where one stage fails, the value chain may possess information without implementation capability.

5.7 Managerial Implications for Palm Oil Companies and Mills

Palm-oil companies should begin by replacing separate sustainability and risk registers with mapped risk relationships. This does not require one universal database immediately, but it does require a common identifier for material exposures. A supplier-legality issue should be traceable from farm data through procurement, certification, ERM, financial analysis and reporting.

Mills should receive particular attention because they form a critical interface between dispersed agricultural production and industrial processing. Mill-level supply sheds provide a practical unit for resilience analysis. Management can identify the proportion of FFB sourced from company estates, organized smallholders, independent farmers and intermediaries; map legality and traceability gaps; estimate future replanting requirements; and model how disruption would affect throughput and economics.

Supplier-development expenditures should be evaluated as resilience investments. Legalization support, farmer organization, training, certification, traceability and productivity programs may appear as operating costs when evaluated individually. Their value becomes clearer when compared with lost customer access, replacement sourcing, underutilized mills or disruption risk.

Business-continuity exercises should also extend upstream. A conventional exercise may simulate a mill outage. A more realistic resilience exercise might simulate simultaneous drought-related FFB reduction, road disruption, temporary exclusion of undocumented suppliers, tighter customer requirements and liquidity pressure. Finance, procurement, sustainability, risk and operations should evaluate the same scenario together.

5.8 Implications for Smallholder Organizations

Farmer organizations can serve as important **resilience intermediaries**. Their value extends beyond collective certification. Groups or cooperatives can aggregate data, lower audit costs, provide training, organize replanting, negotiate finance, manage traceability and reduce transaction costs.

The evidence from de Vos et al. (2023), Wibowo et al. (2023), Hendrawan and Musshoff (2024), and Irawan et al. (2024) supports the importance of group-based approaches. However, organization should not become another formal requirement imposed without support. Weak groups may exist only on paper unless they provide tangible economic functions to members.

A resilient farmer organization should therefore connect compliance with services. Certification becomes more attractive when linked to finance, better inputs, market access, agronomic support, replanting planning or more predictable transactions. The objective should be to make formalization economically valuable rather than merely administratively compulsory.

5.9 Implications for Financial Institutions

Banks and other financial institutions should distinguish between unacceptable sustainability risks and remediable transition gaps. A farmer without formal documentation should not automatically be treated identically to an actor deliberately clearing prohibited forest. Risk-based differentiation can improve both environmental integrity and inclusion.

Financial products could connect disbursement to staged sustainability improvements. A farmer group might receive financing for replanting conditional on verified farm mapping, followed by additional support for certification or improved agronomy. Mills or downstream companies could provide purchase commitments or data support, reducing lender uncertainty.

This approach would convert traceability and sustainability information into credit infrastructure. Better information reduces uncertainty about the borrower, farm and supply relationship. In turn, finance enables the investment required to improve sustainability performance.

5.10 Implications for Government and Standard Setters

Government policy should prioritize interoperability among land administration, farmer registration, ISPO, replanting finance, traceability, and sustainability reporting. Repeated collection of similar information through separate systems increases cost and error risk, whereas jurisdictional and multi-stakeholder approaches can create shared data and coordination infrastructure that supports both sustainability outcomes and smallholder livelihoods (Purnomo et al., 2025; Ayompe et al., 2025).

The expansion of ISPO into downstream and bioenergy activities creates an opportunity to develop common chain-of-custody and assurance foundations. If well designed, data used for ISPO could support other national and market requirements rather than requiring independent parallel infrastructures.

PSPK implementation guidance can similarly encourage entities to connect sustainability-related risk assessment with existing ERM, procurement, internal-control and continuity systems. This would reduce the risk that PSPK implementation becomes a year-end reporting project isolated from management decision-making.

Policy should also recognize implementation asymmetry. Proportionality does not require weakening sustainability outcomes. It can instead mean different implementation pathways, shared infrastructure, staged compliance, public support for legalization and differentiated assurance proportional to risk.

5.11 Implications for Assurance Providers

Assurance becomes more complicated when information originates outside the reporting entity. A company may disclose supplier traceability or legality information collected from thousands of external farmers and intermediaries, so conventional controls focused on internally generated financial data may be insufficient. Large-sample evidence also shows that ESG assurance is heterogeneous in coverage, provider choice, and the number of metrics assured, reinforcing the need to define assurance scope precisely rather than infer reliability from the existence of an assurance statement alone (Gipper, Ross and Shi, 2025).

Assurance systems should examine data lineage: who generated the information, how identity was verified, what transformations occurred, how exceptions were handled, and how management responded to uncertainty. Random field verification, satellite evidence, transaction reconciliation and certification information may need to be combined.

Combined assurance can reduce duplication when internal audit, certification auditors, compliance teams, and sustainability assurance providers coordinate coverage without compromising independence. The objective should be evidence reuse where appropriate, not repeated auditing of the same attribute through disconnected processes. Cross-country evidence further suggests that assurance-provider type is associated with differences in sustainability-reporting quality, which strengthens the case for explicit competence, scope, and quality criteria in assurance design (Bentley-Goode et al., 2025).

5.12 Research Agenda

PORIA generates several empirically testable propositions. Future research could examine whether mills with stronger supplier traceability also exhibit lower supply volatility; whether integrated legality and financing support increases certification rates; whether higher PSPK–ERM integration improves sustainability-related financial disclosure quality; or whether joint continuity and financial stress testing improves disruption performance.

Research can also examine cost incidence. How much does EUDR-related traceability cost at farm, cooperative, mill and refinery levels? Who captures the economic benefits of improved market access? What financing structures most effectively prevent smallholder exclusion?

Post-2027 research will be especially important. Researchers can compare palm-oil companies with different levels of PSPK implementation maturity and investigate whether sustainability-related financial reporting changes capital allocation, supplier development, risk governance or continuity planning.

6. CONCLUSION

Indonesia’s palm-oil sector demonstrates that resilience implementation is substantially more difficult than resilience architecture. Sustainability disclosure, certification, traceability, business continuity, GRC and finance are individually useful, but their effectiveness depends on the interfaces through which information, responsibility, material flows and financial resources move.

The principal implementation problem is therefore not the absence of standards. It is friction created when several legitimate standards and objectives meet a fragmented value chain characterized by heterogeneous actors, unequal capabilities, informal relationships, land-legality challenges, and uneven access to finance. Greater regulatory ambition can improve sustainability, but without interoperable systems it can also increase duplication, cost, uncertainty and exclusion.

Smallholder inclusion is central to this problem. Farmers should not be treated as a uniform compliance category. Differences in land documentation, organization, productivity, liquidity, knowledge and resilience mean that identical requirements can produce very different consequences. Exclusion may improve the apparent sustainability profile of one buyer while relocating risk elsewhere in the market.

Finance is particularly important because implementation ultimately involves choices about scarce resources. Traceability, legalization, certification, replanting, climate adaptation, continuity, data infrastructure and assurance all require financing. The relevant question is therefore not only what standards require, but who should pay for meeting those requirements, who receives the resulting benefits, and who carries residual risk.

The proposed Palm Oil Resilience Implementation Architecture responds to this challenge through eight connected layers: aligning obligations; establishing identity, legality and provenance; translating value-chain risks; financializing material consequences; allocating transition and resilience resources; testing continuity and financial endurance; assuring and governing information; and learning and reconfiguring the system. Its practical value lies in treating these layers as an interconnected implementation cycle rather than as separate compliance projects.

For Indonesia, the convergence of expanded ISPO, PSPK implementation, changing international market requirements and deeper biodiesel use creates both implementation pressure and an opportunity for institutional redesign. The most effective response is unlikely to be the creation of more disconnected compliance systems. It is the construction of interoperable data, governance, financing, continuity and assurance arrangements capable of turning sustainability obligations into genuine value-chain resilience.

REFERENCES

1. Abhayawansa, S. (2022) 'Swimming against the tide: back to single materiality for sustainability reporting', Sustainability Accounting, Management and Policy Journal, 13(6), pp. 1361–1385. Available at: https://doi.org/10.1108/SAMPJ-07-2022-0378.
2. Abu Afifa, M., Nguyen, N.M. and Bui, D.V. (2024) 'Management accounting practices going sustainable: the move toward sustainable risk management in ASEAN developing economies', Competitiveness Review, 35(5), pp. 858–882. Available at: https://doi.org/10.1108/CR-03-2024-0056.
3. Andreassen, R.I. (2020) 'Digital technology and changing roles: a management accountant's dream or nightmare?', Journal of Management Control, 31, pp. 209–238. Available at: https://doi.org/10.1007/s00187-020-00303-2.
4. Anton, S.G. and Afloarei Nucu, A.E. (2020) 'Enterprise risk management: a literature review and agenda for future research', Journal of Risk and Financial Management, 13(11), 281. Available at: https://doi.org/10.3390/jrfm13110281.
5. Apriani, E., Kim, Y.S., Fisher, L.A. and Baral, H. (2020) 'Non-state certification of smallholders for sustainable palm oil in Sumatra, Indonesia', Land Use Policy, 99, 105112. Available at: https://doi.org/10.1016/j.landusepol.2020.105112.
6. Astuti, R. (2021) 'Governing the ungovernable: the politics of disciplining pulpwood and palm oil plantations in Indonesia's tropical peatland', Geoforum, 124, pp. 381–391. Available at: https://doi.org/10.1016/j.geoforum.2021.03.004.
7. Astuti, R., Miller, M.A., McGregor, A., Sukmara, M.D.P., Saputra, W., Sulistyanto and Taylor, D. (2022) 'Making illegality visible: the governance dilemmas created by visualising illegal palm oil plantations in Central Kalimantan, Indonesia', Land Use Policy, 114, 105942. Available at: https://doi.org/10.1016/j.landusepol.2021.105942.
8. Ayompe, L.M., Nkongho, R.N., Acobta, A.N., Tambasi, E.E., Masso, C. and Egoh, B.N. (2025) 'Review of conceptual frameworks for smallholder farmers to achieve sustainable palm oil production', Journal of Cleaner Production, 506, 145525. Available at: https://doi.org/10.1016/j.jclepro.2025.145525.
9. Baumüller, J. and Sopp, K. (2022) 'Double materiality and the shift from non-financial to European sustainability reporting: review, outlook and implications', Journal of Applied Accounting Research, 23(1), pp. 8–28. Available at: https://doi.org/10.1108/JAAR-04-2021-0114.
10. Bentley-Goode, K.A., Simnett, R., Thompson, A. and Trotman, A.J. (2025) 'Choice of assurance provider and impact on quality of sustainability reporting: evidence from sustainability reporting restatements', Accounting & Finance, 65(2), pp. 2135–2172. Available at: https://doi.org/10.1111/acfi.13367.
11. Bhimani, A. (2020) 'Digital data and management accounting: why we need to rethink research methods', Journal of Management Control, 31, pp. 9–23. Available at: https://doi.org/10.1007/s00187-020-00295-z.
12. Choiruzzad, S.A.B., Tyson, A. and Varkkey, H. (2021) 'The ambiguities of Indonesian Sustainable Palm Oil certification: internal incoherence, governance rescaling and state transformation', Asia Europe Journal, 19, pp. 189–208. Available at: https://doi.org/10.1007/s10308-020-00593-0.
13. Christensen, H.B., Hail, L. and Leuz, C. (2021) 'Mandatory CSR and sustainability reporting: economic analysis and literature review', Review of Accounting Studies, 26, pp. 1176–1248. Available at: https://doi.org/10.1007/s11142-021-09609-5.
14. Dalheimer, B., Parikoglou, I., Brambach, F., Yanita, M., Kreft, H. and Brümmer, B. (2024) 'On the palm oil-biodiversity trade-off: environmental performance of smallholder producers', Journal of Environmental Economics and Management, 125,

102975. Available at: https://doi.org/10.1016/j.jeem.2024.102975.

15. de Vos, R.E., Nurfalah, L., Tenorio, F.A., Lim, Y.L., Monzon, J.P., Donough, C.R., Sugianto, H., Dwiyahreni, A.A., Winarni, N.L., Mulani, N., Ramadhan, G., Imran, M.A., Tito, A.P., Sulistiawan, P., Khoirul, M., Farrasati, R., Pradiko, I., Grassini, P. and Slingerland, M. (2023) 'Shortening harvest interval, reaping benefits? A study on harvest practices in oil palm smallholder farming systems in Indonesia', Agricultural Systems, 211, 103753. Available at: https://doi.org/10.1016/j.agsy.2023.103753.
16. de Vos, R.E., Suwarno, A., Slingerland, M., van der Meer, P.J. and Lucey, J.M. (2023) 'Pre-certification conditions of independent oil palm smallholders in Indonesia: assessing prospects for RSPO certification', Land Use Policy, 130, 106660. Available at: https://doi.org/10.1016/j.landusepol.2023.106660.
17. Dermawan, A., Hospes, O. and Termeer, C.J.A.M. (2022) 'Between zero-deforestation and zero-tolerance from the state: navigating strategies of palm oil companies of Indonesia', Forest Policy and Economics, 136, 102690. Available at: https://doi.org/10.1016/j.forpol.2022.102690.
18. Duchek, S. (2020) 'Organizational resilience: a capability-based conceptualization', Business Research, 13, pp. 215–246. Available at: https://doi.org/10.1007/s40685-019-0085-7.
19. Ekaputri, A.D., Gaveau, D.L.A., Heilmayr, R. and Carlson, K.M. (2025) 'Uneven participation of independent and contract smallholders in certified palm oil mill markets in Indonesia', Communications Earth & Environment, 6, 721. Available at: https://doi.org/10.1038/s43247-025-02683-6.
20. El Baz, J. and Ruel, S. (2021) 'Can supply chain risk management practices mitigate the disruption impacts on supply chains' resilience and robustness? Evidence from an empirical survey in a COVID-19 outbreak era', International Journal of Production Economics, 233, 107972. Available at: https://doi.org/10.1016/j.ijpe.2020.107972.
21. Elsbach, K.D. and van Knippenberg, D. (2020) 'Creating high-impact literature reviews: an argument for "integrative reviews"', Journal of Management Studies, 57(6), pp. 1277–1289. Available at: https://doi.org/10.1111/joms.12581.
22. Galaitsi, S.E., Pinigina, E., Keisler, J.M., Pescaroli, G., Keenan, J.M. and Linkov, I. (2023) 'Business continuity management, operational resilience, and organizational resilience: commonalities, distinctions, and synthesis', International Journal of Disaster Risk Science, 14, pp. 713–721. Available at: https://doi.org/10.1007/s13753-023-00494-x.
23. Gaveau, D.L.A., Locatelli, B., Salim, M.A., Husnayaen, Manurung, T., Descals, A., Angelsen, A., Meijaard, E. and Sheil, D. (2022) 'Slowing deforestation in Indonesia follows declining oil palm expansion and lower oil prices', PLoS ONE, 17(3), e0266178. Available at: https://doi.org/10.1371/journal.pone.0266178.
24. Gilbert, C.L. (2024) 'The EU Deforestation Regulation', EuroChoices, 23(3), pp. 64–70. Available at: https://doi.org/10.1111/1746-692X.12436.
25. Gipper, B., Ross, S. and Shi, S.X. (2025) 'ESG assurance in the United States', Review of Accounting Studies, 30(2), pp. 1753–1803. Available at: https://doi.org/10.1007/s11142-024-09856-2.
26. Grabs, J. and Garrett, R.D. (2023) 'Goal-based private sustainability governance and its paradoxes in the Indonesian palm oil sector', Journal of Business Ethics, 188, pp. 467–507. Available at: https://doi.org/10.1007/s10551-023-05377-1.
27. Hendrawan, D. and Musshoff, O. (2024) 'Smallholders' preferred attributes in a subsidy program for replanting overaged oil palm plantations in Indonesia', Ecological Economics, 224, 108278. Available at: https://doi.org/10.1016/j.ecolecon.2024.108278.
28. Hendrawan, D., Chrisendo, D. and Musshoff, O. (2024) 'Strengthening oil palm smallholder farmers' resilience to future industrial challenges', Scientific Reports, 14, 12105. Available at: https://doi.org/10.1038/s41598-024-62426-z.
29. Hillmann, J. and Guenther, E. (2021) 'Organizational resilience: a valuable construct for management research?', International Journal of Management Reviews, 23(1), pp. 7–44. Available at: https://doi.org/10.1111/ijmr.12239.
30. Irawan, S., Pasaribu, K., Busch, J., Dwiyastuti, A., Martanila, H., Retnani, D., Fajri, D.M. and Hukom, V. (2024) 'Cost reduction for upscaling voluntary sustainability standards: the case of independent oil palm smallholders in Central Kalimantan, Indonesia', Frontiers in Forests and Global Change, 7, 1418782. Available at: https://doi.org/10.3389/ffgc.2024.1418782.
31. Ivanov, D. (2020) 'Predicting the impacts of epidemic outbreaks on global supply chains: a simulation-based analysis on the coronavirus outbreak case', Transportation Research Part E: Logistics and Transportation Review, 136, 101922.

Available at: https://doi.org/10.1016/j.tre.2020.101922.
32. Ivanov, D. and Dolgui, A. (2020) 'Viability of intertwined supply networks: extending the supply chain resilience angles towards survivability', International Journal of Production Research, 58(10), pp. 2904–2915. Available at: https://doi.org/10.1080/00207543.2020.1750727.
33. Ivanov, D. and Dolgui, A. (2021) 'A digital supply chain twin for managing the disruption risks and resilience in the era of Industry 4.0', Production Planning & Control, 32(9), pp. 775–788. Available at: https://doi.org/10.1080/09537287.2020.1768450.
34. Kettunen, E. and Pratiwi, A. (2025) 'Towards collaborative EU–Indonesia bargaining on palm oil policy: deconstructing the public discourse', Asia Europe Journal. Available at: https://doi.org/10.1007/s10308-025-00732-5.
35. Knauer, T., Nikiforow, N. and Wagener, S. (2020) 'Determinants of information system quality and data quality in management accounting', Journal of Management Control, 31, pp. 97–121. Available at: https://doi.org/10.1007/s00187-020-00296-y.
36. Lubbe, W., ten Ham-Baloyi, W. and Smit, K. (2020) 'The integrative literature review as a research method: a demonstration review of research on neurodevelopmental supportive care in preterm infants', Journal of Neonatal Nursing, 26(6), pp. 308–315. Available at: https://doi.org/10.1016/j.jnn.2020.04.006.
37. Malik, M.F., Zaman, M. and Buckby, S. (2020) 'Enterprise risk management and firm performance: role of the risk committee', Journal of Contemporary Accounting & Economics, 16(1), 100178. Available at: https://doi.org/10.1016/j.jcae.2019.100178.
38. McDermott, C.L., Addoah, T., Agyarko-Kwarteng, T., Asare, R., Assanvo, A., Bastos Lima, M.G., Bellfield, H., Berlan, A., Carodenuto, S., Gardner, T., Garrett, R.D., Hafferty, C., Hirons, M., Ingram, V., Kumeh, E.M., Lyons-White, J., Mason, J., Meyfroidt, P., Montana, J., de Oliveira, G.L.T., Ramcilovik-Suominen, S., Sotirov, M., Thompson, W. and Winkel, G. (2025) 'Equity in unilateral value chain policies: a monitoring framework for the EUDR and beyond', Forest Policy and Economics, 174, 103469. Available at: https://doi.org/10.1016/j.forpol.2025.103469.
39. Mehraban, N., Kubitza, C., Alamsyah, Z. and Qaim, M. (2021) 'Oil palm cultivation, household welfare, and exposure to economic risk in the Indonesian small farm sector', Journal of Agricultural Economics, 72(3), pp. 901–915. Available at: https://doi.org/10.1111/1477-9552.12433.
40. Monazzam, A. and Crawford, J. (2024) 'The role of enterprise risk management in enabling organisational resilience: a case study of the Swedish mining industry', Journal of Management Control, 35, pp. 59–108. Available at: https://doi.org/10.1007/s00187-024-00370-9.
41. Monzon, J.P., Lim, Y.L., Tenorio, F.A., Farrasati, R., Pradiko, I., Sugianto, H., Donough, C.R., Rattalino Edreira, J.I., Rahutomo, S., Agus, F., Slingerland, M.A., Zijlstra, M., Saleh, S., Nashr, F., Nurdwiansyah, D., Ulfaria, N., Winarni, N.L., Zulhakim, N. and Grassini, P. (2023) 'Agronomy explains large yield gaps in smallholder oil palm fields', Agricultural Systems, 210, 103689. Available at: https://doi.org/10.1016/j.agsy.2023.103689.
42. Mulyasari, G., Djarot, I.N., Sasongko, N.A. and Putra, A.S. (2023) 'Social-life cycle assessment of oil palm plantation smallholders in Bengkulu province, Indonesia', Heliyon, 9(8), e19123. Available at: https://doi.org/10.1016/j.heliyon.2023.e19123.
43. Möller, K., Schäffer, U. and Verbeeten, F. (2020) 'Digitalization in management accounting and control: an editorial', Journal of Management Control, 31, pp. 1–8. Available at: https://doi.org/10.1007/s00187-020-00300-5.
44. Packard, M.D. and Clark, B.B. (2020) 'On the mitigability of uncertainty and the choice between predictive and nonpredictive strategy', Academy of Management Review, 45(4), pp. 766–786. Available at: https://doi.org/10.5465/amr.2018.0198.
45. Petri, H., Hendrawan, D., Bähr, T., Musshoff, O., Wollni, M., Asnawi, R. and Faust, H. (2024) 'Replanting challenges among Indonesian oil palm smallholders: a narrative review', Environment, Development and Sustainability, 26, pp. 19351–19367. Available at: https://doi.org/10.1007/s10668-023-03527-z.
46. Post, C., Sarala, R., Gatrell, C. and Prescott, J.E. (2020) 'Advancing theory with review articles', Journal of Management Studies, 57(2), pp. 351–376. Available at: https://doi.org/10.1111/joms.12549.
47. Pramudya, E.P., Wibowo, L.R., Nurfatriani, F., Nawireja, I.K., Kurniasari, D.R., Hutabarat, S., Kadarusman, Y.B., Iswardhani, A.O. and Rafik, R. (2022) 'Incentives for palm oil smallholders in mandatory certification in Indonesia', Land, 11(4), 576. Available at: https://doi.org/10.3390/land11040576.

48. Purnomo, H., Okarda, B., Juniyanti, L., Kusumadewi, S.D., Puspitaloka, D., Azzahra, M., Nadhira, S., Irawan, P., Liswanti, N., Schoneveld, G.C. and Brady, M.A. (2025) ‘Advancing palm oil sustainability to address the climate crisis: leveraging theory of change and system dynamics model at the jurisdictional level’, Forest Policy and Economics, 181, 103594. Available at: https://doi.org/10.1016/j.forpol.2025.103594.
49. Putri, E.I.K., Dharmawan, A.H., Hospes, O., Yulian, B.E., Amalia, R., Mardiyaningsih, D.I., Kinseng, R.A., Tonny, F., Pramudya, E.P., Rahmadian, F. and Suradiredja, D.Y. (2022) ‘The oil palm governance: challenges of sustainability policy in Indonesia’, Sustainability, 14(3), 1820. Available at: https://doi.org/10.3390/su14031820.
50. Qaim, M., Sibhatu, K.T., Siregar, H. and Grass, I. (2020) ‘Environmental, economic, and social consequences of the oil palm boom’, Annual Review of Resource Economics, 12, pp. 321–344. Available at: https://doi.org/10.1146/annurev-resource-110119-024922.
51. Reich, C. and Musshoff, O. (2025) ‘Oil palm smallholders and the road to certification: insights from Indonesia’, Journal of Environmental Management, 375, 124303. Available at: https://doi.org/10.1016/j.jenvman.2025.124303.
52. Santika, T., Wilson, K.A., Law, E.A., St John, F.A.V., Carlson, K.M., Gibbs, H., Morgans, C.L., Ancrenaz, M., Meijaard, E. and Struebig, M.J. (2021) ‘Impact of palm oil sustainability certification on village well-being and poverty in Indonesia’, Nature Sustainability, 4, pp. 109–119. Available at: https://doi.org/10.1038/s41893-020-00630-1.
53. Spieske, A. and Birkel, H. (2021) ‘Improving supply chain resilience through Industry 4.0: a systematic literature review under the impressions of the COVID-19 pandemic’, Computers & Industrial Engineering, 158, 107452. Available at: https://doi.org/10.1016/j.cie.2021.107452.
54. Stanton, M.C.B. and Roelich, K. (2021) ‘Decision making under deep uncertainties: a review of the applicability of methods in practice’, Technological Forecasting and Social Change, 171, 120939. Available at: https://doi.org/10.1016/j.techfore.2021.120939.
55. Steen, R., Haug, O.J. and Patriarca, R. (2024) ‘Business continuity and resilience management: a conceptual framework’, Journal of Contingencies and Crisis Management, 32(1), e12501. Available at: https://doi.org/10.1111/1468-5973.12501.
56. Stolowy, H. and Paugam, L. (2023) ‘Sustainability reporting: is convergence possible?’, Accounting in Europe, 20(2), pp. 139–165. Available at: https://doi.org/10.1080/17449480.2023.2189016.
57. Suhardjo, I., Akroyd, C. and Suparman, M. (2024) ‘Unpacking Environmental, Social, and Governance Score Disparity: A Study of Indonesian Palm Oil Companies’, Journal of Risk and Financial Management, 17(7), 296. Available at: https://doi.org/10.3390/jrfm17070296.
58. Suhardjo, I., Akroyd, C., Rudyanto, A. and Suparman, M. (2026) ‘Double materiality and sustainability reporting: a qualitative study in a developing country’, Meditari Accountancy Research, 34(1), pp. 90–114. Available at: https://doi.org/10.1108/MEDAR-11-2024-2738.
59. Supriatna, J., Djumarno, D., Saluy, A.B. and Kurniawan, D. (2024) ‘Sustainability analysis of smallholder oil palm plantations in several provinces in Indonesia’, Sustainability, 16(11), 4383. Available at: https://doi.org/10.3390/su16114383.
60. Wagenhofer, A. (2024) ‘Sustainability reporting: a financial reporting perspective’, Accounting in Europe, 21(1), pp. 1–13. Available at: https://doi.org/10.1080/17449480.2023.2218398.
61. Wahid, W.W.C., Aprillia, K.R., Ramatia, D., Setiawati, N., Subkhi, S., Swastika, A.B.D.P. and Rianawati, E. (2024) ‘Improving Indonesia’s palm oil sustainability through financing: a study on disconnects and potential policy solutions’, Indonesian Journal of International Law, 21(5), pp. 121–150. Available at: https://doi.org/10.17304/ijil.vol21.5.1880.
62. Wandri, R., Monzon, J.P., Carciochi, W.D., Hairiah, K., Suprayogo, D., van Noordwijk, M., Asmono, D. and Grassini, P. (2025) ‘Can improved plant nutrition buffer against water-related yield losses in oil palm?’, Agricultural Water Management, 322, 109980. Available at: https://doi.org/10.1016/j.agwat.2025.109980.
63. Watts, J.D., Pasaribu, K., Irawan, S., Tacconi, L., Martanila, H., Wiratama, C.G.W., Musthofa, F.K., Sugiarto, B.S. and Manvi, U.P. (2021) ‘Challenges faced by smallholders in achieving sustainable palm oil certification in Indonesia’, World Development, 146, 105565. Available at: https://doi.org/10.1016/j.worlddev.2021.105565.
64. Weber, M.M., Pedell, B. and Rötzel, P.G. (2024) ‘Resilience-oriented management control systems: a systematic review of the relationships between organizational resilience and management control systems’, Journal of Management Control, 35, pp. 563–620. Available at: https://doi.org/10.1007/s00187-024-00385-2.

65. Wibowo, L.R., Erdi, E., Hutabarat, S., Nurfatriani, F., Utomo, M.M.B., Nawireja, I.K., Pramudya, E.P., Kurniasari, D.R., Cahyono, E., Kurniadi, R., Santosa, A., Fuad, Z. and Satwiko, A.A. (2023) ‘Accelerating certification of oil palm smallholders through institutionalization of various incentives’, Forest and Society, 7(2), pp. 263–294. Available at: https://doi.org/10.24259/fs.v7i2.24679.
66. Wibowo, S., Achsani, N.A., Suroso, A.I. and Sasongko, H. (2022) ‘Integrated Governance, Risk, and Compliance (GRC) and combined assurance: a comparative institutional study’, Indonesian Journal of Business and Entrepreneurship, 8(2), p. 289. Available at: https://doi.org/10.17358/ijbe.8.2.289.
67. Normative and Institutional Sources
68. European Commission (2026) ‘Regulation on deforestation-free products: implementation and application timelines’. Directorate-General for Environment. Available at: https://environment.ec.europa.eu/topics/forests/deforestation/regulation-deforestation-free-products_en (Accessed: 27 August 2026).
69. IFRS Foundation (2023) IFRS S1 General Requirements for Disclosure of Sustainability-related Financial Information. International Sustainability Standards Board. Available at: https://www.ifrs.org/issued-standards/ifrs-sustainability-standards-navigator/ifrs-s1-general-requirements/ (Accessed: 27 August 2026).
70. Ikatan Akuntan Indonesia (IAI) (2025) ‘Standar Pengungkapan Keberlanjutan Efektif Per 1 Januari 2027’. Available at: https://web.iaiglobal.or.id/Berita-IAI/detail/standar_pengungkapan_keberlanjutan_efektif_per_1_januari_2027 (Accessed: 27 August 2026).
71. International Organization for Standardization (ISO) (2019) ISO 22301:2019 Security and resilience—Business continuity management systems—Requirements. Geneva: ISO. Available at: https://www.iso.org/standard/75106.html (Accessed: 27 August 2026).
72. International Organization for Standardization (ISO) (2024) ISO 22301:2019/Amd 1:2024—Climate action changes. Geneva: ISO. Available at: https://www.iso.org/standard/88412.html (Accessed: 27 August 2026).
73. Government of the Republic of Indonesia (2025) Presidential Regulation No. 16 of 2025 concerning the Indonesian Sustainable Palm Oil Certification System. Jakarta. Available at: https://www.peraturan.go.id/files/perpres-no-16-tahun-2025.pdf (Accessed: 27 August 2026).
74. Ministry of Energy and Mineral Resources of the Republic of Indonesia (2026) ‘Mandatory B50 biodiesel programme’, 9 July. Available at: https://esdm.go.id/en/media-center/news-archives/luncurkan-mandatori-b50-esdm-tegaskan-kesiapan-indonesia-perkuat-kedaulatan-energi (Accessed: 27 August 2026).
75. Ridhwan, M.M., Permata, M.I., Marhastari, R., Adli, F.F., Fawaqa, L., Ramadhan, R., Lestari, A.L., Fisakinah, A., Khair, M.A., Ayustira, Y.Z. and Putra, G.D. (2025) Pushing Biodiesel Boundaries: B50 & Beyond—Promise or Premature? Bank Indonesia Working Paper WP/05/2025. Available at: https://www.bi.go.id/en/publikasi/kajian/Pages/Pushing-Biodiesel-Boundaries-B50-Beyond-Promise-or-Premature.aspx (Accessed: 27 August 2026).