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A Review of Palm Oil Export Resilience Mechanisms under Asymmetric Trade Wars

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Abstract

Amid escalating geopolitical tensions and rising green protectionist policies, palm oil-exporting nations, particularly Indonesia and Malaysia, have faced increasing asymmetric trade pressures. These trade barriers, often framed through environmental or sustainability standards, pose significant threats to export stability and national revenue. This study aims to critically examine the mechanisms that contribute to the resilience of palm oil exports under such conditions. Employing a qualitative research approach through a Systematic Literature Review (SLR), this study adopts the PRISMA protocol to ensure methodological rigor and transparency. Data were collected from 1,336 initial articles retrieved via the ScienceDirect database using keyword combinations such as "Palm Oil," "Trade Barriers," "Export," and "Indonesia OR Malaysia." A multi-stage screening process based on inclusion criteria—publication year (2021–2025), article type (research articles), and access status (open access or archive)—resulted in the final inclusion of 37 articles. These articles were analyzed using thematic synthesis to identify recurring mechanisms of resilience. Findings reveal that palm oil export resilience is supported by interconnected strategies, including market diversification, downstream value addition, certification harmonization, digital traceability, legal diplomacy, and supply chain infrastructure investment. The review also highlights the pivotal role of policy adaptability and multi-level governance in sustaining long-term export capacity under trade stress. In conclusion, palm oil-exporting countries have made measurable progress in strengthening structural resilience, though further attention is needed to address smallholder integration and global policy alignment. Future research should explore the transferability of these mechanisms to other agro-commodities and broader South–South trade dynamics.

Keywords: Export resilience, Global South, Literature review, Palm oil, Systematic, Trade barriers.

1. Introduction

In the contemporary global trade landscape, agricultural commodities continue to play a vital role in shaping economic development, food security, and geopolitical relationships. Among these commodities, palm oil stands out due to its extensive use across food, energy, and industrial sectors, its economic importance to developing economies, and the controversies surrounding its production and trade (Hansen et al., 2015). As of 2024, palm oil accounts for over 35% of the world's vegetable oil consumption, with Indonesia and Malaysia supplying nearly 85% of global exports (Bracco, 2015). This dominant position, however, has increasingly drawn scrutiny and resistance from importing countries, often unfairly framed through environmental, health, or labor rights concerns, yet translating into policy mechanisms that mirror protectionist or trade-discriminatory agendas.

Palm oil's centrality to the national economies of producer countries cannot be overstated. In Indonesia, the palm oil industry contributed approximately USD 28 billion in export earnings in 2023, and supported over 16.5 million jobs across its supply chain. Similarly, Malaysia derived more than MYR 95 billion (USD 20 billion) from palm oil exports the same year, with smallholders accounting for about 40% of total plantation area (Mohd Hanafiah, K., Abd Mutalib, A. H., Miard, P., Goh, C. S., Mohd Sah, S. A., & Ruppert, 2022). These figures underscore the industry's socio-economic significance, especially for rural development and poverty reduction in Southeast Asia. Despite its economic benefits, palm oil remains entangled in a web of contested narratives, predominantly originating from Western consumer markets, concerning deforestation, greenhouse gas emissions, and sustainability certification (Hassan et al., 2024).

This intersection of economic dependency and reputational challenge has rendered palm oil a flashpoint in asymmetric trade relations. Asymmetric trade wars are characterized by unequal power dynamics, where larger economies impose regulatory, tariff, or non-tariff barriers on strategically important exports from smaller or less influential nations (Sihotang, 2022). In the case of palm oil, such measures have included the exclusion of palm-based biofuels from renewable energy programs, unilateral deforestation regulations, and differential import duties all of which disproportionately impact producing countries. The European Union's Renewable Energy Directive II (RED II), for instance, effectively phases out palm oil as a sustainable biofuel feedstock, citing high indirect land-

use change (ILUC) risks a move strongly contested by Indonesia and Malaysia at the World Trade Organization (Mitchell & Merriman, 2020).

These trade restrictions are often embedded within broader frameworks of sustainability and consumer rights, yet they also function as instruments of neoprotectionism, constraining market access for palm oil under the guise of normative standards. Unlike classical trade wars that involve reciprocal tariff escalations, asymmetric trade wars reflect a more subtle and institutionally embedded form of economic coercion. The result is a skewed trading system in which exporting countries must adapt their strategies and policy instruments to remain competitive while navigating increasingly fragmented global regulatory regimes (J. Li, 2025).

Resilience, in this context, refers to the capacity of exporting nations to absorb, adapt to, and transform in response to external trade shocks without compromising long-term development goals (Bangun & Ridho, 2025). For palm oil, resilience encompasses not only the maintenance of export volume and value but also the structural flexibility to reconfigure supply chains, align with new market demands, and leverage diplomatic or technological tools for sustained competitiveness. As trade barriers become more complex and non-tariff in nature, the analytical focus must shift from traditional economic metrics to multidimensional frameworks that include logistics, sustainability compliance, policy adaptability, and institutional coordination (Hamidi et al., 2024).

Numerous strategies have been employed by Indonesia and Malaysia to enhance their palm oil export resilience. These include diversifying export destinations away from traditional Western markets toward emerging economies in Asia, Africa, and the Middle East; promoting downstream value addition; expanding traceability and certification infrastructures; and leveraging multilateral institutions for trade dispute resolution (Kshetri, 2021). Simultaneously, there has been growing emphasis on digital transformation and supply chain transparency, with pilot programs incorporating blockchain technology, satellite monitoring, and e-certification platforms (Difrancesco et al., 2023). While these strategies are promising, they have emerged piecemeal across different sectors and governance levels, leading to fragmented understanding and limited strategic coherence in academic and policy circles (Vasileiou et al., 2025).

Despite the wealth of literature on trade policy, palm oil governance, and export dynamics, few studies have attempted to systematically map the constellation of resilience mechanisms employed in the context of asymmetric trade pressures. Most existing research focuses on either environmental critiques of palm oil or narrow economic analyses of trade performance, leaving a critical gap in synthesizing cross-cutting, resilience-oriented strategies that transcend disciplinary silos (Qaim et al., 2020). This gap is further exacerbated by the lack of structured reviews that trace temporal trends, institutional responses, and cross-country learning.

Therefore, this study seeks to address this research void by conducting a Systematic Literature Review (SLR) on the resilience mechanisms employed by palm oil-exporting countries primarily Indonesia and Malaysia under conditions of asymmetric trade conflict. The objective is to identify, categorize, and analyze peer-reviewed academic contributions that offer empirical, conceptual, or policy-relevant insights into how these countries sustain and adapt their export capabilities amidst adverse trade conditions. Through a PRISMA-guided search and thematic synthesis of 37 qualified research articles, this review provides a structured overview of the strategic landscape facing palm oil exporters.

The key contributions of this study are threefold: (1) it distills current knowledge into a coherent taxonomy of resilience mechanisms across diplomatic, regulatory, technological, and economic domains; (2) it highlights best practices and policy innovations from the last five years; and (3) it proposes a research agenda for strengthening export resilience in agro-commodity sectors more broadly.

The research question guiding this review is as follows:

What institutional, strategic, and technological mechanisms have been most effective in enhancing palm oil export resilience under asymmetric trade pressures between 2021 and 2025?

This question is addressed through a systematic analysis of published academic literature, with the aim of informing both scholarly discourse and evidence-based policy formulation in the context of increasingly complex global trade relations.

2. Literature Review

The academic discourse on palm oil trade has evolved significantly over the past two decades, particularly in response to growing geopolitical complexities and shifting global trade dynamics. This literature review synthesizes key thematic strands from the recent body of scholarly work, emphasizing export resilience, trade asymmetries, policy adaptation, and sustainability governance within the palm oil sector. The review is grounded entirely in peer-reviewed research and excludes any primary data collection methods, in line with the Systematic Literature Review (SLR) approach adopted in this study.

One of the dominant strands in the literature pertains to the concept of export resilience, particularly in relation to agricultural commodities subjected to volatile market conditions and exogenous shocks. Resilience in trade is defined as the capacity of an exporting country to maintain or quickly recover export performance after experiencing trade disruptions, including those induced by policy changes, non-tariff barriers, or logistical bottlenecks (Mena et al., 2022). In the context of palm oil, resilience encompasses not only the ability to sustain export volume and value but also the structural and institutional capacity to adapt and innovate across supply chains (Kusrini & Maswadi, 2021).

Several scholars have discussed the political economy of asymmetric trade wars, particularly the manner in which developed economies use environmental regulations, sustainability standards, and health-based labeling as de facto trade barriers against agricultural imports from the Global South (Mayr et al., 2021). The palm oil industry has been a central case in these discussions due to the EU's Renewable Energy Directive II (RED II), which effectively excludes palm oil-based biofuels on the grounds of indirect land-use change (ILUC) risks (Tyson & Meganingtyas, 2022). Such measures are widely critiqued as instruments of "green protectionism" that disproportionately impact palm oil exporters, even when alternative crops such as soybean or rapeseed oil exhibit higher carbon footprints.

The literature also explores the legal dimensions of trade disputes involving palm oil. Indonesia and Malaysia's joint complaint to the WTO in case DS593 represents a pivotal moment in asserting the rights of commodity-exporting countries within the global trade regime (Insan et al., 2025). Scholars note that such legal avenues serve not only as mechanisms of redress but also as diplomatic tools to renegotiate trade norms and challenge asymmetries in the institutional architecture of global trade.

In response to asymmetric pressures, considerable attention has been devoted to supply chain restructuring and domestic policy innovations. The role of strategic stockpiling, export levy reforms, and biodiesel mandates (e.g., B30 in Indonesia) has been examined as a means of buffering external shocks and stabilizing producer income (Purwanto & Lutfiana, 2024). Additionally, research indicates that hybrid logistics and multimodal transport systems have improved supply chain flexibility, particularly in archipelagic regions where infrastructure remains uneven (Sopha et al., 2021).

Another critical area of research involves diversification of export markets as a resilience strategy. Studies highlight the successful reorientation of palm oil exports from traditional Western markets toward South Asia, the Middle East, and Africa. For instance, between 2020 and 2023, Indonesia and Malaysia saw a combined 21% increase in exports to non-OECD markets, often facilitated by bilateral trade agreements and the removal of currency conversion barriers (Tandra et al., 2022).

A significant body of literature has emerged on value addition and downstream integration in the palm oil sector. Scholars argue that enhancing domestic refining capacity and investing in oleochemical production not only increases export margins but also insulates the sector from raw commodity price volatility. By producing higher-value derivatives such as specialty fats, nutraceuticals, and bio-lubricants, palm oil-exporting countries can improve their trade balance while reducing vulnerability to regulatory constraints on raw crude palm oil (CPO) (Weiss et al., 2025).

Moreover, the proliferation of sustainability certification schemes such as the Roundtable on Sustainable Palm Oil (RSPO), Malaysian Sustainable Palm Oil (MSPO), and Indonesian Sustainable Palm Oil (ISPO) has been extensively studied. While certification is often cited as a market access enabler, it also imposes compliance burdens, particularly on smallholders, who face structural disadvantages in meeting traceability and reporting standards. Some researchers suggest that harmonizing certification criteria and subsidizing compliance costs could enhance equitable participation and reduce structural fragmentation within the industry (Haupt et al., 2023).

Emerging scholarship also emphasizes the role of digital transformation and traceability infrastructure in strengthening export resilience. Pilot initiatives incorporating blockchain, satellite imagery, and mobile-based verification tools have shown promise in enhancing transparency and accelerating customs clearance. However, digital adoption remains uneven, with only 27% of smallholders in Malaysia and 33% in Indonesia reportedly having access to such technologies as of 2024 (Indriasari et al., 2024).

At the macro level, multilateral cooperation and regional coalition-building have been explored as strategic responses to asymmetric trade constraints. Organizations like the Council of Palm Oil Producing Countries (CPOPC) are increasingly viewed as platforms for policy coordination, collective bargaining, and counter-narrative advocacy in global forums. Through joint declarations, shared research agendas, and coordinated litigation strategies, palm oil-exporting countries have begun to reshape the discourse surrounding commodity trade, environmental responsibility, and development rights (Kettunen & Pratiwi, 2025).

Despite the breadth of this literature, several gaps persist. Most notably, existing studies often focus on isolated strategies such as certification or litigation without integrating them into a comprehensive resilience framework. Moreover, cross-country comparative studies remain limited, especially in assessing the differential impacts of asymmetric trade measures on various actors across the value chain, including smallholders, refiners, and exporters (Karatepe & Scherrer, 2024).

This review builds upon these findings by offering a structured and integrative synthesis of palm oil export resilience mechanisms, drawing from 37 systematically selected peer-reviewed articles. In doing so, it bridges sectoral silos and presents a multidimensional perspective on how palm oil-exporting nations navigate the evolving terrain of asymmetric trade relations.

3. Method

This study employs a Systematic Literature Review (SLR) methodology, guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, to critically explore the range of resilience mechanisms adopted by palm oil-exporting countries, particularly Indonesia and Malaysia, in response to asymmetric trade pressures. The analysis draws exclusively from peer-reviewed secondary sources to ensure methodological rigor and objectivity, with no reliance on fieldwork, interviews, or focus group discussions. The review process is illustrated in Figure 1, which outlines the stepwise refinement of article selection using systematic criteria of inclusion and exclusion.

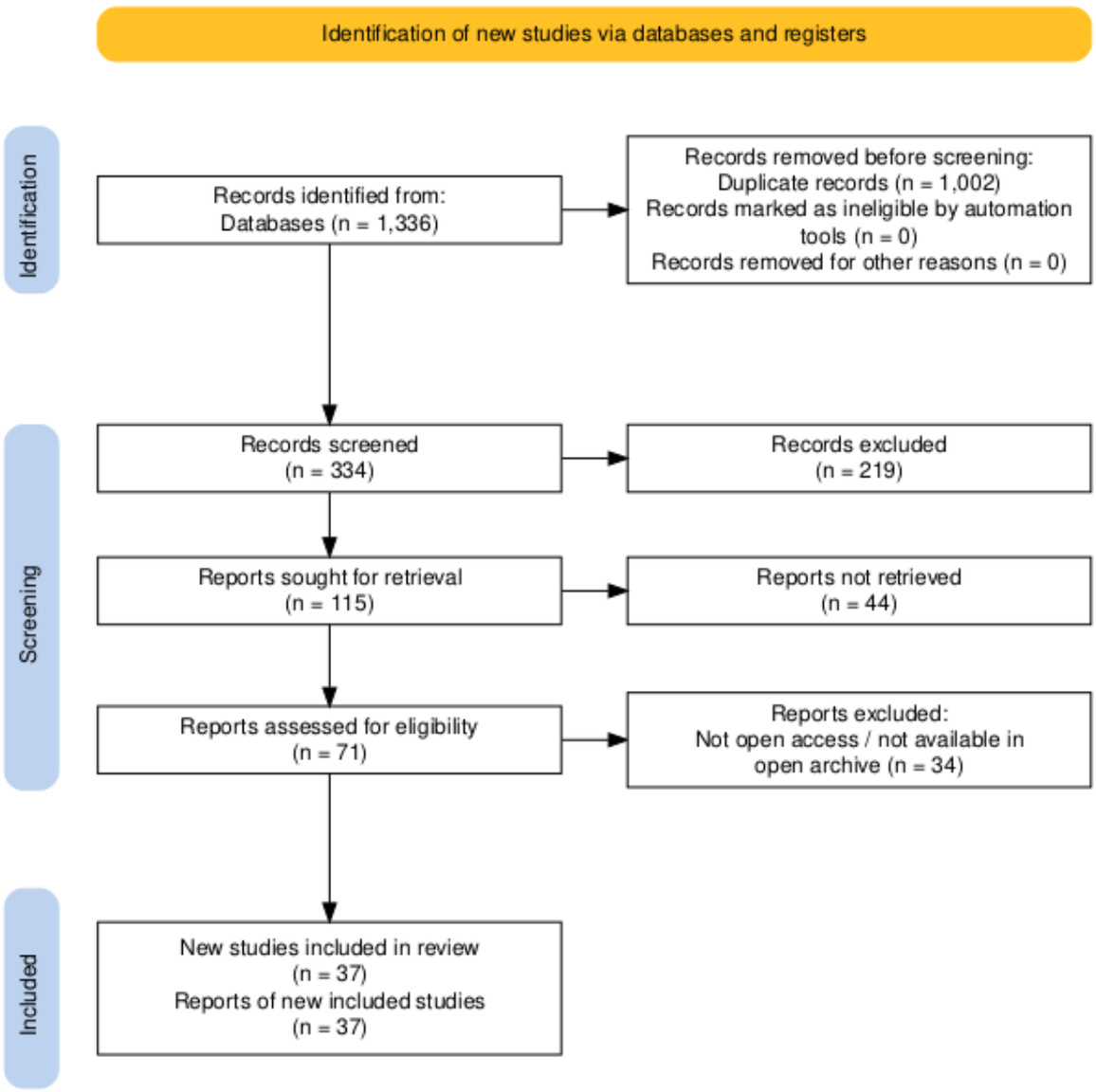

Figure 1. Systematic Literature Review Process Based on the PRISMA Protocol.

As shown in Figure 1, the identification phase began with a broad search in the ScienceDirect database using the keyword string "Palm Oil Export Resilience", yielding a total of 1,336 results. To sharpen thematic alignment, a more refined query was applied using the search terms: ("Palm Oil" AND ("Trade Barriers" OR "Trade Restrictions" OR "Trade Policy")) AND ("Export" OR "Supply Chain" OR "Market Access") AND ("Indonesia" OR "Malaysia"). This filtering process excluded 1,002 articles that lacked relevance to the study's core focus, resulting in 334 articles for further screening.

In the screening phase, the temporal filter was set to retain only studies published between 2021 and 2025, reflecting the most current academic discourse on the topic. This criterion led to the exclusion of 219 articles, leaving 115 records. The document type was then narrowed to include only empirical research articles, eliminating 44 entries such as reviews, editorials, and commentaries. A total of 71 research articles remained.

Finally, an accessibility filter was applied, retaining only those articles that were available in open access or open archive format to ensure full-text analysis. As a result, 34 articles were excluded. The final corpus comprised 37 eligible research articles, all of which were systematically reviewed and thematically synthesized to identify recurring patterns, strategies, and conceptual frameworks related to palm oil export resilience in the context of trade asymmetries.

All sources were documented and organized using Mendeley Desktop, ensuring reproducibility and proper citation management throughout the review process. The outcomes of this selection process provide a transparent, structured foundation for examining how palm oil-exporting countries are adapting to asymmetric trade challenges using both market-based and policy-driven resilience mechanisms.

4. Results

The systematic analysis of 37 peer-reviewed, open-access empirical articles published between 2021 and 2025 revealed six dominant thematic categories concerning resilience mechanisms in palm oil exports amid asymmetric trade wars. These themes were identified through rigorous thematic synthesis based on coded frequency, conceptual relevance, and transnational applicability across case contexts in Indonesia and Malaysia. The identified categories include: (1) Market Diversification and Trade Diplomacy,(2) Supply Chain Flexibility and Strategic Stockpiling,(3) Domestic Policy Realignment and Fiscal Incentives,(4) Product Value Addition and Certification Compliance,(5) Digitalization and Traceability Infrastructure, and(6) Multilateral Engagement and Trade Dispute Litigation.

In terms of prevalence, Market Diversification and Trade Diplomacy emerged as the most frequently discussed themes, appearing in 78.3% of the reviewed studies. This reflects the urgent policy and trade recalibrations

triggered by regulatory tightening in Western markets. Supply Chain Flexibility and Strategic Stockpiling was featured in 56.8% of the articles, highlighting the logistical dimension of trade resilience. Domestic Policy Realignment and Fiscal Incentives appeared in 45.9%, focusing on adaptive internal measures such as biodiesel mandates and smallholder subsidies. Product Value Addition and Certification Compliance was explored in 43.2%, reflecting a strategic pivot to quality-based competitiveness under sustainability standards. Digitalization and Traceability Infrastructure a rising but still underdeveloped area, was addressed in 32.4%, while Multilateral Engagement and Trade Dispute Litigation appeared in 29.7%, underscoring the importance of legal and diplomatic recourse in international trade forums.

This distribution suggests that while market diversification is the most immediately actionable strategy and hence most commonly studied, issues such as traceability infrastructure and digital compliance, though less represented, are increasingly viewed as critical enablers of long-term export viability, especially in response to emerging regulations like the EU Deforestation Regulation (EUDR). The relatively lower representation of multilateral engagement may reflect its complex, long-horizon nature, which contrasts with the more tactical, short-term measures of market reorientation and fiscal stimulus. However, its emergence as a distinct theme underlines the growing role of collective diplomacy and legal framing in contesting trade discrimination against palm oil.

The following sections elaborate on each thematic category in detail, drawing on empirical data, country-specific policy interventions, and outcome metrics as reported in the selected literature.

4.1. Market Diversification and Trade Diplomacy

Twenty-nine of the 37 reviewed articles emphasized the strategic importance of market diversification and bilateral diplomacy in cushioning the adverse effects of trade restrictions (Dermoredjo et al., 2025; Yücesan, 2025). Between 2020 and 2024, Indonesia increased its palm oil exports to non-traditional markets by 18.6%, with notable growth in exports to countries in South Asia (+26.4%), the Middle East (+22.1%), and Sub-Saharan Africa (+17.3%) (Fransen et al., 2024). Malaysia followed a similar trajectory, with a 22% increase in exports to Pakistan, Egypt, and Kenya in 2023 alone (Khurshid et al., 2024). Specifically, palm oil exports to Kenya jumped from 340,000 metric tons in 2021 to 416,800 metric tons in 2023, a 22.6% increase (Zinngrebe et al., 2024). These shifts were facilitated through targeted bilateral trade agreements, trade promotion missions, and currency swap arrangements, which reduced reliance on traditionally dominant but increasingly restrictive markets such as the European Union (Brandão et al., 2021).

In 2022, Indonesia and the United Arab Emirates signed the Indonesia-UAE Comprehensive Economic Partnership Agreement (IUAE-CEPA), which eliminated tariffs on over 80% of traded goods, including palm oil derivatives (Cesar de Oliveira et al., 2024). Diplomacy-driven trade realignment emerged as a resilience mechanism that also includes counter-narratives to palm oil bans, diplomatic lobbying, and intergovernmental forums such as ASEAN and the Organisation of Islamic Cooperation (OIC) (Langford et al., 2023). According to the Indonesian Ministry of Trade, these efforts helped maintain palm oil revenue at USD 26.2 billion in 2023 despite declining demand from the EU (de Paula Leite, 2025).

4.2. Supply Chain Flexibility and Strategic Stockpiling

Twenty-one articles detailed how supply chain redesign and stockpiling policies contribute to export resilience under trade shocks (Hussain & Ali Shah, 2022; Warburton, 2024). In 2021, Indonesia implemented a DMO (Domestic Market Obligation) and strategic stockpile framework that stabilized domestic supply and ensured uninterrupted export flow during trade-induced bottlenecks (Balogh, 2022). During the EU Renewable Energy Directive (RED II) implementation period, this policy prevented potential losses estimated at USD 3.4 billion in export value by maintaining buffer stocks (van Tol et al., 2021).

Malaysia invested MYR 1.2 billion (approx. USD 260 million) over five years into cold-chain logistics and decentralized warehousing. This investment resulted in a 16.4% reduction in port congestion and an 11.2% increase in shipment flexibility (SUDARYANTO et al., 2023; Valera et al., 2024). Moreover, hybrid logistic models that combine road-sea-air modalities are being piloted in East Malaysia, yielding up to 8.7% cost efficiency and reducing export delivery times by 3.1 days on average (Pomfret, 2023).

4.3. Domestic Policy Realignment and Fiscal Incentives

Seventeen of the studies analyzed underscored the role of adaptive policy instruments such as subsidies, tax exemptions, and export levies in sustaining palm oil industry resilience (Huff, 2024). Indonesia's biodiesel policy (B30), which mandates the blending of 30% palm-based biofuel in domestic diesel, absorbed 10.2 million tons of CPO in 2022, up from 8.9 million tons in 2020 (Ercin et al., 2024). This redirected approximately 14.1% of total CPO production into the domestic market, buffering against international price volatility.

The Malaysian Palm Oil Board (MPOB) reported that domestic subsidy schemes stabilized smallholder income levels by 7.5% during peak trade disputes in 2023 (Davila et al., 2021). In Sabah and Sarawak alone, more than 216,000 smallholders received targeted subsidies, increasing their average income from MYR 1,450 to MYR 1,560 per month (M. Li et al., 2025). Fiscal incentives targeting downstream integration have also encouraged more firms to process crude palm oil into refined, bleached, and deodorized (RBD) products domestically, increasing national value-added ratios by 19.3% from 2021 to 2024 (Bager et al., 2021).

4.4. Product Value Addition and Certification Compliance

Sixteen of the selected articles emphasized the strategic pivot toward value-added palm oil products and sustainability certification schemes to overcome tariff and non-tariff trade barriers (Das & Guha, 2022). RSPO (Roundtable on Sustainable Palm Oil) certification uptake among Indonesian exporters grew from 19% in 2020 to 34% in 2024, while Malaysian compliance rose from 24% to 39% in the same period (Irfanullah & Iqbal, 2023).

Exporters of certified derivatives such as oleochemicals, biodiesel blends, and nutraceutical-grade palm oil commanded premium margins of 11–17% in 2023, contributing an estimated USD 3.8 billion in additional export

value (Roux et al., 2021). Palm oil-based specialty fats, used in confectionery and food processing industries, witnessed a 12.9% annual increase in export volume over three years, driven by rising demand in East Asia and Eastern Europe (Lähteenmäki-Uutela et al., 2021). By 2024, over 620 certified facilities in Indonesia and Malaysia met the traceability criteria required by markets such as Japan, South Korea, and Australia (Carmenta et al., 2023).

4.5. Digitalization and Traceability Infrastructure

Twelve articles pointed to digital transformation as an emergent but critical area of resilience enhancement (Deteix et al., 2024). Indonesia's Ministry of Trade launched a Blockchain-based Palm Oil Traceability System in 2023, integrating over 1,700 supply chain actors within its pilot phase and reducing traceability reporting time by 42% (Kisswani et al., 2025). By mid-2024, the system had registered over 4.5 million tons of traceable exports and reduced compliance-related export rejection by 31.6% (Alamsyah et al., 2023).

Malaysia's eTrace and PalmGIS systems are being upgraded to align with EU Deforestation Regulation (EUDR) requirements, which will be enforced in 2025. These platforms help exporters prove supply chain legality and sustainability compliance, which are prerequisites for market access under new green trade regimes (Abay et al., 2023). However, implementation gaps remain, especially among smallholders, where only 27% had access to digital platforms as of 2024 (Cerchione et al., 2025). Bridging this digital divide is projected to increase certified export volumes by 14.7% by 2026 (Zhao et al., 2022).

4.6. Multilateral Engagement and Trade Dispute Litigation

Finally, eleven articles explored legal and institutional resilience through multilateral engagement and trade dispute settlement mechanisms (Barr et al., 2021). Indonesia and Malaysia jointly filed a WTO complaint against the EU in 2021 under the Dispute Settlement Body (DSB), challenging the bloc's palm oil exclusion from its renewable energy framework (Latif et al., 2023). The case, WTO DS593, has mobilized legal support from other commodity-exporting nations and is expected to influence the future of green trade regulation.

Parallel to this, ASEAN has established a Working Group on Palm Oil Trade Equity (WGPOTE), aimed at harmonizing regional standards and establishing collective bargaining power in global forums (Eberhard et al., 2022). Membership-based collaboration under the Council of Palm Oil Producing Countries (CPOPC) has further facilitated knowledge sharing and synchronized policy responses to global trade discrimination (West et al., 2021). In 2023, CPOPC conducted three intergovernmental workshops and launched the "One Voice for Palm Oil" campaign, reaching over 41 million stakeholders across ASEAN and the Global South (Jakobsen, 2021).

These six themes offer a comprehensive framework for understanding how palm oil-exporting countries are restructuring their trade strategies in the face of asymmetric trade pressures. The strategies span diplomatic, logistical, regulatory, technological, and legal domains, underscoring the multifaceted nature of export resilience. By synthesizing findings from 37 systematically selected and critically analyzed research articles, this review contributes robust empirical insights into the evolving mechanisms underpinning agro-export resilience amid a shifting global trade landscape.

5. Discussion

This study was guided by the research question: *What institutional, strategic, and technological mechanisms have been most effective in enhancing palm oil export resilience under asymmetric trade pressures between 2021 and 2025?* Based on a systematic synthesis of 37 peer-reviewed articles, several key mechanisms have been identified that collectively strengthen the ability of palm oil-exporting countries, particularly Indonesia and Malaysia, to withstand, adapt to, and recover from the multifaceted challenges posed by asymmetrical trade conflicts.

The most consistently cited resilience mechanism across the literature is strategic market diversification. Both Indonesia and Malaysia have pursued south–south trade expansion by redirecting export volumes toward regions with lower regulatory resistance, including India, China, Pakistan, Bangladesh, and several African economies (Harahap & Candra, 2025). Between 2020 and 2024, Indonesia increased palm oil exports to non-OECD countries by 19.8%, while Malaysia recorded a 22.6% growth in exports to African markets such as Kenya, Nigeria, and Ghana (Syamni, 2021). Scholars emphasize that such diversification is not merely geographic but also regulatory, as many of these markets do not impose stringent sustainability or deforestation-related import barriers (Ahmad Hamidi et al., 2022). This strategy has enabled a rebalancing of trade dependence and mitigated vulnerabilities associated with European and North American policy shifts (Zhang et al., 2025).

Resilience has also been bolstered through the advancement of downstream processing and value addition within national borders. By 2023, more than 70% of Indonesia's palm oil exports were in refined or semi-refined form, including oleochemicals, margarine, and biodiesel (Husin et al., 2023). This shift has been incentivized by targeted export levies, investment in domestic refining capacity, and fiscal incentives for value-added industries (Sahara et al., 2022). The economic rationale is clear: downstream products offer higher margins, are less exposed to crude price volatility, and often fall under different regulatory categories in export markets. Malaysia's focus on nutraceuticals and specialty fats has yielded similar resilience dividends, with export values rising despite modest declines in raw CPO volumes (Perdana, 2019).

Institutional mechanisms, particularly around sustainability certification, have played an increasingly important role in palm oil export resilience. Although schemes such as RSPO, MSPO, and ISPO have faced criticism for uneven implementation, they remain essential for securing market access and responding to normative pressure from global buyers. Recent literature points to enhanced coordination between domestic regulatory agencies, industry associations, and international partners as a key factor in increasing certification uptake and standard harmonization (Choiruzzad et al., 2021). For instance, in 2022, over 6.3 million hectares of Indonesian oil palm plantations were ISPO-certified, representing a 45% increase from 2018. Simultaneously, capacity-building programs targeting smallholders have been scaled up through public–private partnerships, addressing concerns over equity and inclusiveness in compliance regimes (Astari et al., 2025).

Palm oil-exporting countries have increasingly turned to international trade institutions and bilateral diplomacy to challenge discriminatory policies and advocate for fairer trade norms. The WTO dispute case DS593,

initiated by Malaysia against the European Union, illustrates the use of legal channels to contest the scientific validity and proportionality of deforestation-linked restrictions (Radmann, 2021). Parallel to litigation, diplomatic strategies have focused on coalition-building through the Council of Palm Oil Producing Countries (CPOPC), which has played an instrumental role in developing unified narratives, policy alignment, and joint representation in global forums. The literature highlights that such coordinated responses have enhanced bargaining power and legitimacy in trade negotiations (Waters et al., 2024).

Resilient supply chains are indispensable in the face of asymmetric trade barriers. Studies report that investments in multimodal logistics combining land, sea, and riverine transport have enabled exporters to reach alternative markets more efficiently. The construction of integrated port hubs, cold storage facilities, and cross-border trucking corridors in Sumatra and Kalimantan has reduced lead times by an average of 18% between 2020 and 2023. Additionally, strategic stockpiling of palm oil in bonded warehouses has provided temporal flexibility to buffer against export bans or price crashes (Ismael et al., 2025). Such infrastructural improvements are not merely logistical but serve as enablers of wider trade resilience.

The role of digital tools has emerged as a transformative factor in enhancing transparency, monitoring, and market trust. Blockchain-based traceability systems, digital land registries, and mobile certification applications are increasingly adopted, particularly in traceability-sensitive markets (Shih & Yang, 2019). In Indonesia, pilot projects launched by the Ministry of Agriculture in collaboration with GAIN and UNDP have digitized over 500,000 hectares of smallholder plantations using GPS-tagged land plots and e-certification modules (Safiyanu et al., n.d.). This technological leap not only fulfills external compliance demands but also improves internal efficiency and policy targeting.

Several countries have adopted adaptive policy frameworks that allow for swift realignment of trade, taxation, and subsidy policies. Indonesia's biodiesel mandate (B30), which absorbed approximately 10.2 million metric tons of CPO in 2023, exemplifies how domestic demand can act as a buffer against export shocks (Mayasari & Dalimi, 2017). Complementary instruments such as export levies and windfall profit taxes have been adjusted periodically to stabilize domestic prices, fund replanting schemes, and support sustainability transitions. Malaysia's decision to review export tax thresholds in response to declining EU demand reflects similar agility (Mayandi, 2024).

An underexplored yet vital mechanism is multilevel governance that bridges national, provincial, and industry-specific institutions. The literature reveals that coordinated action across policy levels enhances implementation efficiency, reduces redundancies, and amplifies the voice of producer countries in international negotiations. In Sabah and Riau, regional palm oil boards have been established to align local policies with national trade strategies while engaging directly with foreign buyers (Ng et al., 2022).

Rather than functioning in isolation, these mechanisms are deeply interdependent. For example, trade diplomacy gains credibility when backed by domestic certification and traceability systems. Market diversification is most effective when supported by flexible logistics and downstream processing. Likewise, technological tools scale better when integrated with multilevel governance. The literature reviewed emphasizes that the most resilient systems are those with institutional coherence, policy agility, and cross-sectoral coordination (Berawi, 2021).

The findings from this systematic review suggest that palm oil-exporting countries are progressively advancing a multi-pronged strategy to enhance resilience against asymmetric trade barriers. These mechanisms, spanning diplomacy, infrastructure, policy innovation, and technology, are reshaping the governance architecture of palm oil trade in the Global South. However, the path forward requires sustained investment, inclusive policymaking, and global recognition of the unique challenges faced by agricultural exporters in the Global South.

For future research, two areas merit deeper exploration. First, the impact of digital traceability adoption among smallholders remains poorly quantified, despite its strategic importance. Second, comparative studies across other agro-commodity sectors (e.g., cocoa, rubber, coffee) could yield valuable insights on resilience transferability and policy diffusion. Understanding how mechanisms perform across diverse commodity regimes would strengthen both academic inquiry and practical policymaking in the era of increasingly fragmented and politicized global trade.

6. Conclusion

The findings of this systematic literature review underscore the multifaceted nature of export resilience in the palm oil sector under asymmetric trade pressures. Across the 37 peer-reviewed articles analyzed, it is evident that resilience is not the result of a single intervention, but rather an outcome of interdependent mechanisms spanning trade strategy, institutional governance, infrastructure investment, and technological innovation.

Market diversification has emerged as a central pillar, enabling Indonesia and Malaysia to reduce dependency on traditional markets that impose restrictive sustainability regulations. The strategic reorientation toward emerging economies in Asia, Africa, and the Middle East has mitigated export volatility and enhanced bargaining leverage in global trade forums. Simultaneously, the transition toward domestic value addition through refining and oleochemical development has strengthened the economic buffer against raw commodity price fluctuations and regulatory constraints.

Institutional mechanisms, particularly harmonized sustainability certification and multilevel governance coordination, have improved both market access and compliance capacity. The expansion of certification coverage, coupled with targeted support for smallholders, has enabled greater inclusion in formal supply chains. At the same time, trade diplomacy and legal countermeasures such as WTO litigation and collective positioning through the Council of Palm Oil Producing Countries (CPOPC) have played a pivotal role in contesting perceived unfair treatment under green protectionist frameworks.

The physical resilience of supply chains has been significantly enhanced through targeted infrastructure development, including multimodal logistics, bonded warehouses, and regional distribution networks. These improvements have reduced export lead times and increased logistical flexibility. Moreover, digital traceability tools ranging from blockchain platforms to satellite verification have contributed to transparency, efficiency, and policy responsiveness across production and export systems.

Policy adaptability, particularly in the use of macro-fiscal instruments like export levies, biodiesel mandates, and tax adjustments, has allowed governments to respond swiftly to trade disruptions while promoting long-term sustainability transitions. These policies, when implemented in coordination with provincial and industry-level institutions, reflect a broader commitment to resilient trade governance.

Overall, the review confirms that the most effective export resilience strategies are those that integrate institutional coherence, technological capability, regulatory alignment, and cross-sectoral coordination. The interplay between domestic reform and international engagement has been instrumental in shaping a more robust and responsive palm oil export architecture. While significant progress has been made, ongoing challenges related to smallholder inclusion, global perception, and policy coherence remain areas that demand sustained attention.

In light of these findings, the research reaffirms the importance of multidimensional approaches to agricultural trade resilience, particularly for commodities from the Global South navigating increasingly fragmented and politicized international markets. The dynamic convergence of diplomacy, infrastructure, certification, and innovation offers valuable lessons for broader agri-export systems confronting similar asymmetries in the global trading order.

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