West Science Interdisciplinary Studies
Vol. 03, No. 09, September and 2025: pp. 1679-1691

A Bibliometric Mapping of Palm Oil Supply Chain and Traceability Research

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ABSTRACT

This paper performs a bibliometric analysis to delineate the scientific landscape of palm oil supply chain and traceability research from 2000 to 2025 utilizing data from Scopus. VOSviewer and Biblioshiny were utilized for co-occurrence, co-authorship, and co-citation analysis to discern publication trends, theme clusters, and international collaborations. The findings indicate that research has progressed from focusing on production efficiency and biomass optimization to emphasizing sustainable governance, certification, and digital traceability systems. Malaysia and Indonesia are the primary suppliers, bolstered by robust partnerships with Europe and Australia. This study enhances comprehension of how interdisciplinary collaboration and technology innovation propel sustainability changes in global palm oil supply chains.

Keywords: *Palm Oil, Supply Chain, Traceability, Sustainability, Bibliometric Analysis, EUDR, RSPO, ISPO.*

1. INTRODUCTION

Palm oil is fundamental to global food, cosmetics, and biofuel value chains, with Indonesia and Malaysia collectively accounting for the majority of worldwide production. Recent industry reports indicate that in the marketing year 2024/25, Indonesia constitutes around 58% of worldwide palm oil production, highlighting the influence of Southeast Asia's supply-chain performance on global availability and pricing. With the diversification of quantities and downstream applications, supply chains have evolved into multilayered structures encompassing smallholders, mills, refineries, merchants, and consumer-goods manufacturers, thereby increasing the importance of transparency, risk management, and market access. These dynamics elucidate why traceability—connecting each batch to a verified source—has transitioned from a mere "nice-to-have" to a market need [1].

The policy environment has become more stringent accordingly. The EU Deforestation-free Products Regulation (EUDR) mandates that commodities, such as palm oil, entering the EU market must be verifiably deforestation-free and produced in compliance with local legislation, supported by geolocation data at the plot level [2]. Guidance issued by EU authorities and industry coalitions in 2024–2025 underscores traceability, due diligence, and risk classification, while acknowledging progressive implementation and developing compliance assistance. Concurrent discussions in producer nations and industry organizations illustrate both the aspirations and the practical difficulties of these regulations [3].

Standards for producer countries are also evolving. Indonesia's Sustainable Palm Oil polic y (ISPO) is being revised to enhance transparency and supply chain comprehensiveness, while stakeholders discuss deadlines for the complete integration of smallholders and downstream participants. The Roundtable on Sustainable Palm Oil (RSPO) is concurrently upgrading its standards (2022–2024) to improve auditability and market relevance, while also reporting on the uptake and outcomes of certified supply chains (RSPO Impact Report, 2024). Collectively, these governance tools drive the sector towards enhanced, comprehensive traceability.

The adoption of technology has expedited to fulfill these requirements. Analyses of agri-food supply chains indicate the swift adoption of digital traceability technologies—such as IoT sensing, geographic verification, and distributed ledgers—to document provenance, automate compliance, and facilitate due diligence [4]. In the palm oil sector, blockchain initiatives and theoretical frameworks have been suggested to document transactions from smallholders to mills and refineries, synchronize data granularity with EUDR geolocation mandates, and mitigate information asymmetries among purchasers, auditors, and regulators [5]. Despite varying deployment maturity, the literature indicates quantifiable improvements in data integrity and audit preparedness when digital traceability is incorporated into governance frameworks.

Notwithstanding advancements, environmental and social risk indicators continue to be examined, underscoring the importance of traceability. Independent platforms indicate that, following years of decline, deforestation linked to Indonesian palm oil increased in 2022–2023, despite long-term trends showing improvement compared to the 2010s; other evaluations highlight concentrated concerns in forest-rich areas [6]. The inconsistent signals—long-term declines and sporadic increases in certain places and years—highlight the necessity for customers and regulators to demand verifiable, geographically explicit supply-chain information to distinguish compliant output from areas of residual risk.

Despite the rapid expansion of research on palm oil supply chains and traceability, it continues to be conceptually disjointed across operations management, information systems, environmental governance, and development studies. Research highlights regulatory compliance (e.g., EUDR and ISPO), certification (RSPO), digital infrastructures (blockchain, geolocation), and impact evidence (deforestation and livelihoods); however, an integrated framework illustrating the interconnections among these elements is absent—specifically regarding publication collaborations, predominant methodologies and technologies, thematic evolution over time, and existing geographic and topical deficiencies [7]. A bibliometric methodology can facilitate the synthesis of these variables and inform future research agendas. This study performs an extensive bibliometric analysis of palm oil supply chain and traceability research to (i) delineate the field's temporal development; (ii) identify prominent authors, institutions, countries, and collaboration networks; (iii) elucidate prevailing and emerging themes (e.g., regulatory compliance, certification, digital traceability, smallholder inclusion, due-diligence analytics); (iv) characterize methodological trends and data infrastructures (ranging from geolocation and remote sensing to blockchain-based ledgers); and (v) highlight knowledge deficiencies and prospective research avenues in accordance with rapidly evolving governance (EUDR, ISPO) and standard-setting (RSPO) frameworks.

2. METHODS

This study utilizes a bibliometric research design to thoroughly delineate and examine the intellectual framework, theme progression, and collaborative networks of publications concerning the palm oil supply chain and traceability. Bibliometric analysis provides a quantitative method for comprehending scientific advancement in a discipline by evaluating publication trends, co-authorship, co-citation, and keyword co-occurrence correlations [8]. This technique provides a comprehensive review of the evolution of scholarly focus on palm oil supply chains, especially regarding sustainability, digitalization, and regulatory compliance. The research adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow as a preliminary screening methodology to guarantee data accuracy and relevance prior to bibliometric analysis [9]

The data were obtained from the Scopus database, renowned for its extensive coverage and uniform bibliographic metadata. Utilize search strings that integrate Boolean operators and keywo rds including “palm oil,” “supply chain,” “traceability,” “blockchain,” “sustainability certification,” and “EUDR.” To guarantee data quality and relevance, only peer-reviewed journal articles, con ference papers, and reviews published from 2000 to 2025 were incorporated. The filtering method eliminated non-English documents, editorials, and duplicates. The final dataset was exported in RIS and CSV formats, encompassing fields for author, title, abstract, keywords, affiliation, and citations. This dataset underpins descriptive bibliometric indicators, including annual publication trends by year, nation, and journal source, with citation performance metrics such as total citations, h-index, and average citations per document.

The study employed VOSviewer (version 1.6.20) and Biblioshiny (R-Studio) for co-authorship, co-citation, and keyword co-occurrence analysis in analytical processing. VOSviewer was utilized to create visual representations of the research landscape, delineating theme clusters a nd intellectual connections among authors and organizations [10] Keyword co-occurrence analysis was employed to identify prevailing research themes and nascent subjects, including digital traceabi lity, blockchain applications, smallholder inclusion, and sustainable certification systems. Biblioshiny facilitated longitudinal trend analysis and topic evolution mapping to demonstrate t he temporal shift in research focus from certification and sustainability issues to digital governance and regulatory compliance. The amalgamation of these instruments guaranteed statistic al precision and visual clarity, enabling a thorough comprehension of the knowledge domain related to palm oil supply chain traceability.

3. RESULTS AND DISCUSSION

3.1 Network Visualization

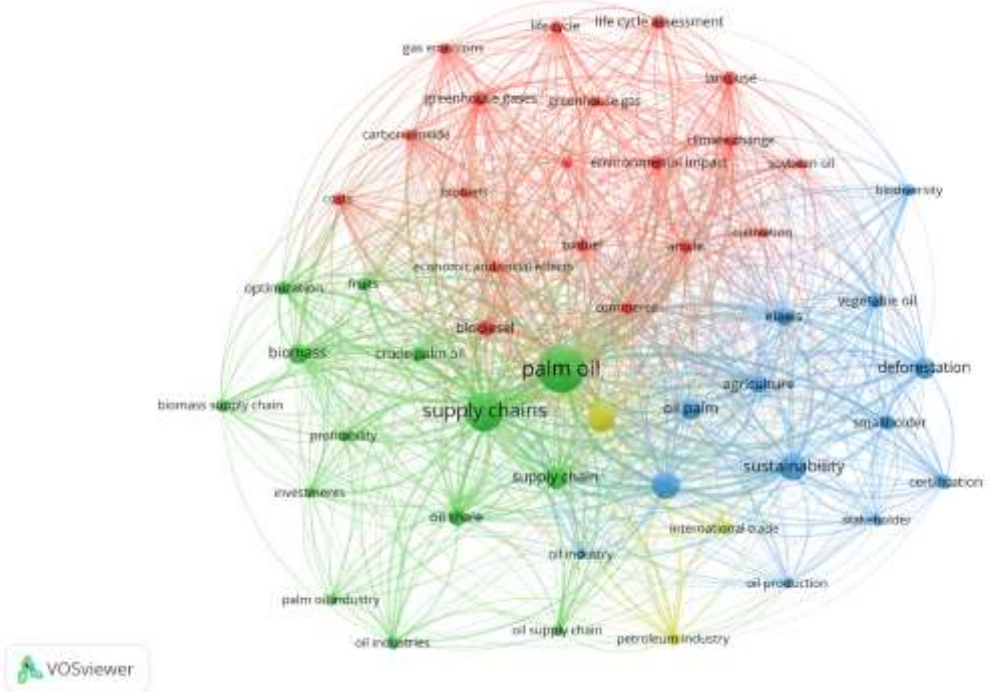


Figure 1. Network Visualization
Source: Data Analysis Result, 2025

The VOSviewer map displays a complex and interconnected intellectual framework in palm-oil research, consisting of many color-coded clusters that collectively represent the thematic diversity of the discipline. The network indicates that "palm oil" and "supply chains" are the most central

nodes, reflecting their high frequency and co-occurrence with other keywords. The thickness and density of connecting lines indicate robust multidisciplinary connections among environmental s cience, industrial engineering, and sustainability studies. The visualization illustrates that research on palm oil is interlinked with wider discussions on climate change, trade, and agricultural management, affirming that supply-chain traceability has developed into a complex, multi-stakehol der research ecosystem.

The red cluster encompasses terms such "life-cycle assessment," "greenhouse gases," "en vironmental impact," "biofuels," and "climate change." This cluster encompasses research examining the environmental externalities associated with palm oil extraction. Researchers in this field employ life-cycle and carbon-footprint approaches to evaluate greenhouse gas emissions, land-use alterations, and biodiversity decline. The significant correlation between "biofuels" and "car bon dioxide" underscores the focus on palm-oil-based biodiesel as a sustainable energy source and a contributor to emissions accounting difficulties. The red cluster embodies the environmental sustainability narrative that supports global policy instruments like the EU Deforestation Regulation (EUDR) and numerous carbon credit programs.

The green cluster associates keywords such as "biomass," "crude palm oil," "profitability," "optimization," and "biomass supply chain." It signifies research domains based on industrial effic iency and circular economy ideas. Research focuses on optimizing logistics, managing costs, and converting palm oil by-products, such as empty fruit bunches, into biomass energy. The network density in this area demonstrates dynamic intersections between supply chain management and rene wable energy economics. This cluster associates "investments," "oil industry," and "profitability" with "biomass," illustrating a pragmatic approach in which traceability is perceived not merely as compliance but as a strategy for value creation through cost reduction and sustainability-driven competitiveness.

The blue cluster includes terms like "deforestation," "smallholder," "certification," " stakeholder," "sustainability," and "agriculture." It denotes the social-governance aspect of palm oil supply networks. This research stream concentrates on policy frameworks, the inclusion of smallholders, and certification methods such as RSPO and ISPO. The robust connection between "sustainability" and "certification" suggests that traceability is frequently implemented via standards that guarantee legal compliance, ethical sourcing, and the safeguarding of livelihoods. The term "smallholder" emphasizes persistent difficulties in including small farmers into traceable supply chains, underscoring issues of equity and capacity-building that are important to discussions on sustainable development.

The three clusters collectively represent a tripartite research paradigm: environmental a ccountability (red), industrial optimization (green), and social sustainability (blue). The physical closeness of nodes like "palm oil," "supply chains," and "sustainability" indicates increasing endea vors to harmonize economic and ecological objectives via digital traceability systems, remote-sensing validation, and transparent certification. The network's high density indicates a progressively unified academic discourse where digital technologies, legislative directives, and market forces intersect. Future study will likely investigate data-driven traceability frameworks, su ch as blockchain, geospatial analytics, and AI-enabled monitoring, to verify compliance, bolster stakeholder trust, and promote global sustainability in the palm oil business.

3.2 Overlay Visualization

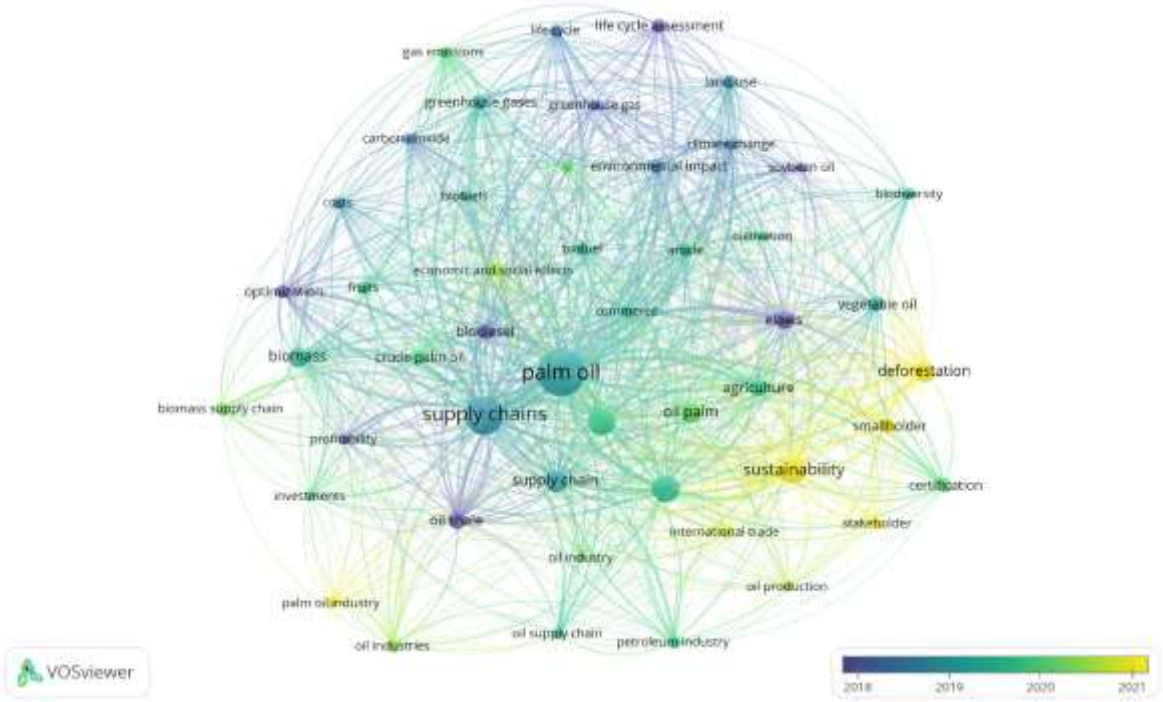


Figure 2. Overlay Visualization
Source: Data Analysis Result, 2025

The overlay graphic illustrates the temporal dynamics of research in the palm oil supply chain, with node colors indicating the average publication year—ranging from purple (older years, 2018) to yellow (recent years, 2021). Central concepts such as "palm oil," "supply chain," "crude palm oil," and "biomass" are represented in cooler hues, signifying that preliminary research on production efficiency, biomass utilization, and industrial logistics predominated the initial phase of scholarship. The research concentrated on economic optimization, cost efficiency, and biomass conversion technologies, representing the preliminary stage of supply chain analysis grounded in operational and industrial engineering viewpoints. The robust connections among "profitability," "optimization," and "biomass supply chain" indicate that the discipline initially prioritized value-chain enhancement and energy diversification prior to the rise of sustainability and governance issues.

The transition from blue-green to yellow hues signifies a progressive evolution in study focus post-2019 towards environmental sustainability, deforestation, and the involvement of smallholders. Terms such as "sustainability," "deforestation," "certification," "stakeholder," and "smallholder" have arisen as contemporary topics, indicated by lighter colors of yellow, reflecting heightened academic focus in recent years. This trend aligns with worldwide regulatory changes, like the EU Deforestation-free Regulation (EUDR) and the enhancement of RSPO and ISPO certification systems, which mandate traceability, transparency, and governance responsibility throughout supply chains. The increasing association between "sustainability" and "certification" demonstrates how researchers are progressively connecting technological supply-chain efficiency with social and ecological accountability, transcending basic production measurements to include ethical sourcing and environmental performance.

The network's color gradient signifies an ongoing integration of digital traceability technology with sustainable governance frameworks. Initial studies focused on "biomass" and "optimization," whereas the recent yellow nodes—such as "deforestation," "stakeholder," and "certification"—indicate that contemporary research investigates data-driven transparency,

encompassing blockchain applications, geospatial monitoring, and smallholder traceability systems. The elevated density and interconnectivity among terms suggest a developing study domain that integrates technology advancements with policy-oriented traceability to synchronize palm oil suppl y chains with international sustainability obligations. Thus, the overlay graphic illustrates an intelle ctual shift from production-focused investigation to a multi-faceted sustainability framework—harmonizing productivity, environmental integrity, and social inclusion within the global palm oil ecosystem.

3.3 Citation Analysis

Comprehending the most significant works within a research field offers crucial insight into its philosophical underpinnings and thematic emphases. Citation analysis identifies extensively referenced papers that have influenced academic discourse on palm oil supply chains, sustainable governance, and deforestation accountability. The table below enumerates the ten most cited publi cations from the Scopus dataset, encompassing a blend of conceptual, empirical, and policy-oriented contributions that collectively delineate the progression of palm oil research from environmental impact assessment to supply chain transparency and certification frameworks.

Table 1. Top Cited Research

Citations	Authors and year	Title
457	Wolf, J.	The Relationship Between Sustainable Supply Chain Management, Stakeholder Pressure and Corporate Sustainability Performance
351	Gardner, T.A., Benzie, M., Börner, J., ... West, C., Wolvekamp, P.	Transparency and sustainability in global commodity supply chains
293	Song, X.-P., Hansen, M.C., Potapov, P., ... Turubanova, S., Tyukavina, A.	Massive soybean expansion in South America since 2000 and implications for conservation
250	Austin, K.G., Mosnier, A., Pirker, J., ... Fritz, S., Kasibhatla, P.S.	Shifting patterns of oil palm driven deforestation in Indonesia and implications for zero-deforestation commitments
250	Henders, S., Persson, U.M., Kastner, T.	Trading forests: Land-use change and carbon emissions embodied in production and exports of forest-risk commodities
239	Murphy, D.J., Goggin, K., Paterson, R.R.M.	Oil palm in the 2020s and beyond: challenges and solutions
210	Kushairi, A., Loh, S.K., Azman, I., ... Sundram, S., Parveez, G.K.A.	Oil palm economic performance in Malaysia and r&d progress in 2017
203	DeFries, R.S., Fanzo, J., Mondal, P., Remans, R., Wood, S.A.	Is voluntary certification of tropical agricultural commodities achieving sustainability goals for small-scale producers? A review of the evidence
198	McCarthy, J.F., Gillespie, P., Zen, Z.	Swimming Upstream: Local Indonesian Production Networks in Globalized Palm Oil Production
194	Ayompe, L.M., Schaafsma, M., Egoh, B.N.	Towards sustainable palm oil production: The positive and negative impacts on ecosystem services and human wellbeing

Source: Scopus, 2025

The citation distribution highlights the interdisciplinary character of palm oil research, encompassing environmental science, supply-chain management, and socio-economic governance concerns. The most-cited paper by Wolf [11] establishes the theoretical foundation of the topic by c onnecting sustainable supply-chain management to corporate sustainability performance, ill ustrating how stakeholder pressure induces operational adjustments. The second-ranked paper by Gardner et al. [12] broadens this discussion to the global commodities level, highlighting openness and accountability procedures that inform contemporary traceability regimes under the EU Defo restation Regulation (EUDR).

Simultaneously, research by Song et al. [13] and Austin et al. [14] elucidates the spatial and ecological aspects of commodity expansion, specifically emphasizing the role of palm-oil-induced land-use change in tropical deforestation. Empirical studies, such those by Henders et al. [15] and DeFries et al. [16], contextualize these environmental challenges within global trade and certification frameworks, illustrating how zero-deforestation pledges and voluntary sustainability standards seek to reduce embedded carbon emissions. Murphy et al. [17] and Kushairi et al. [18] emphasize technological advancement and industrial competitiveness, whilst McCarthy et al. [19] and Ayomp e et al. [20] highlight the social and livelihood consequences for smallholders and local communities. These extensively referenced studies constitute the foundational knowledge of palm-oil traceability research, connecting supply-chain efficiency with environmental integrity and social equity, thereby facilitating the shift from conventional production analysis to the integrated, sustainability-focused scholarship that characterizes the post-2018 research landscape.

3.4 Density Visualization

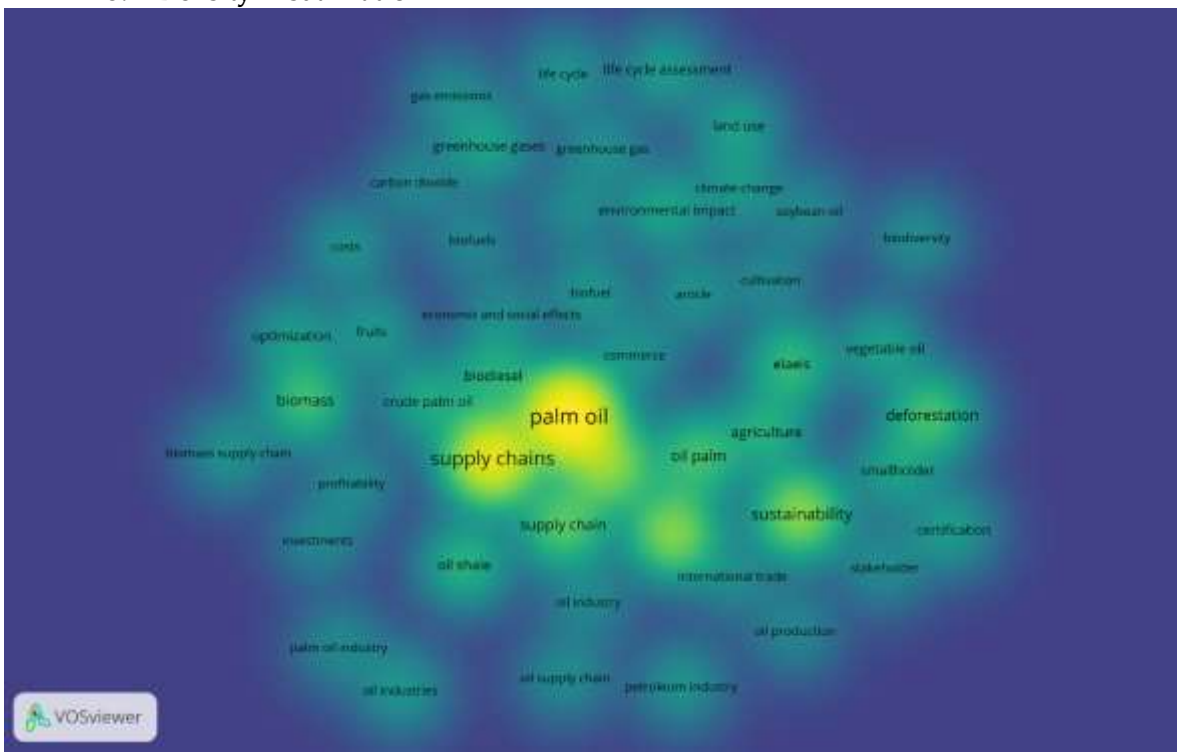


Figure 3. Density Visualization

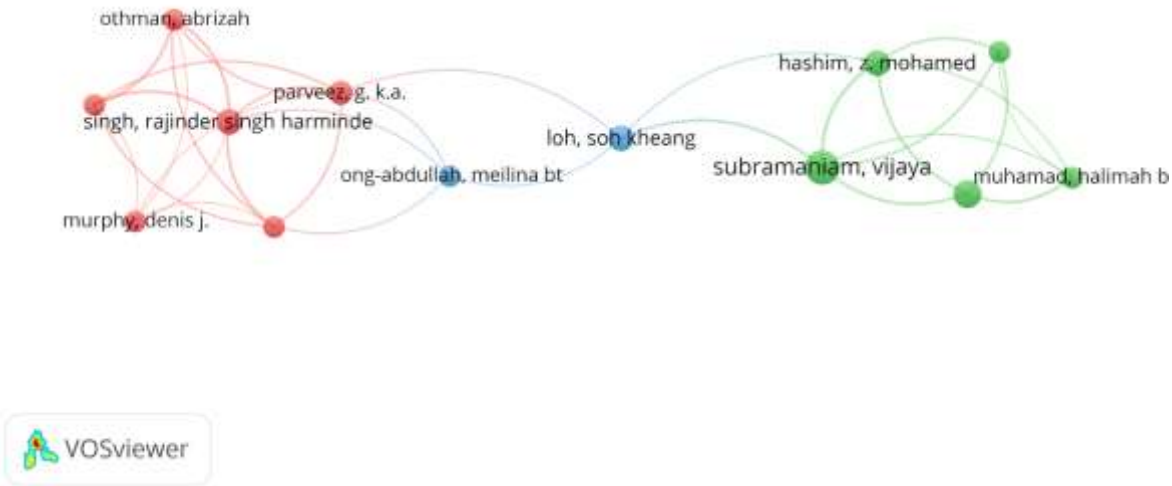
Source: Data Analysis Result, 2025

The density graphic emphasizes the concentration of research activity across theme domains within the palm oil supply chain literature. The luminous yellow area encircling the terms “palm oil,” “supply chains,” and “supply chain” signifies the greatest density of co-occurrence, embodyin g the conceptual and methodological nucleus of the discipline. These nodes function as the central link across several study clusters—from industrial optimization to sustainability governance—

demonstrating that the majority of publications focus on the analysis of efficiency, trade flows, and production systems. The relatively dense green areas surrounding “biomass,” “crude palm oil,” and “biodiesel” indicate a persistent interest in renewable energy and circular-economy applications, highlighting the valorization and economic optimization of palm-oil by-products. The concentration of activity indicates that industrial and environmental efficiency are crucial themes influencing ac ademic involvement in palm oil supply-chain research.

Adjacent to the center yellow cluster, the density gradient transitions into green and blue areas where emergent and peripheral subjects are located—specifically “sustainability,” “deforestation,” “smallholder,” and “certification.” These regions, although less inhabited, underscore an increasing scholarly focus on sustainability governance and traceability systems. The growing prevalence of the terms "deforestation" and "sustainability" indicates a paradigm shift from productivity-focused research to comprehensive frameworks that consider environmental integrity and social equality. The spatial proximity of "stakeholder," "certification," and "agriculture" indicates an increasing convergence of governance, policy, and technological innovation, especially as re searchers investigate traceability tools such as blockchain and remote sensing to guarantee adher ence to global sustainability standards. The density map illustrates a developing knowledge ecos ystem: one rooted in industrial efficiency yet swiftly progressing towards transparent, traceable, and socially responsible palm oil value chains.

3.5 Co-Authorship Network



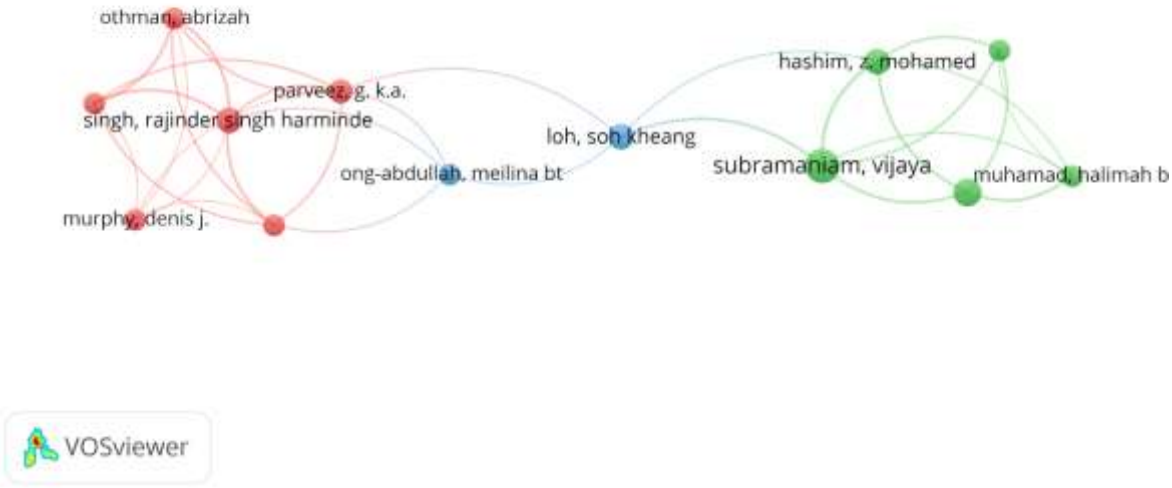


Figure 4. Author Visualization
Source: Data Analysis Result, 2025

The VOSviewer author cooperation network depicts three main clusters of interrelated researchers engaged in palm oil supply chain and sustainability research. The red cluster, spearheaded by Othman, Abrizah, and Rajinder Singh Harminder, constitutes a robust Malaysian research consortium dedicated to sustainable palm oil production, governance frameworks, and digital innovation in oil palm research and development. The green cluster, based on Subramaniam, Vijaya, and associated with Hashim, Z. Mohamed, and Muhamad, Halimah B., exemplifies collaborations in industrial management, value-chain optimization, and technical innovation for sustainable production. The blue cluster connects the two research fronts via Loh, Soh Kheang, and Ong-Abdullah, Meilina BT, who frequently co-author with Parveez, G.K.A., highlighting their crucial role in integrating biotechnological research with supply-chain efficiency analyses. The existence of cross-cluster linkages indicates a developing multidisciplinary approach at the intersection of biotechnology, policy, and sustainability, highlighting Malaysia's prominent position in furthering global palm oil research via coordinated academic collaboration.

Figure 5. Affiliation Visualization
Source: Data Analysis Result, 2025

The institutional collaboration network illustrated in the VOSviewer visualization exhibits a compact yet integrated framework connecting academic and research entities involved in palm oil and sustainable supply chain research. The Department of Chemical and Environmental Engi neering and the School of Engineering and Physical Sciences are centrally located within the green cluster, highlighting their pivotal role in promoting interdisciplinary research that integrates process optimization, environmental performance, and industrial innovation. These institutions serve as conduits between specialized research centers, such as the Centre of Excellence for Green Techn ology (blue cluster) and the Process Systems Engineering Centre (red cluster), signifying a collaborative interchange between applied sustainability research and process engineering prof iciency. The network indicates that a significant portion of research in this field is propelled by engi neering collaborations, concentrating on sustainable production methods, life-cycle assessments, and technical advancements that facilitate the shift towards traceable and environmentally susta inable palm oil supply chains. The cross-cluster links underscore the significance of institutional relationships in promoting scientific integration between green technology development and indu strial process optimization, two critical components of sustainable palm oil research.

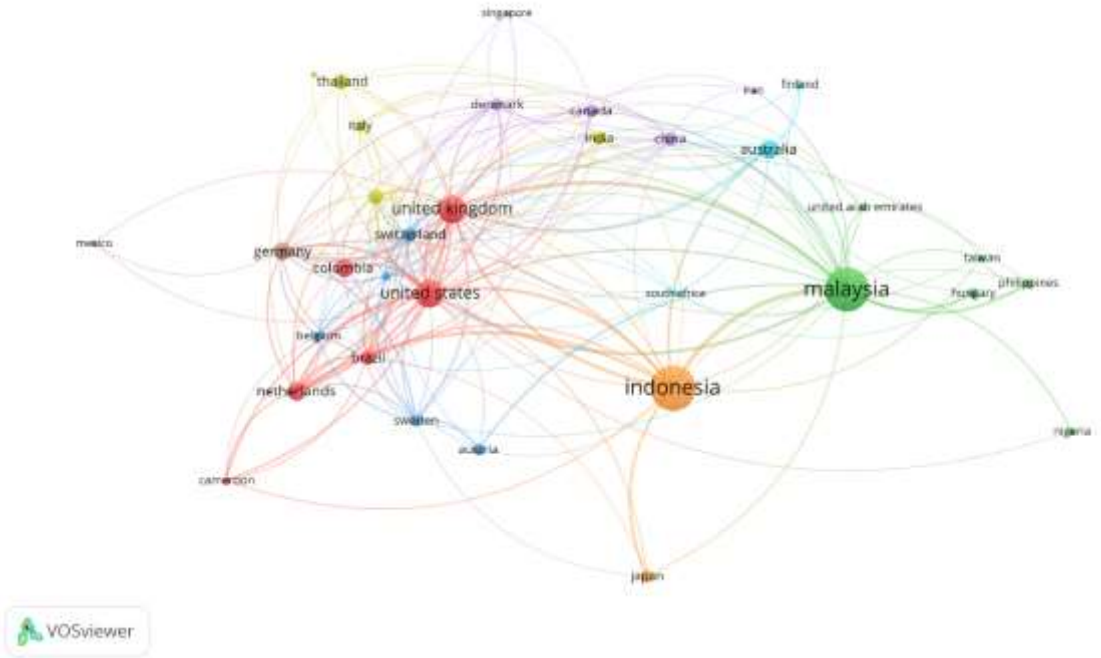


Figure 6. Country Visualization
Source: Data Analysis Result, 2025

The country cooperation network map depicts the worldwide interconnectivity of research pertaining to palm oil supply chains and sustainability. The visualization identifies five prominent clusters, with Malaysia and Indonesia as the principal concentrations of scientific output, underscoring their status as the leading global producers of palm oil and pivotal sites for policy and technological advancement. Both nations uphold robust collaborative relationships with Australia, the United Kingdom, and the United States, signifying active academic exchange and international alliances in sustainability certification, traceability technology, and environmental governance. The United Kingdom and Netherlands act as primary mediators connecting European research communities with Southeast Asia, whilst Germany, Brazil, and Colombia constitute an integrated subnetwork dedicated to land-use change and biofuel research. The intricate network of connections between European and Asian countries indicates that palm oil research has developed into a gen uinely international endeavor, encompassing environmental science, supply-chain management, and policy analysis. This map underscores the pivotal role of Malaysia and Indonesia in shaping the research agenda, bolstered by robust North–South collaborations that seek to harmonize palm oil production with global sustainability and deforestation-free norms.

Discussions

Practical Implications

This bibliometric mapping presents numerous practical implications for policymakers, i ndustry stakeholders, and sustainability practitioners. The visualization of research clusters highlights the growing interconnection among supply-chain optimization, environmental governance, and traceability systems, indicating that decision-makers in the palm oil industry must reconcile operational efficiency with transparency requirements, including the EU Deforestation Regulation (EUDR), RSPO, and ISPO standards. The robust collaborative connections among Mala ysia, Indonesia, and Western research institutions indicate prospects for capacity enhancement and technology transfer, especially in digital traceability, blockchain applications, and geospatial monitoring. These insights offer practical recommendations for industry stakeholders seeking to

fortify compliance frameworks, improve smallholder inclusion, and minimize transaction costs related to sustainability certification. Furthermore, by pinpointing key authors, institutions, and nations, the study functions as a strategic guide for research collaborations, assisting governments and private organizations in allocating funding to burgeoning fields such as data-driven traceability, life-cycle assessment, and bio-based innovation within the palm oil value chain.

Theoretical Contributions

This work theoretically advances the scholarship of sustainability and supply-chain management by empirically delineating the intellectual progression of palm oil traceability research. The study clarifies the field's evolution from an efficiency-oriented paradigm focused on biomass utilization and logistics optimization to a multi-dimensional sustainability paradigm that incorp orates environmental accountability, technological innovation, and stakeholder governance through co-occurrence, co-authorship, and co-citation analyses. This transition enhances the Sustainable Supply Chain Management (SSCM) and Stakeholder Theory frameworks by demonstrating how external institutional forces and global policy mandates influence company sustainability practices in commodity-dependent economies. Moreover, the bibliometric evidence broadens the theoretical scope of global value-chain theory by illustrating that palm oil supply-chain traceability has evolved from a national issue to a transnational governance framework facilitated by digital infrastructures and international partnerships. This paper establishes a basic paradigm for future theoretical integration of traceability systems, regulatory compliance, and socio-environmental resilience in resource-intensive sectors.

Limitations and Future Research Directions

The bibliometric technique offers a thorough overview of the knowledge hierarchy, although many limitations must be recognized. The study exclusively utilizes the Scopus database, which, despite its extensive coverage, may exclude pertinent publications indexed in Web of Science, Google Scholar, or regional repositories, thereby leading to an underrepresentation of local or non-English contributions. Moreover, bibliometric analysis quantifies relationships (such as co-occurrence and citation frequency) but fails to consider qualitative subtleties—such as the contextual richness of case studies, stakeholder perspectives, or policy results. The temporal frame (2000–2025) constrains the interpretation of post-EUDR changes that are still emerging in literature by late 2025. Subsequent study should employ a mixed-methods approach, integrating bibliometric mapping with systematic literature review (SLR) or content analysis to get conceptual profundity. Augmenting the dataset to encompass cross-disciplinary and regional sources, together with altm etric indicators (policy citations, industry adoption), would enhance comprehension of how information diffusion manifests in tangible sustainable shifts within the palm oil ecosystem.

CONCLUSION

This bibliometric analysis offers a thorough examination of the intellectual framework and research progression related to the palm oil supply chain and traceability. The analysis identifies th ree primary research streams: environmental impact and deforestation, industrial optimization and biomass consumption, and sustainability governance via certification and stakeholder inclusion. Malaysia and Indonesia serve as major contributors, engaging in substantial collaboration with Western and Asia-Pacific nations to enhance traceability requirements and sustainable manufacturi ng frameworks. The shift from manufacturing efficiency to digital transparency and environmental accountability signifies the industry's reaction to worldwide legislative changes, including the EUDR, RSPO, and ISPO. This study enhances both academic and practical knowledge by delineating major issues, authors, and collaborations, while underscoring the increasing significance of data-dri ven traceability and international cooperation in establishing sustainable palm oil value chains.

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