

DIGITAL TRANSFORMATION OF HALAL SUPPLY CHAIN: A GLOBAL BIBLIOMETRIC ANALYSIS

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Abstract

The aim of this study is to explore the global development and digital transformation of halal supply chain research through a bibliometric analysis approach. Using 547 articles indexed in Scopus and published between 2008 and mid-2025, the study uses VOS viewer software to examine publication trends, co-authorship networks and thematic structures. The results indicate increasing scholarly interest, with dominant contributions from Southeast Asian countries. Key research clusters focus on halal logistics, traceability, blockchain, sustainability and the integration of digital technologies. The findings reveal a research gap in the empirical application of digital solutions. This study contributes to addressing this gap by mapping the current research landscape and recommending future empirical exploration to operationalise digital halal innovations.

Keywords: Halal supply chain, Digital transformation, Bibliometric analysis, Blockchain.

Introduction

The halal industry plays a strategic role in supporting Indonesia's national economic development and its ambition to become a global halal hub. Central to this ambition is the effectiveness of the halal supply chain, which encompasses the coordination of halal-certified inputs, production processes, logistics, and distribution systems to ensure halal integrity from upstream to downstream activities. Strengthening the halal supply chain requires not only regulatory compliance but also enhanced coordination, traceability, and information flows

among supply chain actors. In this context, digital transformation has emerged as a critical mechanism for improving transparency, efficiency, and trust within the halal supply chain, highlighting the importance of systematically mapping global research trends and technological developments in this field.

Within this broader supply chain perspective, halal tourism represents one of the downstream sectors whose performance depends heavily on the reliability of halal-certified products and services. As Muslim travelers increasingly demand assurance of halal compliance throughout their consumption experiences, service quality, religious atmosphere, and Shariah-friendly facilities become integral components of the halal supply chain rather than isolated tourism attributes. Empirical evidence suggests that Islamic non-physical attributes and external motivators significantly enhance travelers' satisfaction and willingness to recommend halal destinations (Teviana et al., 2025). However, strict Islamic normative values may also suppress positive word-of-mouth when perceived implementation gaps arise, indicating that halal integrity within tourism is closely linked to supply chain consistency rather than certification alone.

From an operational perspective, halal supply chain management (HSCM) plays a pivotal role in safeguarding halal integrity across food, tourism, and other consumer product sectors. Recent bibliometric evidence demonstrates that HSCM research has increasingly shifted beyond Sharia compliance and certification toward the application of digital technologies, such as blockchain and the Internet of Things (IoT), to enhance transparency, efficiency, and consumer confidence (Changalima, 2025). In the halal food sector, producers face substantial operational risks arising from supplier non-compliance, necessitating mitigation strategies based on collaboration and supplier performance evaluation (Azmi, 2025). The resilience of the halal supply chain therefore has cross-sectoral implications, directly affecting consumer trust in sectors such as tourism, where the availability and reliability of halal products form an essential part of the service experience.

Social and spatial dimensions further illustrate that halal markets evolve through complex interactions between economic rationality, moral considerations, and religious values. Evidence from the UK lamb sector reveals that halal markets continue to transform amid tensions between public controversy, ethical debates, and consumer spirituality (Lever et al., 2025). Similarly, consumer behaviour studies in Turkey indicate that halal certification and related labels play a decisive role in purchasing decisions for animal products (Koç & Oğuz, 2025). These findings underscore that the sustainability and competitiveness of halal supply chains

depend not only on technical compliance, but also on the integration of religious values, service quality, and reliable supply chain governance.

Islamic finance has also been identified as a complementary enabler within halal supply chains, particularly by supporting halal-certified enterprises through Sharia-compliant financial mechanisms. By aligning financial operations with Islamic ethical principles, Islamic finance contributes to business legitimacy and market acceptance across halal-related sectors, including food, cosmetics, tourism, and pharmaceuticals (Gunarto & Yanti, 2024). International evidence suggests that Sharia-compliant financing mechanisms can promote enterprise growth by reducing financial constraints faced by halal businesses (Muhammad & Ngah, 2020). Nevertheless, the role of Islamic finance remains unevenly integrated within halal supply chains, especially in developing economies.

In the Indonesian context, variations in stakeholder awareness, ethical orientation, and institutional readiness continue to shape the effectiveness of coordination within halal-related sectors. While halal-oriented business practices have the potential to strengthen trust, reputation, and sustainable wealth management, limitations in financial literacy, knowledge diffusion, and technological adoption remain significant barriers to supply chain integration ; (Herlitah et al., 2023; Daud Awang et al., 2020; Qoyum & Fauziyyah, 2019; Muhammad & Ngah, 2020). These challenges further highlight the strategic importance of digital transformation in improving transparency, traceability, and information flows across Indonesia's halal supply chain.

Despite growing scholarly attention to the halal industry and Islamic finance, existing studies largely examine these domains in isolation or from a macro-policy perspective. Bibliometric and conceptual analyses often focus separately on halal certification, halal SMEs, Islamic finance, or entrepreneurship without systematically addressing their interconnections within digitally enabled supply chains (R Bahara et al., 2025; Dini Lestari & Wiryono, 2023; Napitupulu et al., 2024). As a result, empirical insights into how digital innovation shapes the integration of halal certification, supply chain governance, and supporting financial mechanisms remain limited.

Previous bibliometric studies have explored specific segments of the halal industry, including halal food supply chains (Mi'raj & Ulev, 2024), halal SMEs (R Bahara et al., 2025; Rizal Bahara et al., 2025), the halal industry more broadly (Napitupulu et al., 2024), Islamic finance integration (Dini Lestari & Wiryono, 2023), and halal entrepreneurship (Raimi et al., 2025). While these studies highlight emerging themes such as sustainability, digital technology adoption (e.g., IoT and

blockchain), and competitiveness—particularly in Malaysia and Indonesia—they predominantly adopt a sector-specific lens. Consequently, there remains a lack of research that systematically maps the halal supply chain as a digitally interconnected, cross-sectoral system, particularly in the Indonesian context.

Addressing this gap, the present study conducts a global bibliometric analysis to visualize and analyses the intellectual structure and thematic evolution of research on digital transformation within the halal supply chain. By integrating fragmented strands of literature—including halal certification, supply chain management, Islamic finance, and digital technology—this study provides a comprehensive framework for understanding how digital innovation reshapes halal supply chains. The findings are expected to offer valuable insights for researchers, policymakers, and practitioners, while positioning Indonesia as a strategic actor in the development of a globally competitive and innovation-driven halal supply chain.

Despite the expanding body of literature on the halal industry, halal supply chain management, and digital technologies, existing studies remain largely fragmented and sector specific. Prior bibliometric analyses tend to focus on individual domains—such as halal food, halal SMEs, Islamic finance, or tourism—without systematically examining how digital transformation integrates these domains within a unified halal supply chain framework. Moreover, limited attention has been given to visualizing the intellectual structure and thematic convergence of digital technologies, supply chain governance, and halal certification at a global level, particularly with respect to Indonesia's strategic position. This gap indicates the absence of a comprehensive bibliometric study that explicitly maps the role of digital innovation in shaping an interconnected and cross-sectoral halal supply chain.

Method

This study employs a bibliometric research design to systematically analyse the development, structure, and intellectual landscape. The bibliometric approach follows established methodologies in prior studies (R Bahara et al., 2025; Rizal Bahara et al., 2025; Mi'raj & Ulev, 2024; Napitupulu et al., 2024; Raimi et al., 2025) and is particularly suitable for mapping research trends, collaboration patterns, and thematic evolution in emerging interdisciplinary fields.

The bibliographic data were retrieved exclusively from the Scopus database, selected for its broad coverage of high-quality, peer-reviewed literature and its widespread use in bibliometric studies. Data collection was conducted in December 2025. To capture the evolution of research on halal supply chains and related digital

innovations, the publication period was limited to 2008–2025, reflecting the period during which halal supply chain and digitalization studies began to gain scholarly attention. To ensure comprehensive coverage of the research domain while maintaining conceptual focus, the search strategy was applied to the title, abstract, and author keywords fields using a structured combination of related terms. The final search string included variations and closely related concepts as follows: “halal supply chain” OR “halal value chain” OR “halal supply chain management”.

The inclusion criteria comprised peer-reviewed journal articles and review papers published in English that explicitly address halal supply chains or their intersection with digital innovation and Islamic finance, ensuring academic rigor and thematic relevance. The exclusion criteria encompassed conference proceedings, book chapters, editorials, notes, and other non-peer-reviewed documents, as well as studies focusing solely on halal food certification without a supply chain or system-level perspective, in addition to duplicated or incomplete records. Following a rigorous screening and refinement process, a total of 547 peer-reviewed journal articles and review papers were retained for the final bibliometric analysis.

This study employed two complementary bibliometric techniques, namely co-authorship analysis and keyword co-occurrence analysis, to comprehensively examine the structure and development of research on halal supply chains. Co-authorship analysis was conducted at both the author and institutional levels to identify collaboration patterns and research networks within the scholarly community. This analysis enables the identification of the most productive and influential authors and institutions, while also revealing the structural characteristics of scientific collaboration and knowledge dissemination in the halal supply chain research domain (Donthu et al., 2021).

Keyword co-occurrence analysis was applied using author-provided keywords to explore thematic relationships and the conceptual structure of the literature. Keywords that frequently appeared together were grouped into clusters representing dominant research themes and emerging topics related to halal supply chain management, digital innovation, and Islamic finance (Zupic & Čater, 2015). All bibliometric analyses and visualizations were conducted using VOSviewer version X.X (van Eck & Waltman, 2010) with a full counting method. To enhance transparency and replicability, minimum thresholds were set at three documents and ten citations per author, five documents per institution for co-authorship analysis, and five occurrences per keyword for keyword co-occurrence analysis. Prior to analysis, keyword data were manually cleaned to merge synonymous terms

and remove generic keywords, such as “study” and “analysis,” ensuring the robustness and interpretability of the resulting bibliometric maps.

All visualizations were generated using VOSviewer version 1.6.20, which provides three modes of visualization: network, overlay, and density. These visual representations facilitate the identification of knowledge clusters, collaboration dynamics, and emerging research directions, thereby enabling a comprehensive interpretation of the underlying scientific landscape. Overall, this methodological framework offers a robust and replicable approach to mapping the evolution of scholarly discourse and identifying strategic pathways for strengthening halal supply chains through the integration of digital innovation and Islamic finance.

Results And Discussion

This section presents the results of the bibliometric analysis, including co-authorship network mapping, temporal trend overlay visualisation, and keyword co-occurrence analysis, based on a dataset of 547 Scopus-indexed journal articles published between 2008 and 2025. Beyond describing publication outputs, the analysis provides analytical insights into why specific research and collaboration patterns emerge within the halal supply chain literature. The observed growth in publications reflects increasing global attention to halal governance amid expanding Muslim consumer markets and the diffusion of digital technologies such as blockchain and the Internet of Things. Similarly, emerging collaboration networks highlight the concentration of research activity in countries with established halal certification systems and strong institutional support for digital innovation. Keyword co-occurrence patterns further reveal a thematic shift from compliance-oriented discussions toward digitally enabled supply chain transparency and integration, underscoring the evolving intellectual structure of halal supply chain research.

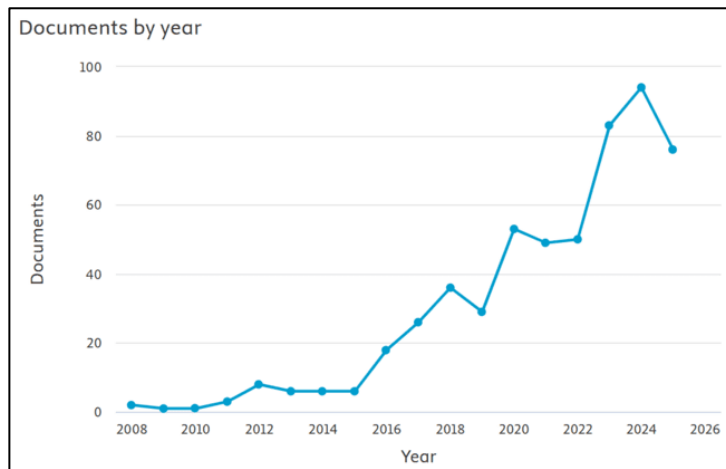


Figure 1. The Number of Publications

Figure 1, an increasing trend in the number of publications over a 18-year period. At the beginning of the period (2008–2012), the number of publications per year was very low (fewer than 10), indicating that the halal supply chain was still considered an infrequent or unpopular topic. An increase began to be seen from 2015 onwards, with a dramatic jump from 2019 to 2024. The peak in 2024 was 94 publications, meaning an increase of almost ten times compared to the beginning of the decade. As of mid-year, 2025 has already recorded 77 publications, indicating a potential new record. This surge indicates that halal logistics and supply chains have become strategic issues for countries and sectors, particularly due to the growth of the global halal industry and the demand for Shariah-compliant logistics systems.

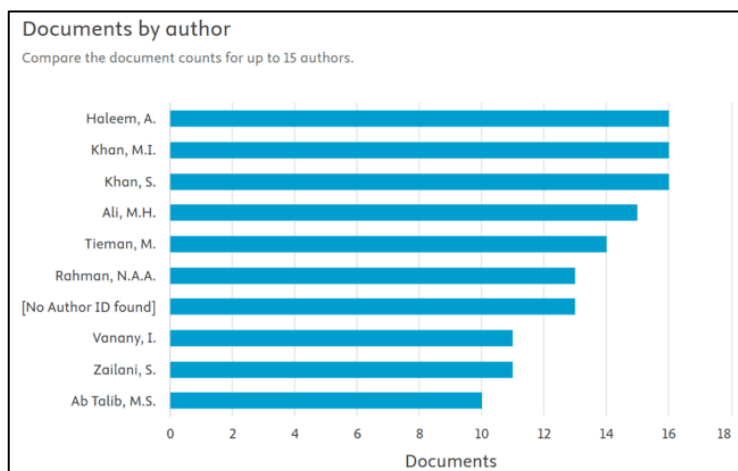


Figure 2. Collaboration Network of Authors

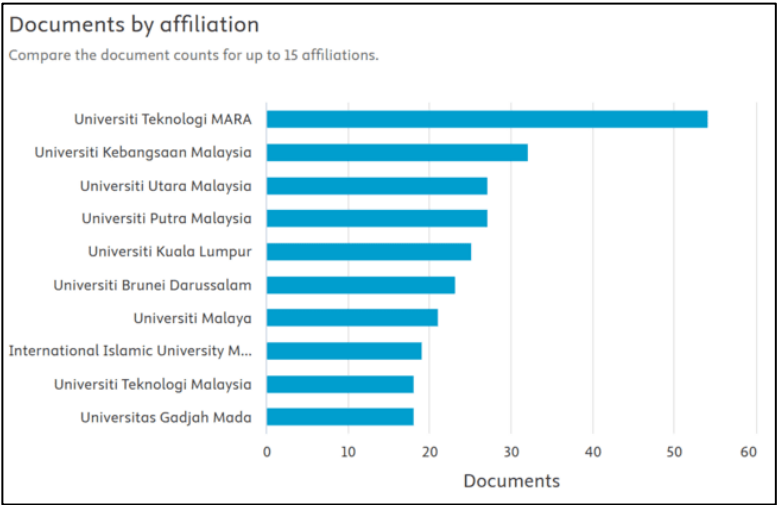


Figure 3. The Number of Academic Publication

Figure 2, the collaboration network of authors actively researching the halal supply chain theme. Several major clusters can be seen, indicating a solid and organised scientific community. Authors such as Haleem A., Khan M.I. and Tieman M. occupy central positions with extensive connections to other authors, reflecting their status as thought leaders. The strong connections between these authors suggest intense collaboration across countries and institutions, particularly in Malaysia, Pakistan and Indonesia. The presence of names such as Zailani S., Ali M.H. and Ab Talib M.S. within a single large node further reinforces the notion that this topic thrives within a collaborative academic ecosystem. This pattern suggests that research into the halal supply chain is not conducted in isolation, but rather through mutually reinforcing scientific networks that are thematically and methodologically aligned.

Figure 3 compares the number of academic publications from up to 15 institutions. Universiti Utara Malaysia leads with nearly 55 documents, followed by Universiti Kebangsaan Malaysia with just over 40. Universiti Putra Malaysia, Universiti Kuala Lumpur and Universiti Utara Malaysia have approximately 25 to 35 documents each. Universiti Brunei Darussalam, Universiti Malaya and International Islamic University Malaysia also contribute a moderate number of documents. At the lower end are Universiti Utara Malaysia and Universitas Gadjah Mada with around 15 to 20 documents each. The dominance of Malaysian universities in the top ranks indicates their strong research involvement in the field being analysed,

with only one Indonesian institution, Universitas Gadjah Mada, among the top contributors.

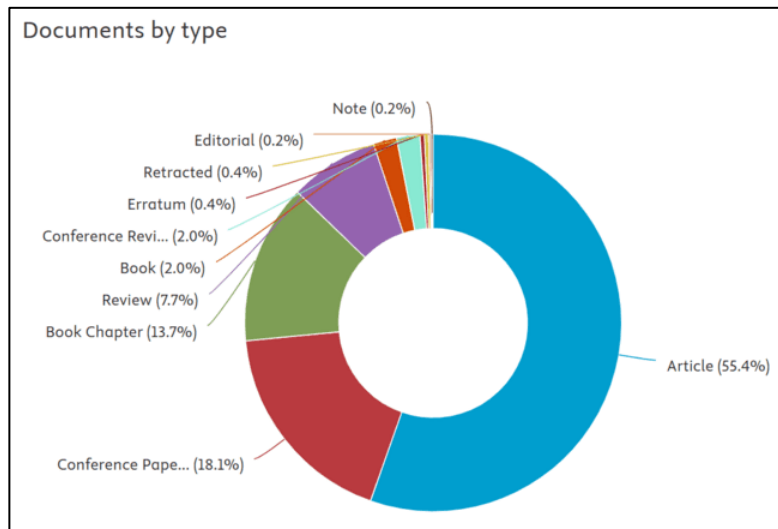


Figure 4. Documents by Type

Figure 4 shows that most publications in the halal supply chain study are scientific journal articles (55.4% of the total 547 documents). This indicates that theoretical and empirical findings in this field are being expressed through academically recognised peer-reviewed publications, strengthening the research's validity and credibility. Conference papers accounted for 18.1%, indicating active discussion in open academic forums. The book chapter contribution of 13.7% reflects an effort to integrate halal supply chain knowledge into broad-scale and comprehensive academic works. Other types of documents, such as review articles, editorials, and erratums, are small but still contribute to critical thinking and improving the literature. The dominance of journal articles confirms that halal supply chain research is mainstream and shows an increase in the quality and quantity of research in the last decade.

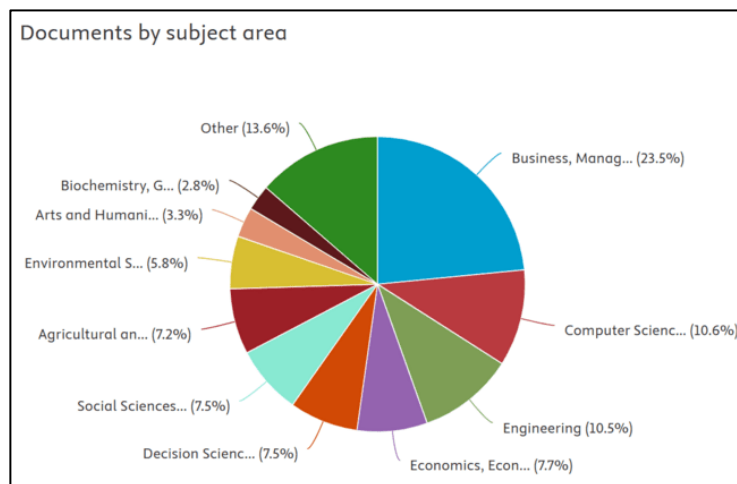


Figure 5. Documents by Subject Area

Figure 5 shows that the halal supply chain is a multidisciplinary topic involving various science branches. Business and Management is the biggest subject at 23.5%, showing that managerial perspectives, efficiency, and strategy are the main concerns in this literature. Computer Science and Engineering are also important at 10.6% and 10.5% respectively, showing the inclusion of technology and engineering elements in supporting the halal system's sustainability and traceability. These elements include the Internet of Things (IoT), blockchain, and Industrial Technology 4.0.

Technologies such as blockchain and the IoT are also being integrated into halal traceability systems. The dual IoT and blockchain-based traceability system provides real-time halal information from the slaughterhouse to the consumer market, achieving an 80.6% user satisfaction rate (Adhiwibowo et al., 2025). In Indonesia, the world's most populous Muslim country, this model demonstrates that this technology increases consumer confidence and supports sustainable development goals (Kurniawan et al., 2025).

However, the effective implementation of the IoT still faces serious challenges, including limited infrastructure, high costs and a lack of collaboration between stakeholders. Studies show that the utilisation of technology in halal certification, particularly in MSME-owned poultry slaughterhouses, remains low, particularly with regard to quality control and digital reporting (Adenan et al., 2025). At a global level, Industry 4.0 technologies such as AI, digital twins and AR show great potential for improving halal integrity; however, their adoption remains limited due to cost issues and institutional resistance (Ellahi et al., 2025). In order to

strengthen the integration of technology-based servitisation, such as the IoT, for halal SMEs to become more resilient and competitive in the global market, strategic steps are needed (Che Hassan & Osman, 2025). Strategic steps are needed to increase human resource capacity, prepare standard technical regulations and provide policy incentives in order to realise a modern and reliable halal supply chain.

The Economics of halal supply chain is also analysed for economic added value, the growth of the halal sector, and its impact on sustainable development. The involvement of the Social Sciences, Decision Sciences, and Agriculture shows that the halal supply chain is not only seen from the logistics and management side, but also related to community behaviour, strategic decision making, and agribusiness aspects as the upstream of the halal supply chain. This shows that research in this field is cross-disciplinary and continues to develop in various scientific spectrums.

Co-authorship Analysis

Co-authorship analysis was employed to examine collaboration patterns among authors in halal supply chain research. Using VOSviewer, authors with a minimum of three publications were included to capture significant contributors within the field. The analysis was visualised through network, overlay, and density representations, which together illustrate the structure of collaboration, its temporal evolution, and the intensity of research activity.

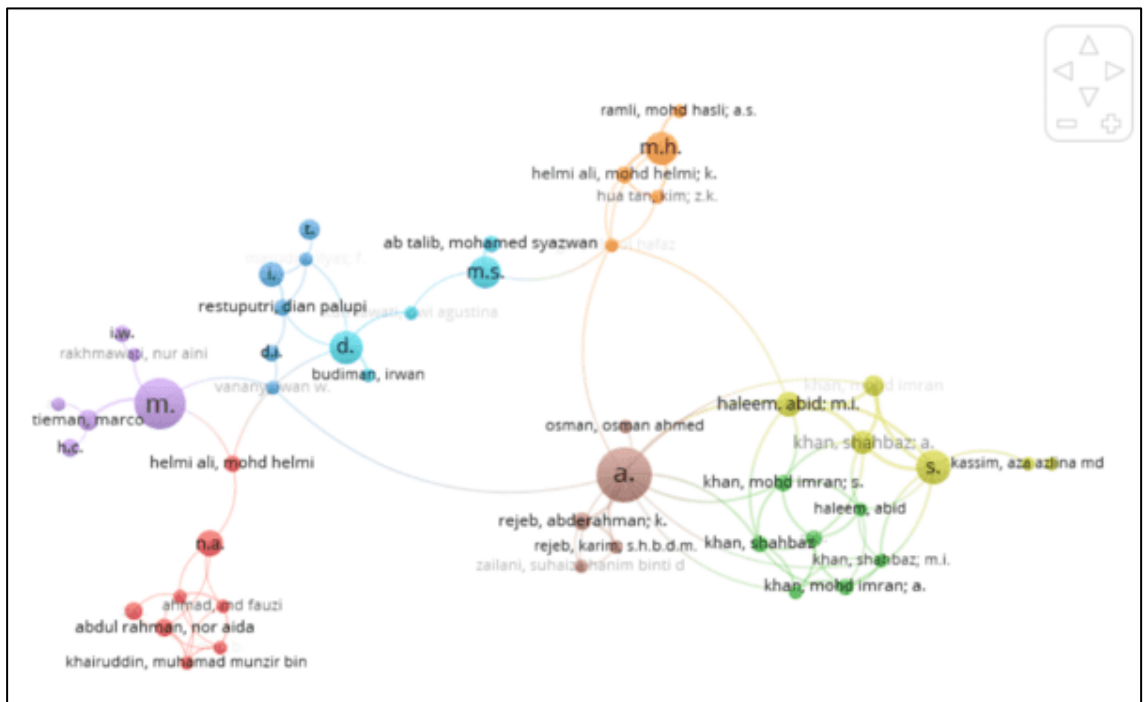
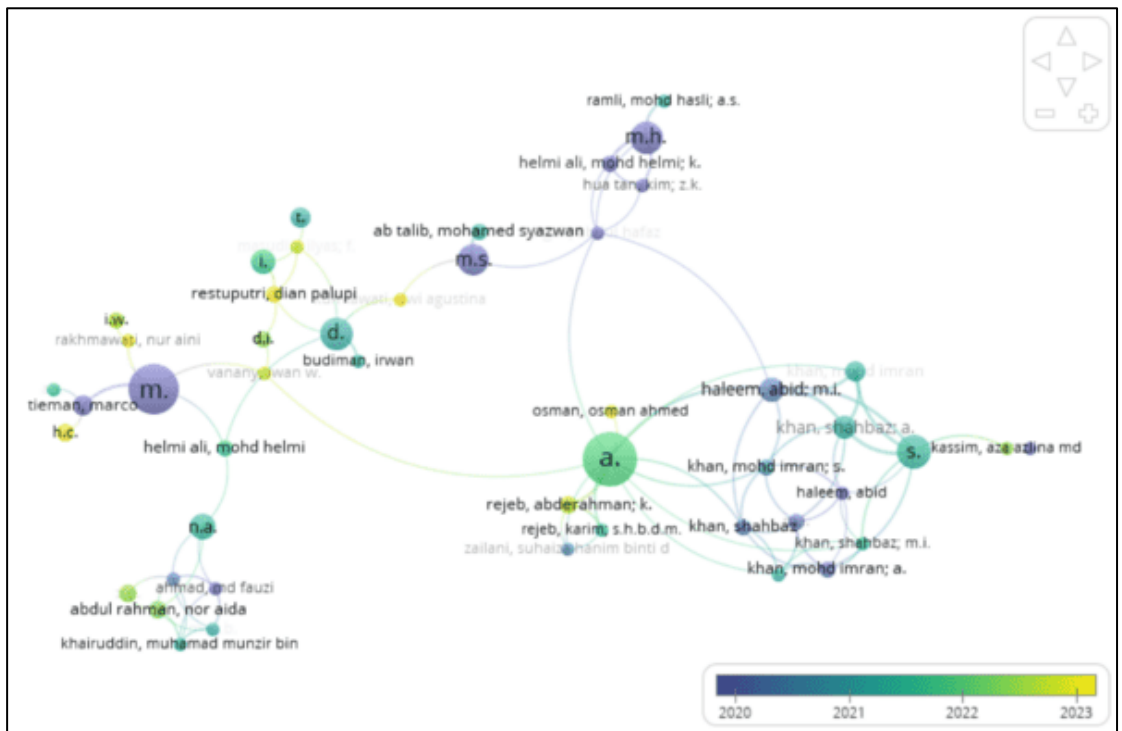


Figure 6. Network Visualisation: Author Collaboration Structure

Network visualization (Figure 6) reveals eight major collaboration clusters, indicating the presence of well-defined research communities within the halal supply chain literature. Several authors occupy central positions within these clusters, suggesting their role as key connectors and knowledge hubs. This concentration of collaboration reflects the cumulative nature of research development in this field, where established scholars often anchor collaborative networks and shape thematic directions.



The overlay visualization (Figure 7) highlights the temporal dynamics of author contributions, revealing both long-standing contributors and emerging scholars. Early contributors form the foundational layer of halal supply chain research, while more recent authors—particularly active since 2022–2023—signal a phase of scholarly regeneration and growing academic interest in digitally oriented halal supply chain studies.

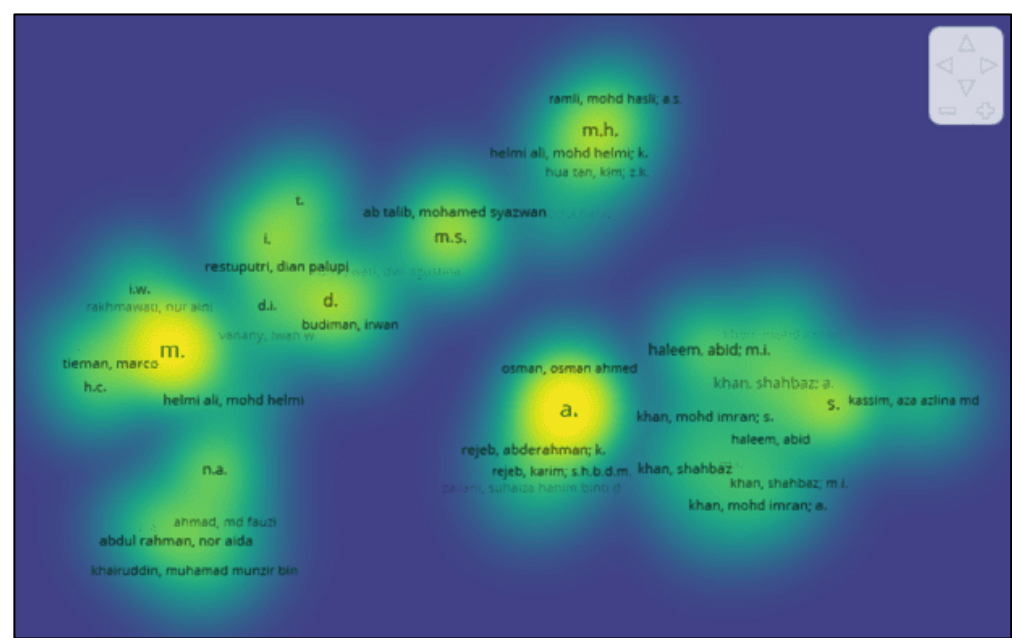


Figure 8. Density Visualization

Complementing these findings, the density visualization (Figure 8) illustrates the concentration of collaborative activity, with the most intensive areas corresponding to authors who demonstrate both high productivity and extensive collaboration. In contrast, peripheral regions represent more isolated contributions, suggesting opportunities for broader collaboration and network integration as the field continues to expand.

Co-occurrence Analysis

A bibliometric analysis was conducted based on co-occurrence keyword analysis to identify conceptual structures and research trends in the field of halal supply chains. A total of 547 scientific articles from indexed databases were analysed, with a minimum of 10 keyword occurrences required. The analysis also used VOSviewer software to produce visualizations of the interrelationships and evolution of the main concepts.

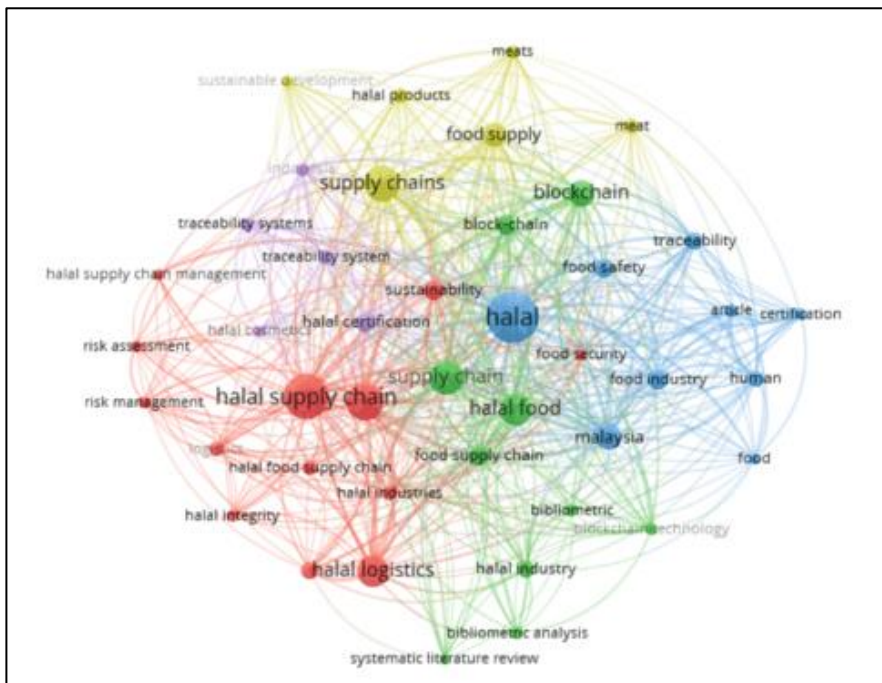


Figure 9 visualises keywords co-occurring in literature relating to the halal supply chain. Each keyword is represented by a node, with lines connecting those with similar occurrences in a document. Node size reflects frequency and colour indicates thematic grouping. Keywords 'halal', 'halal supply chain', 'halal food' and 'halal logistics' dominate the visualization, forming major clusters.

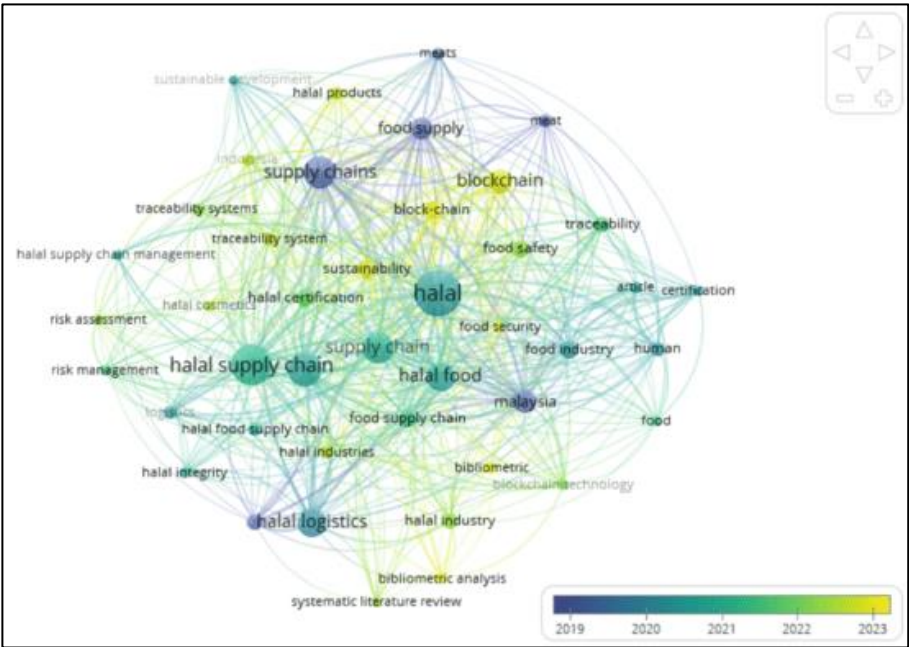


Figure 10. Overlay Visualization: Temporal Evolution of Keywords

Figure 10 shows an overlay visualization displaying the temporal progression of keyword usage in the study. A colour gradient is used to show the average year of occurrence of each keyword, with dark blue representing those used more frequently in the early years (2019–2020) and bright yellow representing those used more frequently in the more recent years (2022–2023). Based on this visualization, it can be seen that terms such as 'blockchain', 'traceability' and 'sustainability' fall within the yellow spectrum, indicating that these topics have started to gain more attention in recent years. In contrast, terms such as 'halal food', 'halal logistics' and 'certification' have been used more consistently over the years. This suggests a shift in the focus of research from fundamental issues such as logistics and certification to technology integration and sustainability in halal supply chain systems. This visualization supports the argument that the field of halal supply chains is evolving dynamically as technology advances and consumers demand transparency and sustainability.

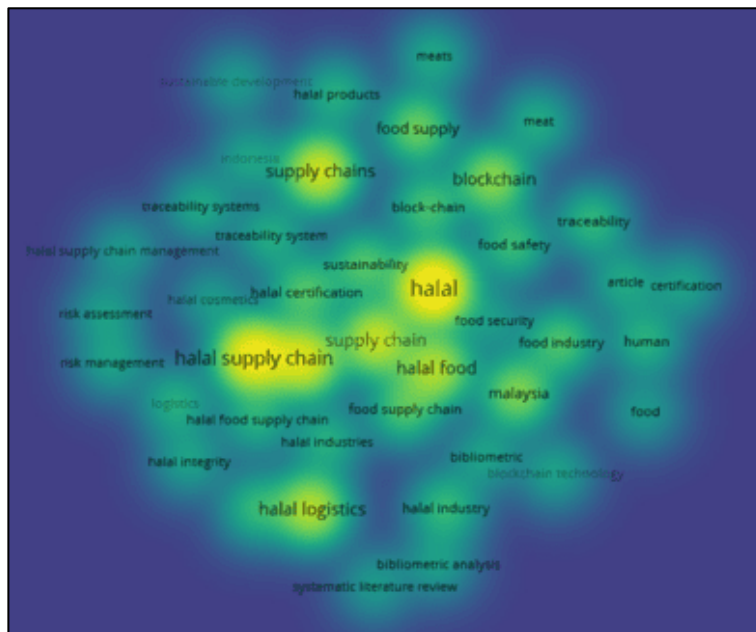


Figure 11. Density Visualization: Density and intensity of research focus

Figure 11 shows a density visualisation indicating the concentration or intensity of frequently appearing keywords in the literature. Yellow signifies the area of highest density, while green and blue gradations indicate lower intensity. The most densely connected terms in this field of research are "halal", "halal supply chain", "halal food" and "supply chain", as revealed by this visualization. Moreover, other keywords such as blockchain, traceability, and sustainability show significant density, indicating that these concepts are emerging as contemporary issues that are starting to receive wider attention in academic research. This visualization provides a quantitative overview of the most researched topic areas while identifying potential research gaps in areas of lower density.

The bibliometric analysis reveals that the most dominant and interconnected keywords across thematic clusters include halal supply chain, halal logistics, halal food, traceability, and sustainability. This pattern indicates that contemporary halal supply chain research extends beyond normative compliance with halal standards and increasingly incorporates concerns related to data integrity, risk management, and traceability systems supported by digital technologies (Chandra et al., 2019a; Kamble et al., 2021). The prominence of these keywords reflects a conceptual broadening of the field, in which halal supply chains are examined as complex systems requiring transparency and accountability across multiple stages.

Overlay visualization shows a clear temporal shift in research focus, particularly since 2022–2023, with growing attention to keywords such as blockchain, traceability, and sustainability. This trend suggests that recent studies increasingly explore digitalization as an enabling mechanism to address persistent challenges in halal assurance, including monitoring, certification credibility, and information asymmetry (Sunny et al., 2020; Senjoyo et al., 2018). While earlier research largely emphasised logistics efficiency and certification mechanisms, newer contributions highlight the role of digital tools in enhancing supply chain visibility and consumer trust (Ahamed et al., 2024; Wahab et al., 2025).

Density visualisation further indicates that core concepts such as halal, halal logistics, and supply chain remain the most intensively researched areas, whereas topics related to advanced digital applications, including halal tokenisation, smart contracts, and digital system-based halal tourism, appear in low-density regions of the map. This suggests that although digitalisation is gaining scholarly attention, empirical and system-level studies on its broader applications within halal ecosystems remain limited (Alqarni et al., 2023; Fernando et al., 2025). Consequently, these underrepresented themes point to significant research gaps that merit deeper investigation.

The bibliometric patterns also highlight the strategic importance and vulnerability of halal food and meat supply chains, which are frequently associated with issues of contamination risk, counterfeit halal claims, and non-compliant logistics practices. Several studies emphasise that maintaining halal integrity in these sectors requires continuous monitoring throughout slaughtering, storage, transportation, and distribution processes (Adhiwibowo et al., 2025; Sunny et al., 2020). However, the clustering results suggest that much of the existing literature still focuses on isolated technological or operational solutions rather than integrated, end-to-end supply chain analyses (Ellahi et al., 2025; Kurniawan et al., 2025).

In addition, the growing linkage between halal supply chains, consumer trust, and sustainability reflects an emerging research orientation that connects halal compliance with ethical consumption and long-term development objectives. Studies indicate that Muslim consumers increasingly consider transparency, process credibility, and sustainability practices when making purchasing decisions, rather than relying solely on halal labels (Che Hassan & Osman, 2025; Chandra et al., 2019b). Nevertheless, the density analysis shows that sustainability-related discussions remain secondary to compliance-focused themes, suggesting that the

integration of halal principles with sustainability frameworks is still at an early stage of scholarly development (Sunmola et al., 2025).

Finally, the literature underscores the importance of collaboration among multiple stakeholders, including producers, halal auditors, logistics providers, regulators, and consumers, in safeguarding halal integrity. While some studies acknowledge challenges related to digital infrastructure, implementation costs, human resource readiness, and regulatory coordination (Ellahi et al., 2025; Wahab et al., 2025), bibliometric evidence indicates that governance and institutional dimensions are less developed compared to technological and operational discussions. This imbalance suggests that future research should move beyond technology-centric perspectives and place greater emphasis on governance models, institutional capacity, and cross-sector collaboration to strengthen the resilience and credibility of halal supply chains (Kamble et al., 2021).

Conclusion

This bibliometric analysis provides a comprehensive overview of the development, structure and emerging trends in halal supply chain research from 2008 to 2025. The findings reveal a significant increase in scholarly output, intensified international collaboration and growing thematic diversity, reflecting the mounting strategic importance of halal supply chains in the global economy. The surge in publications since 2019 suggests a growing awareness of the necessity for robust halal logistics, traceability and transparency systems in response to the expansion of halal markets and the increasing complexity of global supply networks.

Beyond mapping academic trends, the results have important practical implications for stakeholders in the halal industry. The dominance of themes related to traceability, blockchain, and digital transparency highlights the urgent need for industry actors to adopt digital solutions that enhance trust, reduce information asymmetry, and ensure halal integrity throughout the supply chain. For policymakers and regulatory bodies, the concentration of research around certification and compliance highlights the necessity of harmonising halal standards and integrating digital verification mechanisms into national and international halal governance frameworks. Meanwhile, technology providers and Islamic financial institutions are well-placed to play a pivotal role in developing interoperable platforms, smart contracts, and Sharia-compliant digital instruments that can support the growth of transparent, scalable halal supply chain ecosystems.

The analysis shows that there are ongoing research gaps that need to be addressed by the scholarly community and policy makers. Despite the growing interest in digitalization, topics such as halal tokenisation, smart contract-based certification and integrating halal supply chains with digital halal tourism are still under-explored. This suggests that current research tends to focus on technological feasibility rather than systemic integration and real-world implementation.

Research should move beyond bibliometric mapping and focus on testing emerging digital technologies like blockchain, Internet of Things (IoT), and digital tokens in operational halal supply chains. Policy-oriented research should examine regulatory readiness, governance challenges, and cross-country standardization in digitally enabled halal ecosystems. Research should bridge technological innovation, institutional frameworks, and Sharia principles to contribute to the development of resilient, transparent, and competitive halal supply chains.

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