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Information Risks and Supply Chain Resilience: A Global Bibliometric Review with Agricultural Perspectives

Muhammad Aizat Md Sin*, Ahmad Shabudin Ariffin

Faculty of Business and Management Science, Universiti Islam Antarabangsa Tuanku Syed Sirajuddin, Perlis, Malaysia.

*Corresponding Author Email: aizatmdsin@unisiraj.edu.my

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Abstract

This study conducts a bibliometric analysis of research on information risks and supply chain risk management, focusing on insights relevant to the cattle supply chain in Malaysia. Data were collected from Scopus for 2020–2025, resulting in 451 documents analyzed using bibliometric mapping tools. The results show a rising trend in publication output, peaking in 2024, which reflects the growing academic and industry attention to supply chain resilience. The research field is interdisciplinary, with the most substantial contributions from business, engineering, and computer science, while agriculture and veterinary sciences remain less represented, signaling a notable gap. Journal articles dominate the publication types, complemented by conference papers and book chapters, emphasizing peer-reviewed knowledge dissemination. Keyword analysis highlights resilience, sustainability, and digital transformation as central themes, with emerging technologies such as blockchain, artificial intelligence, and big data analytics as key approaches for mitigating risks. Regarding geographic distribution, China, India, and the United States are leading contributors, while Malaysia shows modest but increasing participation through regional collaborations. Overall, the analysis maps global research trends and underlines the need for a stronger focus on agriculture and livestock sectors to enhance food security and supply chain sustainability.

Keywords: Information Risk, Supply Chain, Cattle Industry, Bibliometric Analysis, Research Trends

Introduction

The cattle supply chain in Malaysia is a critical component of the agricultural sector, contributing significantly to the nation's food security and economic stability. However, this supply chain faces numerous risks, particularly related to information management, which can disrupt operations and affect overall performance. Understanding and mitigating these risks is essential for ensuring the sustainability and efficiency of the cattle supply chain in Malaysia.

The primary objective of this study is to identify and analyze the information risks within the cattle supply chain in Malaysia. By understanding these risks, the study aims to propose effective risk management strategies to enhance the resilience and performance of the supply chain.

The cattle supply chain in Malaysia is fraught with various risks that can compromise its efficiency and sustainability. Information risks pose significant challenges due to the complexity and interconnectivity of supply chain operations. These risks can lead to misinformation, delays, and disruptions, ultimately affecting the supply chain's ability to meet demand and maintain quality standards. Addressing these information risks is crucial for improving the overall performance and reliability of the cattle supply chain in Malaysia.

The cattle supply chain in Malaysia faces multiple risks, including logistical, production, and marketing risks. Although less detrimental, logistics risks still impact the livestock industry's performance (Aizat Md Sin et al., 2024). Additionally, input supply risks, such as poor-quality feed and lack of proper waste disposal, are significant concerns (Khan et al., 2023).

Information risks in supply chains arise from factors like the bullwhip effect, lack of trust among partners, and technological issues (Chen, 2009; Su & Zhang, 2011). Effective communication and information sharing are critical to mitigating these risks and ensuring smooth supply chain operations (El Ouarrak & Hmioui, 2024; Vilko et al., 2011).

Various strategies have been proposed to manage supply chain risks, including data analytics, improved information systems, and stakeholder collaboration (El Ouarrak & Hmioui, 2024; Fallahieh et al., 2025). For instance, blockchain technology has been suggested to enhance transparency and traceability in the cattle supply chain (Hashom et al., 2023).

Studies on the livestock supply chain in other regions, such as Indonesia and China, highlight the importance of effectively addressing internal and external factors to manage risks (Yang-Ngam et al., 2019) (M. Xu et al., 2025). These studies emphasize the need for robust risk management frameworks and the integration of innovative technologies to improve supply chain resilience.

The study of information risks in supply chain management is increasingly important as disruptions caused by misinformation, poor data sharing, and technological vulnerabilities undermine business performance and food security worldwide. In Malaysia’s cattle supply chain, these risks are particularly critical because the industry plays a central role in ensuring national food availability, supporting rural livelihoods, and contributing to economic resilience. However, agriculture and livestock remain underrepresented in global research on supply chain risks, leaving policymakers, farmers, and industry players without sufficient evidence-based strategies to manage these vulnerabilities.

Addressing this gap is necessary not only for enhancing the operational efficiency of cattle supply chains but also for safeguarding consumer trust, ensuring halal integrity, and strengthening resilience against external shocks such as pandemics and climate-related disruptions. By focusing on the utility and effectiveness of managing information risks, this study offers valuable insights that benefit multiple stakeholders, from researchers and

policymakers designing sustainable food systems to farmers and industry actors seeking practical tools for risk reduction, thereby highlighting the urgent significance of this research area.

The cattle supply chain in Malaysia is vulnerable to various information risks that can disrupt operations and affect overall performance. By identifying these risks and implementing effective risk management strategies, stakeholders can enhance the resilience and efficiency of the supply chain. Future research should focus on developing comprehensive risk management frameworks and exploring the potential of emerging technologies to mitigate information risks in the cattle supply chain.

Concept map

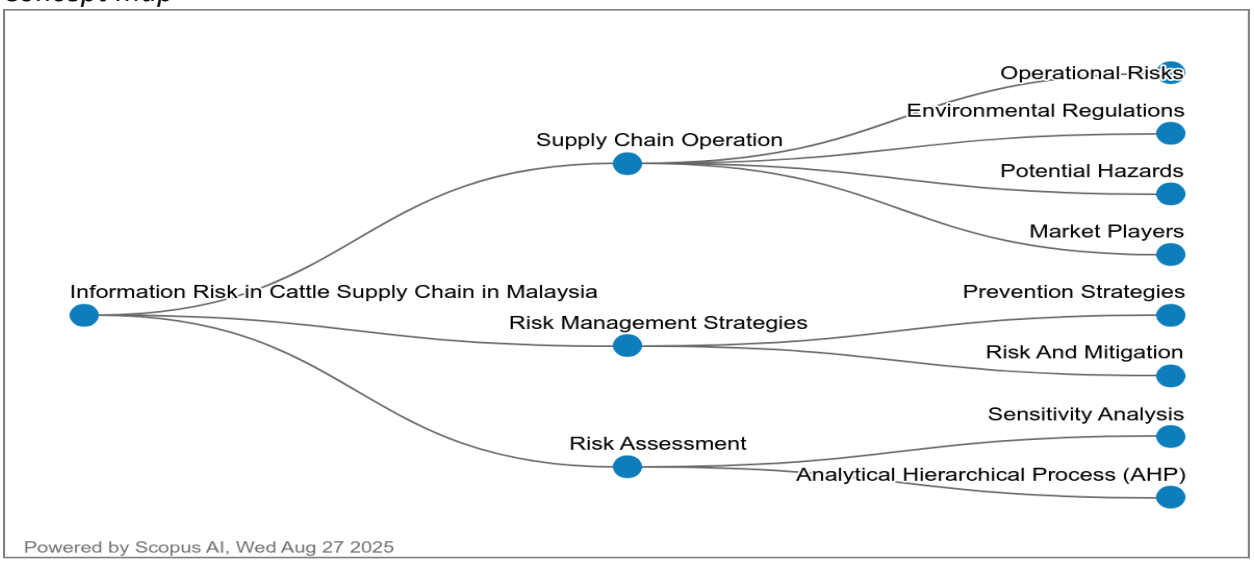

Figure 1: The concept map for Information Risk in the Cattle Supply Chain in Malaysia

The concept map on Information Risk in Cattle Supply Chain in Malaysia illustrates three key dimensions of managing risks: supply chain operations, risk management strategies, and risk assessment. Supply chain operations highlight sources of risks such as operational disruptions, environmental regulations, potential hazards, and the influence of market players. Risk management strategies emphasize prevention, such as vaccination and biosecurity measures, and mitigation through contingency planning. Meanwhile, risk assessment focuses on analytical tools like sensitivity analysis and the Analytical Hierarchical Process (AHP) to prioritize and evaluate risks systematically. Together, these dimensions show that managing information risk in Malaysia's cattle supply chain requires an integrated approach that combines operational awareness, proactive and reactive strategies, and structured decision-making tools to enhance resilience and sustainability.

Research Question

1. What is the number of publications by year from 2000 to 2025?
2. What are the influences and subject area productivity of the topic?
3. What are the documents for the topic by type?
4. What are the top 10 most-cited articles?
5. What are the top 10 countries based on several publications?
6. What are the popular keywords related to the study?

7. What is co-authorship based on countries' collaboration?

Methodology

Bibliometric analysis is a quantitative method used to evaluate scholarly productivity and identify emerging trends within specific research fields. Applying statistical techniques to academic literature collections reveals authorship patterns, publication frequency, and citation behavior (Marvi & Foroudi, 2023). The use of bibliometric methods has expanded considerably across disciplines such as business, management, and health sciences, owing to their ability to trace the historical development of knowledge and to map the evolving structure of scientific inquiry (Öztürk et al., 2024; Koo & Lin, 2023; Lim et al., 2024).

The bibliometric process typically involves several stages, beginning with data extraction from bibliographic databases such as Scopus or Web of Science, followed by visualization and mapping using specialized tools like VOSviewer and bibliometric software (Lim et al., 2024; Hallinger & Kovačević, 2022; Foudah et al., 2024). This methodology is highly flexible, supporting analyses that range from macro-level examinations of entire academic domains to micro-level assessments of the productivity and influence of individual researchers (Costas et al., 2010; Costas et al., 2009). It incorporates multiple indicators commonly grouped into research productivity, scholarly impact, and collaborative activity (Costas et al., 2010; Costas et al., 2009). These metrics are critical for identifying dominant research themes, uncovering gaps in the literature, and highlighting the factors contributing to academic success (Costas et al., 2010; Siu et al., 2025).

Despite its strengths, bibliometric analysis faces several challenges, particularly concerning consistency and methodological rigor. A pressing issue is the need for standardized reporting protocols to ensure reliability and comparability of results, which is especially important in fields such as health and medical sciences where precision and data sensitivity are vital (Koo & Lin, 2023). Nevertheless, bibliometric analysis continues to be a valuable tool for monitoring the evolution of academic disciplines, supporting evidence-based evaluations, and informing the strategic direction of future research efforts (Tomé, 2024; Mezquita et al., 2024; Zhang et al., 2018).

Data Search Strategy

The refined search string resulted in 451 documents retrieved from Scopus using the query: TITLE-ABS-KEY (information AND risk AND supply AND chain AND risk AND management AND performance) AND PUBYEAR > 2019 AND PUBYEAR < 2026. This query was designed to capture literature published between 2020 and 2025. To further align the search with the scope of this study, additional keywords related to the livestock sector were incorporated, with a particular emphasis on cattle supply chain management.

Table 1
The search string

Scopus	**TITLE-ABS-KEY (information AND risk AND supply AND chain AND risk AND management AND performance) AND PUBYEAR > 2019 AND PUBYEAR < 2026**

Data Analysis

VOSviewer

VOSviewer is a specialized software tool designed for constructing and visualizing bibliometric networks, including citation relationships, bibliographic coupling, co-citation, and co-authorship patterns (Li & Wei, 2022; Van Eck & Waltman, 2009; Van Eck & Waltman, 2010). Initially developed to support scientometric studies, it has since evolved into a widely adopted instrument for domain analyses due to its efficiency in processing complex bibliographic data. Its open-access availability and integration with platforms such as Digital Science's Dimensions have further enhanced its accessibility, enabling researchers to generate detailed co-authorship and citation network visualizations with relative ease (Li & Wei, 2022; Van Eck & Waltman, 2009).

A notable strength of VOSviewer lies in its ability to produce advanced graphical representations of bibliometric maps, allowing large and complex datasets to be interpreted quickly and intuitively (Van Eck & Waltman, 2009). Beyond network visualization, the software incorporates text-mining functionalities that construct co-occurrence networks from terms extracted directly from publication content (Li & Wei, 2022). Its web-based extension, VOSviewer Online, further expands these capabilities by offering interactive visualizations that can be embedded in digital platforms, thereby enhancing research dissemination and engagement (Li & Wei, 2022). The tool has been successfully applied across diverse fields, including monitoring advancements in lactic acid production (Cárdenas-Arias et al., 2023), analyzing multi-input transfer function systems, and exploring thematic developments in corporate governance and leadership domains.

Another defining feature of VOSviewer is its ease of use, supported by an intuitive interface that accommodates users with varying technical expertise (Van Eck & Waltman, 2009; Van Eck & Waltman, 2010). Its scalability enables handling extensive datasets, including co-citation maps comprising up to 5,000 scientific journals. The software supports multiple types of bibliometric analyses, such as co-authorship networks, keyword co-occurrence mapping, and citation-based metrics (Malmqvist et al., 2019; Sahu & Chakma, 2024; Hasan et al., 2024). However, the accuracy of its outputs is highly dependent on the quality of structured metadata. Incomplete or inconsistent metadata can compromise results, while misinterpretation of visualizations remains risky if data cleaning and disambiguation are not carefully performed (Li & Wei, 2022).

A key methodological feature of VOSviewer is its application of the association strength (AS_{ij}) normalization technique to quantify co-occurrence data:

$$CS = \frac{C_{ij}}{w_i w_j}$$

This formula calculates the strength of association between items i and j by comparing the observed co-occurrence frequency against the expected frequency under independence. Such normalization ensures that the visualized relationships reflect meaningful associations, thereby enhancing the reliability of the generated bibliometric maps.

In conclusion, VOSviewer represents a powerful and versatile tool in bibliometric research, combining strong visualization capabilities with analytical depth and user accessibility. While widespread adoption underscores its value across diverse domains, meticulous data

preparation and cautious interpretation remain essential to mitigate methodological pitfalls. As bibliometric analysis continues to evolve, VOSviewer is expected to remain a central resource for uncovering scholarly communication patterns and mapping research trends (Li & Wei, 2022; Van Eck & Waltman, 2009; Van Eck & Waltman, 2010; Malmqvist et al., 2019).

NotebookLM

NotebookLM is an emerging AI-driven research assistant developed by Google that enhances the synthesis and interpretation of multiple sources, making it a valuable tool for academic research. In the context of this study, the analysis of 50 abstracts was supported by NotebookLM, which systematically extracted dominant themes, recurring concepts, and underlying theoretical frameworks across the selected literature. This functionality allows the researcher to move beyond isolated article-level summaries and instead discern broader patterns, such as the recurring emphasis on managerial competencies concerning business performance and the repeated focus on supply chain vulnerabilities within the livestock sector. By leveraging its clustering and synthesis capabilities, NotebookLM provides a structured foundation for developing a comprehensive, evidence-based discussion section. At the same time, it helps situate the study within ongoing scholarly debates, strengthening the justification for its unique contribution.

Results

Document by years

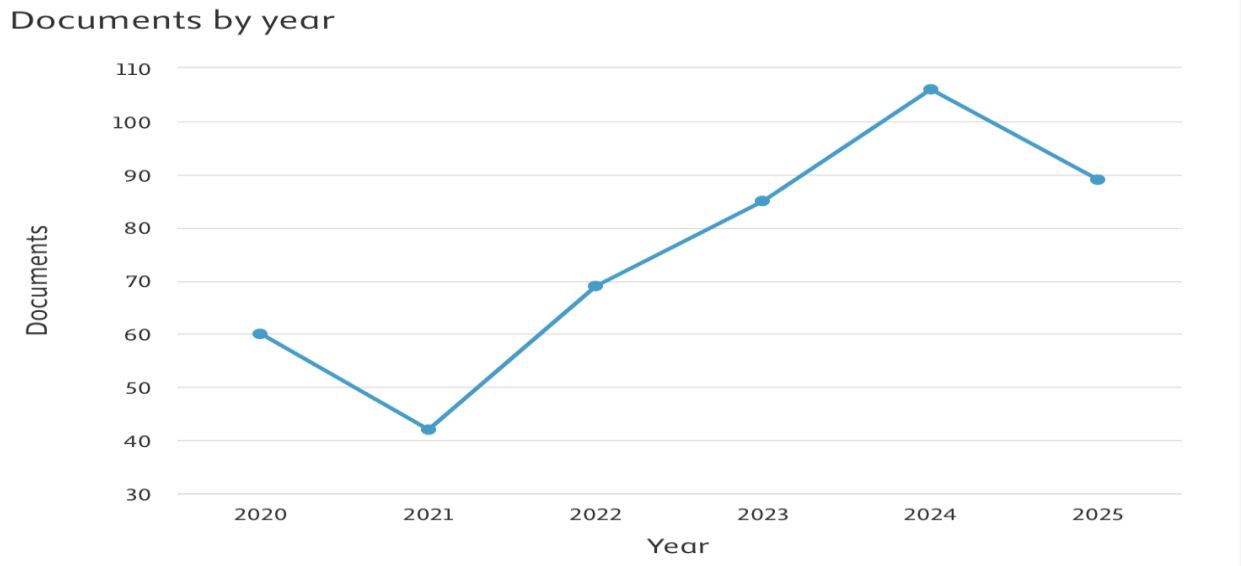

Figure 2: Document by year

Table 2
Document by year

Year	Documents
2025	89
2024	106
2023	85
2022	69
2021	42
2020	60

The distribution of documents across the years highlights a fluctuating but generally rising trend of research in this field. In 2020, 60 documents were recorded, but this number dropped to 42 in 2021, likely influenced by global disruptions such as the COVID-19 pandemic that slowed down research activities. However, from 2022 onwards, the output began to recover, with 69 documents in 2022 and a sharper increase to 85 in 2023, indicating renewed interest in supply chain risks, management, and resilience, particularly in agriculture and livestock industries.

The momentum continued in 2024, reaching the highest point with 106 documents, showing that the topic has gained significant scholarly recognition. 2025, although the year is ongoing, 89 documents have already been published, suggesting strong, sustained interest and potentially surpassing previous years by the end of the year. This upward trajectory reflects the growing global urgency to address food security, supply chain vulnerabilities, and risk management strategies, making the cattle supply chain a critical area of research.

Document by Subject Area

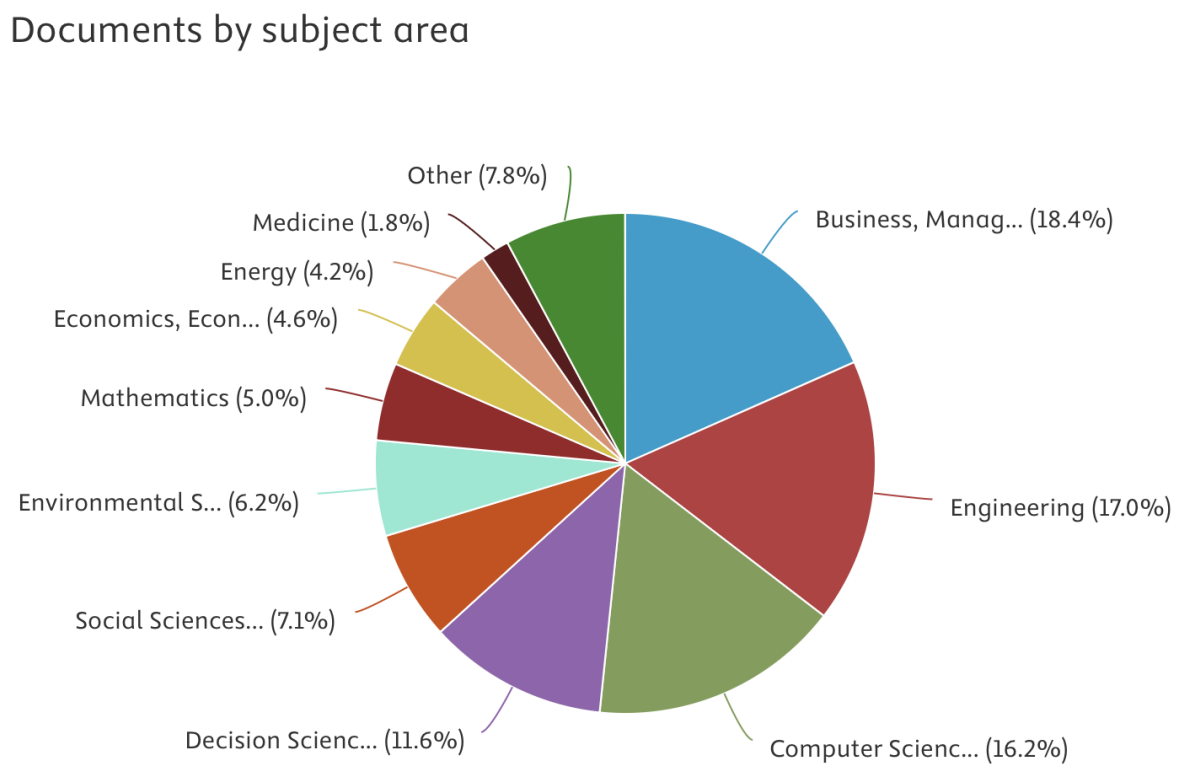

Figure 3: Document by Subject Area

Table 3
Document by Subject Area

Subject area	Documents
Business, Management and Accounting	179
Engineering	166
Computer Science	158
Decision Sciences	113
Social Sciences	69
Environmental Science	60
Mathematics	49
Economics, Econometrics and Finance	45
Energy	41
Medicine	18
Agricultural and Biological Sciences	16
Earth and Planetary Sciences	11
Physics and Astronomy	8
Chemical Engineering	7
Materials Science	7
Multidisciplinary	6
Biochemistry, Genetics and Molecular Biology	4
Health Professions	4
Immunology and Microbiology	4
Psychology	3
Pharmacology, Toxicology and Pharmaceutics	2
Arts and Humanities	1
Chemistry	1
Neuroscience	1
Veterinary	1

The subject area distribution reveals that research on this topic is highly interdisciplinary, with the strongest concentration in Business, Management and Accounting (179 documents), followed closely by Engineering (166) and Computer Science (158). This indicates that much of the scholarship focuses on managerial, operational, and technological dimensions of supply chain and risk management. Other substantial contributions come from Decision Sciences (113) and Social Sciences (69), showing interest in decision-making frameworks and socio-economic implications. Meanwhile, Environmental Science (60) and Mathematics (49) emphasize modeling, sustainability, and quantitative analysis within the context of the supply chain.

In comparison, fields directly related to agriculture and livestock show relatively low representation. Agricultural and Biological Sciences (16) and Veterinary (1) appear at the bottom of the list, suggesting a gap in domain-specific studies of cattle supply chains. Similarly, disciplines like Medicine (18), Biochemistry (4), and Health Professions (4) are only marginally connected, often through food safety, zoonotic disease, or biosecurity perspectives. This pattern highlights that while supply chain risk research is dominated by business, engineering, and computational approaches, there is significant room for expansion in agriculture, veterinary sciences, and food security studies to balance practical industry needs with theoretical and technological insights.

Document by type

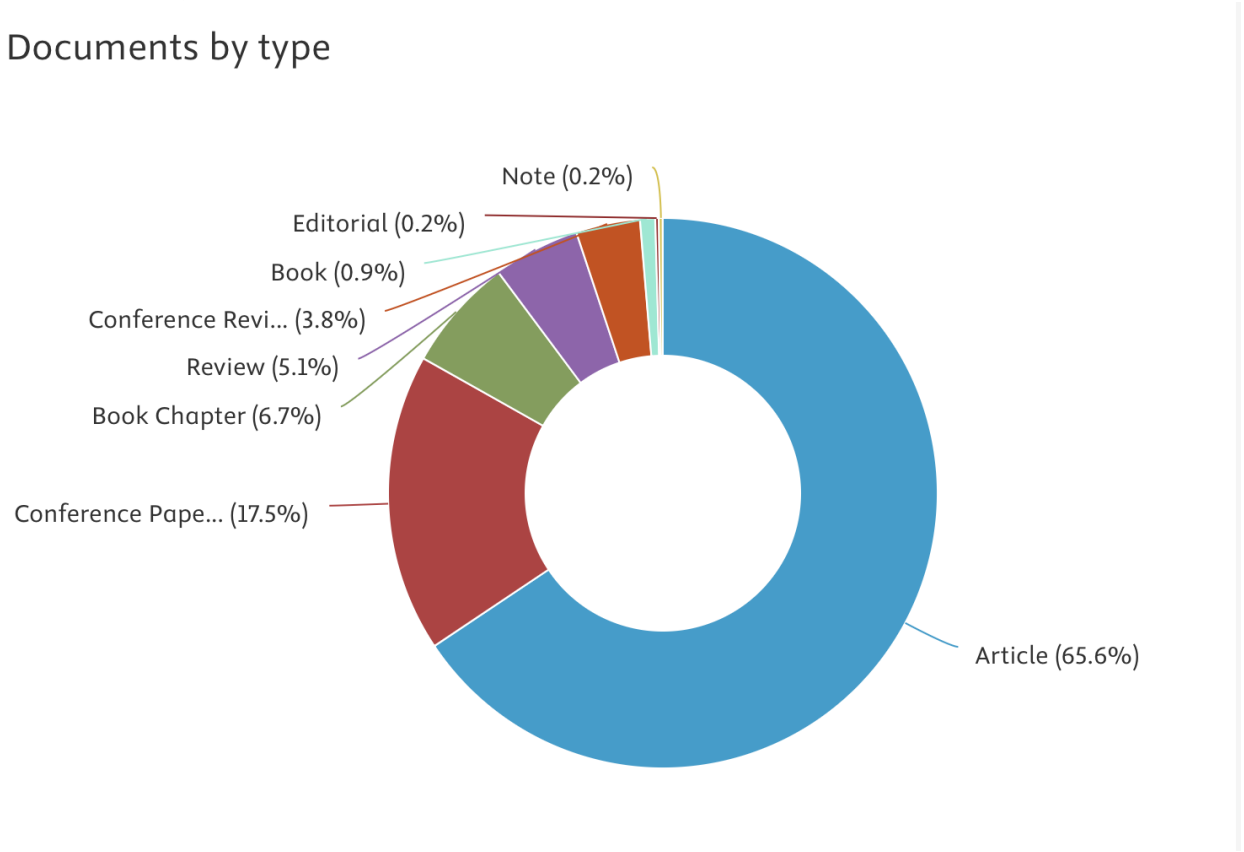

Figure 4: Document by Type

Table 4
Document by Type

Document type	Documents
Article	296
Conference Paper	79
Book Chapter	30
Review	23
Conference Review	17
Book	4
Editorial	1
Note	1

The document type distribution shows that most publications are journal articles (296 documents), reflecting the strong academic focus on peer-reviewed research outputs in this area. Conference papers (79) also represent a significant share, indicating that many studies are presented and discussed at academic and industry conferences before being further developed into journal publications. Other contributions come from book chapters (30) and reviews (23), which suggest efforts to consolidate existing knowledge and provide broader theoretical or conceptual perspectives.

Smaller contributions include conference reviews (17), books (4), and a minimal number of editorials (1) and notes (1). This pattern shows that while articles and conference proceedings dominate the field, there is relatively limited work in producing comprehensive monographs or books. The prevalence of journal articles demonstrates the maturity and credibility of research in this field. At the same time, the lower number of reviews highlights an opportunity for more systematic and critical syntheses to strengthen the knowledge base, especially in emerging areas like agricultural supply chain risk and cattle industry performance.

The top 10 most cited authors

Authors	Title	Year	Cited by
Munir M.; Jajja M.S.S.; Chatha K.A.; Farooq S.(Munir et al., 2020)	Supply chain risk management and operational performance: The enabling role of supply chain integration	2020	344
Azadegan A.; Mellat Parast M.; Lucianetti L.; Nishant R.; Blackhurst J.(Azadegan et al., 2020)	Supply Chain Disruptions and Business Continuity: An Empirical Assessment	2020	145
Sudusinghe J.I.; Seuring S.	Supply chain collaboration and sustainability performance in circular economy: A systematic literature review	2022	238
Xu S.; Zhang X.; Feng L.; Yang W.(S. Xu et al., 2020)	Disruption risks in supply chain management: a literature review based on bibliometric analysis	2020	299
Birkel H.S.; Hartmann E.(Birkel & Hartmann, 2020)	Internet of Things – the future of managing supply chain risks	2020	140
Santagata R.; Ripa M.; Genovese A.; Ulgiati S.(Santagata et al., 2021)	Food waste recovery pathways: Challenges and opportunities for an emerging bio-based circular economy. A systematic review and an assessment	2021	159

Wong C.W.Y.; Lirn T.-C.; Yang C.-C.; Shang K.-C. (Wong et al., 2020)	Supply chain and external conditions under which supply chain resilience pays: An organizational information processing theorization	2020	239
Li Z.; Guo H.; Barenji A.V.; Wang W.M.; Guan Y.; Huang G.Q.(Z. Li et al., 2020)	A sustainable production capability evaluation mechanism based on blockchain, LSTM, analytic hierarchy process for supply chain network	2020	115
Bahrami M.; Shokouhyar S.(Bahrami & Shokouhyar, 2022)	The role of big data analytics capabilities in bolstering supply chain resilience and firm performance: a dynamic capability view	2022	132
Shishodia A.; Sharma R.; Rajesh R.; Munim Z.H.(Shishodia et al., 2023)	Supply chain resilience: A review, conceptual framework and future research	2023	124

The table presents the top ten influential publications (2020–2023) in supply chain risk management, integration, resilience, and sustainability. The most cited article is by Munir et al. (2020), with 344 citations, emphasizing how supply chain integration enhances risk management and operational performance. Closely following, Xu et al. (2020) received 299 citations through their bibliometric review of disruption risks, underlining its significance as a comprehensive reference in the field. In parallel, Wong et al. (2020) (239 citations) explored organizational information processing theory to explain conditions under which supply chain resilience generates value, while Sudusinghe and Seuring (2022) (238 citations) systematically reviewed supply chain collaboration and sustainability performance in the circular economy context.

Other notable contributions include Santagata et al. (2021) (159 citations), addressing food waste recovery in the bio-based circular economy, and Azadegan et al. (2020) (145 citations), which empirically examined supply chain disruptions and business continuity. Technology-driven approaches also feature prominently, such as Birkel and Hartmann (2020) (140 citations) on IoT applications for risk management, Li et al. (2020) (115 citations) on blockchain and AI-driven mechanisms for sustainable supply chains, and Bahrami and Shokouhyar (2022) (132 citations) on big data analytics in resilience and firm performance. More recently, Shishodia et al. (2023) (124 citations) proposed a conceptual framework and research agenda for supply chain resilience, reflecting the ongoing evolution of this research domain.

Top 10 countries based on publication

Figure 5: Top 10 countries based on publication

Table 6
Top 10 countries based on publication

Country/Territory	Documents
China	107
India	82
United States	52
United Kingdom	32
Malaysia	21
Iran	19
Italy	18
Indonesia	17
Australia	16
Canada	15

The country distribution shows that research output on this topic is dominated by China (107 documents) and India (82 documents), highlighting the strong emphasis these nations place on supply chain risk and management, particularly given their large agricultural sectors and growing demand for food security. The United States (52) and the United Kingdom (32) also contribute substantially, reflecting their advanced research infrastructures and global interest in risk management and supply chain resilience.

In comparison, contributions from countries like Malaysia (21), Iran (19), Italy (18), Indonesia (17), Australia (16), and Canada (15) are minor but significant. Malaysia's 21 documents indicate a growing scholarly focus on supply chain risk within its local context, though still limited compared to larger economies. This pattern suggests that while global leaders dominate the research, there is rising participation from developing and middle-income countries, especially in Asia, where food security and agricultural resilience are pressing policy priorities.

Popular keywords related to this study

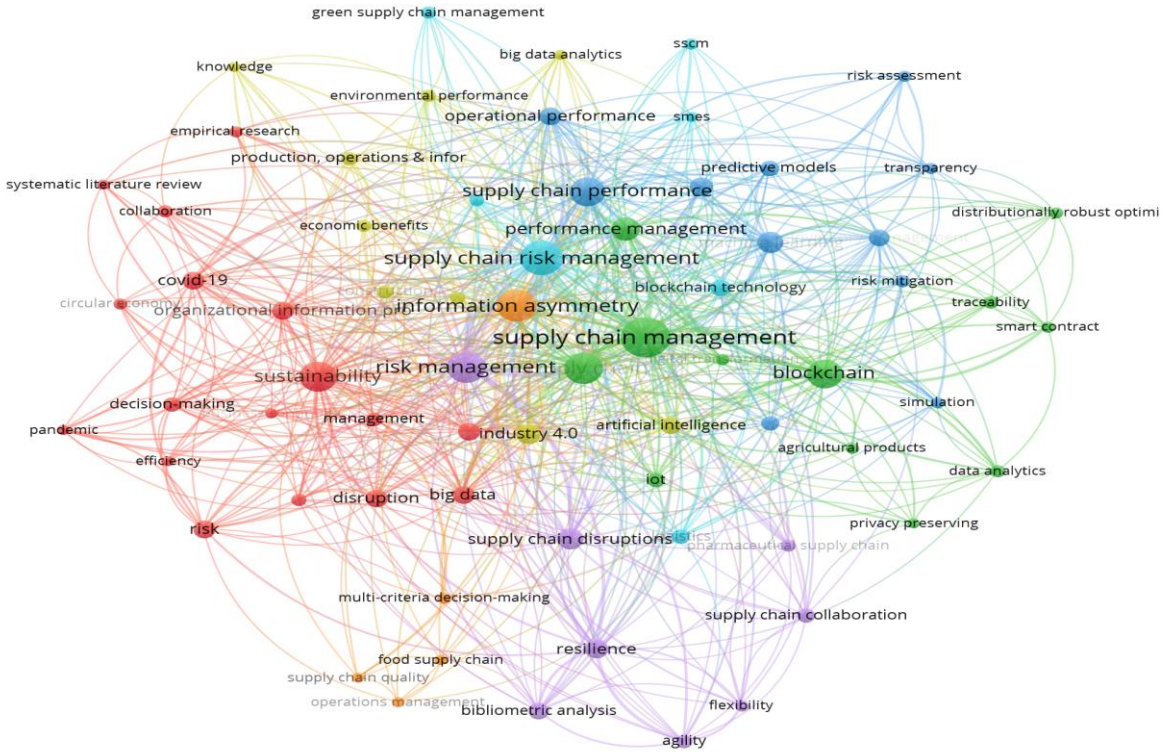

Figure 6: Popular keywords related to this study.

This keyword co-occurrence map highlights the interconnected themes within supply chain risk management and performance research. At the center, dominant concepts such as supply chain management, supply chain risk management, risk management, supply chain performance, and information asymmetry represent the core of the literature. Surrounding these central nodes are several clusters of related themes. The green cluster emphasizes technology-driven solutions, linking terms like blockchain, traceability, smart contracts, simulation, data analytics, and agricultural products, showing how digital tools enhance transparency and risk mitigation. The blue cluster focuses on performance and decision-making, with keywords such as supply chain performance, performance management, predictive models, risk assessment, and risk mitigation, reflecting the importance of evaluating supply chain outcomes systematically. The red cluster relates to sustainability and external shocks, including sustainability, COVID-19, circular economy, collaboration, and efficiency, which highlights the impact of crises and the need for sustainable practices. The purple cluster emphasizes resilience, agility, flexibility, and supply chain collaboration, pointing to strategies for building robustness against disruptions. In contrast, the

orange/yellow cluster covers methodological approaches such as multi-criteria decision-making, supply chain quality, and operations management.

The map shows that global research is dominated by themes of digital transformation (e.g., blockchain, AI, big data), sustainability, and resilience, particularly in response to disruptions like the COVID-19 pandemic. However, agriculture- and food-related terms, such as food supply chains and agricultural products, appear as smaller nodes, indicating that these areas are less developed than manufacturing and technology-driven supply chains. This suggests a vital gap where future studies focusing on the cattle supply chain in Malaysia can contribute new insights by integrating risk management strategies, managerial skills, and performance measures to strengthen food security and resilience in livestock industries.

Co-authorship based on countries' collaboration

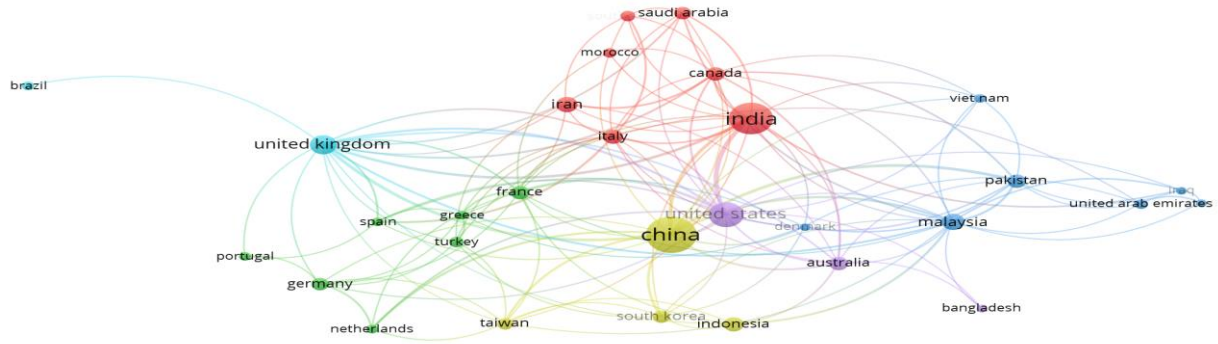

Figure 7: Co-authorship based on countries' collaboration**.**

This figure is a country co-authorship network map from VOSviewer, showing how countries collaborate in supply chain risk management research and related fields. Each node represents a country, the node size indicates research output, and the connecting lines represent co-authorship or collaboration links, with colors forming clusters of closely linked nations.

From the map, China, India, the United States, and the United Kingdom appear as the most central and connected countries, reflecting their leadership in research productivity and global collaborations. China is a significant hub linking to Asian partners such as Indonesia, South Korea, Taiwan, and Western countries like Germany and the Netherlands. India also has strong ties, especially with Canada, Italy, Saudi Arabia, and other Middle Eastern and North African nations. The United States connects broadly with both Asian and European countries, while the United Kingdom shows strong collaborations with European partners, including Germany, Spain, Portugal, and France.

For Malaysia, the map shows active collaborations with countries like Pakistan, Vietnam, the United Arab Emirates, Bangladesh, and Australia. This suggests Malaysia's research network is more regional, with strong connections in Asia and the Middle East, than Western countries. Such positioning highlights Malaysia's potential to expand its global research visibility by building stronger collaborations with leading hubs like China, India, the US, and the UK, while continuing to leverage regional partnerships to address localized supply chain and food security challenges.

Discussion

The dynamic business environment poses significant challenges and disruption risks for supply chains, necessitating a substantial academic and practical focus on Supply Chain Risk Management (SCRM) to navigate complexities and uncertainties. Disruptive events like pandemics have fully exposed supply chain vulnerabilities, driving increased interest in resilience research and the need for robust supply systems. Effective SCRM involves understanding the interplay between a manufacturer's environmental, organizational, and technological contexts. Findings suggest that manufacturers seek collaborative and flexible work settings to respond to challenges, which, alongside enhanced technological setups, increase information processing capability to enable SCRM and agility. Organizational factors like innovation and employee motivation positively impact supply chain performance, and the presence of perceived risk necessitates proactive risk management strategies that emphasize agility.

Strengthening key capabilities is crucial for managing supply and demand-side risks, ultimately leading to improved business performance. Supply chain integration (SCI), encompassing internal, supplier, and customer integration, positively affects SCRM and mediates operational performance. Key sustainable SCRM practices include information sharing with partners, supplier performance assessment, and establishing shared supply management. Developing a risk management culture, which involves raising employee risk awareness and conducting regular risk assessment drills, is vital for building and strengthening supply chain resilience. Furthermore, visibility, collaboration, and innovation are critical factors for reducing supply and demand uncertainty, particularly in sectors like construction. Quantitative methods, such as Network Data Envelopment Analysis (NDEA), are being developed to assess risk mitigation investments across supplier, manufacturing, and customer segments. Business continuity programs (BCPs) are also beneficial in limiting damage from supply chain disruptions and improving financial performance, particularly for companies with flexible or procedural response orientations.

Information technology's rapid development and integration fundamentally transform supply chain networks, enabling higher interdependence and facilitating real-time, reliable decision-making. Digital transformation is critical across various sectors, including the pharmaceutical supply chain, to enhance risk management and achieve sustainable supply performance. A proper digital supply chain leverages connectivity, system integration, and innovative components to generate insights, increasing efficiencies, reducing costs, and minimizing environmental footprints. Advanced data analytics capabilities, such as SCOR-based and big data analytics (BDAC), bolster firm performance by fostering secure, risk-averse enterprises, improving strategic alignment, and enhancing innovative capabilities and information quality, thereby increasing supply chain resilience.

Emerging technologies like the Internet of Things (IoT), machine learning (ML), and blockchain technology play a significant role in modern SCRM. IoT applications increase data availability, improving process transparency, risk knowledge, and overall SCRM performance. Machine learning models serve as practical predictive tools for early disruption detection, forecasting risks, and measuring risk using diverse internal and external data, thus significantly increasing resilience and enabling quicker responses to outages. Similarly, a supply chain control tower, equipped with intelligent decision support systems powered by machine learning, assists

managers in selecting optimal strategies to reduce risk and enhance resilience. Blockchain technology offers considerable potential in SCRM due to its inherent traceability and security features, which positively contribute to the supply chain risk, blockchain technology fit, and new product development performance, while improving transparency and quality control in complex supply chains like the Industrial Hemp Supply Chain. These Healthcare 4.0 technologies (big data analytics, AI, and blockchain) also enhance hospital supply chain operations, innovations, and risk management processes, ultimately improving performance in the healthcare sector.

Beyond these operational aspects, sustainability-related risks (SSCRs) are increasingly impacting supply chains due to globalization and technological advancements. Effective management of these risks, such as environmental hazards, through supplier management and supply chain integration, can lead to positive outcomes for businesses and the environment. The transition to circular supply chains (CSCs) emphasizes collaboration practices like information sharing and risk-sharing to improve sustainability performance, often focusing on environmental and economic aspects. However, this digitalization also introduces new vulnerabilities, particularly information and cybersecurity risks. Therefore, information system audits are essential for identifying vulnerabilities, non-compliance, and control flaws to ensure quality control and system optimization within cyber supply chain risk management frameworks.

Research in supply chain risk and resilience continually evolves, with new topics like operational management, strategy, and sustainable production gaining prominence. There is a clear call for adopting a holistic SCRM approach and developing prescriptive and normative risk models that consider key factors such as process integration, design, information risk, visibility, and risk coordination. Sector-specific challenges across various industries, including pharmaceutical, agri-food, construction, and hospitality, highlight the universal need for advanced IT adoption, robust risk management strategies, and enhanced information flow for improved operational performance and resilience.

Conclusion

This bibliometric study aimed to explore research trends, influential contributions, and emerging themes related to information risks and supply chain risk management with relevance to the cattle supply chain in Malaysia. The analysis examined publication patterns, subject area productivity, document types, citation impact, geographic contributions, keyword co-occurrence, and international collaborations.

The findings reveal a steady growth of publications between 2020 and 2025, with a notable peak in 2024, highlighting the increasing global interest in supply chain risk management. Research is highly interdisciplinary, dominated by business, engineering, and computer science, yet with relatively limited contributions from agriculture and veterinary sciences. This imbalance underscores a vital research gap where livestock and cattle-related issues remain underrepresented. Most outputs take the form of journal articles, indicating strong academic engagement, while reviews and books are fewer, suggesting opportunities for more integrative and synthesizing works. The most influential studies focus on integration, resilience, digitalization, and sustainability, showing how technological innovation and collaboration are central to effective risk management. China, India, and the United States

are leading contributors, while Malaysia demonstrates growing regional participation, primarily through collaborations within Asia and the Middle East.

This study contributes to the broader understanding of supply chain research by mapping how risk management scholarship has evolved in response to disruptions and technological advancements. It provides insights into the centrality of themes such as resilience, sustainability, and digital transformation while identifying the limited focus on agriculture and livestock, which are critical for food security in emerging economies.

The implications of these findings are both academic and practical. For research, the observed gaps suggest the need for greater integration of agricultural and food-related perspectives within supply chain risk studies. For practice, the identified trends indicate that resilience-building strategies must embrace digital technologies, collaborative practices, and sustainability measures to strengthen real-world cattle supply chains and ensure long-term food security.

Despite these contributions, some limitations should be noted. The study is based on data from a single database, which may exclude relevant works indexed elsewhere. Additionally, bibliometric methods focus on patterns of publications and citations without assessing the full quality or context of research findings. Future studies could broaden the dataset, apply complementary qualitative reviews, and focus specifically on agriculture-related supply chains to close the identified gap.

Bibliometric analysis is valuable for identifying knowledge structures, influential contributions, and future directions in supply chain risk management. By uncovering strengths and gaps in the literature, this study emphasizes the importance of extending scholarly attention to underrepresented sectors such as cattle and livestock supply chains. Strengthening these research domains is vital for advancing theoretical knowledge and practical resilience strategies in an era of growing uncertainty.

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