



EXPLORING KEY RICE SUPPLY CHAIN FACTORS USING SYSTEMATIC LITERATURE REVIEW AND BIBLIOMETRIC ANALYSIS

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ARTICLE INFO	ABSTRACT
Article History: Received: 13 September 2024 Revised: 14 October 2025 Accepted: 25 November 2025 Published: 15 May 2026 Keywords: Food supply chain, food security, rice supply chain, systematic literature review, bibliometric.	Food security within the Rice Supply Chain (RSC) has become one of Malaysia's primary concerns, as reflected in agricultural policies that emphasise rice production and measure performance through rice Self-Sufficiency Levels (SSL). However, food security extends beyond production capacity, encompassing the four key dimensions of availability, accessibility, stability and utilisation. Inefficiencies within the RSC adversely impact rice production, thereby reducing SSL. These challenges are being resolved with national transformation agendas that prioritise strategies to ensure equitable food access and reduce food wastage and post-harvest losses, in line with the United Nations Sustainable Development Goals. This study employed a systematic literature review and bibliometric analysis of 132 articles retrieved from both the Scopus (n = 80) and Web of Science (WoS) (n = 52) to examine key dimensions of RSC. Five main components were identified in the analysis: (i) Raw material, (ii) supplier or producer, (iii) distributor, (iv) retailer and (v) consumer. The findings revealed that the keywords "chain" and "model" exhibited the highest occurrence values, indicating their significance as central elements in RSC research. In contrast, the keywords "cooperative" and "trust" registered the lowest occurrence values, suggesting limited scholarly attention to these relational aspects. Overall, the findings provide new perspectives for exploring the multidimensional role of the RSC in achieving food security. They also offer valuable insights for strengthening RSC integration and resilience, thereby contributing to the formulation of sustainable strategies that address Malaysia's food security challenges.
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Introduction

Food security, as defined by the United Nations (UN), refers to the state in which individuals consistently have physical, social and economic access to sufficient and nutritious food that meets their dietary requirements for a healthy and active life (Peng & Berry, 2019). This critical concern is assessed through four main criteria: Availability, accessibility, utilisation and stability. Addressing concerns related to food security has spurred research endeavours focusing on the Food Supply Chain (FSC). Achieving optimal food security requires the food system to generate sufficient supply, maintain consistent inflows and ensure uninterrupted

access to food. The escalating prevalence of food security challenges has heightened global attention towards enhancing FSC. Inconsistent access to the food system is identified as a significant issue that demands attention. Key stakeholders, including governments, policymakers and relevant organisations, are working on strategies to address shortages in the food supply (Addai *et al.*, 2022).

The impending risk of food supply challenges has led to a dire situation. A significant hurdle faced by many impoverished and developing nations is the scarcity of food supply, resulting in elevated worldwide food

price inflation (The World Bank, 2023). It is alarming to note that between 30% and 50% of global food production never reaches human consumption. Approximately one-third of food produced for human consumption is lost, amounting to a staggering 1.3 billion tonnes of food per year (Schanes *et al.*, 2018; Närvänen *et al.*, 2020). According to FAO (2022), around 14% of the world's food continues to be lost at post-harvest stages before it reaches retail shelves. Consequently, various action plans have been implemented to formulate strategies aimed at mitigating shortages in food supply.

As Malaysia strives towards achieving developed nation status, ensuring reliable access to food stands as a paramount national priority. This imperative extends beyond economic considerations and encompasses positive impacts on social aspects as well. Numerous transformation initiatives have been crafted to align with the national development agenda, including the Shared Prosperity Vision 2030 (SPV 2030), the 12th Malaysia Plan 2021–2025, the National Fourth Industrial Revolution (4IR) Policy, the Malaysia MADANI policy framework and the Malaysia Digital Economy Blueprint. These agendas serve as guiding frameworks for fostering the country's economic growth related to food security issues. Therefore, it becomes crucial to concentrate on strategies and policies that secure food access for all Malaysians. This approach not only enhances the overall well-being of the population, but also contributes to the realisation of UN Sustainable Development Goals (SDGs).

The importance of food security requires significant transformations in agri-food systems, as highlighted by Yusriadi and Cahaya (2022) but the problem of food insecurity is still a significant concern. However, few studies still examine the relationship of socio dynamics in contributing to local ecosystems to create food security. In this study, we discuss how social dynamics contribute to normative structures, community habits, and livelihoods to meet the living needs of rural communities in creating household food security and how they try to deal with worsening food insecurity through the local

wisdom of rural communities. The research methodology is participatory qualitative, while data collection is through a Discussion Group Forum (DGF). In the agri-food industry, rice stands out as a staple in many countries, ranking among the primary food crops worldwide. With growing concerns about food security issues tied to the global food system, the Rice Supply Chain (RSC) has been identified as a crucial area for enhancement, given its substantial role in global rice production. Consequently, there is a demand for a resilient system capable of improving rice production and addressing food security challenges. Beyond its role as a food crop, rice serves as a primary income source, particularly in Asia, including Malaysia. According to the Malaysian Investment Development Authority (MIDA) under the National Agrofood Policy 2021–2030 (NAP 2.0), rice is recognised as a key agricultural product contributing significantly to the country's economic development.

Numerous studies have reached a consensus that the global landscape of rice production remains imbalanced. Contemporary academic discourse highlights several critical aspects of the Malaysian RSC, with particular emphasis on productivity enhancement, value chain optimisation, and postharvest loss reduction. These studies underscore the interconnectedness among different operational stages of the supply chain, including production, processing, distribution, and consumption (Kolawole *et al.*, 2021; Magalhães *et al.*, 2022; Dong *et al.*, 2022) which involves different stakeholders. Additionally, other research has focused on the managerial aspects such as policy frameworks and governance mechanisms (Bhattacharya & Fayezi, 2021; Wang *et al.*, 2023). Although advancements in modernisation, policy refinement, and stakeholder collaboration have contributed to improving RSC productivity. Unfortunately, it has been discovered that there are other areas remain insufficiently addressed. This oversight underscores the pressing need for a balanced and integrated approach that simultaneously incorporates all the importance aspects helps to improve the productivity of RSC in the future. Addressing these challenges

identified in recent research is imperative to fostering a resilient and efficient RSC.

The predicament emerged as the influx of imported rice steadily increased, contributing to a decline in self-sufficiency in rice production. Moreover, the persistent upward trajectory in rice consumption is attributed to the expanding population. Therefore, achieving and maintaining the targeted Self-Sufficiency Levels (SSL) for rice production is unattainable without adequate research and development efforts to address production constraints, as highlighted by Mohamed Arshad *et al.* (2011). However, the existing body of research lacks current studies utilising bibliometric methods to comprehensively analyse the RSC. A review of RSC studies appears to be relatively scarce in current research findings. Similar to preceding bibliometric analyses in the other research areas, this study delves into identifying clusters and relationships in the study of RSC areas, commonly referred to as classification research (Chopin *et al.*, 2023; Erboz *et al.*, 2023). Kumbhar (2012) highlights many bibliometric analyses reveal classification as a major topic. To bridge this gap, this research aims to conduct a bibliometric analysis of global literature to assist researchers in identifying potential areas within the scope of RSC studies.

Through an extensive exploration of RSC, factors contributing to the crucial role of designing and planning the supply chain

have been identified, which fall into two main categories. The first category encompasses internal (managerial) factors, as highlighted by Cheraghalipour *et al.* (2019) and Peng *et al.* (2022). The second category comprises external (technical) factors, as explored by Jifroudi *et al.* (2020), Kakkar and Ruchi (2020) and Tao *et al.* (2023). Suryani *et al.* (2022) recommend focusing on the operational and managerial factors to enhance the value of RSC. These studies underscore the importance of strengthening both managerial and technical aspects to ensure the quality and safety of rice.

Also, it has been notified that the RSC can be categorised into two primary levels: (i) Upstream and (ii) downstream stages, which may be distinguished through their position and functions. Singer and Donoso (2008) and Almelhem *et al.* (2025) define the upstream level as the early stages of the supply chain, primarily concerned with production-related processes, whereas the downstream level focuses on customer value creation, encompassing activities closer to the end consumer.

Given the growing body of scientific knowledge on food security, there is an increasing need to systematically collect, categorise, and examine current research areas pertaining RSC. In addressing the challenges associated with rice production, the summaries from previous findings in Table 1 present publications from Google Scholar, as well as journals indexed in

Table 1: Summary SLR in Google Scholar, Web of Science (WoS) and Scopus databases for rice supply chain (RSC) studies

RSC Component	No. of Publication		
	Google Scholar	WoS	Scopus
Raw Material	13	5	7
Supplier/Producer (Farmer)	13	12	9
Distributor	7	3	1
Retailer	1	0	0
Consumer/Customer	1	5	6
RSC network (between RSC components/more than 1 entity)	18	50	34

Note: Data collected by author in 2023
Source: Google Scholar, WoS, and Scopus databases

the Web of Science (WoS) and Scopus. These publications provide an initial insight into the landscape of RSC research.

Based on these analyses of RSC studies highlights significant research gaps. There are two main research categories identified: Single-category studies and multiple-category studies, also known as network relationship studies. Study on the single-category focus on five core components, namely (i) raw material, (ii) supplier or producer, (iii) distributor, (iv) retailer and (v) consumer or customer. Another category is the multiple-category studies to examine the RSC network by discovering relationships and linkages between each component within the RSC. Thus, this study offers another opportunity for an in-depth exploration on these identified components.

Materials and Methods

This study adopted a well-defined search strategy and an a priori approach to data synthesis to enhance consistency and transparency. Following the refinement of the database search platform selection, the focus of paper selection was narrowed down to issues specifically related to the RSC, which is the primary interest of this study. The following search equation was determined to be the most effective among the considered options:

Search = ((“rice supply chain”) AND
PUBYEAR > 2018 AND PUBYEAR < 2024)

The results included research papers published within the past five years only that focused on RSC studies. Analysis of the search algorithm revealed that the study encompassed research papers related to the RSC published between 2018 and 2024. The Boolean operators were applied strategically using quotation marks (“ ”) for the phrase search “rice supply chain”, with the operator AND, to refine the scope and ensure the retrieval of highly relevant papers. These parameters were applied to both the title and abstract fields across selected databases up to 2024. Notably, this study focused on a single-keyword search strategy which was consistent

with the approach outlined by Lu *et al.* (2020); the keyword selection was guided by three main characteristics: (1) The content of the paper, (2) the background of the topic and (3) the authors’ prior experience and knowledge. These characteristics informed the choice of precise keywords to enhance a paper’s visibility and discoverability within academic databases. Referring to the context of this study, it only applied the keyword of “rice supply chain” as its focus research area. Supported by Tripathi *et al.* (2018), Lu *et al.* (2020), and Lee *et al.* (2021), focusing on high-frequency keywords could effectively represent the study’s thematic foundation, which significantly enhanced conceptual clarity and alignment with its research scope. The timeframe of 2018 to 2024 was intentionally selected to capture the most recent developments, emerging trends and ongoing scholarly discussions within the field. Mentioned by Synder (2024) and van Wee and Banister (2024), restricting the review to a recent five-year period would ensure that the analysis remained current and relevant, besides enhancing the academic rigour and credibility of the literature review.

The search algorithm on April 4th, 2023, was described according to Şalvarlı and Griffiths (2021) and Jain *et al.* (2022), using the four-phase flow diagram of the PRISMA method. The extraction and identification, screening, eligibility and inclusion steps were applied before bibliometric analysis. Exploring into WoS and Scopus using Boolean (“; AND”) search, a total of 111 documents were initially retrieved. Limitations were employed to narrow down the selection year, resulting in a final count of 86 papers. Using this method could enhance the reliability and reproducibility of reviews and further give a comprehensive methodology use in conducting bibliometric analysis (Martínez-Falcó *et al.*, 2023).

After filtration and refinement of the data to align with the study’s scope, the total number of documents was reduced from 165 to 139 at the screening phase. Further, assessment of the eligibility of open access papers resulted in a final total of 132 from 139 documents. A network

map was generated using VOSviewer version 1.6.18 to visualise the bibliometric networks (Martínez-Falcó *et al.*, 2023). Keywords that appeared at least 10 times were included, and clusters were identified based on predetermined parameters. This visualisation analysis might help to distinguish the leading research areas in this field, thereby revealing trends within the RSC studies.

Results and Discussion

In WoS database, scientific studies revealed a diverse range of research areas, with the top five highest occurrences by keywords being identified as chain (172), data (38), farmer (37), efficiency (25) and blockchain (24). These prominent keywords further helped to come out with a thematic cluster, underscoring the interdisciplinary between different research areas. This analytical approach allowed for comprehensive areas of investigation.

Findings in WoS revealed that the keyword “chain”, which recorded the highest occurrence value and total link strength, signified that

contemporary research recognised the importance of examining the RSC from the “chain” perspective, where the entire system operated as an interconnected network without excluding any components. The components of the RSC could not be analysed in isolation, as each stage was inherently interdependent.

The strong total link strength between the keyword “chain” and other related elements further indicated a scholarly consensus that RSC studies should be approached through the lens of supply chain integration. This was in line with the findings of Aung and Chang (2014), who examined a traceability system designed to connect the various stages of the supply chain, reinforcing the significance of integration in achieving transparency and efficiency. The analysis served two primary purposes: first, to explore the development of knowledge within the academic discipline, and second, to analyse the linkages between each item. To visually depict the connections and linkages between these items, a keyword occurrence analysis was conducted. Figure 1 facilitates the identification of relationships between the keywords.

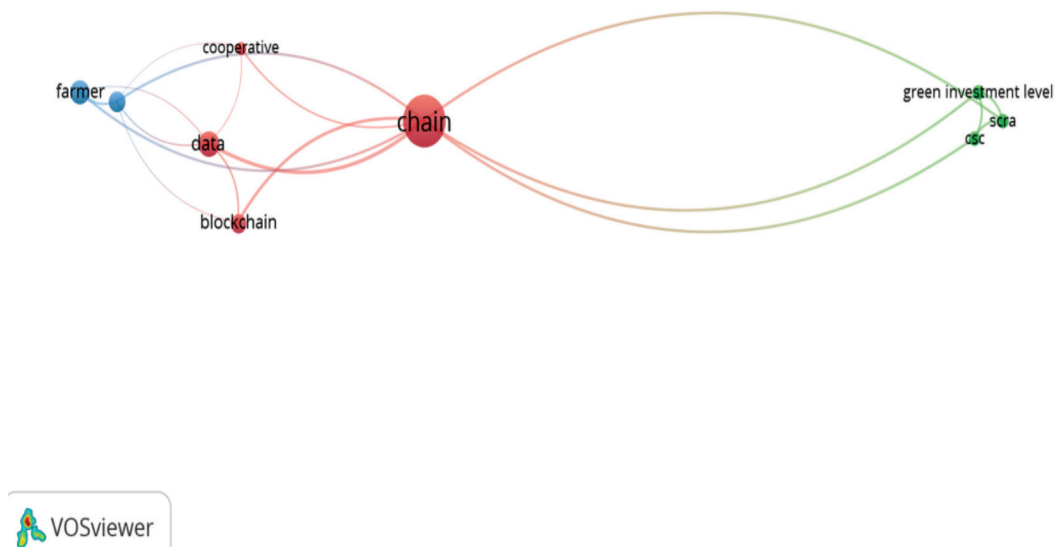


Figure 1: Network map of the occurrence of keywords in the WoS database. For practical reasons, we have included those keywords that appear at least 10 times in the records considered (unit of analysis: all keywords) but excluded keywords which have not related to the study area. The size of the nodes is proportional to the number of times keywords appear

Note: Data analysed by author in 2023

However, it is noted that there was a limited number of studies addressing “cooperative” aspects, which were among the least represented with only 10 occurrences. Also, not many studies had focused on the components of the supply chain where none had been listed in the keyword list except for “farmers”, which could also be categorised as the supplier. This analysis aided in comprehending the aspects of knowledge that fell within the scope of the RSC.

Another aspect covered in the bibliometric analysis was the total link strengths for each keyword: Chain (675), data (234), efficiency (171), blockchain (157), farmer (145), supply chain risk assessment (SCRA) (84) and cooperative (46). These keywords exhibited linkages that measured the cumulative strength of connections between a keyword and another keyword. Notably, the keyword “cooperative” reflects the lowest occurrence value, indicating that a limited number of studies have delved into this aspect, which had not been extensively explored in existing literature.

Meanwhile, in Scopus, the top five occurrences by keywords were model (118), farmer (76), cost (49), price (45) and performance (39). Based on the analysis, the top five keywords with these keywords underscored the extensive research undertaken in the RSC, primarily centred on these aspects, underscoring the significance of this field of study. Notably, a deficiency of studies was identified in the area of trust (10), reflecting the lowest occurrence value in the context of the RSC. Consequently, it could be inferred that there had been limited exploration of trust-related aspects in RSC studies.

A critical analysis revealed that the prominence of the keyword “model” reflects the centrality of conceptual and analytical approaches, particularly those employing simulation-based methods, in understanding and enhancing the RSC. The application of modelling has emerged as one of the most preferred research tools, as it enables the effective capture

and management of uncertainties inherent within RSC processes. According to Wibowo Putro *et al.* (2022), most studies focused on supply chain models to identify strategic components and relationships within the system. This finding underscored the significant scholarly attention devoted to model-driven research in the understanding and optimisation of the RSC.

Visualisation from Scopus of the keyword occurrence analysis was executed to visually depict the connections and linkages between each identified item. The resulting Figure 2 facilitates the identification of relationships among the diverse keywords.

Figure 2 illustrates a substantial correlation network map between each keyword and other items, with “farmer” (455) having the highest total link strength, followed by “cost” (345), “price” (329), “market” (293), “information” (251) and “performance” (210). These keywords demonstrated interconnections, where high link strength signified the number of publications in which two keywords occurred together. This evidence had predominantly focused on the supplier’s perspective, particularly that of the farmer, who served as the primary actor within the RSC. Nguyen *et al.* (2019) identified farmers as active agents in their study, showing that they were intricately interconnected with other elements and components of the RSC.

However, other key components of the supply chain were found less given the attention such as manufacturers, distributors, retailers and consumers. This imbalance indicated a significant need for more comprehensive research that evaluated all components holistically to ensure reliable and equitable access to an adequate food supply. Achieving a high level of food security within the RSC necessitated the inclusion of all stakeholders throughout the process. When every actor in the chain had been effectively integrated, the overall performance, resilience and sustainability of the supply chain would be considerably enhanced.

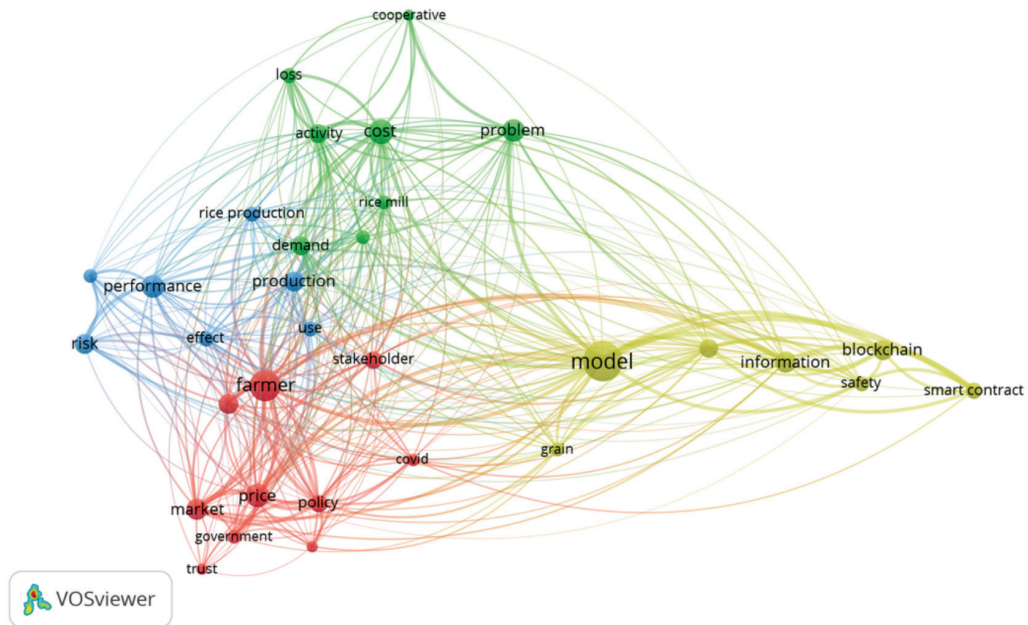


Figure 2: Network map of the occurrence of keywords in Scopus database. For practical reasons, we have included those keywords that appear at least 10 times in the records considered (unit of analysis: all keywords) but excluded keywords, which have not related to the study area. The size of the nodes is proportional to the number of times keywords appear

Note: Data analysed by author in 2023

The Significance of Bibliometric Analysis on Rice Supply Chain Research Insights

Addressing keyword searches in RSC studies had provided new perspectives by identifying existing research gaps and emerging trends. This analysis offers valuable insights for policymakers and encourages greater stakeholder participation. Despite advancements in technology, rice yields in Malaysia remain below SSL, resulting in a persistent reliance on imported rice to meet national demand.

An assessment of the increasing dependence on imported rice highlights the significance of bibliometric analysis in identifying critical RSC themes. The analysis underscores the relevance of specific keywords and their implications for future research. For example, the keyword “chain” recorded the highest number of occurrences and total link strength in the WoS database, whereas in Scopus, “model” was the word that emerged most

frequently. Both keywords were recognised as pivotal elements requiring greater scholarly and practical attention. However, as noted by Wibowo Putro *et al.* (2022), not all RSC studies had comprehensively addressed these crucial aspects despite their prominence.

Another notable finding from the bibliometric analysis concerns keywords with lower occurrences and link strengths, such as “cooperative” and “trust.” These terms appeared less frequently and were insufficiently explored in recent studies indexed in WoS and Scopus. Such underrepresented areas represented substantial gaps that warranted further investigation to strengthen future RSC research.

Bibliometric visualisations had identified potential solutions that could be categorised into managerial and operational dimensions. At the

managerial level, one of the key findings for enhancing food security was strengthening the collaboration not only among stakeholders, but also within national policy frameworks. Studies by Blanckenberg *et al.* (2021), Luo *et al.* (2022), and Underhill *et al.* (2023) emphasised the importance of collaborative networks between farmers, policymakers, and industry actors to foster a resilient and inclusive RSC. Addressing the thematic keywords identified in these studies could provide a structured framework for improving Malaysia's RSC. These insights also suggested that further policy actions, such as targeted subsidies, price stabilisation mechanisms and farmer welfare initiatives, could enhance supply chain performance and ensure long-term sustainability. Policy-oriented RSC research, therefore, played a vital role in informing effective interventions to strengthen Malaysia's rice sector resilience.

At the operational level, issues related to losses during harvesting, drying, storage and milling remained persistent challenges. Nordin *et al.* (2021) highlighted the importance of adopting Good Agricultural Practices (GAPs) to minimise losses. Illankoon *et al.* (2023) further emphasised the potential of circular economy principles, advocating for the utilisation of rice by-products which contributed to both environmental sustainability and economic value creation.

This study also aligned its findings with Malaysia's national policy frameworks, including the National Food Security Action Plan 2021–2025 (DSMN Action Plan), National Agrofood Policy 2021–2030 (NAP 2.0), 12th Malaysia Plan, National 4IR Policy and the Malaysia Economy Blueprint. These policies collectively embed multi-pillar strategies focusing on availability, accessibility, utilisation and stability in food production. The dominance of the keywords “chain” and “farmer” within the analysis underscored their strategic importance in driving improvements across Malaysia's agrifood sector. These findings demonstrated the need for integrated policy alignment and cross-sectoral coordination to optimise the

RSC through enhanced governance, sectoral synergies and macro-level resource planning.

Aligned with Malaysia's evolving food security policies and strategic objectives outlined in the national food agendas, the synthesis revealed that although significant emphasis had been placed on policy development, effective coordination of RSC components remained essential to ensure alignment with prevailing conditions and the core pillars of food security. The prominence of the keyword “chain” underscored the importance of coordination and seamless integration across the entire food supply. This reflected the critical components of availability and stability, which strengthened interlinkages and facilitated smooth RSC flows, ensuring a consistent and stable rice supply. Such alignment was consistent with the objectives of NAP 2.0, which emphasised enhancing efficiency through improved supply chain coordination.

Another notable finding was the keyword “model”, which recorded the highest total link strength and occurrence value. This highlighted the growing significance of model-driven governance strategies. These strategies collectively enhanced stability and utilisation, aligning closely with the fundamental pillars of food security. Furthermore, both the NAP 2.0 and the DSMN Action Plan were extended beyond production enhancement by prioritising the development of a resilient and inclusive supply chain. Therefore, understanding the purpose of thematic synthesis was crucial, as it facilitated the interpretation of patterns and interrelationships linked to specific policy or national contexts, ultimately contributing to the shaping of Malaysia's RSC towards improved resilience and performance.

Conclusions

This study comprehensively examined research related to the RSC by utilising indexed databases which are WoS and Scopus. The analysis of contemporary studies within this field provides valuable insights that can inform

future improvements and strategic directions. The substantial number of keywords identified across these databases highlights potential research areas, their frequency, and total link strength, thereby identifying the most dominant thematic focuses in RSC research.

Overall, this study concluded that although current research trends were addressing pressing food security concerns, further enhancement of the RSC was necessary to promote sustainable practices that integrated social, economic and environmental dimensions. The implementation of innovative strategies and improved stakeholder practices could facilitate more resilient and sustainable systems aligned with SDGs. Despite the growing attention to food security, greater emphasis was required on sustainability-oriented transformations within the RSC to ensure its long-term viability and inclusivity. Furthermore, adopting a holistic perspective which covered both managerial and operational factors including technical, organisation, and human-relational aspects must be examined to ensure balanced and effective outcome.

Given the escalating global concerns over food security, the significance of advancing RSC research cannot be overstated. As rice remains a staple food across many Asian nations, strengthening RSC mechanisms has potential to mitigate food shortages and improve national and regional food resilience. Future research should therefore pursue comprehensive evaluations that contribute to improved RSC performance and, consequently, to the mitigation of food insecurity challenges.

To extend this research, future studies and policy interventions should focus on specific and emerging areas within the RSC. A prominent trend involved the integration of digital and smart technologies, which could enhance traceability, transparency and efficiency across the supply chain. Further research might also explore regional and international collaborations that emphasise cooperative frameworks to strengthen linkages between RSC components. Sustainability remained a

critical domain for future inquiry, particularly in exploring alternative approaches that created added economic value and reinforced the long-term resilience of the rice industry. Moreover, incorporating environmental considerations would be essential in developing a more adaptive and climate-resilient RSC.

In conclusion, addressing the opportunities and challenges identified in this study is fundamental to holistically overcoming food security issues. Bridging research gaps in governance, technology adoption, climate change adaptation, and socio-economic resilience will enable the development of more comprehensive and effective strategies. Such strategies are essential to achieving a resilient, efficient, and sustainable rice supply chain capable of supporting national and global food security goals.

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Conflict of Interest Statement

The authors affirm that this research was undertaken without any personal gain, commercial or financial conflicts of interest.

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