

INTEGRATED HALAL SUPPLY AND VALUE CHAINS FOR THE TAPIOCA AND MOCAF AGRO-INDUSTRY: A SYSTEMATIC LITERATURE REVIEW AND FUTURE SYSTEM DESIGN RESEARCH

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ABSTRACT

Demand for tapioca and mocaf as a strategic substitute for imported wheat flour in Indonesia now requires supply chains that are not only efficient but also protected from any haram or najis contamination, in line with national halal policies for food products. The study conducts a systematic literature review to trace the evolution of research, theoretical lenses, indicators, and variables used to design halal supply and value chains. Its significance lies in a novel methodological integrated of PRISMA protocol, R-Studio bibliometric analysis, and integrated VIKOR with elbow based on clustering within a PICOS to identify the most influential contributions paper. The results screening used PRISMA identified 291 papers, retaining 76 eligible papers. VIKOR simulations used $k = 2$ and $k = 3$ structures with a weighting coefficient of 0.5, producing 9 core publications at elbow points with values of 0.04 and 0.06. Gap analysis focused interpretation of the dendrogram isolated three challenge papers on halal certification and supply chain. The state-of-the-art assessment positioned this work at the intersection of halal chain governance and value chain perspectives, employing validated multi-criteria decision-making with Soft System Dynamics Methodology to enhance halal chain design for tapioca and mocaf agro-industry.



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I. INTRODUCTION

Positioning halal goods as symbols of quality, safety, and ethical responsibility in modern food systems. In this context, managing supply chains and value chains that comply with sharia principles becomes essential, with every stage from the downstream process for raw procurement of raw material to final consumption required to avoid any contamination by haram or najis elements and to comply with certification of halal regulations and transparent traceability requirements, including in Indonesia. Indonesia possesses significant prospects to position itself as a leading player in the global halal industry, robust agricultural sector, and proactive government policies that foster the expansion of halal-focused industries. Within this landscape, cassava-based agro-industries, particularly tapioca flour and modified cassava flour (MOCAF), constitute a strategic commodity group because these ingredients serve as essential inputs in a wide range of food and processed products, making effective supply chain and value chain management crucial for enhancing performance so that competitiveness in international markets can be strengthened [1]. The management of raw material supply availability must therefore be aligned with value-adding efforts, including obtaining halal certification, to secure consumer acceptance in predominantly Muslim markets [2]. Strengthening halal supply chain practices in this subsector still faces multiple obstacles, including limited capabilities of business actors, inconsistent product quality, and uneven application of halal standards and enabling technologies across different supply chains. Ensuring traceability throughout the supply chain is crucial so that consumer-demanded products remain consistently available while fully adhering to halal requirements [3]. Supply chain management, therefore, plays a central role in supervising inbound logistics, identifying critical points in product distribution, and maintaining halal integrity throughout the network [4]. The tapioca and mocaf supply chains feature extensive, dispersed actor networks encompassing cassava farmers, collectors, processing units, distributors, and end-user industries.

This complexity presents distinct challenges for quality control and halal compliance due to variabilities in post-harvest handling practices and logistical facilities, which can significantly affect the consistency of the final product. The pressing need to implement sustainability principles and efficiency promotes the design of a halal product system that concurrently addresses economic, social, and environmental dimensions to enhance traceability and product flow visibility. Conceptually, the discourse surrounding halal supply chains and halal value chains is evolving towards an approach that emphasizes not merely normative compliance but also the integration of halal integrity with value creation, performance, and competitive advantages. Many prior investigations in the halal domain had emphasized issues related to integrity, risk exposure, operational performance, and sustainability outcomes. Sustainable management of supply chains requires distribution strategies that jointly account for technical performance, environmental impact, and economic viability, thereby reinforcing the need for an integrated halal supply and value chain design [5]. Potential halal concerns in tapioca production processes, particularly in West Java, include the risk of contamination from additives and from production methods. As mandated by SNI No. 3451 of 2011, the permissible limit for *Escherichia coli* (*E. coli*) in tapioca flour is 10. This stipulation underscores the likelihood of *E. coli* contamination occurring during the production of coarse tapioca. *E. coli* can survive in the gastrointestinal tracts of both humans and animals and can persist in the environment through fecal matter. Furthermore, there exists a risk of contamination from chicken feces, primarily due to the practice of drying tapioca in open-air environments without sufficient oversight. A targeted SLR on the design of halal supply and value chains for the tapioca and mocaf agro-industry was urgently needed to offer a distinctive and innovative contribution to the research field. The novelty of this systematic literature review lies in its capacity to systematically trace and map the evolution of research on halal supply chains and halal value chains that are specifically relevant to the tapioca and mocaf agro-industry. The theoretical frameworks, analytical methods, indicators, and variables used in previous studies aimed at designing sustainable halal supply and value chains within the tapioca and mocaf sectors. The primary focus of this SLR is to uncover models for developing supply chains and value chains that are not only efficient and transparent but also adhere to halal principles and sustainability, and align with SDG 12, which emphasizes responsible production and consumption patterns.

II. THEORETICAL REFERENCE

The theoretical references in this section establish a rigorous methodological and conceptual foundation for the review by justifying the selection of databases, screening strategies, and synthesis techniques employed. In the systematic literature review on halal supply chain management, these theoretical references delineate and justify the methodological architecture including database selection, screening logic, and synthesis are as follows:

II.1 HALAL SUPPLY AND VALUE CHAIN FOUNDATIONS

Halal supply chain is the coordinated management of flows that must satisfy both sharia requirements and conventional performance, rather than with an added halal label [6]. Recent reviews of halal supply chain research show that most contributions concentrate on compliance, logistics, risk, and sustainability, yet often treat these dimensions in isolation and do not fully connect them to mainstream supply chain theory [7]. A systematic review of halal purchasing along value chains reaches a similar conclusion, showing that halal concerns are frequently confined to procurement routines rather than embedded throughout end-to-end value processes [8]. Strengthening the halal value chain requires consistent assurance of halal compliance from raw material selection through production, logistics, and distribution, supported by robust halal assurance systems and reliable traceability technologies [9].

II.2 AGRO-INDUSTRIAL TAPIOCA AND MOCAF VALUE AND SUPPLY CHAIN

Analyses of cassava product supply chains report persistent weak linkages between upstream and downstream segments, logistical inefficiencies, and limited integration with higher value markets [10]. The development of tapioca and mocaf supply chains is crucial, as it transforms cassava from a primary commodity into a highly competitive input for food and non-food industries, thereby strengthening the incomes of farmers and downstream actors along the value chain [11]. Enhancing tapioca supply chain management from securing sufficient volume, quality, and continuity of raw material supply to mitigating supply chain risks represents a critical prerequisite for maintaining the viability of local starch [12].

II.3 SYSTEMS APPROACHES TO DEVELOPMENT AGRO-INDUSTRIAL TAPIOCA AND MOCAF SUPPLY CHAINS

Systems approaches provide a comprehensive theoretical foundation for analysing complexity of agro-industrial supply chains as integrated systems that link farmers, producer, distributors, and markets through flows of materials, information, and finance [13]. Holistic perspective enables the identification of coordination failures, structural bottlenecks, and leverage points where targeted interventions can increase effectivity, reduce losses, and enhance value added in cassava flour industries [10]. System approach is one of modelling tools are increasingly used to simulate how changes in raw material availability, farmer prices, technology adoption, and substitution policies influence long-term supply security and industrial growth [14]. Systems perspectives also emphasize the importance of aligning agro-industrial upgrading for tapioca and mocaf with broader objectives such as rural development, environmental sustainability, and national food security [15].

II.4 SYSTEMATIC REVIEW OF METHODOLOGICAL FOR THE HALAL SUPPLY CHAIN

Database identification constitutes a critical stage in a Systematic Literature Review, because strategically selecting a suitable combination of multidisciplinary and domain specific determines the completeness, quality, and representativeness of the evidence base the review's theoretical contributions [16]. Bibliometric analysis enables researchers to map publication trends, influential authors, thematic clusters, and methodological gaps in halal supply chain management studies inside the broader knowledge landscape [6].

Structuring data extraction and synthesis with the PICOS framework defining population or problem, interventions, comparisons, and Quantitative methods in the study selection stage are essential to ensure that only articles which genuinely address the identified research gaps and align with the core focus on halal supply chain [17].

III. MATERIALS AND METHODS

The development of the SLR involves five stages: paper planning, database selection, analysis and synthesis, and reporting. The SLR process used the PRISMA method and bibliometric analysis in R-Studio. Each stage was systematically structured to enhance transparency, replicability, and methodological rigor throughout the review are follows:

III.1 PLANNING PAPER

The planning paper was used to systematically map the formulation of research questions, establish screening criteria for selected papers, and develop a synthesis plan. This approach ensures that the literature review process proceeds consistently and transparently as follows:

III.1.1 Pilot Search

A rigorous pilot search was first conducted to refine the review protocol and align the search strategy with the overarching objectives of the study. The pilot search ensures that the research questions are clearly defined through a list of relevant keywords aimed at addressing the research problem across several databases, thus meeting the inclusion criteria [18].

III.1.2 Identification of Studies

Identifying relevant studies required keywords to reveal the dominant themes or conceptual foci in the literature that aligned with the underlying research problem. Keyword analysis was used to address the conditions of the research problem, enabling the bibliometric process to be conducted in line with the issues under investigation [19].

III.2 DATABASE IDENTIFICATION

The selection of databases in the context of SLR was conducted to identify relevant and high-quality literature sources for high-quality, pertinent literature [19]. The literature base could draw on documents catalogued in major international indexing platforms, particularly those listed in Scopus.

III.3 INCLUSION OR EXCLUSION FOR SELECTION PAPER CRITERIA

This step comprised screening and selecting studies that aligned with the core research objectives and questions, while the PRISMA framework served as a clear guide for formulating and applying explicit inclusion and exclusion rules [20]. The stages of the PRISMA protocol used to finalize the eligible articles covered defining inclusion and exclusion parameters, retrieving records from databases, choosing relevant studies, and conducting synthesis [18].

III.4 BIBLIOMETRIC AND QUANTITATIVE SYNTHESIS

The bibliometric evaluation was performed using a machine learning-oriented workflow in the R-Studio environment to detect research gaps and their related value chain configurations. This procedure is intended to uncover shortcomings in existing studies on the development of halal supply and value chain, with the analytical steps described in the subsequent stages:[21]

III.4.1 Factorial Analysis

Factorial analysis is a statistical technique for identifying data structure by grouping data based on observed correlation patterns. This method can be employed in systematic literature reviews (SLR) to determine novelty gaps across various topic clusters. Factorial analysis identifies latent dimensions within the data, facilitates dimensional reduction, and enhances interpretability, enabling key factors to serve as the primary focus in the clustering process [22].

III.4.2 Most Relevant Source

The most relevant sources are journals or conference proceedings that publish the most articles within a specific dataset. Typically expressed as publications per source, this metric enables researchers to gain insights into the literature in their area of study [18]. By identifying these sources, researchers can effectively navigate through the available literature and prioritize readings from outlets that contribute significantly to the field.

III.4.3 Trend Topic Analysis

Trend topic analysis examines how research topics or keywords evolve, enabling the identification of emerging themes within the literature. This analysis leverages keyword frequencies, which are then visualized in formats such as line graphs, heatmaps, or thematic maps [22]. These visual representations indicate when a particular topic begins to emerge. By using trend topic analysis, researchers can gain insights into emerging areas of interest and adapt their investigations to address contemporary issues in their field.

III.4.4 Thematic Map

A thematic map is a two-dimensional visualization that groups related research keywords into clusters, allowing topics to be observed as distinct thematic areas. In this representation, centrality expresses how strongly a theme is connected to other themes within the field, whereas density reflects how well developed and coherent that theme is internally [23].

III.4.5 Dendrogram Analysis

Dendrogram analysis refers to the application of hierarchical clustering to group objects based on similarity. The resulting dendrogram displayed the hierarchical relationships among clustered items, enabling researchers to observe both resemblance and divergence among elements in the dataset [24].

III.5 VIKOR ANALYSIS

The VIKOR (Vlse Kriterijumska Optimizacija I Kompromisno Rešavanje) or Multi-Criteria Decision Making and Compromise Solution method can be employed following the key article selection phase, utilizing PageRank and citation metrics. The VIKOR analysis can be embedded in a systematic literature review as a post-screening synthesis tool, where studies identified through the SLR are treated as alternatives and evaluated against multiple methodological and contextual criteria, thereby producing a compromise ranking of the most representative evidence base for model development [25], [26].

$$A_j = \sum_{k=1}^p \alpha_k \frac{g_k^+ - g_{kj}}{g_k^+ - g_k^-} \quad (1)$$

$$B_j = \max_k \left[\alpha_k \frac{g_k^+ - g_{kj}}{g_k^+ - g_k^-} \right] \quad (2)$$

$$C_j = \lambda \frac{A_j - A^{\min}}{A^{\max} - A^{\min}} + (1 - \lambda) \frac{B_j - B^{\min}}{B^{\max} - B^{\min}} \quad (3)$$

where:

A_j: aggregated group utility for alternative j

B_j: maximum regret for alternative j

C_j: compromise index for alternative j

α_k: weight of criterion k

III.6 ELBOW METHOD

The elbow technique was applied to select an appropriate number of clusters or to define the cutoff for core articles by charting the total within-cluster variation against the cluster count. At the bend of this curve, where further increases in cluster number produced only marginal decreases in dispersion, the optimal clustering solution was inferred [27]. At this point, any further increase in the number of clusters yields diminishing returns in terms of explained variance within the clusters [28].

III.7 PICOS

The structuring of this paper was grounded in the practical challenges encountered in In-donesia's halal supply and value chains for tapioca and mocaf agro-industry. The paper uses the Population, Intervention, Comparison, Outcomes, and Study Design (PICOS) to formu-late research questions and keywords to address them [29]

IV. RESULTS AND DISCUSSIONS

Issues related to halal-compliant products had emerged as a crucial determinant of effective supply chain. At the commodity level, tapioca and mocaf serve as strategic raw materials in the halal food industry, functioning as key components or substitutes for wheat flour in diverse products [30]. Research explicitly linking tapioca and mocaf to the concepts of SLR are as follows:

IV.1 PLANNING PAPER

Preliminary investigations indicate that the halal industry focused on flour and its derivatives is evolving rapidly, driven by increasing consumer and regulatory demands for guarantees of halal compliance, food safety, and sustainability. Multiple investigations on halal food, halal certification of flour-based products, and the evolving halal market indicate a transition from simply fulfilling normative to managing supply and value chains.

IV.1.1 Pilot Search

The agro-industrial commodities of tapioca and mocaf, the interconnections among halal food issues, halal certification mechanisms, halal demand dynamics, and the design of halal supply and value chains have not been comprehensively mapped. The Query of the Systematic Literature Review (SLR) can be seen in Table 1.

Table 1: Initial Keyword for Pilot Search.

Research Problem	Initial Keyword
1. Current handling of halal food has not adequately concentrated on flour-based products, including tapioca and mocaf, particularly concerning aspects of halal compliance, quality, and safety.	“(TITLE ("Halal Food") OR TITLE ("Halal Certification" AND "Flour") OR TITLE ("Halal food" AND "Dynamic") OR TITLE ("Tapioca" AND "Mocaf" AND "Halal Supply Chain" OR "Halal Value Chain")) AND (EXCLUDE (SUBJAREA , "ENVI") OR EXCLUDE (SUBJAREA , "CHEM") OR EXCLUDE (SUBJAREA , "BIOC") OR EXCLUDE (SUBJAREA , "MEDI") OR EXCLUDE (SUBJAREA , "PHYS") OR EXCLUDE (SUBJAREA , "ENER") OR EXCLUDE (SUBJAREA , "VETE") OR EXCLUDE (SUBJAREA , "ARTS")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp") OR LIMIT-TO (DOCTYPE , "re"))”
2. The requirements for halal certification have not yet been incorporated into the design of halal supply chains or halal value chains in the tapioca and mocaf agro-industry.	
3. The evolving nature of halal food demand has not reflected in the way halal supply chains and value chains for tapioca and mocaf are designed.	
4. The existing halal management institutions lack a comprehensive model for maintaining halal certification of products within the tapioca and mocaf agro-industry supply chain.	

Source: Authors, (2026).

This query aims to capture relevant literature on halal certification, supply chains, and value chains in the context of tapioca and mocaf. It ensures a comprehensive search for studies that reflect current challenges and advancements in the halal agro-industry. Based on the keywords used to describe the Research Problem (RP), the following query will be utilized:

Based on the utilized query, a total of 291 papers were retrieved to identify the prevailing issues. An initial analysis of these 291 papers was then conducted through factorial analysis. The factorial map was created in RStudio to visualize keywords or terms from the articles along two principal axes resulting from dimensionality reduction. The proximity of points on the map indicates how frequently these words co-occur within the same documents, allowing clusters of nearby points to be interpreted as thematic clusters, as shown in Figure 1.

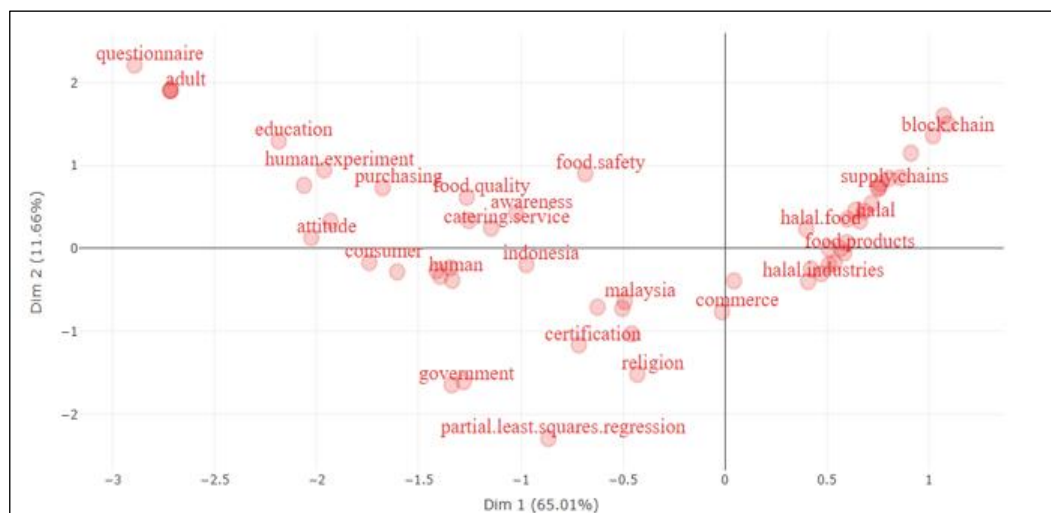


Figure 1: Factorial Analysis Word Map of Halal Food Related Keywords.

Source: Author, (2026).

Dimension 1 accounts for 65.01% of the variation, indicating that this axis captures a significant portion of the structural relationships among the keywords and yields a relatively representative clustering pattern. Dimension 2 contributes 11.66%, and when combined with Dimension 1, the explained variance totals around 76-77%. This level of explained variance is generally considered adequate for visual interpretation in factorial analysis or correspondence analysis.

IV.1.2 Identification of Studies Paper

The identification of studies in SLR begins by mapping the most relevant publication sources in the Scopus database using RStudio. This step aimed to pinpoint journals that served as primary outlets for studies on halal certification, and the configuration of halal supply and value chains. These identified sources will serve as a foundational reference for constructing a comprehensive SLR. The most relevant sources are shown in Figure 2.

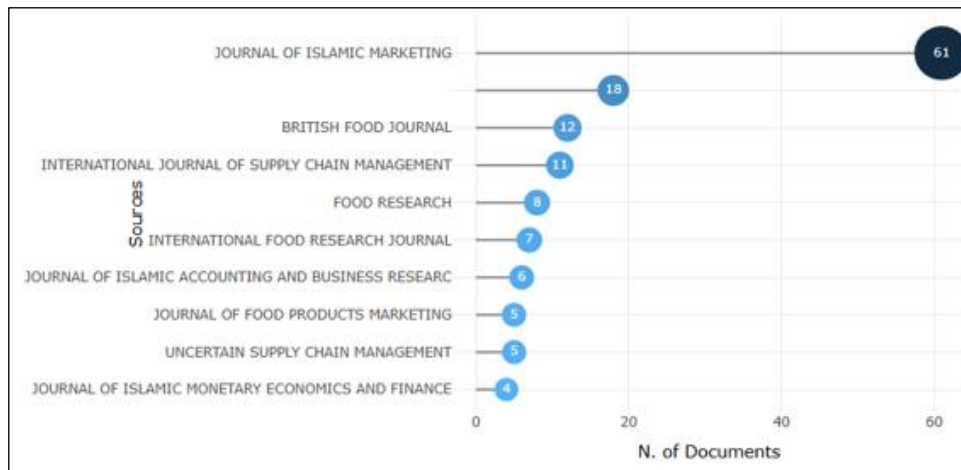


Figure 2: Most Relevant Source.

Source: Author, (2026).

The cumulative trend line showed a marked surge in publications on halal supply or value chains beginning around 2015, with the Journal of Islamic Marketing recording the steepest growth in output compared with the British Food Journal, Food journals, Food Research, and the International Food Research Journal. This trend in productivity aligns with the patterns observed in trend topics, indicating that research focus has increasingly shifted toward issues surrounding food supply chains, halal food, and halal products in recent years. The research trend topics can be viewed in Figure 3.

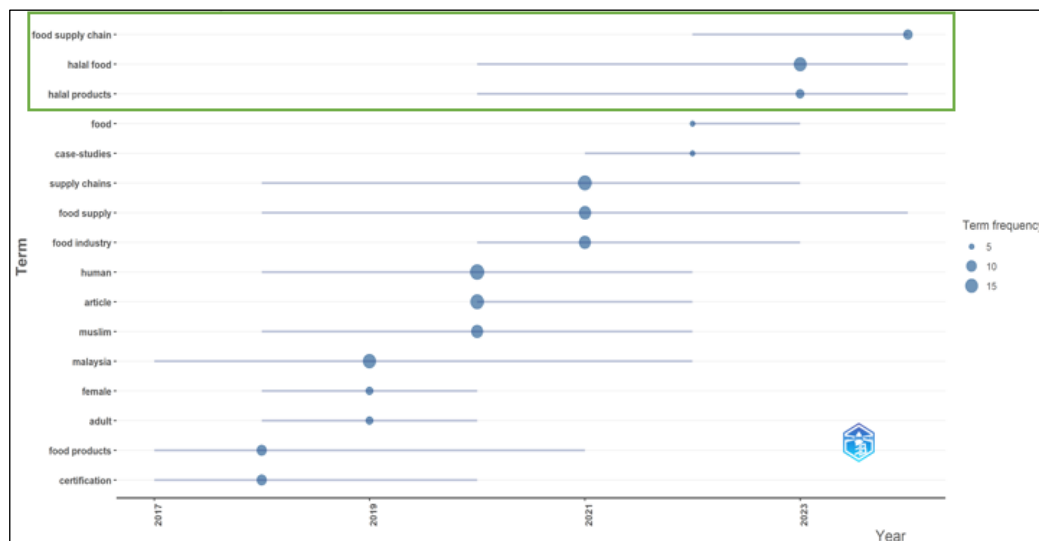


Figure 3: Trend Topic.

Source: Author, (2026).

The points and timelines on the graph reveal that the three terms have emerged more recently, yet with high frequency. This pattern reflected a rising scholarly interest in linking halal compliance with food supply chain management practices. Moreover, the overlap between these topics implied that detailed investigations of halal supply and value chain design in the tapioca and mocaf agro-industry were still at a relatively early stage of development.

IV.2 EXCLUSION CRITERIA

The exclusion of the 291 papers was carried out using five predefined screening parameters and documented through a PRISMA flow diagram. The screening criteria applied to the 291 sources comprised five parameters: duplicate records, cluster scores below 1, halal topics unrelated to food or linked to non-halal food supply chains, articles that did not address halal supply or value chain issues, and studies on halal food that omitted any discussion of supply or value chain aspects, as illustrated in Figure 4.

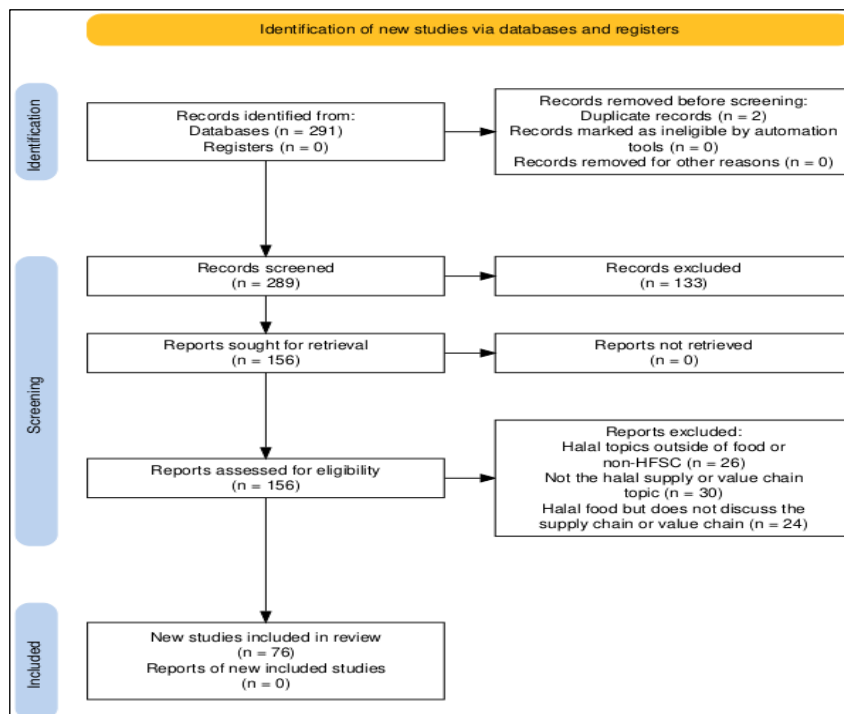


Figure 4: Screening exclusion source paper criteria used the PRISMA Diagram.
Source: Author, (2026).

The PRISMA flowchart depicts how articles were selected in line with PRISMA guidelines, beginning with 291 records retrieved from the database. The screening stage led to the removal of 2 duplicate records, 133 articles with a cluster value below 1, and a further 80 papers excluded according to three predefined categories.

IV.3 BIBLIOMETRIC AND QUANTITATIVE SYNTHESIS

IV.3.1 Bibliometric Analysis

A bibliometric analysis is employed to provide a comprehensive overview of research clusters related to halal food, flour-based halal certification, and halal supply and value chains pertinent to the tapioca and mocaf agro-industry. This bibliometric analysis aims to identify the most productive journal sources, track publication dynamics over time, and uncover patterns of emergence and development for key topics such as food supply chains, halal food, and halal products. The outcomes of the factorial analysis derived from the PRISMA were presented in Figure 5.

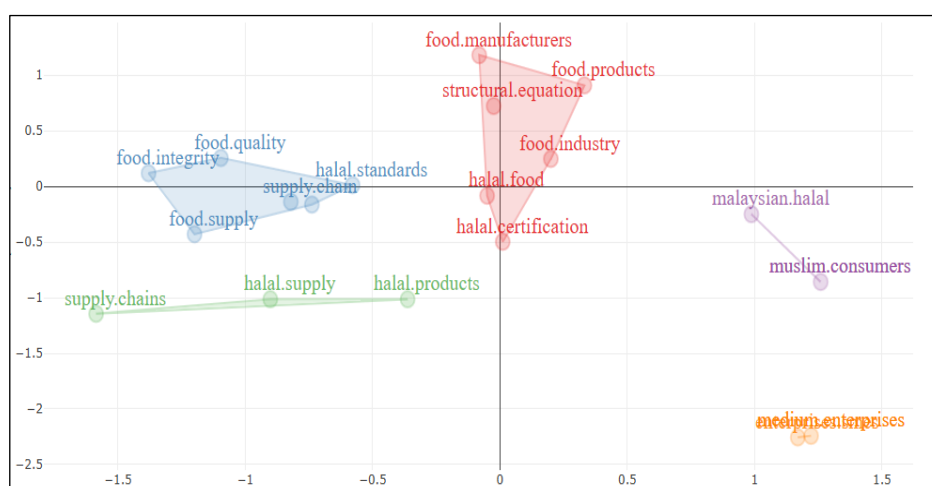


Figure 5: Factorial Analysis for 76 Papers SLR.
Source: Author, (2026).

The keyword cluster map reveals five principal research clusters. The first cluster concerns manufacturing and food industries, incorporating terminology such as food manufacturers, food products, halal food, and halal certification, while the second emphasizes the quality and integrity of food supply chains, including concepts like food quality, food integrity, and food supply. These clusters correspond to the SLR's objective of portraying how studies on halal food and halal certification have progressed toward the design of halal supply and value chains, with niche and motor themes appearing clearly in the factorial analysis and thematic maps in Figure 6.

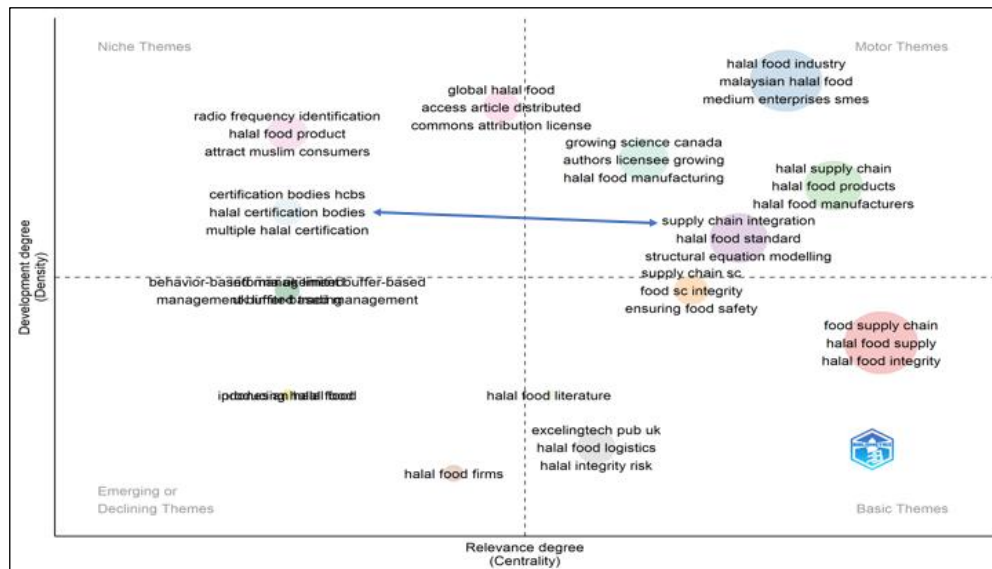


Figure 6: Thematic Map for 76 SLR Papers.
Source: Author, (2026).

The thematic maps illustrate the integration among various topic clusters, with the halal food industry, Malaysian halal food, and medium enterprises emerging as motor themes that have developed and remain highly relevant. Dendrogram analysis is employed to map the proximity of keyword occurrences across thematic clusters, where each color represents a relatively homogeneous issue grouping. It is evident that the term halal certification resides in the blue cluster alongside halal food, the food industry, and structural equation modeling, highlighting discussions on certification aspects and organizational behavior can be seen in Figure 7.

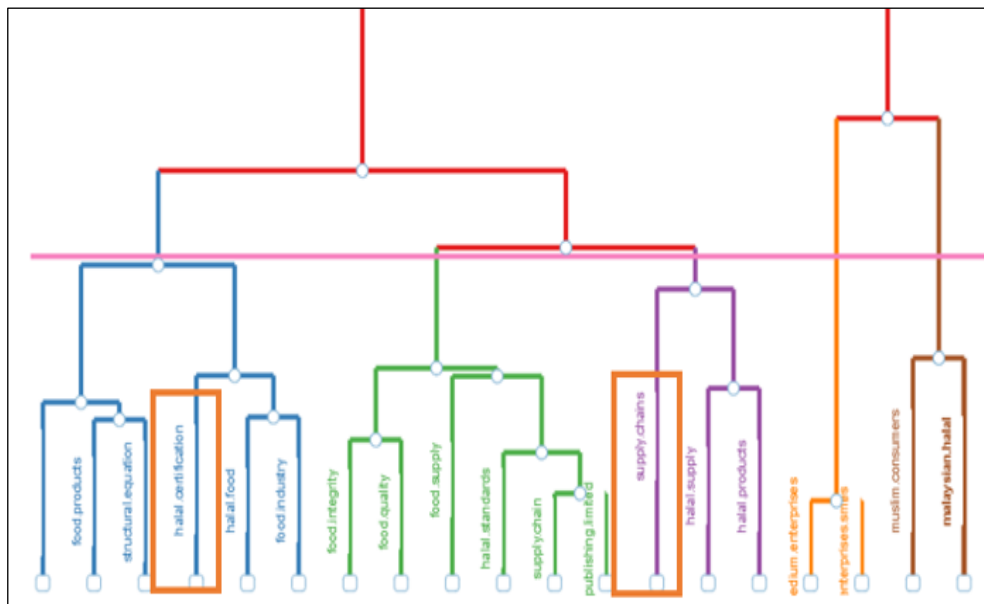


Figure 7: Dendrogram for 76 SLR Papers.
Source: Author, (2026).

The Bibliometric process is conducted to determine the papers to be analyzed in the synthesis process of the SLR, which will help establish the PICOS criteria, research questions, research objectives, state of the art, and the novelty of the research. The selection process for determining which papers to include in the synthesis uses PageRank values and citation counts across the five clusters. Based on the identification of 76 papers, the number of articles to be synthesized was determined using PageRank and citation metrics. PageRank and citation counts are quantitative approaches within the SLR methodology for identifying and prioritizing core articles.

IV.3.2 Synthesis of Quantitative Paper

A quantitative prioritisation procedure was first implemented to characterise the relative prominence of each publication within the dataset. This procedure enabled the identification of highly central contributions that serve as pivotal references for the subsequent stages of the analysis. Based on screening the 76 papers, the highest PageRank value was 1.256, with 20 citations, corresponding to the topic Halal Practices Integrity and Halal Supply Chain. Using these PageRank and citation values, the following steps were to determine the optimal values, assess uncertainty, calculate the compromise index, and establish rankings based on the compromise values. The resulting rankings will be used to determine the cutoff for core papers. The PageRank values for the 76 are shown in Figure 8.

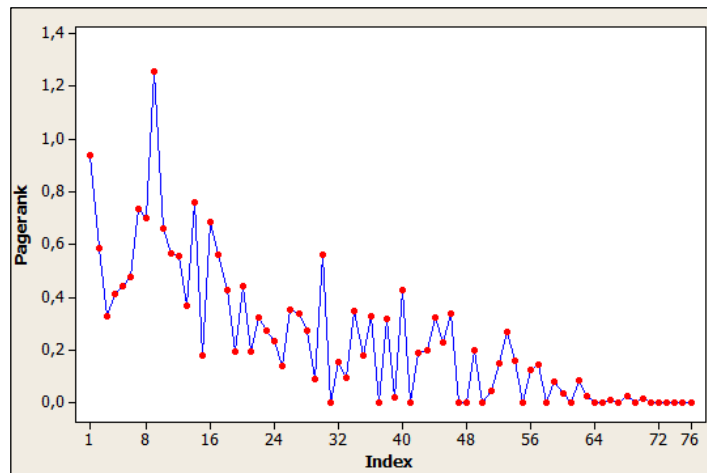


Figure 8: PageRank Scores of Selected Articles by Paper Code.
Source: Author, (2026).

A bibliometric investigation of the curated literature set was undertaken to elucidate the intellectual architecture of the domain. This analytical procedure facilitated a rigorous quantitative estimation of the relative impact and scholarly prominence of each contribution within the dataset. Based on the analysis conducted in R-Studio using the 76 selected papers, the citation counts for each paper were integrated with their PageRank values to identify the core papers, which will serve as the foundation for determining the PICOS framework. The bibliometric analysis of these 76 papers reveals the citation counts for each, as illustrated in Figure 9.

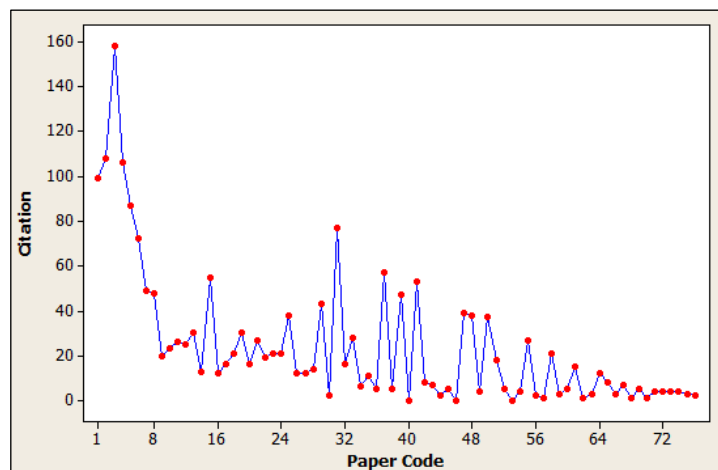


Figure 9: Citation Distribution per Article.
Source: Author, (2026).

A multi criteria decision making procedure was subsequently employed to refine the set of influential studies for the review. Within this procedure, the VIKOR framework was combined with a probabilistic weighting scheme to derive a balanced evaluation of each paper. The determination of weights (w) in the VIKOR method uses the Laplace principle, which assigns equal prior probability $1/n$ to each possible state of nature, thereby assessing alternatives based on the average payoff calculated under this uniform distribution [31]. In this analysis, using the Laplace method with two variables, PageRank and citation counts, the weight for each paper was established at 0.5. The results of the VIKOR analysis, when integrated with the Elbow method, identified 50 papers from the initial set of 76 selected papers, as detailed in Table 2.

Table 2: Final Index Paper Calculations (ΔQ) Based on Article Ranking using VIKOR Analysis.

Paper	Authors	Pagerank	Citation	Norm-Pagerank	Norm-Citation	Weight-Pagerank	Weight-Citation	Total Weight (Si)	R-max (Ri)	CI-Si	CI-Ri	Rank (Q)	$\Delta Q = 2$	$\Delta Q = 3$
1	[4]	0.94	99.00	0.25	0.37	0.13	0.19	0.31	0.19	0.00	0.00	0.00	0.00	0.00
2	[32]	0.58	108.00	0.54	0.32	0.27	0.16	0.43	0.27	0.08	0.13	0.21	0.21	0.00
3	[33]	0.33	158.00	0.74	0.00	0.37	0.00	0.37	0.37	0.04	0.29	0.33	0.12	0.33
4	[34]	0.41	106.00	0.67	0.33	0.34	0.16	0.50	0.34	0.14	0.24	0.38	0.04	0.16
5	[35]	0.44	87.00	0.65	0.45	0.32	0.22	0.55	0.32	0.17	0.22	0.39	0.02	0.06
6	[36]	0.47	72.00	0.62	0.54	0.31	0.27	0.58	0.31	0.20	0.20	0.40	0.01	0.02
7	[37]	0.73	49.00	0.42	0.69	0.21	0.34	0.55	0.34	0.18	0.25	0.43	0.03	0.04

8	[38]	0.70	48.00	0.44	0.70	0.22	0.35	0.57	0.35	0.19	0.26	0.45	0.02	0.05
9	[39]	1.26	20.00	0.00	0.87	0.00	0.44	0.44	0.44	0.09	0.40	0.49	0.04	0.06
10	[40]	0.66	23.00	0.48	0.85	0.24	0.43	0.67	0.43	0.26	0.38	0.64	0.15	0.20
11	[41]	0.56	26.00	0.55	0.84	0.28	0.42	0.69	0.42	0.28	0.37	0.65	0.01	0.16
12	[42]	0.56	25.00	0.56	0.84	0.28	0.42	0.70	0.42	0.28	0.37	0.66	0.01	0.02
13	[43]	0.37	30.00	0.71	0.81	0.35	0.41	0.76	0.41	0.33	0.35	0.68	0.02	0.03
14	[44]	0.76	13.00	0.39	0.92	0.20	0.46	0.66	0.46	0.25	0.43	0.69	0.01	0.03
15	[45]	0.18	55.00	0.86	0.65	0.43	0.33	0.76	0.43	0.33	0.39	0.71	0.03	0.04
16	[46]	0.69	12.00	0.45	0.92	0.23	0.46	0.69	0.46	0.28	0.44	0.72	0.00	0.03
17	[47]	0.56	16.00	0.55	0.90	0.28	0.45	0.73	0.45	0.30	0.42	0.72	0.01	0.01
18	[48]	0.43	21.00	0.66	0.87	0.33	0.43	0.76	0.43	0.33	0.39	0.73	0.00	0.01
19	[49]	0.19	30.00	0.85	0.81	0.42	0.41	0.83	0.42	0.38	0.38	0.76	0.03	0.03
20	[50]	0.44	16.00	0.65	0.90	0.32	0.45	0.77	0.45	0.34	0.42	0.76	0.00	0.03
21	[51]	0.19	27.00	0.85	0.83	0.42	0.41	0.84	0.42	0.39	0.38	0.76	0.01	0.01
22	[52]	0.32	19.00	0.74	0.88	0.37	0.44	0.81	0.44	0.37	0.40	0.77	0.01	0.01
23	[53]	0.27	21.00	0.78	0.87	0.39	0.43	0.83	0.43	0.38	0.39	0.77	0.00	0.01
24	[54]	0.23	21.00	0.82	0.87	0.41	0.43	0.84	0.43	0.39	0.39	0.78	0.01	0.01
25	[55]	0.14	38.00	0.89	0.76	0.45	0.38	0.83	0.45	0.38	0.41	0.79	0.01	0.02
26	[56]	0.35	12.00	0.72	0.92	0.36	0.46	0.82	0.46	0.37	0.44	0.81	0.02	0.03
27	[57]	0.34	12.00	0.73	0.92	0.37	0.46	0.83	0.46	0.38	0.44	0.82	0.00	0.03
28	[58]	0.27	14.00	0.78	0.91	0.39	0.46	0.85	0.46	0.39	0.43	0.82	0.00	0.01
29	[59]	0.09	43.00	0.93	0.73	0.46	0.36	0.83	0.46	0.38	0.44	0.82	0.00	0.00
30	[60]	0.56	2.00	0.55	0.99	0.28	0.49	0.77	0.49	0.34	0.49	0.83	0.00	0.00
31	[61]	0.00	77.00	1.00	0.51	0.50	0.26	0.76	0.50	0.33	0.50	0.83	0.00	0.00
32	[62]	0.15	16.00	0.88	0.90	0.44	0.45	0.89	0.45	0.42	0.42	0.84	0.02	0.02
33	[63]	0.09	28.00	0.93	0.82	0.46	0.41	0.87	0.46	0.41	0.44	0.85	0.01	0.03
34	[64]	0.35	6.00	0.73	0.96	0.36	0.48	0.84	0.48	0.39	0.47	0.86	0.01	0.02
35	[65]	0.18	11.00	0.86	0.93	0.43	0.47	0.89	0.47	0.43	0.44	0.87	0.01	0.02
36	[66]	0.33	5.00	0.74	0.97	0.37	0.48	0.85	0.48	0.40	0.47	0.87	0.00	0.01
37	[67]	0.00	57.00	1.00	0.64	0.50	0.32	0.82	0.50	0.37	0.50	0.87	0.00	0.00
38	[68]	0.32	5.00	0.75	0.97	0.37	0.48	0.86	0.48	0.40	0.47	0.87	0.00	0.00
39	[69]	0.02	47.00	0.98	0.70	0.49	0.35	0.84	0.49	0.39	0.49	0.88	0.00	0.01
40	[70]	0.43	0.00	0.66	1.00	0.33	0.50	0.83	0.50	0.38	0.50	0.88	0.00	0.01
41	[71]	0.00	53.00	1.00	0.66	0.50	0.33	0.83	0.50	0.38	0.50	0.88	0.00	0.00
42	[72]	0.19	8.00	0.85	0.95	0.43	0.47	0.90	0.47	0.43	0.46	0.89	0.01	0.01
43	[73]	0.20	7.00	0.84	0.96	0.42	0.48	0.90	0.48	0.43	0.46	0.90	0.00	0.01
44	[74]	0.32	2.00	0.75	0.99	0.37	0.49	0.87	0.49	0.41	0.49	0.90	0.00	0.01
45	[75]	0.23	5.00	0.82	0.97	0.41	0.48	0.89	0.48	0.43	0.47	0.90	0.00	0.01
46	[76]	0.34	0.00	0.73	1.00	0.37	0.50	0.87	0.50	0.41	0.50	0.91	0.01	0.01
47	[77]	0.00	39.00	1.00	0.75	0.50	0.38	0.88	0.50	0.41	0.50	0.91	0.01	0.01

Source: Authors, (2026).

A ranking of the papers was first obtained using the VIKOR method, and the resulting cluster separation was examined with the elbow approach for K=3 t. The ranking values capture the integrated influence of PageRank and citation metrics, reflecting how closely the 76 selected papers align with the SLR topic. At the same time, the elbow method is then used to delineate the core papers that underpin the PICOS specification and state-of-the-art synthesis, with the VIKOR-based clustering of the top 20 out of 76 papers illustrated in Figure 10.

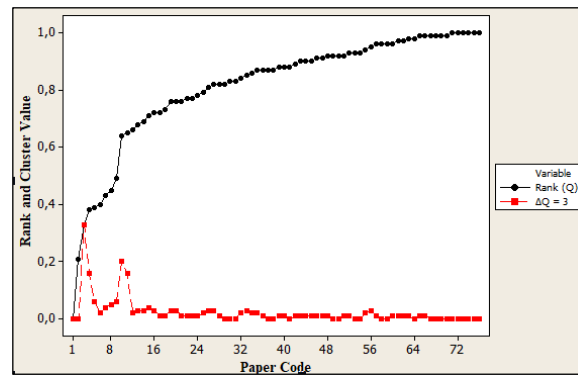
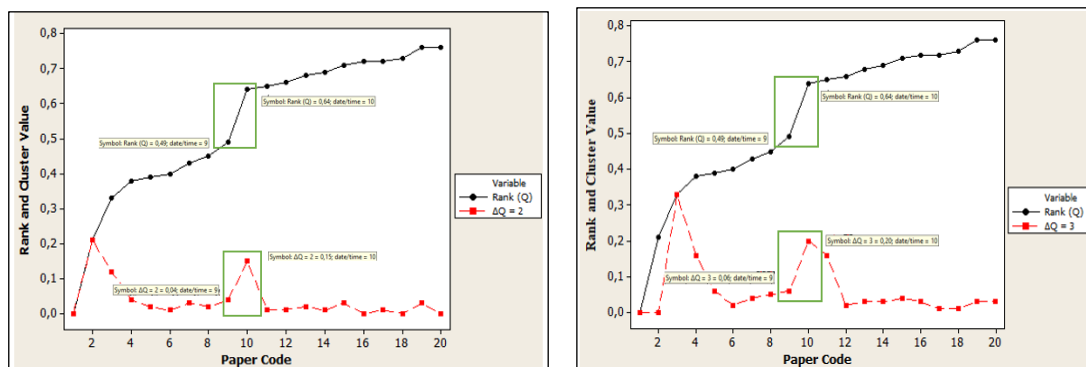


Figure 10: Rank and Citation papers.
Source: Author, (2026).

The elbow method provides a visual procedure for identifying the optimal number of clusters (k) by locating the elbow point on the curve that balances the number of clusters and the corresponding clustering error or compactness [27]. The distribution of the VIKOR based ranking paper and the corresponding cutoff between core and non-core papers is presented in Figure 11.



(a) ΔQ with $k = 2$ (b) ΔQ with $k = 3$
Figure 11: Elbow Curve of Differences Between Rank (ΔQ) Across Papers.
Source: Author, (2026).

The curve displays the successive differences between VIKOR index values Q (ΔQ) with $k = 2$ and $k = 3$ for each paper, ordered from the smallest to the largest Q , thereby revealing relatively flat segments and several sharp jumps. The first and largest elbow, between paper 1 and paper 2, is treated as the main elbow that defines a relatively homogeneous core set in $k = 2$ and $k = 3$. Papers 2 to 9 form a secondary elbow, and papers 10 to 76 are considered non-core and excluded from the cutoff because they lie beyond the elbow zone on the $k = 2$ and $k = 3$ curve and do not require an additional number of papers to be analyzed. The selected papers, ranging from Paper 1 to Paper 9, are listed in Table 3.

Table 3: Synthesis analysis of papers that address the identified research.

No	Authors	Research Objective	Result
1	[4]	The purpose is to detect and rank risks of the halal food supply chain so that these can serve as the foundation for determining critical halal control points to be supervised within a unified halal certification	The paper addresses the identified research gap by providing detailed information on the priority of risks of the halal supply chain, which can be directly mapped to halal certification control points.
2	[32]	Mapping the literature review and the broader halal food research agenda, namely marketing, regulation, and consumer aspects,	The paper is not aligned with the identified research gap because it only presents a general SLR and cannot support of a halal certification.
3	[33]	The blockchain technology to enhance the traceability of halal information in product flows, particularly for tracking certification and halal status.	The paper is not aligned with the identified research gap because it focuses on technological traceability solutions rather than on the process integration structure and inter-actor relationships within an institution's halal supply chain.
4	[34]	Developing integrity of halal supply chain framework that links potential halal violation points with the roles of certification bodies.	The paper is not aligned with the identified research gap because it is conceptually essential but lacks empirical evidence; it is used as a framework reference rather than as a core paper for the integration model.
5	[35]	The effect of integration with suppliers and partners on halal supply chain, which is related to the consistency of certification standard	The paper is not aligned with the identified research gap because it examines only external integration for a single supplier actor, thereby not representing end-to-end performance across the entire supply chain.

No	Authors	Research Objective	Result
6	[36]	Reviewing and mapping research on food safety and halal in the supply chain, including certification and risk control issues, but without developing a model that integrates halal certification with the supply chain.	The paper is not aligned with the identified research gap because it is a Systematic Literature Review that maps bibliometric analysis of halal food safety themes but does not present a model for integrating certification into the supply chain.
7	[37]	Identifying halal ecosystem challenges from the perspective of institutional regulation that influence the implementation of halal certification	The paper is not aligned with the identified research gap because it operates at the macro-ecosystem level and policy rather than addressing operational integration for supply management.
8	[38]	Supply chain integration with suppliers and customers can enhance halal supply chain integrity and product quality, thereby underscoring the role of process integration in the halal certification model.	The paper aligns with the identified research gap because the empirical findings show that internal integration from suppliers to end customers provides variables and managerial levers to improve halal across the supply chain.
9	[78]	Evaluating the extent to which halal practice integrity, consistent with certification requirements across all supply chain actors, improves supply chain performance	The paper is aligned with the identified research gap because the resulting model can be integrated with halal practices, namely certification across all supply chain actors.

Source: Authors, (2026).

Screening the nine selected articles against the identified research gap yielded three core papers from which the PICOS framework, Research Objectives (RO), and the state of the art were derived. This research novelty as shown in Table 4.

Table 4: Key Characteristics of Selected Empirical Studies on Halal Food Supply Chain.

Author	Context	Focus Analysis	Main Findings	Study Design
[38]	An examination of various factors influencing halal food certification from upstream to downstream in	Analyzing variable relationships in the halal assurance framework using SEM-PLS within a Resource-Based View (RBV) perspective	Designing a halal food supply chain performance model that integrates integrity with product safety and quality	Explanatory quantitative with a cross-sectional survey design.
[4]	Practitioners, experts, and academics who understand the halal food supply chain	Risk identification and ranking in the Halal Food Supply Chain using MCDM with Fuzzy AHP weighting	Priority ranking for supply chain risk mitigation focuses on holistic, outsourced management of raw material delays.	Explanatory quantitative based on expert judgment.
[78]	Small and medium enterprises (suppliers and producers) in the food supply chain in Malaysia	Level of implementation of halal practices and integrity throughout the halal food supply chain using SEM-PLS.	Integrity in halal food supply chains through standard compliance, control mechanisms, and effective coordination among actors for sustaining a viable halal supply chain model.	Explanatory quantitative with a cross-sectional survey design.

Source: Authors, (2026).

The columns for Context, Focus of Analysis, and Main Findings are organized as an initial step to extract conceptual elements, which will later be systematically mapped within the PICOS framework. Information regarding who and where the studies were conducted in the Context column will inform the Population component. The focus of analysis and key variables in the Focus of Analysis column will be processed into relevant Interventions and Comparators, while the summary of the main. The PICOS are shown in Table 5.

Table 5: PICOS Result Analysis.

Component	Description
Population (P)	"The agro-industry chain involved cassava farmers as upstream suppliers, SMEs producing coarse and fine tapioca and mocaf as intermediate business users, and cookie-producing SMEs as downstream processors"
Intervention (I)	"The Soft System Dynamic Methodology (SSDM) approach builds on SCOR DS modelling, MCDM, FMEA, and validated dynamic system simulations to design and assess the performance of the halal supply chain model"
Comparison (C)	"The comparative risk-oriented supply chain modelapplies SEM-PLS, while risk prioritisation in the halal food supply chain is conducted using a Fuzzy AHP technique "
Outcomes (O)	"The integrated halal supply chain and value chain model for the tapioca and mocaf agro-industry, along with its institutional model, has been validated by experts and tested for dynamic feasibility using conceptual validation and computerized methods"
Study Design (S)	"System Development and Modeling Study using a quantitative explanatory approach based on decision-making"

Source: Authors, (2026).

Based on the PICOS results, the next step is to formulate the research questions that will serve as the foundation for determining the Research Objectives (RO) and for establishing the state of the art and the research's novelty. The Research Objective derived from the PICOS framework is as follows:

RO 1: Analysis the situational structure of the tapioca and mocaf agro-industry supply chain as a basis for development of halal supply and value chains.

- RO 2:** Identify and prioritize improvements to performance inefficiencies among each actor in the tapioca and mocaf agro-industrial supply chain.
- RO 3:** Analysis the management of halal practices for tapioca and mocaf using value-added and halal risk analyses to enhance halal production.
- RO 4:** Develop a system dynamics model for the halal supply chain for tapioca and mocaf, including scenarios for supply development and halal certification
- RO 5:** Develop a model for the structure and dynamics of the halal supply chain for tapioca and mocaf, including scenarios for supply development and halal certification through simulations and operational feasibility validation. This determination aims to assess the research position that can fill the gap left by previous studies, specifically regarding the integration of halal certification, as shown in Table 6.

Table 6: State of The Art Research Position.

Author	Paper Title	Research result
[78]	“Halal practices integrity and halal supply chain trust in the halal food supply chain”	Halal practices integrity significantly affects halal supply chain trust and performance, as assessed through Cross-Sectional studies and SEM-PLS.
[4]	“Prioritising the risks in the halal food supply chain: an MCDM approach”	An integration of expert judgment and MCDM Fuzzy AHP was used to identify the risks of Halal Food Supply Chain (HFSC) and the raw material integrity model
[38]	“Impact of supply chain integration on halal food supply chain integrity and food quality performance”	A quantitative examination of the relationship in the halal food supply chain was conducted using food quality performance data via SEM-PLS.
Research Position	Integration of the supply chain and halal value chain models to identify and measure supply chain performance and halal value addition, based on decision-making validated through soft system simulation and computerized methods	

Source: Authors, (2026).

This SLR reveals a critical gap in existing studies, which have separately examined halal practices integrity, risk prioritization, and supply chain integration using static methods such as SEM-PLS and MCDM. The present research positions itself by proposing an integrated halal supply and value chain model that employs the Soft Systems Dynamic Methodology (SSDM) and simulation to measure supply chain performance and halal value added dynamically.

IV.4 FUTURE RESEARCH AGENDA

The novelty of the research in developing halal supply chain and value chain models for the tapioca and mocaf agro-industry, it is necessary to develop simulations to validate the success of the halal supply chain development model. The future system design research can be seen in Figure 12.

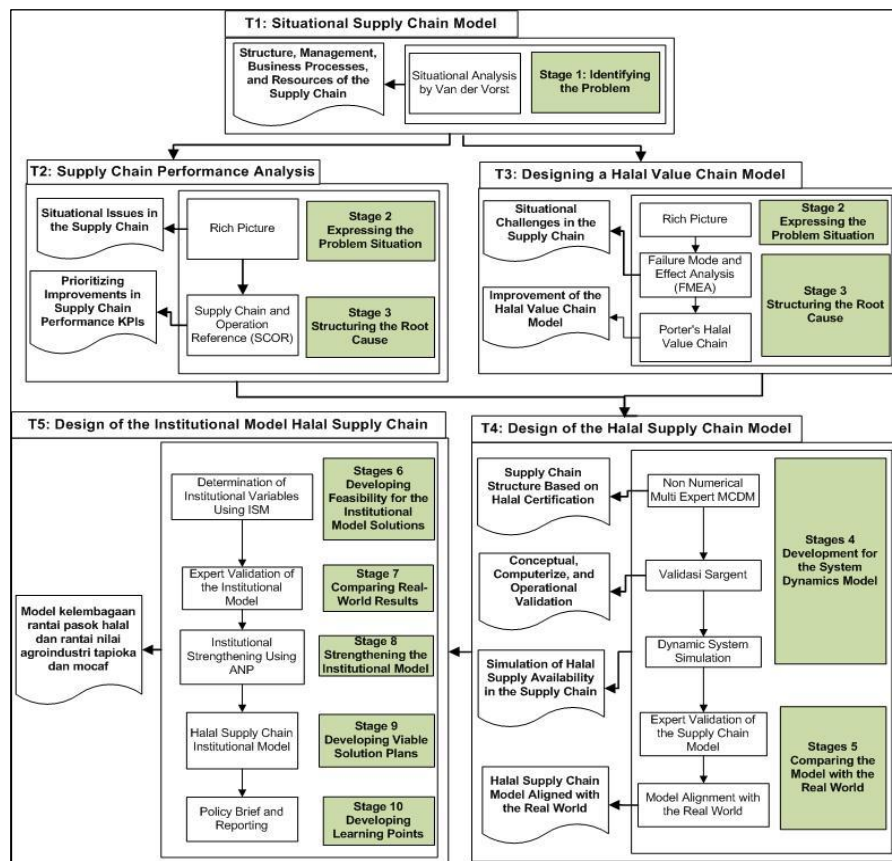


Figure 12: Future system design research with SSDM framework.

Source: Authors, (2026).

V. CONCLUSIONS

Bibliometric analysis revealed that halal certification has not been implemented simultaneously in the development of the supply chains for tapioca and mocaf. The development of the halal supply chain and value chain model based on the Soft System Dynamic Methodology can be conducted using a decision-making framework and integrated institutional systems to manage halal certified supplies. This integration involves a performance-based approach to supply chain management and a competitive advantage based on halal certification through model development for tapioca and mocaf, to address complex issues, validated and verified through both conceptual testing. Future research should focus on tracing, transparency, and tracking to ensure compliance with halal implementation using blockchain.

VI. AUTHOR'S CONTRIBUTION

Conceptualization: Marimin, Sesar Husen Santosa, Titi Candra Sunarti, Jono Mintarto Munandar
Methodology: Sesar Husen Santosa, Marimin, Titi Candra Sunarti, Jono Mintarto Munandar
Investigation: Sesar Husen Santosa, Marimin, Titi Candra Sunarti, Jono Mintarto Munandar
Discussion of results: Sesar Husen Santosa, Marimin, Titi Candra Sunarti, Jono Mintarto Munandar
Writing – Original Draft: Sesar Husen Santosa, Marimin, Titi Candra Sunarti, Jono Mintarto Munandar
Writing – Review and Editing: Sesar Husen Santosa, Marimin, Titi Candra Sunarti, Jono Mintarto Munandar
Resources: Sesar Husen Santosa, Marimin, Titi Candra Sunarti, Jono Mintarto Munandar
Supervision: Marimin, Titi Candra Sunarti, Jono Mintarto Munandar
Approval of the final text: Marimin, Titi Candra Sunarti, Jono Mintarto Munandar, Sesar Husen Santosa

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