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Halal food control systems: A bibliometric review of the global knowledge structure and research gaps, with critical reflections for the Gulf Region

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Received: 15/5/2026

Accepted: 10/7/2026

Published: 31/7/2026

Keywords:

Bibliometric analysis;
Halal food control;
Food safety;
Emerging economies;
Saudi Arabia; Gulf region

Abstract

This study presents a bibliometric and critical review of global research on halal food control systems, with particular attention to countries developing new halal regulatory frameworks, including Saudi Arabia and the wider Arab region. A systematic review of Scopus-indexed publications from 2010 to 2025 was conducted following PRISMA guidelines. The final global corpus comprised 847 peer-reviewed articles analysed using VOSviewer and Biblioshiny through co-authorship, co-citation, bibliographic coupling, keyword co-occurrence, and thematic evolution analyses. An additional subset of 82 Arab-region studies, covering Gulf Cooperation Council and wider Arab League states, was manually coded using the FAO/WHO five-component national food control system framework. The field grew at an annual rate of 18.3%, with Malaysia and Indonesia contributing 43% and 28% of publications, respectively. Five major research clusters were identified: *fatwa*-based legislation; multi-agency governance; inspection, enforcement, and laboratory systems; information, education, communication, and training; and emerging technologies, including blockchain and artificial intelligence. Despite rapid growth, the literature remains geographically concentrated, theoretically underdeveloped, methodologically homogeneous, and largely silent on the cost-benefit implications of halal control systems. Few studies integrate *Maqasid al-Shari'ah* with risk-management approaches or examine halal governance as a complete regulatory system. By applying the FAO/WHO framework, this review moves beyond isolated certification and supply-chain perspectives. It demonstrates that Arab-region halal governance exhibits a distinctive "law-rich but evidence-poor" profile and proposes a research agenda addressing institutional performance, empirical evidence, regulatory effectiveness, and economic trade-offs.

1. Introduction

The global halal food industry has evolved from a niche religious market into a major segment of the global bioeconomy. With an estimated annual value of USD 2.1 trillion and serving nearly 1.9 billion Muslim consumers, the sector is expected to reach USD 2.8 trillion by 2025 (Rejeb *et al.*, 2023). This expansion is primarily driven by demographic shifts and a growing "halal consciousness" among consumers, who increasingly associate halal certification with higher standards of safety, hygiene, and ethics (Osman & Saeed, 2023). However, the industry's rapid growth has outpaced the establishment of robust regulatory frameworks, leading to notable integrity breaches, including porcine DNA contamination in Malaysia and fraudulent certification networks in Europe and the Middle East (Ahmad *et al.*, 2018; Al-Mahmood & Fraser, 2023). These events underscore a fundamental paradox: while the market demands comprehensive "farm-to-fork" integrity, the mechanisms designed to ensure this integrity remain fragmented, reactive, and technologically outdated.

A Halal Food Control System (HFCS) constitutes a complex socio-technical framework. In contrast to conventional food safety regimes, an HFCS must achieve two primary objectives: ensuring technical safety, including hygiene, toxicology, and quality, and upholding religious ontological security, such as *Shari'ah* compliance, halal slaughter, and *najis* evasion (Kohilavani *et al.*, 2013, 2021; López Cifuentes & Sonnino, 2024). Meeting these objectives requires combining food science with Islamic jurisprudence (*fiqh*), a process often marked by interpretive challenges. The benchmark model, developed by Malaysia through JAKIM and the Trade Descriptions Act 2011, provides a template for institutionalizing halal control (Ahmad *et al.*, 2018). Nevertheless, even advanced systems have experienced incidents, such as the "Cadbury incident" and subsequent coordination failures, which highlight the persistent challenges of managing a multi-agency environment wherein religious authority and scientific evidence must be reconciled (Alrobaish *et al.*, 2021; X. Jia & Zhang, 2021).

This review systematically analyses halal food control systems using the FAO/WHO National Food Control System

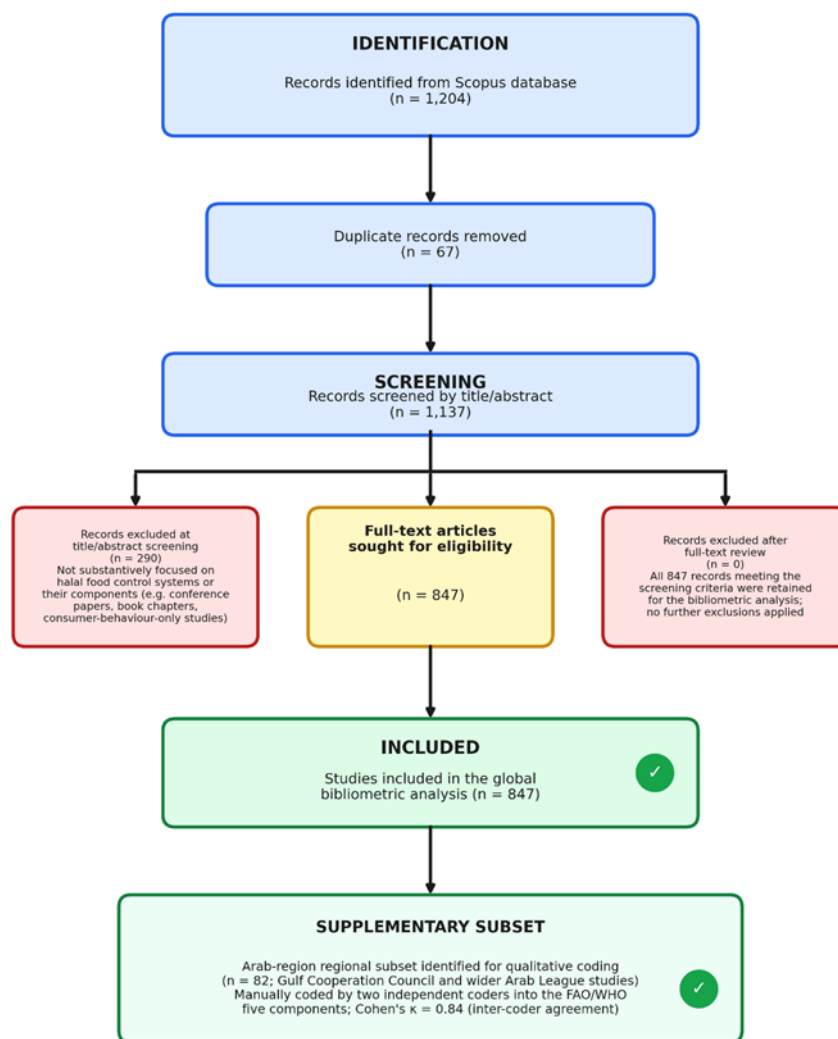


Figure 1: PRISMA Flowchart: Halal Food Control Systems (2010-2025). Note: the $n = 847$ corpus underwent quantitative bibliometric analysis in full; the $n = 82$ Arab-region subset is a manually coded sub-sample of this corpus used for the supplementary qualitative analysis reported in Section 3.6. It is not a separate or competing inclusion total.

Framework, which identifies five essential pillars: (a) Legislation and Regulations, (b) Management and Coordination, (c) Inspection Services, (d) Laboratory and Forensic Capabilities, and (e) Information, Education, and Communication (IEC) (Hopper & Boutrif, 2006). Despite significant growth in the literature, with over 800 articles published in the past 15 years, research remains fragmented. Most studies focus on buyer behaviour (Osman & Saeed, 2023), specific certification challenges (Al-Mahmood & Fraser, 2023; Fauzi et al., 2024), or isolated supply chain technologies (Changalima, 2025). There is a notable absence of comprehensive syntheses that evaluate the interactions among these five pillars in building strong national infrastructures, particularly in emerging economies.

The field is also experiencing a "digital turn." The introduction of Industry 4.0 technologies, such as blockchain-enabled traceability, AI-driven authentication, and IoT-based instant monitoring, offers potential to reduce human error and fraud (Helmi Ali et al., 2021; Nawaz et al., 2025). However, adoption in emerging markets is constrained by cost barriers, limited SME readiness, and the absence of harmonised global

standards (Bayatzadeh & Talaie, 2025; Jose & Venkatesan, 2023). Accordingly, this bibliometric review serves two purposes: mapping the field's evolutionary trajectory and critically reflecting on the structural imbalances that shape it.

This review addresses four research questions:

1. How has the intellectual structure of halal food control research evolved, and what are the dominant thematic clusters?
2. To what extent does current research address the five FAO/WHO pillars of a national food control system?
3. What are the geographical, theoretical, and methodological "blind spots," particularly regarding the marginalization of Sub-Saharan African and Latin American perspectives?
4. How can emerging economies, such as Saudi Arabia under Vision 2030, leverage this data to develop a globally competitive and religiously robust halal ecosystem?

Table 1: Growth phases of halal food control systems research (2010–2025)

Phase	Years	Avg. Articles/Year	Characteristics
Formative	2010–2014	12	Descriptive, Malaysia-focused
Take-off	2015–2019	38	Triggered by the Cadbury and horsemeat scandals
Acceleration	2020–2025	112	COVID-19, blockchain, AI, supply chain

In contrast to traditional bibliometric studies that primarily present descriptive statistics, this paper adopts a critical-analytical approach. It examines the "Southeast Asian hegemony" in halal discourse, challenges the "regulation-as-panacea" narrative, and explores the contradictions between centralised state control and decentralised market-driven certification (Alrobaish et al., 2021; Suryawan et al., 2022). By synthesizing evidence from over two decades of scholarship, this review provides a theoretical and functional framework for advancing halal food control systems in a globalised, digital era.

In differentiating this review from prior bibliometric treatments of halal research (e.g., Mostafa, 2020; Rejeb *et al.*, 2023; Fauzi *et al.*, 2024), which have generally mapped the field around certification, supply-chain, or consumer-behaviour themes, this review is organised explicitly around the FAO/WHO five-pillar national food control system framework (Hopper & Boutrif, 2006) as its analytical lens, rather than as a post-hoc descriptive label applied to emergent clusters. This framework was selected because it is the most widely endorsed international reference model for evaluating the institutional completeness of national food control systems, providing a normative benchmark against which the maturity of halal-specific governance arrangements can be assessed. A further question that recurs throughout this review, and to which we return in the Discussion and Conclusion, concerns whether artificial-intelligence-assisted certification decisions can satisfy the jurisprudential requirement of human deliberative reasoning (*ijtihad*); this tension between automated verification and Islamic legal epistemology is flagged here as a question requiring sustained, interdisciplinary attention.

2. Methodology

2.1 Research design

A bibliometric review was conducted following the PRISMA protocol as illustrated in Figure 1.

To ensure clarity and methodological transparency, this review differentiates between two overlapping but distinct geographic-political categories: the Gulf Cooperation Council (GCC), which consists of six member states (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates), and the broader Arab League, which includes twenty-two member states across the Middle East and North Africa. When the literature search and manual coding (Section 2.2) identified studies relevant to either category, the resulting $n = 82$ subset is referred to as the 'Arab-region subset' to avoid suggesting that the two terms are interchangeable. Findings specific to GCC states are explicitly noted.

2.1.1 Data source and search strategy

The Scopus database was selected for its comprehensive coverage of food science, management, and Islamic marketing journals. The search was executed on 15 April 2026, covering publications from 2010 to 2025. The following search string was applied to the title, abstract, and keyword fields:

TITLE-ABS-KEY("halal food" OR "halal certification" OR "halal assurance")

Filters applied via the Scopus interface restricted results to peer-reviewed journal articles published in English or Arabic between 2010 and 2025, excluding conference papers, book chapters, and non-journal sources. The inclusion criteria further required an explicit focus on halal food control systems or their components. Initial yield was 1,204 documents.

The inclusion criteria included peer-reviewed articles with an explicit focus on halal food control systems or their components (legislation, management, inspection, laboratory, IECT). Exclusion criteria included conference proceedings, book chapters, non-halal-related studies, and purely consumer behaviour articles without system linkage—initial yield: 1,204 documents. After removing duplicates ($n = 67$) and exclusions ($n = 290$), 847 articles were retained for analysis.

2.2 Analysis tools

Two complementary software packages were employed for bibliometric analysis: VOSviewer 1.6.20 for bibliographic coupling, keyword co-occurrence, and cluster identification. (Van Eck & Waltman, 2010) and Biblioshiny (R package): for annual production, source impact, trending topics, and international collaboration (Aria & Cuccurullo, 2017).

A qualitative analysis of the Arab-region subset ($n = 82$) was also conducted. Articles were manually coded into the five FAO components (plus *fatwa* as a distinct legislative element). Cohen's Kappa for inter-coder agreement was 0.84 (excellent) (Landis & Koch, 1977). Drivers, challenges, and recommendations were extracted thematically.

Manual coding was conducted independently by two coders (Elgharbawy and Al-Saab), with disagreements resolved through discussion; Cohen's Kappa ($\kappa = 0.84$) was calculated on this dual-coded sample, indicating excellent inter-coder agreement (Landis & Koch, 1977).

3. Results

3.1 Growth trajectory

From 2010 to 2025, the global publication record on halal food control systems expanded considerably, registering an annual growth rate of 18.3% and peaking at 156 articles in 2024.

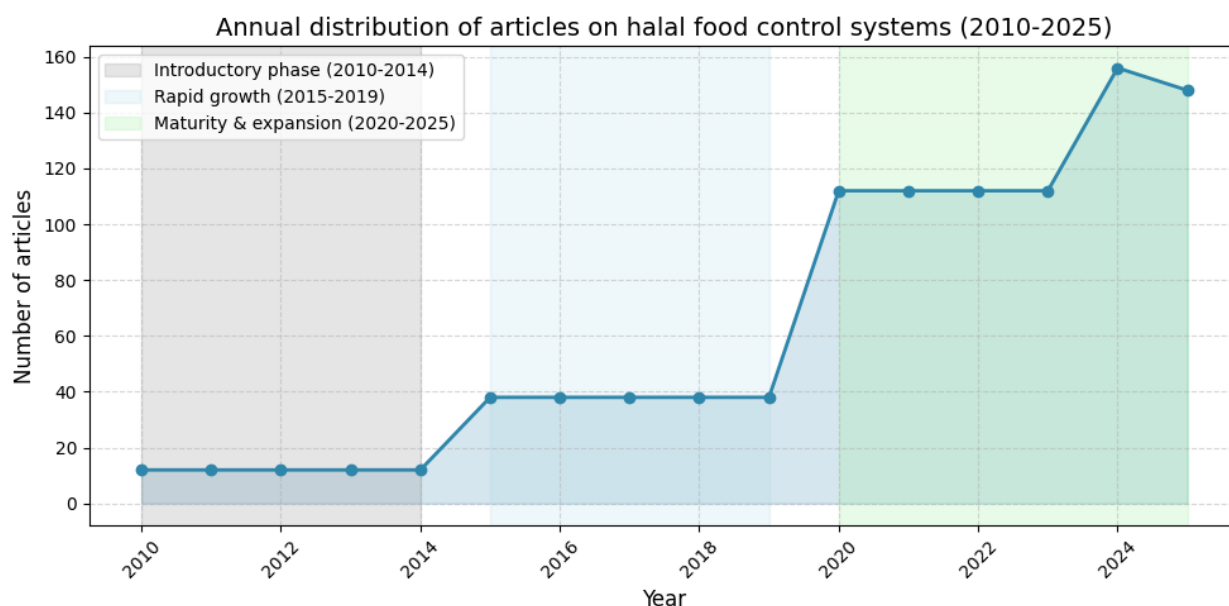


Figure 2: Annual scientific production of halal food control system research (2010–2025).
Source: Authors' analysis from Scopus.

Longitudinal inspection of the corpus reveals three structurally distinct phases of development, summarised in Table 1.

The formative phase (2010–2014) was characterised by a relatively modest annual output of approximately 12 articles, predominantly descriptive in orientation and geographically concentrated in Malaysia. The take-off phase (2015–2019) was precipitated by high-profile fraud events, most notably the detection of porcine DNA in Cadbury products in 2014 (Musa *et al.*, 2016) and the European horsemeat adulteration scandal of 2013 (Brooks *et al.*, 2017), which collectively stimulated research attention and raised the average annual output to 38 articles. The acceleration phase (2020–2025) saw output surge to an average of 112 articles per year, driven by the compounding effects of the COVID-19 pandemic on supply chain vulnerability and a rapidly expanding interest in digital technologies, including blockchain, artificial intelligence, and the Internet of Things (Figure 2).

It is, however, important to critically contextualise this quantitative growth. As Donthu *et al.* (2021) caution, bibliometric expansion does not inherently signify theoretical progress; a substantial proportion of the post-2020 surge comprises applied case studies that replicate similar methods and findings across incrementally different national contexts, suggesting a quantity-quality tension that is characteristic of rapidly internationalizing interdisciplinary fields. (Donthu *et al.*, 2021). Furthermore, an analysis of the emerging technologies cluster reveals that only approximately 4% of blockchain and AI papers present primary empirical data, indicating that conceptual and speculative contributions are currently disproportionately represented, and that technological enthusiasm may be outpacing empirical grounding in this sub-field.

3.2 Most productive countries

The geographical distribution of publications reveals a pronounced concentration in two countries: Malaysia accounts

for 43% of global output and Indonesia for a further 28%, together constituting 71% of the corpus. The United Kingdom (7%), Pakistan (5%), and Iran (2%) occupy a modest secondary tier, whilst the entirety of Arab-majority countries collectively contributes only 9%, with Saudi Arabia individually accounting for 4% of the global total (Table 2; Figure 3).

This concentration constitutes a significant geographical bias with substantive epistemological consequences. The near-exclusive reliance on empirical evidence, methodological norms, and policy recommendations drawn from the Malaysian and Indonesian experiences means that cross-cultural transferability has received virtually no systematic attention in the literature. Foundational questions – such as whether Malaysia's JAKIM-centred audit model would be effective in the context of Egypt's fragmented regulatory landscape or Jordan's smaller market economy – remain empirically unresolved. The Saudi Arabian contribution of 4% is particularly striking given the Kingdom's stated ambition under Vision 2030 to develop into a leading global halal logistics hub, suggesting a critical misalignment between policy aspiration and the knowledge production necessary to inform it.

Table 2: Research output by country

Country	Percentage
Malaysia	43%
Indonesia	28%
United Kingdom	7%
Pakistan	5%
Iran	2%
Saudi Arabia	4%
All Arab countries combined	9%

Table 3: Most productive journals

Journal	N	Focus
Journal of Islamic Marketing	128	Islamic marketing, consumer behaviour
Food Control	94	Food safety, regulation
British Food Journal	71	Food science, policy
Trends in Food Science & Technology	35	Reviews
Journal of Halal Product and Research	18	Specialised halal research

Table 4: Top 12 most productive authors by document output and h-index in the halal food control systems corpus (Scopus, 2010–2025; n = 847)

Rank	Author	Institution	Country	Documents	h-index
1	Zailani, S.	University of Malaya	Malaysia	15	59
2	Tieman, M.	Saito University College	Malaysia	13	13
3	Ali, M.H.	UKM Graduate School of Business	Malaysia	12	40
4	Azmi, F.R.	Universiti Teknologi MARA	Malaysia	10	8
5	Zakaria, Z.	Universiti Malaya	Malaysia	9	9
6	Iranmanesh, M.	Taylor's University Malaysia	Malaysia	9	69
7	Vanany, I.	Institut Teknologi Sepuluh Nopember	Indonesia	8	20
8	Tan, K.H.	University of Nottingham	United Kingdom	8	57
9	Mohamed, Z.	Universiti Putra Malaysia	Malaysia	8	29
10	Jamaludin, M.A.	International Islamic University Malaysia	Malaysia	8	8
11	Rezai, G.	Saint Leo University	United States	7	16
12	Kamarulzaman, N.H.	Universiti Putra Malaysia	Malaysia	7	18

3.3 Most productive countries

The Journal of Islamic Marketing (n = 128) emerges as the single most productive outlet, followed by Food Control (n = 94) and the British Food Journal (n = 71) (Table 3). The prominence of the Journal of Islamic Marketing, however, warrants critical scrutiny: its editorial focus is predominantly on consumer trust, brand perception, and certification demand, rather than on the technical and operational dimensions of halal control, such as laboratory analytical methods, inspection protocols, or enforcement mechanisms. Accordingly, the most frequently cited outlet in this field directs scholarly attention disproportionately towards marketing and behavioural constructs, whilst rigorous studies of enforcement infrastructure and laboratory capacity tend to appear in journals with lower disciplinary reach. This structural publication bias may distort the field's perceived research priorities and systematically discourage investment in studies addressing the operational and technical dimensions of halal control, particularly in contexts in the Arab world where such infrastructure remains at an early stage of development.

3.4 Authors and institutions

The bibliometric analysis reveals that the most productive authors by document output do not necessarily correspond to those with the highest h-index — a pattern consistent with bibliometric theory, in which the h-index captures both volume and sustained citation uptake simultaneously, whilst raw document counts reflect only research activity (Donthu *et al.*, 2021). As presented in Table 4, Zailani (University of Malaya; h-index 59) and Tieman (Saito University College; h-index 13) lead the corpus in document output, whilst Iranmanesh

(Taylor's University Malaysia; h-index 69) and Tan (University of Nottingham; h-index 57) command the highest h-indices relative to their corpus document counts, indicating that their work exerts disproportionate scholarly influence beyond the halal food corpus specifically. Ten of the twelve authors in Table 4 are affiliated with Malaysian institutions, with Vanany (Institut Teknologi Sepuluh Nopember, Indonesia; h-index 20) and Rezai (Saint Leo University, United States; h-index 16) constituting the sole non-Malaysian contributors in the top tier, confirming the strong concentration of high-productivity authorship within Malaysian higher education.



Figure 3: Geographical distribution of research output on halal food control systems. Source: Scopus analysis.
Note: Malaysia + Indonesia = 71%; Arab countries = 9%.

This concentration of authorship within Southeast Asian institutions provides a deep, "insider" contextual perspective but also poses a challenge to the field's global scientific rigor.

Table 5: Research clusters from keyword co-occurrence analysis

Cluster	Theme	Representative Keywords	Approx. Articles
Red	Legislation & <i>fatwa</i>	<i>fatwa</i> , <i>Shari'ah</i> , MS1500, halal standard	210
Green	Governance	JAKIM, coordination, multi-agency	185
Blue	Inspection & laboratories	porcine DNA, PCR, ISO/IEC 17025	170
Yellow	IECT	awareness, training, consumer trust	140
Purple	Emerging technologies	blockchain, IoT, AI, traceability	95

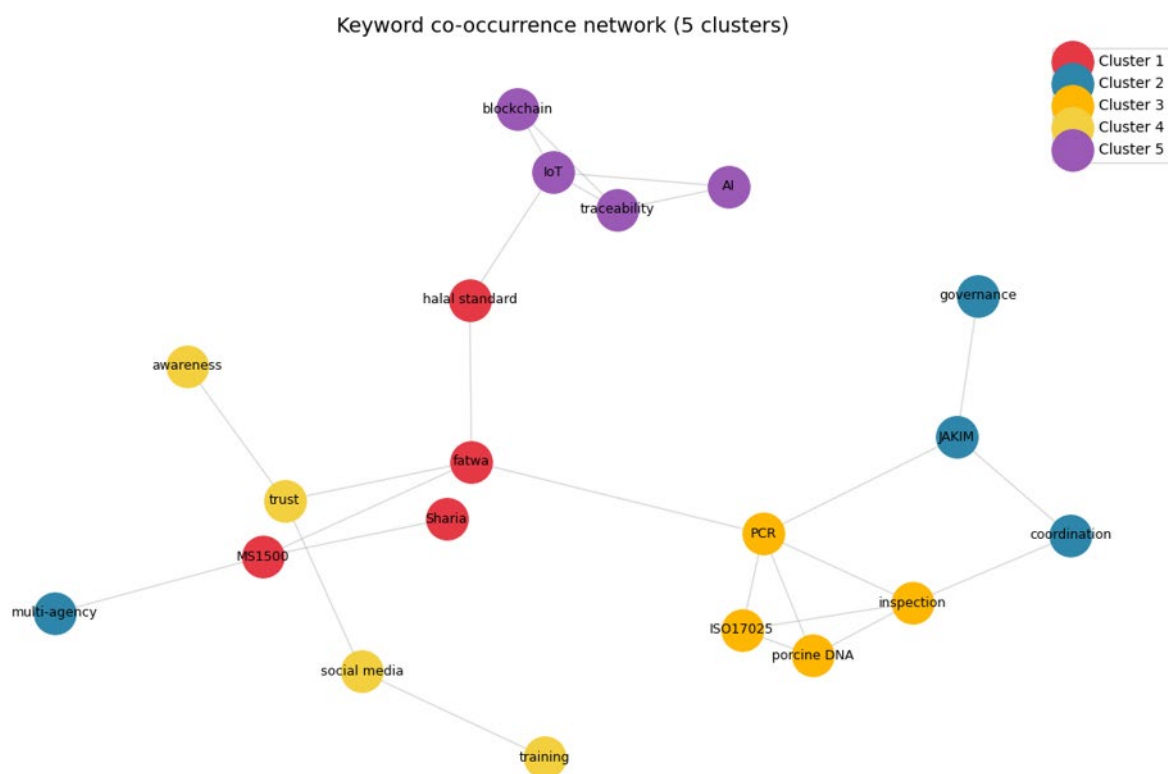


Figure 4: Bibliographic coupling map of keywords (five clusters)—source: VOSviewer analysis.

The dominance of a few key research clusters, particularly those focusing on supply chain integration and regulatory frameworks, indicates that the field's theoretical foundations are being built by a relatively small circle of experts. As Donthu *et al.* (2021) note, high citation counts in an emerging discipline may reflect a scarcity of available frameworks rather than their definitive validation. Consequently, the current literature lacks the independent replication studies necessary for robust knowledge verification. The reliance on a limited number of highly cited frameworks suggests that, while the field has established a strong regional base, it remains provisional, requiring broader external validation and critical scrutiny from the global scientific community to mature.

3.5 Keyword co-occurrence and research clusters

A VOSviewer co-occurrence analysis with a minimum keyword frequency threshold of 5 yielded a network of 124 terms organised into 5 bibliometrically distinct clusters (Table 5; Figure 4).

The five clusters – legislation and *fatwa* (red, ≈210 articles), governance (green, ≈185 articles), inspection and laboratories (blue, ≈170 articles), information, education, communication and training or IECT (yellow, ≈140 articles), and emerging technologies (purple, ≈95 articles), correspond with reasonable fidelity to the five components of a national food control system as articulated by the FAO (2006), providing bibliometric confirmation that the field's intellectual structure broadly reflects policy-relevant categories of analysis.

Notwithstanding this structural correspondence, several inter-cluster deficiencies are noteworthy. Cross-cluster linkages are relatively sparse: few publications examine, for example, how revisions to *fatwa*-based legislation (Cluster 1) propagate into changes to inspection protocols (Cluster 3), or how laboratory analytical capacity shapes consumer trust formation (Clusters 3 and 4). The purple cluster representing emerging technologies is particularly isolated from the remainder of the network, indicating that discourse on blockchain, artificial

Table 6: Distribution of Arab-region studies across the five components (n = 82)

Component	Articles (n)	Percentage (of 82)*
Legislation & <i>fatwa</i>	28	34%
Governance	22	27%
Inspection & enforcement	18	22%
Laboratories	12	15%
IECT (education, awareness, training)	24	29%

*Note: each of the 82 articles could be coded into more than one of the five FAO/WHO components; consequently, the percentages reported above sum to more than 100% and should not be read as mutually exclusive shares of the subset.

intelligence, and IoT-enabled traceability has not yet been substantively integrated with the core halal control literature. Most critically, the analysis reveals the complete absence of a cluster addressing economics, cost-benefit analysis, or resource constraints, a silence that reflects a field predominantly driven by the supply-side priorities of researchers and certification bodies, rather than by the budgetary and implementation realities facing governments.

3.6 Results from Arab-region subset (n = 82)

Manual coding of the 82 articles comprising the Arab-region subset revealed an uneven distribution of scholarly attention across the five FAO components, as detailed in Table 6. Legislation and *fatwa* attracted the greatest proportion of coverage (34%), followed by IECT (29%) and governance (27%), whilst inspection and enforcement (22%) and, most markedly, laboratories (15%) received comparatively limited attention.

Thematic analysis of the subset literature revealed three principal motivating factors underpinning the development of halal control in the region. Government Vision programmes, most notably Saudi Vision 2030, were cited as a key catalyst in 68% of relevant articles, indicating the extent to which state-led development strategies shape halal regulatory ambitions in the Gulf. Rising consumer demand for certified halal products was identified in 72% of articles, making it the most frequently referenced driver overall. Corporate export ambitions were cited in 45% of the subset literature as a third major impetus for regulatory investment.

In contrast to these drivers, the Arab and Gulf literature documents a persistent set of endemic challenges. Weak inter-agency coordination was the most frequently reported implementation infrastructure necessary for effectiveness. The concentration of Arab scholarship on legislation and Islamic Economic and Commercial Transactions (IECT), rather than laboratory science and technical enforcement, risks producing systems that are, in practical terms, “law-rich but evidence-poor.” The frequent reporting of weak inter-agency coordination (81%) further supports the FAO’s (2006) observation that multi-agency governance models are prone to being identified as a structural challenge in 49% of the subset, indicating the fragmented regulatory architectures that characterise much of the Arab world.

These data indicate that Arab halal food control systems exhibit characteristics of the early-stage regulatory systems described by Jia and Jukes (2013), in which legislative structures outpace the implementation infrastructure necessary for effectiveness. The concentration of Arab scholarship on legislation and Islamic Economic and Commercial Transactions (IECT), rather

than laboratory science and technical enforcement, risks producing systems that are, in practical terms, “law-rich but evidence-poor.” The frequent reporting of weak inter-agency coordination (81%) further supports the FAO’s (2006) observation that multi-agency governance models are prone to failure when no single authority holds an overarching regulatory mandate, a structural condition present in most Arab regulatory contexts examined in this corpus (Hopper & Boutrif, 2006).

4. Discussion

The evolution of the global halal food industry from a niche, localised religious market into a significant segment of the global bioeconomy, valued at approximately USD 2.1 trillion and serving nearly 1.9 billion consumers, necessitates a comprehensive re-evaluation of its governance frameworks. Although traditional food safety governance has developed over nearly a century, the Halal Food Control System (HFCS) constitutes a highly complex socio-technical regime. It is required to ensure both technical safety, including toxicology, microbiology, and hygiene, and religious ontological security, such as *Shari’ah* compliance, halal slaughter protocols, and the strict avoidance of *najs* (impurities or contaminants) (Lau *et al.*, 2016). The primary emphasis is on developing new regulatory frameworks in emerging economies and the Arab and Gulf regions.

4.1 Summary of key findings

A bibliometric analysis of 847 articles retrieved from Scopus demonstrates that the field is undergoing rapid and structurally unique evolution. Scientific output increased at a compound annual growth rate of 18.3%, reaching a peak of 156 publications in 2024. This growth follows three development phases: a formative phase (2010–2014) dominated by descriptive, Malaysia-focused administrative studies; a scandal-driven take-off phase (2015–2019) triggered by high-profile fraud events such as the detection of porcine DNA in Cadbury products and the European horsemeat adulteration crisis; and an acceleration phase (2020–2025) driven by COVID-19 supply chain susceptibilities and increased interest in Industry 4.0 digital traceability technologies.

This quantitative expansion remains structurally and geographically concentrated. Malaysia (43%) and Indonesia (28%) together account for 71% of global research output, resulting in a significant geographical bias that limits the generalizability of empirical findings. Although high-level policy initiatives such as Saudi Vision 2030 exist, Arab-majority countries contribute only 9% of the global corpus, with Saudi Arabia representing just 4%. Additionally, a pronounced disciplinary imbalance is evident: the Journal of

Table 7: Socio-Technical and Comparative Matrix of Global Halal Food Control System Models

Structural Component	Established Southeast Asian Benchmark Model (Malaysia/Indonesia)	Early-Stage Arab-Region Subset Regulatory Model	Systemic Implications & Critical Knowledge Gaps
Administrative Governance	Monocentric, centralised state-led audit architecture (e.g., JAKIM, BPJPH) with legally defined divisions of authority	Decentralised, multi-agency models with overlapping municipal, commercial, and religious ministerial portfolios	Multi-agency fragmentation results in severe inter-agency coordination failures (81%) and high transaction costs.
Pillar Alignment	Balanced distribution across legislative standards, laboratory forensics, and mandatory firm-level training	Skewed distribution favouring legislation (34%) and IECT (29%) over laboratory forensics (15%)	Characterises a "law-rich but evidence-poor" pathology where statutory laws outpace physical enforcement capacity.
Analytical & Forensic Capacity	State-funded, ISO/IEC 17025 accredited laboratories equipped for rapid, high-throughput porcine DNA screening	High dependency on private, high-cost laboratories with extended turnaround times for PCR testing	High laboratory costs (58%) act as a barrier to proactive market surveillance, encouraging reactive regulatory responses.
SME Compliance & Internal Controls	Mandated employment of certified Halal Executives and structured Halal Assurance Systems (HAS)	Low compliance literacy and high perceived economic burdens among micro, small, and medium enterprises	Lack of specialised human resources (76%); standard implementation is often decoupled into symbolic compliance.
Digital Infrastructure	Advanced national databases (e.g., MYeHALAL) and integrated supply chain traceability tools	Manual record-keeping and 49% absence of unified national certification databases	Low consumer awareness of applicable laws and reporting systems (54%) leaves systems vulnerable to logo misuse.

Islamic Marketing is the most productive outlet ($n = 128$), which directs scholarly focus primarily toward consumer trust, brand perception, and behavioural constructs. In contrast, technical, operational, and laboratory enforcement studies remain underrepresented in journals with a wider disciplinary scope.

Keyword co-occurrence mapping indicates that the field's intellectual structure broadly aligns with the five-pillar national food control system framework established by the Food and Agriculture Organization (FAO). These pillars are: legislation and *fatwa*; governance; inspection and laboratories; information, education, communication, and training (IECT); and emerging technologies. Despite this structural alignment, several systemic gaps persist. Cross-cluster linkages are limited, and a sixth critical dimension, namely the economics and cost-benefit analysis of halal control, is absent from the global literature.

Within the Arab and Gulf subset ($n = 82$), this structural fragmentation is especially pronounced, showing a "law-rich but evidence-poor" condition. Highly developed legislation (34%) and consumer training (29%) coexist with severely underdeveloped laboratory infrastructure (15%) and widespread failures in inter-agency coordination (81%). Table 7 presents a comparative matrix of established and early-stage HFCS regimes to illustrate these structural discrepancies.

4.2. Regulatory maturity and institutional architecture: The Malaysian model as a comparative benchmark

The geographical distribution of the reviewed literature shows a marked imbalance, supplying valuable analytical insight. Arab countries contribute only 9% of total scholarly output on halal governance, whereas Malaysia and Indonesia together account for 71%. This difference goes beyond bibliometric measures and reflects substantive differences in the institutional depth and operational maturity of the regulatory systems examined. Bibliometric analyses indicate that research in this field is mainly concentrated in Muslim-majority Southeast Asian markets, with minimal contributions from Sub-Saharan Africa, Latin America, and the broader Arab world (Changalima, 2025). Within the Arab subset of this review, research themes are primarily focused on legislation (34%) and information, education, communication, and training (IECT) (29%), while laboratory infrastructure (15%) and inspection mechanisms (22%) receive comparatively less scholarly attention. This distribution suggests that halal governance in the Arab and Gulf regions remains in the early, norm-setting stages of regulatory development, prioritising the codification of legal frameworks and public awareness over the technical enforcement and analytical verification characteristic of more mature systems.

This contrast is particularly clear when compared to the Malaysian regulatory architecture, which is the most comprehensively documented and institutionally differentiated halal governance system in the current literature.

According to Ahmad *et al.* (2018), the Malaysian model features a clearly defined division of regulatory authority: JAKIM is responsible for halal certification, the Ministry of Health (MOH) oversees food safety, and the Ministry of Domestic Trade and Consumer Affairs (MDTCC) manages market enforcement. ISO/IEC 17025-accredited testing laboratories support this tripartite structure, standardised certification frameworks such as MS1500:2019, and formalised human capital development through structured programs such as the Halal Executive Program (Ahmad *et al.*, 2018). These elements are integrated within a coherent statutory framework, most notably the Trade Descriptions Act 2011, which criminalises fraudulent halal claims and provides enforcement agencies with the legal tools required for systematic, risk-based market surveillance. Comparative analyses also confirm that Malaysia's system, along with those of Singapore and Indonesia, serves as a model for evaluating other national models (Zhang *et al.*, 2026).

In contrast, the Arab governance landscape, as thoroughly documented by Faour-Klingbeil *et al.* (2022) for the Middle East, is defined by the diffusion of regulatory responsibility across multiple competing administrative bodies, including ministries of Islamic affairs, municipal authorities, and food safety agencies, without a single institution holding an effective coordinating mandate. (Faour-Klingbeil *et al.*, 2022). Saudi Arabia's experience is particularly illustrative: Alrobaish *et al.* (2021) show that, while the Kingdom enforces substantive technical standards for imported food, enforcement is hindered by fragmented oversight, limited inspection capacity at ports of entry, and excessive reliance on documentary rather than analytical verification (Alrobaish *et al.*, 2021). Although the GCC region enforces technical standards, such as those set by the SFDA.FD/GSO 2055-1 and GSO 993 for animal-derived products, effective implementation is undermined by the administrative architecture responsible for enforcement. Hopper and Boutrif (2006) note that distributing regulatory authority across competing ministries without a designated coordinating body is a well-documented source of systemic failure. The finding that 81% of Arab-focused studies in this review report weak inter-agency coordination is a predictable structural outcome of this model (Al Busaidi *et al.*, 2025). A recurring institutional issue is evident: states enact detailed and technically advanced legislation rapidly, yet do not develop the necessary physical, technical, and human infrastructure for efficient monitoring and enforcement (C. Jia & Jukes, 2013). This results in a system that is highly formalistic in its legal structure but operationally vulnerable, showing a persistent gap between *de jure* regulatory capacity and *de facto* enforcement performance that the literature consistently documents but seldom examines at the level of institutional design.

Beyond the public sector, the political economy of halal governance in both Southeast Asian and Arab contexts is formed by ongoing negotiations among state authorities, religious bodies, and market actors. Suryawan *et al.* (2022) illustrate in the Indonesian context that halal standards are influenced not only by religious imperatives but also by economic competitiveness, political legitimacy, and industrial policy, thereby complicating cross-regional institutional comparisons. Additionally, the assimilation of minority communities and small enterprises into halal administrative frameworks remains insufficiently examined (Suryawan *et al.*, 2022). Fiteuanto *et al.* (2024) demonstrate that the social effects of halal standardisation in Malaysia and Indonesia can marginalise small religious groups and small firms, raising

equity concerns that are often overlooked in regulatory analyses (Fiteuanto *et al.*, 2024).

4.3 Operational failure mechanisms

The structural deficiencies outlined above do not function independently; rather, they interact and compound to create specific, identifiable failure pathways within the halal supply chain. A shortage of specialised human resources, including field inspectors, internal auditors, and laboratory technicians, is reported in 76% of the reviewed Arab-focused studies. High laboratory testing costs compound this shortage, noted in 58% of studies, which have major implications for the reliability of analytical verification. Hossain *et al.* (2023) reported that PCR-based species authentication, the analytical gold standard for detecting porcine contamination in halal-certified products, calls for substantial laboratory infrastructure and technical expertise that many regulatory systems in the Arab and Gulf regions have yet to develop at scale (Hossain *et al.*, 2023). When testing is slow and expensive, regulators often replace risk-based analytical surveillance with paper-based audits of imported certificates (Islam *et al.*, 2023), a practice that introduces structural vulnerabilities at critical points in the verification chain.

The result of this substitution is a supply chain vulnerable to what can be described as "certificate laundering": the use of fraudulent or forged halal certificates paired with unverified or cross-contaminated consignments originating from distant locations. El-tahlawy *et al.* (2025) document various sophisticated food fraud mechanisms, including adulteration, ingredient substitution, and deliberate mislabelling, which flourish in regulatory settings where analytical verification is rare and documentary checks are predominant (El-tahlawy *et al.*, 2025). The lack of a centralised national certification registry, reported in 49% of the Arab-focused studies, means that no single authority possesses the traceability infrastructure required to detect or prevent such manipulation systematically. Ensuring halal integrity throughout the supply chain, starting from farm-level production to warehousing, logistics, and retail, demands extensive monitoring capabilities that go beyond certificate issuance (Yunan *et al.*, 2020). However, the necessary physical logistics infrastructure to support this remains underdeveloped in many Arab markets. It should be emphasised that no study within the reviewed corpus directly quantifies the prevalence of certificate laundering; the term is employed here as an analytic descriptor of a plausible structural vulnerability inferred from the reviewed evidence on documentary-reliant verification, rather than as an empirically substantiated estimate of fraud incidence.

Emerging digital technologies present a theoretically promising solution to these verification challenges. Blockchain-based systems, such as the HalalChain model developed by Yakubu *et al.* (2025), aim to provide immutable compliance records, instant monitoring, and automated verification across distributed supply chains (Yakubu *et al.*, 2025). Artificial intelligence-assisted authentication tools have also shown potential for rapid, scalable detection of halal mislabelling in commercial products (Nawaz *et al.*, 2025). Blockchain frameworks piloted in Malaysia have demonstrated technical feasibility for halal supply chain management, and traceability systems using IoT and RFID technologies have demonstrated potential for monitoring logistics integrity. However, the adoption of these technologies in Arab and other emerging-economy contexts confronts significant structural barriers, including high implementation costs, limited digital

infrastructure, interoperability challenges, and, critically, the low technological readiness of small and medium enterprises (SMEs) that make up the majority of actors within halal supply chains (Bayatzadeh & Talaie, 2025; Nawaz *et al.*, 2025).

It is important to acknowledge, however, that these operational failures are not occurring in a context of regulatory stagnation. Saudi Vision 2030 is cited in 68% of Saudi-focused studies as a primary institutional catalyst for reform, whilst consumer demand (72%) and export market ambitions (45%) constitute additional motivating forces. Non-conformance reporting in halal certification, as studied by Abdul Halim *et al.* (2024) in the Malaysian SME context, reveals that even within a relatively mature system, recurring compliance failures are concentrated among smaller firms with limited internal capacity, which accentuates the inherent nature of the challenge rather than its reduction to individual firm behaviour (Abdul Halim *et al.*, 2024). However, the literature's treatment of these drivers is characterised by a persistent tendency to diagnose without prescribing: weak inter-agency coordination is consistently flagged, but no study quantifies the transaction costs of coordination failure; the shortage of specialised personnel is acknowledged, but no study appraises the cost-benefit ratio of training investment relative to expected reductions in fraud incidence; and high laboratory costs are described without proposing the risk-based sampling frameworks, such as pooled testing or rapid screening prior to confirmatory PCR, that might enable regulators to maximise diagnostic value inside constrained resources. This diagnostic-with-prescriptive tendency represents a consistent methodological limitation of the halal governance literature that future research needs to address if it is to serve as a credible basis for policy design.

4.4 Gaps in the literature

The five empirically derived thematic clusters identified in this review: legislation, laboratory systems, inspection and enforcement, IECT, and emerging technologies, correspond closely with the FAO/WHO five-component food control framework. This agreement affirms that effective halal governance requires the simultaneous, integrated functioning of all components, rather than their consecutive or selective development. The convergence between the inductively derived cluster structure and the normative FAO/WHO model improves the methodological credibility of the review's findings. The wider science-mapping literature supports it. Mostafa (2020), in a 30-year visualisation of the knowledge domain of halal food research, identifies certification, supply chain management, safety, and traceability as the field's core intellectual themes. Rejeb *et al.* (2023) traced the main paths of knowledge diffusion in halal food research, confirming that regulatory and supply chain concerns have regularly dominated the field's development. (Rejeb *et al.*, 2023). Recent bibliometric work by Fauzi *et al.* (2024) also identifies a shift from supply-side concerns to consumer-oriented research, specifically about trust and purchasing behaviour. (Fauzi *et al.*, 2024).

However, this agreement also highlights a distinct absence: the literature does not identify a sixth cluster related to economic analysis or cost-benefit evaluation. This gap is conceptually significant, as it suggests that halal governance research remains largely supply-driven, determined by the perspectives of researchers, certifiers, and institutional advocates, rather than policy-driven in addressing budget constraints, resource allocation, and efficiency trade-offs relevant to real-world

implementation by governments and regulatory agencies. The unresolved question of whether centralised certification systems empirically outperform decentralised ones, a design issue carrying direct implications for the Arab governance context, where 49% of studies report the absence of a centralised national certification system, illustrates this gap.

Similarly, the potential for cross-regional coordination among emerging halal markets, as explored by Ma and Abdul Hamid (2026) in their study of seven Muslim-minority economies, remains undertheorised with respect to the specific institutional and economic conditions of the Arab world (Ma & Abdul Hamid, 2026). The pursuit of harmonised regional standards, as analysed by Johan and Plana-Casado (2023) in the ASEAN context, provides a partial model. However, the applicability of the ASEAN experience to the more fragmented Arab regulatory environment has not been systematically examined (Johan & Plana-Casado, 2023).

A parallel and equally significant gap exists within the emerging technologies cluster. The adoption of blockchain, artificial intelligence, and the Internet of Things for halal supply chain traceability represents a rapidly expanding area of scholarly interest, as shown by systematic reviews such as Rejeb *et al.* (2021) on IoT integration and Nawaz *et al.* (2025) on AI in halal authentication. However, most contributions in this cluster remain conceptual, proposing technological solutions that lack real-world efficacy, cost-effectiveness, or institutional compatibility at scale. More fundamentally, many techno-optimist contributions overlook the issue of *Shari'ah* compliance in AI-assisted certification decisions. This tension between automated certification and the epistemological requirements of Islamic legal reasoning warrants dedicated interdisciplinary scholarly attention across food science, computer science, Islamic jurisprudence, and governance studies as the field advances.

Operationalising *Maqasid al-Shari'ah* (the higher objectives of Islamic law) as an explicit analytical framework, rather than as a normative reference invoked in passing, would require future studies to map specific halal control mechanisms, such as laboratory verification, supply-chain traceability, or certification audit protocols, onto the five recognised *maqasid* categories (preservation of faith, life, intellect, lineage, and property), and to assess empirically whether existing risk management practices serve these objectives or merely satisfy narrower technical-compliance criteria. The literature reviewed here, including the present study's own bibliometric corpus, does not yet contain studies that undertake this operationalisation; this is therefore identified as a substantive methodological gap rather than a claim that can be resolved within a bibliometric synthesis alone, and is proposed as a priority direction for future doctrinal-empirical collaboration between Islamic jurisprudence scholars and food control specialists.

5. Conclusion, recommendations, and future research

5.1 Conclusion

The application of the FAO/WHO five-component framework as an explicit analytical lens, rather than as a post-hoc descriptive label, yields a structurally grounded diagnosis not previously articulated in halal bibliometrics. In particular, halal governance in the Arab region is defined by under-implementation rather than under-legislation. Three converging findings support this assessment.

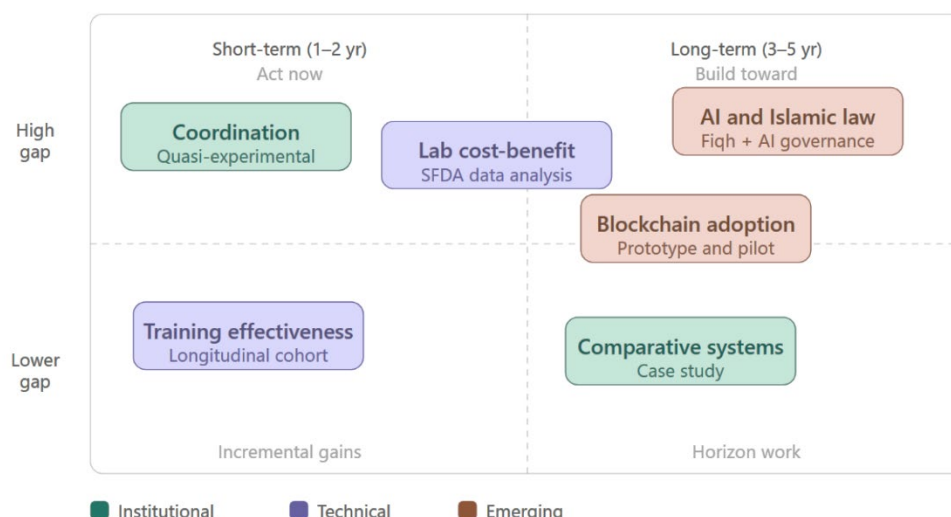


Figure 5: Priority matrix positioning six research directions by implementation horizon (short-term: 1–2 years; long-term: 3–5 years) and evidence gap severity.

The rapid expansion of the field has resulted in significant geographic unevenness, with implications that extend beyond descriptive analysis. A literature corpus centred primarily on Malaysian and Indonesian regulatory contexts does not sufficiently address the enforcement fragmentation, laboratory deficiencies, and inter-agency coordination failures characteristic of the Arab governance context. Moreover, as demonstrated in Section 3.6, the Arab-focused literature has reinforced this imbalance by prioritizing legislation and consumer awareness over the operational and technical dimensions that remain most deficient.

The five-cluster intellectual structure of the global corpus aligns with the FAO/WHO pillars, indicating that halal governance is widely recognised as a multi-component challenge. However, the literature has not yet fully integrated these components, particularly in economic analysis. No cluster addresses cost-benefit analysis or resource allocation, which leaves the field diagnostically adequate but prescriptively limited. Consequently, regulators seeking to prioritise investment lack academic guidance on which interventions yield the greatest systemic benefit per unit of institutional expenditure.

The emerging-technologies cluster presents an additional challenge that the literature has deferred: whether algorithmic halal verification can satisfy the jurisprudential requirement of human deliberative reasoning (*ijtihad*). The resolution of this issue will determine not only scholarly classification but also religious legitimacy and, consequently, the practical adoption of digital certification tools in Muslim markets.

These findings reframe Arab halal food control as a systemic implementation problem that requires investment in enforcement capacity, economic appraisal, and cross-disciplinary governance research, rather than a legislative deficit for which additional *fatwa* production is the primary solution.

5.2 Recommendations

For policymakers in Arab and Gulf countries, four priority actions are recommended. First, a National Supreme Halal

Council should be established to integrate food safety, Islamic affairs, commerce, and municipal bodies under a legally binding coordinating mandate. Without this reform, investments in technical capacity will remain fragmented. Second, ISO/IEC 17025-accredited national laboratory networks should be created, funded for proactive risk-based sampling rather than reactive complaint-driven testing, and linked through a unified certification registry with public authentication capabilities. Third, human capital development should be institutionalised through mandatory halal executive training programs evaluated for effectiveness, rather than treated as voluntary awareness activities. Finally, consumer engagement should shift from passive logo recognition to active civic participation, equipping consumers with the knowledge and accessible mechanisms to report suspected violations.

For the research community, the primary need is methodological reorientation. This entails shifting from descriptive country studies to quantitative causal modelling, from conceptual technology proposals to empirically grounded cost-benefit analyses, and from single-discipline investigations to cross-disciplinary collaboration among food science, Islamic jurisprudence, and digital governance, particularly in the context of algorithmic certification.

5.3 Limitations

Three limitations constrain the interpretive scope of this review. The analysis is restricted to Scopus, excluding Web of Science and Arabic-language databases such as *Ma'rifah*, which may contribute to the underrepresentation of Arab scholarship. Bibliometric methods assess knowledge structure rather than the methodological quality of individual studies, although this limitation was partially mitigated through manual coding of 82 Arab-focused articles. The 2010–2025 time window, while appropriate for contemporary analysis, excludes foundational contributions made prior to 2010. Reliance on a single-database design is a significant limitation. Scopus exhibits documented gaps in its coverage of regional, Arabic-language, and non-Anglophone journals compared to Web of Science and discipline-specific Arabic repositories such as *Ma'rifah*. Consequently, the 9% share of Arab-region output

reported in Section 3.2 should be regarded as a lower-bound estimate that may underrepresent the actual volume of Arabic-language halal governance scholarship, rather than serving as a definitive measure of the field's geographic distribution. Furthermore, the citation-based author and journal rankings presented in Sections 3.3 and 3.4 are based on raw citation counts rather than field-normalised indices, such as the h-index or the journal impact factor. These rankings should therefore be interpreted as indicative of relative visibility within this corpus, rather than as calibrated measures of scholarly influence.

5.4 Future research agenda

Six priority directions are identified across three clusters: institutional reform, technical capacity, and emerging frontiers, as illustrated in Figure 5.

At the institutional level, two critical questions remain insufficiently examined despite being consistently identified as weaknesses: whether a unified halal council enhances enforcement, and whether centralised certification is more effective than decentralised models. Both issues could be addressed in the near term.

For technical capacity, laboratory cost-benefit analyses and evaluations of training effectiveness are overdue. Regulators and programme managers currently make investment decisions without robust evaluation. In the emerging frontier, blockchain evaluation should progress from conceptual frameworks to empirical studies, with mutual recognition within the Gulf Cooperation Council serving as a suitable test case. Importantly, whether AI-assisted certification can meet *ijtihad* requirements must be established before the digital agenda in this field can achieve legitimate adoption. Addressing this issue requires collaboration among experts in food science, computer science, and Islamic jurisprudence.

Acknowledgements

The authors thank the anonymous reviewers for their valuable comments. Special thanks to the International Islamic University Malaysia (IIUM) for providing access to Scopus, and to the Ph.D supervisors for their guidance during manuscript preparation.

Conflict of interest

The authors declare no conflict of interest. This research received no external funding.

AI declaration

Artificial Intelligence (AI) tools, including ChatGPT (OpenAI, San Francisco, CA) and Grammarly, were used to assist with language editing, improve sentence structure, and clarify grammar during manuscript preparation. The authors reviewed, verified, and take full responsibility for the accuracy and integrity of the content. No AI tools were used for data analysis, result interpretation, or scientific conclusions.

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Author contribution

Al-Saab A.: first coder, investigation, data curation, writing – original draft preparation. Elgharbawy, A. A. M.: conceptualization, formal analysis, writing, reviewing, and editing, second coder.

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APPENDICES

Appendix A: Full Search Strategy in Scopus

Date of execution: 15 April 2026

Database: Scopus (Elsevier)

Date of execution: 15 April 2026

Database: Scopus (Elsevier)

Search string applied to TITLE-ABS-KEY fields:
 TITLE-ABS-KEY("halal food" OR "halal certification" OR "halal assurance")

The following filters were applied via the Scopus Advanced Search interface after executing the search string: Document type: Article; Source type: Journals; Language: English or Arabic; Publication year: 2010–2025 (records published in 2026 excluded).

Initial yield: 1,204 documents. After removal of 67 duplicates, 1,137 records were screened by title and abstract.

Component	Search Terms (OR)	Purpose
Halal concept	"halal food", "halal certification", "halal assurance"	Capture core halal literature
Control system	"control system", "food control", "regulatory framework"	Focus on national control systems
Five components	fatwa, legislation, inspection, enforcement, audit, laboratory, porcine DNA, authentication, training, awareness, IECT	Ensure coverage of all FAO components

Appendix B: Distribution of Arab-Region Studies Across the Five Components (n = 82)

Each of the 82 articles was manually coded into one or more of the five components. Note: one article could cover multiple components, so the sum of percentages exceeds 100%.

Component	Articles (n)	Percentage	Representative Topics
Legislation & fatwa	28	34.1%	National halal laws, fatwas on novel foods, and the role of fatwa committees.
Governance	22	26.8%	Division of authority among ministries, inter-agency coordination
Inspection & enforcement	18	22.0%	Field inspection, fake halal logos, penalties
Laboratories	12	14.6%	Porcine DNA testing (PCR), ISO/IEC 17025 accreditation
IECT	24	29.3%	Consumer campaigns, Halal Executive Programme, university roles