

Green Halal Supply Chain for Halal Food Industry: Integrating Islamic Ethics and Sustainability Science

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Abstract: The global halal food industry has grown rapidly, yet the systemic integration of Shariah compliance with environmental sustainability principles remains a critical gap in both academic discourse and industrial practice, particularly in Indonesia as the world's largest Muslim consumer market. This study aims to address four research questions, namely how the concept of Green Halal Supply Chain (GHSC) has evolved in the academic literature, what factors constitute GHSC in the halal food industry, how halal compliance and sustainability can be effectively integrated, and what GHSC framework is appropriate for Indonesia's sustainable halal food industry. Methodologically, this is a conceptual paper that develops a theoretical framework through an integrative review and synthesis of supply chain management theory, halal supply chain scholarship, sustainability science, and Islamic jurisprudence on environmental ethics, supported by empirical data drawn from credible government and institutional sources. The results indicate that GHSC can be conceptualized through three interdependent dimensions, namely the green dimension (green procurement, eco-production, green logistics, waste management), the halal dimension (halal assurance, traceability, compliance), and the sustainability dimension (environmental, social, economic), which are then integrated into a Green Halal Supply Chain Framework (GHSCF) built upon six theoretical streams. In terms of implications, this study affirms that halal ethics and sustainability science are philosophically aligned, such that Islamic principles like the prohibition of israf (waste), the concept of khilafah (stewardship), and hifz al-bi'ah (environmental preservation) serve as theological foundations that parallel contemporary sustainability principles. The primary contribution of this paper is to provide a conceptual framework and adoption pathway for future empirical validation, while also enriching supply chain management theory, policy, and managerial practice within the sustainable halal food industry.

Keywords: Green Halal Supply Chain; Halal Food Industry; Sustainability; Maqasid Syariah; ESG; Circular Economy.

Introduction

The global halal food industry has emerged as one of the most dynamic growth segments of the international food economy. The State of the Global Islamic Economy report (DinarStandard, 2023) projects the global halal food market to reach USD 2.4 trillion by 2024, driven by a compound annual growth rate (CAGR) of 6.3%. This growth is underpinned by a global Muslim population exceeding 1.9 billion (Pew Research Center, 2023) and rising middle-class purchasing power across Muslim-majority economies in Southeast Asia, the Middle East, and Sub-Saharan Africa. Indonesia home to approximately 242.7 million Muslims representing approximately 87% of the national population (BPS, 2021), occupies the world's largest single-country Muslim consumer market and faces strategic imperatives to develop a globally competitive, sustainable halal industry ecosystem (Putri et al., 2024).

Indonesia's formal halal governance architecture has expanded significantly since the enactment of Law No. 33/2014 on Halal Product Guarantees and Government Regulation No. 39/2021 about Penyelenggaraan Bidang Jaminan Produk Halal. Badan Penyelenggaraan Jaminan Produk Halal (BPJPH, 2023) reports over 4.5 million certified products as of December 2023 nearly three times the 2019 figure. The Global Islamic Economy Indicator (GIEI), part of the State of the Global Islamic Economy report (DinarStandard, 2023), ranks Indonesia among the top-tier countries globally in overall Islamic economy development. Yet this institutional maturation has not been accompanied by commensurate environmental sustainability integration: a survey by the Indonesian Business Council for Sustainable Development (IBCSO) of 120 certified halal food companies found that only 14.2% had formally integrated green supply chain practices, and merely 8.3% had published sustainability or ESG reports (IBCSO, 2023).

Environmental pressures on food systems are intensifying simultaneously. The UNEP Food Waste Index Report (UNEP, 2024) documents approximately 1.05 billion tons of food wasted globally in 2022. The Intergovernmental Panel on Climate Change (IPCC) estimates that the global food system contributes 21–37% of total anthropogenic greenhouse gas (GHG) emissions when land use, agricultural production, processing, packaging, transport, and waste are comprehensively accounted (IPCC, 2023). In Indonesia, Badan Pangan Nasional (Bapanas) estimates food loss and waste (FLW) at 23–48 million tons per year, equivalent to IDR 213–551 trillion in economic losses annually (4–5% of GDP) (Bapanas, 2023). These systemic pressures apply with

particular force to Indonesia's rapidly expanding halal food processing sector.

The convergence of halal market expansion, environmental imperatives, and ESG capital markets creates an unprecedented strategic context. Bloomberg Intelligence, (2023) reports that global ESG investment assets exceeded USD 40 trillion in 2022, projected to reach USD 53 trillion by 2025, approximately one-third of total global assets under management. Within Islamic capital markets, Green Sukuk (Shariah-compliant green bonds) have emerged as a fast-growing instrument for financing environmentally sustainable projects: global green and sustainable Sukuk issuance reached approximately USD 15 billion in 2021 (IFN, 2023), and Indonesia alone issued a cumulative USD 9.6 billion in green Sukuk between 2018 and 2023 (Diplomat, 2025), making it the world's pioneering sovereign Green Sukuk issuer since its first issuance in 2018. While Green Sukuk proceeds are directed toward environmentally eligible projects rather than halal certification per se, Indonesia's leadership in this instrument signals a state-level institutional commitment to green Islamic finance that the corporate halal food sector could, in principle, draw upon as a financing pathway for GHSC infrastructure investment.

The concept of Green Halal Supply Chain (GHSC) has emerged as an integrative framework that simultaneously ensures product halalness, environmental sustainability, supply chain efficiency, and social responsibility. GHSC synthesizes Green Supply Chain Management (GSCM) principles (Sarkis et al., 2011) with halal supply chain frameworks (Tieman, 2011), grounded in Maqasid Syariah as the ethical-normative foundation of Islamic economics. Despite growing academic interest, research developing a comprehensive GHSC framework for the Indonesian halal food industry remains exceptionally limited. Structured searches of academic literature using the keyword 'halal supply chain' return a substantial and growing body of work, yet only a small fraction explicitly integrate 'sustainability' or 'green' keywords, and searches combining 'green' and 'halal' supply chain terms return markedly fewer results, of which a minority focus on the Indonesian context specifically. Existing studies are characteristically partial: some address halal supply chain without incorporating environmental sustainability dimensions; others examine green supply chain without integrating halal assurance requirements (Harsanto et al., 2024; Kurniawati & Cakravastia, 2023). This study addresses four research questions: (RQ1) How has the GHSC concept evolved in academic literature? (RQ2) What factors constitute GHSC in the halal food industry? (RQ3) How can halal and sustainability dimensions be effectively integrated? (RQ4) What GHSC framework is appropriate for Indonesia's sustainable halal food industry?

Indonesia's domestic halal food and beverage market is valued at approximately USD 173 billion (DinarStandard, 2023), encompassing over 26 million food micro, small, and medium enterprises (MSMEs). Despite this scale, the environmental performance of Indonesia's halal food supply chain reveals structural deficiencies across three dimensions. The input gap: halal procurement standards are governed exclusively by Shariah compliance criteria without reference to ecological sourcing or supplier environmental performance. The process gap: the SJPH criteria set out under BPJPH Decree No. 20/2023 mandate segregated production, documented cleaning procedures, and five core compliance elements (commitment and responsibility, materials, halal production process, product, and monitoring and evaluation), but contain no explicit provisions for energy efficiency, carbon emissions management, or cleaner production technologies (BPJPH, 2023). The output gap: the ~22% national plastic recycling rate and 23–48 million tons of annual FLW demonstrate that end-of-life supply chain management operates without systematic circular economy principles. Table 1 provides a comprehensive empirical snapshot of these structural challenges.

Table 1. Empirical Snapshot: Indonesian Halal Food Industry and Environmental Challenge Indicators

Indicator	Data / Value	GHSC Implication	Source
Halal certified products (Dec 2023)	4.5 million products; ~3× growth vs 2019	Large compliance base; no green integration requirement in current SJPH	BPJPH, (2023)
MSME halal certification rate	Estimated <20% of registered food MSMEs have active halal cert	GHSC adoption gap concentrated in SME segment largest by firm count	Kementerian Perindustrian RI, (2024)
Food industry solid waste	Food and beverage processing is among Indonesia's significant industrial waste contributors	Urgent need for waste management integration into halal SC governance	KLHK, (2022)
Food loss and waste (FLW)	23–48 million tons/year; IDR 213–551 trillion economic loss (4–5% GDP)	CE and reverse logistics principles essential for GHSC economic viability	Bapanas, (2023)
National plastic waste and recycling	Indonesia generated 56.63 million tons of waste in 2023, of which ~19% (10.8 million tons) was plastic; national plastic recycling rate was only ~22%	Packaging reform critical; green procurement standards must address packaging	KLH/BPLH, (2025), citing SIPSN data

Halal companies with formal GSC	Only 14.2% of 120 surveyed certified halal food companies	Confirms systemic adoption gap; validates urgency of GHSC framework	IBCSD, (2023)
ESG reporting (halal food sector)	Only 8.3% published sustainability or ESG report	Low transparency limits access to ESG and Green Sukuk capital markets	IBCSD, (2023)
Global ESG AUM	USD 40 trillion (2022); projected USD 53 trillion by 2025	Capital market pressure for GHSC adoption intensifying irreversibly	Bloomberg Intelligence, (2023)
Green Sukuk (Indonesia cumulative issuance)	Indonesia issued USD 9.6 billion cumulative green Sukuk, 2018-2023	Demonstrates a viable green Islamic finance channel potentially extensible to GHSC infrastructure financing	IFN (2023); The Diplomat (2025)
Indonesia NDC net-zero target	2060 Net Zero Emission; Enhanced NDC 2022	Regulatory pressure on all industrial sectors including halal food to decarbonize	KLHK, (2022)

Sources: BPJPH (2023); Kementerian Perindustrian RI (Kemenprin), (2024); KLHK, (2022); Bapanas (2023); KLH/BPLH, (2025); IBCSD (2023); Bloomberg Intelligence (2023); IFN (2023).

"International comparators underscore Indonesia's relative underperformance in GHSC integration. Malaysia, ranked first in the State of the Global Islamic Economy report (DinarStandard, 2023) has positioned its Halal Industry Development Corporation (HDC) as a promoter of integrated halal-green industrial zones, reflecting an institutional push toward environmental integration in halal standards. The UAE's National Food Security Strategy 2051 links food security with ecosystem protection and sustainable production, but its publicly available policy documents do not explicitly mandate that halal food supply chains undergo environmental impact assessments. Saudi Arabia's Vision 2030 reform agenda has likewise promoted its Halal Products Development sector alongside environmental management system (EMS) requirements for manufacturers more broadly. These comparators demonstrate that GHSC integration is becoming a de facto requirement for competitive halal market access not an optional CSR enhancement. Indonesia's failure to develop a systematic GHSC framework risks competitive disadvantage as premium halal import markets (GCC, EU, East Asia) increasingly require verifiable sustainability credentials alongside halal certification.

This study makes four original contributions: (1) a systematic map of GHSC conceptual evolution across three developmental phases; (2) identification and categorization of GHSC determinant factors across three interdependent dimensions; (3) establishment of the philosophical alignment between Islamic ethics and contemporary sustainability science; and (4) development of the Green Halal Supply Chain Framework (GHSCF) a five-layer operational model integrating six theoretical streams with measurable KPIs and a three-tier adoption pathway for Indonesian halal food companies.

Theoretical Foundation

1. Triple Bottom Line and Sustainability Theory

The Triple Bottom Line (TBL) concept, first articulated by Elkington, (1997) in *Cannibals with Forks*: The Triple Bottom Line of 21st Century Business, fundamentally reframed corporate performance measurement by demanding evaluation across three equal dimensions: financial performance (profit), social impact (people), and environmental impact (planet). In supply chain management, TBL extends performance evaluation from dyadic buyer-supplier relationships to entire supply chain networks, demanding that environmental and social impacts at upstream supplier stages are managed as rigorously as cost and quality metrics (Agyabeng-Mensah et al., 2020). Subsequently acknowledged that TBL has frequently been operationalized as a mere parallel reporting framework rather than a transformative management approach calling for reorientation toward regenerative rather than merely sustaining practices (Elkington, 2018). This regenerative extension resonates particularly with the Islamic concept of *istishlah* (public welfare maximization), which demands not merely avoiding harm but actively promoting flourishing. Critiqued TBL's dimensional incommensurability a limitation addressed in the GHSCF by maintaining dimensional distinctiveness while enabling integrated governance through the Maqasid Syariah normative foundation (Norman & MacDonald, 2004).

2. Maqasid Syariah: The Normative Architecture of GHSC

Maqasid Syariah (the objectives of Islamic law), systematized by Abu Ishaq Al-Shatibi (d. 790 AH) in al-

Muwafaqat, establishes five essential objectives (*al-kulliyat al-khams*) Islamic law is designed to protect: preservation of religion (*hifz al-din*), life (*hifz al-nafs*), intellect (*hifz al-aql*), lineage (*hifz al-nasl*), and property (*hifz al-mal*). Contemporary Islamic scholars have substantially expanded this framework: Ibn Asyur proposed preservation of the social order (*hifz al-ummah*); Yusuf al-Qaradawi and others explicitly include preservation of the environment (*hifz al-bi'ah*) as a sixth essential objective with direct Quranic grounding (Hasanah, 2020).

Maqasid Syariah provides three critical contributions to GHSC theory. First, it establishes theological legitimacy for environmental sustainability requirements within halal certification reframing green practices not as optional CSR additions but as religious obligations. The Quran commands: 'Do not cause corruption in the earth after it has been set in order' (QS 7:56); 'Corruption has appeared throughout the land and sea by what the hands of people have earned' (QS 30:41). Second, the principle of *la darar wa la dirar* (no harm to self or others) from the Prophet's Hadith (Ibn Majah) constitutes what contemporary Islamic environmental law scholars describe as the foundational prohibition on industrial pollution, equivalent in religious authority to the prohibition on consuming haram substances. Third, the concept of *istihsan* (juristic preference for public welfare) provides legal tools for BPJPH to incorporate environmental criteria into halal standards without Shariah violation. Kismawadi, (2024) argues compellingly that a halal food industry maximizing short-term profitability through environmental externalization is in fact violating *hifz al-mal* by imposing future costs on the community a powerful argument for GHSC adoption as religious obligation.

3. Green Supply Chain Management (GSCM) Theory

GSCM, theorized by Sarkis et al., (2011) in their landmark organizational theory review, represents the systematic integration of environmental thinking into all aspects of supply chain management. Sarkis et al. synthesized multiple theoretical lenses: institutional theory (regulatory and normative adoption pressures), resource-based view (environmental capabilities as competitive advantage), transaction cost theory (governance mechanisms for green supply relationships), and stakeholder theory (multi-actor environmental demands). This multi-theoretical foundation makes GSCM theory particularly suited to the complex multi-stakeholder context of the halal food industry. Sarkis & Dou, (2018) operationalize GSCM through four dimensions: green procurement (supplier environmental evaluation), eco-production (manufacturing process environmental optimization), green logistics (transportation and packaging efficiency), and reverse logistics or investment recovery (take-back, refurbishment, valorization). Sarkis et al., (2020) further demonstrate that GSCM adoption accelerates during systemic disruptions COVID-19, climate events when supply chain vulnerabilities are exposed. This foundational GSCM perspective is complemented by Seuring & Müller, (2008) conceptual framework for sustainable supply chain management, which distinguishes between “supplier management for risks and performance” and “supply chain management for sustainable products” a distinction that maps directly onto the GHSC context, where halal compliance risk and positive environmental performance must be managed as parallel, not competing, objectives.

4. Halal Supply Chain Theory

Halal Supply Chain (HSC), conceptualized by Tieman, (2011) through practitioner interviews, describes a supply chain network ensuring halal integrity through four integrated pillars: halal integrity (continuous Shariah compliance), halal logistics (physical contamination prevention), halal traceability (origin and process documentation), and halal assurance (systematic sustained compliance management). Tieman's foundational contribution was establishing halal as a systemic supply chain property a 'from farm to fork' quality requiring continuous governance rather than point-in-time product certification. Rejeb et al., (2021), in a bibliometric analysis of halal food supply chain literature, identified five dominant research clusters: halal certification and compliance, supply chain management and operations, consumer behavior and trust, technology and traceability, and sustainability and environmental management, confirming sustainability as a growing and increasingly central theme within HSC scholarship over the period studied. Kurniawati & Cakravastia, (2023) identified three unresolved challenges directly relevant to GHSC: halal integrity under increasing supply chain complexity; limited MSME adoption; and scarcity of studies combining sustainability with HSC. Selim et al., (2022) established empirically that consumer trust in halal logistics is significantly mediated by perceived transparency and traceability suggesting GHSC's enhanced IoT-blockchain traceability infrastructure simultaneously strengthens halal trust and environmental verification. More recent scholarship has begun to make the HSC-sustainability linkage explicit: Haleem et al., (2021), in an India-centric study, proposed a conceptual framework directly linking halal supply chain management practices with sustainability outcomes, while Khan et al., (2022) empirically examined the relationship between halal supply chain management and sustainability performance, finding that halal compliance and sustainable practice adoption are positively associated rather than in tension a finding that lends direct empirical support to this study's central premise.

5. Stakeholder Theory and Institutional Isomorphism

Stakeholder Theory provides the political economy framework for GHSC adoption dynamics: long-term organizational success requires satisfying the legitimate interests of all stakeholders not merely shareholders (Freeman & Mcvea, 2001). For halal food companies, GHSC is subject to multi-stakeholder institutional pressures: Muslim consumers increasingly demanding halal-sustainable combinations (particularly younger, urban consumers 18–35); BPJPH and KLHK exercising coercive isomorphic pressure through regulatory requirements; and ESG investors creating market isomorphism through financing conditions. DiMaggio & Powell, (1983) institutional isomorphism theory further explains GHSC diffusion: coercive isomorphism via Indonesia's Enhanced NDC 2022 and the Ministry of Industry's Green Industry Standard (Standar Industri Hijau, established under Permenperin No. 51/M-IND/PER/6/2015 and periodically updated); mimetic isomorphism as Indonesian halal food companies look to more institutionally advanced halal industry ecosystems, such as Malaysia's Halal Industry Development Corporation (HDC) initiatives, as reference models; and normative isomorphism through the halal certification infrastructure itself (SMIIC, JAKIM), which, notably, does not yet formally incorporate environmental requirements into its halal standards a gap this study identifies as a concrete lever for future institutional development rather than an accomplished fact.

6. Circular Economy Theory and Halal Industry Applications

The Circular Economy (CE), developed by the Ellen MacArthur Foundation, (2021) drawing on cradle-to-cradle design principles, advocates for a system designed to eliminate waste and keep materials in productive use through biological and technical cycles. CE's core principles eliminate waste and pollution by design, circulate products and materials at highest value, regenerate natural systems map directly onto Indonesia's most critical halal food industry environmental challenges: 23–48 million tons of annual FLW, a national plastic waste stream in which food-sector packaging is a major contributor (KLH/BPLH, 2025), and biodiversity impacts from unsustainable agricultural sourcing. The Islamic prohibition of *israf* (waste) creates theological alignment with CE waste elimination principles. The concept of *tayyib* (wholesome, beneficial, and pure) extends halal certification toward ecological purity, creating a natural halal-CE convergence. Lehtokunnas et al., (2022) demonstrate that CE transitions in food consumption involve fundamental social practice changes precisely the kind that Islamic value reframing ('halal and pure' as ecologically pure) can accelerate in Muslim-majority contexts.

7. ESG Framework and Islamic Finance Convergence

The ESG (Environmental, Social, and Governance) framework has evolved from voluntary CSR reporting into a mainstream investment assessment methodology with direct capital allocation implications. Rajgopal, (2023) positions ESG as fundamentally a risk management framework extending beyond financial risk to encompass transition risk (carbon regulation exposure), physical risk (climate supply chain disruptions), and social risk (reputational, labor, integrity risks). For Indonesian halal food companies, all three risk categories are material. The convergence of ESG and Islamic finance creates a potential incentive structure for GHSC: Indonesia's cumulative USD 9.6 billion in sovereign Green Sukuk issuance between 2018 and 2023 demonstrates that issuers can access capital markets by demonstrating environmental project eligibility (Diplomat, 2025). While no dedicated “Green-Halal Sukuk” instrument currently exists, Indonesia's established sovereign Green Sukuk Framework provides an institutional precedent that could, with adaptation, be extended to corporate issuers seeking preferential financing for GHSC infrastructure investment.

Table 2. Research Gap: Positioning This Study in the GHSC Literature Map

Author(s)	Research Focus	Contribution	Limitation / Gap
Rejeb et al. (2021)	Halal food SC & sustainability bibliometrics (bibliometric analysis)	Identifies sustainability as growing HSC theme; 5-cluster mapping	No operational framework; gap between bibliometric insight and implementation
Kurniawati & Cakravastia (2023)	Halal SC: sustainability & operations research review	Strong OR perspective; identifies 3 unresolved sustainability-HSC challenges	Green dimension not explicitly integrated; no GHSC model developed
Harsanto et al. (2024)	Digital technology 4.0 on halal SC (systematic review)	Blockchain-IoT traceability as dual-purpose infrastructure	Technology-focused; GHSC framework absent; environmental KPIs underdeveloped
Putri et al.	Halal SC research	Indonesian contextual	Green dimension absent; no

(2024)	landscape in Indonesia	depth; confirms halal-green gap	framework for integration
Kismawadi (2024)	Halal food industry and sustainability (book chapter)	Bridges halal industry and sustainability discourse explicitly	Descriptive; no operational GHSC framework or empirical validation
Sarkis et al. (2011)	GSCM: organizational theory review (foundational)	Multi-theoretical GSCM foundation; institutional, RBV, stakeholder lenses	Halal ecosystem entirely absent; Islamic ethics not addressed
This study	GHSC framework for Indonesian sustainable halal food industry	Integrates 6 theoretical streams; 5-layer operational GHSCF; 3-tier adoption model	Conceptual; pending empirical SEM-PLS validation (future research)

Source: Systematic literature synthesis, this study. (2026)

Method

1. Research Design and Philosophical Positioning

This is a conceptual paper. Rather than reporting findings from primary data collection or a formal systematic literature review, it develops a theoretical framework through the integrative synthesis of established supply chain management theory, halal supply chain scholarship, sustainability science, and Islamic jurisprudence on environmental ethics. This approach is appropriate when the research objective is to identify a conceptual gap between two established but historically disconnected literatures halal supply chain management and green/sustainable supply chain management and to propose a novel integrative framework bridging them (Denyer & Tranfield, 2009). The study's epistemological positioning is interpretivist-constructivist: it constructs a theoretical framework by synthesizing and reinterpreting existing knowledge and normative sources rather than testing pre-specified hypotheses against primary data.

2. Literature Engagement and Sourcing

Literature discussed in this paper was identified through structured searches of academic publisher platforms with strong coverage of supply chain management, Islamic economics, and food science including Emerald Insight, MDPI, ScienceDirect, Taylor & Francis Online, SpringerLink, and Google Scholar using search terms combining 'halal supply chain' with 'sustainability,' 'green,' 'GSCM,' 'blockchain,' 'traceability,' 'Maqasid Syariah,' and 'circular economy.' Priority was given to recent literature (predominantly 2021-2026) to reflect current scholarship, supplemented by foundational, highly-cited theoretical works cited across the field regardless of publication date, consistent with standard practice in conceptual and theory-building papers. All sources cited in this paper, including government reports, regulatory documents, and news sources used for empirical context, were individually verified for bibliographic accuracy and public accessibility at the time of writing. Numeric claims for which sufficiently precise, verifiable, and current sources could not be identified have been deliberately omitted or presented qualitatively rather than with false precision; readers seeking company or sector-specific quantitative benchmarks are encouraged to consult BPJPH, Kementerian Perindustrian, and MEMR primary reporting directly, as these are periodically updated.

3. Conceptual Integration and Framework Development

The integration of theories and concepts followed an integrative conceptual synthesis approach. Rather than treating halal supply chain management, green supply chain management, sustainability science, and Islamic ethics as separate theoretical domains, the study systematically mapped their overlapping concepts, complementary functions, and distinctive contributions to the development of the proposed framework. The integration was conducted through four sequential stages: concept identification, conceptual mapping, theoretical integration, and framework construction.

First, key constructs and principles were identified from the selected literature on supply chain management (SCM), halal supply chain management (HSCM), green and sustainable supply chain management (GSCM), sustainability science, and Islamic environmental ethics. From SCM and GSCM literature, concepts related to green procurement, sustainable production, green logistics, resource efficiency, waste management, reverse logistics, and circular economy were identified. From HSCM literature, concepts concerning halal integrity, segregation, traceability, halal assurance, and halal risk management were extracted. Islamic ethical concepts, including amanah (trust and responsibility), 'adl (justice), maslahah (public benefit), ihsan (excellence), and the prevention of environmental harm, were identified as normative principles for evaluating and guiding supply chain practices.

Second, the identified concepts were mapped according to their conceptual similarities, complementarities, and potential areas of integration. Concepts were not combined merely because they appeared in related literature; integration was undertaken when concepts addressed a common supply chain function or sustainability objective while contributing distinct theoretical meanings. For example, halal traceability and environmental traceability were considered complementary mechanisms for ensuring transparency and accountability across the supply chain, while halal segregation and pollution prevention were connected through the broader principle of maintaining product integrity and preventing harm or contamination. This mapping process resulted in integrated concepts that simultaneously address halal requirements, environmental sustainability, and ethical responsibility.

Third, the theoretical domains were assigned complementary roles within the proposed framework. SCM provides the structural and operational foundation for understanding supply chain activities and inter-organizational coordination. HSCM contributes the requirements for maintaining halal integrity throughout the supply chain, while GSCM and sustainability science provide the environmental and resource-efficiency dimensions. Islamic ethics and Maqasid Syariah provide the normative foundation that connects these dimensions by emphasizing responsibility, justice, public benefit, moderation, and the prevention of harm. Thus, Islamic ethics is conceptualized not simply as an additional supply chain practice but as an ethical orientation that guides how halal and environmental sustainability principles should be implemented.

Finally, the integrated concepts were organized into a conceptual framework by distinguishing foundational principles, supply chain practices, and expected sustainability outcomes. The framework therefore conceptualizes Green Halal Supply Chain as an integrated system in which Islamic ethical principles provide normative direction, halal requirements safeguard product and process integrity, and green supply chain practices reduce environmental impacts and improve resource efficiency. The resulting framework is intended to explain how these previously fragmented dimensions can be combined into a coherent approach for achieving sustainability in the halal food industry. The proposed relationships are conceptual and theory-driven rather than empirically tested in this study; consequently, the framework is presented as a basis for subsequent empirical validation.

Results and Discussion

1. Evolutionary Trajectory of GHSC Concept

The GHSC concept has evolved through three distinct developmental phases, each characterized by different theoretical emphases, methodological approaches, and integration levels between halal and sustainability scholarship. Table 3 maps this evolution.

Table 3. Evolutionary Phases of GHSC Concept Development in Academic Literature

Phase	Period & Characteristics	Dominant Research Themes	Representative Studies
Phase 1: Parallel Development	2000–2012. Independent streams. No cross-disciplinary citation. Halal SC in Islamic economics journals; GSCM in operations management journals. Foundational frameworks established.	Halal integrity; halal logistics; four-pillar HSC model; GSCM organizational theory; green procurement basics	Tieman (2011); Sarkis et al. (2011); Zailani et al. (2010); Omar & Jaafar (2011)
Phase 2: Awareness of Integration Gap	2013–2019. First cross-disciplinary citations emerge. Recognition of integration need. HSC risk and traceability dimensions expanded. Sustainability awareness grows in HSC but remains peripheral.	Halal SC risk; traceability technology; consumer trust; sustainability awareness in halal context; ISO-halal interfaces	Zulfakar et al. (2014); Ab Talib et al. (2015); Fathi et al. (2016)
Phase 3: Active Integration Efforts	2020–present. Intensifying framework integration. Digital technology (blockchain-IoT) enables dual-purpose infrastructure. Maqasid Syariah sustainability literature growing. Green Sukuk creates financial convergence incentives.	Bibliometric GHSC analysis; blockchain traceability; ESG-halal convergence; Maqasid sustainability; GHSC framework development; COVID-19 supply chain disruption research	Rejeb et al. (2021); Kurniawati & Cakravastia (2023); Harsanto et al. (2024); Putri et al. (2024); Kismawadi (2024); this study

Source: Conceptual literature synthesis, this study. Phase 1–2 entries reflect foundational works identified through the literature engagement described in the Conceptual Approach section; Phase 3 entries reflect recent (predominantly 2021–2026) scholarship identifying the halal-sustainability integration trend.

Phase 1: Parallel Development (2000–2012)

The foundational phase was marked by independent, non-communicating development of halal supply chain and green supply chain as separate research streams. Tieman, (2011) established the four-pillar HSC model through qualitative practitioner interviews, addressing halal integrity, logistics, traceability, and assurance without environmental dimensions. Around the same period, Zailani et al., (2010) examined halal traceability and tracking systems as a mechanism for strengthening halal food supply chain integrity in Malaysia, while Omar & Jaafar, (2011) proposed an early conceptual model of the halal supply chain in the food industry. Simultaneously, Sarkis et al., (2011) published their landmark GSCM organizational theory review, synthesizing institutional, resource-based, stakeholder, and transaction cost theories without any reference to the halal ecosystem. These parallel tracks reflect broader disciplinary boundaries: halal SC research was situated in Islamic economics and marketing journals, while GSCM research occupied operations management and industrial engineering literature. The absence of cross-disciplinary citation in this phase represents a fundamental missed opportunity that subsequent phases have struggled to overcome.

Phase 2: Awareness of the Integration Gap (2013–2019)

The second phase was characterized by growing recognition of the conceptual gap, though systematic integration remained elusive. Zulfakar et al., (2014) extended the foundational HSC risk agenda by proposing a conceptual framework for halal food supply chain integrity enhancement, centering traceability, dedicated assets, and trust and commitment among supply chain members as integrity-enhancing factors. Ab Talib et al., (2015) systematically reviewed the critical success factors of halal supply chain management, consolidating government support, transportation planning, information technology, human resource management, collaborative relationships, halal certification, and halal traceability as the field's core success dimensions. Fathi et al., (2016) shifted attention toward the demand side, empirically demonstrating that consumer concern about halal status and media coverage significantly drive willingness to pay for halal logistics, establishing consumer trust as a distinctive HSC performance consideration. Together, these studies opened the HSC framework toward broader performance and stakeholder-trust considerations. Several sustainability scholars began identifying halal supply chains as distinctive sustainability governance contexts. However, empirical integration studies remained rare, and no comprehensive theoretical framework bridging both domains was produced during this period. This phase established the intellectual pre-conditions for Phase 3 integration efforts.

Phase 3: Active Integration Efforts (2020–Present)

The current phase is distinguished by intensifying, if still incomplete, integration efforts. Rejeb et al., (2021) conducted the first comprehensive bibliometric analysis of sustainability in halal food supply chain research, finding sustainability growing from ~5% to over 22% of HSC publications between 2015–2021. Kurniawati & Cakravastia, (2023) applied operations research perspectives to HSC sustainability, explicitly identifying the absence of green dimension integration as a critical gap. Harsanto et al., (2024) demonstrated how blockchain-IoT infrastructure can simultaneously serve halal traceability and environmental monitoring the key technological convergence enabling GHSC integration. Putri et al., (2024) confirmed the dominance of halal compliance themes in Indonesian HSC research and near-total absence of green dimension integration. Kismawadi, (2024) explicitly positioned halal food industry sustainability as an integrated research agenda. This study synthesizes these Phase 3 contributions into the GHSCF, addressing the remaining integration gap.

2. Determinant Factors of Green Halal Supply Chain

Synthesis of the halal supply chain, green supply chain management, and Islamic environmental ethics literature discussed above identifies three interdependent factor groups constituting GHSC. These dimensions are operationally inseparable: addressing only one or two creates partial improvement likely outweighed by persistent impacts from unaddressed dimensions.

Green Dimension: Environmental Integration

Green procurement requires simultaneous evaluation of supplier Shariah compliance and environmental performance a dual-certification challenge most halal supply chains have not systematically addressed. In the halal context, this means evaluating suppliers on halal-specific criteria (prohibited substances absence, slaughter methods, najis-free operations) and environmental performance (ISO 14001 or equivalent, emissions, waste management, resource efficiency) through integrated audit protocols. The convergence offers efficiency gains: shared site visits and documentation reviews replacing parallel assessment processes. For Indonesian halal food companies sourcing from smallholder agricultural suppliers the majority of the domestic raw material supply base integrated audits must be supplemented with supplier capacity-building programs. This adoption gap is corroborated by a growing body of Indonesia-focused empirical work. Agustina et al., (2023) documented halal supply chain management practices among Indonesian restaurants, while Andespa et al., (2024) identified

persistent structural challenges facing micro and small enterprises implementing halal supply chain management in West Sumatra. Cahyono et al., (2023) found that halal supply chain management practices significantly enhance competitive advantage among halal agroindustry SMEs, and Fajrah et al., (2025) conducted a bibliometric mapping confirming that sustainable halal supply chain research targeting small and medium enterprises remains a comparatively underdeveloped research stream. Silalahi et al., (2022) examined the specific factors shaping Indonesian SMEs' intention to adopt halal practices, while Firdiansyah et al., (2021) proposed an early conceptual model for integrating green supply chain management principles directly into halal supply chain management. Giyanti et al., (2021) further showed that halal standard implementation among food manufacturing SMEs is driven primarily by regulatory and market-access pressures rather than voluntary sustainability motivation a pattern consistent with the coercive-isomorphism dynamic discussed earlier in this study.

Eco-production must integrate SJPH requirements with cleaner production principles. Indonesia's food processing sector is generally understood to operate at meaningfully higher energy intensity than global best-practice benchmarks (MEMR, 2022) representing a plausible efficiency improvement opportunity that would benefit from company-level energy audits to quantify precisely. SJPH's segregated production lines, dedicated halal equipment, and documented cleaning procedures create physical infrastructure that can simultaneously serve halal integrity and contamination prevention for environmental management. An integrated SJPH-ISO 14001-ISO 50001 management system enables co-documentation and co-auditing, reducing compliance costs while improving performance.

Green logistics in the halal context faces the specific challenge of maintaining halal cold chain integrity while reducing carbon emissions. Emerging solutions include GPS-enabled route optimization simultaneously minimizing contamination risk (through reduced handling) and carbon emissions (through fuel efficiency); electric or hybrid vehicles eliminating diesel exhaust contamination concerns for sensitive halal products; and shared halal cold chain infrastructure amortizing both environmental and halal compliance investments across multiple companies. Selim et al., (2022) found that Malaysian third-party halal logistics providers offering environmental management certifications alongside halal certification achieved significantly higher trust scores and client retention suggesting market readiness for GHSC logistics integration.

Waste management must address both Shariah-compliant disposal requirements and circular economy optimization. Islamic jurisprudence provides specific provisions for handling haram by-products (*najis*) that restrict certain conventional recycling pathways. However, Islamic principles of benefit maximization (*al-maslaha*) and *israf* prohibition create strong religious endorsements for circular economy practices: biogas generation from organic halal food waste (Shariah-compliant as energy production), composting of vegetable residuals, and valorization of halal slaughter by-products through dedicated processing channels. Lehtokunnas et al., (2022) demonstrate CE transition requires fundamental social practice change framing waste reduction as religious obligation (*israf* prohibition) could accelerate adoption in Muslim-majority contexts.

Halal Dimension: Integrity, Traceability, and Compliance

Halal assurance in GHSCF goes beyond SJPH certification to proactive management of halal risk throughout increasingly complex supply chains. Tieman, (2011) identifies three halal risk categories requiring management: contamination risk (cross-contact with haram substances), integrity risk (fraudulent labeling), and traceability risk (inability to verify compliance claims). Periodic public reporting from BPJPH and LPPOM MUI on halal fraud and mislabeling cases in Indonesia underscores the continuing operational urgency of robust halal assurance systems that GHSC strengthens through technological traceability; precise trend figures should be drawn from BPJPH's official annual reports as they become available. Risk and resilience considerations further shape this compliance dimension. Kristanto & Kurniawati, (2023) developed a halal supply chain risk management framework specifically for frozen food industries, addressing a segment particularly exposed to cross-contamination and cold-chain integrity risk. At a broader systemic level, Vanany et al., (2021) proposed a supply chain resilience capability framework for mitigating COVID-19-era disruptions, a framework with direct relevance to halal supply chains given their reliance on segregated, often more fragile, logistics infrastructure. Ali et al., (2022) empirically confirmed that supply chain integration significantly strengthens halal food supply chain integrity and food quality performance outcomes, underscoring integration, not merely compliance monitoring as a critical resilience lever.

Halal traceability has undergone a technological revolution directly relevant to GHSC integration. Blockchain-IoT halal traceability systems create immutable, transparent supply chain records simultaneously documenting halal compliance (species verification, slaughter method documentation, ingredient certification) and environmental performance data (carbon emissions per kilogram, water use, energy consumption, supplier ESG scores). Harsanto et al., (2024), in a systematic review of digital technology 4.0 applications in halal supply chains, identify blockchain-IoT traceability as a recurring theme with demonstrated potential to improve both traceability coverage and fraud detection, positioning it as dual-purpose infrastructure serving halal compliance and environmental performance verification simultaneously; the review does not report a single generalizable improvement percentage across implementations, as outcomes vary substantially by technology maturity and organizational context. This technological convergence nonetheless represents one of the more concrete GHSC

integration mechanisms identified in the literature: a single infrastructure investment with the potential to deliver dual halal-environmental performance verification. This convergence is corroborated by a broader body of empirical work: Hew et al., (2020) critically evaluated whether blockchain-based halal traceability represents genuine disruption or overstated hype, concluding that realized benefits depend heavily on organizational readiness rather than the technology alone; Hendayani & Fernando, (2022) found that blockchain adoption measurably improves halal supply chain performance and competitiveness; and Karyani et al., (2024) documented growing Indonesian consumer and regulatory interest in blockchain-based halal certification. Ellahi et al., (2023) systematically reviewed blockchain-based food traceability frameworks more broadly, and Zulihuma et al. (2022) demonstrated practical applications of blockchain in halal supply chain management. Complementing this technology-adoption literature, Handayani et al., (2022) conducted a bibliometric review confirming that halal suppliers play a central, underexamined role in preserving food supply chain integrity, reinforcing the case for supplier-level technology integration within the GHSCF.

Halal compliance requires harmonizing multiple regulatory regimes. Domestically, SJPH under Law No. 33/2014 and Government Regulation No. 39/2021 provides the mandatory framework. Internationally, OIC/SMIIC 1:2019, “General Requirements for Halal Food,” governs halal food trade among OIC member states; as of this writing, this standard does not contain explicit environmental sustainability criteria. Indonesian halal food companies that voluntarily adopt environmental management practices ahead of any future international standard revision would be positioned for first-mover advantage should such a revision eventually occur, though this remains a forward-looking possibility rather than an announced regulatory certainty.

Sustainability Dimension: TBL in the Halal Food Context

Environmental sustainability in the halal food supply chain should prioritize five areas: GHG emissions reduction (consistent with Indonesia's Enhanced NDC 2022 net-zero by 2060 commitment); FLW reduction from 23–48 million tons annually toward SDG 12.3's 50% reduction target by 2030; packaging waste reduction from the current ~22% national plastic recycling rate; water consumption efficiency in food processing (particularly critical in Java, where water scarcity is most acute nationally despite hosting the majority of Indonesia's population and industrial base, in contrast to relatively water-abundant Sumatra, Kalimantan, and Papua); and biodiversity protection in agricultural supply chains, most directly through addressing deforestation linked to palm oil sourcing. Indonesia's dominant food-related deforestation driver alongside broader global commodity-deforestation concerns such as soy and cattle that shape international sustainability standards. Each area has both environmental and Islamic ethics dimensions: water conservation connects to Islamic wudu-related water ethics; biodiversity protection connects to the Quranic prohibition of *fasad* (environmental corruption). Empirical comparisons reinforce this green-dimension argument: M. Ali, (2022) directly compared sustainable food supply chain practices between halal and non-halal food systems, finding measurable differences in environmental performance metrics between the two. These environmental targets align with globally recognized benchmarks; Leal et al., (2023), in their SDG-focused encyclopedic treatment of sustainable consumption and production, situate food loss and packaging waste reduction as central to SDG 12's monitoring framework, directly relevant to the FLW and packaging targets discussed above.

Social sustainability addresses labor rights, food safety, and community welfare throughout the supply chain. The (ILO, 2022) highlights that food and agriculture value chains employ very large numbers of workers globally, with high concentrations of informal labor and unsafe working conditions in processing segments a pattern directly applicable to Indonesian halal food industry SMEs, where informal labor arrangements are common. GHSC social sustainability requirements align with Islamic labor ethics: the Prophet's instruction to 'pay workers before their sweat dries' establishes a religious basis for fair labor standards paralleling ILO core standards. Food safety governance a core SJPH requirement also constitutes a social sustainability obligation, since halal consumers place elevated trust in certified products based on the religious integrity of the certification system (Selim et al., 2022).

Economic sustainability must resolve the perceived trade-off between environmental compliance costs and profitability. Agyabeng-Mensah et al., (2020) demonstrate that green logistics practices can improve financial performance through four mechanisms: cost reduction through efficiency improvements, revenue enhancement through sustainable-product premiums, risk reduction through supply chain resilience, and capital access improvement through ESG investor engagement. For Indonesian halal food companies specifically, at least three contextual economic sustainability drivers plausibly operate, meriting further empirical investigation: (1) potential premium pricing in export markets with strong sustainability expectations (GCC and EU), the precise magnitude of which would need to be established through market-specific pricing studies; (2) the Ministry of Industry's Green Industry Standard (Standar Industri Hijau) incentive scheme, which provides recognition and market-access benefits for certified green manufacturers; and (3) Islamic bank green financing products, such as those offered by Bank Syariah Indonesia (BSI), which could in principle be extended toward preferential rates for GHSC-implementing halal food companies.

3. Philosophical Alignment Between Islamic Ethics and Sustainability Science

A central theoretical contribution of this paper is that the relationship between Islamic halal ethics and contemporary sustainability science is one of deep philosophical alignment rather than mere pragmatic compatibility. This alignment has profound implications for GHSC framework development and adoption: GHSC is not an external imposition of secular sustainability requirements on Islamic practice but an authentic expression of Islamic values that sustainability science has independently arrived at through empirical and philosophical reasoning. Table 4 systematically maps these convergences.

Table 4. Philosophical Convergences Between Islamic Ethics and Contemporary Sustainability Principles

Islamic Principle	Quranic / Jurisprudential Source	Sustainability Science Parallel	GHSC Operationalization
Israf (prohibition of waste and excess)	QS 7:31; QS 17:26–27; widely cited in halal jurisprudence and fiqh al-bi'ah	Zero-waste manufacturing; circular economy waste elimination principle (EMF, 2021)	Food waste reduction targets; packaging minimization; reverse logistics and CE valorization
Khilafah (environmental stewardship)	QS 2:30; QS 6:165; foundational in Islamic environmental ethics literature	Corporate environmental stewardship; planetary boundaries concept (Rockström et al.,	Environmental management systems integrated into SJPH; mandatory green procurement 2009)
La darar wa la dirar (no harm)	Prophetic Hadith (Ibn Majah); foundational Islamic legal maxim across madhabs	Precautionary principle; pollution prevention; externality internalization	Supply chain environmental impact assessment; green supplier audit protocols
Hifz al-bi'ah (environmental preservation)	Extended Maqasid Syariah; Ibn Asyur; Al-Qaradawi; contemporary fiqh al-bi'ah	Environmental sustainability as TBL pillar; SDG 13, 14, 15	Environmental KPIs in SJPH renewal; Green Industry certification for halal manufacturers
Tayyib (wholesome, pure, beneficial)	QS 2:168; QS 5:88; halal-tayyib dual concept in Islamic food ethics	Holistic food quality including ecological footprint; organic and sustainable certification	Integrated halal-tayyib-green certification standard; eco-sourcing requirements
Mizan (balance and equilibrium)	QS 55:7–9; creation ordered in balance that must not be disturbed	Ecological balance; biodiversity conservation; ecosystem services valuation	Sustainable sourcing standards for palm oil, soy, livestock in halal food SC
Ujrah al-ajir (worker justice)	Hadith: 'Pay worker before sweat dries'; QS 4:58; Islamic labor ethics	Social sustainability; living wage; ILO core labor standards (ILO, 2022)	Social audit of halal SC workers; fair labor standards in SJPH extension
Istislah / Maslaha (public welfare)	Al-Ghazali; Al-Shatibi al-Muwafaqat; foundational Islamic legal reasoning	Stakeholder theory; public goods; social impact investing; ESG social pillar	Integrated ESG-halal reporting; community welfare KPIs; social sustainability audit

Source: Author's systematic synthesis drawing on Quran, authenticated Hadith, classical jurisprudence (Al-Shatibi, Ibn Asyur, Al-Qaradawi), and contemporary sustainability science literature.

The philosophical alignment documented in Table 4 has practical adoption implications. Framing GHSC adoption as fulfillment of Islamic religious obligations rather than merely responding to regulatory or investor pressure can activate religious motivation as a more persistent, intrinsically-motivated adoption driver. Research on Islamic ethical consumption (Rehman & Shabbir, 2010) demonstrates that religiously motivated behavior change is more durable and less price-sensitive than economically motivated change. BPJPH's religious authority could be leveraged to issue guidance on the religious obligation of halal food producers to minimize environmental impacts following JAKIM Malaysia's precedent of issuing sustainable halal practice guidance creating an institutional mechanism for GHSC adoption that transcends regulatory compliance.

4. Green Halal Supply Chain Framework (GHSCF)

Based on systematic theoretical synthesis and empirical data integration, this study proposes the Green Halal Supply Chain Framework (GHSCF) a comprehensive five-layer operational architecture for Indonesia's sustainable halal food industry. The framework resolves the fundamental integration challenge by establishing a common normative foundation (Layer 1) that legitimizes both halal compliance and environmental sustainability as manifestations of the same underlying Islamic ethical and sustainability science principles. Table 5 presents the complete GHSCF architecture with operational components, key activities, measurable KPIs, and theoretical grounding for each layer.

Table 5. Green Halal Supply Chain Framework (GHSCF): Five-Layer Operational Architecture

Layer	Core Components	Key Activities	Performance KPIs	Theoretical Grounding
Layer 1: Normative Foundation	Maqasid Syariah; Triple Bottom Line (TBL); Stakeholder Theory; Islamic ethics (israf, khilafah, la darar)	GHSC governance structure development; Islamic sustainability policy; BPJPH-KLHK coordination; stakeholder mapping; Fatwa-based environmental guidance	Syariah compliance index; stakeholder satisfaction score; ESG policy coverage (%); GHSC governance maturity level (1–5)	Maqasid Syariah; Elkington (1997); Freeman (1984)
Layer 2: Halal & Green Inputs	Dual halal-green procurement; halal-certified suppliers with environmental credentials; eco-farming; integrated supplier audit	Integrated SJPH-ISO 14001 supplier evaluation; sustainable agricultural sourcing; supplier capacity building programs; Scope 3 emissions mapping	% suppliers with dual halal-green cert; % eco-sourced raw materials; supplier ESG score; Scope 3 GHG emissions (tCO ₂ e/year)	Sarkis et al. (2011); Tieman (2011); SJPH Gov. Reg. 39/2021
Layer 3: Production Process	Eco-production; halal manufacturing (SJPH); waste minimization; clean technology; energy management (ISO 50001)	Integrated SJPH-ISO 14001-ISO 50001 management system; cleaner production adoption; food waste valorization; halal integrity controls; GHG monitoring	Energy intensity (GJ/ton processed); food waste rate (%); halal compliance rate (%); Scope 1+2 GHG (tCO ₂ e/year); water use (m ³ /ton)	Sarkis & Dou (2017); Fahrudin (2019); EMF (2021); ISO 50001:2018
Layer 4: Distribution & Logistics	Green logistics; halal cold chain; blockchain-IoT traceability; carbon-efficient routing; EV/hybrid fleet	Route optimization (dual halal-carbon); blockchain halal-carbon dual traceability; IoT cold chain monitoring; EV fleet transition; shared halal-green DC	CO ₂ e per unit distributed; halal contamination rate (%); traceability coverage (%); cold chain deviation rate; on-time delivery with halal integrity (%)	Selim et al. (2022); Harsanto et al. (2024); Rejeb et al. (2021)
Layer 5: Sustainable Performance	Environmental, Social & Economic KPIs; integrated ESG+halal reporting; CE outcomes; consumer trust measurement; Green Sukuk eligibility	Annual integrated ESG-halal report (GRI 300/400 + SJPH metrics); CE diversion tracking; GHSC performance dashboard; Green Sukuk documentation; consumer trust survey	ESG composite score (GRI-aligned); halal-green trust index; EBITDA margin; CE material diversion rate (%); FLW reduction vs baseline; sustainability report publication rate	Elkington (1997); Rajgopal (2023); Agyabeng-Mensah et al. (2021); IFN (2023)

Source: Developed by the author through conceptual integration of six theoretical streams discussed in the Theoretical Foundation section. KPIs are illustrative and designed to be broadly compatible with GRI Standard 300/400 and SJPH requirements; they have not been empirically validated and are intended as a starting point for future measurement development, not a finalized reporting standard.

Layer 1 (Normative Foundation) is architecturally critical because it prevents GHSC from being operationalized as two parallel compliance systems one for halal requirements and one for environmental requirements that are administratively burdensome and conceptually fragmented. By grounding both dimensions in a common normative framework (Maqasid Syariah + TBL), Layer 1 establishes that halal compliance and environmental sustainability are expressions of the same underlying obligation: to manage resources, production, and distribution in ways that protect life, preserve the environment, and serve the public welfare. This philosophical unification enables Layers 2–4 operational integration to be driven by consistent principles rather than competing requirements, reducing implementation friction.

Layer 2 (Halal and Green Inputs) addresses the input gap through an integrated audit protocol combining SJPH supplier verification with ISO 14001 environmental management system assessment reducing audit costs through shared site visits and documentation review while generating dual compliance verification. For the Indonesian halal food industry's predominantly smallholder agricultural supply base, the integrated audit approach must be accompanied by supplier capacity-building programs developing smallholder environmental management capabilities alongside halal certification maintenance.

Layer 3 (Production Process) addresses the process gap through simultaneous SJPH and cleaner production management. The key institutional mechanism is an integrated management system standard combining SJPH with ISO 14001 and ISO 50001 (energy management). Energy-intensive equipment such as industrial boilers and refrigeration systems is generally recognized as a major contributor to food processing energy consumption (MEMR, 2022), making it a plausible priority area for efficiency investment, though company-specific energy audits would be needed to establish precise savings potential for any given facility. Malaysia's MS 2400 Halal Supply Chain Management standard series, covering halal logistics and transportation, offers a regional template for formalizing halal supply chain standards that Indonesia could draw upon in developing integrated halal-environmental management guidance.

Layer 4 (Distribution and Logistics) deploys blockchain-IoT integration as the enabling technology for real-time dual halal-environmental performance monitoring. Blockchain provides the immutable record architecture for halal compliance documentation (ingredient sourcing, processing certificates, chain-of-custody), while IoT sensors capture real-time temperature, humidity, and location data for cold chain integrity. Critically, the same IoT infrastructure captures fuel consumption, engine emissions, and route data that feed carbon footprint calculations enabling dual-purpose monitoring from a single investment. Harsanto et al. (2024) identify blockchain-IoT traceability as a recurring and promising theme across digital halal supply chain implementations, with environmental data capture emerging as a secondary benefit in more advanced deployments; systematic, generalizable performance benchmarks across implementations remain an area for future empirical research.

Layer 5 (Sustainable Performance) represents the systemic outcome evaluation architecture of GHSC. Integrated ESG-Halal reporting, combining GRI Standard 300/400 sustainability disclosures with halal-specific performance metrics, could plausibly become an increasingly relevant transparency practice for globally oriented halal food companies as investor ESG expectations, green financing disclosure requirements, and international halal market access conditions continue to evolve though the pace and inevitability of this shift should be treated as a directional expectation rather than a firm timeline. The GHSCF's Layer 5 KPIs are designed to be broadly compatible with GRI Standard 300 (Environmental) and GRI Standard 400 (Social), providing a conceptual starting point should companies choose to pursue integrated halal-sustainability reporting.

5. Three-Tier GHSC Adoption Pathway

Translating GHSCF from conceptual architecture to operational reality requires a phased adoption pathway calibrated to the heterogeneous capabilities of Indonesian halal food companies. Table 6 presents the three-tier model.

Table 6. GHSC Three-Tier Adoption Pathway for Indonesian Halal Food Companies

Tier	Target Companies	Priority GHSCF Layers	Key Actions and Enabling Policies
Tier 1: Foundation	Large halal food manufacturers with existing SJPH and ISO certifications; export-oriented; access to professional management systems	Layers 1–3: Normative foundation; dual supplier audit; eco-production integration	Develop integrated SJPH-ISO 14001 management system; implement green procurement policy; establish GHSC governance committee; publish first ESG-halal report; apply for Green Industry certification (Kemenperin)
Tier 2: Integration	Medium halal food companies with active SJPH; developing	Layers 2–4: Supply chain greening; blockchain-IoT	Invest in blockchain-IoT traceability (via green Islamic financing, e.g. from BSI); develop halal-green

	operations management capacity; regional market focus	traceability; logistics optimization	supplier capacity building program; join an existing Kawasan Industri Halal (Halal Industrial Estate, KIH); seek Green Industry incentive tax relief
Tier 3: Optimization	All certified halal food companies including MSMEs; cooperative clusters; smallholder-integrated halal SCs	Layer 5 and CE: Full performance reporting; CE waste valorization; community social sustainability	Access cooperative GHSC infrastructure sharing (cold chain, traceability platforms); participate in collective ESG-halal reporting programs; BPJPH-Kemenperin MSME capacity building; form halal-green agricultural supply cooperatives

Source: Developed by author as a conceptual proposal based on the literature synthesis presented above. Enabling policies reference Indonesia's Green Industry Standard scheme (Kementerian Perindustrian), SJPH (BPJPH), the sovereign Green Sukuk Framework (Ministry of Finance), and existing Kawasan Industri Halal (Halal Industrial Estates, KIH) such as those in Cikande, Sidoarjo, and Bintan.

Research Implications

1. Theoretical Implications

This study makes four primary theoretical contributions to the supply chain management and Islamic economics literatures. First, the GHSCF represents a novel attempt at a comprehensive operational framework explicitly integrating GSCM, HSC Theory, TBL, CE, ESG, and Maqasid Syariah, responding to the integration gap identified by Kurniawati & Cakravastia, (2023). Second, the philosophical alignment mapping (Table 4) offers a systematic correspondence between Islamic ethical principles and their sustainability science parallels, contributing to Islamic economics theory beyond supply chain management specifically. Third, the three-phase evolutionary map of GHSC concept development provides a structured intellectual history of the field, developed through the literature engagement approach described above. Fourth, the three-tier adoption pathway offers a conceptual model of GHSC diffusion calibrated to company scale, intended as a contribution to operations management theorizing on sustainable practice adoption that future empirical work can test and refine.

2. Managerial Implications

For halal food industry practitioners, GHSCF provides a structured, phased transformation roadmap. As a starting point worth prioritizing, companies could consider Layer 4 (blockchain-IoT traceability) investment, given its potential to simultaneously strengthen halal compliance verification and enable environmental performance monitoring from a single infrastructure investment though “qualifying for Green Sukuk financing” would depend on the specific eligibility criteria of the Green Bond and Green Sukuk Framework and should be confirmed with the Ministry of Finance or relevant financial institutions on a case-by-case basis. Tier 1 companies (large manufacturers) should develop integrated SJPH-ISO 14001 management systems as the institutional foundation. Tier 2 companies should prioritize supplier development programs building halal-green dual compliance capacity across their agricultural supply base. MSME halal food companies (Tier 3) should explore cooperative GHSC infrastructure sharing arrangements collective blockchain traceability platforms, shared halal-green cold chain infrastructure distributing investment costs while enabling collective ESG-Halal reporting and Green Sukuk access.

3. Policy Implications

Four policy recommendations emerge with specific institutional addressees. First, BPJPH should incorporate environmental performance criteria into SJPH renewal requirements initially as voluntary Tier 1 standards, progressively as mandatory requirements following the JAKIM Malaysia precedent. Second, Kementerian Perindustrian should extend the Green Industry Incentive Scheme to explicitly include halal food manufacturers adopting GHSCF, creating financial incentives for integration. Third, OJK (Financial Services Authority) should develop a Green-Halal Sukuk corporate framework enabling halal food companies to access preferential financing for GHSC infrastructure investments. Fourth, BPJPH and KLHK could consider establishing a joint working group to explore the feasibility of a national GHSC credentialing scheme, which, if developed, could enhance the export competitiveness of Indonesian halal food products in premium markets that increasingly expect verifiable sustainability credentials alongside halal certification.

Conclusion

This conceptual paper has addressed its four stated research questions, yielding five principal conclusions with both theoretical and practical significance.

First, GHSC is constituted by three interdependent and operationally inseparable dimensions: the green dimension (green procurement, eco-production, green logistics, waste management), the halal dimension (halal assurance, traceability, compliance), and the sustainability dimension (environmental, social, economic sustainability). Partial adoption addressing only one or two dimensions is insufficient to capture GHSC's systemic benefits and may expose companies to risks from unaddressed dimensions.

Second, the integration of halal ethics and sustainability science has deep philosophical roots established through systematic mapping of eight Islamic principles onto their sustainability science parallels (Table 4). Islamic prohibitions of israf (waste), the concept of khilafah (stewardship), the principle of la darar wa la dirar (harm prohibition), and the Maqasid Syariah objective of hifz al-bi'ah (environmental preservation) are authentic theological precursors of contemporary sustainability science. This philosophical alignment enables GHSC to be positioned as religious obligation potentially activating more durable adoption behavior than regulatory compliance framing.

Third, the empirical data synthesis (Table 1) reveals a structural GHSC adoption gap only 14.2% of certified halal food companies have integrated green supply chain practices alongside converging regulatory (Enhanced NDC 2022), market (ESG capital, Green Sukuk), and competitive (international halal market access conditions) incentives creating conditions for accelerated adoption that the GHSCF operationalizes.

Fourth, the Green Halal Supply Chain Framework (GHSCF) comprising five operational layers grounded in six theoretical streams, with measurable KPIs and a three-tier adoption pathway provides both an academic contribution to supply chain management theory and a practical transformation tool for Indonesia's halal food industry.

Fifth, this paper proposes blockchain-IoT traceability integration as a plausible high-leverage investment point for GHSC implementation, given its potential to simultaneously support halal compliance verification and environmental performance monitoring from a single infrastructure investment; this proposition, like the framework as a whole, awaits empirical testing to confirm its relative return on investment compared to alternative starting points.

Limitations

Four principal limitations bound this study's conclusions. First, as a conceptual paper, the GHSCF and its associated KPIs and adoption pathway are theoretical propositions, not empirically validated instruments; they require future validation through SEM-PLS, ANP quantitative analysis, or case study research before being applied as operational or reporting standards. Second, the study focuses exclusively on the halal food industry; generalization to other halal sectors (cosmetics, pharmaceuticals, fashion) requires sector-specific research. Third, several quantitative figures cited in this paper are time-sensitive and drawn from the most recent publicly available government and institutional reports at the time of writing; readers should consult primary sources directly for current figures. Fourth, because this paper is not a formal systematic literature review, its literature engagement, while carefully sourced and verified, does not claim the completeness or reproducibility of a PRISMA-protocol review; a follow-up systematic review using institutional Scopus/Web of Science access would strengthen the evidence base underlying the conceptual claims made here.

Future Research Agenda

Five priority research directions emerge: (1) empirical GHSCF validation through SEM-PLS with a representative sample of Indonesian halal food manufacturers across company size categories; (2) longitudinal case studies documenting GHSC implementation processes, challenges, and outcomes; (3) development of an integrated SJPH-ISO 14001 management system standard through action research with BPJPH and Kementerian Perindustrian; (4) empirical assessment of green Islamic financing uptake and gaps for GHSC infrastructure investment among Indonesian halal food SMEs; and (5) cross-country comparative study of GHSC adoption trajectories in OIC member states (Indonesia, Malaysia, Turkey, Saudi Arabia) to identify transferable policy lessons.

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