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#### **Abstract**

In the face of global dynamics and growing Muslim consumer awareness of halal products, as well as environmental concerns, the integration of the Halal Supply Chain, sustainability principles, ecological ethics, and Maqasid Syariah (the principles of Islamic law) is becoming increasingly important. The method used is a literature review, which examines research results to provide a comprehensive overview of the development and position of this research compared to existing research. This integration of concepts is intended to encourage macro policies related to the halal industry and will organize micro areas related to company or business actor practices. This article aims to illustrate the interrelationship of these concepts within a mutually supportive strategic framework, resulting in the formulation of an integrated model that not only meets halal standards but is also socially and environmentally responsible within the corridor of Islamic values. The implications can increase consumer trust, strengthen brand image, expand market access, and contribute to sustainable development.

## **INTRODUCTION**

The global halal industry has shown significant growth, particularly in the food, pharmaceutical, cosmetics, and logistics sectors. However, challenges to sustainability and environmental responsibility are increasingly emerging. This necessitates a holistic approach to halal supply chain management, integrating the principles of sustainability, environmental ethics, and the primary objectives of Islamic law (Maqasid Syariah).

These four aspects have a close goal and impact on the comfort and safety of human survival in particular and life in this world in general. The Halal Supply Chain aims to ensure the halalness of products at every stage of production. (Firdaus & Safitri, 2023) Sustainability aims to maintain three key aspects of life in the world: environmental, social, and economic. (Elkington, 1998) Environmental ethics aims to raise awareness that nature is not merely a resource to be freely exploited, but has intrinsic value and must be respected. (Hudha et al., 2019). Maqashid Syariah aims to realize welfare in the world (Kurniawan & Hudafi, 2021). These four concurrent goals are perfectly suited to be combined to ensure the well-being of life on Earth, oriented toward sustainability. In this context, the focus is on integrating these four concepts to encourage halal, ethical, environmentally friendly, and sustainable production activities.

This research refers to several previous studies related to the discussion of the current article and serves as a reference in the analysis, including:

Hasanah and Fahruddin's research, "Analysis of Halal Supply Chain Management (SCM) in the Perspective of Maqashid Syariah," explains that the guarantee of halal products mandated by law can be achieved by implementing halal supply chain management as a whole from upstream to downstream. Policy makers have formulated several critical and strategic factors that can encourage the successful implementation of halal supply chain management in Indonesia, namely: First; The government as a stakeholder formulates several critical factors in drafting a regulation that can encourage the creation of a halal product, namely compiling halal indicators, halal industrial areas, and procedures for granting halal certification. Second, Academics as technology providers are Business actors who have access to fulfilling Sharia finance and information technology. Third, the user community is more concerned and aware of the use of halal products as a form of compliance with sharia (sharia compliance). (Hasanah & Fahruddin, 2021)

In their research, Firdaus and Safitri explained that the Halal Supply Chain Implementation Variable has a positive effect on the performance of food MSMEs in Bekasi Regency. For validity and reliability tests, all statements from the questionnaire fall into this category. Suggestions for food MSMEs in Bekasi Regency must continue to provide good guidance and be able to implement the halal supply chain properly, starting from the production process, the materials used, the transportation process, the storage process, and the handling process are by the halal concept and also continue to pay attention to several important factors, namely technological, organizational, and environmental factors. (Firdaus & Safitri, 2023)

The research regarding the halal supply chain above shows the importance of implementing a halal supply chain in the halal industry.

In their research, Hapsosro and Bangun explain that sustainable development requires that people's needs be met by increasing their production potential while simultaneously ensuring equal opportunities for everyone. This means that economic development that ignores the capacity of natural resources and the environment will lead to future development problems. The main elements supporting economic sustainability are sustainable economic prosperity, equity, and the distribution of prosperity. (Hapsoro & Bangun, 2020) This research reinforces the importance of sustainability in the context of production in order to achieve sustainable economic prosperity, equality, and distribution of prosperity.

The results of Faizah's research explain that in an axiological perspective, the benefits of applying environmental ethics in education that are expected to emerge are the development of students' conceptual knowledge about environmental ethics, the development of procedural knowledge to develop students' skills and capacity in applying the principles of environmental ethics and the three pillars of sustainable development, students are encouraged to develop their personalities into wise and moral people by caring about the environment, the realization of educational interventions for better environmental conditions, successfully developing students' attitudes and beliefs to strive to become humans with environmentally aware knowledge, skills, attitudes and values to shape a sustainable future for future generations. (Faizah, 2020) This research, although in an educational context, is highly relevant because environmental ethics must be built on knowledge, attitudes, and skills. Knowledge of environmental ethics alone will have no impact without an attitude, meaning implementation. The habit of practicing ethical behavior will foster skills in maintaining environmental ethics.

Maqashid Syariah (objectives of Sharia) is a normative approach that emphasizes the protection of five main aspects: religion, life, reason, descendants, and property. In his research, Sofyani, performance measurement using the Maqasid Syariah Index is considered ineffective

because it only covers religious aspects without considering financial aspects. Therefore, this study uses a more comprehensive, new measurement to measure the application of Sharia governance on Maqasid Syariah performance using the Integrated Maqasid Al-Shari'ah Performance Measure (IMSPM) concept.(Deza & Sofyani, 2022)

Regarding asset management, Irwan his research, he argued that the distribution of wealth, by Islamic values in the maqashid sharia, is highly urgent, as hifdzul mal (protecting wealth) encompasses a broad range of aspects, including its management, use, and distribution, so that wealth truly benefits human life. This is because wealth serves not only personal but also social functions.(Irwan, 2021)

From previous research, Maqoshid Sharia as a measurement is less effective because it only covers religious aspects, so it requires scientific integration to be more comprehensive.

The concept integration model in the halal context has been studied by Qanita et.al with the title "Integration of Has With Blockchain As Halal In Maqashid Sharia Perspective" explaining that the integration of blockchain in the implementation of the Halal Assurance System (HAS) is a solution that can be applied to facilitate documentation and traceability of the halal production flow, where this is one of the weaknesses experienced by business actors in obtaining halal certification. In addition, the use of blockchain in HAS can create better transparency so that fraudulent acts in halal production management can be minimized. Blockchain becomes a control system so that halal sustainability continues even after obtaining halal certification so that business actors are not negligent in running their production businesses at all times. Based on the PESTELE analysis, blockchain-based HAS has a great opportunity to encourage the development of the halal industry in Indonesia. However, what may be a challenge lies in the aspect of human error related to integrity and business ethics for the individuals involved. However, when viewed from the perspective of maqashid sharia, the integration of blockchain-based HAS in order to encourage halal sustainability has fulfilled the five aspects of maqashid dharuriyyah, namely hifdz al-din, hifdz al-nafs, hifdz al-'aql, hifdz alnasl, and hifdz al-maal.(Qanita et al., 2024)

The integration in the above research focuses on blockchain integration in the implementation of the Halal Assurance System (HAS), which represents halal sustainability, and is then analyzed from the perspective of maqashid sharia. This clearly differs from the current research, which seeks to integrate broader concepts with environmental ethics.

The current research integrates the four concepts discussed in previous research. This reveals a gap in prior research, as it has not integrated these concepts and has focused on individual concepts and the integration of different concepts. Integration is necessary because the four concepts are aligned, and their integration will further strengthen the concepts, which in turn will strengthen policies related to the halal industry.

This article aims to explore how this integration can strengthen the competitiveness of the halal industry and make a real contribution to sustainable development in line with Islamic values.

#### **METHODS**

This research method employs a literature review approach, which involves an in-depth review of studies and references from articles, books, and research journals.(Andriani, 2022)The objective is to identify and analyze previous studies that discuss each concept: halal supply chain, sustainability, environmental ethics, and magashid sharia. Then, synthesize findings from various

sources to examine the relationship and potential integration between these concepts. Furthermore, develop a model or theoretical framework of integration for the halal industry based on the literature.

#### RESULTS AND DISCUSSION

## **Halal Supply Chain Concept**

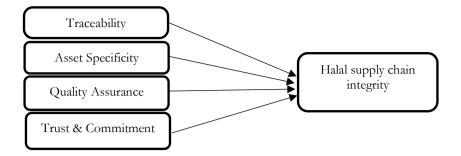
Halal Supply Chain is a supply chain management system that guarantees the halalness of products from the source to the end consumer. (Pramesti & Amir, 2023) It encompasses not only the ingredients but also the production, storage, transportation, and distribution processes. From an Islamic perspective, halalness encompasses not only the substance but also the procedures and intentions involved in every economic activity. Therefore, ethical behavior by producers is essential in carrying out a series of production processes.

In the context of the halal supply chain, there are several important aspects that must be considered to ensure the halal status of a product or service. Some of the elements involved in the halal supply chain include:

- 1. Halal Raw Materials: All raw materials used in production must be halal. This means they must be sourced, processed, and stored according to halal requirements.
- 2. Clear assets (halal sources): all assets that are capital for the production process are assets that are not mixed with non-halal sources.
- Halal Factory, Equipment, and Production Process: The factory or production facility must meet the cleanliness and halal standards set out in Islam, use equipment that is clean and free from contamination by non-halal materials, and be processed according to halal requirements.
- 4. Halal Certification: At every stage of the supply chain, halal certification by a competent authority is required. This certification assures that the product or service meets established halal standards.(Law No. 33 of 2014, nd)
- 5. Halal Storage and Distribution: Halal products must be stored and distributed separately from non-halal products. Proper storage and distribution methods must also be ensured to prevent contamination or alteration of the product's halal status.
- 6. Labeling and Information: Halal labels must be displayed on every halal product or service to ensure consumers can easily identify halal products. Information regarding ingredients, production processes, and halal certification must be available.(IHATEC, 2023)

Fulfillment of the six components above will encourage the implementation of the Halal Supply Chain in the context of the halal industry, in this case food and beverage production, so that the traceability of the production process, quality assurance that is the right of consumers will be truly implemented well, so that the integrity of the Halal Supply Chain will be realized.

The following is a brief overview of achieving a Halal Supply Chain with integrity in food and beverage production activities.(Suastrini, 2023):



## Sustainability Concept

The concept of sustainability includes three main dimensions: economic, social, and environmental. (Elkington, 1998) All three are in line with the principle of maslahah, or public welfare. Sustainable economic activity must consider the preservation of natural resources, the well-being of society, and the equitable distribution of benefits. The economic aspect drives the achievement of economic prosperity, as Hapsoro points out, stating that the three main elements supporting economic sustainability are sustainable economic prosperity and the equitable distribution of prosperity. (Hapsoro & Bangun, 2020), social aspects encourage the achievement of security and peace, and environmental aspects encourage the achievement of environmental sustainability and reduce high carbon emissions. Some examples of the implementation of sustainability in life:

- 1. Islamic economics: prohibition of usury, the necessity of fair transactions, and equitable distribution of wealth through zakat and waqf.
- 2. Agriculture and the environment: The teachings of the Prophet SAW strongly encourage tree planting, water conservation, and not damaging the environment.
- 3. Lifestyle: Islam teaches a simple life (zuhud), avoiding excessive consumption, and prioritizing blessings.

Sustainability in Islam is not a new concept, but an integral part of Islamic teachings. Through the principles of monotheism, caliphate, trustworthiness, and the maqasid sharia, Islam has provided an ethical and spiritual foundation for sustainability, encompassing environmental, social, and economic dimensions. This approach is holistic, sustainable, and equitable.

#### The Concept of Environmental Ethics

Environmental ethics in Islam emphasizes humanity's mandate as caliph on earth. The Quran teaches principles such as moderation (israf), maintaining balance (mizan), and prohibiting damage (fasad). Therefore, supply chain management must also consider carbon emissions, waste, energy efficiency, and resource conservation. Maintenance of the universe is seen as part of maqashid sharia. Thus, basic human needs no longer consist of five basic things (al-kulliyatul al-khamsah) but six (al-kulliyatul al-sittah). Without changing the structure (al-kulliyatul al-khamsah) as initiated by al-Syatibi(Thohari, 2013), but the rules of ushul fiqh can be used, which say:

"(something that mediates the implementation of something obligatory, then it is considered obligatory)".

#### Maqashid Syariah as a Normative Framework

Maqashid al-Shariah is the purpose given by Allah (al-Shari') in every shari'a or law. The purpose of maqashid al-Shari'a is for the benefit of humanity, not for Allah, who created shari'a.(Adzkiya, 2020)

More clearly, maqashid sharia is the desired goal of making a rule. This concept is always associated with Imam Abu Ishaq asy-Syatibi, who is known as the Father of Maqashid Syariah. This concept was popularized in his book Al-Muwafaqat. According to Thahir bin Asyur in his book Maqashid ash-Syariah al-Islamiyah, maqashid sharia are several goals and lessons that serve as the basis for sharia in all provisions of religious law, so these goals are not just for one specific sharia law product. (Nasution & Nasution, 2020.).

The concept of maqashid developed by Asy-Syatibi is based on the priority of human needs, namely, three levels in maqashid sharia.(Waid & Lestari, 2020):

#### 1. Dharuriyyat

Maqashid dharuriyyat is a primary maslahah because it greatly affects human life, both in religious and worldly aspects. Dharuriyyat is the highest level of maslahah. If dharuriyyat is not fulfilled, the welfare of the community will be unstable, or there will be inequality and injustice that damage the social order. In maqashid dharuriyyat, five things must be maintained: hifdz aldin (maintaining religion), hifdz al-nafs (maintaining the soul), hifdz al-'aql (maintaining reason), hifdz al-nasl (maintaining offspring), and hifdz al-maal (maintaining wealth).

## 2. Hajiyat

Maqasid Hajiyat are secondary benefits. Fulfilling them is necessary to make life easier or alleviate hardships. Failure to fulfill them will cause hardship, but not to the point of destroying human life.

## 3. Tahsiniyat

Maqasid tahsiniyat are maslahah (benefit) that are moral demands for goodness and nobility. Failure to fulfill these needs does not lead to harm or hardship. These maqasid are necessary as tertiary needs to improve the quality of human life.

Upholding the principles of sharia (maqashid sharia) is a primary objective that should be prioritized in every business transaction using the sharia system, including in the development of the halal industry through the halal supply chain. Maqashid sharia emphasizes the benefit of all parties. Maqashid sharia can be a benchmark for the suitability of the ultimate goal of a transaction based on the main indicators, namely the maqashid dharuriyyah al-khamsah (hifdz al-din, hifdz al-nafs, hifdz al-'aql, hifdz al-nasl, and hifdz al-maal).

Integration of halal supply chain, sustainability, and environmental ethics must lead to the achievement of maqashid, for example, maintaining health through halal and thayyib food, maintaining environmental sustainability, protecting natural resources as a trust, and creating a fair economic system.

#### **DISCUSSION**

## Integration Model: Halal supply chain, Sustainability, Environmental Ethics, and Maqashid Syariah

This integration model involves four pillars, including:

- Halal Compliance: Sharia-compliant products and processes. The halal supply chain ensures
  that the products or services produced meet halal standards from start to finish in the
  production and distribution process. This involves all relevant parties, from raw material
  suppliers and manufacturers to distributors and consumers, ensuring halal compliance at every
  stage.
- 2. Operational Sustainability: Energy efficiency, zero-waste, and material circularity. Therefore, to maintain the sustainability of production activities, exploitation must be avoided, natural resources must be used efficiently, and production waste must be recycled to create zero-waste and reduce environmental pollution. Ultimately, the circulation of production materials will be maintained stably.
  - The principle of sustainability emphasizes efficient resource utilization, waste reduction, and minimal negative environmental impact. In the context of the halal supply chain, this means prioritizing the use of environmentally friendly raw materials, energy-efficient production processes, and responsible waste management.
- 3. Environmental Ethics: Reducing the ecological footprint and preserving God's creation. Every production activity that uses natural resources will inevitably leave an ecological footprint, but how can this ecological footprint not be a destructive one, but rather an effort to use natural resources while still paying attention to environmental sustainability? Environmental ethics in this context emphasizes moral and social responsibility towards the environment. This includes efforts to preserve nature, avoid overexploitation of natural resources, and protect the rights of other living creatures.
- 4. **Maqashid Sharia**: A normative basis for guiding business policies and strategies. With these five essential principles in mind, human actions in the context of production will be more directed towards achieving well-being, rather than harm or destruction.
  - a. Hifdz al-din

Islamic teachings encourage its followers to always consume halal and wholesome food. This is clearly stated in several verses of the Quran, such as Surah al-Baqarah verse 168, Surah al-Maidah verse 88, and Surah an-Nahl verse 114. Consuming halal products embodies Islamic teachings. Therefore, production activities aimed at ensuring the availability of halal products for the public are also part of upholding the religion. This also includes ensuring the traceability and sustainability of halal production.

### b. Hifdz al-nafs

The integration of the halal supply chain, sustainability, environmental ethics, and Maqasid Sharia to maintain halal product traceability, sustainability (economic, social, and environmental aspects), and ethics in production activities is truly a manifestation of human life protection. Halal traceability ensures halal products from upstream to downstream, the preservation of natural resources, the creation of ample employment opportunities, and a more balanced social life.

## c. Hifdz al-aql

Implementing a halal supply chain can guarantee the certainty of halal products, eliminating concerns about halal contamination. Implementing sustainability can balance socio-economic and environmental aspects. Implementing environmental ethics can change the mindset of business actors regarding resource efficiency.

#### d. Hifdz al-nasl

The implementation of a halal supply chain is also part of the hifdz al-nasl (Islamic way of life). Halal products in circulation can be enjoyed by various groups, including the younger generation. Therefore, ensuring product halalness is also crucial to ensure safe consumption for future generations. Implementing sustainability can achieve ideal social, economic, and environmental aspects, which will undoubtedly produce a quality generation. The application of environmental ethics will safeguard the environment and natural resources, ensuring they continue to be a source of life for the future.

### e. Hifdz al-maal

Islam requires that people spend their wealth in the right way, including consuming halal products. Ensuring product halalness through the implementation of a halal supply chain can be useful in assuring consumers that they are not allocating their funds to non-halal purchases. Similarly, from the perspective of business actors, implementing a halal supply chain as an integral part of hifdz al-maal can reduce production and logistics costs, thereby avoiding wasteful actions. The implementation of sustainability is the implementation of asset protection in general because, in essence, a balanced social, economic, and environmental life is part of valuable assets. The application of environmental ethics is the protection of resources, where producers treat workers with respect for human dignity, and the effective and efficient use of natural resources to avoid wasteful actions.

## Implications of the Integration Model:

1. Increased Consumer Confidence:

By ensuring products are halal and sustainable, this model can increase Muslim consumers' trust in the products and brands that adopt it.

2. Brand Image Strengthening:

Companies that implement this model can strengthen their brand image as socially and environmentally responsible entities.

3. Wider Market Access:

By meeting halal and sustainability standards, companies can reach a wider market, including global markets that are increasingly concerned about environmental and social issues.

4. Contribution to Sustainable Development:

This integration model contributes to the achievement of the Sustainable Development Goals (SDGs) set by the UN.

This model can serve as a guide for companies in establishing a halal supply chain system that is not only competitive but also socially and spiritually responsible.

#### **CONCLUSION**

The integration of the Halal Supply Chain, Sustainability, Environmental Ethics, and Maqasid Syariah (the principles of Sharia) is a strategic approach that is not only relevant to Islamic values but also capable of addressing global sustainability challenges. This approach will foster a blessed, competitive, and environmentally friendly business ecosystem. Policies, standardization, and commitment from various parties are needed to concretely realize this vision.

#### REFERENCE

- Adzkiya, U. (2020). Analisis Maqashid Al-Syariah Dalam Sistem Ekonomi Islam dan Pancasila. *JESI (Jurnal Ekonomi Syariah Indonesia*), 10(1), 23. https://doi.org/10.21927/jesi.2020.10(1).23-35
- Andriani, W. (2022). Penggunaan Metode Sistematik Literatur Review dalam Penelitian Ilmu Sosiologi. *Jurnal PTK dan Pendidikan*, 7(2). https://doi.org/10.18592/ptk.v7i2.5632
- Deza, R. L. R., & Sofyani, H. (2022). Syariah Governance dan Maqashid Syariah di Perbankan Syariah di Indonesia. Reviu Akuntansi dan Bisnis Indonesia, 6(2), 11–34. https://doi.org/10.18196/rabin.v6i2.12857
- Elkington, J. (1998). Cannibals with Forks: The Triple Bottom Line of 21st Century Business. New Society Publishers.
- Faizah, U. (2020). ETIKA LINGKUNGAN DAN APLIKASINYA DALAM PENDIDIKAN MENURUT PERSPEKTIF AKSIOLOGI. *Jurnal Filsafat Indonesia*, *3*(1), 14–22. https://doi.org/10.23887/jfi.v3i1.22446
- Firdaus, F., & Safitri, W. (2023). Analisis Halal Supply Chain Serta Pengaruhnya Terhadap Performance UMKM Makanan di Kabupaten Bekasi. *JEMSI (Jurnal Ekonomi, Manajemen, dan Akuntansi*), 9(4), 1101–1112. https://doi.org/10.35870/jemsi.v9i4.1239
- Hapsoro, N. A., & Bangun, K. (2020). PERKEMBANGAN PEMBANGUNAN BERKELANJUTAN DILIHAT DARI ASPEK EKONOMI DI INDONESIA. *Lakar: Jurnal Arsitektur*, *3*(2), 88. https://doi.org/10.30998/lja.v3i2.7046
- Hasanah, M., & Fahruddin, Abd. R. (2021). Analisis Halal Supply Chain Management (SCM) Dalam Perspektif Maqashid Syariah. *At-Tasharruf Jurnal Kajian Ekonomi dan Bisnis Syariah*', 2(2), 73–80. https://doi.org/10.32528/at.v2i2.5424
- Hoelman et al, M. B. (2015). Panduan SDGs Untuk Pemerintah Daerah (Kota dan Kabupaten) dan Pemangku Kepentingan Daerah (pp. 1–64). International NGO Forum on Indonesian Development.
- Hudha, A. M., Husamah, & Rahardjanto, A. (2019). Etika Lingkungan (Teori dan Praktek Pembelajarannya) (pp. 1–170). Penerbit Universitas Muhammadiyah Malang.
- IHATEC. (2023, June 26). Supply Chain Halal di Indonesia. *Indonesia Halal Training Center*. https://ihatec.com/seperti-apa-penerapan-supply-chain-halal-di-indonesia/
- Irwan, M. (2021). KEBUTUHAN DAN PENGELOLAAN HARTA DALAM MAQASHID SYARIAH. *Elastisitas Jurnal Ekonomi Pembangunan*, *3*(2), 160–174. https://doi.org/10.29303/e-jep.v3i2.47
- Kurniawan, A., & Hudafi, H. (2021). KONSEP MAQASHID SYARIAH IMAM ASY-SYATIBI DALAM KITAB AL-MUWAFAQAT. *Al-Mabsut*, *15*(1), 30–38.
- Nasution, M. S. A., & Nasution, R. H. (n.d.). FILSAFAT HUKUM Islam & Magashid SYARIAH.
- Pramesti, S. D., & Amir, F. (2023). IMPELENTASI HALAL SUPPLY CHAIN MANAGEMENT SEBAGAI STRATEGI PENINGKATAN LABA PADA UMKM DI KABUPATEN BANGKALAN. 08(01).
- Qanita, A., Maghfuroh, N. L., & Muhammad, Z. (2024). INTEGRASI HAS BERBASIS BLOCKCHAIN SEBAGAI HALAL SUSTAINABILITY DALAM PERSPEKTIF MAQASHID SYARIAH. 7(1).
- Suastrini, F. (2023). MANAJEMEN LOGISTIK HALAL. Nusantara Hasana Journal, 2(9), 260–268. https://doi.org/10.59003/nhj.v2i9.838

- Thohari, A. (2013). Epistemologi Fikih Lingkungan: Revitalisasi Konsep Masalahah. E-Journal Fakultas Syariah Dan Ilmu Hukum, 5(2), 146–161.
- UU No. 33 Tahun 2014. (n.d.). Database Peraturan | JDIH BPK. Retrieved 12 June 2024, from http://peraturan.bpk.go.id/Details/38709/uu-no-33-tahun-2014
- Waid, A., & Lestari, N. (2020). TEORI MAQASHID AL-SYARI'AH KONTEMPORER DALAM HUKUM ISLAM DAN RELEVANSINYA DENGAN PEMBANGUNAN EKONOMI NASIONAL. *JURNAL LABATILA*, 4(01), 94–110. https://doi.org/10.33507/lab.v4i01.270