



Rice strategy: Improving sustainable halal agri-food system through green marketing and shifting consumer behavior with a quintuple helix approach

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ABSTRACT

This study aimed to examine the role of RICE strategy (Reinforcement, Influence, Collaboration, and Evolution) in enhancing the sustainability of halal agri-food systems through green marketing and shifting consumer behavior. The significance of halal certification and the growing demand for sustainable food products was examined in the context of Indonesia predominantly Muslim population. The methodology combined a literature review and case study analysis to explore the contributions of various stakeholders including government, academia, industry, civil society, and the environment toward improving halal food production systems. Technological integration, including blockchain, IoT, Lean Knowledge Management (LKM), and digital technologies, were examined as methods for optimizing halal food supply chains and ensuring sustainability. The results showed that key challenges in implementing green marketing, include supply chain inefficiencies, lack of infrastructure, and limited adoption of eco-friendly technologies by MSMEs. In conclusion, this study emphasized the importance of a collaborative approach to overcome obstacles and enhance the global competitiveness of Indonesia halal food industry, while also promoting environmental responsibility and consumer awareness.

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1 Introduction

According to Prayuti & Yuyut (2020), approximately 80% of the population in Indonesia is Muslim. This implies that business actors and the government must ensure the safety of products in accordance with Islamic Sharia law and health standards, including Halal certification. The concept of halal refers to products permissible under Islamic law in line with the Qur'an and Hadith which serve as the basis for regulations in the food industry. These two sources of law provide comprehensive guidance for Muslims globally about halal-compliant food products. In the context of globalization, halal product business is recognized as a significant contributor to the global economy (Yulia & Lady 2015). This underscores the necessity of advancing sustainable halal food farming system, considering that food is a basic human need.

To improve a sustainable halal food farming system, green marketing has been proposed as a strategy that emphasizes environmental values and practices to attract consumers (Romadhona 2024). Shifting consumer behavior also needs to be calculated using the Quintuple Helix approach. This innovation model can overcome the existing challenges of global warming through the application of knowledge due to the focus on social exchange and exchange within a particular state or country subsystem.

2 Methodology

This study was conducted with a qualitative approach, using a comprehensive literature review and case study analysis to explore the role of RICE strategy in promoting sustainable halal agri-food systems through green marketing and shifting consumer behavior. Data were collected from existing studies, government reports, and industry publications to examine the influence of various stakeholders including government, academia, industry, civil society, and the environment on halal food supply chain. Additionally, the integration of technologies such as blockchain, Internet

of Things (IoT), Lean Knowledge Management (LKM), and digital tools was analyzed through a review of relevant technological implementations in halal food systems. The results will offer practical solutions for overcoming challenges in green marketing and improving sustainability within the sector.

3 Factors Influencing Consumer Behavior in Green Marketing Halal Agri-Food

According to Atmaja & Utami (2017), the following seven factors influence consumers purchasing power of organic products.

- Family and lifestyle factor consists of five variables namely family, lifestyle, beliefs, advertising, and education level. It is the dominant factor and can explain data variations, with a variance percentage of 19.587%.
- Habitual and personal factor consists of three variables namely habits, profession, and age. This factor can explain the data variations with a variance percentage of 7.912%.
- Convenience and perception factor consists of four variables including convenience, perception, location, and price suitability. This factor can explain the data variations with a variance percentage of 6.485%.
- The product and promotion factor consists of four variables including label, direct marketing, product appearance, and sales promotion. This factor can explain the data variations with a variance percentage of 5.536%.
- Motivation factor consists of two variables namely motivation and product packaging. This factor can explain the data variations with a variance percentage of 5.110%.
- Service and price factor with two variables, namely service and price, are the final decision. This factor can explain the data variations with a variance percentage of 4.988%.

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- a. Friends and Income factor consists of two variables namely friends and income. This factor can explain the data variations with a variance percentage of 4.662%.

4 RICE Strategy for Improving Sustainable Halal Agri-Food System

RICE strategy represents Reinforcement, Influence, Collaboration, and Evolution. It was designed to strengthen halal food system in Indonesia by emphasizing green marketing and changing consumer behavior. Each element of RICE has a specific focus, particularly reinforcement aims to strengthen the fundamentals of halal industry, influence targets education and consumer behavior towards selecting more sustainable halal products, collaboration fosters cross-sector partnerships, while evolution ensures that the system continues to grow and innovate in line with global trends. To implement RICE strategy effectively, the Quintuple Helix approach which promotes the development of a win-win scenario, was used (Figure 1). This includes ecology, knowledge, and innovation, fostering connections between the democratic, social, and economic spheres (Carayannis *et al.* 2012).



Figure 1: RICE strategy illustration; source: group documentation (2024)

4.1 Government

According to Santoso (2023), the ideal conditions for a new policy differ from those of a halal certification policy. The government plays an important role in strengthening the foundation of halal industry by strengthening regulations, providing incentives for MSMEs to adopt modern production technologies, as well as supporting the development of infrastructure. Utomo *et al.* (2021) mentioned that the government can build an Islamic financial ecosystem in support of halal industry by integrating the financial sector, educational institutions, and collaborations with entrepreneurs. Additionally, green marketing campaigns should be instituted by regulating halal labels and tax incentives for companies that comply with sustainability standards. The government can also fund research and development (R&D) focused on innovation and initiate public-private partnerships to build facilities that meet halal and environmental standards.

4.2 Academia

Educational institutions play a key role in developing curricula that include halal literacy, green marketing, and sustainability. This also includes how IR4.0 could impact halal manufacturers, such as blockchain, IoT, automation, and artificial intelligence (Rahman *et al.* 2023). As pointed out by Haleem *et al.* (2020), academic studies help address challenges in halal supply chain management and certification processes, ensuring product integrity at every stage. Universities also collaborate with industry stakeholders to develop innovative halal products and more environmentally friendly production technologies (Muhammed *et al.* 2015). Therefore, academics can conduct studies to understand consumer behavior regarding halal products and assist the industry with infrastructure needs analyses. These institutions also play a vital role in innovation through R&D focused on new halal products as well as more efficient and environmentally friendly production technologies.

4.3 Industry

Industry players, including MSMEs and large companies, can collaborate to strengthen the competitiveness of halal sector through the application of modern technologies and digitalization in food supply chain management, such as investigating ingredients, slaughterhouses, imported commodities, logistics, distribution, warehouses, and storage (Santoso *et al.* 2023). Thomas (2019) reported that corporate social responsibility initiatives enhance consumer trust and purchase intentions for halal products. Therefore, the industry plays a role in launching

marketing campaigns that emphasize halal and sustainability aspects as well as investing in the necessary infrastructure to ensure products meet standards. Investment in R&D for the development of new halal products and environment-friendly alternatives is also important for maintaining competitiveness in the global market.

4.4 Civil Society

According to Krisna (2023), halal literacy is the knowledge and comprehension of a product by a consumer. This is significant because determining a product halal or haram status entails not only reading the label but also understanding the product. Civil society organizations can run educational programs on the importance of sustainable halal products and provide training on how to check labels and sustainability standards. These organizations also help MSMEs expand the distribution of halal products in remote areas and establish community cooperatives. In addition, civil society plays a crucial role in monitoring halal business practices and advocating policies that support sustainability.

4.5 Rapid Identification of Halal Risk

Blockchain system facilitates the identification and tracking of hazards related to food safety. For instance, blockchain facilitates the rapid identification and recall of products during cross-contamination. By enabling real-time access to a tamper-proof record of the complete history, blockchain technology can assist in resolving the issue of fraud and contamination in SC. A disparity between the recorded data and the actual product can be promptly identified and resolved, thereby reducing the tendency of fraudulent products to reach consumers. This will reduce harm to consumers and preserve the confidence in halal-certified products.

4.6 Environment

Based on the study by Sulaiman *et al.* (2014), millions tons of halal food waste is illegally dumped or landfilled each year, contributing to environmental degradation. To ensure that halal industry is environmentally friendly, concrete steps such as the adoption of clean production technologies and more efficient waste management need to be promoted. Civil society supports greening initiatives around production sites and promotes the upcycling of waste into economically valuable products. These organizations also work with academics to develop eco-certification programs for companies that implement green business practices.

5 Challenges of Green Marketing in Improving Sustainable Halal Agri-Food System

A major challenge in green marketing is how industries can efficiently manage supply chains without adding to the environmental burden. The lack of Lean Supply Chain (LSC) implementation in halal food industry indicates that significant effort is still needed to reduce waste and costs. However, studies have shown that demand collaboration, continuous improvement, and inventory management practices are the most effective tools for implementing LSC to reduce costs and waste (Manzouri *et al.* 2014). It is challenging to adopt green marketing because producers and consumers do not fully comprehend the concept of sustainability. Many manufacturers continue to use traditional, non-green production techniques, and customers are still unaware of the importance of selecting sustainable halal products. When used properly, green production techniques reduce waste and pollution while also producing financial benefits and a positive public image (Seth *et al.* 2018).

MSMEs continue to lag in the adoption of eco-friendly technologies. According to Aqmal (2023), MSMEs face challenges in marketing products through a new eco-friendly marketing strategy that uses technology, as it pertains to comprehension, preparedness, and application of the technology. Marketed items find it challenging to adhere to green marketing guidelines. The lack of laws and infrastructure that enable green marketing presents another challenge. It is challenging to attain the intended outcomes when attempting to promote sustainable halal products through green marketing without sufficient support. This underscores the need for more efforts to increase competitiveness, literacy, and infrastructure support for green marketing in halal food system.

6 Technological Integration in Sustainable Halal Agri-Food Systems

Technological integration plays a crucial role in enhancing the sustainability of halal agri-food systems. This integration entails the use of advanced technologies to improve various aspects of the supply chain from farm to fork, ensuring that halal food products are safe, clean, and environmentally friendly. The following are the key technological integrations that contribute to sustainable halal agri-food systems.

6.1 Blockchain Technology

Blockchain technology plays a critical role in ensuring transparency and traceability within halal agri-food supply chains. According to Hayes (2024), a blockchain is a decentralized digital ledger that securely stores

records across a network of computers in a transparent, immutable, and tamper-resistant manner. Each "block" in the chain contains data, and these blocks are linked chronologically, creating a secure system that is widely known for application in cryptocurrency. However, the potential of blockchain extends beyond cryptocurrencies. In halal food industry, blockchain enables the tracking of halal status, providing assurance that each step in the production process, from raw material sourcing to the final product, adheres to halal standards. As Kurniawan *et al.* (2023) explained, blockchain-based traceability systems are particularly useful in verifying halal compliance and ensuring food safety. By documenting every process, these systems provide a transparent custody chain for halal products. This guarantees that halal integrity and safety of food products are maintained throughout the supply chain, thereby reinforcing consumer trust.

6.2 Internet of Things (IoT)

The IoT is revolutionizing the food industry by enabling various devices, such as sensors and electronic systems, to communicate through an Internet network, thereby facilitating automated processes. According to Sari (2024), IoT connects multiple devices that can perform tasks such as data collection and processing without human intervention. This level of automation offers significant advantages for the monitoring and management of complex systems, including supply chains. In halal food industry, IoT plays a crucial role in maintaining safety standards and ensuring product quality throughout the supply chain. Bigliardi *et al.* (2022) emphasized that IoT helps limit food waste, manage unpredictable variations, and track the quality of foodstuffs, critical for ensuring compliance with halal standards. IoT solutions address not only the technical aspects of food production but also social, environmental, and economic concerns, making it a key technology for enhancing sustainability in halal agri-food systems.

6.3 Lean Knowledge Management (LKM)

Lean Knowledge Management (LKM) plays a crucial role in enhancing the efficiency and effectiveness of operations within halal agri-food supply chains. According to Kristian (2024), LKM aims to reduce waste and increase efficiency in all aspects of production or services provided by a company. By eliminating activities that do not add value, organizations can optimize the value delivered to customers, which is essential in highly regulated industries, such as halal food production. Diniaty *et al.* (2024) emphasized the critical role of LKM in empowering perishable food supply chains (PFSC) to embrace traceability technology. This is particularly important in ensuring the integrity of halal supply chains, as LKM enables these systems to operate more efficiently while maintaining transparency and compliance with halal standards.

6.4 Digital Technologies

Digital technology has fundamentally transformed work operations, communication, and access to information. According to Universitas Cakrawala (2023), digital technology entails the use of computers and electronic systems to process, store, and transmit data electronically. This includes hardware and software that facilitate information management, making digital tools essential in modern industries, including agri-food systems. In the context of halal agri-food systems, digital technologies offer potential solutions for improving sustainability from economic, social, and environmental perspectives. Bahn *et al.* (2021) emphasized that the application of digital technology can enhance the efficiency and sustainability of agri-food supply chains. Nusran *et al.* (2023) outlined the role of mobile applications in improving accessibility for consumers to verify halal status of products. The adoption of digital halal certification not only serves Muslim consumers needs but has also gained global recognition, including from non-Muslim communities. Despite the challenges related to data security and ethical concerns, digital technologies provide a pathway toward a more inclusive, transparent, and halal-compliant food and beverage industry.

7 Conclusions

In conclusion, implementing a RICE strategy is very important for strengthening the sustainable halal food system in Indonesia through green marketing and changing consumer behavior. This strategy aims to strengthen the foundations of halal industry, influence consumer behavior

to select more sustainable halal products, and promote cross-sector collaboration. It is in line with the Quintuple Helix innovation model, which integrates aspects of ecology, knowledge, and innovation to create synergy between democratic, social, and economic elements towards facing global challenges, such as climate change.

Despite the potential, significant challenges hinder the implementation of green marketing in halal food systems. Lack of understanding of poverty, low adoption of environmentally friendly technology by MSMEs, as well as limited infrastructure and regulations are the main obstacles. Overcoming these obstacles requires collaborative efforts among the government, historians, industry, civil society, and the environment. With the right support, Indonesia can increase the competitiveness of halal products in the global market and also promote goodwill towards the environment, making this strategy not only relevant but also urgent.

Conflict of Interest

The authors declare no conflict of interest.

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