

Identifying Halal Critical Points in the Supply Chain of the Halmahera Hydroponic Home Industry

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Abstract

The increasing number of Muslim consumers who are concerned about the halal status of food products has made halal assurance essential, not merely at the level of the finished product but across the entire supply chain. This study sets out to identify Halal Critical Points (HCP) within the supply chain of a hydroponic home-based enterprise, namely Halmahera Home Industry, situated in Kajen District, Pekalongan Regency, Central Java. A descriptive qualitative approach was applied, drawing on field observation and in-depth interviews with the business operator. Eight HCP aspects, namely nutrients and fertilizer, growing media, water source, harvesting tools, cleanliness of the production area, packaging, storage, and distribution, were examined through the lens of the Halal Supply Chain Management (HSCM) framework. The results indicate that all eight HCP aspects within this home-based enterprise have, in principle, been satisfied, despite the absence of formal halal certification. These findings point to the considerable potential of small-scale hydroponic businesses for integration into a wider halal food supply chain, on condition that formal certification is subsequently pursued. This study contributes to the development of a more inclusive halal audit framework intended for micro and small enterprises operating within the urban agriculture sector.

Keywords: Halal Critical Points; Halal Supply Chain; Halal Supply Chain Management; Home Industry; Hydroponics

1. Introduction

1.1. Background

The global halal food industry has displayed a consistently upward trajectory, propelled by the expansion of the world's Muslim population, which has now surpassed 1.9 billion people [7]. Indonesia, as the country with the largest Muslim population worldwide, possesses a halal market potential that is both substantial and strategically significant, not only with respect to consumption but also in terms of production and the export of halal food products. Even so, verifying a product's halal status cannot rely solely on an inspection of its raw materials; rather, confirmation is required at every link of the production chain, from upstream sourcing through to the final point of distribution.

It is precisely within this context that the concept of Halal Supply Chain Management (HSCM) becomes pertinent. Far from being a simple extension of conventional supply chain management, HSCM constitutes a governance framework that embeds halal principles into every stage through which a product flows, encompassing raw materials, production, packaging, storage, and ultimately distribution to the end consumer [1]. Within this framework, the notion of Halal Critical Points (HCP) is introduced as a tool for pinpointing locations along the supply chain that carry the potential for contamination or for violations of halal principles.

The agricultural sector, and hydroponic farming in particular, has frequently been overlooked in discussions of halal food assurance. Yet vegetables and food crops grown hydroponically remain susceptible to contamination through production inputs such as fertilizer, growing media, water, tools, and post-harvest handling procedures. The halal status of a product is determined not merely by the absence of unlawful substances in a direct sense, but equally by the degree to which cross-contamination with unclean (najis) materials is prevented throughout the production chain [2].

Halmahera Home Industry represents one such micro-scale enterprise engaged in hydroponic vegetable cultivation in Kajen District, Pekalongan Regency. The business operates a greenhouse-based cultivation system that relies on AB Mix nutrient solution, rockwool as its growing medium, and water drawn from both well and municipal (PDAM) sources. Although the operation is comparatively small in scale, enterprises of this kind merit particular attention from an HSCM perspective precisely because the entire production process unfolds within a single, directly and comprehensively observable unit.

1.2. Research Gap

Academic inquiry into halal assurance within agricultural supply chains, hydroponic farming included, remains markedly limited. The bulk of existing HSCM research has concentrated on large-scale food processing operations, the halal meat industry, or the logistics sector [3], [4]. Micro-scale enterprises such as home-based hydroponic farms, by contrast, have rarely been examined through a systematic HCP lens, notwithstanding the fact that such enterprises frequently serve as principal suppliers to traditional market vegetable traders, whose produce is ultimately consumed by the wider public, Muslim consumers among them.

This gap becomes even more pronounced when one considers that most home-scale hydroponic operators remain largely unfamiliar with, let alone formally apply, HSCM principles. The absence of accessible technical guidance tailored to micro-enterprises in matters of halal assurance constitutes a distinct challenge that academic research is well placed to address.

1.3. Research Objectives

This study pursues three objectives: (1) to identify the Halal Critical Points (HCP) present within the hydroponic supply chain of Halmahera Home Industry; (2) to assess the extent to which existing production practices align with HSCM principles; and (3) to formulate strategic recommendations enabling home-based hydroponic operators to adopt more formal and standardized halal practices.

2. Literature Review

2.1. The Concept of Halal In Islamic Perspective And Regulation

The term “halal” derives literally from Arabic, signifying that which is “permitted” or “lawful under Islamic law.” Within the domain of food, the concept of halal extends to every dimension connected with the sourcing of ingredients, processing, storage, and distribution, all of which must conform to the requirements of Islamic law (Al-Quran, Surah Al-Baqarah: 168). In Indonesia, halal product assurance is formally governed under Law No. 33 of 2014 concerning Halal Product Assurance, which mandates that every product circulating within the country obtain halal certification on a phased basis [8].

The Halal Product Assurance Agency (BPJPH), as the institution charged with implementing this law, has established that halal assurance extends beyond the finished product to encompass the entire production process. This implies that every input, item of equipment, and procedural step within the production chain must be subject to halal verification [9]. This standard aligns with the guidance set out in the Codex Alimentarius [14] and with international benchmarks established by bodies such as JAKIM in Malaysia [15] and the GSO of the Gulf Cooperation Council.

2.2. Halal Supply Chain Management (HSCM)

Halal Supply Chain Management (HSCM) refers to a supply chain management approach that embeds the principles of halal integrity into every activity and transaction occurring along a product's flow [1]. The concept emerged in response to the limitations inherent in traditional halal certification systems, which verify only the finished product without scrutinizing the entirety of the preceding process.

According to [3], HSCM rests on three principal dimensions: halal integrity, contamination avoidance, and traceability. These three dimensions are mutually reinforcing and must be applied in conjunction with one another to ensure that a product is genuinely halal from upstream sourcing through to final delivery. In practical terms, implementing HSCM demands collaboration among multiple actors across the supply chain, spanning raw material suppliers, producers, distributors, and retailers alike.

Research conducted by [2] demonstrates that the effective implementation of HSCM yields benefits that extend well beyond compliance with halal principles, also serving to strengthen consumer trust, reinforce brand reputation, and open access to high-value international halal markets. This finding lends further weight to the argument that investment in HSCM constitutes not merely a religious obligation but also a sound strategic business decision.

2.3. The Concept of Halal Critical Points (HCP)

Halal Critical Points (HCP) represent an adaptation of the Critical Control Points (CCP) concept found within the Hazard Analysis and Critical Control Points (HACCP) system used in conventional food safety management. Within a halal context, HCP designates specific points in a production process or supply chain at which a significant risk to halal integrity arises, thereby requiring rigorous monitoring and control [4].

Identifying HCP typically involves mapping the entire supply chain process and subsequently evaluating each stage according to its potential risk of halal contamination. Stages carrying a high risk of contamination by unlawful or unclean substances are designated as HCP and must be controlled through clearly defined standard operating procedures (SOPs) [5]. This approach enables producers to allocate monitoring resources efficiently toward the points of greatest criticality.

Within the agricultural sector, HCP identification extends well beyond raw materials alone. The type and origin of fertilizer used, the condition of the growing medium, the quality of the water source, and the methods employed in post-harvest handling and distribution may all constitute critical points capable of affecting the halal integrity of agricultural products [6].

2.4. Hydroponic Farming And Its Relevance To Halal Assurance

Hydroponics is a cultivation method that substitutes nutrient-enriched water for conventional soil as the growing medium. This system has gained considerable popularity among urban farmers owing to its efficient use of land and water, together with its capacity to yield high-quality fresh produce throughout the year, irrespective of seasonal constraints [10], [11].

Viewed through a halal lens, hydroponics possesses distinctive characteristics. On the one hand, the enclosed greenhouse system can minimize the risk of contamination originating from the external environment. On the other hand, reliance on synthetic inputs such as AB Mix chemical fertilizer, whose composition may at times incorporate animal-derived ingredients, calls for more rigorous halal verification. Research by [6] found that certain liquid fertilizers available on the market contain bone extract or other animal-derived substances whose halal status requires clarification.

Furthermore, while growing media such as rockwool, manufactured from volcanic rock fibers, are inherently free of animal-derived content, it remains necessary to confirm that their manufacturing process does not involve additives that raise halal concerns [12]. The same scrutiny applies to irrigation systems, storage containers, and harvesting tools, all of which warrant evaluation from the standpoint of cleanliness and halal integrity.

2.5. Prior Research

Several studies of relevance have been conducted in this field. Reference [3] developed a comprehensive HSCM framework and identified the principal components of a halal supply chain, including risk management considerations and traceability systems. This work has come to serve as one of the most influential theoretical foundations within HSCM scholarship.

Reference [2] examined a medium-scale halal food industry and found that consistent HSCM implementation exerted a positive effect on Muslim consumer satisfaction and on access to halal markets. Reference [4], meanwhile, focused specifically on halal logistics and found that cross-contamination during transportation constitutes one of the most significant yet frequently overlooked HCP risks within the industry.

Within the agricultural domain, [5] analyzed HCP within the organic farming industry and found that production inputs, particularly organic fertilizers derived from animal materials, represent a primary critical point warranting close attention in halal auditing. Reference [6], for its part, examined the application of halal concepts specifically within plant cultivation and underscored the need for more operationally grounded technical guidance for farmers.

3. Research Method

3.1. Research Approach And Design

This study adopts a descriptive qualitative approach employing a single case study strategy. This approach was selected because the research aims to develop an in-depth understanding of how halal principles are applied within the specific context of a home-based industry, rather than to produce statistical generalizations [13]. The case study design enables the researcher to explore, in a holistic manner, the context, processes, and underlying mechanisms that shape the practices observed.

3.2. Research Location And Subject

The research was conducted at Halmahera Home Industry, a micro-scale enterprise engaged in hydroponic vegetable cultivation, located in Kajen District, Pekalongan Regency, Central Java. This location was selected on the grounds that the enterprise typifies the home-based hydroponic industries that have emerged within a predominantly Muslim regency, and because it had not yet obtained formal halal certification despite production practices that could, relatively speaking, be verified.

The research subject was the business operator, who served as the key informant and was interviewed in depth regarding every operational aspect, ranging from the procurement of production inputs through to the distribution process reaching the end consumer.

3.3. Data Collection Techniques

Data were gathered through three complementary techniques. The first was an in-depth interview with the business operator, conducted using a semi-structured interview guide developed around the eight HCP aspects identified from the literature. The second was field observation, undertaken to directly examine the physical condition of the greenhouse, the equipment in use, the harvesting process, and the storage system. The third was documentary review, encompassing proof of purchase for production inputs, the labeling of products used, and visual documentation of the production facility's condition.

3.4. Research Instrument

The principal instrument employed in this study was an interview guide constructed around the Halal Critical Points framework as applied to the agricultural sector. This guide addressed eight central aspects: (1) the halal status of the nutrients or fertilizer used; (2) the condition and origin of the growing medium; (3) the quality and source of irrigation water; (4) the cleanliness and halal status of harvesting equipment; (5) the cleanliness of the production area with respect to contaminants; (6) the type and origin of the packaging used; (7) the conditions and procedures governing product storage; and (8) the methods and procedures employed in distributing products to consumers.

Each aspect was assessed against three parameters: the availability of physical evidence, the consistency of practice, and compliance with HSCM principles. The assessment was conducted qualitatively, with outcomes classified as "Fully Met," "Partially Met," or "Not Met."

3.5. Data Analysis Technique

Data were analyzed using qualitative content analysis with a deductive approach, whereby field data were interpreted against the previously established HCP and HSCM theoretical framework. The analytical process involved data reduction, in which information relevant to the research focus was identified and selected; data presentation, in the form of a systematic HCP evaluation table; and conclusion drawing, based on the patterns and findings that emerged from the analysis.

The validity of the findings was strengthened through source triangulation, in which information obtained from interviews was compared against and verified using field observation and existing documentation. This process ensured that the research findings reflected actual conditions in the field rather than relying merely on subjective claims made by the informant.

3.6. HCP Analysis Framework

The HCP analysis framework employed in this study was adapted from the models developed in [4] and [5], subsequently tailored to the context of home-scale hydroponic farming. The eight HCP aspects evaluated can be visualized as a linear flow extending from production inputs through to the point at which the product reaches the consumer, with each stage carrying the potential to become a contamination point requiring control.

4. Results and Discussion

4.1. Profile Of Halmahera Home Industry

Halmahera Home Industry is a hydroponic vegetable cultivation enterprise operated independently by a single family in Kajen District, which also serves as the administrative seat of Pekalongan Regency. The business runs a hydroponic system combining the Nutrient Film Technique (NFT) and Ebb-and-Flow methods within a simple greenhouse capable of shielding the plants from extreme weather, pests, and external environmental contamination.

The crops cultivated comprise a range of leafy vegetables, including lettuce, pakcoy, spinach, and hydroponic water spinach (kangkung). The harvest is sold directly to household consumers and to vegetable traders in the surrounding Kajen and Pekalongan areas. Although the enterprise's production capacity remains modest, with revenue fluctuating according to season and market demand, it nonetheless demonstrates consistent growth potential as public interest in fresh, high-quality vegetables continues to rise.

4.2. Identification And Evaluation Of Halal Critical Points (HCP)

Drawing on the in-depth interview and field observation, the following presents the evaluation results for the eight HCP aspects examined in this study:

Table 1: Evaluation Results of Halal Critical Points at Halmahera Home Industry

No	HCP Aspect	Halal Indicator	Status	Verification Result
1	Nutrients (Input)	The AB Mix fertilizer used carries a clear brand label and is halal-certified by a trusted manufacturer.	Met	Paramudita-brand AB Mix, already branded and commercially available.
2	Growing medium	Rockwool or other growing media are new, clean, and sterile, free of animal waste.	Met	Infarm-brand rockwool, sterile and fungus-resistant.
3	Water source	Water used is free from waste contamination, impurities, or other unlawful substances.	Met	Water sourced from well and PDAM, meeting clean water standards.
4	Harvesting equipment	Harvesting tools (knives/scissors) are dedicated to plants, cleaned thoroughly, and not used on non-halal products.	Met	Dedicated gardening tools, with no contact with unlawful substances.
5	Area cleanliness	The production area is protected from contamination by unclean animals such as dogs and pigs.	Met	Enclosed greenhouse, preventing entry of animals and pests.
6	Packaging	The plastic wrapping used is new, not recycled from non-halal products.	Met	New plastic, sourced from a trusted supplier.
7	Storage	Products are stored in a clean location, separated from unclean or non-halal items.	Met	Vegetables packaged and stored in a clean, separate location.
8	Distribution	During shipment, products do not come into direct contact with non-halal products within the same vehicle.	Met	Dedicated vegetable distribution, not mixed with other products.

4.2.1. HCP-1: Nutrients and Fertilizer

The first aspect evaluated concerns the type of nutrient solution used in the hydroponic system. Halmahera Home Industry uses AB Mix nutrient solution from the Paramudita brand. AB Mix is a nutrient solution containing macronutrients and micronutrients essential to plant growth, generally formulated from inorganic mineral salts.

From a halal standpoint, inorganic mineral salts are intrinsically free of animal-derived content and are, in principle, halal. Reference [2] cautions, however, that some hydroponic fertilizer manufacturers occasionally incorporate organic supplements, such as fish bone extract or blood meal, that may originate from animal sources into their nutrient formulations. Verifying the halal certification of AB Mix manufacturers therefore remains necessary to ensure that no problematic additives are present.

In this particular case, although Paramudita AB Mix has not explicitly stated halal certification on its product label, its mineral-based composition together with the manufacturer's solid reputation within the hydroponic community provides a reasonable degree of initial assurance. Nonetheless, it remains advisable to follow up with direct confirmation from the manufacturer regarding the halal status of its formulation.

4.2.2. HCP-2: Growing Medium

The growing medium employed is rockwool from the Infarm brand. Rockwool is a mineral fiber produced from basalt and other rocks heated to melting point and then spun into fibers. Rockwool is inherently free of animal-derived content, and its manufacturing process, which involves extremely high temperatures exceeding 1,000°C, effectively sterilizes the product against potential biological contamination.

The Infarm rockwool in use is marketed as sterile and fungus-resistant, indicating that it has undergone a sterilization process during manufacturing. This condition strongly supports halal integrity, since a sterile growing medium minimizes the risk of contamination from pathogenic microorganisms or unwanted organic matter [12]. The practice of using new rockwool for each planting cycle likewise constitutes good practice for preventing cross-contamination between cycles.

4.2.3. HCP-3: Water Source

Water represents the single most dominant component within a hydroponic system, serving not only as the medium through which nutrients are transported but also as the primary growth medium for plant roots. Halmahera Home Industry draws water from two sources, namely a well and the municipal water utility (PDAM). Both sources qualify as clean water meeting the standards set out in Minister of Health Regulation No. 492 of 2010 concerning Drinking Water Quality Requirements [16].

From a halal perspective, water that is clean and free from contamination by unclean or unlawful substances is considered halal and pure (thahir). Well water and PDAM water, under normal conditions, satisfy this criterion. Periodic testing of water quality nevertheless remains advisable to ensure the absence of contamination from drainage systems or other pollution sources nearby that could affect groundwater quality [6].

4.2.4. HCP-4: Harvesting Equipment

The harvesting equipment used consists of knives and scissors dedicated exclusively to gardening activities and never employed in cutting or handling non-halal products. This practice aligns with the cross-contamination avoidance principle central to HSCM.

Reference [4] emphasizes that cross-contamination arising from equipment used interchangeably for both halal and non-halal products constitutes one of the most common yet frequently neglected risks within a halal supply chain. Dedicating specific equipment exclusively to halal products, coupled with regular cleaning procedures, represents an essential step in preserving halal integrity at this particular critical point.

4.2.5. HCP-5: Cleanliness of the Production Area

The presence of a greenhouse as an enclosed cultivation system confers a significant advantage from a halal perspective. The greenhouse effectively prevents the entry of animals capable of contaminating the plants, including animals considered unclean (najis) within Islam, such as dogs and pigs, as well as smaller creatures such as rats that may carry harmful contaminants.

Reference [5] found that enclosed production systems such as greenhouses substantially reduce the risk of halal contamination compared with open-field farming systems. The choice to operate within a greenhouse therefore proves advantageous not only in terms of productivity and crop quality, but also indirectly supports the halal integrity of the resulting products.

4.2.6. HCP-6: Packaging

Hydroponic vegetable products are packaged using new plastic purchased from a trusted supplier. The use of new plastic, rather than used or recycled material, constitutes a minimum requirement for halal food packaging, intended to avoid contamination arising from prior use.

While plastic is generally an inert material that does not react with food under normal conditions, certain types of plastic contain additives such as plasticizers and stabilizers that, at particular concentrations, may migrate into food products. Selecting food-grade plastic that meets food safety standards is therefore a matter warranting further attention from the business operator [9].

4.2.7. HCP-7: Storage

Vegetables ready for sale are stored, already packaged in plastic, in a clean location separated from other items that may carry the potential for impurity. Although simple, this storage system satisfies the fundamental halal storage principle of segregation from non-halal products or items.

Within the context of a home-based business, the challenge of maintaining halal-compliant storage can at times prove difficult given limited space and facilities. Nevertheless, as long as a clear and consistent separation is maintained between the storage area for food products and the storage area for other items, particularly those carrying the potential for impurity, the halal principle of storage can be considered satisfied [1].

4.2.8. HCP-8: Distribution

The final aspect evaluated concerns the process of distributing the product to consumers. Halmahera Home Industry distributes only hydroponic vegetable products and does not combine them with other products during shipment. This means that the risk of cross-contamination during distribution can be minimized.

Reference [4] identifies distribution and logistics as one of the most vulnerable critical points within a halal supply chain, particularly when distribution vehicles are used interchangeably to transport both halal and non-halal products. In the case of Halmahera Home Industry, this risk remains comparatively low given the small scale of distribution and its exclusive focus on vegetable products.

4.3. Risk Analysis And Potential Improvements

Taken as a whole, the evaluation results indicate that all eight HCP aspects at Halmahera Home Industry have, in principle, been satisfied. Several areas nevertheless warrant further attention in order to elevate the quality of halal assurance from the level of informal practice to a formally verified standard.

Table 2: HCP Risk Analysis and Mitigation Recommendations

HCP Aspect	Potential Contamination Risk	Risk Level	Mitigation Recommendation
Nutrients	Use of fertilizer containing animal-derived materials without clear halal status	Moderate	Select MUI halal-certified AB Mix products
Growing medium	Cross-contamination from rockwool previously used for other plants	Low	Use new rockwool for every planting cycle
Water	Water contamination from poorly managed drainage systems	Low	Conduct routine water quality testing and safeguard the source
Equipment	Use of multifunctional tools contaminated with unlawful substances	Moderate	Dedicate specific equipment to halal plant cultivation
Packaging	Use of recycled plastic or plastic containing hazardous additives	Low	Use new food-grade plastic for every harvest

4.4. Potential For Integration Into A Broader Halal Supply Chain

The findings of this study indicate that Halmahera Home Industry possesses a solid foundation upon which to build toward integration into a wider halal food supply chain. Its principal asset lies in production practices that are already substantially aligned with HSCM principles, notwithstanding the absence of formal documentation and certification.

Home-based enterprises of this nature are well positioned to serve as trusted suppliers to halal vegetable retailers, halal-certified restaurants, or even supermarkets committed to halal products. This potential aligns with the trend observed in [2], in which increasingly halal-conscious Muslim consumers have begun to seek out vegetables and agricultural products whose halal status can be verified more comprehensively.

Even so, several concrete steps must be undertaken before formal participation in a halal supply chain becomes possible. First, the operator needs to register the business with BPJPH to obtain halal certification, now accessible through the Self-Declare mechanism designed for micro and small enterprises. Second, a simple yet well-documented internal Halal Assurance System (SJH) should be developed, covering standard operating procedures for each previously identified HCP stage. Third, input suppliers, whether for nutrients or packaging, should be selected on the basis of existing halal certification, thereby strengthening the integrity of the supply chain as a whole.

4.5. Discussion: The Relevance Of HSCM To Micro-Scale Agricultural Enterprises

One of the principal contributions of this study lies in demonstrating that the HSCM framework, hitherto applied predominantly to medium- and large-scale food industries, can and indeed should be adapted for micro-enterprises operating within the agricultural sector. Home-based hydroponic businesses possess distinctive characteristics that, in many respects, actually facilitate the application of HSCM principles, namely a small and tightly controlled scale of production, a short and uncomplicated supply chain, and the direct involvement of the owner across the entirety of the production process, which in turn simplifies monitoring.

This finding lends support to the argument advanced in [6] that small-scale agricultural enterprises in fact hold a comparative advantage in implementing halal principles relative to large industries, provided that operators possess sufficient awareness and commitment alongside operationally clear and accessible technical guidance. What is required is not a complex system but rather one that is consistent and well documented.

Worth noting, however, is the fact that most micro-scale agricultural operators, including the one examined in this study, adopt practices consistent with halal principles not out of formal awareness of HCP or HSCM concepts, but rather as a consequence of habit and religious values already internalized within daily life. This suggests that formal education concerning HSCM need not begin from scratch; it can instead be built upon existing practical foundations by supplying a scientific framework and more structured documentation procedures.

4.6. Business Identity Information And Halal Product Code

In support of the traceability system, one of the principal pillars of HSCM, every business unit within a halal supply chain should ideally possess an identity that can be traced digitally. The Quick Response (QR) code shown in Figure 1 contains identity information for Halmahera Home Industry, serving as a reference point within the halal hydroponic supply chain examined in this study.



Fig. 1: Halal Supply Chain Identity Code – Halmahera Hydroponic Home Industry (Address: Kajen District, Pekalongan Regency, Central Java)

Developing a digital identification system such as this QR code represents a practical and affordable initial step toward building traceability capacity among micro-enterprises. Through a QR code containing business information, consumers and business partners are able to access basic information regarding the producer's identity, location, and halal commitment quickly and conveniently. This step aligns with the recommendation in [9] concerning the development of a more inclusive halal information system accessible to business operators across every scale.

5. Conclusion

This study has successfully identified and evaluated eight Halal Critical Points (HCP) within the supply chain of Halmahera Hydroponic Home Industry in Kajen District, Pekalongan Regency. Overall, the findings indicate that every HCP aspect examined, namely nutrients, growing medium, water source, harvesting equipment, area cleanliness, packaging, storage, and distribution, has, in principle, been satisfied within the day-to-day operational practice of this enterprise.

This condition demonstrates that home-scale hydroponic enterprises such as Halmahera Home Industry hold considerable promise for integration into a broader halal food supply chain ecosystem. The existing foundation of practice constitutes a highly valuable asset, requiring only further formalization, standardization, and improved documentation to achieve formal recognition within the national halal assurance system.

This study further demonstrates the relevance of the HSCM framework and the HCP concept to micro-enterprises within the urban agriculture sector, a segment that has, to date, received comparatively limited attention within the halal food literature. Adapting the HSCM framework into a form that is more operational and more accommodating of small enterprises constitutes an urgent need in the context of empowering micro, small, and medium enterprises (MSMEs) within the halal food sector.

6. Recommendations

Building on these findings, several recommendations are directed toward the relevant stakeholders. For the operator of Halmahera Home Industry, it is recommended to: (1) promptly register the business with BPJPH through the Self-Declare Halal mechanism made available to micro and small enterprises; (2) develop simple, documented standard operating procedures for each identified HCP aspect; (3) ensure that all production input suppliers, particularly for AB Mix nutrients and plastic packaging, hold valid halal certification; and (4) develop a simple traceability system, such as a QR code, containing business identity information and a statement of halal commitment.

For local government and relevant institutions, this study recommends the development of halal mentoring programs specifically directed at micro-scale agricultural operators, hydroponic farmers included. Such programs should be accompanied by operational technical guidance that is not solely grounded in top-down regulation but is also responsive to the actual conditions faced by operators in the field.

For future researchers, it is recommended that the scope of investigation be broadened to encompass a greater number of hydroponic business units across multiple regions, thereby enabling the development of a more comprehensive and representative halal profile map. Developing a standardized HCP evaluation instrument tailored to the hydroponic agricultural sector likewise constitutes an important research agenda warranting further attention.

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