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The Halal Value Model: Integrating Triple Helix Collaboration in the Traditional Food Sector

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Abstract
This study aims to develop a Triple Helix model to strengthen halal values in the Indonesian traditional food industry. It is driven by the observation that halal value has not yet been fully optimized in traditional food production, thereby limiting the sector's growth and competitiveness. This research employed a mixed-method approach by combining qualitative and quantitative techniques. Qualitative data were collected through in-depth interviews with traditional food industry practitioners and regulators to explore key challenges in implementing halal value within the industry. While the qualitative findings were then analyzed and structured quantitatively using the Analytic Network Process (ANP) to construct and prioritize elements within the Triple Helix framework involving government, industry, and knowledge institutions. The results indicate that collaboration among the three actors in the Triple Helix framework serves a critical role in strengthening halal value development. Regulatory support emerges as the most significant solution to address key challenges in the halal value chain. Specifically, supplier-related problems can be addressed through regulations on production standards and raw material supply stabilization. Production challenges require the evaluation and improvement of industry regulations, while marketing challenges can be mitigated through increased media exposure and public awareness. In addition, the lack of halal knowledge among practitioners can be resolved through regulatory-based halal certification training programs. Overall, the study highlights that regulatory reinforcement supported by collaboration between entrepreneurs and government institutions represents the most effective strategy for developing a sustainable halal value model for traditional food industries in Indonesia.

Keywords: *analytic network process; halal value; traditional food; triple helix.*

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Introduction

Halal food refers to food that complies with Islamic dietary standards (Hawwa 2024; Shoid, 2023; Waluyo, 2013). The food industry also has tremendous potential as an alternative driver of global economic growth (Mardhiyah et al., 2023). In a world gripped by uncertainty and market disruptions, the global halal food industry represents a growing and strong market opportunity (Amer, 2024; Boni, 2019). The global halal food market had increased from $1,300.75 billion in 2022 to $1,501.5 billion in 2023 at a compound annual growth rate (CAGsR) of 15.4%. The halal food market is expected to keep growing to $2,583.18 billion in 2027 at a CAGR of 14.5% (Store, 2023). According to the rising Muslim population across the world, it is significantly contributing to the growth of the halal food market (Nawawi, 2020). The Muslim population comprises individuals who adhere to the Islamic faith and its practices. The increasing demand for halal-certified food among Muslims is driven by the assurance it provides regarding food safety and hygiene (Demirci et al., 2016; Rahayu, 2023).

It also signals which food outlets are permissible to be patronized by Muslims (Ezlika, 2022; Ismail et al., 2023). As a result, the halal certification provides manufacturers with an avenue to indicate their target consumers in achieving the Islamic standard (Tubastuvi, 2023; Salindal, 2018). Some food producers opened their minds to halal certification of their products (Silalahi, 2024). It also provides opportunities for big-, medium-, and small-scale businesspersons (Saguy, 2022). To secure a substantial share of both local and global halal market, stakeholders may position themselves either as suppliers of halal-certified food and non-food finished products or as suppliers of raw materials essential for the production and processing of halal goods (Al-mazeedi, 2020; Latif et al., 2014; Salindal, 2018).

The impact of regulation often forces Indonesian traditional food industry business actors to significant cost issues – including registration, auditing, and testing the quality of food (Effendi, 2021; Eva, 2023). Limitations of human power sources, such as personnel, time, and costs on maintenance certification, often involve several complicated documents and requirements and become a difficult burden (Hakim, 2015; Sulistyo, 2015). Traditional foods were processed using techniques rooted in the community's rich cultural heritage(Amer, 2024; Savelli et

al., 2019). Consumers' demand for traditional halal products, particularly foods, continue to expand. However, such foods are still largely prepared in the household level and within the largely unregulated informal food sector (Aworh, 2023). Their production is characterized by slow manual operations, where the processes are not standardized and the quality of the products is variable and often poor (Amer, 2024).

Indonesia is known as one of the most culturally diverse countries in the world (Jawas, 2021; Wardana et al., 2023). This diversity is evident in the richness of its traditional cooking heritage, which varies by region and community. With rapid economic growth, the culinary sector has become an important part of the industrial economy. Recently, the culinary industry, especially traditional food products, has observed significant growth due to rising market demand and the commercialization of local food traditions (Hassoun, 2023). This richness has earned international recognition. According to a global food encyclopedia called Taste Atlas, which provides information about traditional dishes, local ingredients, and authentic restaurants, Indonesian traditional cuisine is ranked as the ninth most popular food in the world, with a score of 4.7 (Aworh, 2023). This global recognition is closely related to the large domestic market of Indonesia. As the country home to the largest Muslim population in the world, Indonesia had an estimated 231 million Muslim citizens in 2021, according to the data provided by the World Population Review (Atlas, 2023). This demographic attribute offers a large potential in the development of halal-based culinary industries, particularly in the traditional food industry (Rachman, 2019).

Indonesia is projected to rank among the top three countries in the global food sector, with its market value expected to increase from US$3.960 billion to US$5.960 billion by 2026, supported by a domestic Muslim consumers base of around 1.5 million (Airlangga, 2024). This confirms Indonesia's role as one of the leading halal food exporters in the world. But the halal certification has generated more awareness among the Indonesian Muslims on the importance of traditional halal food (Katuk et al., 2020; Kurniawati et al., 2019; Purwanto et al., 2021).

Policies and regulations regarding certification are constantly changing and different in each country or sector, supporting a lack of business awareness of benefit certification. Halal certification power is

competitive in Indonesia, and it brings confusion as a reason for obstacles to the Indonesian traditional food industry in creating a halal value chain (Santoso, 2022). In Indonesia, BPJPH (*Badan Penyelenggara Jaminan Produk Halal*), as Halal Assurance Administrator, declares the obligation to guarantee halal products, which are ratified in Law No. 33 of 2014 concerning the guarantee of halal (Rahman, 2023; Megonondo, 2023). In the existing reality, there were several obstacles in the food industry, such as the certification process, which is complicated, creating a halal value chain at home industry food is difficult to achieve (Abror et al., 2019; Stevens, 2022; Maulana, 2022; Aqimuddin, 2023).

Strengthening and optimizing the halal value chain for conventional food products requires proper regulatory support and institutional coordination (Arshad et al., 2019). Past studies have revealed that it is possible to enhance innovation and industrial development through cooperation among different stakeholders, with special emphasis on the Triple Helix concept that focuses on university, industry, and government interactions (Mardhiyah et al., 2023; Rejeb et al., 2023). Evidence has also been established that cooperation among different stakeholders is instrumental in promoting innovation, improving industry competitiveness, and enhancing governance in emerging industries – including the halal industry. In terms of the halal value chain, the Triple Helix concept suggests that universities serve as center of knowledge creation and research-driven innovation, industries are responsible for implementation and process execution, and governments provide regulations. Through such interaction between the three entities, the halal value chain would be strengthened in terms of stages, such as supplier management (supply), storage, processing (production), and sales/distribution (Harsya, 2022). Some previous research works have applied multi-criteria decision-making methods, such as the Analytic Network Process (ANP), in the assessment of complex stakeholder engagements. The use of the ANP enables the assessment of the complex relationships between factors and stakeholders within a network, thus making the method suitable for the assessment of complex collaborative governance arrangements – including the Triple Helix.

Therefore, based on the premises outlined above, the current research aims to develop halal value in the traditional food industry in Indonesia based on the implementation of the Triple Helix principle.

The developed model will be instrumental in addressing the regulatory issues facing the industry and provide strategic solutions for the industry through the application of the triple helix principle, thus fostering the development of a halal environment for the advancement of the traditional food industry in Indonesia (Dashti, 2024).

Literature Review

Halal Food Industry

Food industry growth in Indonesia is encouraging the regulator to develop an innovation mark halal chain through the Micro, Small, and Medium Enterprises (MSME) sector (Rahmadi, 2021). The phenomenon and the previous study found that the food industry's growth in Indonesia initiated to the awareness production of the halal value chain, making a product with integrity, halal safety, and keeps away the signs of halal doubt in it (Sunitiyoso, 2023; Susanty, 2020; Handayani, 2022; Vanany, 2020). There is also previous research which states that food integrity in the halal value chain can be categorized into four dimensions: chain supplies, materials, standard production, service, and consumers (Ali, 2020).

Food industry processed through various techniques and methods of processing, as well as utilize development knowledge and technology (Masruroh, 2020; Rashid, 2020). Therefore, it must go through the halal chain and up to the implementation of halal certification. Indonesia has the largest Islamic population in the world; however, it has not yet attained a leading position as a key player in the global halal products sector, particularly within regional, international, and global levels (Akbar et al., 2023; Lestari et al., 2021). This issue focused on government attention in overseeing the halal industry, particularly in relation to processing techniques, storage, and handling practices. In many cases, concerns arise over the use of preservatives that may contain substances prohibited under Islamic law (Jaelani, 2017).

Halal Value Chain

A value chain initially represents a set of activities performed by focal companies operating in a particular industry (N Masruroh, 2020) to deliver a valuable product or service to the market (Vargas et al., 2020). This aims to identify and connect the various models of a company's activities, identifying the critical factors that create the operating con-

ditions under which the value chain operates – such as infrastructure, policies, regulations, and serves to understand better the company's relationship with suppliers, customers, and others (MacCarthy, 2016; Tripathi, 2023; Yang, 2006). The value chain industry needs sales mapping to track and analyze the contributions of various chains and their surrounding relationships (Hesary, 2022)

Michael Porter's cluster theory emphasizes the importance of geographic concentration of interconnected firms, suppliers, service providers, and related institutions in a given industry (Porter, 1991). The theory has been used to study the competitiveness of industries and the economic development of a given region. Past literature suggests that industries characterized by a cluster model have a substantial positive effect on the economy. For instance, literature on the logistics cluster suggests that using Porter's cluster model to explain the competitiveness of the logistics industry in Asian countries (Chung, 2016).

Similarly, research on industrial clusters has revealed that the interaction between firms and supporting institutions within a cluster increases the rate of knowledge spillovers, innovation, and the formation of new firms (Xu et al., 2022). Empirical research has also revealed that industries located within clusters have a higher rate of employment and wage growth than isolated firms (Campi, 2024). Despite its strong contribution to understanding industrial competitiveness, Porter's cluster theory does not specifically address the development of halal-based industry clusters. The framework primarily focuses on geographic and economic interactions among firms and supporting institutions, without explicitly considering halal governance, certification systems, and religious compliance requirements that are essential within the halal value chain.

The halal cluster would essentially refer to the geographic region or community (Puspita et al., 2023). Various businesses and organizations are involved in producing, processing, and marketing halal products and services. Since Porter's influential study was published in 1998, academics and practitioners have utilized the cluster concept as a common framework when examining clusters for numerous industries. In this context, the value chain cluster model introduced by Porter provides a useful conceptual lens to understand the interconnection

between actors within a halal cluster, as illustrated in Figure 1 (Porter, 1991).

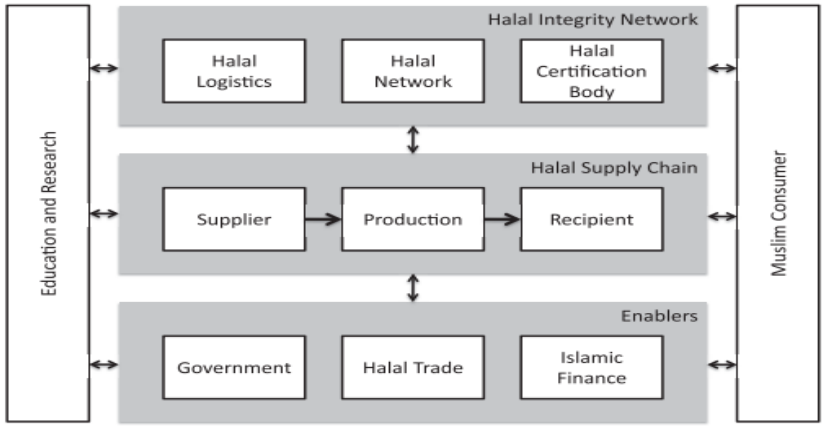

Figure 1. Michael Porter's Value Chain Cluster
Sources: Marco Tieman, 2015

Halal value chain is through Indonesian traditional food and Triple Helix collaboration, as well as the implementation of the halal value chain on products. However, there has been no significant research discussing strategies and efforts to overcome the problems in halal value in Indonesia. Therefore, the researcher takes a position in this study by placing the research focus on the study, mapping, and analysis of the Indonesian traditional food Industry to create the effectiveness of halal value through the Analysis Network Process (ANP) approach for becoming a novelty of this writing (Iqbal, 2022).

Triple Helix Collaboration

The triple helix collaboration of government institutions, businesses, and universities can afford to increase creativity, as well as delivering halal value chain creation and innovation in every area of the traditional food industry (Dewandaru et al., 2021; Etzkowitz, 2011; Figueiredo, 2022). According to Rashid and Mohd Helmi, the aspects, conditions, and mechanisms are considered as the main variables that determine the successful development of the halal value chain in the food industry (Ali, 2020). Those aspects become the important things or foundations and pillars for the realization of halal value in the Indonesian

traditional food industry, which is in line with the halal aspect (Susanty, 2022; Asmiddin et al., 2022; Prabowo et al., 2012).

Universities on the triple helix, according to Asmiddin et al., (2022), Firmansyah et al., (2022) and Leydesdorff (1998) shows that academics or researchers have potential to increase innovation to reach superior competitive halal value in each traditional industry (Asmiddin et al., 2022; Firmansyah et al., 2022; Leydesdorff, 1998). Academics' role in developing human resources can have a positive impact on business actors through field science management or business governance (Etzkowitz, 2008; Leydesdorff, 1998). The Triple Helix approach to business gives awareness to businessmen to create halal value in the product to be distributed (Nawawi, 2020; Musari, 2023; Sri Umiyati, 2020). The government plays a supportive role in creating a halal value chain with enclosed regulations (Nu'man, 2023) . In this context, it functions both as a facilitator and a regulator ensuring the effective implementation and continuous development of halal chains in every industry, including culinary traditions in Indonesia (Vargas, 2019).

Triple helix collaboration involves the interaction between universities, business, and government, emphasizing synergy and strong commitment among stakeholders in carrying out their duties (Mardhiyah et al., 2023; Musari, 2023; Umiyati, 2020; Mathews, 2022). Within this framework, the government plays a pivotal role by providing incentive programs, fostering a conducive business environment, and offering educational guidance to both the society and the private world for supporting creative industry development (Leydesdorff, 1998; Purwanto et al., 2021).

As actors involved in empowering society, the government functions as a facilitator, particularly in providing financial support through industry groups to enhance capacity and quality industry (Sharma, 2022),. It also assumes a supervisory role, exercising regulatory authority and conducting evaluations through activities that involve measuring the sustainable industry (Achmad et al., 2023; Agustina, 2023).

Business is a private actor that presents its infrastructure and as a funder supports changes to the source power people and business processes. Academics function as a drafter standardization as well as

certification of products and skills in human resources (Kurniasih, 2020). Academics also play an important role in holding standard indicators geographically, such as observing the quality results prepared at home industry (Rita, 2020). The triple helix model attempts to account for a synthesis between opposing principles in which new resolutions found that allow several tasks to be accomplished, even as each influences the other, as the Figure 2 (Leydesdorff, 1998).

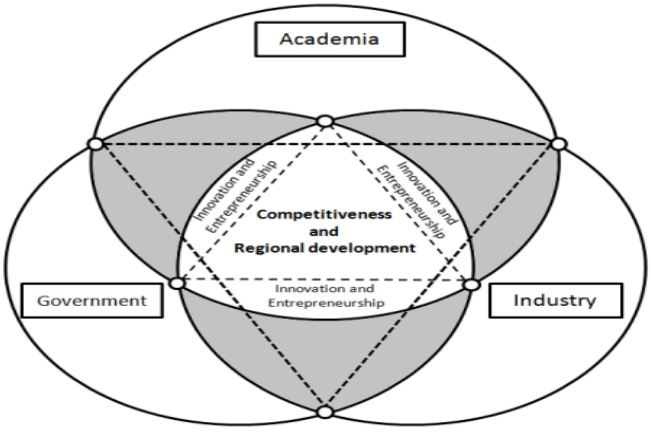

Figure 2. Triple Helix Collaboration Model
Source: Luis Farinha, J. Ferreira, 2013

Method

In this study, a mixed approach was employed through qualitative and quantitative approaches. For the qualitative approach, in-depth interviews were conducted to gain insights into the development of the halal value chain in Indonesia. The data collected were then used in the Analytic Network Process (ANP), converted expert judgments into quantitative data to determine the major factors in the development of a Triple Helix model in the traditional food industry The basis of ANP is structuring complex problems to become framework cluster networks, building comparison pairs (*pairwise comparison*), and switching priority locally from elements in clusters to produce alternatives (Saaty, 1999). The advantage of ANP from another methodology aims to catch something marked or views represented by several experts (Saaty, 2006). The ANP can be used to find the main factors with the most dominant influence and determine the priority order of the study (Ascarya, 2009).

The ANP method obtained data through in-depth interviews and focused group discussions (FGDs) involving experts, practitioners, and regulators (Saaty, 2001). Each FGD consisted of a small group of 3–6 participants to ensure depth of discussion, considering the limited availability of experts in the traditional halal food industry. To enhance analytical clarity and transparency, each participant was assigned a specific code based on their institutional background.

The expert group (E1–E2) consisted of Indonesian traditional food business leaders and halal product analysis experts in halal industry development and pharmacy. The practitioner group (P1–P2) included industry actors and the chair of the traditional food industry association, who are directly involved in production and distribution practices. Meanwhile, the regulator group (R1–R2) comprised representatives from the Halal Product Guarantee Agency (BPJPH) under the Ministry of Religious Affairs, who are responsible for policy formulation and supervision of halal certification (Hasan, 2021). This coding system was applied consistently throughout the ANP analysis to distinguish perspectives, strengthen data triangulation, and improve the rigor of expert judgment aggregation.

Therefore, clear respondent criteria were established to guide the sampling process. The respondents were selected using purposive sampling, whereby individuals with significant expertise and relevant experience in the field were chosen. The research utilized a total of six key informants, consisting of two experts, two practitioners, and two regulators. Each category had two respondents, as the ANP does not require a larger number of respondents due to the nature of the research, which relies on the expertise of the respondents to the research topic. The expert respondents were selected based on their expertise in the development of the halal industry and the analysis of the halal value chain. The practitioner respondents were individuals who are actively engaged in the management and development of economic activities within industries that are associated with Islamic boarding schools. The regulatory respondents were individuals who were responsible for the formulation and regulation of policies relating to halal certification and Islamic economic practices.

There were several sequential stages in this study. *The first*, in-depth interviews and focused group discussions (FGDs) were conducted with competent Islamic boarding school (*pesantren*) economic practitioners, academics, industry actors, and regulators within the scope of the traditional food industry. This stage aimed to identify the main problems, constraints empirically, and causal factors underlying the sub-optimal empowerment of Islamic boarding school–based traditional food enterprises. The interview and FGD results consistently revealed key issues, including limited halal knowledge and skills, supply instability and cross-contamination risks, inadequate storage facilities, non-standardized production processes, low awareness of halal certification, and complicated regulatory procedures.

The second, the empirical findings obtained from the interviews and FGDs were systematically synthesized and translated into problem clusters, sub-criteria, and interrelationships, which then formed the basis for constructing the ANP network framework. At this stage, questionnaires for pairwise comparisons were developed strictly based on the identified empirical factors, and subsequently distributed to experts, halal supervisors, practitioners, and regulators to assess the relative importance and influence among elements within the network. This procedure ensured that the ANP framework was derived from field data rather than researcher assumptions, thereby minimizing subjectivity and potential bias.

The third, ANP analysis was conducted to determine priority problems, solution alternatives, and strategic recommendations for optimizing traditional food industry manufacturing in driving the halal value chain (Fanani, 2022; Saaty, 1999). Overall, this study is expected to substantively contribute to the scientific development of the traditional food industry, serve as a reference for improving Islamic boarding school economic empowerment, and enhance practitioners' awareness of the importance of an integrated halal ecosystem in strengthening the halal value chain in Indonesia, which aims to optimize traditional food industry manufacture (Fanani, 2022; Saaty, 1999). This study is expected to contribute the development of the traditional food industry and serve as a reference in improving the economic empowerment of Islamic boarding schools, while raising practitioners' awareness of the importance of the halal ecosystem in strengthening Indonesia's halal value chain.

The results of extracting information about problems, solutions, and optimizing Triple Helix Regulations in the ANP network structure as shown in Figure 3. After the model structure was validated, the next step was to implement it using Super Decisions software to construct a pairwise comparison questionnaire based on the Analytic Network Process (ANP) method (Saaty & Vargas, 2006). In this stage, respondents compared elements within each cluster to determine their relative influence using Saaty's 1–9 scale. Although the judgments were obtained qualitatively from experts, they were then converted into quantitative priority weights through ANP calculations. The priority weights obtained from each respondent were first tested for consistency to ensure the reliability of the pairwise comparisons. After fulfilling the consistency requirements, the priority values from all respondents were aggregated by calculating the average weight. To examine the level of agreement among respondents, this study applied Kendall's Coefficient of Concordance (W). This coefficient measured the degree of consensus among multiple raters when ranking several elements within a cluster. The value of W ranges from 0 to 1, where W = 1 indicates perfect agreement, while W = 0 indicates no agreement among respondents.

The Kendall's coefficient is calculated using formula as follows:

$$W = \frac{12S}{m^2(n^3 - n)}$$

where:

and :

$$S = \sum_{j=1}^{n} (R_j - \bar{R})^2$$

$$\bar{R} = \frac{m(n+1)}{2}$$

with:

- W: Kendall's coefficient of concordance
- m: number of respondents (raters)
- n: number of objects or elements being ranked
- R_j: total rank of the -th element given by all respondents
- $\bar{R}$: average of total ranks
- S: sum of squared deviations of each element's total rank from the mean rank

Thus, the numerical values generated in this stage are not primary quantitative survey data, but rather quantified expert judgments used to determine priority relationships and the level of consensus among respondents in developing the halal value chain model.

In this case, the data collection technique used interview techniques involving three experts, three regulators, and three industry practitioners who have an understanding of the problems studied. The results of interviews conducted by all the experts formed the ANP framework (model). The data collection technique aimed to distribute the questionnaire to the comparison partner for all informants to get the value priority (weight). Questions in the ANP questionnaire in the form of pairwise comparison (comparison couple) between elements in clusters were used to identify highly influential (more dominant) and differences from one side. A numeric scale of 1-9 was used as the results degree from the verbal assessment (Table 1).

Table 1. Comparison of Verbal Scale and Numerical Scale

Verbal Scale	Numeric Scale
The influence is much greater	9
	8
The influence is greater	7
	6
Greater influence	5
	4
Slightly bigger impact	3
	2
The effect is just as big	1

Sources: Ascarya (2015)

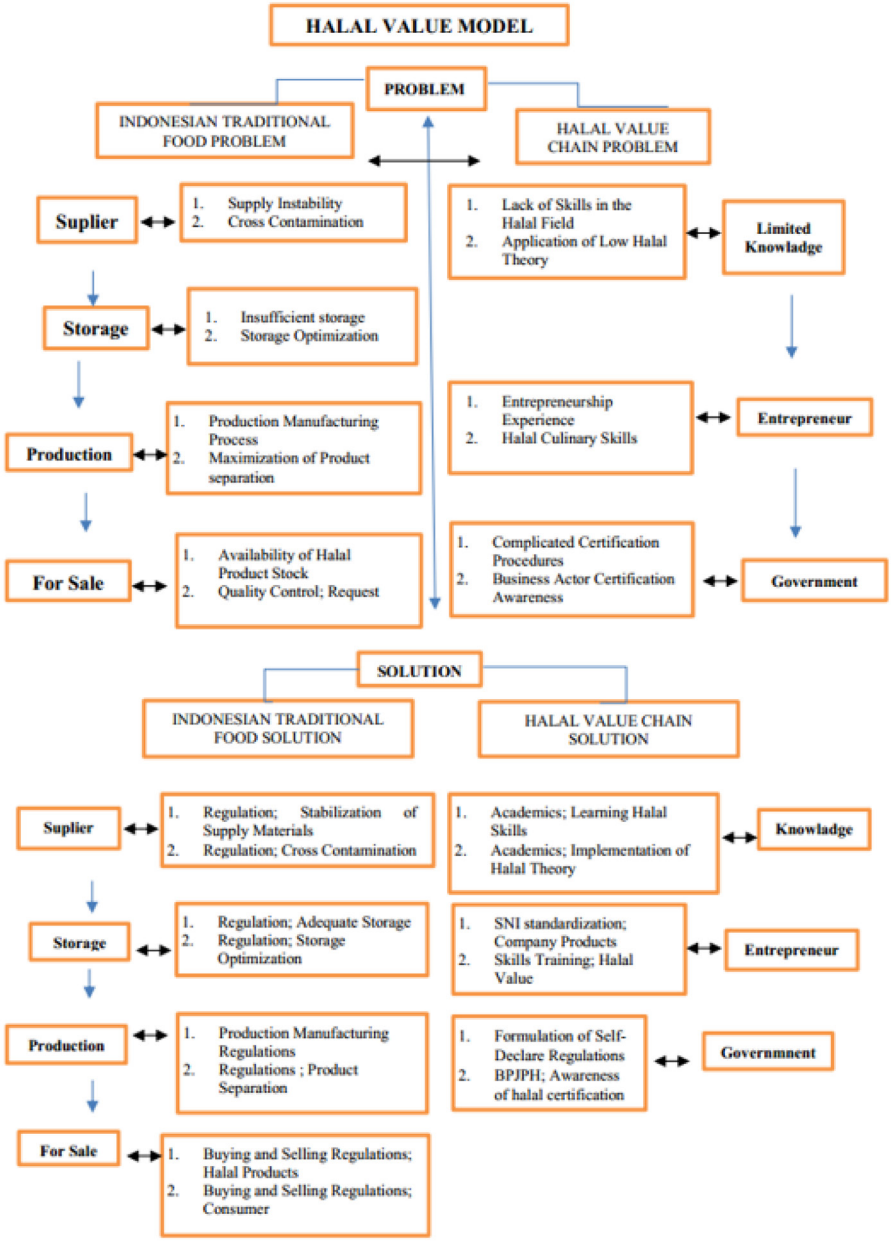

Figure 3. Fabricating Halal Value Model
Sources: Researchers Illustrations

Results and Discussion

Analysis Result of Traditional Food Industry Problems

The ANP results show that supplier-related problems (30%) are the highest priority in the traditional food industry, followed by production (25%), for sale (23%), and storage (21%). This indicates that upstream factors, particularly raw material availability, stability, and contamination risks, serve a more dominant role than downstream issues in shaping the halal value chain (Wibowo, 2020). From a theoretical perspective, these findings strongly support the Triple Helix model, which emphasizes the interdependence of government, academia, and industry in addressing systemic value chain challenges.

Empirically, the prominence of supplier and production issues confirms the relevance of the Triple Helix theory, especially the roles of government as regulator and academia as sources of halal knowledge and standardization, consistent with previous studies (Janahi et al., 2022; Yunita, 2020). However, this study extends the literature by revealing that supplier problems in traditional food industries are not merely technical, but also institutional and regulatory, as confirmed by FGD and interview findings highlighting informal suppliers, unstable raw materials, and halal uncertainty.

These insights explain why supplier-related issues dominate the ANP priorities and demonstrate the strong applicability of the Triple Helix framework in capturing the need for regulatory intervention, halal literacy, and compliance implementation. Nevertheless, the findings also expose a limitation of the classical Triple Helix model, which assumes formalized institutional interactions, whereas traditional food industries are characterized by informality, cultural practices, and resource constraints, particularly at the supplier level (Yunita, 2020).

Accordingly, this study develop a contextual refinement of the Triple Helix model for halal traditional food industries, emphasizing stronger government intervention and targeted halal supervision to address weak institutional capacity at the grassroots level, thereby extending the empirical application of the theory in halal value chain development (Janahi et al., 2022). The priority distribution of problems in the traditional food industry, based on the ANP results, is presented in Table 2.

Table 2. Analysis Result Score (Mean) of Priority Traditional Food Industry Problems

Ind. Traditional Food Industry	All	Mean
Supplier	2.74	0.30
Storage	1.91	0.21
Production	2.26	0.25
For Sale	2.08	0.23

Sources: Researchers Illustrations

The ANP results reveal that structural and capability-related issues dominate the halal value chain. Inadequate halal-compliant storage, systemic weaknesses in manufacturing processes, and the prioritization of product availability over quality control indicate that traditional food producers face infrastructural gaps, limited standardization, and survival-oriented market behavior. These findings support the previous Triple Helix research, highlighting the roles of government regulation, academic knowledge transfer, and industry implementation (Mardhiyah et al., 2023).

However, FGD and interview evidence reveal that informal practices, limited capital, and inherited production habits significantly influence decision-making – exposing limitations of the classical Triple Helix framework. In the capability clusters, limited knowledge, lack of practical halal skills, entrepreneurial experience, and low awareness of halal certification emerge as the main bottlenecks, confirming that human capital and behavioral factors outweigh technological constraints.

Overall, the findings validate and extend the Triple Helix framework and previous study by proposing a context-adaptive, capability-based model, where infrastructural readiness, informal practices, and human capital development are important to strengthening the halal value chain in traditional food industries (Mardiana Firdaus et al., 2022). The prioritization of supplier-related solutions, based on the ANP results, is presented in Table 3.

Table 3. Synthesis Priority of Supplier Solutions in the Traditional Food Industry Based on Average Score (Mean)

Supplier	All	Mean
Regulation: Stabilization of Supply Materials	3.52	0.39
Regulation: Cross Contamination	5.48	0.61

Source: Researcher Processed Data

The ANP results show that within the supplier solution cluster, cross-contamination control (61%) is prioritized over material supply stabilization (39%), indicating that protecting halal integrity is considered more urgent than ensuring raw material continuity. This finding supports the Triple Helix theory, highlighting the complementary roles of government in halal supervision, academia in risk mitigation frameworks, and industry in implementing preventive practices at the upstream level. However, the dominance of cross-contamination solutions suggests that halal risks are not merely logistical but are embedded in behavioral practices and informal supplier relationships, which are only partially addressed by the classical Triple Helix framework. This indicates the need for a more operationalized Triple Helix model that emphasizes daily halal compliance practices.

In the storage solution cluster, the prioritization of adequate storage facilities and storage optimization confirms the relevance of the Triple Helix model, as halal-compliant storage requires regulatory support, academic standard setting, and industry implementation. Nevertheless, the findings also reveal a theoretical gap, as the model does not fully account for resource scarcity and infrastructural readiness in micro- and small-scale enterprises. Overall, the results confirm the earlier study on the relevance of the Triple Helix theory, while also proposing a context-adaptive, halal value chain-oriented framework that incorporates operational risks, infrastructural constraints, and informal industry practices (Dewandaru et al., 2021). The prioritization of storage-related solutions based on the ANP results is presented in Table 4.

Table 4. Synthesis Priority of Storage Solutions in the Traditional Food Industry Based on Average Score (Mean)

Storage	All	Mean
Regulation: Adequate Storage	5.39	0.60
Regulation: Storage Optimization	3.61	0.40

Source: Researcher Processed Data

Based on the geometric mean results, the selected storage solution refers to the Regulation of the Commodity Futures Trading Supervisory Agency of the Republic of Indonesia No. 2 of 2021 concerning Warehouse Technical Requirements or Controlled Atmosphere Storage (CAS). The ANP results indicate that storage adequacy (60%) is prioritized over storage optimization (40%), indicating that the main challenge in the traditional food industry lies in the lack of minimum halal-compliant storage infrastructure rather than inefficiency in existing facilities. Accordingly, Triple Helix collaboration should prioritize infrastructural provision supported by regulation, technical guidance, and industry implementation.

In the production solution cluster, regulatory-based solutions emphasize manufacturing process improvement over product separation, suggesting that systemic production improvements are more critical than technical measures itself. These findings align with the Triple Helix theory, yet also reveal its limitation in assuming formalized industrial settings. Therefore, the results are in line with the previous research that indicates the need for a context-adaptive refinement of the Triple Helix model for informal and resource-constrained traditional food industries (Janahi et al., 2022). The prioritization of production-related solutions based on the ANP results is presented in Table 5.

The ANP calculation results show that the Manufacturing Production solution is 58% and the Separation Production is 42% in the Traditional Food Industry. Therefore, this indicates that Triple Helix collaboration is expected to provide solutions that focus on addressing existing problems in Manufacturing Production and Separation Production.

Table 5. Synthesis Production Solution Priority Based on Average Score (Mean)

Production	All	Mean
Production Manufacturing Regulations	5.18	0.58
Regulations: Product Separation	3.82	0.42

Source: Researcher Processed Data

Analysis of For Sale Solutions in the Traditional Food Industry

There are solutions offered through buying and selling regulations for both producers and consumers. These solutions are analyzed using the ANP method. The results of data processing using Super Decision Software Version 2.10.0, particularly regarding the prioritization of for-sale solutions according to all respondents, are presented in Table 6.

Table 6. Synthesis Priority of For Sale Solutions Based on Average Score (Mean)

For Sale	All	Mean
Buying and Selling Regulations: Halal Products	4.94	0.55
Buying and Selling Regulations: Consumer	4.06	0.45

Source: Researcher Processed Data

The ANP results show that Halal Product Availability Trade Regulation (55%) is prioritized over Product Feasibility Regulation for Consumer Availability (45%) in the traditional food industry. This finding supports the Triple Helix framework, where government trade regulation has a central role in ensuring market access and continuity of halal products, while academia and industry contribute to strengthening product feasibility and consumer trust. The dominance of product availability solutions indicates that market access remains more urgent than post-market feasibility control for micro and small-scale producers.

Theoretically, this result is consistent with the Triple Helix theory and results from other study, which emphasizes the government's strategic role in correcting market constraints and enhancing industrial competitiveness. However, the tendency to prioritize market access over consumer-oriented feasibility also reveals a limitation of the classical Triple Helix model, which does not fully capture survival-oriented behavior in traditional industries (Etzkowitz, 2011).

Overall, the synthesis of halal value chain solutions confirms that government-driven interventions dominate across the value chain, reinforcing the view of government as the key orchestrator within the Triple Helix. This study, therefore, suggests a government-led Triple Helix configuration, adapted to the traditional food industry, where regulatory intervention becomes the primary driver of halal value chain strengthening. The prioritization of halal value chain solutions based on the ANP results is presented in Table 7.

Table 7. Synthesis Priority of Halal Value Chain Solutions Based on Average Score (Mean)

H.V. Chain Solutions	All	Mean
S. Knowledge	2.93	0.33
S. Entrepreneur Experience	1.36	0.15
S. Government	4.71	0.52

Source: Researcher Processed Data

The ANP agreement results show that government-regulator solutions (52%) are prioritized, followed by academic knowledge-based solutions (33%) and industry–entrepreneurial solutions (15%). This pattern reflects the functional roles within the Triple Helix framework, where government acts as the main regulator and supervisor of the halal value chain, academia provides knowledge and capability development, and industry implements operational practices. The dominance of government-led solutions indicates that regulatory intervention remains the most decisive factor in addressing systemic halal value chain challenges in the traditional food industry.

Theoretically, these findings align with the Triple Helix model, which emphasizes interaction among regulation, knowledge production, and industrial application. However, the lower priority of industry solutions reveals structural limitations in traditional food enterprises, particularly limited resources and capabilities, reinforcing the relevance of a government-centered Triple Helix configuration for micro and small-scale industries.

In the limited knowledge solution cluster, the emphasis on academically driven solutions confirms that gaps in halal and legal skills, as well as low implementation of halal theory, are primarily human

capital issues. This supports the Triple Helix assumption that academia serves an important role in knowledge generation and diffusion, as well as suggests that effective halal value chain strengthening requires a knowledge-intensive Triple Helix approach, supported by regulatory frameworks and industry participation. The prioritization of limited knowledge solutions based on the ANP results is presented in Table 8.

Table 8. Analysis Result of Priority of Limited Knowledge Solutions Based on Average Score (Mean)

Knowledge	**All**	**Mean**
Academics; Learning Halal Skills	6.73	0.75
Academics; Implementation of Halal Theory	2.27	0.25

Source: Researcher Processed Data

The ANP calculation results indicate that Halal Product Availability Trade Regulation (55%) is prioritized over Product Feasibility Regulation for Consumer Availability (45%) in the traditional food industry. This finding is consistent with the Triple Helix theory and previous research, which emphasizes the strategic role of government in correcting market constraints and ensuring access to halal products through regulatory instruments. In this context, trade regulation functions as a key mechanism to stabilize supply and expand market reach, while product feasibility regulation reflects the complementary roles of academia in developing feasibility standards and industry actors in ensuring product compliance at the consumer level (Figueiredo, 2022). The dominance of product availability solutions suggests that – for traditional food enterprises, market access, and continuity – remain more urgent than post-market feasibility control, a condition that aligns with the Triple Helix assumption that institutional intervention becomes critical when industry capability and consumer awareness are still developing.

Analysis of Entrepreneur Solution Synthesis Results on the Halal Value Chain

As for the solutions addressing the problems of entrepreneurial experience and skills among culinary business actors, the ANP method was employed to determine their priority levels. The results of data processing using Super Decision Software Version 2.10.0, particularly regarding the prioritization of entrepreneur-related solutions based on respondents' assessments, are presented in Table 9.

Table 9. Analysis Result of Entrepreneur Solution Prioritization Based on Average Score (Mean)

Entrepreneur Experience	All	Mean
SNI standardization; Company Products	5.69	0.63
Skills Training; Halal Value	3.31	0.37

Source: Researcher Processed Data

The Geometric Mean ANP indicates that solution Professionality or Experience Answered entrepreneurship with Constitution No. 20 of 2014 Concerning Development Entrepreneurship produce number agreement by 63 %, and solution Skills Answered entrepreneurship with Regulations About Development National Entrepreneurship produce number agreement by 37 %. This matter, aligned with the Triple Helix collaboration, will provide entrepreneur-focused solutions for creating Halal Value.

Analysis of Government Solution in the Halal Value Chain

As for the solutions addressing the problems of entrepreneurial experience and skills among culinary business actors, the ANP method was employed to determine their priority levels. The results of data processing using Super Decision Software Version 2.10.0, particularly regarding the prioritization of entrepreneur-related solutions based on respondents' assessments, are presented in Table 10.

Table 10. Analysis Result of Government Solution Prioritization Based on Average Score (Mean)

Entrepreneur Experience	All	Mean
SNI standardization; Company Products	5.69	0.63
Skills Training; Halal Value	3.31	0.37

Source: Researcher Processed Data

The result of Mean ANP shows that solution Halal Certification and Awareness is possibly answered with Regulation Minister of Religion No. 20 of 2021 Concerning Halal certification for Micro and Small Business Actors (Permenag 20/2021), produce number agreement by 22 % on Self Declare Regulation and 78% for BPJPH socialization; will raise awareness of Halal Certification. This matter, aligned with the Triple Helix collaboration, will provide solutions focused on the

Regulations Minister of Religion for creating Halal Value (Mardhiyah et al., 2023).

Law No. 18 of 2012 on Food, Article 71 explained that food as all substances derived biological sources, including agricultural, forestry, fishery, husbandry, sea, and water products. Regulation of Commodity Futures Trading of the Republic of Indonesia No. 2 of 2021 concerning Technical Requirements for Warehouses or Storage Places with Warehouse Receipt Systems. Regulation of the Head of the Food and Drug Administration (PerBPOM) No.25/2020 concerning Guidelines for Good Production Practices for Commercial Sterile Food After Packaging.

Regulation of the Minister of Trade No. 18 of 2022 on Guidelines for the Development, Arrangement, and Guidance of Shopping Centers and Self-Service Stores, supported by Fatwa DSN/MUI No. 11/DSN-MUI/IX/2017 of 2017 on Sale and Purchase Agreements; PerBPOM No. 27 of 2017 on Registration of Processed Food; PMA No. 13 of 2022 Concerning Training and Certification Competency of Halal Auditors and Halal Supervisors; and Standardization of Company Products, written in Law No. 20 of 2014 concerning Standardization and Conformity Assessment Article indicate regulations are the objective standard perpetrator business face science and aspects of the output product that will be circulated. Minister of Religious Regulation No. 20 of 2021 on Halal Certification for Micro and Small Business Actors as the principle of Triple Helix collaboration to create Halal Value.

Conclusion

This research aims to develop a Triple Helix model to strengthen halal value in Indonesia's traditional food industry. It is motivated by the fact that the optimization of halal value in traditional food production is not being optimized optimally. For the purpose of addressing the problem, the Analytic Network Process (ANP) was applied to determine the major hindrances, solutions, and strategies for the development of halal value chains with the involvement of universities, industry, and government. The ANP model was developed based on the data from in-depth interviews and focus group discussions with the respondents from the halal industry. The ANP indicators were derived from the major issues that came out from the interview data, such

as halal knowledge, supplier reliability, production processes, storage, market accessibility for the purpose of sale, and regulatory knowledge. The research indicators were classified into clusters such as supplier, production, storage, market for sale, knowledge, and regulation. The research findings revealed that the major hindrance to the development of halal value chains is the limited level of halal knowledge among practitioners, followed by the regulatory issues in production and marketing. This indicates the need for the development of the triple helix for the development of halal value chains in the traditional food industry in Indonesia. Overall, the results confirm that government-led regulatory solutions, reinforced by academic capacity building and industry implementation, provides the most suitable halal value model for traditional food development in Indonesia. By integrating expert judgment, interview evidence, and structured ANP analysis, this study offers a robust and empirically grounded framework for strengthening halal value chains in emerging halal industries.

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