Improving the implementation of Indonesian halal logistics: a statistical approach

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Abstract

In Indonesia, only a limited number of logistics providers have obtained halal certification, despite halal logistics playing a crucial role in preserving product integrity and preventing cross-contamination. This study analyzes the implementation of halal logistics by identifying key variables that influence the availability of halal products in the Indonesian market. Using a quantitative research approach, data were collected through surveys of 108 companies, including 35 logistics service providers and 73 halal-certified MSMEs, as well as semi-structured interviews with logistics service providers and MSME business actors in the food sector. The data were analyzed using multiple regression analysis to identify the most significant factors influencing the availability of halal products. The findings suggest that the availability of halal product information, consistent worker training, and corporate environmental responsibility are the primary variables influencing the availability of halal products. These insights provide a foundation for policymakers to develop regulations that strengthen halal logistics, enabling logistics providers and MSMEs to allocate resources more effectively and maintain halal product availability in the market. As one of the few studies examining halal logistics in Indonesia's food sector, this research contributes to the broader discourse on halal supply chain management and policy development. This study highlights the importance of stronger stakeholder collaboration in enhancing halal logistics sustainability in Indonesia.

INTRODUCTION

The halal industry, rooted in Islamic dietary laws, gained significant economic importance in the late 20th century due to globalization, increased consumer awareness, and government regulations that support halal certification [1]. Beyond food, halal certification now extends to cosmetics, pharmaceuticals, and logistics, shaping the contemporary halal economy [2]. This expansion has driven the industry's growth beyond Muslim-majority nations, creating a substantial global market [3].

Figure 1 illustrates the growth of the global halal economy from 2020 to 2024, showing a significant upward trend. The market value increased from $2.2 trillion in 2020 to a projected $3.2 trillion in 2024, highlighting the rising demand for halal products and services worldwide [4]. According to the Halal Guidebook's second edition, experts predict the global halal economy will reach $3.2 trillion by 2024, with the food and beverage sector leading the way [4].
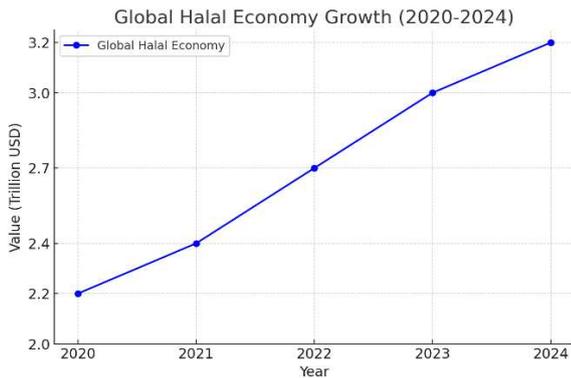
Figure 1. Global Halal Economy Growth Chart (2020-2024)

For Muslims, food must adhere not only to halal standards prescribed by Islamic law but also meet the criterion of tayyib, ensuring it is wholesome and fit for consumption [5]. Cross-contamination poses a significant risk, potentially transforming halal products into non-halal ones, highlighting a unique challenge in the industry [6].

Nugroho et al. [7] refer to this characteristic of halal products as cross-contamination with non-halal products. Cross-contamination occurs due to the discovery of pig DNA, pork, and other ingredients in halal products. Similarly, in 2014, Malaysian authorities discovered non-halal ingredients in Cadbury Malaysia's halal chocolate products [8]. Research on the distribution of halal products is essential to consider the risk of cross-contamination between halal and non-halal products. The risk is the possibility of cross-contamination, where halal products may become non-halal [9]. Consequently, research into the distribution of halal products becomes crucial to mitigate the risk between halal and non-halal items, aiming to prevent halal products from inadvertently becoming non-halal [2].

[10] discovered that Muslim consumers exhibit a high awareness of halal products. Consequently, inadequate management of halal product distribution can result in issues such as scarcity, overstocking, and product damage due to contamination with non-halal items [11]. Damaged products contribute significantly to waste within the supply chain, underscoring the need for strategies to manage the impact of waste resulting from product damage [12]. The implementation of a halal supply chain and effective logistics is crucial to ensure the efficiency and effectiveness of halal product distribution.

The halal supply chain represents a relatively new area in supply chain research, warranting further investigation [13]. Given this context, there is a pressing need for a study that examines the adoption of halal standards by logistics providers in Indonesia. Currently, only a small number of logistics providers in Indonesia have obtained halal certification [14]. However, given the critical role of halal logistics in maintaining the integrity of halal products, it is imperative to conduct comprehensive research and analysis to assess the extent to which logistics providers in Indonesia adhere to halal standards [15]. This study aims to shed light on the implementation challenges and successes of integrating halal requirements into logistics practices within the Indonesian context.

As noted earlier, there has been an increasing demand for implementing halal supply chains (HSC) and halal logistics to ensure the integrity of halal products [7]. [16] have proposed frameworks and models for maintaining HSC integrity. Several key determinants are crucial for the success of HSC, including government support, transportation planning, information technology, human resources, collaborative relationships, halal certification, and halal traceability [2]. The need for a supply chain approach to guaranteeing halal integrity, while investigating barriers to managing HSC effectively. Therefore, halal logistics plays a crucial role in ensuring the halal status of food products [7].

Halal logistics encompasses all activities involved in product distribution, contamination prevention processes, and adherence to Shariah principles [17]. According to Saidah et al. [1], transportation, warehousing, material handling, and procurement activities must comply strictly with halal requirements. Implementing halal storage and transportation practices has a significant impact on a company's financial performance [1]. The necessity of segregating halal and non-halal products during warehousing and transportation to prevent contamination [18]. Key Halal Compliance Points for processed products emphasize the importance of closely monitoring critical aspects, such as storage, warehousing, transportation, and product handling, to maintain adherence to halal standards [19]. Manufacturers are responsible for ensuring products are produced in accordance with halal standards and that there is no cross-contamination with non-halal materials [20]. To authenticate halal meat products, the implementation of halal supply chains and verification methods is crucial for ensuring the authenticity of these products. These measures ensure that products meet halal requirements throughout the entire production, distribution, and consumption process.

Several barriers hinder the widespread adoption of halal logistics certification in Indonesia. Regulatory challenges, including the complexity of obtaining halal certification and the lack of standardized enforcement mechanisms, have contributed to slow adoption rates [21]. Additionally, logistical costs associated with maintaining halal compliance, such as dedicated storage, transportation segregation, and certification fees, create financial burdens for logistics providers, particularly small and medium enterprises [22]. Furthermore, awareness among logistics companies regarding the importance of halal compliance remains relatively low, resulting in inconsistent implementation of halal logistics practices [21].

Furthermore, all logistics companies need to use materials derived from halal sources when packaging halal products. Talib et al. [23] conducted a study focusing on halal practices within the poultry processing industry, revealing that the use of halal animal feed, adherence to proper sharia-compliant slaughter methods, and appropriate post-slaughter processes (including handling, packaging, transportation, and storage of poultry products) are crucial factors determining halal integrity in this sector [24].

The capabilities of halal logistics play a critical role in maintaining halal integrity throughout the supply chain, from farm to consumer [1]. Therefore, ensuring the complete separation of halal and non-halal products during logistics operations is necessary to guarantee the halal status of a product [25]. This practice shields halal products from contamination with non-halal items or substances until they are delivered to the consumer [26]. In conclusion, the implementation of halal logistics is pivotal in assuring the integrity of halal products. This involves rigorous adherence to halal standards and practices throughout the logistics process to uphold the sanctity of halal products from production through distribution and consumption.

Conducting a study to analyze the implementation level of logistics providers will enable an assessment of how well logistics providers in Indonesia implement halal standards. This study aims to derive valuable insights and lessons learned that can inform the formulation of policy proposals for halal logistics in the country. The research will contribute by examining and analyzing the current state of halal logistics implementation in Indonesia, thereby providing a basis for developing policy recommendations to enhance adherence to halal standards within the logistics sector. Despite the growing importance of halal logistics, there is a lack of comprehensive studies analyzing the actual implementation level of halal standards among logistics providers in Indonesia. Previous studies have primarily focused on conceptual frameworks or case studies with limited scope, leaving a research gap in assessing the practical adherence and challenges faced by logistics providers.

METHOD

This study employs a quantitative approach to examine logistics service providers and MSMEs in Indonesia. The research utilizes a random sampling method to ensure representativeness in data collection. The selected samples include business operators from the logistics sector and MSME-level business actors from the food sector in Indonesia. The sample data are collected through randomization. To provide an overview of the research stages, a summary of each step in the research methodology is provided, offering a comprehensive explanation of each stage described in Figure 2. Refer to the figure; the literature review is done to develop questionnaires. The questionnaires are used to collect data from respondents. The first step in collecting data is a pilot study to determine the validity and reliability of the data, ensuring the validity and reliability of the questionnaires. Then, the questionnaires are used to collect data until the number of required samples (respondents) is obtained. After that, data processing, analysis, and interpretation are conducted to draw conclusions and provide recommendations.
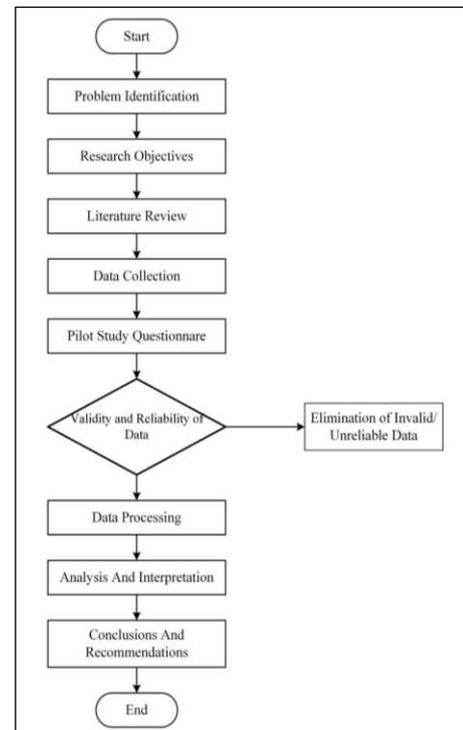

Figure 2. Research flow diagram

In this study, the population consists of logistics service providers in Indonesia. At the same time, the selected samples comprise business operators in the logistics service sector and MSME-level business actors in the food sector in Indonesia. The sample was drawn using a random sampling method to ensure that each entity had an equal chance of being selected, thereby ensuring the study's results are representative of the broader population. This research sampled a total of 108 companies, consisting of 35 logistics service companies and 73 MSME-level companies that have obtained halal certification. This study relies on primary data obtained directly through questionnaire-based assessments by the researchers and secondary data, including R-table information, halal logistics elements, and questionnaires related to halal logistics.

Data collection in this study used observation, interviews, and questionnaires. The observation was conducted by directly examining the company's production flow and overall condition. This approach allowed the researchers to understand the flow of the company's supply chain. The research process consisted of three main phases. The data collection phase, conducted from January to March 2024, involved observing, interviewing, and distributing questionnaires to logistics service providers and MSMEs. This was followed by the data analysis phase, which took place from April to June 2024, during which responses were processed, statistical tests were performed, and a multiple regression analysis was conducted to identify key influencing factors. Finally, the results interpretation and report writing phase, conducted from July to August 2024, focused on analyzing findings, drawing conclusions, and preparing the final research documentation.

Interviews were conducted with five company owners from the logistics sector and seven MSME representatives who had obtained halal certification. Each interview lasted 30–45 minutes and focused on four key topics: procurement processes, production flow, distribution methods, and product return management. The interview questions covered procurement, production, distribution, and product returns. The insights gained from these interviews were later used to design the questionnaires.

The questionnaire method involved distributing a list of questions for respondents to complete. The questionnaires used a Likert scale ranging from 1 to 5, where 1 represents "strongly disagree," 2 represents "disagree," 3 represents "neutral," 4 represents "agree," and 5 represents "strongly agree."

Validity Test

Validity refers to the extent to which a measuring instrument accurately measures what it is intended to measure. A valid instrument effectively demonstrates this by reliably assessing the desired constructs or variables. In conducting a validity test, researchers typically perform a data sufficiency test at a 5% significance level (α) and a 95% confidence level, resulting in a critical Z-value of 1.96. The error rate (e) is set at 10%. The assumption is that the population probability of being sampled is 0.5. This test determines whether the collected data is adequate for further analysis and interpretation, utilizing formulas such as those described, particularly relevant in contexts where the number of small and medium enterprises is dynamic.

Moreover, Pearson's product-moment correlation analysis is commonly employed to assess the relationship between individual item scores and the total score. This analysis helps determine whether the questions effectively measure the underlying constructs. Firdaus [19] suggests using the Pearson product-moment formula to evaluate validity, where if the calculated correlation coefficient (r) is greater than the critical value (r table), the variable is deemed valid; otherwise, it is considered invalid. In summary, validity testing ensures that the instrument used accurately measures the intended variables or constructs [27], employing statistical methods to validate the instrument's effectiveness and reliability in research studies.

Reliability Test

A reliability test assesses how consistent the measurement results are when repeated on the exact symptoms multiple times [2]. Use a measuring tool with the Cronbach Alpha technique in this reliability test. If a variable is worth measuring, r => 0.60, it is said to be reliable. Meanwhile, if a variable is worth a count <0.60, it is said to be unreliable.

The normality test determines whether the data distribution follows or approaches a normal distribution. The Kolmogorov-Smirnov test is one of several tools used to test for normality [28]. The Likert scale is a tool used to measure the attitudes, opinions, and perceptions of individuals or groups regarding social phenomena [2].

Multiple regression analysis examines the relationship between a dependent variable (Y) and multiple independent variables (X_1, X_2, ..., X_n), making it suitable for assessing the factors that influence halal-certified logistics services. This method helps identify key determinants of logistics efficiency and service availability. The process begins with data collection that meets classical

regression assumptions, followed by model formulation $Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + ... + \beta_nX_n + e$. Hypothesis testing evaluates the significance of coefficients, and residual analysis ensures compliance with the assumptions. The results are interpreted through regression coefficients and R^2, which measures the model's explanatory power. A higher R^2 value indicates that the independent variables better explain variations in the dependent variable. This approach provides a structured analysis for policymakers and logistics providers to enhance the implementation of halal logistics.

This study aims to address the following research questions: (1) What are the key factors influencing the successful implementation of halal logistics in Indonesia? (2) What are the main challenges logistics providers face in obtaining halal certification? (3) How does the implementation of halal logistics impact the efficiency and integrity of halal product distribution? However, this study has some limitations. First, although the sample size is representative, it may not fully capture regional variations in logistics operations. The remainder of this paper is structured as follows: Section 2 provides a review of the existing literature on halal logistics and supply chain management. Section 3 discusses the research methodology used in this study. Section 4 presents the findings and analysis of halal logistics implementation in Indonesia. Finally, Section 5 concludes the study with key insights, implications, and recommendations for policymakers and industry stakeholders.

RESULT AND DISCUSSION

Researchers conducted a pilot study before distributing the questionnaire to all respondents, during which they distributed questionnaires to 108 respondents to assess the validity and reliability of the questions provided. The process of evaluating the research instrument will be carried out with consideration of the answers obtained after filling out the questionnaire, as well as their relevance.

The survey was divided into two sections. The first section includes respondent biodata, consisting of three questions. The second section presents research questions that involve 32 variables related to respondents' perceptions of implementing Halal Logistics in Indonesia. Thirty-two variables were obtained from distributing questionnaires. By filling in the data, respondents were asked to rate on a scale of 0 - 5, where 0 means "Disagree" and 5 means "Strongly agree". The total number of respondents in this study was 108. An explanation of the 32 variables is provided in Table 1.

Table 1. Variables of Halal Logistics Implementation

Dimensions	Sub Dimension	Variables	Description	Reference
Implementation of halal logistics	Availability of Halal Products	Halal products are always available according to market demand	Y	[29]
		Information about halal products is always available and transparent	X_1	[30]
		The image of the halal product delivery company greatly influences consumer confidence in the product.	X_2	[31]
	Social	Workers who handle halal products are highly competent and trustworthy	X_3	[32]
		Workers who handle halal products receive training in a planned and consistent manner.	X_4	[32]
		Workers have sufficient knowledge of Islamic law when handling halal products.	X_5	[32]
Organization		Informed data on halal products is harmonized between producers, logistics service providers, and consumers.	X_6	[5]
		Manufacturers and logistics service providers excel at planning and evaluating halal product business strategies.	X_7	[29]
	Stakeholders	Halal product business performance indicators are aligned between producers and logistics service providers.	X_8	[29]
		The objectives and focus between producers, logistics service providers, and consumers of halal products are aligned to avoid conflicts.	X_9	[32]
		Good management of halal products affects the company's revenue	X_{10}	[13]
Finance	Financing	There is growing investment in the halal product business	X_{11}	[33]
		Halal product consumers experience significant growth.	X_{12}	[12]

Dimensions	Sub Dimension	Variables	Description	Reference
Transporta-tion	Reliability	There are developments in the marketing strategy of halal products	X_{13}	[33]
		Special treatment of halal products affects corporate financing	X_{14}	[29]
		Halal product transportation costs are determined by the quality of service provided	X_{15}	[23]
		The number of products delivered is in accordance with consumer orders	X_{16}	[34]
		Products are distributed with good quality and follow the description provided	X_{17}	[2]
		During distribution, halal products remain hygienic and are not mixed with non-halal goods.	X_{18}	[32]
		The temperature of halal products is always well maintained during the shipping process.	X_{19}	[32]
	Electability	Shipping companies can adapt well to halal policies	X_{20}	[32]
		Shipping companies can cope with fluctuations in demand for halal products.	X_{21}	[32]
	Asset management	Halal product deliveries can always be made at a Predetermined time	X_{22}	[32]
		Halal product delivery can be done with the expected frequency	X_{23}	[35]
		Halal product delivery mileage varies widely.	X_{24}	[35]
		During the distribution process, there is an excessive stock of halal products.	X_{25}	[32]
	Security	There are many significant threats during the halal product delivery process.	X_{26}	[29]
		Shipping halal products uses separate containers or vehicles from those used for non-halal products.	X_{27}	[29]
Sustaina-bility	Carbon Emissions	The company has a target to reduce CO2 emissions from year to year	X_{28}	[15]
	Route Optimization	Average mileage per shipment of halal products by the company planning	X_{29}	[15]
		Average travel time for shipping halal products according to the company's planning	X_{30}	[15]
	Regulatory Compliance	The company complies with environmental regulations when shipping halal products.	X_{31}	[7]
	Impacts to Air and Water Quality	The company is responsible for monitoring and reducing air and water pollution generated during the production and delivery of halal products.	X_{32}	[29]

Table 1 outlines the key dimensions of halal logistics implementation, including availability, organization, finance, transportation, asset management, security, and sustainability. Availability ensures halal products meet market demand, while the organization covers transparency, consumer trust, and stakeholder coordination. Finance examines revenue impact, investment growth, and marketing strategies. Transportation focuses on reliability, adaptability, and maintaining product integrity. Asset management ensures timely delivery and stock control, whereas security emphasizes threat mitigation and proper handling. Lastly, sustainability addresses carbon emissions, route optimization, and regulatory compliance, forming a structured framework for evaluating halal logistics operations.

Researchers conducted the pilot study to evaluate and improve the developed survey instrument. The sampling technique used in the pilot study was convenience sampling, as preferred by the researcher. It is commonly used for explanatory research or questionnaire testing, but its limitations are notable. The pilot study was conducted in two stages: qualitative and quantitative. The qualitative pilot study was used to validate the content and format of the research instrument. The first stage, or qualitative pilot study results, was then used as a table of questions for 10 pilot study questions or assessment tools. The second stage involved the quantitative pilot study. The quantitative pilot study data are used to test the validity and reliability of the research instrument.

Questionnaire validation is not only based on journal literacy, but also on the validity of experts, ensuring the population is accurately targeted [36]. The research questionnaire was validated by four individuals, comprising three directors of logistics service providers and one academic. The qualitative pilot study was conducted over four iterations, and no comments were received from the fourth respondent; therefore, the researchers can use the instrument to collect data. The results of the first stage, or qualitative pilot study, are then used to improve a questionnaire or research instrument, which is

subsequently used for the second, or quantitative, pilot study. At this stage, the research instrument underwent evaluation to determine any necessary modifications or enhancements to the questionnaire developed in the previous phase. This evaluation involved testing the validity and reliability of data collected from an initial sample of 30 respondents. A questionnaire is considered valid if its statements or questions effectively measure the intended variables. Meanwhile, reliability refers to the consistency or stability of a measuring instrument over time [2].

The results of the validity and reliability tests ensure that the data obtained are both valid and reliable. Should improvements be identified, the researcher adjusts the instrument based on feedback gathered during this evaluation phase. Conversely, if the survey instrument proves suitable with no further modifications required, it proceeds to the data collection phase. In this study, the validity test utilized the Spearman correlation test due to the abnormality of the data. The validity was assessed by comparing the correlation coefficient (r count) of each statement with the critical correlation coefficient value (r table) at α = 0.05, set at 0.361. Statements were deemed valid if their correlation coefficient (r count) exceeded 0.361, meeting the requirements outlined in Table 2.

Reliability was tested using Cronbach's alpha (α), where a higher coefficient indicates greater reliability. A questionnaire achieves reliability if it achieves a Cronbach's alpha value above 0.6 [37]. Overall, the reliability test results indicated that all dimensions were reliable. Table 2 presents detailed outcomes of the validity and reliability tests for each dimension.

This research sampled a total of 108 companies, consisting of 35 logistics service companies and 73 MSME-level business actors from the food sector in Indonesia. Based on the processing of the analyzed data, it shows that the amount of valid data on all variables is (n = 108), while the amount of missing data on these variables is 0, which means that this data is valid and there is no missing data. H_0: Significance value p > 0.05, then the data is not normally distributed. H_1: If the significance value p < 0.05, then the data is usually distributed. Analysis of data normality measured using the Shapiro-Wilk test indicates that all variables analyzed follow a normal distribution characterized by a p-value < .050, which means that there is a rejection of Ho in this hypothesis test.

Table 2 presents the validity and reliability test results for halal logistics dimensions. Spearman test values (0.871–0.884) and Cronbach's Alpha (0.87–0.881) confirm strong

validity and reliability. All dimensions meet the required thresholds, ensuring consistency in measurement tools for assessing the implementation of halal logistics.

At this stage, an assumption test is used for the variables involved in multiple regression to determine whether the data meet the data assumptions for linearity, normality, homoscedasticity, and independence of error. Assumption testing utilizes histograms to determine data normality, residual graphs with predicted values to assess the independence of error and residuals, and graphs of residuals versus predicted values to test for homoscedasticity and linearity.

Based on Figure 3, the graph indicates that the data is normally distributed because the peaked curve is centered in the middle of the data distribution, and the skewness of the data is also centered.

Correlation Analysis

From the correlation value, it is found that there is a positive correlation between the dependent variable and other independent variables.

Table 2. Validity and reliability test

Variables	Dimen-sions	Validity	Relia-bility	Interpre-tation
		Spear-man test	Cronbach's Alpha	
Organiza-tion	Social	0.873	0.876	Valid and Reliable
	Stakehol ders	0.874	0.871	Valid and Reliable
Finance	Finan-cing	0.878	0.874	Valid and Reliable
	Relia-bility	0.883	0.874	Valid and Reliable
Transpor-tation	Flexi-bility	0.872	0.874	Valid and Reliable
	Asset Manage ment	0.879	0.871	Valid and Reliable
	Secu-rity	0.873	0.875	Valid and Reliable
	Carbon Emissio ns	0.871	0.87	Valid and Reliable
	Route Optimiza tion	0.873	0.876	Valid and Reliable
Sustaina-bility	Regulat ory Complia nce	0.879	0.881	Valid and Reliable
	Impacts to Air and Water Quality	0.884	0.879	Valid and Reliable

The most significant correlation is between the dependent variable and variable X_1, r(108) = .547, p < .001, as well as with other dependent variables. Multicollinearity assessment is necessary when multiple predictors are involved, as seen between the dependent variable X_{12} and X_{13} (r = 0.675, p < 0.001) and the dependent variable X_{12} and X_{14} (r = 0.450, p < 0.001), which require further analysis using a multicollinearity check. Linearity testing can be done by analyzing the residuals of the regression model formed. Figure 3 above shows that the data distribution is evenly distributed, indicating that the data has a linear relationship.

Testing for unequal variance is called the heteroscedasticity test. Alternatively, testing for the same data variance is referred to as homoscedasticity. Figure 4 shows the data variance, which does not form a funnel/triangle and/or diamond pattern, indicating that the data falls into the homoscedasticity category.

Regression assumes that each predicted value is independent, meaning that it does not depend on the values of other variables. If the residuals are independent, the data distribution pattern appears random and similar to the null plot, as shown in Figure 5, which indicates that the data is independent of error.
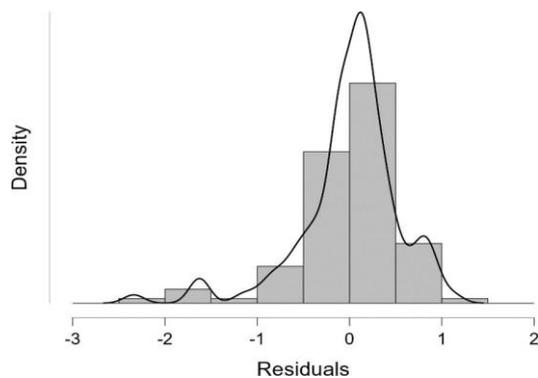

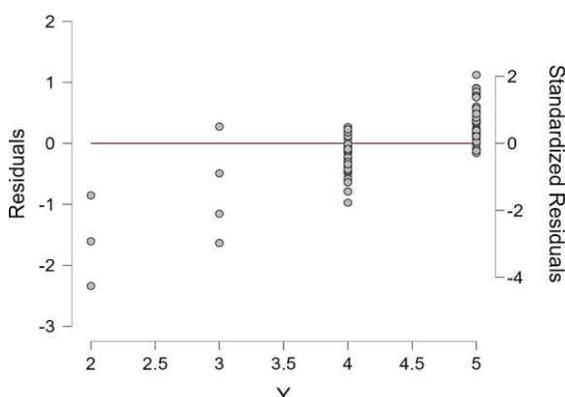Figure 3. Normality Test Density vs. Residual

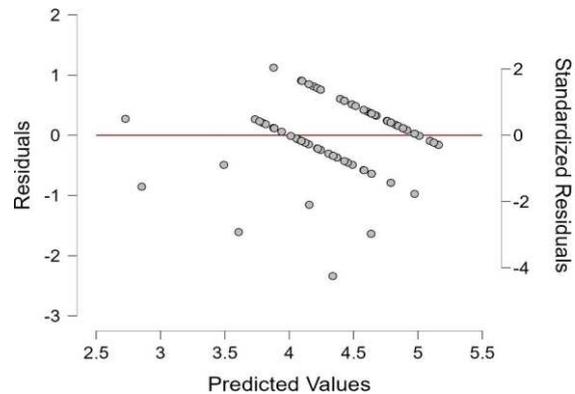Figure 4. Linearity Test Residuals vs. Dependent

Figure 5. Independence of Error Test Residuals vs. Predicted

The coefficient table obtained for the beta coefficients above shows that the highest Beta value is *for X_1*, which is 0.513, indicating that variable X_1 can cause changes in variable Y by 51.3%, followed by variable X_{17} at 25.7%. So, in this regression equation, the X_1 value dominates the dependent variable (Y). In addition, from the beta coefficient value, it is also known which independent variable has the most dominant influence. The Standardized Coefficient Beta Test compares the Standardized Coefficient Beta values of each variable. For example, in the case above, the Coefficient Beta value for $X_1 > X_{17}$ means that Information Regarding Halal Products is Always Available and Transparent (X_1) contributes dominantly to the implementation of halal logistics compared to other variables. So it can be concluded, in this regression model, the most dominant variables affecting the dependent variable in order are X_1 (Information about halal products is always available and transparent), X_{17} (Products are distributed with good quality and following the description given), X_{13} (There are developments in the marketing strategy of halal products), X_4 (The workforce handling halal products receives planned and consistent training), X_{32} (The company is responsible for monitoring and reducing air and water pollution generated during the production and delivery of halal products) and X_{12} (Consumers of halal products have experienced significant growth). When viewed in the coefficient table above, it can be concluded that each independent variable does not exhibit symptoms of multicollinearity in the regression model because all the variables' Tolerance values are > 0.1 and VIF values < 10.

Multicollinearity checking by building an MLR model on one dependent variable and six independent variables to be predicted. Next, conduct a collinearity diagnostic analysis by examining the tolerance value and partial correlation. Multicollinearity is indicated if the

tolerance value is low (< 1 - R^2). In this case, the value of R_2 = 0.411, so that (1 - R_2 = 0.589) shows that the tolerance value is low on X_{12} and X_{13}, with tolerances <0.589. Furthermore, to see multicollinearity, it is done by looking at the collinearity diagnostics table, where if there are two variables with the maximum value in the same dimension, it is considered to have high multicollinearity; in this case, it occurs in variables X_{12} and X_{13}, where this assumption is reinforced by the substantial correlation value of the two variables. Therefore, the elimination of variable X_{13} still yields the appropriate analysis.

Variable selection employs the Backward Method, where all predictors are initially included in the model and their respective contributions are calculated. Predictors with insignificant contribution rates (b<0.1) were removed from the model/equation. This process was repeated until all predictors were statistically significant. After 27 iterations, the following is the best result: the variable with the most influence on the dependent variable. The following is a summary table of the backward method with JASP.

The order of variables using the backward value is determined gradually by the JASP application, which examines the correlation value between variables. The greater the Pearson's r value of the independent variable on the dependent variable, the greater the level of correlation. As for the independent variables, the smaller the R-squared value, the smaller the level of correlation between the independent variables. This is the basis for decision-making in variable selection.

The process of selecting variables ensures the best model fit by minimizing redundancy and improving predictive accuracy. The Backward Method systematically refines the regression model by eliminating variables with insignificant contributions, ensuring that only the most impactful predictors remain. This iterative approach enhances the model's explanatory power while reducing potential biases caused by multicollinearity. As a result, the refined model provides a more reliable basis for assessing the relationship between independent variables and the implementation of halal logistics.

In general, the above model's R-value is the best, with an R-value of 0.639 after deducting variables that are considered not to have affected the dependent variable. The variables selected after 27 iterations, along with an explanation of each, are presented in Table 3.

Table 3. Key Variables and Descriptions in Halal Product Management

Variables	Description
Halal products are always available according to market demand	Y
Information about halal products is always available and transparent	X_1
Workers who handle halal products receive training in a planned and consistent manner.	X_4
Halal product consumers experience significant growth	X_{12}
There are developments in the marketing strategy of halal products	X_{13}
Products are distributed with good quality and follow the description provided	X_{17}
The company is responsible for monitoring and reducing air and water pollution generated during the production and delivery of halal products.	X_{32}

H_0: Significance value p> 0.05, then there is no effect of the independent variable (X_n) on the dependent variable (Y)

H_1: Significance value $p <= 0.05$, then there is an influence of the independent variable (X_n) on the dependent variable (Y)

In hypothesis testing, H_0 (null hypothesis) states that if the significance value (p) is greater than 0.05, the independent variable (X_n) does not affect the dependent variable (Y). Meanwhile, H_1 (alternative hypothesis) states that if p is 0.05 or less, the independent variable (X_n) significantly influences the dependent variable (Y). After examining the regression model with variable selection in Table 4, the model was recalculated using the same regression model, and the R-squared value for this model is shown in Table 5.

Table 4. Coefficient

Model	Unstandar-dized		Standard Error	Stan-dardi-zed	t	p
H_0	(Inter-cept)	4.463	0.069		64.779	< .001
H_1	(Inter-cept)	1.303	0.543		2.37	0.018
	X_1	0.534	0.094	0.503	5.700	< .001
	X_4	0.172	0.086	0.175	1.989	0.049
	X_{12}	-0.151	0.091	-0.146	-1.658	0.100
	X_{17}	0.349	0.126	0.269	2.765	0.007
	X_{32}	-0.201	0.093	-0.195	-2.165	0.033

Table 5. Model Summary - Y

Model	R	R²	Adjusted R²	RMSE
H_0	0.000	0.000	0.000	0.716
H_1	0.625	0.390	0.360	0.573

By using six variables to predict the value of the dependent variable, researchers obtained an R-squared value of 0.625. This R-squared value is good enough because the closer it is to 1, the better the model fit by the regression will be. The value of the latest regression model is presented in the table below. Based on Table 5, the latest regression model results are as follows: $Y = 1,303 + 0.534X_1 + 0.172X_4 - 0.15_{X12} + 0.349X_{17} - 0.201X_{32}$.

The results of retesting the regression model using JASP software show the final regression equation or model for the combination of variable Y and 6 X variables (X_1, X_4, X_{12}, X_{17}, X_{32}). The equation is $Y = 1.303 + 0.534X_1 + 0.172X_4 - 0.151X_{12} + 0.349X_{17} - 0.201X_{32}$.

The results of creating this new model are not significantly different from those of the previous one, indicating that the model built is sufficient. In the model above, this intercept value is only meaningful and predicts logically if X_1, X_4, X_{12}, X_{17}, and X_{32} are not equal to 0. In each regression coefficient, the addition of 1 value of X_4 will increase by 0.172. This means that the variable of labor handling halal products and receiving training in a planned and consistent manner contributes 0.175 for an additional value of 1 in predicting that halal products are always available according to market demand. This is in line with research conducted by [38], [39]. The exciting thing is that the value of X_{32} is negative, indicating an opposite effect between variables X_{32} and Y. The implication of this finding is the importance of finding a balance between green practices and operational efficiency, as revealed by [40]. Companies should consider innovations and technologies that can reduce environmental impact without compromising the overall performance of halal logistics. In this context, if small and medium-scale companies are given more responsibility for sustainability, their performance in providing halal products will be enhanced to meet market needs. This is relevant to the statement [41] that small and medium-scale companies face the main challenge of limited resources.

When viewed from the beta coefficient value in regression modelling, the variables that have the most influence on the dependent variable are X_1 (Information about halal products is always available and transparent), X_4 (Workers who handle halal products receive training in a planned and consistent manner), X_{12} (Consumers of halal products experience significant growth), X_{17} (Products are distributed with good quality and following the description provided), and X_{32} (The company is responsible for monitoring and reducing air and water pollution generated during the production and delivery of halal products). Therefore, the focus of this research on implementing halal logistics should be to increase transparency regarding the halal products and their distribution, ensuring adherence to the rules.

The relationship between increased transparency of information about halal products (X_1) not only has a direct impact on consumer confidence but can also strengthen worker performance through practical training (X_4). Thus, companies should focus on developing these two aspects simultaneously to improve the implementation of halal logistics. The synergy between information transparency and worker capability development is crucial in creating a strong and reliable halal supply chain, as stated by [42].

Additionally, continuing to refine the marketing strategy for halal products and providing training to the workforce on handling halal products is also crucial. Another factor that affects the dependent variable is the company's responsibility for reducing air and water pollution during the production and delivery of halal products. As a result, it is expected that consumers of halal products will experience significant growth.

The contribution of the six variables that most significantly affect the performance of halal implementation, in general, is how halal product transparency information is available both from the product handling process during production and during product distribution, where all elements involved are expected to know halal standards, so that training is needed for the relevant workforce in carrying out halal implementation. In addition, no less important is how the company responds to its role in mitigating adverse environmental impacts associated with the handling and distribution of halal products.

However, the six selected variables, which are indicated to be very significant in influencing the dependent variable, are variables that already demonstrate exemplary performance in improving the implementation of halal logistics. So, the variables not included in the regression model must be considered. Researchers/companies must continue to enhance or improve the performance of variables not included in the model to improve the implementation of halal logistics. One example is variable X_{10}: Effective halal product management has a positive impact on company revenue. If this performance improves, the implementation of halal logistics will also be better, along with other variables.

Improvements that can be made gradually by the company are to maintain the performance of the fifth variable X_1 (Information about halal

products is always available and transparent), X_4 (Workers who handle halal products receive training in a planned and consistent manner), X_{12} (Consumers of halal products experience significant growth), X_{17} (Products are distributed with good quality and following the description provided), and X_{32} (The company is responsible for monitoring and reducing air and water pollution generated during the production and delivery of halal products). In addition, improving the performance of variables not included in other models, such as improving the image of a halal product delivery company, significantly affects consumer confidence in these products (X_2). The workforce handling halal products is highly competent and trustworthy (X_3). The data about halal products is harmonized between producers, logistics service providers, and consumers (X_5).

This study identifies key factors influencing the availability of halal products, emphasizing the importance of information transparency and employee training. Unlike previous research, which focuses on theoretical models or specific cases, this study provides a comprehensive empirical assessment. The findings highlight gaps in halal logistics adherence, which impact consumer trust, policymaking, and operational practices in the logistics and food sectors. However, potential data collection bias and methodological constraints must be acknowledged. This study contributes to the literature by empirically assessing the implementation of halal logistics in Indonesia and providing actionable policy recommendations. Future research should investigate the role of technology in enhancing transparency and the external factors that influence policy development.

CONCLUSION

Based on the beta coefficient value in regression modelling, the variables that have the most influence on the dependent variable are X_1 (Information about halal products is always available and transparent), X_4 (Workers who handle halal products receive training in a planned and consistent manner), X_{12} (Consumers of halal products experience significant growth), X_{17} (Products are distributed with good quality and following the description provided), and X_{32} (The company is responsible for monitoring and reducing air and water pollution generated during the production and delivery of halal products). These findings align with the research objective of identifying key factors influencing the effectiveness of halal logistics implementation.

This research has a limited scope, focusing on respondents from SMEs and certain logistics companies. Of the 108 respondents, 75% stated that the availability of information on halal products is a significant factor affecting consumer confidence. In contrast, 85% agreed that consistent training for workers contributes to improved product quality. Additionally, 70% of respondents noted that a company's responsibility towards environmentally friendly practices also plays a significant role in attracting consumers.

To enhance halal logistics, SMEs should prioritize product transparency and worker training. Key strategies include clear halal standards, transparent product tracking, and regular employee training. These measures can help maintain halal integrity and strengthen consumer trust. Policymakers can support this by providing incentives and developing infrastructure, such as training centres and integrated distribution systems, to promote broader adoption of halal logistics and strengthen Indonesia's halal industry.

In general, improving the performance of halal logistics implementation is categorized into several aspects, namely enhancing performance during the production and distribution process following Islamic law, employee training to provide a thorough understanding of halal handling standards, transparency of information regarding the process and distribution of halal products so that there is no bias in defining halal products or contamination of halal products, how the logistics distribution performance of halal products in terms of time and distance in delivery and finally focus on how the logistics of halal products can affect the impact on the environment. Future research could explore a broader sample, including multinational companies, to examine whether the findings hold in different operational scales and regions.

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