

Original Article

Analysis of the Impact of Infrastructure Development on Gross Regional Domestic Product of West Lombok Regency 2010 – 2023

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This article contributes to:



Abstract. The global halal food industry has experienced rapid expansion, driven by growing Muslim populations and increasing consumer demand for certified halal products. Despite this growth, small-scale food producers continue to face significant challenges in implementing effective halal traceability systems within complex global supply chains. This study investigates the traceability challenges encountered by small-scale food producers in Indonesia, with broader implications for the global halal food sector. Employing a qualitative research design, data were collected through in-depth semi-structured interviews with fifteen small-scale halal food producers in Bengkulu Province, Indonesia. Thematic analysis was applied to identify key patterns and themes from the data. The findings reveal four major themes: (1) systemic traceability challenges related to documentation and supply chain visibility; (2) difficulties in accessing and maintaining halal certification; (3) limited adoption of digital technologies for traceability management; and (4) trust and integrity issues across the supply chain. This study concludes that targeted policy interventions, technology capacity-building programs, and streamlined certification processes are essential to support small-scale producers in achieving robust halal traceability. The findings contribute to the growing body of halal supply chain literature and offer practical implications for industry stakeholders and policymakers.

Keywords: Halal Traceability, Supply Chain Management, Small-Scale Food Producers, Halal Certification, Indonesia.

1. Introduction

The global halal industry has emerged as one of the fastest-growing segments of the international food market. With a Muslim population exceeding 1.9 billion people worldwide, the demand for certified halal products has expanded beyond traditionally Muslim-majority countries to encompass markets in Europe, North America, and East Asia [1]. According to the State of the Global Islamic Economy Report [2], the global halal food market was valued at approximately USD 1.27 trillion and is projected to reach USD 2.0 trillion by 2030. This remarkable growth has placed increasing pressure on producers, distributors, and regulators to ensure that halal integrity is maintained throughout the entire supply chain.

Halal traceability — the capacity to track and verify the halal status of a product from its point of origin through all stages of processing, distribution, and retail — is widely recognised as the cornerstone of halal supply chain integrity [3]. Effective traceability systems enable producers and consumers to confirm that food products comply with Islamic dietary requirements at every stage of production. These systems must account

Article info

Revised:

2024-3-20

Accepted:

2024-6-20

Publish:

2024-8-21



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for the sourcing of raw materials, slaughtering practices, processing conditions, storage, logistics, and packaging. In an era of globalised trade, where supply chains span multiple countries and involve numerous intermediaries, maintaining end-to-end halal traceability has become a formidable challenge.

Small-scale food producers occupy a particularly vulnerable position within the halal supply chain. Unlike large corporations with dedicated compliance teams and technological infrastructure, small and medium-sized enterprises (SMEs) frequently lack the financial resources, technical expertise, and institutional support needed to implement comprehensive traceability systems [4]. In Indonesia — the world's most populous Muslim-majority country — the majority of food producers are small-scale enterprises operating in the informal sector. These producers play an indispensable role in supplying halal food products to local and regional markets, yet they often operate with limited documentation practices, fragmented supply networks, and inadequate awareness of halal certification requirements.

Despite the importance of halal traceability for food integrity and consumer trust, the existing academic literature has paid insufficient attention to the specific challenges faced by small-scale producers. Most prior research has focused on large corporations or has examined halal supply chain management from a macro-level policy perspective [5], [6]. There is a notable gap in the literature concerning the lived experiences of small-scale food producers who must navigate complex certification requirements, supply chain documentation demands, and technology adoption pressures with limited resources.

This study therefore addresses the following research questions: (1) What are the primary traceability challenges faced by small-scale food producers in Indonesia? (2) How do certification requirements affect the capacity of small-scale producers to maintain halal traceability? (3) To what extent do small-scale producers adopt digital technologies to support their traceability systems? (4) How do trust and integrity concerns manifest across the halal supply chain from the perspective of small-scale producers?

The primary objective of this study is to provide a nuanced, empirically grounded understanding of halal traceability challenges as experienced by small-scale food producers in Indonesia. By employing a qualitative research approach and drawing on direct interviews with producers, this study contributes rich, contextual insights to the halal supply chain literature. The findings also offer practical recommendations for policymakers, certification bodies, and industry stakeholders seeking to support the integration of small-scale producers into global halal supply chains.

2. Literature Review

2.1 Halal Supply Chain and Traceability

A halal supply chain is defined as an integrated network of activities, resources, and actors that collaborates to ensure the halal integrity of a product from its origin to the end consumer [7]. The concept of halal integrity encompasses not only the intrinsic characteristics of a product — such as the use of permissible ingredients — but also the processes and conditions under which the product is handled, processed, transported, and stored. Any contamination, cross-contact with non-halal substances, or failure of documentation at any point in the supply chain can compromise the halal status of an otherwise permissible product [8].

Traceability within the halal supply chain refers to the ability to follow a product's journey across all stages of the supply chain and to access relevant information about its compliance at each stage [9]. Effective halal traceability systems serve multiple functions: they provide consumers with verifiable assurance of a product's halal status; they enable

producers and distributors to identify and address points of contamination or non-compliance; and they facilitate regulatory oversight by certification authorities. Scholars have identified several key components of halal traceability systems, including product identification, data capture and documentation, information sharing across supply chain partners, and verification mechanisms [3].

The literature highlights that halal traceability is inherently more demanding than conventional food traceability because it must address not only physical product attributes but also procedural requirements derived from Islamic jurisprudence (fiqh). For instance, the slaughter of animals for halal consumption must adhere to specific conditions, including the invocation of the name of Allah, the use of a sharp blade, and the complete severance of the jugular veins. Documenting and verifying these procedural requirements across a global supply chain requires a level of information granularity that many existing food traceability systems are not designed to provide [5].

2.2 Global Supply Chain Challenges for Halal Products

Globalisation has profoundly transformed the structure of food supply chains, enabling the sourcing of ingredients and materials from geographically dispersed locations. While this has brought cost efficiencies and product variety, it has also introduced significant complexity into the management of halal supply chains [1]. When a single food product may contain ingredients sourced from dozens of countries, each with different halal certification standards and regulatory frameworks, maintaining end-to-end halal integrity becomes extremely challenging.

A key challenge in global halal supply chains is the lack of harmonisation among halal standards across different countries and certification bodies [10]. Countries such as Malaysia, Saudi Arabia, the United Arab Emirates, and Indonesia each maintain distinct halal certification requirements, and products certified as halal in one jurisdiction may not automatically meet the standards of another. This lack of mutual recognition creates compliance burdens for producers seeking to access multiple export markets and contributes to fragmentation within the global halal trade [11]. Additionally, the multi-tier nature of global supply chains makes it difficult to ensure transparency and accountability at every level. First-tier suppliers may be audited and certified, but the halal status of second- and third-tier suppliers — who provide raw materials, additives, and processing agents — is often less well-monitored [8]. This opacity creates vulnerabilities in halal supply chains that can be exploited, whether deliberately through adulteration or inadvertently through inadequate documentation and communication practices.

2.3 Small and Medium Enterprises (SMEs) in the Halal Industry

SMEs constitute the backbone of the food production sector in many developing countries, including Indonesia, where they account for a substantial proportion of total food output and employment [4]. However, SMEs often face systemic disadvantages in meeting the requirements of formal halal supply chains. These disadvantages include limited financial capital for investment in traceability technology, a lack of skilled personnel with expertise in halal compliance, and insufficient awareness of certification procedures and documentation standards [10].

Previous studies have found that SMEs in the halal food sector frequently operate with informal and fragmented supply networks, making it difficult to gather the comprehensive documentation required for halal certification [5]. Many small-scale producers rely on verbal agreements with suppliers rather than formal contracts, and they lack the leverage to demand detailed halal documentation from upstream suppliers.

This informality creates significant gaps in the traceability record and exposes producers to the risk of inadvertently including non-halal inputs in their products.

The cost of halal certification is also a significant barrier for SMEs. While large corporations can absorb the costs of annual certification audits, renewal fees, and compliance consulting, small-scale producers may find these costs prohibitive relative to their revenue [6]. Furthermore, the bureaucratic complexity of certification processes — which often require extensive documentation, facility inspections, and ongoing compliance monitoring — can be overwhelming for producers operating with limited administrative capacity.

2.4 Technology Adoption and Halal Traceability

Advances in digital technology have opened new possibilities for improving halal traceability. Technologies such as radio frequency identification (RFID), blockchain, the Internet of Things (IoT), and enterprise resource planning (ERP) systems have been proposed as solutions to enhance supply chain transparency and data integrity in halal food systems [12]. Blockchain, in particular, has attracted considerable scholarly attention due to its potential to create an immutable, decentralised record of transactions and product movements across the supply chain, thereby reducing the risk of fraud and documentation errors [13].

Despite the theoretical promise of these technologies, their adoption by small-scale producers in developing countries remains limited. Barriers to technology adoption include high implementation costs, a lack of technical literacy, inadequate digital infrastructure, and limited awareness of available solutions [11]. Moreover, the benefits of digital traceability systems are most fully realised when they are adopted across the entire supply chain; unilateral adoption by individual producers without corresponding uptake by suppliers and buyers has limited impact. This systemic challenge underscores the need for coordinated, sector-wide approaches to technology adoption in the halal food industry.

2.5 Trust and Integrity in Halal Supply Chains

Trust is a fundamental prerequisite for effective halal supply chain management. Producers must trust that their suppliers are providing genuinely halal-certified inputs; consumers must trust that the products they purchase comply with halal standards; and certification bodies must trust that producers are accurately representing their compliance [7]. When trust breaks down at any point in the chain, the integrity of the entire halal supply chain is jeopardised. Research has identified several factors that can undermine trust in halal supply chains, including fraudulent certification, mislabelling, substitution of halal ingredients with non-halal alternatives, and the falsification of documentation [6]. These issues are not merely academic concerns: high-profile halal fraud cases in Malaysia, the United Kingdom, and Brazil have demonstrated the real-world consequences of trust failures in halal supply chains, including significant reputational and economic damage to affected producers and certification bodies.

For small-scale producers, trust-building is particularly challenging because they often lack the formal verification mechanisms and institutional credibility that large corporations can offer. Consumers and buyers may be sceptical about the halal claims of small producers who lack recognisable certification logos or established reputations. This scepticism can disadvantage small producers in competitive markets, even when their products are genuinely compliant with halal requirements [10].

3. Method

3.1 Research Design

This study adopts a qualitative research design, which is appropriate given the exploratory and interpretive nature of the research questions. Qualitative inquiry enables researchers to gain rich, contextual insights into the experiences, perceptions, and challenges of research participants, and is particularly well-suited to investigating complex social phenomena such as supply chain management practices in specific organisational and cultural contexts [14]. The epistemological stance of this study is interpretivist, acknowledging that the experiences of small-scale food producers are shaped by their unique social, economic, and regulatory environments and that these experiences cannot be fully captured through quantitative measurement alone.

3.2 Research Site and Participant Selection

The study was conducted in Bengkulu Province, located on the western coast of Sumatra, Indonesia. Bengkulu Province was selected as the research site because it is representative of many Indonesian provinces in which small-scale food production is prevalent, halal certification awareness is growing, and regulatory enforcement of halal standards is gradually being strengthened in line with national policy directives. The province's food production sector is dominated by small-scale enterprises engaged in the processing of local agricultural products, seafood, and traditional Indonesian food items.

Participants were selected using purposive sampling, a technique that allows researchers to deliberately select information-rich cases that are most likely to yield insights relevant to the research questions [15]. The inclusion criteria for participation in this study were: (1) the participant operates a food production enterprise with fewer than 50 employees; (2) the enterprise produces food products intended for sale as halal products or for markets where halal certification is required or expected; and (3) the participant has direct operational knowledge of their enterprise's supply chain and certification practices. A total of fifteen small-scale food producers participated in the study, representing a range of food product categories including processed snacks, beverages, spices and seasonings, and traditional food items.

3.3 Data Collection

Data were collected through in-depth semi-structured interviews conducted between January and April 2024. Semi-structured interviews allow researchers to explore predetermined themes while remaining flexible enough to pursue unanticipated lines of inquiry that emerge during the interview [16]. An interview guide was developed based on the themes identified in the literature review and the specific research questions of this study. The guide covered the following broad areas: (1) participants' understanding and experience of halal traceability; (2) challenges encountered in documenting and verifying halal compliance across the supply chain; (3) experiences with the halal certification process; (4) current and desired use of technology for traceability management; and (5) perceptions of trust and integrity in supply chain relationships.

Each interview was conducted in Bahasa Indonesia to ensure that participants could express themselves freely and accurately in their native language. Interviews were audio-recorded with the informed consent of each participant and subsequently transcribed verbatim. Transcripts were then translated into English for analysis. To protect participant confidentiality, all participants were assigned pseudonyms, and any identifying information was removed from the transcripts. The average interview duration was approximately 65 minutes, with individual interviews ranging from 45 to 90 minutes.

3.4 Data Analysis

The interview data were analysed using thematic analysis, following the six-phase framework proposed by Braun and Clarke [17]. This framework involves: (1) familiarisation with the data through repeated reading of transcripts; (2) generation of initial codes from the data; (3) searching for themes by clustering related codes; (4) reviewing and refining candidate themes; (5) defining and naming final themes; and (6) producing the written analysis. Thematic analysis was conducted using both inductive and deductive approaches: initial coding was largely inductive, driven by the content of the data itself, while theme development was informed by the theoretical framework established in the literature review. To enhance the trustworthiness and rigour of the analysis, several strategies were employed. First, member checking was conducted by sharing a summary of key findings with five of the original participants and inviting their feedback on the accuracy of the interpretations. Second, researcher triangulation was achieved by having both authors independently analyse a subset of the transcripts and subsequently comparing and reconciling their coding frameworks. Third, an audit trail was maintained throughout the analysis process, documenting decisions made in the development and refinement of themes. These strategies collectively support the credibility, transferability, and dependability of the study's findings [18].

4. Results and Discussion

3.1 Theme 1: Systemic Traceability Challenges

The most pervasive challenge identified by participants was the difficulty of maintaining comprehensive and reliable documentation across their supply chains. The majority of participants reported that they had limited or no formal systems for recording the origins, processing conditions, and halal status of the inputs they used in their products. Many relied on memory, informal records, or brief handwritten notes rather than systematic documentation practices.

"We know our regular suppliers, and we trust them. But if someone asks us to prove that all our ingredients are halal from the beginning, we honestly don't have the paperwork to show it."

This finding is consistent with the observations of Ab Talib et al. [5], who noted that SMEs in developing countries typically operate with informal supply relationships characterised by verbal agreements and social trust rather than contractual obligations and formal documentation. While such informality may be functional within tight-knit local networks, it creates significant vulnerabilities when producers seek to demonstrate halal compliance to external certification bodies or international buyers.

Participants also identified supply chain visibility as a major concern. Many reported that they had little knowledge of or control over the conditions under which their raw materials were produced or processed prior to reaching them. In several cases, participants acknowledged that they sourced ingredients from multiple intermediaries, making it effectively impossible to trace the full supply chain back to the point of origin. This opacity is particularly problematic in the context of halal compliance, where the status of raw materials at the source is directly relevant to the halal integrity of the finished product.

A particularly salient issue raised by participants was the challenge of seasonal and opportunistic sourcing. Several producers reported that they occasionally sourced materials from unfamiliar suppliers when their regular suppliers were unable to meet demand, or when prices from alternative sources were significantly lower. In these

instances, there was even less assurance about the halal status of the sourced materials, and the documentation available was typically minimal. This finding highlights the tension between economic pragmatism and halal compliance that small-scale producers must navigate on a day-to-day basis.

3.2 Theme 2: Certification Barriers and Bureaucratic Burden

Halal certification emerged as a critical yet contested theme in the participants' accounts. While all participants expressed an understanding of the importance of halal certification for market access and consumer trust, the majority described the certification process as burdensome, costly, and poorly adapted to the realities of small-scale production. In Indonesia, halal certification is administered by the Halal Product Assurance Organizing Agency (BPJPH), a government body established under Law No. 33 of 2014 on Halal Product Assurance [19]. While this law has strengthened the regulatory framework for halal certification, participants indicated that the requirements it imposes can be difficult for small producers to meet.

"The requirements ask us to document everything — every ingredient, every process, every supplier. For a small operation like ours, that takes enormous time and effort, and we don't always have someone who knows how to do it properly."

The financial costs associated with certification were a recurring concern. Participants noted that certification fees, combined with the costs of facility upgrades needed to meet certification standards and the indirect costs of time spent preparing documentation, constituted a significant burden on their limited budgets. This aligns with findings from Bonne and Verbeke [6], who identified cost as a primary barrier to halal certification among SMEs in Muslim-minority markets. In the Indonesian context, although the government has introduced subsidised certification programmes for certain categories of small producers, awareness and access to these programmes was reported as uneven among the study participants.

Beyond financial costs, participants identified procedural complexity as a major deterrent to certification. Several participants who had attempted to obtain certification described experiences of being asked to resubmit documentation multiple times due to minor errors or incomplete information, of unclear or inconsistent guidance from certification officers, and of lengthy waiting periods that disrupted their production planning. These procedural frustrations have been documented in the broader literature on regulatory compliance among SMEs and suggest that there is significant room for reform in the design and administration of halal certification processes for small-scale producers [4].

Renewal requirements were also identified as a challenge. Halal certification in Indonesia is subject to periodic renewal, requiring producers to undergo re-inspection and re-documentation at regular intervals. For small producers with limited administrative capacity, managing renewal timelines while simultaneously attending to the day-to-day demands of their businesses was described as stressful and sometimes resulted in lapses in certification coverage. Such lapses can have significant commercial consequences, particularly for producers who supply certified halal product markets or who wish to access export channels that require valid certification.

3.3 Theme 3: Limited Technology Adoption

The third major theme to emerge from the data concerned participants' use — or more accurately, their limited use — of digital technologies to support halal traceability. The majority of participants relied on manual, paper-based systems for recording product

information, sourcing data, and certification documentation. Only a minority had adopted any form of digital tool for supply chain management, and none were using advanced technologies such as RFID, blockchain, or dedicated halal traceability software.

"I know there are apps and systems for this kind of thing. I've seen them at trade exhibitions. But the cost is high, and I don't know how to use them. We just use notebooks and WhatsApp groups with our suppliers."

This finding reflects broader patterns of digital technology adoption among SMEs in developing countries. Research consistently shows that SMEs face multiple barriers to the adoption of digital supply chain management tools, including high upfront investment costs, limited digital literacy, concerns about data security, and uncertainty about the return on investment [11]. In the context of halal traceability, these barriers are particularly consequential because digital systems offer significant advantages over manual methods in terms of data accuracy, accessibility, and tamper resistance.

Several participants expressed interest in adopting digital tools if they were made more affordable and user-friendly. This suggests that demand-side barriers — such as cost and complexity — are more significant obstacles than a lack of motivation or awareness. This finding has important implications for technology developers and policymakers: there is a market for simple, low-cost digital traceability tools among small-scale halal producers, but this market will remain undersupplied without deliberate efforts to develop solutions tailored to the capacity and resource constraints of this segment.

The use of mobile messaging applications, particularly WhatsApp, as an informal communication and coordination tool within supply chains was noted by several participants. While this does not constitute a formal traceability system, it represents a form of digital engagement that could potentially serve as a bridge towards more structured digital traceability practices. Policymakers and technology developers may find it productive to build on this existing behaviour by developing halal traceability tools that integrate with or complement familiar communication platforms.

3.4 Theme 4: Trust Deficits and Supply Chain Integrity

The fourth theme addresses the role of trust in participants' supply chain relationships and their perceptions of the integrity of the broader halal supply chain. Participants expressed a complex and often ambivalent relationship with trust: while many reported high levels of personal trust in their established suppliers, they also expressed significant concern about the reliability of halal claims across the broader supply chain, particularly in relation to suppliers they did not know personally.

"With our regular supplier, I am confident. We have known each other for years. But what about his suppliers? And their suppliers? That is where I start to worry."

This observation highlights a fundamental challenge in halal supply chain integrity: the concentration of trust at the level of direct, interpersonal relationships, with diminishing confidence as the supply chain extends beyond the immediate circle of known partners. This pattern of trust is consistent with findings from the broader supply chain management literature, which distinguishes between relational trust — built through repeated personal interactions — and institutional trust — derived from formal verification systems such as certification and auditing [7].

Several participants reported concerns about the reliability of halal certificates held by their suppliers. Some expressed doubts about whether certification bodies consistently applied rigorous standards in their auditing practices, particularly in relation

to smaller or less well-known suppliers. A few participants mentioned having encountered suppliers who claimed to hold halal certification but could not produce verifiable documentation when pressed. These experiences eroded participants' confidence in the formal certification system as a reliable proxy for halal integrity.

Consumer trust was also raised as a significant concern. Participants noted that consumers in their markets were increasingly aware of halal issues and were becoming more discerning in their purchasing decisions. At the same time, the absence of a universally recognised halal label or certification standard in the Indonesian domestic market created confusion among consumers and made it difficult for small producers to differentiate their genuinely halal products from those of competitors making unverified halal claims. This market dynamic creates perverse incentives: producers who invest in genuine halal compliance may receive no market advantage over those who make halal claims without adequate substantiation.

5. Conclusion

This study has investigated the halal traceability challenges faced by small-scale food producers in Indonesia, drawing on in-depth qualitative interviews with fifteen producers in Bengkulu Province. The findings reveal that small-scale producers confront a complex and interconnected set of challenges across four dimensions: systemic traceability difficulties rooted in informal supply chain practices and limited documentation; certification barriers arising from financial costs and procedural complexity; constrained adoption of digital technologies due to cost, capacity, and awareness limitations; and trust deficits that undermine confidence in halal supply chain integrity at both the producer and consumer levels. These findings extend and deepen the existing literature by providing empirically grounded insights into the specific mechanisms through which structural disadvantages translate into traceability challenges for small-scale producers. The study contributes to the halal supply chain literature by demonstrating that traceability is not merely a technical problem amenable to technological solutions, but is fundamentally a governance challenge that requires coordinated action across regulatory, institutional, commercial, and technological domains.

6. Declaration

Author contributions and responsibilities - The authors made major contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

Funding - This research did not receive external funding.

Availability of data and materials - All data is available from the author.

Competing interests - The authors declare no competing interests.

Did you use generative AI to write this manuscript? - I do not use AI assistance in my manuscript.

Declaration of generative AI and AI-assisted technologies in the writing process - During the preparation of this work the author did not use AI to write, edit, or other things related to the manuscript.

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