Journal of Economic and Financial Studies
Vol. 2 No. 2 Juni 2026
E-ISSN: 3089-6479
Open Access: https://journals.ai-mrc.com/finanomics

Soybean Supply Chain Efficiency and Sustainability of Tempe SMEs: A DEA Analysis from an Islamic Economic Perspective

Solihah Sari Rahayu [1]*, Raden Nurhayati [2], Junjun Kurnia [3], Izzwah Nauroh [4], Mukhlis Lubis [5]
[1,2,3] IAILM Latifah Mubarokiyah Suryalaya, Indonesia
[4] Universitas Padjadjaran, Indonesia
[5] Sekolah Tinggi Agama Islam Negeri Mandailing Natal, Indonesia
[1]solihah.sr@gmail.com*, [2]radennurhayati28@gmail.com, [3]junjun440@gmail.com,
[4]izzwah22001@mail.unpad.ac.id, [5] mukhlis@gmail.com

Article Info

Article history:
Received 25-04-2026
Revised 21-05-2026
Accepted 17-06-2026

Keyword:
Soybean Supply Chain; Efficiency; Data Envelopment Analysis (DEA); Tempe SMEs; Islamic Economics; Supply Chain Sustainability.

ABSTRACT

This study examines the efficiency of the soybean supply chain as a sustainability instrument for small and medium-sized enterprises (SMEs) in the tempe industry, viewed through the lens of Islamic economics. Although previous studies have extensively assessed supply chain efficiency using quantitative approaches, limited attention has been given to integrating Islamic economic principles into efficiency evaluation, particularly in the soybean supply chain of tempe-producing SMEs. This study addresses this gap by combining technical efficiency analysis with the values of justice, fairness, and sustainability emphasized in Islamic economics.Using the Data Envelopment Analysis (DEA) method, the research analyzes the efficiency of three soybean suppliers in Bandung: Cimahi, Ujung Berung, and Jamika. The results show that Ujung Berung and Jamika exhibit technical efficiency, while Cimahi remains inefficient due to suboptimal management of input variables, such as soybean prices, distance, and delivery time. The study also integrates Islamic economic principles, emphasizing efficiency not only as a technical measure but as a tool for justice, fairness, and sustainability. The findings underline the importance of optimizing input management to ensure equitable and sustainable practices in the tempe production supply chain, which is crucial for the long-term survival and competitiveness of SMEs in the sector. This research contributes to the understanding of how Islamic economic values can be applied to supply chain management, promoting both efficiency and social responsibility.

INTRODUCTION

Food sovereignty is one of the structural challenges faced by many developing countries, including Indonesia (Okesanya et al., 2025; Pawlak & Kołodziejczak, 2020). The high dependency on imported strategic food commodities not only reflects the limitations of domestic production capacity but also highlights the vulnerability of the economic system to global dynamics that are difficult to control (Mukhlis, 2025; Mukhlis & Saidah, 2025). In the long term, this condition can impact the sustainability of the food processing industry, particularly small and medium-sized enterprises (SMEs) that have limited capital and bargaining power to deal with fluctuations in raw material prices.

Soybean (Glycine max L.) is one of the strategic food commodities with an important role in meeting the plant-based protein needs of society. In addition to being used as a raw material for vegetable oil, soybeans are a key input in various processed food products that are widely consumed. In Indonesia, soybeans have high economic and social value because they are the main raw material for traditional food products such as tempeh, which is consumed across various social and economic groups. However, Indonesia's soybean production capacity has not yet been able to optimally meet

.

domestic demand. Field research results indicate that soybean shortages often occur when cooperatives do not supply imported tempeh for small businesses such as tempeh production.

This is supported by data from the Ministry of Agriculture, which shows that Indonesia's soybean imports decreased from 2.67 million tons in 2019 to 2.27 million tons in 2023, with a compound annual growth rate (CAGR) of -3.9%. This indicates progress in reducing dependence on foreign supplies, but the decrease is not due to increased domestic production; rather, it is attributed to rising global soybean prices, making imports more expensive. In fact, imports still account for nearly the entire demand in Indonesia, emphasizing a structural dependence. Several factors affect this, including research conducted in Karawang, which analyzed data from two periods: 1991–2005 and 2006–2020, and found that soybean production declined due to a reduction in harvested land area (Okesanya et al., 2025; Pawlak & Kołodziejczak, 2020). This is projected to continue to reduce soybean production due to a decrease in harvested land area by 2030. The imbalance between production and consumption has made Indonesia structurally dependent on soybean imports from international markets, especially from the United States.

The dependence on soybean imports is reflected in the large volume and value of national imports. According to data from the Central Bureau of Statistics, Indonesia's soybean imports in 2024 reached 2.37 million tons, with a value of more than 1.24 billion US dollars. This large import value shows that soybeans are not only a food commodity but also a significant source of economic pressure. Fluctuations in international prices, changes in global trade policies, and exchange rate volatility directly affect soybean prices at the domestic level, ultimately impacting the cost structure of soybean-based processing industries.

On the other hand, the large volume of soybean imports also highlights the great economic potential of soybean-based downstream industries. One of the most prominent processed soybean products in Indonesia is tempeh. Tempeh is a traditional fermented product with high protein content that has been part of the consumption pattern for decades. Tempeh production is dominated by small and medium-sized enterprises (SMEs) spread across various regions and plays a vital role in providing nutritious food at affordable prices while absorbing local labor.

The SME tempeh industry has distinctive characteristics, including a relatively small scale of operation, the use of simple technology, and a high dependence on soybean raw material supplies (Kamgang et al., 2023). The sustainability of the tempeh business is highly determined by the stability of soybean supplies, raw material prices, and smooth distribution from suppliers to producers. In a condition of high import dependence, the tempeh industry becomes highly vulnerable to supply chain disruptions and increases in production costs.

The tempeh production process involves a series of interconnected stages, starting from soybean procurement, grinding, soaking, boiling, fermentation using Rhizopus oligosporus, and ending with the distribution of the finished product to consumers (Nair et al., 2023).. Each stage requires good coordination between business actors and suppliers to ensure efficient production. Delayed shipments, reduced raw material quality, or price increases in soybeans can directly affect the productivity and profitability of the tempeh industry.

From a management perspective, these activities form a supply chain system that integrates the flow of raw materials, information, and finances from suppliers to end consumers. Supply chain management aims to ensure that raw materials are available in the right quantity, quality, and time at an efficient cost. A poorly managed supply chain can result in resource wastage, cost inefficiencies, and production instability, ultimately threatening the sustainability of the business.

Theoretically, efficiency is the key performance indicator of a production unit (Wang & Komatsu, 2017). Efficiency reflects the ability of business actors to optimally utilize inputs to produce the desired output. In SMEs, efficiency plays a crucial role because limited resources leave little room for inefficiencies. Therefore, improving supply chain efficiency becomes one of the main strategies to maintain competitiveness and business sustainability.

.

Previous studies have shown that supply chain efficiency significantly affects food industry performance. Studies in the agroindustry sector highlight that factors such as raw material prices, distribution distance, input quality, and timely deliveries are key determinants of operational efficiency. However, most of these studies focus on large-scale industries or national logistics systems, while research specifically examining supply chain efficiency in the tempeh SME sector is still relatively limited.

To measure efficiency in systems involving multiple inputs and outputs, non-parametric approaches such as Data Envelopment Analysis (DEA) are widely used. DEA is a method designed to measure the relative efficiency of decision-making units by comparing the ratio of output to input used. The main advantage of this method is its ability to capture the complexity of production systems without requiring assumptions about a specific production function. Therefore, this method is relevant for analyzing supply chain efficiency in SMEs that have diverse production characteristics.

Several studies have applied DEA to the agricultural and food industries to identify efficiency levels and sources of inefficiency (Barboza Martignone et al., 2024). However, most of these studies define efficiency purely as a technical or economic measure, without linking it to the dimensions of business sustainability and the normative values underpinning economic activities. In practice, efficiency has broader implications, especially for industries that play a role in food provision and community welfare.

In Islamic economics, efficiency is not only understood as maximizing profit but also as part of the trust in managing resources. The Quran explicitly prohibits wastefulness and encourages the balanced and responsible use of resources. The principle of justice in muamalah demands that every party in the supply chain receives their proportional rights without exploitation or inequality. Thus, efficiency in the perspective of Islamic economics has a strong moral and social dimension.

The hadith of Prophet Muhammad SAW also emphasizes the importance of honesty, justice, and responsibility in economic activities. Efficient production and distribution practices reflect efforts to maintain fair pricing, product quality, and timely order fulfillment. In the food industry, supply chain efficiency contributes to the sustainability of supplies and price stability, which ultimately supports the welfare of society at large.

Although the values of efficiency and sustainability have long been part of Islamic teachings, empirical studies integrating supply chain efficiency measurements with the perspective of Islamic economics are still very limited. Most Islamic economics research focuses on the financial and banking sectors, while real sectors such as food industries and supply chains have not received much attention. This highlights a significant research gap that needs to be filled, particularly in efforts to link quantitative analysis with Islamic normative values.

Based on this context, it is necessary to conduct a study that not only measures the technical efficiency of soybean supply chains but also positions it as an instrument for the sustainability of the tempeh SME sector from the perspective of Islamic economics (Ardania et al., 2023). This approach allows efficiency to be understood more comprehensively as a mechanism supporting business continuity, responsible resource management, and justice in economic relations.

The novelty of this research lies in the integration of soybean supply chain efficiency measurement using DEA and the interpretation of its results through Islamic economic principles (Setiawan et al., 2023). Unlike previous studies that view efficiency purely as a technical goal, this study positions efficiency as a sustainability instrument with economic, social, and moral dimensions. Focusing on the tempeh SME sector, this research provides both empirical and conceptual contributions that are relevant for the development of supply chain efficiency literature and Islamic economics.

The implications of this research are broad (Vidiati et al., 2023). Economically, the results are expected to form the basis for strategies to improve supply chain efficiency that can reduce production costs and enhance the competitiveness of the tempeh industry (Mukhlis, Janwari, et al., 2023; Mukhlis & Abdullah, 2025). Socially, this research supports the sustainability of SMEs, which play a vital role in food provision and local labor absorption. Normatively, this research enriches Islamic economics

studies with empirical evidence on the role of efficiency in achieving fair and sustainable resource management.

RESEARCH METHODS

This study uses a mixed-method approach with a quantitative framework and qualitative data support to analyze the efficiency of the soybean supply chain in the small and medium-sized tempe industry. The research was conducted in small and medium-sized tempe industries operating in urban areas with characteristics of a homogeneous imported soybean supply chain. Supply chain identification was carried out to map the relationships among key players in the raw material distribution system, as presented in Figure 1.

Primary data were obtained through interviews and direct observation of tempe SMEs in Mandalajati District, while secondary data were sourced from official publications and relevant scientific literature.

The unit of analysis in this study is the soybean supplier, which directly interacts with tempe producers and is treated as a Decision-Making Unit (DMU). Efficiency is analyzed using the input-oriented Data Envelopment Analysis method with the assumption of variable returns to scale. Input variables include soybean price, distribution distance, quality, supply quantity, and delivery time, while output variables represent the level of raw material order fulfillment.

Slack analysis is used to identify sources of inefficiency and determine improvement targets for inputs. The efficiency measurement results are then interpreted using the principles of Islamic economics to provide a normative dimension to the supply chain performance.

RESULTS

The analysis of supplier performance measurement was conducted using the DEA method by comparing the output and input values based on three different soybean suppliers. The soybean suppliers for this tempe SME (Small and Medium Enterprises) are from several areas in Bandung, namely Cimahi, Ujung Berung, and Jamika. This analysis aims to measure the efficiency level of each supplier and provide information to the Tempe SME in order to optimize both supplier and company performance.

Table 1. Input and Output Variable Values in Supply Chain Performance Measurement

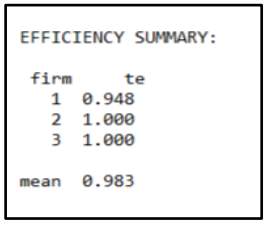
Decision Making Unit (DMU)	Output	Performance Measurement (Input)				
	Order Fulfillment (%)	Soybean Prices Based on Suppliers (Rp/Ton/Week)	Distance Between Suppliers and Factory (Km)	Quality of Soybean by Suppliers (%)	Fulfillment of Soybean Order Quantity (Ton/Month)	Delivery Time from Suppliers to Factory (Hour)
Cimahi	90	8000000	18	90	4	24
Ujung Berung	100	7000000	6,4	95	4	12
Jamika	100	7000000	13	95	4	24

Source: Data Processing Results by the Author Team

Efficiency is defined as the ratio between output and input (Lestari, 2015:170). The determination of output and input variables is necessary in measuring the level of efficiency using this DEA method. The output variable used in this analysis is order fulfillment, and the input variables are: 1) soybean prices from each supplier; 2) the distance between the supplier and the factory; 3) the quality of soybeans from the supplier; 4) the fulfillment of soybean order quantity; 5) the delivery time from the supplier to the factory. The values for each of these variables can be seen in Table 1.

.

A Decision-Making Unit (DMU) is defined as the unit to be analyzed in efficiency measurement. In this analysis, there are three DMUs: DMU Cimahi, DMU Ujung Berung, and DMU Jamika. A DMU is considered relatively efficient if it has an Overall Technical Efficiency (OTE) score equal to 1. On the other hand, a DMU is considered relatively inefficient if it has an OTE score smaller than or below 1.



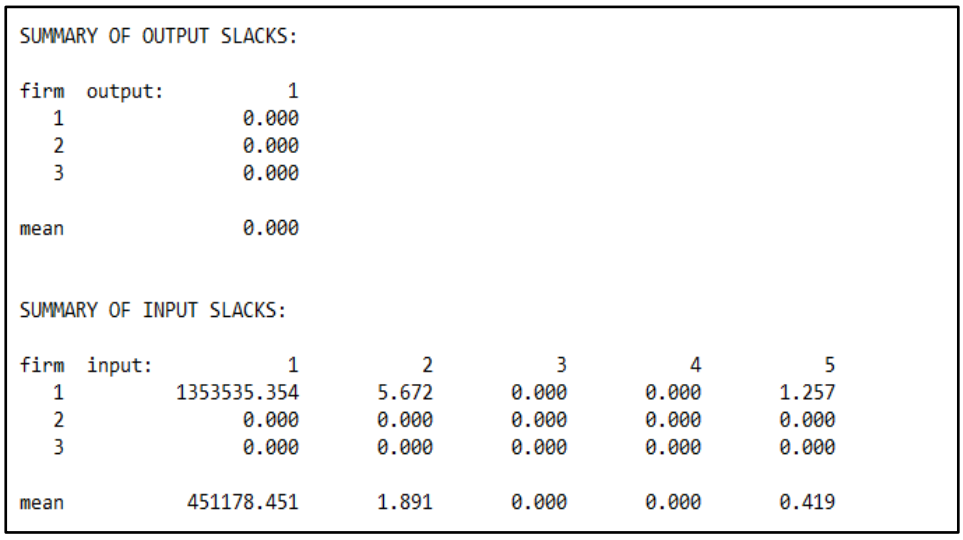
```
EFFICIENCY SUMMARY:

 firm     te
    1  0.948
    2  1.000
    3  1.000

mean   0.983
```

Figure 1. Supplier Efficiency Measurement Results
Source: Data Processing Results by the Author Team

The calculation using the DEA method has yielded efficiency scores for each observed DMU, as shown in Figure 4. The analysis results in Figure 4 indicate that the DMUs of Ujung Berung (Firm 2) and Jamika (Firm 3) are relatively efficient, while the DMU of Cimahi (Firm 1) is relatively inefficient. This is due to the fact that the DMUs of Ujung Berung and Jamika have achieved a score of 1, while the DMU of Cimahi has not reached a score of 1, instead being at a value of 0.948, corresponding to an efficiency rate of 94.8%.



```
SUMMARY OF OUTPUT SLACKS:

firm  output:          1
   1               0.000
   2               0.000
   3               0.000

mean               0.000


SUMMARY OF INPUT SLACKS:

firm  input:           1         2         3         4         5
   1          1353535.354     5.672     0.000     0.000     1.257
   2                0.000     0.000     0.000     0.000     0.000
   3                0.000     0.000     0.000     0.000     0.000

mean           451178.451     1.891     0.000     0.000     0.419
```

Figure 2. Output Slack and Input Slack Values for Each DMU
Source: Data Processing Results by the Authors

Output slack values can occur when there are DMUs that are not relatively efficient, where the output amount can be increased to make the DMU efficient. In this case, a relatively efficient DMU is indicated by an output slack value of 0. Output variable 1 represents order fulfillment. Based on Figure 5, it can be observed that the output slack values for all three DMUs have reached 0, meaning that these three DMUs are relatively efficient and there is no need to reduce orders.

Input slack values can occur when there are DMUs that are not relatively efficient, where the input amount can be reduced to make the DMU efficient. Similarly to output slack, a relatively efficient DMU is indicated by an input slack value of 0. Input variable 1 represents the price of soybeans based on each supplier, input variable 2 is the distance between the supplier and the factory, input variable 3 is the quality of soybeans from the supplier, input variable 4 is the fulfillment of the soybean order quantity, and input variable 5 is the delivery time from the supplier to the factory. Based on Figure 5, it can be seen that the input slack values for the Ujung Berung and Jamika DMUs have reached 0, indicating relative efficiency, while the Cimahi DMU is not yet efficient. Its

`

efficiency can be improved by reducing the soybean price by 1,353,535.354%, the distance between the supplier and the factory by 5.672%, and the delivery time from the supplier to the factory by 1.257%.

```
SUMMARY OF PEERS:

 firm  peers:
   1      3    2
   2      2
   3      3


SUMMARY OF PEER WEIGHTS:
  (in same order as above)

 firm  peer weights:
   1   0.947 0.002
   2   1.000
   3   1.000
```

Figure 3. Summary of Peers (Benchmark)
Source: Data Processing Results by the Authors' Team

The supplier that has not yet achieved efficiency (Firm 1) requires benchmarks or references from DMUs that have already achieved efficiency (Firm 2 and 3). In the analysis results shown in Figure 6, Firm 1 must refer to Firm 3 and Firm 2 as peers or benchmarks. The reference measurement is represented by the lambda weights, which range from 0.947 to 0.002. This indicates that Firm 3 contributes 94.7% and Firm 2 contributes 0.2% towards achieving the efficiency target set by Firm 1.

```
Results for firm:     1
Technical efficiency = 0.948
 PROJECTION SUMMARY:
  variable            original        radial          slack      projected
                         value      movement       movement          value
 output      1          90.000         4.949          0.000         94.949
 input       1     8000000.000         0.000  -1353535.354   6646464.646
 input       2          18.000         0.000         -5.672         12.328
 input       3          90.000         0.000          0.000         90.000
 input       4           4.000         0.000          0.000          4.000
 input       5          24.000         0.000         -1.257         22.743
 LISTING OF PEERS:
  peer   lambda weight
    3      0.947
    2      0.002
```

Figure 4. Calculation of Technical Efficiency for DMU Cimahi
Source: Data Processing Results by the Author Team

In the DEA input-output model, input targets are classified as either target radial movement or target slack movement, depending on the values they represent. In Firm 1, namely DMU Cimahi, it is observed that Input 2 (the distance between the supplier and the factory) is inefficient over a 24-hour period. Therefore, a slack movement reduction of -5.672 is required to meet the projected value of 12.328. The same calculation method is applied for the next input.

```
Results for firm:     2
Technical efficiency = 1.000
 PROJECTION SUMMARY:
  variable           original        radial         slack     projected
                        value      movement      movement         value
 output     1         100.000         0.000         0.000       100.000
 input      1     7000000.000         0.000         0.000   7000000.000
 input      2           6.000         0.000         0.000         6.000
 input      3           4.000         0.000         0.000         4.000
 input      4          95.000         0.000         0.000        95.000
 input      5           4.000         0.000         0.000         4.000
 LISTING OF PEERS:
  peer   lambda weight
    2      1.000
```

Figure 5. Technical Efficiency Calculation of DMU Ujung Berung
Source: Data Processing Results by the Author Team

In Company 2, as shown in Figure 8, referred to as the DMU Ujung Berung, there is no radial movement or slack movement for any input values. As a result, its performance already meets the efficiency target and is highly optimal in accordance with the predicted values provided.

```
Results for firm:     3
Technical efficiency = 1.000
 PROJECTION SUMMARY:
  variable           original        radial         slack     projected
                        value      movement      movement         value
 output     1         100.000         0.000         0.000       100.000
 input      1     7000000.000         0.000         0.000   7000000.000
 input      2          13.000         0.000         0.000        13.000
 input      3          95.000         0.000         0.000        95.000
 input      4           4.000         0.000         0.000         4.000
 input      5          24.000         0.000         0.000        24.000
 LISTING OF PEERS:
  peer   lambda weight
    3      1.000
```

Figure 6. Calculation of Technical Efficiency for DMU Jamika
Source: Data Processing Results by the Authors' Team

In Company 3, as shown in Figure 9, also known as DMU Jamika, there is no radial movement or slack movement for any input values. As a result, its performance has already met the efficiency target and is highly optimal in accordance with the predicted values provided.

DISCUSSION

Supply Chain Efficiency as the Foundation for the Sustainability of Tempe SMEs within the Framework of Islamic Economics

The results of this study indicate that the efficiency of the soybean supply chain is a key foundation for the sustainability of the small and medium tempe industry, particularly in situations of high dependence on imported raw materials (Central Insight, 2025). However, from the perspective of Islamic economics, sustainability is not solely understood as the ability to survive financially, but as the ability to maintain a balance between business continuity, equitable distribution, and social welfare.

.

When all three suppliers are able to meet demand in terms of quantity, but show differences in technical efficiency, it emphasizes that the sustainability of the tempe industry is not only determined by supply adequacy but by how the supply is managed fairly and responsibly (Mukhlis et al., 2024; Mukhlis, Maryam, et al., 2023). In Islam, the management of economic resources must avoid practices that harm other parties covertly, including through disproportionate distribution costs or repeated untimely deliveries.

DMU Ujung Berung and Jamika, which achieved perfect technical efficiency scores, demonstrate that the principle of balance or mizan is reflected in their supply chain practices (Ramdhani et al., 2024). The management of costs, distribution distance, raw material quality, and delivery time is proportional, thus not imposing excessive burdens on tempe producers. In contrast, DMU Cimahi, which has not yet reached the efficiency frontier, reflects distortions in the supply chain structure that could erode the sustainability of the tempe business in the medium to long term.

Avi Budi Setiawan et al.(2023), from the perspective of Islamic economics, such distortions are not neutral in value. Inefficiency in input use may shift risks and costs onto small business owners who have limited bargaining power. Therefore, this finding underscores that efficiency is not merely a technical variable, but an instrument for economic justice in ensuring the continuity of soybean-based food production.

The Meaning of Efficiency Behind the DEA Scores as a Reflection of Muamalah Governance

The Data Envelopment Analysis approach in this study reveals that the main source of inefficiency does not stem from failure to meet output, but from the disproportionate use of inputs. All DMUs show a zero output slack, indicating that the order fulfillment obligations have been met optimally. From an Islamic perspective, this can be interpreted as the fulfillment of the contract in terms of the final output.

However, Islam does not only assess the legitimacy of contracts based on fulfilled output but also on the accompanying processes. The excessive use of inputs, such as higher raw material prices without justifiable quality, inefficient distribution distances, and long delivery times, reflects weak muamalah governance (OEC World, 2025). In Islamic economic practice, transactions that create economic harm for one party are contrary to the principle of justice.

Cimahi's inefficiency, which stems from a combination of price, distance, and delivery time, shows that transaction costs in the supply chain are not managed optimally. These costs could eventually be passed on to tempe producers through higher raw material prices or supply uncertainty. In Islamic economics, such mechanisms risk creating imbalances in benefits and burdens, making input efficiency an important condition for ensuring equitable distribution.

This finding challenges conventional approaches that often view increased supply volume as the primary solution. This study shows that from an Islamic perspective, input optimization is more aligned with the principles of avoiding wastefulness and protecting wealth, rather than expanding capacity, which risks creating new inefficiencies.

Benchmarking as a Manifestation of the Principle of Taawun in the Supply Chain

Benchmarking analysis shows that DMU Cimahi should primarily refer to DMU Jamika and Ujung Berung as benchmarks for efficiency. In management literature, benchmarking is often understood as a competitive mechanism. However, in Islamic economics, this process can be interpreted as a form of taawun or cooperation in goodness.

Efficient suppliers are not only market competition winners but also serve as sources of structural learning for other suppliers (BPS-Statistics Indonesia, 2025; Kusnandar, 2025). By replicating best practices related to managing distance, time, and costs, inefficient suppliers can improve their performance without needing to scale up their operations or pressure others.

For tempe SMEs, this benchmarking provides an ethical foundation in supplier selection. Decisions are no longer based solely on the lowest price but on stability, reliability, and long-term efficiency. Within the framework of Islamic economics, selecting efficient and trustworthy business

`

partners is part of the effort to maintain business sustainability and avoid dependency on practices that could be detrimental.

Supply Chain Efficiency and Economic Resilience from the Perspective of Maqashid Syariah

The Data Envelopment Analysis approach in this study not only produces a ranking of technical efficiency between suppliers but also provides an empirical basis for assessing the quality of economic governance in the soybean supply chain (Vidiati et al., 2023). When the DEA results are viewed through the lens of maqashid syariah, each efficiency score represents how much the supply chain practices contribute to protecting the basic interests of business actors and collective economic sustainability.

1. DMU Ujung Berung and Jamika as Representations of Hifz al Mal

DMU Ujung Berung and Jamika, which achieved perfect technical efficiency scores, are at the efficiency frontier, demonstrating the ability to manage all inputs proportionally to achieve maximum output. From the perspective of maqashid syariah, this condition directly relates to the principle of hifz al mal, which refers to the protection of wealth and livelihood sources.

The efficiency of raw material costs, relatively short distribution distances, and timely deliveries reflect the practice of resource management that is trustworthy. Suppliers do not impose unnecessary additional costs on tempe producers (Baroh et al., 2024; Wagimin et al., 2024). This is important because for tempe SMEs, profit margins are relatively thin and highly sensitive to input cost changes. Thus, the efficiency of DMU Ujung Berung and Jamika functions as an economic protection mechanism for tempe producers, not just as operational excellence for suppliers.

In the maqashid framework, such practices contribute to the sustainability of community livelihoods. Tempe producers can maintain production stability, product price, and quality without having to sacrifice other aspects of their business. Efficiency here is not merely a technical achievement but a tangible effort to maintain collective economic welfare.

2. DMU Cimahi and Indications of Imbalance in Trust Management

Unlike the other two DMUs, DMU Cimahi shows an efficiency score below one, indicating that input usage is suboptimal. Slack analysis reveals that inefficiency primarily stems from higher raw material prices, longer distribution distances, and longer delivery times. These three factors form a disproportionate cost structure.

From an Islamic economics perspective, this condition can be seen as an indication of imbalance in trust management (Burgess et al., 2023; Sedat, 2023). Wastefulness of resources, whether in the form of time, cost, or distribution distance, contradicts the principle of israf. While DMU Cimahi is still able to meet output demand, input inefficiency may shift the economic burden to tempe producers, especially if these additional costs are passed on in the form of higher raw material prices.

From the perspective of maqashid, this situation may weaken the protection of tempe producers' wealth. When input costs rise without commensurate value addition, the economic resilience of producers becomes fragile. In the long run, this condition may disrupt business sustainability and threaten the economic stability of the local community dependent on the tempe industry.

The structural dependence of the tempe industry on imported soybeans places the supply chain as a critical point in maintaining small business economic continuity. From the perspective of maqashid syariah, this condition is not merely understood as a technical production issue, but as a matter of protecting the basic interests of society (Doetsch & Huchzermeier, 2024; N, 2023). The efficiency of the soybean supply chain is directly related to hifz al mal, which refers to the protection of the wealth and livelihood sources of micro and small businesses that are the backbone of the local economy.

The findings of this study show that suppliers who can manage inputs efficiently play a role in buffering against external risks stemming from global price fluctuations and international logistical

uncertainties (Mukhlis, Arifin, Ridwan, & Zulbaidah, 2025; Mukhlis, Arifin, Ridwan, Zulbaidah, et al., 2025). Within the maqashid framework, this capability functions as a preventive mechanism to avoid greater economic damage. When distribution costs, delivery times, and raw material quality can be controlled, the risk of income erosion for tempe producers can be minimized. This aligns with the principle of sadd al dzari'ah, which aims to close the path to greater harm.

Conversely, inefficiency in the supply chain reflects a failure to maintain a balanced use of resources. Disproportionate costs, suboptimal distribution distances, and excessive delivery times eventually burden tempe producers, who in the market structure are in a relatively weak bargaining position. From the perspective of Islamic economics, this condition may undermine the principle of distributive justice because the economic risks and burdens are not evenly distributed across supply chain actors.

Efficiency in this study can therefore be understood as a rational effort to maintain the continuity of dignified economic activities. Local economic resilience does not emerge from mere business scale expansion, but from the ability of economic actors to manage resources trustworthily and proportionally. Therefore, improving the efficiency of the soybean supply chain is not just a business strategy, but part of an effort to safeguard the collective welfare of the community dependent on the tempe industry as a livelihood source.

Efficiency as an Instrument for Ethical Sustainability in Halal Supply Chains

In Islamic economic discourse, sustainability cannot be separated from the ethical dimensions of managing economic activities (Sickles et al., 2020; Sujová et al., 2023). This study places supply chain efficiency as an instrument of sustainability that is ethical, not just technical. Efficiency becomes an indicator of how supply chain actors uphold trust in managing limited resources without waste and without unfairly shifting economic burdens onto others.

The soybean supply chain in the tempe industry shows an asymmetric relationship between suppliers and small producers. In such a situation, efficient suppliers contribute to creating a more just muamalah relationship. Optimal cost and time management help tempe producers maintain price stability, product quality, and avoid pressure to lower production standards. This practice aligns with the principle of la dharar wa la dhirar, which prohibits causing harm to oneself or others in economic activities.

Efficiency also serves as a mechanism to prevent covert exploitation in the supply chain. When inefficiencies are left unchecked, additional costs tend to be passed onto the party with the weakest bargaining power, in this case, small-scale tempe producers. From an Islamic perspective, such practices may violate the principle of justice in muamalah, even if there is no formal contract violation. Therefore, efficiency becomes an important indicator for assessing the ethical quality of economic relationships in the supply chain.

Furthermore, the findings of this study expand the meaning of the halal concept in the food supply chain. Halal is not just limited to raw materials and production processes, but encompasses fair, transparent, and efficient supply chain governance. Efficiency achieved without waste reflects the prohibition of israf, while proportional distribution of costs reflects social justice. Therefore, an efficient soybean supply chain can be seen as a holistic manifestation of halal, integrating sharia compliance with economic sustainability.

This approach positions efficiency not as the end goal, but as a means to create a just and sustainable economic system. In the context of the tempe industry, supply chain efficiency directly contributes to protecting small business actors, stabilizing food prices, and ensuring the sustainability of community livelihoods. This reaffirms that Islamic economics is not outside the realm of modern managerial analysis but provides a normative framework that enriches the meaning and direction of efforts to enhance efficiency itself.

Position and Contribution of the Research in the Literature

By combining DEA, soybean supply chains, and Islamic economics in the tempe industry, this research occupies a unique position in the literature. Previous studies tend to separate technical

efficiency analysis from normative studies (Lee & Johnson, 2013; Najar, 2020). This study shows that measuring efficiency can serve as an empirical tool for evaluating the application of Islamic economic values in supply chain practices.

This contribution is not only contextual but conceptual (Mukhlis, Arifin, Ridwan, & Zulbaidah, 2025; Mukhlis, Arifin, Ridwan, Zulbaidah, et al., 2025). This research opens up the development of an evaluation model for supply chains based on efficiency and values, which can be replicated in other food sectors within the halal industry ecosystem.

CONCLUSION

This research demonstrates that understanding the upstream supply chain flow patterns of soybeans is a key prerequisite for ensuring the sustainability of the small and medium-sized tempe industry. The study conducted on tempe SMEs in the Mandalajati area of Bandung City proves that business sustainability is not solely determined by the ability to meet consumer demand, but is significantly influenced by the level of efficiency in managing inputs within the raw material supply chain. The results of the measurement using Data Envelopment Analysis reveal variations in efficiency levels among soybean suppliers. The suppliers in Ujung Berung and Jamika have achieved optimal technical efficiency, while the Cimahi supplier is not yet on the efficiency frontier due to the disproportionate use of inputs, particularly in terms of raw material prices, distribution distance, and delivery time. These findings emphasize that the main source of inefficiency in the tempe SME supply chain lies not in the output side, but in the management of inputs. From the perspective of Islamic economics, supply chain efficiency in this study carries a broader meaning than just operational performance. Efficiency reflects the implementation of principles such as trust, fairness, and the prohibition of wastefulness in muamalah activities. Efficient suppliers contribute to maintaining a balanced economic relationship with tempe producers, while inefficiency may create unjust cost burdens and weaken the sustainability of small businesses. The use of the DEAP method has proven to be an effective empirical tool for evaluating the quality of economic relationships in the soybean supply chain. The measurement results can be used by tempe SMEs and stakeholders as a basis for making strategic decisions, particularly in supplier selection, cost control, and the formulation of more sustainable marketing strategies. Therefore, supply chain efficiency not only functions as an instrument for performance improvement, but also as a foundation for economic sustainability that aligns with Islamic economic values.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in the conduct of this research or the publication of this article. The study was conducted impartially, and the authors have no financial, personal, or professional relationships that could potentially influence the research outcomes.

ACKNOWLEDGMENTS

Special thanks to UNPAD students Alycia Andriyana, Siti Alya Ridwan, Fitria Handayani, and Amanda Siti Nurhafizah for their assistance with the observations, as well as to all other parties who contributed to the insights in this paper.

REFERENCES

Ardania, K. G., Hendrarini, H., & Wijayati, P. D. (2023). Analysis of Added Value of Tempeh *Agroindustry* (Case Study of Karlim's Tempeh Agroindustry in Sepande Village, Sidoarjo Regency). *Himalayan Journal of Agriculture*, *4*, 1–10. https://doi.org/10.47310/hja.2023.v04i01.015

.

Barboza Martignone, G. M., Ghosh, B., Papadas, D., & Behrendt, K. (2024). The Rise of Soybean in International Commodity Markets: A Quantile Investigation. *Heliyon*, *10*(15), e34669. https://doi.org/10.1016/j.heliyon.2024.e34669

Baroh, I., Windiana, L., Shodiq, W. M., & Khan, W. A. (2024). Analysis of Soybean Production Trends in Indonesia. *BIO Web of Conferences*, *104*, 00020. https://doi.org/10.1051/bioconf/202410400020

BPS-Statistics Indonesia. (2025, July 29). *Imports of Soybean by Major Country of Origin, 2017-2024—Statistical Data*. BPS Indonesia. https://www.bps.go.id/en/statistics-table/1/MjAxNSMx/imports-of-soybean-by-major-country-of-origin--2017-2023.html

Burgess, P. R., Sunmola, F. T., & Wertheim-Heck, S. (2023). A Review of Supply Chain Quality Management Practices in Sustainable Food Networks. *Heliyon*, *9*(11), e21179. *https*://doi.org/10.1016/j.heliyon.2023.e21179

Central Insight. (2025, September 25). *Indonesia's Reliance on Imported Soybeans to Meet* Demand. https://centralinsight.com/indonesias-reliance-on-imported-soybeans-to-meet-demand/

Doetsch, S., & Huchzermeier, A. (2024). The Intersection of Supply Chain Resilience and Sustainability from a Theoretical and Practical Perspective: An Integrated Framework. *Journal of Cleaner Production*, *484*, 144306. https://doi.org/10.1016/j.jclepro.2024.144306

Kamgang, S. E., Boiral, O., Guillaumie, L., & Brotherton, M.-C. (2023). Responsible Sourcing in the Food Industry: A Scoping Review. *Environment, Development and Sustainability*, *26*(8), 19325–19349. https://doi.org/10.1007/s10668-023-03509-1

Kusnandar, V. B. (2025, April 29). *Indonesia's Soybean Imports Rise 17% in 2024* [Databoks]. Pusat Data Ekonomi Dan Bisnis Indonesia; databoks.katadata.co.id. https://databoks.katadata.co.id/en/trade/statistics/68099fca34ff3/indonesias-soybean-imports-rise-17-in-2024

Lee, C.-Y., & Johnson, R. (2013). Operational Efficiency. In A. Badiru, *Handbook of Industrial and Systems Engineering, Second Edition* (Vol. 20131247, pp. 17–44). CRC Press. https://doi.org/10.1201/b15964-5

Mukhlis, L. (2025). A Phenomenological Study of Personal Spiritual Experiences in Navigating Religious Pluralism within Interfaith Communities. *Irfana: Journal of Religious Studies*, *1*(6), 212–220.

Mukhlis, L., & Abdullah, M. N. (2025). *Hukum Keluarga Islam di Indonesia* (1st edn). Mukhlisina Revolution Center.

Mukhlis, L., Arifin, T., Ridwan, A. H., & Zulbaidah. (2024). Integrating Artificial Intelligenceand Maqāṣid al-Syarī'ah: Revolutionizing Indonesia's Sharia Online Trading System. *Computer Fraud and Security*, *2024*(11), 301–309. https://doi.org/10.52710/cfs.238

Mukhlis, L., Arifin, T., Ridwan, A. H., & Zulbaidah. (2025). Reorientation of Sharia Stock Regulations: Integrating Taṣarrufāt al-Rasūl and Maqāṣid al-Sharī'ah for Justice and Sustainability. *Journal of Information Systems Engineering and Management*, *10*(10s), 58–66. https://doi.org/10.52783/jisem.v10i10s.1341

Mukhlis, L., Arifin, T., Ridwan, A. H., Zulbaidah, Rosadi, A., & Solehudin, E. (2025). Reformulation of Islamic Stock Law: The Application of Taṣarrufāt al-Rasūl and

`

Maqāṣid al-Syarī‘ahto Develop a Dynamic and Sustainable Islamic Capital Market in Indonesia. *Journal of Posthumanism*, *5*(3), 1–13. https://doi.org/10.63332/joph.v5i3.913

Mukhlis, L., Janwari, Y., & Syafe`i, R. (2023). INDONESIA STOCK EXCHANGE: THEORETICAL AND PHILOSOPHICAL ANALYSIS OF MUDHARABAH AND MUSYARAKAH CONTRACTS. *Yurisprudentia: Jurnal Hukum Ekonomi*, *9*(2), 243–264. https://doi.org/10.24952/yurisprudentia.v9i2.8466

Mukhlis, L., Maryam, S., & Sormin, S. A. (2023). Model Pembelajaran Living History Berbasis PjBL Untuk Meningkatkan Keterampilan Histografi Mahasiswa. *Jurnal Educatio FKIP UNMA*, *9*(4), 1800–1809. https://doi.org/10.31949/educatio.v9i4.5595

Mukhlis, L., & Saidah, Y. (2025). Dynamics of Nature-Based learning in Developing Children’s Motoricic Skills: Teacher and Parent Perspectives. *HUMANISMA: Journal of Gender Studies*, *9*(1), 64–79. http://dx.doi.org/10.30983/humanisme.v4i2.9366

N, S. (2023). *Achieving Sustainable Supply Chain Management: Best Practices and Strategies for* Success. https://www.linkedin.com/pulse/achieving-sustainable-supply-chain-management-best-practices-nanda

Nair, R. M., Boddepalli, V. N., Yan, M.-R., Kumar, V., Gill, B., Pan, R. S., Wang, C., Hartman, G. L., Silva E Souza, R., & Somta, P. (2023). Global Status of Vegetable Soybean. *Plants*, *12*(3), 609. https://doi.org/10.3390/plants12030609

Najar, B. W. (2020). Efficiency and/or Effectiveness in Managing Organizations. *Journal of Education and Culture* Studies, *4*(2), p131. https://doi.org/10.22158/jecs.v4n2p131

OEC World. (2025). *Soybeans in Indonesia Trade*. The Observatory of Economic Complexity. https://oec.world/en/profile/bilateral-product/soybeans/reporter/idn

Okesanya, O. J., Fadele, K. P., Ahmed, M. M., Musa, S. S., & Ogaya, J. B. (2025). Food Security in the Poorest Countries of the World: A Paradigm Shift Toward Sustainable Solutions. In *Advances in Food Security and Sustainability* (Vol. 10, pp. 1–40). Elsevier. https://doi.org/10.1016/bs.af2s.2025.08.002

Pawlak, K., & Kołodziejczak, M. (2020). The Role of Agriculture in Ensuring Food Security in Developing Countries: Considerations in the Context of the Problem of Sustainable Food Production. *Sustainability*, *12*(13), 5488. https://doi.org/10.3390/su12135488

Ramdhani, R., Nurmala, T., Soleh, M., & Ruminta, R. (2024). Soybean Production Prediction Based on Its Relationship to Climate Change: A Case Study in Karawang, Indonesia. *International Journal of Agriculture and Biology*, *32*(04), 373–377. https://doi.org/10.17957/IJAB/15.2212

Sedat, A. (2023). *Supply, Supplier, Supply Chain, Supply Chain Management, Supplier Selection, Supplier Development* [SAKARYA UNIVERSITY]. https://www.researchgate.net/publication/374849215_Supply_Supplier_Supply_Management_Supply_Chain_Supply_Chain_Management

Setiawan, A., Purwaningsih, Y., Suryantoro, A., & Antriyandarti, E. (2023). Soybeans Import of Indonesia: What *Makes* Happen? (A Case in Indonesia). *Proceedings of the 5th International Conference on Economics, Business and Economic Education Science, ICE-BEES 2022, 9-10 August 2022, Semarang, Indonesia*. Proceedings of the 5th International Conference on Economics, Business and Economic Education Science,

.

ICE-BEES 2022, 9-10 August 2022, Semarang, Indonesia. https://doi.org/10.4108/eai.9-8-2022.2338590

Sickles, R. C., Song, W., & Zelenyuk, V. (2020). Econometric Analysis of Productivity: Theory and Implementation in R. In *Handbook of Statistics* (Vol. 42, pp. 267–297). Elsevier. https://doi.org/10.1016/bs.host.2018.11.007

Sujová, E., Vysloužilová, D., Koleda, P., & Gajdzik, B. (2023). Research on the Evaluation of the Efficiency of Production Processes Through the Implementation of Key Performance Indicators. *Management Systems in Production Engineering*, *31*(4), 404–410. https://doi.org/10.2478/mspe-2023-0045

Vidiati, C., Mokti, H. A., Selasi, D., & Iqbal, M. (2023). Assistance of MSMEs: Sustainability Business of Tempe Entrepreneurs, Tegalkarang-Palimanan-Cirebon. *International Conference On Research And Development (ICORAD)*, *2*(1), 56–62. http://www.adpi-indonesia.id/icorad/index.php/home/article/view/96

Wagimin, Kurnia, W. I., & Fattah, A. (2024). Analysis of the Impact of Soybean Price Increases on the Availability of Soybean Stocks in the Somber Small Industrial Center Area of Balikpapan City. *Journal La Lifesci*, *5*(6), 611–620. https://doi.org/10.37899/journallalifesci.v5i6.1722

Wang, X., & Komatsu, S. (2017). Improvement of Soybean Products Through the Response Mechanism Analysis Using Proteomic Technique. In *Advances in Food and Nutrition Research* (Vol. 82, pp. 117–148). Elsevier. https://doi.org/10.1016/bs.afnr.2016.12.006