Sainteks: Jurnal Sain dan Teknik
E-ISSN: 2685-8304
Volume 8 Nomor 02 Tahun Tahun
http://ejournal.uicm.ac.id/index.php/sainteks/

Soft System Methodology for Modeling Green Lean Manufacturing Halal SMEs in Tangerang Regency

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Abstract: *Halal food micro, small, and medium-sized enterprises (MSMEs) make a significant contribution to the local economy, but they still face challenges related to waste management, energy efficiency, and the sustainable use of resources. This study aims to develop a model for implementing clean production in halal food MSMEs in Tangerang Regency to support the achievement of Sustainable Development Goal (SDG) 12 on responsible consumption and production. The study uses the Soft System Methodology (SSM), which involves problem identification, Rich Picture development, CATWOE analysis, conceptual model development, comparison of the model with actual conditions, and formulation of recommendations for improvement and implementation. The results indicate that the main issues include production waste, plastic packaging waste, and water and energy waste. The CATWOE analysis identified the key actors in the system, the transition toward environmentally friendly, energy-efficient, and water-efficient waste management, and halal regulatory support as critical implementation factors. A comparison of the model with actual conditions showed that 37.03% of respondents were optimistic that applying the 3R principles could improve productivity. In comparison, 51.8% of respondents were optimistic that work flexibility would increase. Proposed improvements include using technology in food packaging and waste management, as well as refining food processing procedures to reduce potential waste generation. Thus, SSM is an effective tool for developing an initial model for clean production implementation in halal food MSMEs and can serve as the foundation for developing sustainability strategies for the sector.*
Keywords: green, halal, lean, SMEs, soft system methodology

DOI: http://doi.org/10.37577/sainteks.v8i02.1166
Received: August, 026. Accepted: September, 2026. Published: September, 2026

INTRODUCTION

Micro, Small and Medium Enterprises (MSMEs) contribute to economic growth. One growing MSME sector is food. Halal food MSMEs have grown significantly as the government enforces halal certification obligations (Nugroho et al., 2020). MSMEs face challenges in waste management, energy efficiency, and sustainable resource utilization. This aligns with the implementation of Sustainable Development Goal (SDG) 12, namely Responsible Consumption

and Production. In line with the Sustainable Development Goals, strategies to increase the productivity of halal food MSMEs will be implemented to achieve responsible production and consumption. This research is also aligned with the National Research Priority on Food Security.

Various innovations can significantly reduce food waste. Cleaner production can improve efficiency and reduce environmental impact (Aulia and Indrasti, 2023). Food waste affects food security, the environment, and the economy. Awareness and responsible consumption are crucial for reducing waste. (Wulansari et al., 2019). Food waste management in retail. Food waste management contributes to sustainable value creation. Customer value propositions influence the food waste management practices adopted. Larger retailers implement complex and costly waste management solutions (Huang et al., 2022).

Developing a circular economy model in the food sector considers costs, transforming food business models through digital technology, and stakeholder engagement. One of the challenges in developing a circular economy model is the lack of digital food platforms (De Bernardi et al., 2023). Additive manufacturing positively impacts the circular economy. Industry 4.0 supports sustainable production and the capabilities of the circular economy (Hennemann Hilario Da Silva & Sehnem, 2022). Successful green manufacturing initiatives improve the productivity, quality, and reliability of MSME businesses in India. Significant factors influencing green practices include customer attributes and technology adoption. An evaluation of the impact of green manufacturing on business performance and the key factors influencing the implementation of green practices (Singh et al., 2022). Implementing clean production practices contributes to sustainability by encouraging more efficient production processes and reducing environmental burdens. This approach is increasingly supported by technological innovation, which can improve the ability of organizations to identify, manage, and control environmental impacts throughout production activities (Fritsch Denes et al., 2022). Through simulations, the impact on sustainable industrial growth has been identified, and stakeholders play a role in ensuring the sustainability of halal MSMEs (Masood & Zaidi, 2023). Green management, digital transformation, and halal management influence sustainable performance. Integrating sustainability into business models improves performance (Sari et al., 2024). Implementing cleaner production emphasizes preventive strategies across processes, products, and services by improving material and energy efficiency while minimizing risks to people and the environment. In relation to the Sustainable Development Goals, particularly SDG 12, cleaner production provides a practical framework for reducing waste generation, improving energy efficiency, and promoting sustainable resource utilization (Farace & Tarabella, 2024). Cleaner production is a strategy implemented on an ongoing basis across processes, products, and services to improve product use efficiency and minimize risks to humans and the environment. It is implemented continuously across processes, products, and services to improve resource utilization and minimize pollution from a production activity, also increasing efficiency (Fadilah et al., 2022) (Aulia and Indrasti, 2023).

The benefits of implementing clean technology are increased income and the creation of a cleaner and more sustainable industry (Hendrawati et al., 2023). Cleaner production can be applied at various levels of industry, including MSMEs. MSMEs can achieve sustainability by adopting environmentally friendly practices. Sustainable manufacturing significantly improves MSMEs' environmental performance. Government regulations positively influence environmental performance. Environmental innovation increases the impact of sustainable manufacturing on performance (Hermawan et al., 2024). Food waste impacts food security, the environment, and the economy. Awareness and responsible consumption are essential for waste reduction (Wulansari et al., 2019). Food waste management in retail. Food waste management contributes to sustainable value creation. Customer value propositions influence the food waste management practices adopted. Larger retailers implement complex waste solutions and incur costs (Huang et al., 2022). SMEs use digitalization to access information and finance (Rahman Soesilo & Liosten Rianna Roosida Ully Tampubolon, 2023). To map and model the implementation of cleaner production in halal food MSMEs, Soft System Methodology (SSM) is needed. SSM is utilized as an

analytical technique for model development in food agroindustry development based on MSME development (Ritonga, 2023). SSM has also been used as a tool in COVID-19 eradication strategies (Nuryanto, 2021).

Previous researchers have studied cleaner production in MSMEs and related Soft System Methodology. Previous researchers focused only on cleaner production without modeling with Soft System Methodology. Other researchers used Soft System Methodology for modeling but did not focus on implementing cleaner production in halal food MSMEs. Research on Soft System Methodology in MSMEs is very minimal. Therefore, this research models the implementation of cleaner production in halal food MSMEs using Soft System Methodology. SSM is used to build an initial model in agroindustrial waste (Rohimah, Surjasa, et al., 2026).

The novelty of this research is integrating advanced modeling techniques with contextual industrial analysis, offering a more adaptive and scalable framework. The findings are expected to contribute both theoretically, by enriching existing models, and practically, by providing actionable strategies for improving performance and sustainability. This combination of Lean, Green, and Halal is important in Tangerang because it is a major contributor to waste in Banten Province; data from DLHK show that Tangerang Regency generates 2,700 metric tons of waste per day. Table 1 below summarizes previous research on Soft System Methodology, halal, and cleaner production.

Table 1. Literature Review: Soft System Methodology, halal, and cleaner production

No	RESEARCH TITLE	YEAR	HIGHLIGHT
1	Prediction of the performance of halal food industry using a system dynamics simulation model	2024	Halal assurance, and still early modeling in halal implementation.
2	Assurance information systems design for blockchain - based micro, small and medium enterprises in Indonesia	2021	Contribution of halal SMEs to the national economy, use of technology. Not yet improving production.
3	Industri Halal sebagai Paradigma bagi Sustainable Development Goals di Era Revolusi Industri 4.0	2024	Contribution of the halal industry to the economic, social, and environmental dimensions of the SDGs through technological advancements and strategic frameworks
4	Asesmen Teknologi Pada Industri Kecil Dan Menengah Garmen (Kasus Kajian: CV JK)	2022	Improvement Strategy to improve technology, but green assessment is not yet implemented.
5.	Implementasi SDGs-12 Melalui Pengembangan Komunitas Dalam Program Csr	2023	Sustainable consumption and production, not specific to halal SMEs
6	Produksi Bersih Pada Home Industri Dalam Rangka Pengendalian Pelestarian Lingkungan	2020	Recycling waste into products, energy saving, machine maintenance, water saving, but not specific to halal SMEs and lean production.
7	Analysis of Cleaner Production Implementation in Printed Batik At Batik Puspa Kencana SME In Laweyan, Surakarta	2017	Implementation of cleaner production, a solution in raw material purchasing in general SMEs, not specific to halal SMEs.
8	Designing Clean Production of Tofu Processing Industry in UD. Sumber Urip Pelaihari	2018	Good housekeeping, facility modification, recovery, and reuse in food production, but not specifically discussing critical points of halal.

9	Assessing Technological Sophistication in Food Ingredient Industry: A Path to Modernization for Ensuring Food Safety and Quality	2023	Measurement of technology content with AHP and technometry, but limited in food safety and quality.
10	Regulation and law enforcement on the protection of halal products in Indonesia	2023	Halal regulation, stakeholder coordination, but not yet integrated with green lean production

Method

Figure 1 below shows an overview of the Soft Systems Methodology.

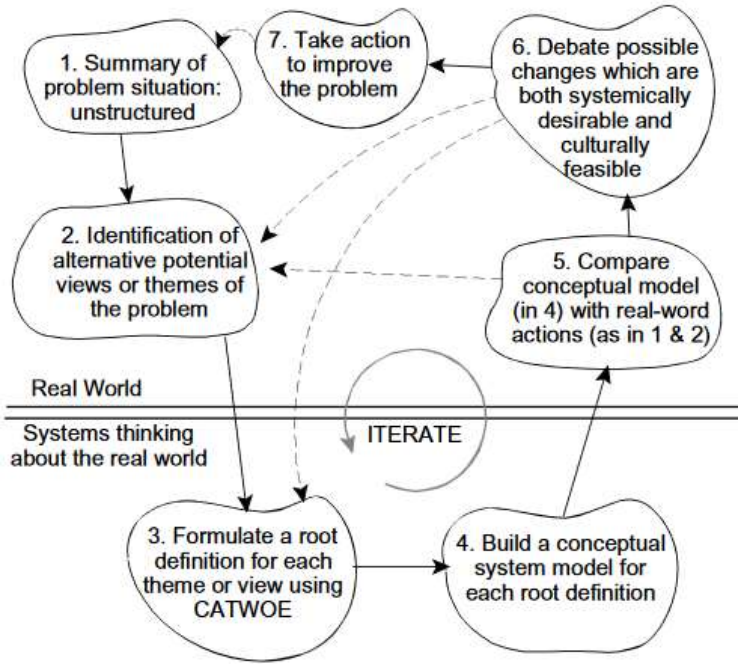

Figure 1. A flow diagram of Checkland's SSM (Daellenbach et al., 2005)

The stages of the soft systems methodology adopted in this research are as follows. (Hananto & Septiani, 2020; (Bhagya et al., 2026)):

1. Determine the existing problem

   In the first stage, determining the existing problem aims to identify and understand the problems in halal food MSME systems. These problems are understood as complex situations involving human, process, technological, environmental, and organizational aspects. The study conducted a comprehensive problem identification, considering three main perspectives: Lean Production, Green Production, and Halal Production.

   From a Lean perspective, identification focuses on various forms of waste in the production process. Waste can take the form of overproduction, waiting, transportation, unnecessary motion, inventory, defects, overprocessing, and unused human potential. Identification may also include process imbalances, waiting times, nonvalue-added activities, and inefficient use of resources.

   From a Green Production perspective, the identification process focuses on energy, water, raw materials, additives, packaging materials, and waste generated during production. Environmental aspects not only in industry but also in education include emissions, resource use, solid and liquid waste, and opportunities to apply the Reduce, Reuse, Recycle, and Replace (4R) principles (Rohimah, Nuraini, et al., 2026).

From the Halal Production perspective, the identification focuses on compliance with halal requirements throughout the production process chain. Aspects considered include raw materials, additives, auxiliary materials, production facilities, equipment, storage, processing, packaging, and distribution, likely in fish cracker production (Hernadi & Nadia, 2026). The assessment also focuses on the potential for contamination by non-halal or impure materials, the mixing of materials, and non-compliance with procedures for handling materials and products.

2. Collect data and information and describe it in a Rich Picture
   The second stage involves creating a Rich Picture to illustrate the problem situation comprehensively. Data and information are collected to describe in a Rich Picture by interviewing the Lembaga Pendamping Proses Produk Halal and 3 (three) SME representatives. The Rich Picture is used to show the relationships between a mix of groups that influence the implementation of Halal Green Lean Manufacturing (Berg et al., 2019). The Rich Picture describes the flow of raw materials from suppliers to finished products, the flow of information, production activities, value-added and non-value-added activities, sources of waste, energy and water usage, waste generation, and critical halal control points. The rich picture in this study not only illustrates waste from a Lean perspective but also highlights waste and environmental impacts from a Green perspective, as well as critical points for meeting halal requirements. The results serve as the basis for identifying system elements that require further analysis.
3. CATWOE analysis (Customer, Actor, Weltanschauung, Owner, Environment)
   In the third stage, CATWOE Analysis, the steps taken are as follows (Daellenbach et al., 2005). Identify stakeholders related to the system. Stakeholders include individuals or agencies. Fill in the identification results in the CATWOE table.
   - Customer: the party that feels the positive and negative impacts of the system
   - Actor: the party with activities in the system
   - Transformation: activities in the system
   - Weltanschauung: assumptions underlying the view of the system
   - Owner: the person in charge of the system
   - Environment: external environment
4. Develop a conceptual model
   This modeling aims to ensure the developed system meets expectations. Next, the model undergoes performance testing, specifically the 3E test (efficacy, efficiency, and effectiveness) (Fahturizal et al., 2023). Efficiency is used to assess a system's ability to produce output with the least possible use of inputs. Efficacy assesses a system's ability to achieve established goals or targets. Effectiveness assesses whether a system can achieve its intended objectives, considering the interrelationships among results, processes, resources, the environment, and halal requirements.
5. Comparison of the model with real conditions
   The comparison identified gaps between the system that should be implemented and the system currently in place. To compare the model with real conditions, a questionnaire was conducted to assess SMEs' optimism about implementing green lean through reduce, reuse, and recycle (Rohimah et al., 2025). The study used purposive sampling, specifically targeting MSMEs that use single-use plastic and paper.
6. Improvement stage
   The desired changes are focused on reducing waste, reusing goods, and recycling goods, which will make work areas more flexible.
7. Implementation stage
   This stage implements the identified improvement alternatives. Implementation is carried out based on the change priorities identified in the previous stage and tailored to MSME capabilities. Implementation may include the development or revision of Standard Operating

Procedures (SOPs), increasing marketing, the reorganization of production facilities, improvements to material flow, the reduction of activities that do not add value, the control of energy and water usage, waste management, the application of the 4Rs, and the strengthening of controls at critical halal control points, digitalazation (Putri et al., 2023) (Syamsudin, Naim, et al., 2024) (Soesilo, 2024). Figure 2 below shows the analysis steps using Soft System Methodology.

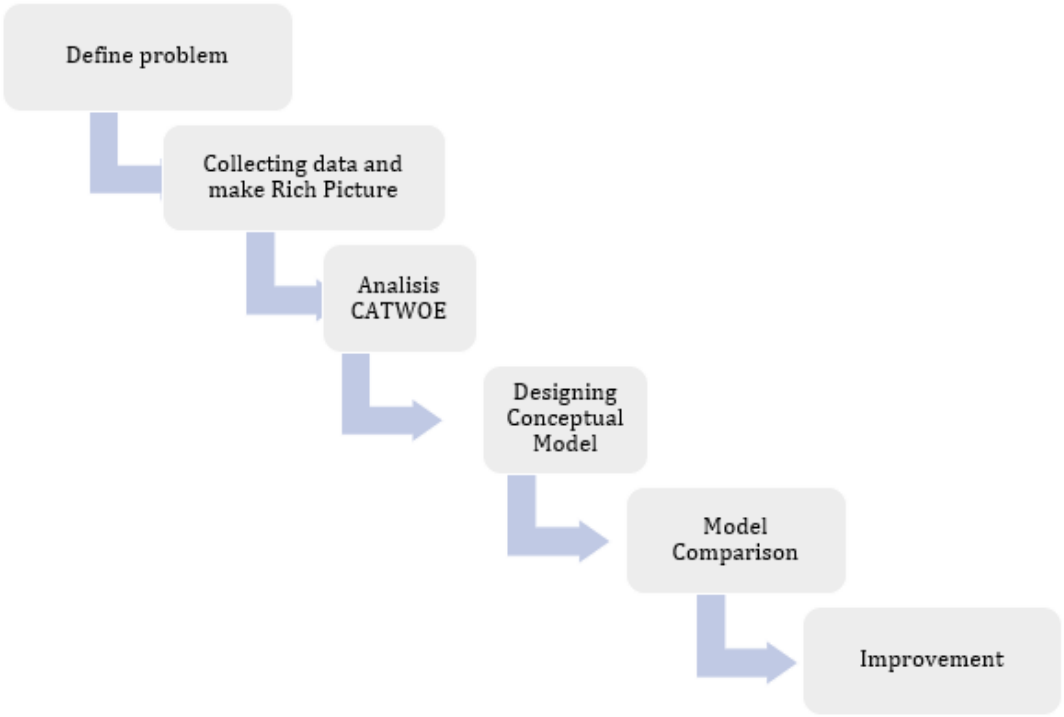

Figure 2. Research Flowchart

RESULT AND DISCUSSION

This section presents the results of an analysis of implementing clean production at halal food MSMEs in Tangerang Regency using the Soft System Methodology (SSM) approach integrated with the Lean Manufacturing perspective. The analysis was conducted in stages, beginning with identifying actual problems, mapping system conditions using a Rich Picture, conducting CATWOE analysis, developing a conceptual model, and finally comparing the model with actual field conditions. Lean Manufacturing principles were used to identify non-value-added activities (waste) in the production process, while the clean production approach focused on reducing waste, improving energy and water efficiency, and ensuring sustainable resource use.

1. Determine the existing problems

   The problems faced are related to waste in halal food production. The waste in question includes residual production, plastic packaging waste, as well as water and energy waste during the production process.
2. Collect data and information and describe it in a Rich Picture.

   From the questionnaires distributed to stakeholders, information related to clean production can be mapped in the following Rich Picture.

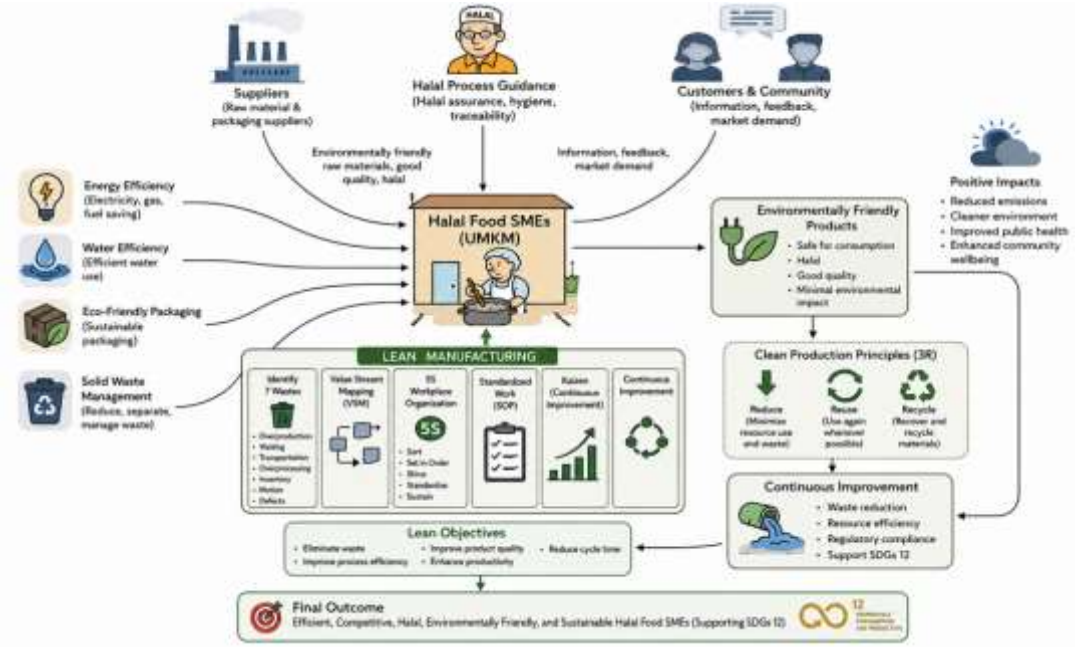

Figure 3. Rich Picture Green Lean Manufacturing in Halal SMEs

The Rich Picture of Green Lean Manufacturing in halal SMEs illustrates a halal food SMEs system that integrates three key perspectives: lean manufacturing, green manufacturing, and halal requirements. Systemically, halal food MSMEs are at the center of the system, as all activities involving suppliers, consumers, production processes, energy and water use, waste management, and halal oversight ultimately converge on the production processes of MSMEs. The main flow are Suppliers to Halal MSMEs to Environmentally Friendly Products to Consumers & the Community.

Three main types of interventions in MSME processes include lean manufacturing, which eliminates waste and improves process efficiency; green production, which reduces environmental impact and improves resource efficiency; and halal assurance, which ensures that ingredients, processes, facilities, hygiene, traceability, and products meet halal requirements.

3. CATWOE Analysis (Customer, Actor, Weltanschauung, Owner, Environment)
   The following table presents the results of the CATWOE element identification, which will serve as the basis for developing the root definition and conceptual model in the subsequent stages of the SSM.

Table 2. CATWOE Analisys

Dimension	Explanation
Customer	Halal Food SMEs's customer
Actor	Halal Food SMEs
Transformation	Conventional waste disposal becomes environmentally friendly, energy-efficient, and water-saving
Weltanschauung	Cleaner production supports responsible consumption and production
Owner	Halal regulation body (BPJPH)
Environmental	Limited knowledge related to sewage treatment technology

Source: Data Analysis, 2025

The results of this analysis are expected to provide a foundation for formulating changes that are effective, efficient, and acceptable to stakeholders, so that implementing Green Lean Manufacturing at halal food MSMEs in Tangerang Regency can support increased productivity, environmental sustainability, and compliance with halal requirements.

4. Build conceptual model

   The conceptual model uses three parameters, namely efficacy, efficiency, and effectiveness (Septiana & Maulany, 2021). Table 2 below shows the identification results.

Table 3. Identification of 3E parameters in the conceptual model

Parameter	Note
Efficacy	Whether reducing waste, reusing goods, and recycling goods (3Rs) can realize responsible consumption and production.
Efficiency	Whether reducing waste, reusing goods, and recycling goods will make work more productive
Effectivity	Whether reducing waste, reusing goods, and recycling goods will make work more flexible.

(source: data analysis,2025)

This conceptual model serves as the basis for identifying feasible and desirable changes in the production systems of halal food MSMEs. Integrating efficacy, efficiency, and effectiveness is expected to result in a Green Lean Manufacturing system that is productive, environmentally friendly, sustainable, and compliant with halal requirements, while remaining realistically implementable in line with the characteristics and capabilities of MSMEs in Tangerang Regency.

5. Comparison of models with real conditions

   Questionnaires were distributed to SME actors to collect data on plastic or paper packaging use and the application of the 3R concept. Data processing will be carried out after collecting questionnaire results and observations, which will be input and processed using Microsoft Excel. The questionnaire data will be grouped into relevant categories, such as the type of packaging used by SMEs and the level of implementation of the 3R concept (Reduce, Reuse, Recycle) as a clean production practice. The number of respondents was 65 SMEs in Tangerang Regency that use single-use plastic or paper packaging. Based on the questionnaire given to representatives of halal food MSMEs, data on the description of existing real conditions is obtained. Table 4 below shows the comparison results.

Table 4. Model Comparison

Target	Respond of Halal SME's
Whether reducing waste, reusing goods, and recycling goods will make work more productive	37,03% respondent optimis will achieve target
Whether reducing waste, reusing goods, and recycling goods will make work more flexible.	51,8% of respondents are optimistic that they will achieve the target

(source: data analysis,2025)

Comparing models with real-world conditions helps identify feasible and desirable changes—changes that are ideal from a systems perspective and realistic for MSMEs. The

14.77 percentage-point difference indicates that the benefits of implementing the 3Rs are perceived as having a stronger impact on flexibility than on productivity.

6. Improvement phase and implementation plan

   Based on the model comparison results, the next model should focus on strengthening the implementation of the 3Rs—not only in environmental aspects but also in improving production processes. For green lean implementation, stakeholder suggestions and input are needed as improvement steps. The following table shows stakeholder inputs.

Table 5. Improvement

Target	Improvement
Whether reducing waste, reusing goods, and recycling goods will make work more productive	Utilization of technology in food packaging Utilization of technology in waste management
Whether reducing waste, reusing goods, and recycling goods will make work more flexible.	Food processing procedures to reduce potential waste generation

(Source: data analysis,2025)

Improvements are focused not only on reducing waste in the production process, but also on optimizing technology, reducing environmental impact, improving productivity and quality, and meeting halal requirements. This study combines several parameters, including environmental friendliness, productivity, and halal compliance, whereas previous studies have addressed each of these parameters separately.

Conclusion

SSM modeling can provide an overview of the potential and challenges of halal food MSMEs in adopting cleaner production. SSM also identifies an initial model to guide cleaner production implementation. Suggested improvements include using technology in food packaging and waste treatment, and improving food processing procedures to reduce potential waste. SSM has a limitation in that it is highly dependent on the perspectives, interpretations, and assumptions of the people or participants involved. The improvement phase bridge between the current state of the system and its desired state. Implementing improvements is expected to create a production system that is more efficient, effective, environmentally friendly, productive, and aligned with halal principles, while remaining realistic to implement given the characteristics and capacity of halal food MSMEs in Tangerang Regency. The theoretical contribution of this study is the development of an integrated conceptual framework that connects SSM with Green Lean Manufacturing and halal production requirements. The practical contribution is the formulation of improvement alternatives that are contextualized to the characteristics and capabilities of halal food SMEs. Future research should validate the model on a larger scale involving more SMEs.

References

Aulia, N. I., & Indrasti, N. S. (2023). Penerapan Produksi Bersih Pada Industri Kecil Menengah (Ikm) Pengolahan Tahu Di Indonesia: Literatur Review. *Jurnal Teknologi Industri Pertanian*, *1*(33), 10–19. https://doi.org/10.24961/j.tek.ind.pert.2023.33.1.10

Berg, T., Bell, S., & Morse, S. (2019). Using rich pictures outside of soft systems methodology: A case study analysis. *International Journal of System of Systems Engineering*, *9*(3), 257. https://doi.org/10.1504/IJSSE.2019.102815

Bhagya, T.G. (2026). Soft Systems Methodology as a Conceptual Framework for Vehicle Routing Problem. *Spektrum Industri*, 24 (1), 161-175. https://doi.org/10.12928/si.v24i1.584

Daellenbach, H. G., McNickle, D. C., & McNickle, D. C. (2005). *Management science: Decision making through systems thinking* (1. publ). Palgrave Macmillan.

De Bernardi, P., Bertello, A., & Forliano, C. (2023). Circularity of food systems: A review and research agenda. *British Food Journal*, *125*(3), 1094–1129. https://doi.org/10.1108/BFJ-05-2021-0576

Fadilah, R. N., Armadhan, W. S., Negara, I. Z. S., Kisworo, W., & Negari, I. T. (2022). *Penerapan Produksi Bersih pada Produksi Rumahan Tempe UMKM Mbah Sarwono di Kecamatan Bawang, Kabupaten Banjarnegara, Jawa Tengah*. (1).

Fahturizal, I. M., Zulkarnaen, I., Fauziyah, Y., & Kurnia, H. (2023). Penerapan Metode Soft System Methodology Pada Peningkatan Produktivitas di Industri Manufaktur Indonesia. *Jurnal KaLIBRASI - Karya Lintas Ilmu Bidang Rekayasa Arsitektur, Sipil, Industri*, *6*(2), 70–81. https://doi.org/10.37721/kalibrasi.v6i2.1190

Farace, B., & Tarabella, A. (2024). Exploring the role of digitalization as a driver for the adoption of circular economy principles in agrifood SMEs – an interpretive case study. *British Food Journal*, *126*(1), 409–427. https://doi.org/10.1108/BFJ-12-2022-1103

Fritsch Denes, Q. R., Schneider, R. D. C. D. S., & Kipper, L. M. (2022). Life cycle assessment and relations with triple bottom line in meat production: A systematic approach about cleaner production. *Management of Environmental Quality: An International Journal*, *33*(6), 1528–1552. https://doi.org/10.1108/MEQ-09-2021-0206

Hananto, A., & Septiani, W. (2020). Pendekatan Soft System Methodology Untuk Perancangan Model Pembelajaran Praktik Berbasis Produksi. *Jurnal Teknik Industri*, *10*(1), 53–65. https://doi.org/10.25105/jti.v10i1.8389

Hendrawati, T. Y., Gustia, H., Darto, D., Wusono, C. N., Hardiman, B., & Ramadhani, A. (2023). Pengabdian kepada Masyarakat Peningkatan Pendapatan Usaha Mikro UMKM PT. Herbor Cipta Nusantara Melalui Penerapan Teknologi Produksi Bersih Eco Enzim Dari Limbah Kulit Buah. *Jurnal Pengabdian Masyarakat Teknik*, *6*(1), 15. https://doi.org/10.24853/jpmt.6.1.15-21

Hennemann Hilario Da Silva, T., & Sehnem, S. (2022). The circular economy and Industry 4.0: Synergies and challenges. *Revista de Gestão*, *29*(3), 300–313. https://doi.org/10.1108/REGE-07-2021-0121

Hermawan, A. N., Masudin, I., Zulfikarijah, F., Restuputri, D. P., & Shariff, S. S. R. (2024). The effect of sustainable manufacturing on environmental performance through government regulation and eco-innovation. *International Journal of Industrial Engineering and Operations Management*, *6*(4), 299–325. https://doi.org/10.1108/IJIEOM-04-2023-0039

Hernadi, R., & Nadia, D. (n.d.). *Implementation of Food Safety for Halal Food Smes: A Case Study of Fish Crackers*.

Huang, I. Y., Manning, L., Wood, V., James, K. L., Millington, A., Grigoriadis, V., & Ward, S. (2022). Creating sustainable value through food waste management: Does retail customer value proposition matter? *British Food Journal*, *124*(10), 3201–3219. https://doi.org/10.1108/BFJ-06-2021-0693

Masood, A., & Zaidi, A. (2023). Empowerment of SME's sustainability in halal cosmetics' ecosystem by diagnosing growth constraints. *Journal of Islamic Marketing*, *14*(2), 622–644. https://doi.org/10.1108/JIMA-12-2020-0371

Nuryanto, A. (2021). Aplikasi Soft System Methodology (SSM) Untuk Pengembangan Strategi Pemberantasan dalam Pandemi Covid-19 di Selandia Baru. *Jejaring Administrasi Publik*, *13*(1), 59–69. https://doi.org/10.20473/jap.v13i1.29356

Putri, S. N., Ningrum, S., Putri, V. M., & Chotimah, C. (2023). Penerapan Hazard Analysis And Critical Control Point (Haccp) Dalam Proses Pembuatan Bakso Pada Katering Y Di Kota Malang. *DedikasiMU : Journal of Community Service*, *5*(3), 329. https://doi.org/10.30587/dedikasimu.v5i3.6240

Rahman Soesilo & Liosten Rianna Roosida Ully Tampubolon. (2023). Analysis Transformation and Digitalization of MSMes (Literature Review). *Formosa Journal of Multidisciplinary Research*, *2*(3), 649–658. https://doi.org/10.55927/fjmr.v2i3.3660

Ritonga, U. S. (2023). Analisis Soft System Methodology Pembangunan Agroindustri Pangan Berbasis Pengembangan UMKM di Indonesia. *Jurnal Riset Ilmu Ekonomi*, *2*(3), 110–129. https://doi.org/10.23969/jrie.v2i3.36

Rohimah, A., Nuraini, N., Sunariyanti, E., & Rusdiana, N. (2026). Sosialisasi Implementasi Reduce, Reuse, Recycle, dan Replace untuk Siswa SMA Muhammadiyah 1 Yogyakarta. *Jurnal Masyarakat Madani Indonesia*, *5*(2), 1248–1252. https://doi.org/10.59025/6np43x18

Rohimah, A., Surjasa, D., Fitriana, R., Shintadewi Julian, E., Yulianto, A., & Hoerudin. (2026). Developing a food safety model for biogenic silica powder from palm oil boiler ash using soft system methodology. *BIO Web of Conferences*, *219*, 02003. https://doi.org/10.1051/bioconf/202621902003

Rohimah, A., Valentin, A. D., Hernadi, R., & Nadia, D. (2025). *Analisa Kesiapan Teknologi untuk Implementasi Produksi Bersih di UMKM Makanan Halal Kabupaten Tangerang*.

Sari, R. K., Alfarizi, M., & Ab Talib, M. S. (2024). Sustainable strategic planning and management influence on sustainable performance: Findings from halal culinary MSMEs in Southeast Asia. *Journal of Modelling in Management*. https://doi.org/10.1108/JM2-12-2023-0324

Septiana, T. D., & Maulany, R. (2021). Pengembangan Manajemen Data Dan Informasi Menggunakan Analisis Soft System Methodology Di Universitas Advent Indonesia. *TelKa*, *11*(1), 1–13. https://doi.org/10.36342/teika.v11i1.2473

Singh, M., Singh, K., & Sethi, A. S. (2022). Contribution of green manufacturing for realizing business performance in Indian small and medium scale organizations (SME's). *Journal of Science and Technology Policy Management*, *13*(2), 329–357. https://doi.org/10.1108/JSTPM-11-2020-0163

Soesilo, R. (2024). Enhancing Operational Performance through Green Manufacturing Practices: Case Studies from TQM Implementation in the Indonesian Industrial Sector. *Siber Journal of Advanced Multidisciplinary*, *2*(1), 1–7. https://doi.org/10.38035/sjam.v2i1.92

Syamsudin, Naim, A., Sartono, Valentin, A. D., Sapriyadi, Hussin, M., Soesilo, R., & Husodo, P. (2024). Implementation of Work Layout Creation Using Blocplan at SME Sinar Mutiara Karang Serang Village. *Formosa Journal of Multidisciplinary Research*, *3*(7), 2673–2682. https://doi.org/10.55927/fjmr.v3i7.10277

Wulansari, D., Ekayani, M., & Karlinasari, L. (2019). Kajian Timbulan Sampah Makanan Warung Makan. *ECOTROPHIC : Jurnal Ilmu Lingkungan (Journal of Environmental Science)*, *13*(2), 125. https://doi.org/10.24843/EJES.2019.v13.i02.p01