DINASTI INTERNATIONAL JOURNAL OF DIGITAL BUSINESS AND MANAGEMENT (DIJDBM)
E-ISSN : 2715-4203
P-ISSN : 2715-419X
DINASTI PUBLISHER
https://dinastipub.org/DIJDBM dinasti.info@gmail.com +62 811 7404 455

**DOI:** https://doi.org/10.31933/dijdbm.v5i2
**Received:** January 24th, 2024, **Revised:** February 20th, 2024, **Publish:** March 6th, 2024


# Green Supply Chain Implementation on Tempeh Industry in North Jakarta

**Nursery Alfaridi S Nasution[1], Nofrisel[2], Andriyan[3], Sekar Widyastuti Pratiwi[4], Muhammad Luqmanul Hakim[5]**
[1]Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, nursery.alfaridi@gmail.com
[2]Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, nofrisel@yahoo.com
[3]Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, yaan1809@gmail.com
[4]Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, sekarwidy10@gmail.com
[5]Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, mhluqmanulh@gmail.com

Corresponding Author: sekarwidy10@gmail.com[4]

**Abstrak:** Penelitian kualitatif didasarkan pada data primer dan data sekunder. Tujuan penelitian ini adalah menjelaskan penerapan *green supply chain management* pada industri tempe, dan menggambarkan penerapan green supply chain management pada limbah yang dihasilkan dari pengelolaan industri tempe untuk menciptakan keberlangsungan lingkungan dan menjaga lingkungan agar bersih dari masalah limbah industry. Hasil dari penelitian ini menunjukkan bahwa penerapan *green supply chain management* sudah terlaksanakan dengan baik. Penggunaan bahan baku juga sesuai dengan prinsip green supply chain. Selain itu sudah terdapat kolaborasi yang baik dalam rantai pasok. Namun, penerapan green supply chain pada industry tempe di Jakarta Utara masih perlu beberapa perbaikan pada alur supply chainnya. Penelitian lanjutan yang membahas faktor yang menyebabkan kinerja *green supply chain* perlu dilakukan secara empiris.

**Abstract:** *Qualitative research relies on both primary and secondary data. This research aims to elucidate the implementation of green supply chain management in the tempeh industry, as well as to illustrate how green supply chain management can be applied to effectively manage waste generated by the tempeh industry. The ultimate goal is to promote environmental sustainability and mitigate the issue of industrial waste, thereby ensuring a clean and healthy environment. The findings of this study indicate that the integration of green supply chain management in the tempeh industry has been effectively executed. The utilization of raw resources also aligns with the concepts of green supply chain. In addition to that, there is excellent cooperation within the supply chain. Nevertheless, there are still areas for improvement in the supply chain flow of the green supply chain implementation in the tempe business in North Jakarta. Additional empirical study is required to examine the aspects that contribute to the performance of green supply chains.*

**Keyword:** *green supply chain management, sustainability, supply chain management, waste management*

## INTRODUCTION

Extreme climate change has occurred in different places of the world, not only in Indonesia. According to the World Meteorological Organization (WMO), the global average temperature has been consistently setting new records for the highest temperature each year. In particular, 2019 has been identified as the hottest year worldwide since 1850, following the previous record set in 2016. This occurrence is commonly known as global warming (BMKG, 2020). An initiative to tackle this issue involves the establishment of a collaborative agreement known as the Sustainable Development Goals (SDGs), consisting of 17 global objectives set by the United Nations. The aim of these goals is to accomplish sustainable development by the year 2030. The SDGs encompass a range of areas, such as the reduction of poverty, eradication of hunger, improvement of health, promotion of education, attainment of gender equality, and preservation of the environment. The objectives encompass economic, social, and environmental aspects, with a particular emphasis on eliminating disparities and safeguarding the environment. The SDGs seek to establish a fairer, all-encompassing, and enduring world, with a focus on global collaboration to tackle worldwide obstacles. Within the Sustainable Development Goals (SDGs), the 13th objective pertains to "Action on Climate Change," specifically targeting initiatives aimed at mitigating the effects of global warming. This objective centers on implementing measures to reduce and counteract the effects of climate change, while also improving the ability of communities to adapt and withstand its impacts. By incorporating sustainable practices and actively working to mitigate climate change, we may successfully attain wider development objectives, safeguard human welfare, and maintain the long-term sustainability of our planet for future generations.

This study focuses on the problem of global warming within the textile sector. Tempeh is a well renowned traditional Indonesian cuisine. Tempeh production in Indonesia is primarily conducted by tempeh artisans operating at the home, small, and medium scales. Waste produced in the tempeh business might arise from many mechanisms. Initially, the manufacture of tempeh necessitates energy for the fermentation, heating, and chilling procedures. When the energy originates from fossil fuels like coal or petroleum, this procedure can generate greenhouse gas emissions, particularly carbon dioxide (CO2). Furthermore, the transportation of both raw materials and finished goods along the textile industry's supply chain can also have a significant impact on carbon emissions. Conventional motor vehicles powered by fossil fuels have the potential to release greenhouse gases during transportation.

According to the National Standardization Agency, the average annual tempeh consumption per person in Indonesia is approximately 6.45 kilograms (Badan Standarisasi Nasional, 2012). The production of tempeh necessitates a substantial amount of water, and as previously mentioned, the resulting waste is likewise variable. Optimizing the waste treatment process in the tempeh sector can be achieved using standardization. However, this has not been fully realized due to the inclusion of business players operating as home industries with limited capital. Therefore, the implementation of green supply chain management is thought to have the capability to address this issue. Green supply chain management is a progressive strategy for managing supply chain operations that incorporates environmental factors into several practices, including green design, green purchasing, and supplier collaboration, with the aim of enhancing sustainability and minimizing environmental effects (Green et al., 2012; Novitasari & Agustia, 2021; Zhu, 2022), the integration of environmental management into supply chain operations is crucial for mitigating environmental impacts and fostering sustainability (Naina & Fernando, 2019; Rajamanickam et al., 2019; Sunarya et al., 2023). Supply chain management primarily focuses on economic and value goals (Benned et al., 2021; Hutabarat et al., 2021; Widyastuti

et al., 2024) but green supply chain management not only aims to achieve economic and value targets but also places substantial emphasis on ecological considerations.

## METHOD

This study is descriptive research that employs a qualitative methodology, focusing on a case study of the home-based tempeh sector in North Jakarta. The descriptive qualitative research method employs a case study methodology to provide a comprehensive description of a specific occurrence or instance. Descriptive qualitative research entails a concentrated examination of the setting, behavior, and relationships within a particular situation or place to gain a comprehensive understanding. This methodology enables researchers to provide a comprehensive account of the specific attributes and changes of a particular instance, while also comprehending the circumstances in which the instance takes place (Fadli, 2021; Robbani, 2022). The study included primary and secondary data sources. Primary data refers to information that is collected directly from informants or sources through interviews and direct observations. For example, primary data can be obtained by interviewing tempeh craftspeople and observing their waste management practices. Secondary data refers to information that is gathered through sources such as literature studies, references, documents, and observations made at the research site. The data was gathered by firsthand observation and interviews with skilled artisans. The study focused on the demographic and samples of tempeh craftsmen located in North Jakarta.

## RESULTS AND DISCUSSION

In managing a green supply chain, the main goal is to reduce adverse impacts on the environment. Thus, in the tempeh industry, efforts are being made to reduce the impact of these workers by using environmentally friendly raw materials, namely organic or non-GMO (non-genetically modified organism) soybeans, to reduce the use of pesticides or chemical fertilizers that have a negative impact on the environment. As with other qualitative research, data collection in this study was conducted by interviewing resource persons and first explaining the purpose and objectives of the research. Furthermore, the author interviewed Tempeh Craftsman 1, and he stated that he had practiced green supply chain management, Tempeh Craftsman 1 said:

*"Initially, I was unfamiliar with the concept of green supply chain management. However, upon receiving an explanation, I came to comprehend that the management practices have been implemented in my business align with the principles of green supply chain management, which have been in place since the inception of my business. This implies that I also safeguard the surrounding ecosystem to establish a secure and pristine environment for waste management. Artisans in this region have also adopted environmentally friendly supply chain management."*

Effective waste management in the tempeh sector is crucial for safeguarding the environment and promoting public health. The trash generated by the tempeh business can be classified into two distinct categories: non-organic waste and organic waste. Non-organic waste comprises non-organic materials, such as plastic, paper, or metal, that are utilized in the manufacturing of tempeh. The non-organic waste can undergo recycling or processing to enable its reuse or safe disposal in compliance with relevant environmental standards. This statement was verified by Tempeh Artisan 1 during an interview, who explicitly stated:

*"Tempeh production generates both solid and liquid waste streams. Liquid garbage can be discharged into the sewer system as it poses no environmental hazards. We also receive this feedback during counseling sessions from various environmentally conscious institutions. The liquid waste is a byproduct of the natural fermentation of water-soaked soybeans. It can be*

*safely disposed of without further treatment. As for the solid waste, it takes the form of soybean skin after the peeling and drying process. We collect the soybean skin in sacks and avoid disposing of it in the sewer due to potential hazards. To prevent any waste from entering the sewer, each production site is equipped with a filter specifically designed for capturing soybean skin".*

Source: Research Data

***Figure 1 Waste Screening Process from Tempeh Production***

Moreover, the organic waste produced during the process of making tempeh originates from the surplus soybean ingredients, such as soybean hulls or tofu dregs. These waste materials possess significant potential for reuse and transformation into products that have increased value. Below are several methods for effectively handling organic waste in the manufacturing of tempeh:

1. Composting involves the conversion of organic waste generated during tempeh production into compost. This process entails the addition of additional organic materials, such as dried leaves or straw, resulting in the manufacture of agriculturally beneficial fertilizer.
2. Biogas can be generated from tempeh waste via anaerobic fermentation. The biogas generated can serve as a fuel for cooking or electricity generation.
3. Biogas can be generated from tempeh waste via anaerobic fermentation. The biogas generated can serve as a fuel for cooking or electricity generation.
4. Derivative products: Tempeh waste can be utilized to make many derivative products, including miso and soy sauce. Tempeh waste can be utilized as raw materials to produce other products, hence conferring economic value to the trash.

Implementing organic waste management practices can effectively mitigate negative environmental consequences and generate additional value from garbage that was previously regarded as a challenge. Furthermore, the handling of this organic waste is closely connected to the concept of green supply chain management, which encompasses the incorporation of sustainability and environmentally conscious elements in the tempeh production process. Therefore, it is crucial to guarantee the reusability of the byproducts generated during tempeh production. This was verified by an interview with Tempe Artisan 1, who explicitly claimed that:

*"Green Supply Chain Management, is also implemented in the production of tempeh. One example is the substitution of plastic with banana leaves for wrapping tempeh. Initially, plastic is used in this process, but it is later replaced with banana leaves."*

The utilization of organic waste is the outcome of the training attended by tempeh artisans. Furthermore, this was corroborated by conducting interviews with the waste the waste collector, who explicitly indicated that:

*"I exclusively source waste from tempeh production from tempeh craftsmen. I have also engaged in discussions with residents on waste collection methods, and I do not purchase waste directly from tempeh craftsmen." They believe that this alone contributes to waste management."*

Recycled tempeh waste is provided to farmers that require it. Distribution can be accomplished by cooperating with farmers in nearby areas to the tempeh production site. Utilizing tempeh waste as animal feed has numerous advantages, mostly by mitigating trash. As also mentioned during the interview with the waste collector, who explicitly indicated that:

*"Each morning, I visit the residences of the tempeh producers to collect their discarded materials. This task is performed daily due to the high risk associated with any delay of even a single day. The accumulation of skin waste resulting from tempeh production emits a highly unpleasant stench. Therefore, I diligently collect it from each production site at regular intervals. Typically, every production site yields a single sack, which I subsequently transport to the waste processing facility for treatment. Daily, I transport roughly 40 sacks, and the management facility is located nearby."*

Source: Research Data

***Figure 2 Waste Collection from Tempeh Craftsmen***

Hence, tempeh craftsmen do not actively engage in waste management; instead, they just hand over the trash to collectors, who in turn sell it to farmers. This action is mutually advantageous for both sides. As also mentioned by Tempeh craftsmen 2:

*"The application of green supply chain management effectively ensures environmental stability in this region. The collaboration of waste collectors has alleviated my confusion regarding waste disposal, thereby providing me with assistance."*

Source: Research Data

***Figure 3 Waste Distribution from Waste Collector to Farmers***

Several positive outcomes can be achieved through the implementation of green supply chain management. These outcomes include the preservation of environmental stability, the creation of a clean environment, the preservation of natural resources in excellent shape, and the establishment of a work culture that places an emphasis on sustainability and the environment. If the environment is favorable, it will also be favorable to have sufficient resources for the emotional and psychological stability of individuals. As also mentioned by Tempeh craftsmen 2:

*"In order to preserve a healthy environmental ecosystem, I also prioritize waste management. By utilizing natural ingredients and materials that can be reused, I have successfully reduced production costs."*

***Challenges and Barriers to GSCM Implementation***

When implementing green supply chain management, it is inevitable to encounter hurdles and challenges. Potential problems that may arise encompass resource constraints, opposition to change from suppliers or consumers, and substantial upfront expenses for repairing or replacing current infrastructure. Therefore, firms require a firm dedication, cooperation with stakeholders, and a well-developed plan for implementing green supply chain management.

Nonetheless, the absence of green supply chain management in the tempeh industry may result in adverse consequences. These include the utilization of environmentally unfriendly raw materials, a rise in tempeh waste due to subpar waste management practices, inadequate energy efficiency, and a dearth of collaboration with business partners.

*"If waste management is not implemented effectively and there is a lack of cooperation with waste collectors, the production process will undoubtedly have a detrimental impact on the environment. This will result in pollution of rivers and the emission of unpleasant odors due to air pollution in the area."*

Hence, to mitigate these adverse effects, it is highly recommended for the tempeh industry to incorporate green supply chain management into their operations. By embracing

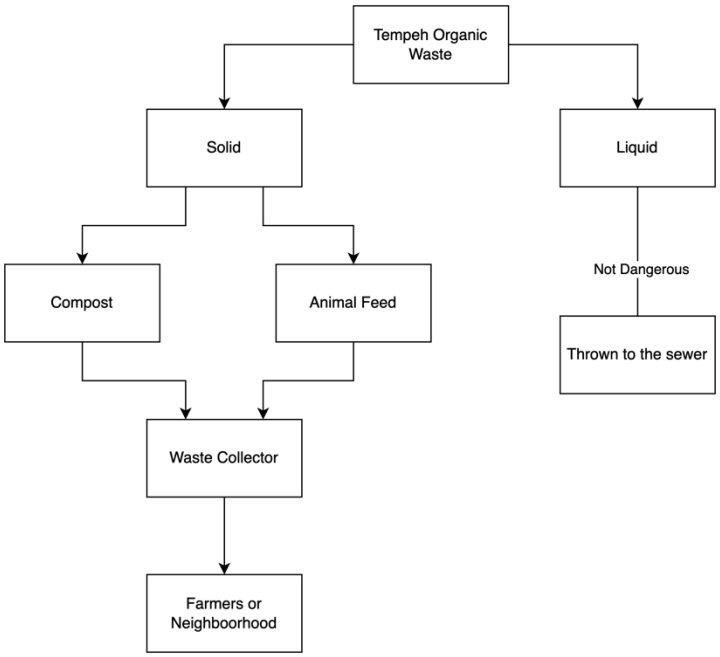
green supply chain management, they may effectively address the problems mentioned above.

***Table 1 Comparison of conditions in the tempeh sector with and without the use of Green Supply Chain Management (GSCM)***

| No | Not Implementing GSCM | Implementing GSCM |
|---|---|---|
| 1. | Environmental pollution caused by the accumulation of waste | Establish an environment that is both steady and devoid of waste, while maintaining cleanliness. |
| 2. | Transform into a reservoir of pathogens because of the waste produced from pollution. | The origin of the sickness can be resolved. |
| 3. | The adjacent neighborhoods are experiencing disruption. | Individuals can enhance their quality of life and adhere to societal norms more effectively. |
| 4. | Water pollution | Minimize water pollution |

Source: Research Data

The author proposes in Figure 1 that tempeh craftsmen should engage in solid waste processing by collecting all reusable waste through a waste collector. Subsequently, the local inhabitants or farmers in need will acquire it. Thus, the supply chain flow becomes more concentrated.




Source: Research Data

***Figure 4 Tempeh Organic Waste Flow***

## CONCLUSION

Based on the findings from the observations and interviews, it can be inferred that tempeh craftsmen in North Jakarta possess a comprehensive understanding of green supply chain management and actively apply its principles. The tempeh sector in Jakarta has implemented eco-friendly practices in manufacturing, distribution, and waste management.

These practices involve the use of natural products instead of harmful chemicals, ensuring both consumer and environmental safety. The implementation of green supply chain management in North Jakarta can be replicated in the tempeh industry in other cities and

expanded to achieve widespread adoption of green supply chain management principles. This approach emphasizes not only the outcome but also the entire process from upstream to downstream.

Nevertheless, the tempeh industry cannot independently carry out the implementation of green supply chain management. It necessitates cooperation from all participants in the supply chain, including raw material suppliers, tempeh craftsmen (involved in manufacturing), and the transportation industry responsible for distributing both products and raw materials.

To mitigate the effects of global warming on the textile industry, the implementation of sustainable measures such as the utilization of renewable energy, effective waste management, and environmentally conscious production techniques can effectively diminish greenhouse gas emissions. Moreover, if it is necessary, obtaining an environmental certification, such as ISO 14001, can provide tempeh producers with clear guidelines for implementing sustainable practices. Nevertheless, the successful execution of this green supply chain management necessitates the active participation and understanding of all stakeholders, including suppliers, manufacturers, and end-users. Customers play a crucial role in determining the outcome. If customers prioritize this adoption, they will transition to environmentally sustainable items and abandon those that are not eco-friendly. Consequently, manufacturers will naturally adopt green supply chain management to ensure the long-term viability of their firm. As also mentioned on previous research that environmental concern has positive impact to motivation to adopt certain product (Nasution & Utami Tjhin, 2020). Adopting green supply chain management in a firm demonstrates its capacity for innovation, which in turn influences the perceived value of the customers (Nasution et al., 2020).

Future study can explore the impact of customer awareness of green products on green product sales. Furthermore, analogous study might be carried out on the tempeh sector in other urban areas. Furthermore, analogous investigations can be carried out with the integration of green supply chain management technology into the distribution process. Therefore, the data gathered on the adoption of green supply chain management in the tempeh business is more comprehensive.

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