



The Circular Economy of the Food Bank Supply Chain in Bandung City, West Java

Sri Widiyanesti^{1,2†} and Bintang Mahardhika¹

¹School of Economics and Business, Telkom University, Jl. Telekomunikasi No. 1 Ters. Buah Batu, Bandung-40257, Indonesia

²Center of Excellent Digital Business Ecosystem, Jl. Telekomunikasi No. 1 Ters. Buah Batu, Bandung-40257, Indonesia

†Corresponding author: Sri Widiyanesti; widiyanesti@telkomuniversity.ac.id

Abbreviation: Nat. Env. & Poll. Technol.

Website: www.neptjournal.com

Received: 30-04-2024

Revised: 30-06-2024

Accepted: 03-07-2024

Key Words:

Food bank
Food waste
Circular economy
Supply chain

Citation for the Paper:

Widiyanesti S. and Mahardhika B., 2025. The circular economy of the food bank supply chain in Bandung City, West Java. *Nature Environment and Pollution Technology*, Vol. 24, No. 1, D1682. <https://doi.org/10.46488/NEPT.2025.v24i01.D1682>

Note: From year 2025, the journal uses Article ID instead of page numbers in citation of the published articles.

ABSTRACT

Food banks play a crucial role in reducing food waste and addressing food vulnerability. Their operations involve an efficient supply chain that collects surplus food, processes it, and distributes it to those in need. This aligns with the goals of a circular economy, aiming to minimize food crises. This research aims to understand the supply chain of the Food Bank Bandung and analyze the implementation of circular economy principles within its supply chain. The study employs qualitative methods, with data gathered through interviews conducted with representatives from the Food Bank located in Bandung City. The collected information was used to design a comprehensive supply chain model, which was then meticulously analyzed. The analysis reveals that the Food Bank in Bandung effectively implements a circular economy by transforming surplus food, which would otherwise go to waste, into consumable items. Furthermore, the food bank adopts circular economy concepts by providing inedible food to Black Soldier Fly (BSF) cultivation for maggot consumption, which then can be used as an alternative source of protein for animal feed. The findings of the study show how circular economy practices can be integrated into food bank operations. By analyzing the circular economy approach in the Food Bank of Bandung, this research contributes to the existing body of knowledge and provides a foundation for future studies, offering a more extensive dataset for researchers and practitioners in the field.

INTRODUCTION

Food banks play a significant role in implementing circular economy principles to reduce waste and decrease food vulnerability (Syalianda & Kusumastuti 2023). According to research conducted by Syalianda & Kusumastuti (2023), the government plays an important role in addressing hunger-reduction issues and enhancing food security within the implementation of circular economy goals within food banks. The association between the supply chain and the standards of the circular economy is vital and must be adjusted, as highlighted by Montag (2022). An exceedingly viable and effective supply chain can minimize nourishment emergency dangers, as demonstrated by Tan et al. (2022).

Currently, society has adopted supply chain systems in everyday life, businesses, and organizations, both consciously and unconsciously. According to Frederico (2021), the supply chain involves all parties, from suppliers, manufacturers, transporters, warehouses, and retailers to customers. As a real example, food banks, as explained by Syalianda & Kusumastuti (2023), are organizations that apply the concept of the supply chain. Food banks collect food waste from donors, process it, and distribute it to various institutions that provide food to the community in need. The processing of food waste reduces waste and maximizes resource utilization (Dewilda et al. 2021, Studnička 2021). This is closely related to the circular economy system.



Copyright: © 2025 by the authors

Licensee: Technoscience Publications

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Circular economy (CE) involves the circulation of materials and energy, with the primary goal of reducing waste (Arruda et al. 2021). CE supports an economic system that prioritizes the reduction of resource use and mitigates environmental impact (Montag 2022). The implementation of the circular economy is particularly beneficial in countries with high levels of waste production, as noted by Waluyo & Kharisma (2023).

According to the report from the United Nations Environment Programme (UNEP) titled “Food Waste Index 2021” (Forbes et al. 2021), Indonesia has the highest waste production in Southeast Asia, reaching 20,938,252 tons per year. Moreover, the waste composition graph published by SIPSN (National Waste Management Information System) in 2023 indicates that 41.6% of Indonesia’s total waste is food waste, followed by wood at 12.5%, paper at 11.5%, plastic at 17.3%, and others 17.1%, emphasizing that the majority of waste in Indonesia is food waste (SIPSN 2023).

Given the prevailing waste conditions in Indonesia, this research aims to confirm that the Food Bank Bandung has implemented a circular economy to address the issue of food waste in Indonesia. Moreover, food banks in other cities can adopt a similar system to what has been implemented in Bandung to assist in addressing food waste in Indonesia.

In the introduction, we delineate the pivotal role of food banks in addressing food waste and hunger reduction. Additionally, we expound on the significance of implementing an effective and efficient supply chain to adhere to the principles of circular economy. The material and methods section provides a detailed explanation

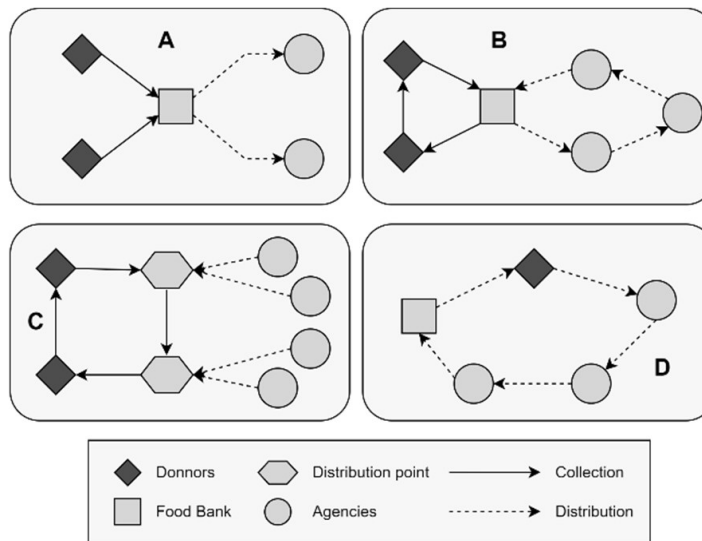
of supply chains, food banks, and circular economy. Furthermore, we articulate various insights derived from interviews with Food Bank experts in Bandung and process this information to formulate a supply chain design. The results and discussion section scrutinizes the supply chain of the Food Bank Bandung concerning circular economy principles. In the conclusion, we draw conclusions based on the preceding discussions.

MATERIALS AND METHODS

A. Supply Chain

The supply chain is defined as a flow encompassing individuals, organizations, technology, activities, information, and resources. Various entities are involved in producing and delivering a product from its initial stage to the end user (Bigliardi et al. 2022). To meet consumer demand for products and services, the concept of the supply chain refers to the integration of material and information flows across all supply chain entities (Coyle et al. 2021). This involves coordination among entities such as distributors, suppliers, manufacturers, wholesalers, and customers (Wieland & Durach 2021). For example, Rivera et al. (2023) describe several supply chain models from food banks in Fig. 1.

Food banks occasionally directly distribute food to individual institutions (Network A), but institutions are often aggregated and visited along routes to enhance transportation efficiency (Network B). Additionally, it is possible to introduce food distribution points to share the distribution effort between food banks and institutions (Network C).



Source: Rivera et al. (2023)

Fig. 1. Several food bank supply chains reported in the literature.

Furthermore, in Network D, food banks visit donors and institutions by organizing pickup locations and distribution flows. From the supply chain model above, we know that a good supply chain will simplify all actions in each process.

A well-managed supply chain can reduce costs, enhance efficiency, and ensure timely product delivery (Zhao et al. 2023). Ensuring the smooth flow of materials, information, and resources efficiently from the initial processes to product delivery to the end user is crucial. Supply chain management involves coordination and integration in every process and activity within the supply chain (Solaimani & Van Der Veen 2021). This encompasses relationship management and processes within the supply chain, aiming to achieve a competitive advantage for all entities in the supply chain (Storer et al. 2014). The multidisciplinary nature of supply chain management integrates concepts from various fields, such as strategic management, marketing, and organizational behavior (Solaimani & Van Der Veen 2021). Researches by (Wieland & Durach 2021, Zhao et al. 2023, and Solaimani & Van Der Veen 2021) emphasize the integration of the supply chain can minimize resources required, waste generated, emissions emitted, and adverse environmental effects throughout the whole supply chain, achieving a balance of internal sustainable efficiency. These are certainly closely related to.

B. Circular Economy

The idea of the circular economy has drawn a lot of attention lately. According to Tapia et al. (2021), the circular economy is a system in which items that reach the end of their useful life are converted into resources for others, closing the circle within the industrial ecosystem and minimizing waste. According to the European Commission (EC), the circular economy is a type of economy where the value of products, materials, and resources is maintained for as long as possible by minimizing the amount of waste produced (Kirchherr et al. 2023). This definition aligns with the broad definition issued by the Joint Research Centre of the European Commission, emphasizing the rotational use of resources, including energy and materials (Mies & Gold 2021). A circular economy can be implemented in the FnB (Food and Beverage) sector. According to Liaros (2021), studies have shown that the food industry has prioritized circular economy principles such as reducing waste and pollution. The food industry can develop self-sustaining production systems that leverage supply chain management and circular economy business models to reduce waste and environmental impact (Montag 2022).

In addition to being a theoretical idea, the circular economy is a workable strategy for advancing a sustainable economy, environment, and society (Roberts et al. 2021). It's

critical to take into account a variety of sector- and region-specific tactics and practices in order to make an efficient transition to a circular economy. The implementation of a closed-loop system is a crucial component of the circular economy, focusing on reducing the use of non-renewable and toxic raw materials, reusing goods and services through better design, and recycling waste into new resources that can be further used and consumed (Patwa et al. 2021). Additionally, the application of circular economy principles requires a deep understanding of the potential of the supply chain and its entities, emphasizing the importance of recycling and expanding sustainability services (Kalemkerian et al. 2022).

To realize the implementation of the circular economy, the application of practices is essential, and it is crucial to develop strategies in the form of a circular business model as a complex and flexible system (Grabowski 2021). This strategy contributes to the formation and development of the circular economy by ensuring that materials and resources in the economy function for as long as possible (Khomenko et al. 2021). By combining these strategies and frameworks, entrepreneurs and policymakers can achieve a transition to the circular economy by generating value for the environment and society (Beccarello & Foggia 2022).

C. Food Bank

The food bank is a non-profit organization that assists low-income communities in obtaining food and distributes it through various non-profit social solidarity institutions (Akkerman et al. 2023). Responding to the urgent needs of those facing food insecurity, this system functions as an essential emergency food supply system (Akkerman et al. 2023). Food banks play a crucial role in addressing food insecurity and poverty by providing long-term supplies to many individuals experiencing severe food insecurity (Berti et al. 2021).

In addition to addressing food insecurity, food banks also play an important role in combating food waste by effectively redistributing food stocks to those in need, thus reducing the environmental impact of food waste (Penalver & Aldaya 2022). By collecting surplus edible food from various sources, food banks contribute to reducing food waste (Akkerman et al. 2023).

Typically, food banks do not directly provide food to end consumers but operate as intermediaries between food suppliers and institutions serving individuals in need (Blackmon et al. 2021). Food banks distribute food to communities in need to address food insecurity. The organization requests, stores, and delivers food from various donors, including local producers, retail food stores, federal commodity distribution programs, and the food industry (Rao

et al. 2021). Functioning as wholesalers, food banks store and manage food obtained from donors before distributing it to charitable organizations addressing food insecurity (Akkerman et al. 2023). Subsequently, the food provided to charitable organizations is distributed to communities in need (Montoli et al. 2023).

This research uses qualitative methods and data collection is carried out by interview. Interview participants are food bank experts (Top level management), and the number of interview participants was 3 people. Our research process includes several steps to ensure the reliability of our results. First, we interviewed the food bank expert to understand the supply chain flow from an initial product to an end product. Next, we process the information from the sample to create a supply chain design, and we ensure that the supply chain design aligns with the one depicted in Fig. 1. Data Collection:

A. Information Collection and Interview

The sample we use here is a Food Bank located in Bandung City, West Java. In these interviews, we collected important data and information from the Food Bank supply chain that can help us to understand how the Food Bank supply chain actually works. Here is some information we obtained from the food bank:

Several donors send food to food banks, but sometimes, food banks pick up food from another donor before there is an agreement between the food bank and donors. Some donors

are farms, industrial hotels, bakeries, distributor warehouses, and communities.

1. The food bank only accepts surplus food.
2. The food management standards at the food bank are already in accordance with BAPANAS (National Food Agency of
3. Indonesia) standards. Additionally, the food bank has established a Memorandum of Understanding (MOU) with the NHI Bandung Polytechnic to ensure the safety of the processed food.
4. The food bank will deliver food to charitable institutions and schools, but the priority is charitable institutions, which will later distribute it to people in need.
5. Some non-processable food will be provided to BSF (Black Soldier Fly) cultivation to be used as a food source.

RESULTS AND DISCUSSION

After obtaining various pieces of information from the food bank, we processed the data to formulate a supply chain design, as illustrated in Fig. 2.

The supply chain depicted in Fig. 2 can be aligned with the Model A supply chain illustrated in Fig. 1. In this context, the food bank sources food from various sources, including farms, industrial hotels, bakeries, distributor warehouses, and

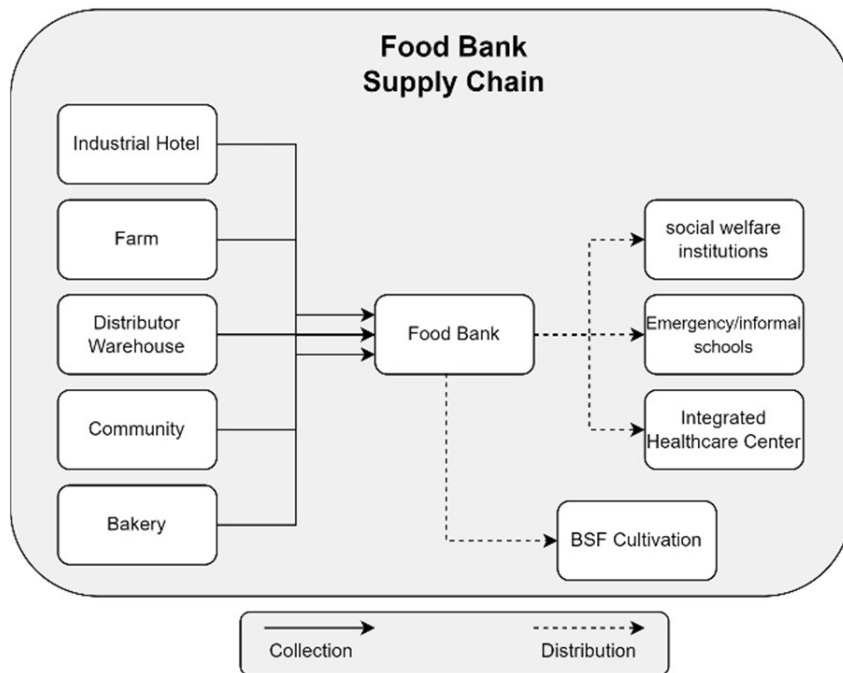


Fig. 2. Food Bank Supply Chain.

the community. Subsequently, the food bank processes the acquired food for distribution to social welfare institutions, emergency/informal schools, integrated health care centers, and BSF Cultivation, where they all act as agencies. The provision of food to BSF Cultivation is only executed when there is food deemed unsuitable for consumption.

If we compare the supply chain at Bandung Food Bank with (Syalianda & Kusumastuti 2023), we will find slight differences in the middle-to-end loop. Bandung Food Bank has a partner in the form of BSF cultivation, which has the benefit of dealing with food that cannot be passed on to beneficiaries. This has a big impact because food that cannot be eaten will not become waste and will be reused as food for maggots.

Examining the food bank supply chain illustrated in Fig. 2, it can be asserted that the food bank has successfully implemented the concept of a circular economy. Firstly, by processing and distributing surplus food from various donors, food banks have turned surplus food that would be wasted into many varieties of food that can be consumed by many people.

Then, Food Bank Bandung provides unprocessable food to BSF Cultivation. In this process, the food serves as consumption for maggots. On the other hand, magot can bring several advantages such as processing organic waste, valuable protein-rich for livestock and fish, and also contributing to economic resilience (Supena et al. 2021, Indrasari 2021). Those are aligned with the circular economy concept when the value of products, materials, and resources is maintained for as long as possible by minimizing the amount of waste produced (Kirchherr et al. 2023).

CONCLUSIONS

The Food Bank Bandung has successfully implemented a circular economy within its supply chain, as evidenced by the detailed analysis of its processes. The supply chain design, illustrated in Fig. 2, begins with the collection of surplus food, processing of food, and distribution of prepared food to agencies. Furthermore, the Food Bank Bandung implements a circular economy in the process of delivering inedible food to BSF cultivation. This food serves as feed for maggots, and these maggots have the potential to create new value by processing organic waste and providing protein-rich food for fish and livestock. Additionally, this initiative contributes to economic resilience.

This study has several limitations. Firstly, the Food Bank Bandung is insufficient to represent all the food banks throughout Indonesia. Therefore, we recommend for future research to do the inclusion of a larger dataset. Additionally,

this study does not compare all food banks in Indonesia. Despite these limitations, the research makes a valuable contribution by validating the ability of Food Bank Bandung to implement a circular economy in its supply chain. (SIPSN 2023). For practice, we recommend adding an entity that can close the loop on food that cannot be given to beneficiaries. This will be beneficial because if food that cannot be eaten is not managed it will become waste and can damage the environment. For policy, we recommend facilitating and establishing good cooperation with food banks in the area so that food surpluses can be resolved effectively and efficiently.

ACKNOWLEDGMENT

This paper is an output of the supply chain and circular economy project. We would like to express our gratitude to the editorial team and reviewers of the Journal International for their invaluable contributions to the refinement and enhancement of our research on the circular economy. The journal's commitment to scholarly excellence and its dedication to advancing knowledge in the field has been instrumental in shaping the quality and depth of our work. This acknowledgment extends to the entire editorial board for providing a platform that fosters intellectual discourse and the dissemination of innovative ideas.

REFERENCES

- Akkerman, R., Buisman, M., Cruijssen, F., De Leeuw, S. and Haijema, R., 2023. Dealing with donations: Supply chain management challenges for food banks. *International Journal of Production Economics*, 262, p.108926. <https://doi.org/10.1016/j.ijpe.2023.108926>
- Arruda, E.H., Melatto, R.A.P.B., Levy, W. and Conti, D.M., 2021. Circular economy: A brief literature review (2015–2020). *Sustainable Operations and Computers*, 2, pp.79–86.
- Beccarello, M. and Di Foggia, G., 2022. A circularity mapping framework for urban policymaking. *Journal of Politics and Law*, 16(1), p.11.
- Berti, G., Giordano, C. and Mininni, M., 2021. Assessing the transformative potential of food banks: The case study of Magazzini Sociali (Italy). *Agriculture*, 11(3), p.249. <https://doi.org/10.3390/agriculture11030249>
- Bigliardi, B., Filippelli, S., Petroni, A. and Tagliente, L., 2022. The digitalization of supply chain: A review. *Procedia Computer Science*, 200, pp.1806–1815. <https://doi.org/10.1016/j.procs.2022.01.381>
- Blackmon, L., Chan, R., Carbral, O., Chintapally, G., Dhara, S., Felix, P., Jagdish, A., Konakalla, S., Labana, J., McIlvain, J.D., Stone, J.D., Tang, C.S., Torres, J. and Wu, W., 2021. Rapid development of a decision support system to alleviate food insecurity at the Los Angeles Regional Food Bank amid the COVID-19 pandemic. *Production and Operations Management*, 30(10), pp.3391–3407.
- Coyle, J.J., Novack, R.A., Gibson, B.J. and Langley, C.J., 2021. Supply chain management: A logistics perspective. *SSRN*, 11, p.49
- Dewilda, Y., Silvia, S., Riantika, M. and Z., 2021. Food waste composting with the addition of cow rumen using the Takakura method and identification of bacteria that play a role in composting.
- Forbes, H., Quedsted, T. and O'Connor, C., 2021. UNEP - UN Environment Programme. Retrieved 14 November 2023 from <https://www.unep.org/resources/report/unep-foodwaste-index-report-2021>.

- Frederico, G.F., 2021. From Supply Chain 4.0 to Supply Chain 5.0: Findings from a Systematic Literature Review and Research Directions. *Logistics*, 5(3), pp.49. <https://doi.org/10.3390/logistics5030049>
- Indrasari, M., 2021. Maggot BSF cultivation development strategy as economic resilience during a pandemic. *Sinergi: Jurnal Ilmiah Ilmu Manajemen*, 11(2), pp.18-20.
- Khomenko, I., Vuychenko, M., Gomeniuk, M., Mazur, Y. and Haidai, O., 2021. Imperatives for the formation and development of the circular economy and global waste management. *E3S Web of Conferences*, 2021.
- Kirchherr, J., Yang, N.N., Schulze-Spüntrup, F., Heerink, M.J. and Hartley, K., 2023. Conceptualizing the Circular Economy (Revisited): An analysis of 221 definitions. *Resources, Conservation and Recycling*, 194, p.107001. <https://doi.org/10.1016/j.resconrec.2023.107001>
- Liaros, S., 2021. Circular food futures: What will they look like? *Circular Economy and Sustainability*, 1(4), pp.1193-1206.
- Mies, A. and Gold, S., 2021. Mapping the social dimension of the circular economy. *Journal of Cleaner Production*, 321, p.128960. <https://doi.org/10.1016/j.jclepro.2021.128960>
- Montag, L., 2022. Circular economy and supply chains: Definitions, conceptualizations, and research agenda of the Circular Supply Chain Framework. *Circular Economy and Sustainability*, 3(1), pp.35-75. <https://doi.org/10.1007/s43615-022-00172-y>
- Montoli, P., Ares, G., Aschemann-Witzel, J., Curutchet, M.R. and Giménez, A., 2023. Food donation as a strategy to reduce food waste in an emerging Latin American country: a case study in Uruguay. *Nutrire*, 48(1), p.22.
- Patwa, N., Sivarajah, U., Seetharaman, A., Sarkar, S., Maiti, K. and Hingorani, K., 2021. Towards a circular economy: An emerging economies context. *Journal of Business Research*, 122, pp.725-735. <https://doi.org/10.1016/j.jbusres.2020.05.015>
- Penalver, J.G. and Aldaya, M.M., 2022. The Role of the food banks in saving freshwater resources through reducing food waste: The Case of the Food Bank of Navarra, Spain. *Foods*, 11(2), p.163.
- Rao, M., Bilić, L., Duwel, J., Herentrey, C., Lehtinen, E., Lee, M., Calixto, M.A.D., Bast, A. and De Boer, A., 2021. Let Them Eat Fish!—Exploring the possibility of utilizing unwanted catch in food bank parcels in the Netherlands. *Foods*, 10(11), p.2775. <https://doi.org/10.3390/foods10112775>
- Rivera, A.F., Smith, N.R. and Ruíz, Á., 2023. A systematic literature review of food banks' supply chain operations with a focus on optimization models. *Journal of Humanitarian Logistics and Supply Chain Management*, 13(1), pp.1025.
- Roberts, T., Williams, I., Preston, J., Clarke, N., Odum, M. and O'Gorman, S., 2021. A Virtuous Circle? Increasing Local Benefits from Ports by Adopting Circular Economy Principles. *Sustainability*, 13(13), p.7079.
- SIPSN, 2023. Sistem Informasi Pengelolaan Sampah Nasional. Available at: <https://sipsn.menlhk.go.id/sipsn/>. [Accessed 12 November 2023].
- Solaimani, S. and Van Der Veen, J., 2021. Open supply chain innovation: an extended view on supply chain collaboration. *Supply Chain Management*, 27(5), pp.597-610. <https://doi.org/10.1108/scm-09-2020-0433>
- Storer, M., Hyland, P., Ferrer, M., Santa, R. and Griffiths, A., 2014. Strategic supply chain management factors influencing agribusiness innovation utilization. *The International Journal of Logistics Management*, 25(3), pp.487-521.
- Studnička, P., 2021. Possibilities of waste reduction in gastronomy.
- Supena, M.H., Wiryati, A.S.S.G. and Subagio, A.A., 2021. Business analysis of black soldier flies (BSF) as an alternative feed for fish cultivation in Bogor City, West Java. *E3S Web of Conferences*, 2, p.21.
- Syalianda, R. and Kusumastuti, R.D., 2023. Analysis of an Indonesian bank sustainability using system dynamics simulation. *Community Engagement, and Social Environment*, pp.5.
- Tan, Y., Feng, H., Popp, J. and Oláh, J., 2022. Minimizing waste in the food supply chain: Role of information system, supply chain strategy, and network design. *Sustainability*, 14(18), p.11515.
- Tapia, C., Bianchi, M., Pallaske, G. and Bassi, A.M., 2021. Towards a territorial definition of a circular economy: exploring the role of territorial factors in closed-loop systems. *European Planning Studies*, pp.1-20.
- Waluyo, B. and Kharisma, D., 2023. Circular economy and food waste problems in Indonesia: Lessons from the policies of leading countries. *Cogent Social Sciences*, 9(1), pp.1-23.
- Wieland, A. and Durach, C.F., 2021. Two perspectives on supply chain resilience. *Journal of Business Logistics*, 42(3), pp.315–322. <https://doi.org/10.1111/jbl.12271>
- Zhao, N., Hong, J. and Lau, K.H., 2023. Impact of supply chain digitalization on supply chain resilience and performance: A multi-mediation model. *International Journal of Production Economics*, 259, p.108817. <https://doi.org/10.1016/j.ijpe.2023.108817>