Designing a Sustainable Organic Waste Management Strategy Based on Biopore Technology for the Dapur Oma Rempong Catering Business in Semarang

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Abstract: Organic waste from the catering sector has become a significant concern due to the increasing volume of food waste generated. This study aims to identify cleaner production strategies in the small and medium-sized catering industry in Dapur Oma Rempong, Semarang, and direct the development of sustainable waste management strategies through a cleaner production option. The research adopts a qualitative method with a case study design, where data were collected through field observations and in-depth interviews. The data were analyzed descriptively, focusing on identifying existing conditions and exploring potential waste management strategies that could be implemented. Findings reveal that the business generates approximately 3–5 kg of organic waste per day. However, the current waste handling system is still unsorted and not yet optimized. Although the business owner is aware of the importance of better waste management, limited knowledge and experience pose significant challenges in its implementation. Based on the findings, the proposed strategy includes separating organic and inorganic waste, as well as applying biopore technology to convert organic waste into useful compost. This strategy is expected not only to reduce the amount of waste produced but also to raise environmental awareness in SME operations and serve as a model for environmentally friendly waste management practices in the broader catering industry.

Keywords: *waste management, catering SMEs, cleaner production, biopore*

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1. Introduction

Waste is a persistent problem in Indonesia, by its serious impacts on the environment and public health. According to Ministry of Environment and Forestry (KLHK, 2022) the total waste generated in Indonesia in 2022 reached 68.7 million tons per year, with 60% of it being organic waste, primarily food waste which accounts for 41.27% of its total. This issue is exacerbated by a lack of public knowledge regarding proper waste management and disposal.

In general, waste is divided into two main categories, i.e. organic waste and inorganic waste. Organic waste consists of natural materials that can be decomposed naturally, such as food scraps, leaves, and agricultural waste. Although it can be decomposed, this process requires time and specific conditions to occur effectively. Data from the National Waste Management Information System (SIPSN, 2023) indicates that approximately 28.3% of total waste in Indonesia is food waste. In contrast, inorganic waste includes materials that cannot be decomposed naturally, such as plastics, metals, glass, and paper. This type of waste takes a very long time to break down and often pollutes the environment if not managed properly. Data shows that 51.47% of total waste in Indonesia is inorganic (Waste4Change, 2023). The discharge of waste in the environment without prior treatment can lead to pollution in various aspects: water pollution from organic waste leachate which permeates into the soil,; soil pollution that reduces land fertility due to the accumulation of waste in final disposal siteor *Tempat Pembuangan Akhir*, and air pollution caused by poorly managed waste burning.

In Semarang, one of Indonesia's major cities, managing catering waste has become an important issue. The catering industry significantly contributes to organic waste generation through food scraps produced during preparation and serving. Data from the Semarang City Environmental Agency indicates that about 38.28% of total waste in Semarang comes from households and the food service industry (Dinas Lingkungan Hidup Kota Semarang, 2023). According to data from the Sistem Informasi Pengelolaan Sampah Nasional (SIPSN) in Semarang City in 2023, the predominant type of waste is food waste, which accounts for 60.8% of the total waste. (Figure 1)

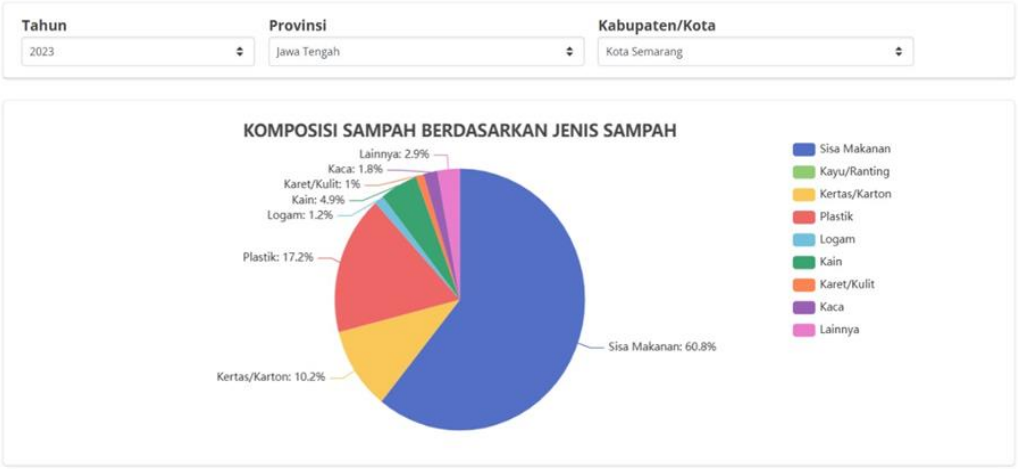

Figure 1. Waste composition based on its type
(Source: SIPSN Kota Semarang, 2023)

As indicated by Figure 1, organic waste contributes the largest portion of waste composition in Semarang, and this presents significant challenges in waste management in Semarang. The majority of waste is generated from domestic activities, while contributions from the commercial sector and public facilities account for only about 17%. This can be observed in the sources of waste produced in Semarang City, where household waste is the largest contributor, accounting for 72% of total waste production. (Figure 2). This underscores the need for waste management strategies that focus on reducing organic and plastic waste, particularly those originating from households.

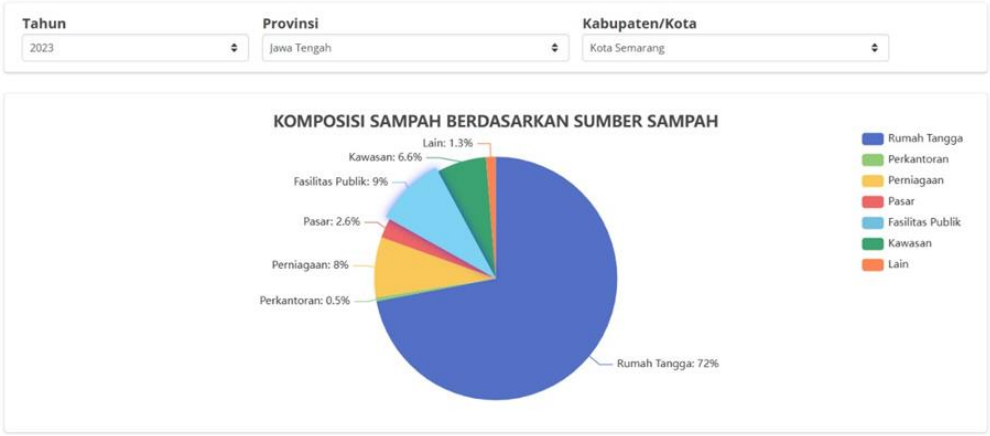

Figure 2. Waste composition based on its sources
(Source: SIPSN Kota Semarang, 2023)

In facing these challenges, an innovative and sustainable waste management approach is needed, particularly in industrial sectors such as catering. The catering industry plays a strategic role in reducing organic waste generated, considering its significant contribution to total food waste. Therefore, waste management strategies based on cleaner production could provide a solution that can be implemented to mitigate the negative impact of waste on the environment. Cleaner production is a preventive and integrated environmental management strategy, continuously applied throughout the production process and the product life cycle. Its goal is to reduce risks to humans and the environment by improving the efficiency of natural resource use, preventing pollution, and minimizing waste generation at the source (UNEP, 2003; Ministry of Environment, 2018). The necessary aspects of cleaner production include (1) resource use efficiency (2) pollution prevention: (3) waste management; (4) technological innovation (ILO, 2013). Resource use efficiency indicates improving efficiency in the use of raw materials, energy, and water while reducing the use of hazardous materials (Sari et al., 2012). Pollution prevention which emphasizes minimization of waste from all stages by replacing hazardous materials with environmentally friendly alternatives (Purwanto, 2005). a)

Waste management involves an effective waste management system, including recycling and reusing materials to minimize generated waste (Ministry of Environment, 2018). Finally, technological innovation focuses on utilizing environmentally friendly technologies and innovations in the production process to reduce environmental impacts (Fransiska, 2010).

This approach provides a strong foundation for implementing clean production in the catering industry, focusing on reducing food waste and resource efficiency at every operational stage.

Cleaner production in the catering industry focuses on reducing food waste generated during the serving and processing stages. One example of clean production implementation can be seen at Proklamasi Catering Service in Jakarta, where they apply efficient methods in the use of raw materials and waste processing (Proklamasi Catering Service, 2023). By identifying the right raw materials and minimizing waste during the production process, they have successfully reduced the amount of final waste generated. Research shows that through the application of clean production, companies can save on material usage such as lunch boxes and improve waste processing, thereby not only lowering operational costs but also positively contributing to the environment (Sari, 2003). Furthermore, other research indicates that implementing a good waste management system in the catering industry can minimize negative impacts. For instance, by implementing wastewater treatment facilities (IPAL) that meet standards, the liquid waste generated can be better managed before being discharged into the environment. This is crucial for preventing pollution and maintaining public health in surrounding communities (Malinda, 2020). Thus, the application of clean production not only provides economic benefits for the catering industry but also supports environmental sustainability. The primary objective of this paper is identifying the cleaner production strategies in the small and medium-sized catering industry in Dapur Oma Rempong, Semarang, and formulating recommendations for solutions to address these cleaner production options.

2. Materials and Method

The data collection method used in this study is a qualitative method in the form of interviews and observations. The selection of interviews as one of the techniques is due to its ability to dig up in-depth information regarding the experiences, perceptions, and challenges faced by the owner and employees of Dapur Oma Rempong in implementing clean production practices. Interviews provide conversations in questions, allowing researchers to adjust questions based on the responses of the informants, so that they can better explore relevant topics. In addition, interviews also help understand the specific context of this small and medium business. Interviews were conducted three times with a duration of 60 minutes per meeting. In collecting data related to the Dapur Oma Rempong catering business, the key informant was Mrs. Ellen Anglina Triwardhani as the owner and head of the kitchen. This informant has in-depth knowledge regarding menu development, food processing practices, and waste management.

On the other hand, observation was selected because it can help researchers to directly observe the operational process at Dapur Oma Rempong, including waste management methods and the implementation of clean production practices. With direct observation, researchers can identify good practices and challenges expressed during interviews, thus providing more accurate data on daily reality. Observations were conducted in three meetings with each meeting lasting for 30 minutes. The combination of these two techniques aims to gain an understanding of the implementation of clean production in the small and medium catering industry and formulate practical recommendations for Dapur Oma Rempong in improving their waste management.

To increase data validity, this research applies a triangulation technique that serves to strengthen the data obtained through interviews with the manager, so that the data obtained does not only depend on one point of view but strengthens the findings through verification between parties. The inference model in this research is inductive, which means that the analysis is carried out by drawing empirical data collected in the field into a conclusion. Based on the results of direct observations and interviews, researchers draw conclusions gradually by paying attention to the real conditions that occur in the field (Dapur Oma Rempong). Researchers do not directly use theory as a basis but start by building understanding from the data collected through interviews and observations. This method is in accordance with the qualitative approach which aims to explore the problem in depth according to the real conditions at the research location.

3. Results and Discussion

The location selected for this study is Dapur Oma Rempong, which is a small and medium catering business operating in Semarang, Indonesia. The selection of this location was based on several considerations, including: (1) Contribution to organic waste, because Dapur Oma Rempong plays a significant role in producing organic waste, especially from food scraps generated during the food serving and preparation process. With data showing that around 60.8% of total waste in Semarang is food waste, this location is a relevant example for implementing better waste management strategies; (2) Increasing public knowledge, because there is an urgent need to raise public knowledge about proper waste management. Dapur Oma Rempong can be a model for other small businesses in implementing environmentally friendly waste management practices, as well as educating the public about the importance of waste sorting and management; (3) Innovation potential, because this catering business has the potential to implement a clean production approach, which can reduce the negative impact of waste on the environment. By implementing technology and resource efficiency methods, Dapur Oma Rempong can show how the catering industry can contribute to environmental sustainability; (4) Community support, because this location also allows for community involvement in waste management programs, where training and outreach can be conducted to increase community participation in reducing organic waste. Taking these factors into consideration, Dapur Oma Rempong was selected as the research location to explore the challenges and solutions in implementing clean production in the catering industry in Semarang.

Figure 3. The location of Dapur Oma Rempong
(Source: Personal documentation, 2024)

An interview with the son of the owner of the Dapur Oma Rempong catering business provides a new perspective, where Reinata Bayu Putra Dewangga explained that the Dapur Oma Rempong catering business can produce approximately 3-5 kg of vegetable and fruit peel waste. He also said that the Dapur Oma Rempong catering business must act in managing organic waste because so far food waste has only been collected in plastic bags and thrown away, although this food waste is directly thrown away to the Garbage Disposal Site (TPS) but Reinata thinks that food waste can be used as fertilizer with sales value and utility value. Analysis of the interview with Mrs. Ellen Anglina Triwardhani as the owner and Reinata Bayu Putra Dewangga as the son of the owner, due to the lack of knowledge about significant contributors to food waste. They have the same views and opinions about the environment so that through the Dapur Oma Rempong catering business, they can consciously manage food waste to reduce the increasing amount of food waste, therefore they are willing to open themselves to being involved in cleaner production.

> *"The most common waste is from peeling fruits and vegetables, such as leftover parts of produce. It's from the preparation of ingredients before they are cooked. we put it all in a plastic bag and throw it in the trash"*
> (Ellen Anglina Triwardhani, 14th October 2024)

The catering business produces waste in the form of vegetable peelings, fruit scraps, and wilted vegetables, which are estimated to account for 30% of the total raw materials used in the cooking preparation process (Ministry of Environment and Forestry, 2020). This waste generally comes from the cooking preparation process, where the catering service produces an average of 5-10 kg of organic waste daily (Soobirumbassa & Rachmanto, 2023). The business owner does not separate the waste by their types, but instead mixes it all together, which can increase the potential for pollution if not managed properly (Pratama, 2024). The management of plastic and packaging waste at Dapur Oma Rempong is done by wrapping it in plastic and directly discarding it into general waste bins. This practice is not only common among small businesses but also a concern across various sectors, including hotels, restaurants, and cafes. For example, the DKI Jakarta government requires hotel, restaurant, and cafe management to reduce and process their waste independently in accordance with DKI Governor Regulation No. 102 of 2021. The aim is to reduce the waste sent to the final disposal site (TPA) and encourage producers to take responsibility for the waste they generate.

Meanwhile, liquid waste, such as used cooking oil, is disposed directly into the sink. This practice has the potential to pollute drainage systems and the surrounding environment. According to existing data, it is known that about 6.8% of people dispose of used cooking oil directly into the sink, and 3.2% dispose of it into the soil or drainage systems (Kamaruzaman et al., 2022). Improper disposal of oil can cause blockages in water channels and pollute the soil and groundwater sources, which negatively impacts public health and ecosystems. Food waste is also managed in a similar manner, being wrapped in plastic and disposed of, with a total of 3-5 kg of food waste being discarded daily.

This catering business does not have a written waste management policy and believes that its small-scale operation does not generate waste that significantly impacts the environment. According to research, the Indonesian government has issued various regulations related to waste management that require every industry, including

SMEs, to implement proper waste management practices. For example, Law No. 32 of 2009 on Environmental Protection and Management emphasizes the importance of waste management to prevent pollution and environmental damage. However, many SMEs still do not understand or comply with these regulations and often view waste management as an additional burden that hinders their business. To date, the business owner has not received any outreach from the government regarding waste management but feels the need for further training to understand the environmental impact of their practices.

The owner believes that the amount of waste produced is still relatively small and insignificant, so they do not feel it harms the environment. They assume that since their business is still small-scale and operates in a less densely populated area, the impact of improper waste disposal will not be significant. However, they are beginning to realize that although the amount of waste they generate may seem small, the accumulation of similar practices by many other businesses can have a large impact on the environment.

> *"For a small-scale business like ours, I don't think it has a major impact because the waste we produce is relatively small. For example, if we were working with large amounts of meat or chicken, that would create a strong odor, but in our case, the waste goes directly into the drainage system, and there's no noticeable smell."*
>
> (Ellen Anglina Triwardhani, 14th October 2024)

Although they do not currently use specialized technology, the business owner is interested in adopting waste management technologies in the future, including the implementation of a biopore system. The main challenge in applying such technology is the lack of knowledge and the need for further education. The business owner stated that they need more information about effective waste management methods. They understand the importance of proper waste management for the sustainability of their business, especially since some waste can be turned into organic fertilizer, reducing the need to purchase fertilizer from external sources. They also plan to reduce waste over the next year by implementing environmentally friendly practices.

4. Alternative Strategy

4.1 Separation of Organic and Inorganic Waste

The initial step that can be implemented in waste management at Dapur Oma Rempong is the separation of organic and inorganic waste. This separation aims to facilitate further processing in an effective and environmentally friendly manner. Organic waste includes kitchen scraps such as food leftovers, fruit peels, and vegetables, while inorganic waste consists of plastics, paper, and other packaging materials.

To ensure this process runs optimally, dedicated waste bins should be provided with clear labels and placed at strategic points within the workspace. According to Suyana (2010), there should also be a bin for residual waste, such as tissue paper that cannot be recycled. This separation process must be supported with education for employees, whether through brief training sessions, visual media, or direct guidelines, so that everyone understands the procedures and their purposes (Waste4Change, 2020).

Biopore technology was chosen as a small to medium scale organic waste management solution in Dapur Oma Rempong, Semarang, which produces 3 to 5 kg of organic waste per day. The use of biopores as a natural composting method relies on the role of soil organisms, such as worms and microbes, in accelerating the decomposition of organic matter, in line with the approach developed by Alfiqri et al. (2024) under the BYGJUSO program in RW 09 Sorosutan, Yogyakarta. The results of the BYGJUSO study showed that 17 biopore sites could manage up to 50% of residents' household organic waste, with natural decomposition occurring within 2 to 3 weeks before the compost could be harvested and used. With proper separation, waste materials that still have value, such as plastic and paper, can be sent to recycling partners, while organic waste can be managed through the biopore system.

4.2 Innovative Organic Waste Processing with Biopores

As an advanced form of organic waste management, the biopore system can be applied. This technology works by placing organic waste into vertical holes in the ground, allowing for faster and more efficient natural decomposition. This system has been proven to significantly reduce the volume of waste while simultaneously increasing the soil's water absorption capacity (Widyastuty et al, 2019).

The technical steps involve digging a hole 80–100 cm deep and inserting a PVC pipe with a diameter of approximately 10–20 cm, which has been perforated around its surface. Organic waste is gradually inserted into the pipe and covered with a perforated lid to maintain air circulation. After a fermentation process of about three months, the organic waste decomposes into compost that can be used for gardening or sold (Sutrisno, 2021).

Biopores are well-suited for small-scale businesses due to their space efficiency and ease of construction. The best location is an open yard or area near the kitchen that does not interfere with daily operations. In addition to reducing waste and producing compost, biopores also minimize odors, prevent pests, and improve soil quality ecologically.

4.3 Regular Monitoring

To ensure the strategy is implemented effectively, regular monitoring activities are required. This can include recording the amount of waste generated each week and evaluating the performance of the waste separation and management system. Suripin (2001) emphasizes that periodic evaluations are essential to assess the effectiveness of the system and to encourage continuous improvement.

5. Conclusion

This study reveals that Dapur Oma Rempong, a small-scale catering business in Semarang, contributes to the daily generation of organic waste in the city. However, the waste management system at this establishment remains unstructured, with most waste being disposed of without proper separation. Through interviews and observations, it was found that the business owner is environmentally conscious and willing to adopt eco-friendly solutions. One promising innovation is the application of biopore technology as a method for processing organic waste. This system is simple, does not require a large area, and is well-suited for small enterprises. Biopores allow

organic waste to be converted into useful compost while simultaneously reducing environmental pollution.

The implementation of biopore technology at Dapur Oma Rempong presents several potential benefits. First, the business can produce organic compost for its own use or for commercial purposes, supporting the principles of a circular economy. Second, the use of biopores can improve soil quality, minimize odors, and reduce the presence of pests—an important consideration for culinary businesses. Third, the successful adoption of this system may serve as an educational model for other SMEs to implement low-tech yet effective waste management solutions. Lastly, consistent use of biopore-based organic waste management could attract the attention of local governments or environmental organizations, potentially leading to support in the form of training programs, partnerships, or incentives for SMEs that embrace sustainable practices.

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