# Waste Management in an Urban Village through Biopore Organic Waste and Composting Education: A Lesson from Giwangan Village, Yogyakarta

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***ABSTRACT***

Yogyakarta is facing a waste emergency. The Special Region of Yogyakarta government temporarily closed the Piyungan Final Waste Processing Site (TPA) from July 23 to September 5, 2023. This closure was made because the waste in the Piyungan TPA had exceeded capacity. As a result, there are many piles of garbage both on the main road and in housing complexes. The purpose of this study is to explain and evaluate the efforts made by Giwangan Village in educating and applying organic waste biopores and composting to address waste problems in the city of Yogyakarta. Under the framework of the triple helix model, community development activities are done by teaching people how to make biopores, how to harvest compost, and the evaluation activities related to biopores and organic waste. The outcomes of this activity included an addition of 5 biopore points for organic waste in each of the 4 neighborhood units (RW) in Giwangan Village, a 200 kilogram first compost harvest, a 90% reduction in organic waste, and—most importantly—community awareness to manage waste and the surrounding environment in order to create a sustainable Giwangan Village. With the collaboration of the community, government, and universities, this article contributes to alternative solutions to the waste problem so that they can be implemented in other urban villages in the Yogyakarta City area.

*Keywords: Organic waste, biopore hole, biopore organic waste, compost, landfill closure*

## 1. INTRODUCTION

The city of Yogyakarta faces a number of major ecological issues. Ever since the Piyungan landfill was shut down owing to overcapacity, trash has been piling up in every available space. In accordance with Circular Letter No. 658/8512 from the Regional Secretariat of the Special Region of Yogyakarta Province dated July 21, the area will be closed from July 24 to September 5, 2023. There has been a cascade of issues brought on by the trash emergency. There has been a rise in air pollution, which is likely attributable to the widespread practice of burning garbage (Firdaus & Rukmorini, 2023).

To overcome the waste problem in their area, the Yogyakarta City Government launched the "Mbah Dirjo" movement. Mbah Dirjo is an abbreviation of mengolah limbah dan sampah dengan biopori ala Jogja, or processing waste and garbage with Jogja-style biopore." It is a movement to invite people to manage organic waste through biopori either independently, at the household level, or communally (Portal Berita Pemerintah Kota Yogyakarta, 2023). Hence, making biopores is a solution for handling organic waste at the household level.

The principle of biopore is to make compost (Mardiyani & Utomo, 2020; Siswati & Edahwati, 2017). The diameters of these biopores vary. Even a single block or 20 centimeters can be utilized. The making of biopore is quite simple. Residents could make biopores using paralon pipes that were drilled with holes and then planted to a depth of around 80 cm. It can

hold enough garbage for a month at 20 cm. Those who really do not have land can do it collectively. Biopores of a larger size can be made using two 25-kg-used paint buckets that are stacked and partially planted. According to the Major of the City of Yogyakarta, Singgih Raharjo, the "Mbah Dirjo" movement has been implemented in a number of areas, including Kampung Giwangan and Balapan Klitren, Yogyakarta, where some residency areas have independent waste processing facilities using the biopori method.(Antaranews.com, 2023).

The "Mbah Dirjo" movement is targeted to reduce organic waste by up to 60 tons per day, or around 30 percent of the waste generation in Yogyakarta City. The city produces around 200 tons of waste per day. In order to achieve this target, the Yogyakarta City Government requires state civil servants and village-owned enterprises to carry out the "Mbah Dirjo" movement. Through the "Mbah Dirjo" derivative program called "Mbah Dirjo Sowan", every state civil servant (ASN) was asked to create a facility for processing organic waste using the biopore method in their respective homes.

Giwangan is one of the urban villages in Yogyakarta that is located in the southern part of the City of Yogyakarta, an area that is being developed into a growing area and, at the same time, the entrance to the City of Yogyakarta from the south. The area of Giwangan Village is 1.26 km2, which is divided into 7 kampong (sub-village), namely Giwangan, Ponggalan, Mendungan, Mrican, Sanggrahan Pemukti, Malangan, and Ngaglik sub-village. The Giwangan Village area is further divided into 13 community units (RW) and 44 neighborhood units (RT). At the end of 2017, the population of Giwangan Village was 3,805 males and 3,872 females (Jogjakota.go.id, 2018). Figure 1 depicts the map of the city of Yogyakarta, where the Giwangan village is highlighted in white.

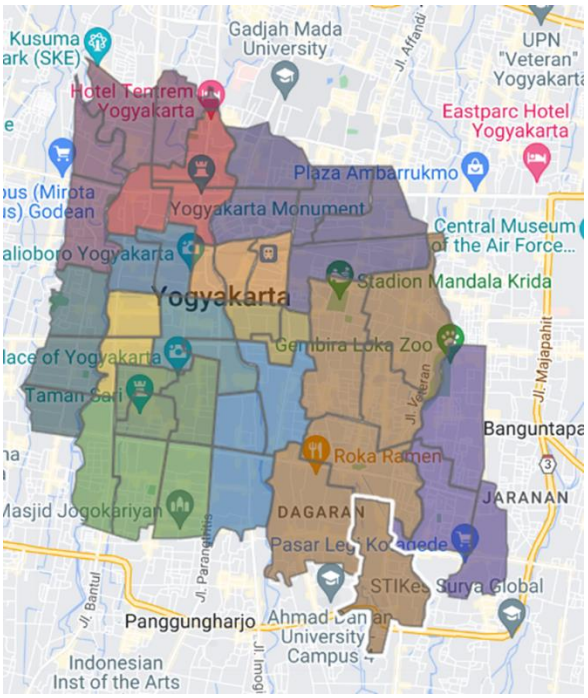


**Figure 1: The map of city of Yogyakarta and Giwangan village**
Source: Generated from Google map

Giwangan Village has implemented the biopore organic waste in some parts of its areas even before the “Mbah Dirjo” movement. Four jumbo biopres are located in RW 11, in the Sanggrahan kampong (sub village) area. The Giwangan village government already has a vision towards an environmentally sustainable village. Giwangan Village has also promoted

the planting of longan fruit so that Giwangan Village is known as Klengkeng (longan fruit) Village, spesifically in the Sanggrahan sub village.

The purpose of planting longan trees in residential areas is to green them up, and residents can also eat the fruit. Apart from that, the compost from the four jumbo biopores in RW 11 can be used for fertilizer in the village greening movement. However, the biopore found in RW 11 and the biopore promoted by the "Mbah Dirjo" movement still use very simple technology. There is no routine mixing of organic waste or adding activators to biopores, so composting takes a relatively long time, which is about one year. Figure 2 presents the biopori launched by the Mayor of the City of Yogyakarta. Figure 3 shows the collection of compost from the biopri in RW 11 and the longan harvest, which was attended by village officials and the surrounding community.

**Figure 2: Biopore at the official launch of "Mbah Dirjo" movement**
Source: (Portal Berita Pemerintah Kota Yogyakarta, 2023)


**Figure 3: Biopore at RW 11 and compost and longan fruit harvesting**
Source: Own compilation

As shown in Figure 2, the "Mbah Dirjo" movement only created a very basic biopore pattern in the form of holes in the ground. Then in Figure 3, during the biopore opening activity in RW 11 to harvest compost, it can be seen that not all of the organic waste put in has been

decomposed into compost. There are still dry leaves that have not been decomposed into compost because of the absence of additional activators or the mixing of organic waste in the biopore in RW 11. Agitation of organic waste is necessary so that microorganisms that decompose waste are not only concentrated in the lower waste layer. The addition of an activator may reduce the time for converting waste into compost from a year to only 1–3 months. (Ruslinda et al., 2021).

In order to socialize the "Mbah Dirjo" movement in other RWs in the Giwangan area and to encourage sustainable waste management, the Giwangan village government asked for expertise from the university to provide waste management training and assistance to the community through the university's community service activities. This organized community service activity receives funding from the Ministry of Education, Culture, Research and Technology through the Territory-Based Community Service (PBW) scheme. The collaboration between universities, government, and the community to address community problems is called the triple helix model (Etzkowitz, 2008; Kadiman, 2006).

The objective of this study is to explain and evaluate the efforts made by Giwangan Village in educating and applying organic waste biopores and composting to address waste problems in the city of Yogyakarta. Under the framework of the triple helix model, community development activities are done by teaching people how to make biopores, how to harvest compost, and the evaluation activities related to biopores and organic waste.

This study contributes to the literature by providing insight on how to address environmental problems at the village level after the Piyungan landfill closure. This study also adds to the literature in relation to community empowerment under the triple helix that was done in DIY before, for example, oyster mushroom farmer empowerment (Sumbodo et al., 2022), urban farmer empowerment (Sumbodo et al., 2021), sugar coconut farmer empowerment (Mulyono et al., 2021), and ornamental fish farmer empowerment (Ika et al., 2021).

## 2. LITERATURE REVIEW

Waste management, due to the continued increase in waste volume, has become a problem in large cities in Indonesia. A study in Bandung (Hidayat, 2021), Surakarta (Lolo et al., 2023), Surabaya (Andina, 2019; Fadlilah & Setiani, 2021), Batang Regency (Budihardjo et al., 2023), and Badung Regency, Bali (Yuliastuti et al., 2013) has discussed the waste problem and alternate solutions to overcome the waste management problem. According to these studies, community-based waste management is an alternative solution to environmental problems caused by piles of garbage. There are several activities that have been carried out in the context of community-based waste management in Indonesia, for example: (1) reducing the volume of inorganic waste with the 3R movement (reduce, reuse, recycle) (Haryanti et al., 2020; Puspitawati & Rahdriawan, 2012); (2) reducing organic waste by making biopores and compost (Budihardjo et al., 2023; Lolo et al., 2023; Pudjiastuti et al., 2020); and (3) recycling plastic with technology into fuel (Syamsiro & Ika, 2019).

In accordance with the current waste problem and the "Mbah Dirjo" movement launched by the Yogyakarta city government, this article will focus on discussing biopore. The biopore absorption hole is a simple technology for making compost and one of the solutions used to deal with excess waste in densely populated residential areas (Idris et al., 2022). As stated earlier, the diameters of these biopores vary around 20 -100 with a length of 80-100 cm. The method used to create biopore holes has a low cost and minimal impact on the ecosystem [14]. Humans' own willingness and consciousness to combat environmental problems like water scarcity and waste pollution are the most important resources (Sakroni et al., 2023). Biopores

that coated in organic waste, acts as a water reservoir for nearby plants and the ground, and also aids in the fading of the organic material into compost (Lolo et al., 2023).

Organic waste can be composted through anaerobic biological decomposition, often known as composting. Composting takes advantage of the metabolic waste products of microorganisms, which include water, carbon dioxide (CO2), ammonia (NH3), and heat (Policastro & Cesaro, 2023). Compost is typically made from decomposable organic materials such as agricultural waste, byproducts from the agro-industrial sector, and other such residues (Budihardjo et al., 2023). In agriculture, compost is crucial because to the high phosphorus content of the organic waste it is generated from (Möller, 2015). The primary benefit of decomposing organic waste is a reduction in waste volume. The ability to generate biogas makes the anaerobic decomposition process both novel and crucial in the treatment of organic waste (Grosser et al., 2017). To eliminate waste, society must shift its focus from final disposal to initial causes. The source method involves a series of intermediate treatment facilities before the trash reaches the following treatment facility (Möller, 2015).

Microorganisms play an important role in the composting process, which results in the production of compost. The microorganism starter for the decomposition process is defined as Effective Microorganism 4 (EM4). The EM4 fermentation bacteria microorganism is also usually called an activator in the composting process. It can be obtained in the agricultural shop or made on our own. The way to make homemade EM4 is by mixing the ingredients, namely 0.5 kg of banana peel, 0.5 kg of pineapple peel, 0.5 kg of papaya peel, 1.5 kg of inner banana stem, 0.25 kg of long beans, 0.25 kg of kale, and 0.25 kg of water, then blending until smooth. Then add 1 kg of granulated sugar and 0.5 liters of liquid coconut sugar or palm wine into the bucket and stirring until smooth. Close the bucket and let it stand for one week. After 7 days, the resulting solution is collected in stages every day, filtered, and then put into a tightly closed container. The solution is EM4, which is ready to use and can last up to 6 months (Siswati & Edahwati, 2017). The waste from making EM4 can be used as organic fertilizer.

The easiest and most economical way to make compost activator media is as follows: Prepare 1 bucket of rice bran and mix the purchased EM4 with molasses in a 1:1 ratio. Dilute with an equal measure of water. Put the mixture of EM4, molasses, and water in the bucket containing the bran and stir well. When it is evenly distributed, the activator media is sprinkled evenly on the biopores, where the organic waste is. After that, biopori organic waste is sprayed with water to keep the organic waste moist. Close the biopore holes, and the organic fertilizer will be ready in 30–60 days, depending on the density of the organic waste used to make the compost.

The following are some of the advantages of biopore infiltration pores, as stated by Pudjiastuti et al. (2020). It can help with (1) lowering organic waste, (2) making soil productive, (3) assisting in preventing flooding, and (4) influencing the amount of groundwater.

As stated earlier, this study discuss the efforts made by Giwangan Village in educating and applying organic waste biopores and composting to address waste problems in the city of Yogyakarta. Hence, this study contributes to the body of knowledge by shedding light on how to address environmental issues at the village level following the closure of the Piyungan landfill in Yogyakarta. This study also contributes to the literature pertaining to community empowerment under the triple helix done in DIY.

## 3. METHODOLOGY

This study utilizes qualitative approach to scrutinize the tasks engaged by the university's peoples. To answer the research question of "what is happening" in specific cases of adaptability and empowerment in urban development, a qualitative methodology was deemed adequate. Additionally, "what was incorrect or inappropriate" and "what should the involved

parties do" in reaction to the process phase were both defined through the use of qualitative analysis (Creswell & Poth, 2016). Furthermore, this relational approach is correct for analyzing phenomenological studies involving people, groups, and institutions, such as the response of a community in an urban village to a waste and environmental problem in Yogyakarta.

The activities taken by the community service team include: (1) in-class meetings of organic waste biopores and composting training; (2) providing or subsidizing the construction of 5 biopore points for organic waste in each of the 4 RWs in Giwangan village; and (3) composting process and harvesting. Evaluation of the success of several activities will be carried out by distributing questionnaires, for example, during training on making organic waste biopores and compost harvesting. Figure 4 displays the process of making compost.


**Figure 4: The process of making compost**
Source: Own compilation

# 4. RESULTS

There are three phases to this community service program: introduction, education, and action. The first step is to spread the word about the program to potential participants and collaborators. This event took place at the Giwangan Village Meeting Hall. Village officials, RW leaders, and Giwangan residents who care about the environment participated in this endeavor.

## 4.1 Training in organic waste biopores and composting

Training of waste management including how to make organic waste biopores and composting was also held at the Giwangan Village Meeting Hall. The training was conducted on July 24, 2023 with 50 participants. The training educates the Giwangan community how to sort waste so that organic waste enters the biopore. Inorganic waste is sorted first, which is waste that can still be deposited in a waste bank, such as paper and plastic bottles. So the waste that is thrown away is inorganic residual waste, such as baby diapers or food wrapping paper. The training also discussed the shape and design of organic waste biopores, which will be built at agreed locations in the RW areas used as pilots, namely RW 6, 8, 9, and 10. Figure 5 presents the training organized by the service team.

After the waste management training is finished, training participants are asked to fill out a questionnaire to determine the level of understanding and effectiveness of the. The results of the training evaluation questionnaire are summarized in Table 1.


**Figure 5: Training in waste management, biopres, and composting**
Source: Own compilation

. As presented in Table 1, questions 1, 2, and 7 reflect the success of waste management training in which biopores and composting materials are included in the training material. Answers to these above questions show that 100% of respondents (50 training participants) perceive the training materials as easy to understand, the training is beneficial for the community, and the participants are willing to participate and practice household waste management, respectively.

**Table 1: Results of evaluation of training questionnaires**

| No | Question | Results | |
|---|---|---|---|
| | | Percentage | Answer |
| **1** | Explanation of waste management training presenters is easy to understand | 100 | Yes |
| **2** | Waste management training is very beneficial for the community. | 100 | Yes |
| **3** | Have you ever received waste management information before? | 26<br>74 | Yes<br>No |
| **4** | Have you ever received training on biopore organic waste and composting before? | 20<br>80 | Yes<br>No |
| **5** | What type of waste is generated most in your household? | 46<br><br><br>40<br><br>14 | Organic waste and food waste<br><br>Plastic, plastic packaging, and goods made of plastic<br>Paper, cardboard and articles made of paper |
| **6** | Do you feel confused about how household waste will be managed after the Piyugan landfill is closed? | 74<br><br>26 | Yes<br><br>No |
| **7** | After the waste management training, I am willing to participate and practice household waste management. | 100 | Yes |

Meanwhile, questions numbers 3–6 expose whether the participants are the right targeted audience for the waste management training. Table 1 shows that 74% of the participants have not received any waste management training before (question number 3), while 80% of the respondents say that they have not received any training about biopores or composting before. Seventy-four percent of the respondents perceive that they are confused about how household waste will be managed after the Piyugan landfill is closed. Meanwhile, organic and food waste are the most common waste generated in their household. Hence, the participants in the training are the right targeted audience for the training.

### 4.2 Construction of biopores

After the education stage, the next phase of the community service program is action. The construction of biopores is part of the action or implementation of the program. During the socialization stage, it has been suggested by the Head of Giwangan Village that four RWs will be the collaborators of the community service program. Therefore, the construction of biopores is placed in five points of each of RW 6, 8, 10, and 11, for a total of 20 biopores to be built in the Giwangan village area. It takes about one week to build 10 organic waste biopores made from concrete blocks with a diameter of 0.8 meter. For one biopore, two blocks of concrete are needed so that the depth of the biopore is around 1–2 meter. Figure 6 shows the biopores that have been built in the RW 10 area.


**Figure 6: Organic waste biopores at RW 10**
Source: Own compilation

The evaluation stage in the implementation of biopore manufacturing activities is the number of biopores that have been successfully made according to a predetermined schedule. There are 20 organic waste biopores, and they are used by residents for the composting process.

### 4.3 Composting process and harvesting

After the biopores are sufficiently filled with organic waste, the next implementation stage is the composting process. The process of making compost has been explained in the methods section, which begins with mixing microorganisms (activators) into organic waste with a waiting time of around 4-8 weeks until the compost is ready to be harvested.

After the composting process, the next step is compost harvesting. There are 10 biopores located in RW 10 and 11 that are ready to be harvested in the first stage of compost harvesting. Each biopore can produce 20–25 kg of compost, so with 10 biopores, 200–250 kg of compost can be produced. The compost harvested from the biopore is filtered first and then put into plastic packaging, whose logo is also designed by the community service team. Figure 6 depicts the compost harvesting event that community leaders attended on August 29, 2023, as well as packaged and ready-to-sell compost samples. Figure 7 depicts the compost harvesting event that community leaders attended on August 29, 2023, as well as packaged and ready-to-sell compost samples.

Evaluation of the composting process and compost harvesting is done by distributing questionnaires to 50 respondents who have participated in the waste management training activities. The results of the questionnaire evaluating compost making and compost harvesting are presented in Table 2.

**Table 2: Results of the evaluation of composting and compost harvesting questionnaires**

| No | Question | Results | |
|---|---|---|---|
| | | Percentage | Answer |
| **1** | What percentage of household organic waste is reduced with biopores? | 80<br>16<br>4 | >90%<br>>75-90%<br>>50-75% |
| **2** | My family participates in the composting process by simply throwing organic waste into the nearest biopore. | 100 | Yes |
| **3** | My family manages waste by sorting it properly to protect the environment | 90<br>10 | Yes<br>No |
| **4** | The compost from the biopore is beneficial for the environment where I live | 100 | Yes |

Table 2 suggests that the reduction of household organic waste is up to 90% in the 4 RWs in the Giwangan Village area. All the respondent family members participated in filling the biopore with the organic waste. Ninety percent of the respondents say that they manage waste by sorting it properly. All of the respondents agree that the compost from the biopore is beneficial to the environment. The high reduction of household organic waste and community participation in filling the biopore with organic waste suggest that there has been community awareness to manage waste and the surrounding environment among Giwangan Village residents.


**Figure 7: Compost harvesting event**
Source: Own compilation

## 5. CONCLUSION

This study aims to describe and assess Giwangan Village's efforts to educate about and implement organic waste biopores and composting in order to mitigate waste issues in Yogyakarta. Teaching people how to generate biopores, how to collect compost, and how to evaluate activities linked to biopores and organic waste are all examples of community development activities that can be carried out within the framework of the triple helix model. The results of this attempt included a 90% reduction in organic waste, a first compost harvest of 200 kilograms, the addition of 5 biopore points for organic waste in each of the 4 neighborhood units (RW) in Giwangan Village, and, most importantly, increased awareness among the local populace about the importance of waste management and environmental protection in the pursuit of a more sustainable Giwangan Village. This study contributes to alternate solutions to the trash problem that can be adopted in other urban villages in the Yogyakarta City region through partnerships between the community, government, and academics. A suggestion for the next community service activity is to intensify urban farming activities to utilize compost obtained from biopori. In addition, assistance and training on magot cultivation to utilize organic waste can be carried out.

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