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# Sustainable solid waste management in tourism villages: Challenges and strategies for environmental sustainability tourism village

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## ABSTRACT

**Background**: Solid waste management plays a crucial role in ensuring sustainable tourism development. In Guwosari Tourism Village, the introduction of the integrated waste processing site/*Tempat Pengolahan Sampah Reduce, Reuse, Recycl* (TPS 3R) Go Sari, initiated by Village-Owned Enterprises/*Badan Usaha Milik Desa* (BUM Desa) Guwosari Maju Sejahtera in 2019, has expanded its service area, aiming to cover 550 families by 2024. Despite its success, there are challenges related to the effectiveness of the waste management system in the village, particularly concerning waste incineration processes and the overall sustainability of the program. **Methods**: This study uses a literature review approach, collecting relevant data based on keywords such as Environmental Sustainability, Go-Sari, Guwosari Tourism Village, Incinerator, Municipal Solid Waste, and Waste Management Strategy. The qualitative descriptive data evaluation method allows for a thorough analysis of the existing solid waste management system at TPS 3R Go-Sari. **Findings**: The study identifies several issues in the solid waste management system at TPS 3R Go-Sari, including air pollution caused by smoke from incinerators during the burning of waste residues. Additionally, the accumulation of ash from incineration poses environmental concerns. Moreover, only about 20% of the village's total waste is processed at the facility, and the high cost of waste collection is a burden for the villagers. **Conclusion**: While TPS 3R Go-Sari has made strides in managing solid waste in Guwosari Tourism Village, it faces significant challenges such as air pollution, limited waste processing capacity, and high collection costs. The implementation of the Zero Waste concept shows potential but requires addressing these issues for better sustainability and community impact. **Novelty/Originality of the Study**: This study provides a unique examination of the practical challenges of applying the Zero Waste concept in a tourism village setting, focusing on the environmental and financial issues surrounding waste incineration and management. It also offers insights into the integration of sustainable waste practices in rural tourism areas.

**KEYWORDS**: environmental sustainability; Guwosari Tourism Village; solid waste management system; tourism village; TPS 3R Go-Sari.

## 1. Introduction

Indonesia is the country with the fourth largest population in the world. The increase in population has led to an increase in the amount of municipal solid waste (MSW) produced. To date, Indonesia still faces many problems related to the MSW manajemen (Qonitan et al., 2020). In 2023, the number of Indonesian population is 278,696,200 (BPS, 2024). If every people generates 0.4 kg/day of MSW (Winanti et al., 2022), estimated waste generated in Indonesia is 111,478 ton/day of MSW. Indonesian consists of 91 major cities

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and semi-city areas called the Regensions, either surroundiaku ng major towns or existing independently in different parts of the country. The total number of islands in Indonesia is 16.056 islands so Indonesian is considering as a the largest archipelago in the world. (Chaerul et al., 2007).

One of the Indonesian provinces with a waste problem is the Special Region of Yogyakarta, (Sudibyo et al., 2017) with a population of 4,073,907 in 2023. There is a lot of potential for tourism in the Special Region of Yogyakarta (DIY), including opportunities for beach, site, temple, and environment tourism. According to data from the Yogyakarta City Environmental Agency (DLH), this leads to the waste problem that the Special Region of Yogyakarta faces. On average, the volume of waste increases annually by 11.53% (Arsanti & Giyarsih, 2012). The amount of waste in 2022 reached 2.117 tons per day, according to figures from the Daerah Istimewa Yogyakarta (DIY) Environmental Agency (DLH). The Sleman district produces the most waste each month—roughly 706,77 tons each day. Following Bantul District with 542,18 tons per day, Yogyakarta City with 325,02 tons per day, Gunungkidul District with 366,11 tons per day, and Kulon Progo District with 177,14 tons per day are the following.

The waste system in the Yogyakarta Special Region is managed by landfills (TPA), specifically the Piyungan Landfill in Bantul Regency, the Wukirsari Landfill in Gunungkidul Regency, and the Banyuroto Landfill in Kulon Progo Regency. However, three districts—Sleman Regency, Bantul Regency, and Yogyakarta City—become part of the regional TPST. The amount of waste created in each landfill, according to the DIY Environmental Agency (DLH), is far more than the landfills' current capacity to manage waste (Arsanti & Giyarsih, 2012).

The DIY Regional Government officially closed permanently the Piyungan Final Disposal (TPA) on April 2024. The closure was marked by the laying of the first stone of TPA fencing and vegetation planting in the passive zone by DIY Regional Secretary Beny Suharsono on Tuesday, 5 March 2024 at TPA Piyungan, Bantul, Yogyakarta. The DIY has made planning a full decentralization of the management of garbage by the district/city in the DIY region. It was a milestone in the change in the management of garbage from the system of collecting, transporting, discarding to the reduction of sources, melting, and handling. TPA Piyungan can be seen in Figure 1.

Fig. 1. TPA Piyungan
(Setyawan, 2023)

Tourism plays a significant role in the economic development of villages. With their unique characteristics, tourism villages offer opportunities for community empowerment and can mitigate the negative effects of urbanization (Salouw & Pramono, 2023). Based on data from The Ministry of Tourism and Creative Republic Indonesia, Special Region of Yogyakarta is one of the provinces in Indonesia, has 168 tourism villages in 2023, or almost

61.6% of all existing villages. DIY province is one of the areas that is actively carrying out campaigns for independent waste management, one of which is Guwosari Tourism Village (Seto & Kamaluddin, 2023). Guwosari village is one of the tourism villages located in Pajangan Subdistrict, Bantul Regency (Asih et al., 2022). Bantul Regency is one of the five districts in the Special Region of Yogyakarta. Based on status, villages in Bantul Regency are divided into as many rural villages as possible—41 villages and urban villages (urbanarea) as many as 34 villages. Bantul Regency, too, is part of the Center National Strategic Area (PKSN) (Wahyudi et al., 2022).

Solid waste management is a critical aspect of sustainable tourism development. Proper waste handling ensures that tourist destinations remain clean, attractive, and environmentally friendly. Increased waste production per capita is correlated with economic activities such as population growth, urbanization, and living standards (Wilson & Velis, 2015). Paying special attention to waste problems is very important for the survival of the next generation. Responsible solid waste management plays a vital role in ensuring a sustainable and healthy planet for the coming generations by reducing waste, promoting recycling, and adopting eco-friendly practices. As one of the regencies that is aware of the waste problem, the government of Bantul Regency is trying to develop a solid waste management system by building a mini integrated waste processing site. Solid waste management in Guwosari Tourism Village is managed by BUMDes Guwosari Maju Sejahtera. BumDes created a solid waste management service business unit by constructing TPS 3R Go-Sari in 2019. In 2024, the service area will have covered 550 families, up from 125 families in 2019. TPS 3R Go-Sari is one of the best BUMdes programs (Minardi, 2023). BUMdes initiatives play a crucial role in local development, economic empowerment, and sustainable practices. TPS Go-Sari likely involves active participation from local residents. Collaboration between community members fosters a sense of ownership and shared responsibility. We discuss about eksisting condition of solid waste management in Guwosari Tourism Village. We identifies solid waste management problems related to TPS 3R Go-Sari.

## 2. Methods

The research location is in the village of Guwosari. Guwosari Tourism Village is located in Kapanewon Pajangan, Bantul district, Yogyakarta Special District Province (Minardi, 2023). The village territory on the north side borders Bangunjiwo Village; on the east side is bordered by Ringinharjo Village; on the south side is bounded by Wijirejo and Sendangsari Village; and on the west side is bordered by Sendangsary Village. Map TPS 3R Go-Sari in Guwosari Tourism Village.

This paper used the literature from Guwosari Village Law No. 5 of 2019, the Central Bureau of Statistics (BPS), official government website, and Google Scholar databases. The Guwosari Village Law No. 5 of 2019, the Central Bureau of Statistics (BPS), and official government website database covered the white literature, while the Google Scholar database covered the literature published in national journals. This approach was conducted to get better coverage, especially within the national context of Indonesia. The retrieved articles were published during the period from … to …. The literature was retrieved by using the keywords “environmental sustainability,” “tourism village,” “solid waste management system,” and “TPS 3R,”. Article selection was conducted using the PRISMA protocol (https://prisma-statement.org/). The first selection was conducted by reading the titles and abstracts. Only literature that fit the criteria was included in the further process.

The criteria for the first selection were the context of the literature that fits the purpose of this paper. The publication year was not used for selection criteria since the present study attempted to cover all available literature about sustainable solid waste management. Therefore, some of the old literatures were included in the paper. The second selection was conducted by deep reading the content and arranging it into the table. The second selection

criteria were based on eligibility. 150 papers were filtered, and 32 papers were reviewed and used in the present study.

## 3. Results and Discussion

### *3.1 Municipal solid waste*

Municipal Solid Waste (MSW) is defined as solid waste, which comprises all household garbage as well as non-hazardous wastes such as construction debris, business and institutional wastes, and street sweeping (Magutu et al., 2010). Waste collected from homes, businesses, schools, workplaces, and retail establishments is known as MSW. Cardboards, newspapers, cartons, fruits, vegetables, furniture, leftover food, papers, clothing, organic material, and non-renewable goods like tin and plastic containers are some examples of these wastes. MSW is defined as any materials that are unwanted, needless, and abandoned as a result of society and everyday activities. MSW does not include industrial, radioactive, or medical waste. Wastes of these types are handled differently (Subramani & Murugan, 2014).

### *3.2 Municipal solid waste management*

The methodical, ecologically conscious process of reducing, and handling garbage is known as waste management (Asih et al., 2022). Waste management is necessary to recover resources and lessen the negative effects of waste's non-gradual accumulation on the environment and human health. Waste materials are collected, transported, processed, recycled, disposed of, and monitored. Waste management is a set of actions and strategies to reduce the negative effects that waste buildup has on people's health and the environment. These tasks include gathering, classifying, transporting, and processing waste (either with or without energy recovery) (Kaur et al., 2023).

Using the waste management hierarchy as a guide is the best approach for managing solid waste. The following are included (Subramani & Murugan, 2014): (1) Waste minimization or reduction, which is the practice of preventing waste from entering the waste stream by means of product reuse and prioritizing waste reduction above all else. (2) Reusing resources. (3) Recycling is the act of removing recyclable materials from waste, such as paper, metals, plastic, and glass, and repurposing them for new uses. Biodegradable waste components are composted as part of biological processing. converting biodegradable garbage into compost. (4) Waste incineration, either with or without energy recovery.

Indonesia is an archipelago made up of thousands of islands. The complexity of solid waste management in Indonesia is rising due to urbanization and community agglomeration in urban regions. 'Collect-transport-disposal' garbage management is still a common practice in Indonesian cities. In general, well-organized waste management that is integrated from upstream to downstream with a "cradle-to-grave" perspective, taking into account potential aftereffects, is the way to solve sustainable waste management. The implementation of sustainable solid waste management necessitates the dedication and cooperation of all relevant parties. The goal of good environmental governance is to promote sustainable solid waste management while simultaneously improving environmental conditions. It is a dynamic and complicated concept (Fariz et al., 2024). Unpleasant odors, the spread of illness, and groundwater contamination are just a few of the harmful effects that improper solid waste management can have on the environment and public health (Ogundele et al., 2018).

### *3.3 Policy of solid waste management*

At the national and regional levels, waste management is already regulated in Indonesia. Law No. 18 of 2008 on Waste Management and Regulation No. 03 2013 of the

Minister of Public Works of the Republic of Indonesia on The Provision of Facilities and Infrastructure to Handle Domestic Waste and Domestic Waste Equivalents are the two national laws that govern waste management. Regional Regulation No. 3 of 2013 on Management of Domestic Waste and Governor's Regulation No. 21 of 2014 on Guidelines of Waste Management, Licensing for Waste Management Businesses, and Environmental Compensation are just two of the provincial regulations that apply to DIY projects. Bantul Regency Regional Regulation No. 2 of 2019 on Management of Domestic Waste and Domestic Waste Equivalents is in effect at the regent or city level (Setyawan, 2023).

### *3.4 Tourism village*

One of Indonesia's main sources of foreign exchange earnings is the country's tourism industry. According to the Ministry of Tourism and Creative Economy (Kemenparekraf), a tourism village serves as a platform for regional development and community empowerment by showcasing attractions, traditions, and local wisdom to visitors. To promote village development and community welfare, the Indonesian government creates tourism villages. The government has also made an effort to force revenue distribution to the community. According to Artana and Irwanti, 2013, Sukariyanto, 2015, tourism villages represent a form of rural development that combines attractions, accommodation, and supporting facilities within the structure of community life (Rozdianda & Gultom, 2024). Based on the Pedoman Identifikasi Daya Tarik Wisata by Pujaastawa & Ariana (2015), a tourism village, usually called Desa Wisata, is a village that offers a complete rural experience along with natural landmarks, customs, and distinctive features that collectively draw visitors.

Village Law No. 6/2014 has provided assistance for the development and empowerment of the village. This law gives the villages the ability to oversee tourism and reap financial and social rewards for their rural areas (Purnomo et al., 2020). The law also encourages direct community involvement in development initiatives, such as tourism-related ones. The environment, socioculture, and economy are all incorporated into the idea of a tourism village (Dangi & Jamal, 2016). The goal of tourism villages is to empower rural communities and support local government. Tourism villages have a distinct quality that draws visitors who are looking to expand their knowledge, comprehension, and skill set. Other industries, including housing, transportation, the arts, and MSMEs, are also strongly tied to the tourism sector. Due to the direct involvement of rural communities in the development of tourism villages, Desa Wisata has a major economic influence on the community. The idea of a tourism village is to have the community take the lead in developing tourism within the village.

First of all, village tourism encourages the locals to be more welcoming to tourists. The more welcoming the community is, the more accepting and understanding of other cultures there will be. While maintaining local values, the community also learns more about tourism services and becomes more skilled in providing them. The village's potential and human resource competencies will be made known to the village community. Every tourism village in Indonesia exhibits varying supply and demand conditions. On the supply side, factors influenced by tourism potential, such as natural, cultural, and man-made attractions, come into play. On the demand side, it is the perceptions and needs of tourists or visitors to these tourism locations that matter (Formica & Uysal, 2006). The execution of tourism development involved everything from fundamental infrastructure to tourism management with connections to local businesses, the private sector, and the government. The village's basic tourism infrastructure can be expanded to include safe travel accommodations, homestays, road infrastructure, and transportation availability. Tourism management has emerged as a crucial structure and regulation for tourism settlements. Village-owned businesses, youth organizations, tourism awareness groups (Kelompok Sadar Wisata), etc., can manage tourism in their communities. Depending on the needs and culture of the village, the management organizations in the villages are typically varied. The management

of the tourism village incorporates well-developed environmental ecosystems into the local economy.

### *3.5 The Guwosari tourism village*

According to The Law of The Guwosari Village, Pajangan Sub-District, Bantul District Number 5 of 2019 Regarding The Medium-Term Development Plan Of Guwosari Village For The Period 2018 - 2024, the Guwosari Village was formed from the combination of two villages, Selarong and Iroyudan on the order of the Governor of Yogyakarta Special District in October 1947. The name Guwosari was chosen as the middle way so that the entire community could be accepted without eliminating the region's icon, the Selarong Gua or the Secang Gua. The name of Guvosari itself became another name of the area or the region called Selarung because the name Selaronga during the Java War encompassed the entire Guwosari Village even to its surrounding desades.

The name Selarong is derived from the name of Prince Aryo Selarung, the son of Chakra Hanyokrowati or Prince Sedo Krapyak, the second King of the Mataram Sultans of the Wife of the Empress I (Kulon), the King of Ayu. It is not known whether the younger name is RM. Wuryah or 14 RM. Chakras, because they both have the same title, the Prince of Aryo selarong. But it's possible they're the same person. It is believed that the name Iroyudan is derived from the name of Kyai Ageng Wiroyudo, Major Commander of Sultan Hamengkubuwono I and also Grandfather of the Queen's Wife Sultan Hamenkubuwano I. However, in ancient maps, the map of the War of Java, the village of Iroyidan is not written, appears to be part of the territory of Selarong.

According to The Law of The Guwosari Village, Pajangan Sub-District, Bantul District No. 5 of 2019 Regarding The Medium-Term Development Plan Of Guwosari Village For The Period 2018 - 2024, Guwosari Tourism Village which belongs to the Kalurahan of Guwosari, Kapanewon Pajangan, Bantul district, DIY Yogyakarta which is an integral part of the territory of the district of Bantul which consists of 75 (seventy-five) villages. The village is located in the Pajangan district, which has an area of 830 Ha, a population of 12.745 person The village is administratively divided into 15 Pedukuhan and 77 Households (Rumah Tangga/RT). The list of name 15 Pedukuhan are Kembangputihan, Kentolan Lor, Kentolan Kidul, Gandekan, Dukuh, Iroyudan, Kadisono, Kembanggede, Karangber, Santan, Kalakijo, Kedung, Bungsing, Watugedug and Pringgading.

Guwosari Village features diverse areas shaped by their distinct functions and local potentials. The agricultural zone includes Gandekan, Dukuh, and parts of Kembanggede and Santan, focusing on farming activities. The village's administrative center is located in Iroyudan, home to the Guwosari Tourism Village Hall and the core of governmental affairs. Various handicrafts thrive in different parts of the village—Santan is known for its stone crafts, Kentolan Selatan for traditional blankon making, Watugedug for sculpture, and Pringgading for wooden crafts. Kalakijo has also begun developing batik as a new creative endeavor. The culinary tourism area, centered around Ingkung dishes, spans Karangber, Santan, Kalakijo, and Kentolan Lor. As the pioneer of culinary tourism in the region, it has inspired neighboring areas to follow suit. Currently, fifteen culinary stalls actively contribute to strengthening the local economy. The farming sector is concentrated in Bungsing, an area well-known for its poultry farms and chicken trade.

The Guwosari Village is one of the tourism villages in Bantul district located in Pajangan district so we can called it "The Guwosari Tourism Village". The diverse potential of the village makes the community around it more innovative to improve the tourism that exists in the Guwosari Village at the same time supporting the economy of the community. The village of Guwosari itself already has several tours that have become reliable to attract the tourists, for example, Goa Selarong (Selarong Cave), culinary tours of Ingkung Kuali, Pancuran noni-noni, and the spring of the Santen well. Goa Selarong is a historic site (Wulandari et al., 2023) that tells how Prince Diponegoro fought during the Java War in 1825-1830 and it is the Cultural Reserve in Bantul District (Wulandari et al., 2023). There are two caves in the Selarong Cave, namely Goa Kakung (Kakung Cave) occupied by the

Prince Diponegoro, and Goa Putri (Putri Cave) occupied with his wife named Raden Ayu Retnonongsih.

a) b)


Fig. 2 (a) Goa Selarong; (b) Ingkung Kuali

When visiting the Guwosari Tourism Village, it is advised to try the chicken inkung that is a reliable food in this village. The Guwosari Tourism Village is famous as the center of chicken inkung in the Bantul district. There are at least 18 chicken farmers managed by both the staff and the village community marketing agencies (LPMD). One of the most famous remains of chicken inkung is the Warung Inkung Kuali. Ingkung itself is a chicken that is cooked with areh spice and served whole and is served with rice, sambal (traditional chili sauce), and vegetables.

In addition to some of the tourist attractions mentioned above, there is a new tourist attraction in the Guwosari Village which is Jati Banned Tourist Park located in Dusun Iroyudan. This park is one of the best programs of Lurah Village Guwosari Masduki Rohmad, S.I.P. where every Dusun is required to make one best. Then, on the meeting attended by the chief of state, RT, RW and local residents, the site was finally formed as a tourist destination, the Park of Jati Forbidden, because at that time tourism became the most prominent sector among the people. Place the Jati Larangan Tourist Park by chance next to a grave that has a historical story, so it will be a religious tourist spot. The tomb is the tomb of Mbah Wiroyudho, which is why it is called Dusun Iroyudan. The chief of the Iroyudan Dusun, Muhammad Hisyam (45) stated from his explanation that Mbah Wiroyudho was a friend of war of Prince Diponegoro and was a practitioner of the Keraton of Ngayogyakarta Hadiningrat.

Guwosari Tourism Village can still be developed because in addition to its strategic locations (Wulandari et al., 2023). The village is only about 15 km from Yogyakarta or just 3 km from Bantul city centre and very easy to reach by motor vehicle. The location is easy to find: from Jogja City, take the direction of Bantul Road until you find the Great One Mosque, then take the right and then follow the directions to the town of Pajangan. The village also has a variety of tourist potential such as natural tourism, historical tours, food security tours, educational tours and culinary tours. It is supported by the village government, the presence of pokdarwis, BUMDes and local communities (Wulandari et al., 2023).

Many regions' economies can support high levels of employment and income due to tourism. Nonetheless, the industry contributes to resource consumption and environmental effects, which have an adverse effect on public health. Based on the Environment and Tourism Book by Holden (2008), the generation of municipal solid waste (MSW) is one of the tourism industry's most significant effects. This tendency, where MSW increases as the seasonal population of the tourist places or regions rises, has been documented in numerous studies (Lloréns et al., 2008; Shamshiry et al., 2011; Teh & Cabanban, 2007). As a result, it is crucial in these locations to gather, transport, process, and ultimately dispose of the MSW in a way that is both economical and environmentally friendly (Chen et al., 2005).

### *3.6 Municipal waste management in Guwosari Village*

The population of the Guwosari Village in 2018 was 12.754 people and if a waste generation rate assumption of 0.4 kg/capita/day, the estimated waste generation in Guwosari Village is 5.101,6 kg or 5,1 tons/day. The source of MSW came from household, farming, industrial, school, traditional market, tourism etc. The huge amount of MSW produced by the Guwosari tourism village should be of concern to the entire government and villagers.

The village of Guwosari is one of the independent villages and was once named by the Government of the Yogyakarta Special District as the best village of Yogyakarta. This is due to the tourist potential it has, the independence of the village government and the community, as well as its seriousness in the handling of MSW (Setyawan, 2023). The Municipal Solid Waste handling is a serious concern of the Guwosari Kalurahan Goverment. According to The Law of The Guwosari Village, Pajangan Sub-District, Bantul District Number 5 of 2019 Regarding The Medium-Term Development Plan Of Guwosari Village For The Period 2018 - 2024 that Lurah's vision for the next six (6) years is "the realization of a democratic Guwosari Tourism Village government to make the village community religious, healthy, intelligent, independent, and culturally based on the assets and potential of the village".The word "healthy" means the Guwosari people who have physical, spiritual and social health and are the guidelines for the village to deal with garbage seriously. The fourth mission is to environmentally-conscious and sustainable development to ensure the harmonization of ecological, economic, social and cultural spaces (Minardi, 2023).

Municipal solid waste management in Guwosari is managed by the Badan Usaha Desa or Kalurahan (BUM Desa/BUM Kal) Guwasari Maju Sejahtera which has been in existence since 2016. BUM Village has several business units but the only outstanding business unit is Go-Sari which was established in 2019 for managing garbage. It was said to be successful because it was able to attract the attention of the province and support a budget of 1.6 billion from the Dana Keistimewaan (Danais). Paniradya Kaistimewan saw that Guwosari was able to combine the local wisdom of Java, namely, Memayu Hayuning Bawana with the environment in the handling of garbage. Making MSW doesn't burden the pitch, but it's pretty much finished at the end level (Minardi, 2023).

The handling of MSW in Guwosari Village has taken commendable steps toward independent solid waste management. They established a Zero Waste initiative through the creation of a 3R Waste Processing Site (TPS 3R) called Go-Sari. This TPS 3R was established in November 2019 by the Bum Desa Guwasari Maju Sejahtera (Minardi, 2023). The head of the MSW Unit of Guwosari BUMDes, Mr. Muhammad Nur Muntaha, said that the presence of the Go-Sari TPS was the aspiration of the Lurah of the village and the village community to dispose of the garbage. Although previously there were two Self-Managing Waste (PSM) in Guwosari with the number of customers around 2.000 families of the total number of families in the Guwosari Village a total of 4.000 households. The number of customer of TPS 3R Go-Sari is 550 households (Minardi, 2023) so it can be said that already 2550 households in village of Guwosari managed the garbage well and 1500 households is still all kinds of handling of the waste (HumasDIY, 2024).

TPS 3R Go-Sari processed MSW approximately 1 ton of waste per day and transformed into valuable resources (Minardi, 2023). If We compared with the estimation of the daily amount of MSW in Guwosari village of 5,1 tons, the amount of waste processed in TPS 3R Go-Sari is about 20% of the total waste generated. It should be the concern of the Guwosari Government to be able to increase the waste processing in TPS 3R Go-sari, in particular the quantity of waste that can be processed.

The waste processed facility in TPS 3R Go-Sari focuses on sorting, composting, and collecting recyclable items. Guwosari's approach is transformative. Instead of viewing waste as a problem, they see it as an opportunity. Villagers actively participate in waste separation at the household level. Items like plastic, organic waste, and inorganic materials are sorted. Some waste is converted into maggots (used for various purposes), while recyclable plastics are sold. The sorting process of MSW at TPS 3R Go-Sari is carried out by

grouping the garbage into 4 types, i.e. bosok, rongsok, godog and popok. Each of these types of waste will be treated using its own waste treatment method which will be described as follows (Minardi, 2019). Flow Chart of MSW processing can be seen in Figure 3.

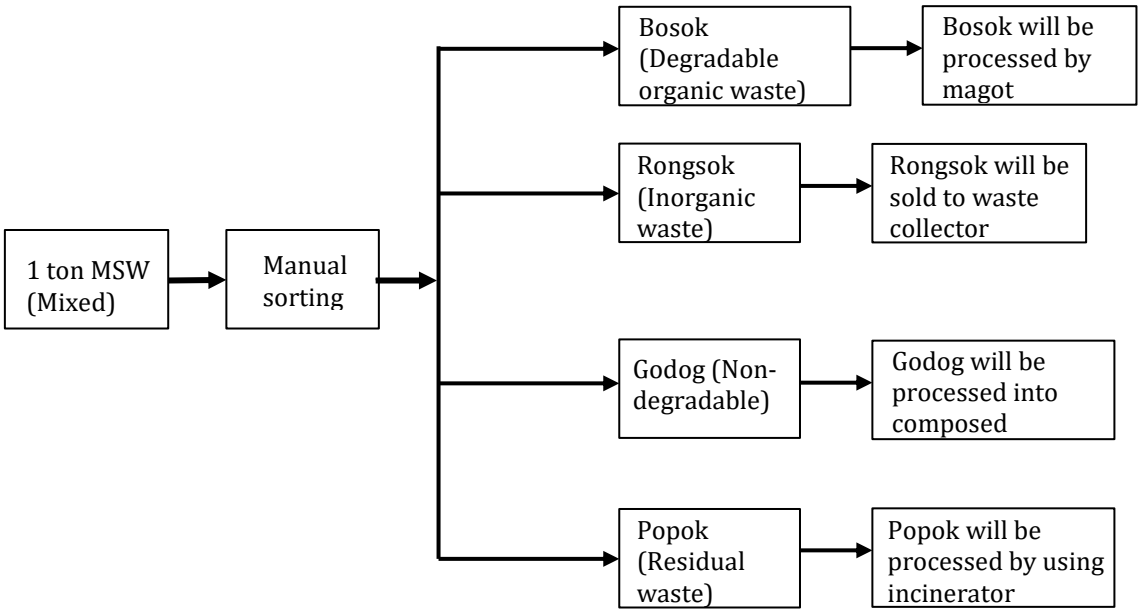


Fig. 3. Flow chart of MSW processing at TPS 3R Go-Sari

*3.6.1 Bosok or degradable organic waste*

Degradable organic waste containing high nutrition can be processed into animal feed at a low cost. As an animal feed, maggot has a function as a protein source that can substitute for animal meal. Maggot is a Black Soldier (*Hermetia illucense*) insect larvae that can convert organic material into its biomass. Maggot BSF has the Latin name Hermetia illuciens L, which belongs to the flies' sister (family Diptera), whose body resembles a bee, is black and has a length of 15-20 millimeters (Masrufah et al., 2020). This method can decompose organic waste in a short time, reduce odors, and be sustainable. The processed product of maggot bioconversion is animal feed with a high protein source. BSF larvae can be sold directly by the community to customers (e.g. reptile breeders or bird markets), made into pellets to be more profitable. This circular economic process involves the community in maggot cultivation and organic waste collection. Maggot can solve four main problems, namely: the generation of organic waste by degrading organic waste in a short time, the price of a high protein source by producing sustainable protein sources, increasing demand for animal feed by producing healthy feed of good quality; and improving the economy of the community (Wulandari et al., 2023). The growing media used by the maggot for its growth comes from organic or household garbage from the village community of Guwosari who subscribed to the garbages at the TPS and for the medium to grow itself it is not necessary to be processed first because later maggot can process or disassemble its own legs (Annisa & Maula, 2022). At TPS 3R Go-Sari, the organic waste processed is 150 kg of waste per day, resulting in 40-50 tons of maggots.

Inorganic waste that has economic value, usually called "rongsok," is sold to waste collector. It encompasses various types of inorganic waste materials that are no longer useful in their original form. Common examples of rongsok include broken household items, discarded electronics, old furniture, metal scraps, plastic containers, and other materials that can be salvaged or recycled. Godog or non-degradable organic waste is organic waste that cannot be processed with maggot, then will be processed into compost for example leaves and branches. The resulting compost is not economically valuable so it is only used to fertilize the soil in the less productive Guwosari Kalurahan.

Popok or residual waste includes waste material that was neither recycled nor reused. It encompasses items that were not collected separately for recycling or composting/digestion. Residual waste is dominated by diapers, wrappers, fabrics, clothes, and masks, which will be disposed of using two incinerators, each with a capacity of one ton per day. An effective way to reduce waste and produce excess electricity for personal use is through incineration, which also converts thermal energy into electrical energy. This makes incineration a promising method for treating waste (Febijanto et al., 2024).

There are 12 staff who work at TPS 3R Go-Sari to handle a ton of garbage every day using waste transportation vehicles. Training of trainers (ToT) was carried out for 12 waste sorting workers at TPS Go-Sari. The goal of involving the marginals is to empower the marginal peoples of the village by providing relatively light and competent jobs but providing a clear income (Minardi, 2023).

As a BUMDes business unit, TPS 3R Go-Sari is used to make a profit from the fee paid of gargabe that is imposed on the community. The amount of fee paid of collection gargabe charged to the community varies, for example households of IDR 30.000/month, pubs or dining houses of IDR 50.000 / month, reception cottages, schools, and educational parks of Rp 250,000/month. In addition to the repayment of garbage, the profit is derived from the activities of the sale and sale of waste, which still has an economic value, so it requires accuracy in the sorting of waste because it will increase the value of the waste. Then sales buy maggot with a profit between IDR 7.000 to IDR 10,000/kg (Minardi, 2023).

## 4. Conclusions

Because of the extremely limited capacity of the Piyungan Landfill for disposing of waste and the need to preserve this capacity for the future, landfilling is significantly more harmful to the environment than sustainable solid waste management, which has lower greenhouse gas emissions, higher potential for energy recovery, and less pollution. Landfills provide a permanent geological repository for garbage, but they also present environmental risks related to air pollution, groundwater pollution, global warming, and health effects. garbage minimization has been practiced, encompassing source reduction and recycling, leading to a decrease in solid municipal garbage over the previous two to four years. Sustainable solid waste management ought to be in line with a society's financial resources as well as the assimilation potential of the surrounding ecosystem. Thus, it is essential to handle solid waste in a sustainable manner. In order to put the zero waste idea into practice, a program for the separation of household solid waste at the source was held in 2019. The features, contents, and variability of the generated waste must be identified for sustainable solid waste management in a tourism village.

Bosok, Rongsok, Godog, and Popok are the four categories of Go-Sari garbage in Guwosari Tourism Village, according to the solid waste management policy implemented for the village's environmental sustainability. Waste transportation vehicles are used every day to collect waste. Maggots are used in the composting process at a 3R Waste Processing Site (TPS 3R) in Go-Sari. From a systematic standpoint, three areas—better system status investigation, stakeholder coordination through needs analysis and role and responsibility agreements, and system planning that takes into account the circumstances of the situation—receive insufficient attention at the moment and should be further addressed. In the meantime, non-technical elements include the potential for ecotourism, local food, crafts, and community empowerment. Evaluating the relationship between the solid waste management system and the environmental impact that aided in the expansion of the research will be fascinating. It will assist in locating a long-lasting system.

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## Author Contribution
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