

## Implementation of Sustainable Waste Management with the Zero Waste Concept Towards a Banyumas Eco-City

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### Abstract

*Sustainable waste management is an important aspect of building an environmentally friendly city. Banyumas, a district in Central Java, Indonesia, has taken steps to implement sustainable waste management towards Banyumas Eco City by implementing the zero waste concept. The Zero Waste concept is not just about recycling but rather a completely transformed resource and waste management system. The aim of this research is to analyze and evaluate the implementation of sustainable waste management in Banyumas, as well as its impact on the environment and local communities. This research methodology uses a qualitative approach. The results of this research show that Banyumas has implemented various strategies for sustainable waste management. One of the steps taken is public education and awareness about the importance of good waste management. Programs such as distributing rubbish bins, campaigns to reduce the use of single-use plastics, and training on organic waste processing have been carried out by local governments and environmental institutions. Apart from that, Banyumas has also developed adequate infrastructure for waste management. This includes the construction of a modern final disposal site (TPA) with adequate sanitation, as well as waste sorting and recycling facilities. Implementation of environmentally friendly technology, such as the use of renewable energy in waste processing, has also been carried out. The impact of implementing sustainable waste management in Banyumas has been seen. Environmental quality has improved, with significant reductions in air and water pollution. Apart from that, local communities also experience economic benefits, such as new job opportunities in the waste management sector.*

*Keywords: Management, Banyumas, Zero Waste, Eco-City.*

### A. Introduction

The world is currently facing major environmental problems, namely the issue of global warming and climate change. Accumulation of waste that is not managed properly is the cause of this environmental problem (Sholihah, 2020). Waste that is not managed properly is a serious challenge in efforts to create a sustainable environment. The negative impact that arises from unmanaged waste is not only on the environment but also has an impact on human health. Banyumas, as one of the regions that cares about waste processing, has become the best example of implementing sustainable waste management.

It is important to implement good waste management by educating the public in managing waste well, not only by breaking it down but by making it part of people's daily lifestyle.(Andini et al., 2022). Production and consumption activities carried out by the community need to be accompanied by sustainable waste management. This is also influenced by several factors such as physical environmental characteristics, population density and distribution, and socio-economics. Waste that is managed well and sustainably becomes the community's potential in the economic sector as well as being a means of improving the economy of the surrounding community.

Sustainable waste management implemented with the progressive Zero Waste concept in Banyumas brings new hope for the future of this city's environment. Banyumas' efforts to become an Eco-City or a city with a sustainable concept that is environmentally friendly and able to maintain a balance between meeting human needs and preserving nature is carried out through this approach. The implementation of the zero waste concept in Banyumas has produced positive impacts, including reducing the amount of waste produced, optimizing the use of resources, and minimizing negative impacts on the environment (Sholihah, 2020). The Zero Waste concept not only emphasizes reducing waste, but also focuses on reuse, recycling and waste composition to reduce the environmental footprint (Widiarti, 2012).

Cooperation from all aspects and related parties as well as adequate legal regulations, are needed for sustainable waste management. One of them is implementing appropriate technology in sustainable waste management training, which is expected to increase public awareness to play an active role in waste management (Andini et al., 2022). Planning for training programs that teach practices in environmentally friendly organic and inorganic waste processing is also carried out by the company because it is an implementation of SDGs-12 (Salemdeeb et al., 2021).

The basis for preparing a sustainable waste management plan in Banyumas Eco-City is the Regional Medium Term Development Plan (RPJMD) and Banyumas Regent Regulation Number 32 of 2022. The existence of these regulations certainly shows that implementing sustainable waste management is part of the regional government's efforts to achieve sustainable development goals. Banyumas has created a sustainable, clean and

healthy environment through innovative policies and programs. Optimizing the use of resources is carried out with an approach that focuses on reducing waste at the source, reusing items that are still suitable for use, and recycling.

The approach in the Zero Waste concept involves the role of all elements of society, from individuals, families, communities, and businesses, to local governments (Birkin et al., 2021). Efforts to ensure the success of this program require the active involvement and participation of all parties. The cooperation of all parties and strong commitment give hope for Banyumas to become an example for other cities in Indonesia in managing waste and becoming a sustainable city.

## **B. Literature Reviews**

### **1. Management**

Management is an activity or process carried out to utilize resources effectively by arranging, managing and supervising to obtain optimal benefits (Kuncoro, 2004). Management can refer to various areas of management such as natural resource management, organizational management, or project management. Currently, the environmental issue that is hotly discussed by the public is waste management. Along with population growth and human activities, the volume of waste produced continues to increase. With the increase in the volume of waste produced, there is a need for sustainable waste management methods.

Through 3R (reduce, reuse, recycle) waste reduction can be implemented with several recycling programs that focus on waste management. To reduce the volume of waste disposed of in final disposal sites (TPA) to a percentage of 20%, a recycling program for inorganic waste such as plastic, paper and metal is carried out. To produce useful compost, it is necessary to manage organic waste by composting organic waste at the home ladder (Rosnawati et al., 2018).

To reduce the volume of waste while producing energy that can be used sustainably, modern incinerator technology is starting to be used. Handling of remaining waste using methods that require sanitary landfills (Wong et al., 2022). The involvement of the government, private sector and community influences integrated waste management. Community participation: Through waste banks and 3R household efforts,

community participation is the key to the success of waste management programs. The hope is that waste management can contribute to sustainable development using a comprehensive approach.

## 2. Rubbish

Garbage is waste in the form, type and composition found in the environment and is influenced by community culture and the natural conditions of an area (Budi Setianingrum, 2018). Waste management methods in developed countries have been regulated with discipline in sorting waste with the aim of reducing existing waste generation so that it is easier to group, organize, and match. However, waste separation methods in developing countries do not proceed as planned. This is because when people throw away their waste, they still mix organic, inorganic, and metal waste together, making handling difficult.

Waste is a serious environmental problem throughout the world considering that the impact of poor waste management can damage the environment. The sources of waste, its impact on the environment, and the efforts that have been made to manage and reduce waste are important aspects of waste. Waste comes from several sectors, namely the household, industrial, agricultural and public sectors. Waste generated from the household sector consists of food waste, paper, plastic, and metal. The industrial sector is the sector with the largest waste contributor compared to other sectors, which includes production waste and raw material waste. The agricultural sector produces organic waste, such as plant residues and fertilizers which are beneficial for this agricultural sector. Apart from that, in the public sector the waste produced is medical waste and construction waste.

## 3. Zero Waste Concept

The Zero Waste concept is an approach that has received special attention in recent years to reduce the environmental impact of waste production. Zero waste is an activity that is part of a lifestyle carried out with the aim of eliminating waste through recycling and adopting a resource-saving lifestyle (Adquisiciones et al., 2019). Research that focuses on implementing zero waste in industry and supply chains was carried out by (Shah et al., 2021) shows that a very significant reduction in industrial waste is influenced by

product design that considers recycling and dismantling. The same opinion was also expressed (Adesina, 2021) which analyzes how circular supply chains can support the principle of zero waste through the reuse, repair, remanufacturing, and recycling of products and packaging.

The implementation of household-scale waste banks and composting at the community level has been proven to reduce the generation of waste sent to final disposal sites (Adebayo & Areo, 2021). Changes in people's behavior through a zero-waste lifestyle, such as using recyclable packaging, are necessary to change people's behavior (Awasthi et al., 2021). The zero waste concept as a whole offers a new paradigm in waste and waste management. For this reason, collaboration between various stakeholders and wider community participation is needed to apply this principle in practice to create a sustainable environment.

### **C. Research Methods**

The type of research used in this research is qualitative research with case study methods and evaluative descriptive methods. The qualitative approach is carried out with a mathematical assessment, namely that the value measure used is not a number or score but rather the quality of the data. This qualitative approach is in line with the characteristics of the research method chosen, namely descriptive evaluative. This is because the descriptive method is a way of research work to describe or explain the condition of an object (reality or phenomenon) in accordance with the conditions and situations that actually occur when the research takes place.

The Evaluation Method is an evaluation of a program as a scientific method used with the aim of determining the efficiency and effectiveness of a particular program, policy, project and activity, whether it has occurred, is currently occurring, or proposed future programs (R. Yusuf, 2021). Data collection was carried out in this research through observation, interviews, and documentation studies. Apart from that, this research was supported by library research in order to obtain data or information with the help of libraries such as books, notes, documents, and other references, in determining informants using the purposive sampling method.

The purposive sampling method is a way of taking data sources or informants in a study with certain considerations. The purpose of certain considerations in determining the source of research data is that the informant must have an understanding and information regarding the problem or research object so that this can make it easier for researchers to obtain information or data. Key informants include environmental services, academics, the business world, the community, and the general public. The data obtained was then analyzed to formulate appropriate steps to implement a zero-waste program for Banyumas City.

## **D. Results and Discussion**

### **1. Zero Waste Concept**

The zero waste concept is an effort made with the aim of minimizing waste, starting from the waste production process until the end of production. The regional scale urban waste processing technology system is implemented in this zero waste concept so that it can reduce the volume of waste as much as possible and create a small industry from waste management. Waste management with the zero waste concept is oriented towards an integrated waste processing system, technology used in composting, recycled plastic and paper waste, waste incineration technology, organic waste which is processed into animal feed using technology, technology in final waste disposal sites, the role of community in handling and managing waste, processing waste in metropolitan cities, and implementing recycling efforts.

According to (Widiarti, 2012), the concept of zero waste was first used by Palmer in 1973 as a term used to recover resources from chemical waste. The concept of recycling was first introduced in America in 1960 and lasted until 1970. In the 1980s and early 1990s, when the landfill agreement was implemented, the recycling movement continued to develop. However, recycling is not a real alternative to disposal, so in the end the term "total recycling" was coined. As a solution to waste management, zero waste is one of the most visionary concepts in solving the waste problem. This is because the aim of the Zero waste concept itself is to reduce waste thrown into landfills and incinerators as well as local economic development with the aim of building healthy and sustainable cities.

Gratissari in Yunarti (Andini et al., 2022) defines the zero waste concept as an integrated waste management concept which includes the process of reducing the volume of waste generated. The objectives of implementing the zero-waste urban waste concept as a whole are:

- 1) Extending the life of final disposal sites by reducing the volume of waste generation that must be disposed of in landfills.
- 2) Predicting increasingly limited use of landfill sites.
- 3) Optimizing limited waste transportation facilities.
- 4) Reduce transportation costs to landfill.
- 5) Increasing the active role of the community.

Waste management with the zero waste concept is the first preparatory stage, namely, the waste collected from residents is immediately sorted based on the material and then stored at the holding post. These holding posts are divided based on the type of waste, including organic waste, paper, plastic, metal, and bottles. After passing the preparation stage, it continues with the processing stage. Organic waste that has been sorted is then processed into fertilizer (compost), while inorganic waste materials that can be recycled are then processed into recycled products. Meanwhile, inorganic waste such as glass bottles that cannot be reprocessed, is collected to be processed as needed.

The remaining waste that cannot be recycled and can no longer be used as a trading commodity is processed by burning at this last stage. With the zero waste concept, in general, no waste is produced because this system uses a comprehensive material recycling system approach. Zero waste is a concept that aims to reinvent industrial and urban systems so that all products can be reused, repaired and recycled sustainably without damaging the environment.

The application of the zero waste concept is not just recycling but rather a completely transformed resource and waste management system. In recent years, the concept of zero waste has received attention as an approach to reducing the environmental impact due to increasing waste production. The aim of the zero waste concept is to redesign industrial, business and societal systems so that all products can be used, reconstituted and returned safely to nature without creating waste, this is a holistic approach (Rahardjo, 2010). To significantly reduce waste generation and create a

sustainable material flow system, the zero waste concept is believed to be able to handle this problem by applying the principles of reduce, reuse, recycle, and restore. It has been proven that several cities in the world that implement the zero waste concept, such as San Francisco, Kamikatsu (Japan), and Capannori (Italy) have succeeded in implementing this concept by reducing waste to landfill by up to 80% through recycling and material recovery.

Cities that have implemented the zero waste concept in managing waste sustainably have 7 main parameters in the zero waste concept, namely geo-administrative, socio-cultural, environmental, economic, organizational, government and policy. In designing a city with zero waste principles, a holistic approach is used in managing waste sustainably. The ability of the local context and global market conditions to show maximum zero-waste adaptation and regional identification is the key to implementing a zero-waste strategy.

## **2. Implementation of Sustainable Waste Management**

Sustainability is a term that is widely used in various fields, including waste management. Sustainability in waste management is a step that is carried out continuously with the aim of meeting needs and making life more meaningful (Riali, 2020). In other words, sustainable waste management actually has an impact on the survival of many people. There are four criteria for assessing the sustainability of waste management, namely environmental desirability, economic optimization, community acceptance, justice, and administrative provisions. In various countries in recent years, efforts have been made to reduce the amount of waste with stricter regulations by encouraging source reduction, reusing waste that can still be used and recycled, and producing energy from waste.

The regulations made by the government in an effort to reduce the amount of waste are in line with an educational approach. The government has introduced strict regulations regarding waste sorting even at the household level. The way to do this is by providing separate waste containers for organic and non-organic waste to each household. To maximize this activity, a system is used which is accompanied by a regular collection



schedule and the provision of a more efficient temporary disposal site. As a strategic step in processing non-organic waste, the government is building a modern recycling center.

This modern recycling center is equipped with supporting facilities such as the latest technology for separating, cleaning, and recycling waste, so it is hoped that it can reduce pressure on conventional waste disposal sites (A. Yusuf & Prayogi, 2020). Apart from focusing on regulations for waste processing, the government also empowers the community through a composting program that supports local agriculture with the aim of utilizing organic waste. Then, the government collaborates with the private sector to encourage sustainable practices in the business world. The private sector, in this case the company, is encouraged to take responsibility for the production waste they produce by supporting and implementing recycling programs. The government provides incentives for companies to reduce the use of single-use packaging and switch to environmentally friendly materials.

Strengthening the supervision system in sustainable waste management involves monitoring officers for the Community and Companies in ensuring the implementation of waste sorting rules and sustainable practices. If it is violated, sanctions will be imposed, and conversely, if the rules are obeyed, then rewards will be given to those who comply. The impact of implementing sustainable waste management becomes apparent over time (Hidayah et al., 2021). This can be seen from increased environmental cleanliness, reduced contribution to climate change, as well as positive health and economic benefits felt by the community. The implementation of sustainable waste cannot be separated from the concept of sustainable waste management, namely the zero waste concept.

Banyumas Regency is one of the regencies that has succeeded in processing more than 80 percent of its waste. This cannot be separated from the role of the Banyumas Regency Government which is able to handle the waste problem in the form of closing final disposal facilities by residents, which then leads to accumulation of waste in the Temporary Waste Disposal Area (TPS). The Banyumas Regency Government offers a solution to the waste problem it is facing by turning waste into money by implementing the Trash Bear (Trash Turns Money) program. This program was successful because the Banyumas Government, in this case the Regent of Banyumas, did not replace one landfill

with another but instead implemented sustainable waste processing efforts as mandated in Law no. 18 of 2008 by looking for the right waste processing equipment.

The function of the Temporary Disposal Site (TPS) was initially only as a temporary waste collection site but was later converted into a place to process waste, and a Recycling Center (PDU) studio was also provided. From this management, the results of waste reduction have a positive impact on the community because a circular economy has been created in the Banyumas community. This cannot be separated from the role of Community Self-Help Groups (KSM), which process waste starting from sorting processing to turning it into paving, magot, and compost. The results of maggot production per day reach an average of 3.5 tons, which is equivalent to IDR 17,500,000. This waste processing does not just produce maggots but produces Refuse Derived Fuel or alternative fuel to replace coal with an average production of 24 tons per day or the equivalent of Rp. 9,000,000 (detik.com). This activity is an effort made by the Banyumas Regency Government to handle waste in the downstream sector.

Waste management in the upstream sector of Banyumas Regency is almost the same as the downstream sector, namely involving citizen participation by creating the Banyumas Online Waste (Salinmas) and Ojeke Inyong (Jeknyong) applications. The community is given the same opportunity to sell their plastic waste to Community Self-Help Groups by cutting the waste into 5 cm pieces. In terms of infrastructure, the Banyumas Regency Government provides Integrated Waste Processing Sites (TPST), inorganic and organic waste sorting machines, Banyumas Online Waste (Salinmas) and Ojeke Inyong (Jeknyong) applications, Environmental and Education Based Final Disposal Sites (TPA BLE), Recycling Centers Recycling (PDU), a pyrolysis machine for processing waste into Refuse Derived Fuel or alternative fuel to replace coal, and a paving block making machine.

### **3. Banyumas Eco-City**

The zero waste concept is a sustainable waste management concept that includes Eco City criteria (Moustafa Saad et al., 2017). Banyumas Regency is ranked second as the largest district in Central Java Province, with an area of around 68.96 km<sup>2</sup> and a population of more than 300,000 people (Banyumas, 2022). In line with population growth

and economic development, the volume of waste increases from year to year. In 2021, the average daily waste generation in 2021 will reach 180 tons, with a composition of around 55% organic waste, plastic (15%), paper (10%), and other waste (Banyumas DL, 2022). Currently, sustainable waste management is an urgent issue in various regions, including Banyumas. The increasing volume of waste from time to time that is not balanced with management that is not handled properly has the potential to cause environmental, social, and public health problems.

Banyumas Eco City is an environmentally friendly city concept that is planned to be built in Banyumas Regency, Central Java. The aim of the Eco-City concept is the application of sustainable principles in city planning and development (Kuncoro, 2004). The main features that will be implemented in Banyumas Eco City include the following:

a. Environmentally friendly sustainable mobility.

The concept of transit-oriented development where residential areas, commercial, public areas, and public areas promoted in Banyumas Eco-City are oriented towards access to public transportation such as trains and electric buses. Apart from the transportation sector, user-friendly facilities are created for pedestrians and bicycles.

b. Green buildings with an environmentally friendly concept

The buildings that will be implemented in Banyumas Eco-City have green building standards in all their buildings. All materials used are environmentally friendly materials, energy and water use is carried out efficiently and conservatively, and even waste management and green open spaces are carried out optimally.

c. Renewable energy

The energy that will be used in Banyumas Eco City is planned to come from renewable energy such as solar, wind, and bioenergy at least 30%. Not only does it reduce carbon emissions, renewable energy also makes cities more resilient and independent.

d. Integrated Water and Waste Management Installation System

Rainwater and wastewater management will be carried out in an integrated manner through water and wastewater treatment plants with the aim of being able to

be reused as non-drinking water or channeled into rivers after meeting certain quality standards.

e. Smart City Technology

Implementation of smart city technology is carried out to observe, study and regulate various city systems in real-time, such as transportation, energy, waste and sanitation, security, and public services.

In city management with the basic concept of an eco-city, it is called an environmentally friendly city. In other words, it is a city development concept that combines 3 (three) pillars, namely ESD (ecology, economy, and socio-culture) (Putranto et al., 2023). The basic concept of an eco-city is a city built based on the principles of urban community living based on the carrying capacity of the environment. The main goal of many ecological cities with the basic eco-city concept is to eliminate all carbon waste, produce energy entirely through renewable sources, and maintain the living environment for the carrying capacity of a healthy city ecosystem.

One of the main aspects of Banyumas Eco City is environmental protection and restoration (Suyanto et al., 2015). This concept includes various efforts to minimize negative impacts on the environment and maximize the use of renewable natural resources. Examples include the use of renewable energy, such as solar power and biomass, as well as the use of rainwater and waste recycling systems.

Apart from that, Banyumas Eco City also strives to improve air quality by reducing greenhouse gas emissions. One way to do this is by encouraging the use of sustainable transportation, such as bicycles and electric vehicles. This provides an opportunity for the community to play an active role in efforts to improve the environmental quality in Banyumas Eco-City.

## **E. Conclusion**

Banyumas Regency is one of the regencies that has succeeded in processing more than 80 percent of its waste. This cannot be separated from the role of the Banyumas Regency Government, which is able to handle the waste problem in the form of closing final disposal facilities by residents, which then leads to the accumulation of waste in the Temporary Waste Disposal Area (TPS). Waste management in the upstream sector of

Banyumas Regency is almost the same as the downstream sector, namely involving citizen participation by creating the Banyumas Online Waste (Salinmas) and Ojeke Inyong (Jeknyong) applications. Sustainable waste management implemented with the progressive Zero Waste concept in Banyumas brings new hope for the future of this city's environment.

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