



## The Impact of Waste Management and Application of the 3R Method in the Majalengka Heuleut Landfill as a Supplement to Environmental Pollution Material

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### Abstract

Waste accumulation at the Heuleut Landfill, Majalengka, West Java, exceeds its capacity, negatively impacting the environment and public health. The landfill receives over 100 tonnes of waste daily, with each person contributing an average of 0.7 kg daily. Poor waste management has led to soil, water, and air pollution, affecting agricultural yields and increasing health risks for local communities. This study employed a qualitative descriptive approach, collecting primary data through field observations and interviews and secondary data through document analysis. Findings highlight the urgent need for better waste management to mitigate environmental damage. As part of an ecology course, students were introduced to the 3Rs (Reduce, Reuse, Recycle) through interactive Flash Player applications, showcasing waste processing alternatives such as briquette, pulp, and compost production. The positive response from students reflects increased environmental awareness and understanding of sustainable waste management practices. To address the waste crisis, the Heuleut Landfill should serve as a disposal site and implement effective waste management strategies. Applying the 3R principles can help maintain environmental sustainability and improve the welfare of the surrounding community.

## INTRODUCTION

The Earth acts as a complex ecological system where various life forms can survive without artificial intervention. Humans, as the most evolved species, co-exist with other species on the planet. However, continuous human development generates waste, which then becomes a significant environmental problem (Ma & Hipel, 2016) (Vinti et al., 2023) (Herrera-Franco et al., 2024). Waste is one of the common environmental problems, which can be in the form of organic and inorganic waste that is often found around settlements. Indonesia is assumed to produce up to 64 million tonnes of waste per year (Agung et al., 2021). According to information collected from the Ministry of Environment and Forestry (KLHK) in 2022, the total waste production in Indonesia will reach 68.7 million tonnes per year, with the majority being organic waste, especially food waste which accounts for 41.27%. Around 38.28% of this amount comes from households. In addition, organic waste is also the largest contributor to greenhouse gas emissions when not managed properly. Based on the same data, around 65.83% of waste in Indonesia is still transported and disposed of in landfills (TPA) (Kementerian Lingkungan Hidup dan Kehutanan, 2023). Based on the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 6 of 2022 concerning the National Waste Management Information System, it is recommended to make fundamental changes in the way waste is managed, focusing on waste reduction and handling. The goal of reducing waste is for all sectors of society, including government, businesses, and the general public, to take steps to limit waste production. The application of the 3R method (Reduce, Reuse, Recycle) is also emphasised as part of the waste management efforts (Kementerian Lingkungan Hidup dan Kehutanan, 2022). From a higher policy perspective, it should be emphasised that any

use of materials, whether recycled or new, should aim to reduce environmental impacts and promote long-term sustainability (Gehandler & Millgård, 2020).

Indonesia's dynamic population growth will indirectly lead to various problems, including the issue of waste. The World Health Organization (WHO) defines waste as objects that are not used, not needed, not wanted, or that are discarded by humans and do not occur naturally (Harjanti & Anggraini, 2020). Globally, only a quarter of municipal waste collected is diverted to waste management methods such as recycling, anaerobic digestion and composting. The traditional practice of landfilling, where non-recyclable waste is buried, is often found in communities. Due to limited open space in developing countries, waste is often dumped in heaps or pits rather than buried with soil. Landfills are used for temporary storage and processing of waste through sorting, recycling and treatment before burial (Nanda & Berruti, 2021). Landfill is an important part of the waste management system that provides sustainable services to communities in each region. National programmes consider landfill as a solution for proper waste management. However, the existence of landfills is often controversial because of the inconvenience they cause. Nevertheless, the government is still making efforts to provide landfills as part of its responsibility for environmental hygiene and public health. It is hoped that a clean and safe landfill can reduce the negative environmental and health impacts of landfilling (Priatna et al., 2020). Rapidly growing urban populations and the adoption of consumptive lifestyles similar to those in developed countries have made five developing countries, such as China, India, Brazil, Indonesia and Mexico, among the top ten MSW producers. In general, developed countries produce more MSW per capita than developing countries because waste production is related to

economic level and social welfare (Nanda & Berruti, 2021).

Heuleut landfill is a landfill that accommodates waste from the Majalengka region with an area of 7 hectares. This landfill is located in Heuleut Village, Kadipaten District, Majalengka Regency, West Java, which began operating in 1997. The problem at this landfill based on an interview with the Heuleut Landfill Coordinator is that the accumulation of waste at the Heuleut Landfill exceeds its capacity, creating environmental and health problems for local residents. Water and air pollution occurs due to water flowing from the landfill and methane gas from the waste. Environmental pollution caused by landfill leachate has been one of the typical dilemmas of landfilling methods. Leachate is a liquid that appears when water percolates through solid waste, containing dissolved or suspended substances from various materials and biodecomposition processes (Kamaruddin et al., 2017). Residents are bothered by the pollution and waste of the Heuleut landfill, which affects the quality of health, agriculture and livestock. The daily waste volume is estimated to be more than 100 tonnes, with an average amount of about 0.7 kilograms of waste per person per day. Waste has not been separated between organic and non-organic waste and the lack of heavy equipment as an operational facility at the landfill. TPA Heuleut has not yet acted as a waste management site that applies the 3R method, namely Reduce (reduce), Reuse (reuse), and Recycle (recycle). The Majalengka Regency government's policy towards the Heuleut Landfill, in 2020, has widened the landfill area by about 3 hectares and built a building that is used as the landfill coordinator's office, but there is no policy regarding the waste management system. The problem formulation of this research consists of:

1. what is the impact of waste management in Heuleut landfill on the surrounding environment?
2. how do students respond to waste management in Heuleut landfill?

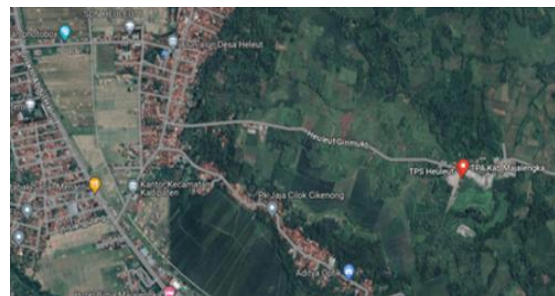
3. how to deal with waste through the application of the 3R method?

The purpose of this research is to analyse the impact of waste management the impact of waste management in Heuleut landfill on the surrounding environment, analyse residents' responses to waste management in Heuleut landfill, and find out how to deal with waste through the application of the 3R method.

## METHOD

### 1. Place and Time of Research

The research was conducted at the Heuleut Landfill (TPA), which is located in the Heuleut Village area, Kadipaten District, Majalengka Regency, West Java. This landfill is located 10 km from the centre of Majalengka, with a travel time of about 18 minutes. The survey was conducted on 15 and 16 April 2024.



**Figure 1.** Map of Heuleut Landfill Site

### 2. Research Methods

This study used a qualitative descriptive method with primary and secondary data collection (Kim H, Sefcik JS, 2017). Primary data was obtained through field observations, which included interviews with the chief coordinator of the Heuleut landfill, administrative staff, and local residents. Secondary data was obtained through document review. The analyses carried out include the identification of the condition of the Heuleut landfill and the waste management within it. The identification of the condition of Heuleut Landfill includes a description of the site, while waste management includes an explanation of the different waste management methods used at Heuleut Landfill.

## RESULTS AND DISCUSSION

### 1. Waste Management and Impact of Heuleut Landfill in Majalengka Regency

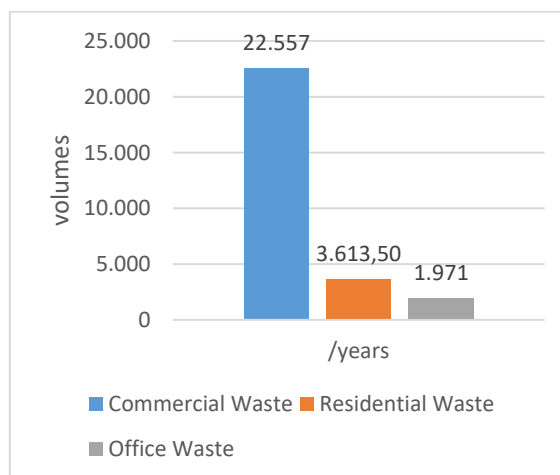
Waste management involves all stages, from waste generation to final disposal. In general, activities in waste management include controlling the amount of waste, waste collection, transfer and transport, and final waste treatment and disposal (Herrera-Franco et al., 2024). One of the impacts of the presence of waste is the aesthetic degradation around the waste disposal site, which can trigger social conflicts with the surrounding communities. Typically, community resistance is related to issues that threaten health, safety, decreased convenience, and limited space for landfills. Sites for waste disposal require large areas of land, but in big cities, land is increasingly limited due to rapid population growth.

Article 20 and Article 22 of Law Number 18 Year 2008 on Waste Management divide waste management into two main groups. The first group is Waste reduction, which includes limiting waste production (R1), reuse (R2), and recycling (R3). The second group is Waste handling, which includes sorting based on the type, amount, and/or nature of waste as well as collection, which includes the collection and transportation of waste from its source to temporary shelters or integrated waste processing facilities. The government has regulated waste management through Article 19 of Law Number 18 Year 2008 on Waste Management. Through the law, the government gives significant authority to provincial, city, and district governments to plan and manage waste in their respective areas.

Sustainable waste management requires a series of planned actions to reduce environmental impacts and increase resource returns. Integrating landfill management is one of the main strategies in this effort, considering that most of the world's major sanitation areas are currently facing great pressure due to the accumulation of millions of tonnes of untreated waste over the past five decades (Jeon et al., 2024). If not managed appropriately, landfills can pose major environmental risks. According to literature, landfills are a source of environmental as well as human health problems, caused by soil,

water and air pollution (Ren et al., 2022). Landfill management can involve strategies such as remediation and rehabilitation of disposal areas, and transformation from an uncontrolled disposal system to a more environmentally sustainable one (Siddiqua et al., 2022).

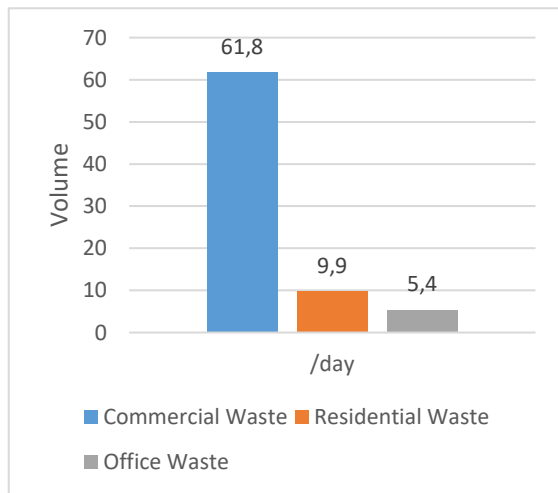
Waste management at the Heuleut landfill in Majalengka Regency has so far only applied the open dumping method. This method is the most ancient and simple waste disposal approach that is often applied in developing countries. This method basically only involves direct dumping of waste without any closure measures. This piling approach causes various pollution problems, including unpleasant odours, soiling, water contamination, and the spread of diseases as it can be a breeding ground for disease vectors such as flies and rats (Siddiqua et al., 2022). Various types of waste from markets and households, which were initially segregated between organic and inorganic waste, are eventually mixed together due to constraints in the number of fleets and heavy equipment such as excavators.



**Figure 2.** Waste Data/year at Heuleut Landfill

Waste from various sources accommodated in the Heuleut landfill volume reaches an average of 28,141.5 tons/year, when detailed the waste comes from three sources, namely: Commercial waste/wet waste from markets and terminals, the volume/day reaches 61.8 tons. Residential waste (non-commercial) consists of dry waste of 9.9 tons/day. Service, office, and hospital waste

with dry waste type is 5.4 tons/day. The daily waste data can be seen in Figure 3 below.



**Figure 3.** Waste Data/day at Heuleut Landfill

Based on the waste data presented in Figure 2 and Figure 3, the volume of waste in the Heuleut landfill in Majalengka Regency in a day reaches 77.1 tons, and in a year the volume of waste can reach 28,141.5 tonnes. The average composition of waste in Indonesia (Source of Indonesian Waste Characteristics 2009, Ministry of Environment) is as follows.

**Table 1.** Waste Characteristics

Type of Waste	Waste Material	%
Organic	Kitchen waste	58%
	Paper waste	9%
	Wood waste	4%
	Rubber rubbish	2%
	Fabric waste	2%
	Other organic waste	6%
		14
Anorganic	Plastic waste	%
	Glass waste	2%
	Metal/metallic waste	2%
		19
	Other inorganic waste	%

Heuleut Landfill in Majalengka Regency is a type of landfill that has just implemented open dumping, so there are many impacts of problems that can be caused by the presence of waste that has not implemented the 3R (Reduce, Reuse, Recycle) management

method. Suboptimal waste management in landfills can cause various health problems for the surrounding community. Waste that is not managed properly can produce methane gas and unpleasant odours, which have the potential to cause respiratory problems and other diseases. In addition, poorly managed leachate can contaminate groundwater sources, which in turn can negatively affect the health of the people who use the water.

Environmental pollution is one of the main impacts of waste management in landfills. Waste that is not managed properly can contaminate soil and water. Management methods such as open dumping often lead to the infiltration of hazardous substances into soil and water, which threatens local ecosystems. The following is an overview of the conditions at the Heuleut landfill site.



**Figure 4.** Conditions at the Heuleut Landfill Site

## 2. Student Response to Waste Management at Heuleut Landfill

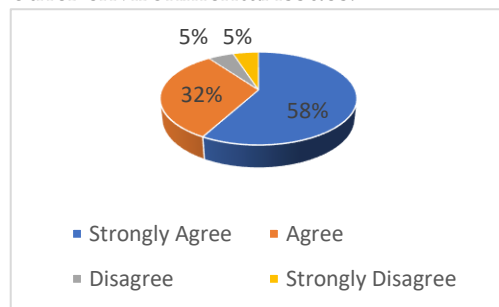
After conducting surveys and interviews with Heuleut landfill managers, the next step was to show the videos and images to students enrolled in ecology courses and then ask them



to provide feedback on waste management at Heuleut landfill. Students' positive response to waste management reflects an increase in environmental awareness.

Previous research supports these findings. For example, research by (Sofiyah et al., 2023) developed an audio-visual-based documentary film as a learning medium on environmental pollution material, showing that using audio-visual media can improve students' understanding of ecological issues. In addition, research by (Kustandi et al., 2021) emphasises that visual media plays a significant role in achieving learning objectives, including increasing environmental awareness. Another study by (Basuki et al., 2020) showed that using audio-visual media in distance learning can improve students' understanding and interest in learning.

Thus, using visual media, such as videos and images, in ecology learning effectively increases students' awareness and understanding of waste management and other environmental issues.



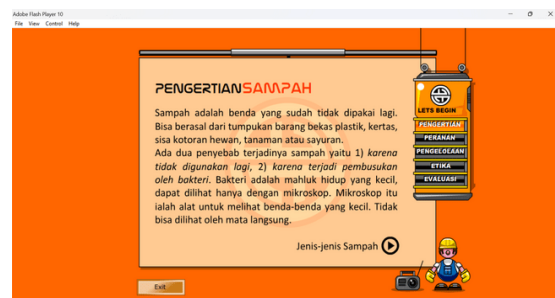
**Figure 5.** Student Response to Waste Management at Heuleut Landfill

The results of student responses showed that around 58% chose to strongly agree, and 32% chose to agree. This can be interpreted as the students' concern for the condition of waste management in the Heuleut landfill is very high. Students began to realise the importance of protecting the environment and creating a balanced ecosystem.

### 3. Waste management through the application of the 3R method

The application of the 3R method as an effort to manage environmentally friendly

waste, this method is used as a supplement to environmental pollution material for students. As the material presented is related to waste recycling with 3 recycling into a product of economic value, namely making briquettes, pulp, and compost, as an alternative to environmentally friendly waste management which is delivered to students with the help of interactive flash player applications to increase their understanding. The following is the appearance of the application used as a supplement to the material.



**Figure 6.** View of the Waste Management Flash App

This Flash application serves as a medium to deliver material that includes understanding waste, roles, waste management, environmental ethics, and evaluation. The procedures for making briquettes, pulp, and compost are enjoyable, and interactive animations are easy to understand. Through this material supplement, it is hoped that students can care more about the environment by stimulating their creative ideas in managing waste into valuable products.

Research conducted by (Pristika dewi, 2021) shows that Flash-based interactive learning media can assist teachers in teaching waste sorting and help students become more familiar with the types of garbage. In addition, another study found that animated media significantly affected students' understanding of waste management in IPAS subjects in elementary schools (Maskhuriyah et al., 2024). Another study also showed that interactive animation can increase students' interest and understanding of waste education based on its type because the designed application displays attractive images and sound

animations during the learning process (Nurseptaji & Prasetyo, 2021).

Thus, using interactive Flash applications that display procedures for making briquettes, pulp, and compost can increase students' awareness and creativity in managing waste into valuable products, which aligns with previous studies findings.

### CONCLUSION

Heuleut Landfill is a landfill that still applies an open dumping system, waste from various regions in Majalengka Regency still does not have a separation technique between organic and inorganic waste. The impact of this waste management results in a surge in the volume of waste which reaches more than 100 tons/day. The existence of this landfill results in various health problems and environmental pollution. Students' responses to waste management in the landfill show a positive response, which means that students are very concerned about waste management in the Heuluet landfill.

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