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REVIEW ARTICLE

The impact of pollution from hazardous and toxic materials (B3) waste on public health

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Abstract

Land pollution by B3 waste can have an impact on human health, the environment and even the sustainability of natural resources. In 2021, Indonesia produced around 60 tons of B3 waste from the industrial sector. In several industrial sectors, it was reported that several workers complained of health problems due to soil contamination by B3 waste. Some of the health impacts that may arise due to B3 waste pollution are acute to chronic health problems, skin and respiratory tract irritation, and decreased quality of life due to decreased health conditions. Therefore, effective B3 waste management is needed to prevent environmental pollution and protect human health.

Keywords: B3 Waste, Pollution, Public Health.

INTRODUCTION

Soil pollution is a serious environmental problem that has a wide impact on human health, ecosystems, and the sustainability of natural resources. This pollution occurs due to the entry of hazardous substances into the soil, such as industrial waste, pesticides, and agricultural chemicals (Yaylalı-Abanuz, 2011). This process can change the physical and chemical properties of the soil, reduce fertility, and disrupt the life of microorganisms that play an important role in maintaining the balance of the ecosystem (Angon et al., 2024). In addition, soil pollution can cause groundwater contamination, which in turn can threaten the health of communities that depend on these water sources.

Land pollution due to hazardous and toxic waste (B3) is a serious problem faced by many countries, including Indonesia. B3 waste, which is produced from various industrial sectors such as manufacturing, agriculture, and mining, can damage the physical and chemical structure of the soil, as well as reduce its fertility. According to data, in 2021, Indonesia produced around 60 tons of B3

waste, with most of it coming from the industrial sector. This waste often pollutes the soil through an illegal landfill process, causing groundwater contamination and resulting in negative impacts on public health and agricultural land productivity (Larasati, 2022).

Disposal of Hazardous and Toxic Materials (B3) waste that is not in accordance with regulations can have serious impacts on human health and the environment. According to Law Number 32 of 2009 concerning Environmental Protection and Management, every individual or entity that produces B3 waste is required to carry out proper management, including storage, transportation, and destruction in accordance with applicable provisions (Valedra and Sitabuana, 2022). However, violations of these regulations often occur, such as the disposal of B3 waste to unqualified final disposal sites (TPA), which can cause soil and water pollution (Berliana et al., 2023). In addition, many health facilities still do not comply with B3 waste sorting and management procedures, thus potentially increasing the risk of disease spread and ecosystem damage (Tarigan and Amalia, 2022).

Land pollution due to hazardous and toxic waste (B3) has a significant impact on the environment and public health. B3 waste, which often contains heavy metals and hazardous chemical compounds, can damage soil quality, reduce fertility, and affect soil pH and microorganisms. In Sleman Regency, Yogyakarta, although the amount of household B3 waste is only around 0.488% of the total domestic waste, this type of waste is very dangerous because it can contain heavy metals that are toxic and carcinogenic (Iswanto et al., 2016).

Health cases due to Hazardous and Toxic Materials (B3) waste are a serious concern in various sectors, especially industry and health care facilities. Research shows that improperly managed B3 waste disposal can cause various health problems for workers and the surrounding community. For example, PT INKA, workers reported health complaints such as headaches and skin irritation, which were caused by exposure to heavy metals such as lead (Pb), copper (Cu), and mercury (Hg) contained in the waste. Long-term exposure to B3 waste can disrupt the respiratory system, cause nausea, vomiting, and more serious nervous disorders, including the potential for death (Ichtiakhiri and Sudarmaji, 2015).

Addressing soil pollution is essential to maintaining ecosystem health and the sustainability of natural resources. Contaminated soil not only reduces agricultural productivity, but can also threaten public health through contamination of food and water. Therefore, efforts to rehabilitate contaminated soil must be a priority, including the application of clean up technologies such as bioremediation and phytoremediation that utilize microorganisms or plants to decompose hazardous substances. In addition, strict regulations on waste disposal and increasing public awareness of the importance of waste management are also needed. By carrying out effective handling, we can restore soil quality, support sustainable agriculture, and protect the health of future generations. This handling is not only the responsibility of the government, but also involves the active role of the community and industry to create a cleaner and safer environment.

MATERIALS AND METHODS

This study adopts a literature review approach by collecting information from various previous studies to evaluate land pollution caused by B3 waste on public health. In this process, several relevant literature sources were used, including a search through Google Scholar, which is an effective platform for finding scientific articles and journals related to health and environmental issues. By utilizing this database, this study aims to present a comprehensive picture of how B3 waste pollution affects the health of individuals and the community as a whole.

RESULTS AND DISCUSSION

Management of hazardous and toxic waste (B3) is one of the main challenges in maintaining environmental sustainability and public health. According to Law Number 32 of 2009 concerning Environmental Protection and Management, B3 waste management includes a series of activities

such as reduction, storage, collection, transportation, utilization, and processing of the waste. During the COVID-19 pandemic, the management of B3 medical waste has become increasingly important. The government has issued strict regulations to ensure that medical waste is not mixed with household waste, as well as encouraging waste minimization and sorting from the start (Valedra and Sitabuana, 2022). According to Indonesian regulations, particularly Government Regulation No. 101 of 2014, B3 waste is classified based on its source and characteristics. By source, it can be categorized into non-specific sources (e.g., maintenance activities), specific sources (e.g., industrial processes), and other sources such as expired products or packaging residues. Based on its hazardous characteristics, B3 waste includes explosive, flammable, toxic, reactive, corrosive, and infectious waste (Romi, 2023). Common examples are clinical waste from healthcare facilities (e.g., sharps and infectious materials), industrial by-products (e.g., used oils and chemical spills), and household items like batteries and expired chemicals.

Managing B3 waste effectively is crucial to prevent environmental contamination and health risks. Key practices include identifying and classifying the type of B3 waste generated, implementing strategies to minimize waste production, and utilizing designated facilities for temporary storage until the waste can be treated or disposed of safely. Treatment methods vary depending on the type of waste but often include thermal treatment or incineration to destroy hazardous components and chemical treatment to neutralize toxic substances. In Indonesia, the management of B3 waste is strictly regulated to ensure safe handling and disposal. Producers are required to manage their waste responsibly, with direct disposal into the environment prohibited without prior treatment. By adhering to these regulations and adopting best practices in B3 waste management, the risks posed by hazardous materials can be significantly reduce (Suyuti et al., 2023).

Heavy Metal Contamination

The content of heavy metals (Pb) and Cadmium (Cd) in groundwater in the Bekasi housing complex. There are Pb and Cd contents that exceed the determined groundwater limits. Pb results were obtained with levels of 0.0509 mg/L and 0.0556 mg/L, while Cd levels were 0.0051 mg/L, 0.0056 mg/L, 0.0055 mg/L, 0.0061 mg/L, 0.0051 mg/L(Komarudin et al., 2021). Lead (Pb) content in urine based on quantitative analysis of respondents' urine samples is above the normal value, that $\geq$ 0.15 mg/L (Dhanti et al., 2022).

Impact of B3 Waste on Health

The impact of hazardous and toxic waste (B3) on health and the environment is an important issue raised in various studies.

1. Acute and Chronic Health Disorders
   B3 waste, especially those containing heavy metals such as lead, can cause poisoning, nervous disorders, and various other health problems. Short-term exposure can cause headaches, nausea, and skin irritation, while long-term exposure can cause damage to organs such as the kidneys and liver, as well as increase the risk of cancer.
2. Skin and Respiratory Tract Irritation
   Workers exposed to B3 waste often experience health complaints such as dermatitis and respiratory problems due to the concentration of hazardous vapors. In addition, B3 waste can cause irritation to the eyes and skin (Ichtiakhiri and Sudarmaji, 2015).
3. Decreased Quality of Life
   In Lakardowo Village, the community experienced a decline in quality of life due to environmental pollution by B3 waste. Diseases such as dermatitis are often experienced by children and women, indicating a significant social impact from the disposal of this waste (Wardani et al., 2021).

Management Efforts

According to Berliana et al., 2023 B3 waste management steps are as follows:

1. Waste Identification and Classification: Identifying types of B3 waste based on hazards and sources for proper handling.
2. Waste Reduction: Efforts to reduce the amount of B3 waste through reusing materials or reducing processes that produce waste.
3. Safe Handling: Waste with hazardous properties needs to be handled with safe procedures to prevent accidents and further pollution.

With clear regulations and awareness of the long-term impacts of B3 waste, it is hoped that this waste management can be carried out more effectively to protect human health and the environment.

CONCLUSIONS

The importance of B3 (Hazardous and Toxic Materials) waste management cannot be ignored, considering the serious impacts that can be caused to human health and the environment if this waste is not managed properly. B3 waste, which includes various types of hazardous chemicals such as pesticides, industrial solvents, and medical waste, has the potential to pollute soil, water, and air, which in turn can affect public health. Long-term exposure to these toxic materials can cause various health problems, including nervous system disorders, respiratory diseases, and even cancer. Therefore, effective B3 waste management is essential to prevent environmental pollution and protect human health. Proper processing processes, such as recycling, safe disposal, and the use of environmentally friendly technologies, can help reduce the risk of exposure to these hazardous materials. In addition, public awareness of the importance of B3 waste management also needs to be increased so that each individual plays an active role in protecting the environment and public health. Thus, the implementation of an efficient B3 waste management system not only protects human health but also contributes to environmental sustainability for future generations.

Author contributions

Farah Aini Dahalan, Mimin Indriani Mulia: Conceptualization, analysis, writing draf, and editing.

Conflict of Interest

There is no conflict of interest in this study.

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Data availability

Data related to the findings of this study are available at the corresponding author.

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