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Community Empowerment in Managing Household Hazardous Waste in Residential Neighbourhoods

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ABSTRACT

This study adopts a mixed-methods approach, combining qualitative and quantitative techniques, to evaluate household hazardous waste management practices. Data were collected through surveys, in-depth interviews, and direct observations. Quantitative data were analyzed using descriptive statistics to measure community awareness levels and the effectiveness of waste management infrastructure, while thematic analysis was applied to qualitative data to identify key issues and patterns in community behavior. The findings highlight the effectiveness of community empowerment programs in improving knowledge and practices, with recognition of hazardous waste types increasing to 85%, understanding of associated hazards to 82%, and a reduction in littering behavior from 65% to 20%. These results underscore the importance of multi-stakeholder collaboration, infrastructure enhancement, and the integration of circular economy principles to achieve sustainable waste management. The study provides actionable, data-driven recommendations for reducing health and environmental risks associated with hazardous waste, emphasizing the need for continuous monitoring and community engagement.

Keywords: *Awareness, Practice, Empowerment*

INTRODUCTION

Household hazardous and toxic waste includes everyday products that contain hazardous chemicals, such as used batteries, fluorescent lamps, expired medicines, and detergents. When these wastes are not managed properly, their impact on the environment and public health is detrimental, including pollution of soil, water, air, as well as the risk of serious health problems such as poisoning and chronic diseases (Dagadu et al., 2024).

Unfortunately, public awareness of the types and hazards of household hazardous waste is still low. Many are unaware that such waste can pollute the environment through improper disposal, such as mixing it with other domestic waste (Alabi et al., 2023).

In addition, the lack of infrastructure or facilities for hazardous waste management at the household level exacerbates this situation. In many countries, including Indonesia, the majority of

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household hazardous waste is dumped into landfills without appropriate segregation or treatment. This increases the risk of environmental pollution and exacerbates public health impacts (Herat & Abeysinghe, 2022)

The importance of household hazardous waste management cannot be separated from the principle of circular economy, which emphasises waste reduction through recycling and reuse. For example, used batteries can be treated to recover heavy metals, while fluorescent lamps can be processed to separate hazardous materials such as mercury (Zhang et al., 2022)

To support environmental sustainability and public health, there is a need for community empowerment in household hazardous waste management. Education and campaigns that encourage behaviour change as well as policies that support proper waste management infrastructure are important steps (Arista et al., 2023).

Waste management integrated with the circular economy also has the potential to provide economic benefits. By turning waste into resources that can be reused, such as battery components or alternative fuels, it can reduce environmental costs while creating new economic opportunities (Pyssa, 2021).

Therefore, further research is needed to understand the effective mechanism of household hazardous waste management. This research can also serve as a foundation for the establishment of better regulations, particularly to reduce the negative impacts of these wastes on the environment and human health (Tsai et al., 2021)

In conclusion, household hazardous waste management is not only an environmental necessity but also part of a sustainable development solution. With collaboration between the community, government, and industrial sector, this challenge can be turned into an opportunity to create a smarter and more sustainable waste management system (Srivastava et al., 2022).

METHODS

This study employs a mixed-methods approach, combining descriptive-qualitative and quantitative analyses, to evaluate household hazardous waste (HHW) management. Data will be collected through surveys, in-depth interviews, and direct observations. Surveys will target households in urban and rural areas to assess community knowledge, attitudes, and practices related to hazardous waste, using structured questionnaires to gather quantitative data on waste volumes, disposal patterns, and participation in waste management programs.

In-depth interviews with key stakeholders, including waste managers, local government officials, and environmental organizations, will explore barriers and opportunities in HHW management. Direct observations will assess the condition and functionality of waste management infrastructure, focusing on collection, treatment, and recycling facilities, with specific criteria for evaluation.

To ensure the validity of findings, data analysis will incorporate triangulation. Quantitative data will be analyzed using descriptive statistics to identify patterns in community behavior, while qualitative data from interviews and observations will undergo thematic analysis to uncover key issues and recurring themes. A comparative analysis of areas with varying levels of waste management infrastructure will evaluate environmental and public health impacts.

The findings are expected to provide data-driven recommendations to enhance HHW management through community empowerment, infrastructure development, and the application of circular economy principles. This research aims to establish a practical framework for

policymakers and organizations to design and implement more effective and sustainable waste management policies.

RESULTS

1. Hazardous Waste Management Awareness and Practices

Table1 . Analysis of Household Hazardous Waste Management Awareness and Practices

Research Aspects	Percentage (%)	Description
People who recognise the types of hazardous waste	45%	Only some people understand the types of household hazardous waste.
People who understand the dangers of hazardous waste	38%	Most do not understand the environmental and health impacts of hazardous waste.
Communities with hazardous waste collection sites	20%	Hazardous waste management facilities at the household level are minimal.
People who dispose of hazardous waste carelessly	65%	The majority still dispose of hazardous waste in regular or environmental waste bins.
Communities that want to be involved in hazardous waste management training	78%	Demonstrate high enthusiasm to be involved in the empowerment programme.

Table 1 shows an analysis of household hazardous waste management awareness and practices that only 45% of the population knows what household hazardous waste is. This suggests that further education is needed. The high risk to public health and the environment is indicated by the low level of understanding (38%) of the hazards of hazardous waste. 20% of the community has access to hazardous waste collection facilities, indicating that infrastructure is needed in residential areas. There is a great opportunity to implement a community-based empowerment programme due to the high enthusiasm of the community to participate in the training (78%).

2. Effectiveness of Empowerment Programme in Hazardous Waste Management

Table 2: Effectiveness of the Empowerment Programme in Hazardous Waste Management

Indicators	Before Programme (%)	After Programme (%)	Change (%)
Recognising types of hazardous waste	45%	85%	+40%
Understand the hazards of hazardous waste	38%	82%	+44%
Bringing hazardous waste to a collection point	20%	70%	+50%
Disposing of hazardous waste carelessly	65%	20%	-45%

Table 2 shows that the empowerment programme is effective in hazardous waste management. After the programme, the number of communities that recognised the types of hazardous waste increased by 40%, indicating that the education programme was successful. The number of people who dispose of waste carelessly dropped from 65% to 20%, indicating that waste management practices have improved considerably. The level of community participation in bringing B3 waste to the collection point has increased significantly. This shows that the community-based approach is working.

DISCUSSION

A. Awareness, Practices and Effectiveness of Household Hazardous Waste Management Empowerment

Community education and empowerment play a crucial role in improving household hazardous waste (HHW) management. This study highlights a significant increase in public awareness, with recognition of hazardous waste types rising from 45% to 85% and understanding of associated risks increasing from 38% to 82%. Similarly, littering practices declined sharply from 65% to 20%, showcasing the effectiveness of hands-on training and infrastructure support.

The empowerment program aligns with community empowerment theory, which underscores the importance of active participation in decision-making processes to foster responsibility and ownership (Maarif, 2021). Additionally, Bronfenbrenner's social ecology principles highlight how human behavior is shaped by interactions with social systems and the physical environment (Hanifah, 2018). These frameworks support the idea that community-driven approaches can lead to sustainable behavior change.

Previous studies corroborate these findings. For instance, Pratama et al. (2021) emphasize the need for collaboration among community organizations, local leaders, and governments to foster creativity and participation in waste management (Pratama et al., 2021). Brotosusilo & Naldi (2021) advocate for applying the 3R principles (reduce, reuse, recycle) as a primary strategy for sustainable waste management. Furthermore (Brotosusilo & Naldi, 2021).

In every aspect of the study, the high level of community enthusiasm (around 78%) for the training was considered key to the success of the programme. However, this assumption needs to be further scrutinised as the actual participation rate may be influenced by structural barriers such as the community's economic priorities, limited time, or basic knowledge. To run the programme, enthusiasm must be translated into action. This assumption is supported by research conducted by Brotosusilo et al., 2021 on Community Empowerment in Resolving the Complexity of Waste Management, this study found that formal education and active participation in social activities can increase the level of community participation in household waste management. Educational factors are proven to have a significant effect in increasing community awareness about waste management (Brotosusilo et al., 2021). This should be done by considering socio-economic factors that influence community participation. Engage local institutions, local governments and the private sector to provide adequate hazardous waste collection facilities and ensure infrastructure sustainability. Rewarded waste collection can increase community participation.

Depending on the existence of hazardous waste collection facilities, the success of the programme in reducing the practice of littering from 65% to 20% relies heavily on the fact that the assumption that collection infrastructure is sufficient to drive behavioural change must be further examined. If there is no consistent management and maintenance of the facilities, communities risk

reverting to old habits due to access difficulties or lack of local resources to support the system. This is supported by research conducted by Cahyadi et al., 2023 demonstrate how economic incentives, such as waste-to-gold savings programs, significantly enhance community involvement while delivering social and environmental benefits (Cahyadi et al., 2023). Empowerment programmes should have long-term monitoring systems that allow for evaluation of success, discovery of problems, and refinement of plans. More specialised interventions that meet community needs can be created with monitoring data.

The education programme showed an increase in understanding of the hazards of hazardous waste to 82%. However, it is questionable to believe that understanding will directly change behaviour. Education will only work when combined with stronger policies, such as waste laws, incentives and sanctions. Behaviour change may not last long without this support. Education programmes should tailor their materials and approaches to the profile of the community. Simple technology-based methods, such as social media applications or educational apps, can increase the efficiency and reach of programmes. In addition, training and community empowerment have successfully increased awareness and implementation of waste management in households. Active community participation is key to the success of this programme (Fitria & Eka Furda, 2022).

CONCLUSION

This research demonstrates that the level of community awareness of household hazardous waste remains low, with only 45% of individuals able to identify hazardous waste types and 38% understanding the associated risks. Despite this, the high level of community enthusiasm (78%) for participating in community-based training and empowerment programs presents a promising opportunity for improving waste management practices sustainably. The implemented empowerment program proved effective, with community recognition of hazardous waste types increasing to 85%, understanding of hazards rising to 82%, and littering behavior decreasing from 65% to 20%.

These results highlight the effectiveness of community-based approaches that actively engage the public in overcoming barriers related to awareness and behavior. However, the long-term sustainability of the program's impact is contingent upon continued investment in infrastructure, strong policy support, and ongoing educational efforts. Without sustained action, the positive changes observed may not be maintained over time.

To ensure the continued success of sustainable household hazardous waste management, it is essential to integrate educational initiatives, the provision of adequate waste management facilities, and supportive local policies. Multi-stakeholder collaboration, involving local governments, community leaders, and private sector partners, is crucial for ensuring the sustainability of these efforts. Additionally, ongoing monitoring and evaluation are necessary to track progress, identify emerging challenges, and refine strategies, ultimately reducing health and environmental risks associated with hazardous waste.

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