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Post Earthquake Disaster Waste Management In Island Countries: Indonesian Case

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Abstract

This study investigates the challenges and strategies of post-disaster waste management in island countries, with a specific focus on Indonesia, a nation frequently affected by natural disasters. Using the 2018 disaster in Palu, Central Sulawesi as a case study, the research employs quantitative methods to collect data and analyze the issues faced in waste management post-disaster. The study measures waste management options, social considerations, and organizational aspects using a Likert scale, with data collected through questionnaires and document analysis. Regression analysis and structural equation modeling are used to determine relationships between variables. The findings reveal significant impacts of waste management choices and social considerations on organizational aspects. The study underscores the importance of education, awareness, and environmental integration in decision-making, and highlights the role of organizational factors and human resource capacity in effective waste management. The research provides recommendations for government policy and regulation formulation for post-disaster waste management. However, the study's focus on a specific case study necessitates further research to deepen understanding of earthquake disaster waste management in Indonesia.

Keywords: *Environmental, Government policy, Natural disasters, Waste management*

Introduction

Indonesia is an archipelagic country consisting of around 13,500 islands. Its tropical climate conditions make it vulnerable to disasters due to tropical storms(Kastolani and Mainaki 2018). Indonesia also has a series of mountains and active volcanoes spread across almost all of its large islands as part of the Pacific Ring of Fire(Supasri et al., 2012). Indonesia's unique and complex geographic location makes it vulnerable to various natural disasters, especially earthquakes. Many scientists have conducted research on natural hazards and disasters in Indonesia, such as tsunamis (Horspool et al.(2014); Hsu et al.(2006); Lavigne et al.(2009); Paris et al.(2010)), earthquakes (Ashadi et al.(2015); Aydan(2008); Bellier et al.(2016); Briggs et al.(2006); Darpito et al.(2011); Ghosal et al.(2012); Nalbant et al.(2005); Singh et al.(2010)), volcanic eruptions (Jenkins et al.(2013); Lavigne(1999); Lavigne and Gunnell(2006); Lavigne et al.(2000); May and Lavigne(2012); Picquot et al.(2013); Surono Jousset et al.(2012)) and floods (Akmalah and Grigg(2011); Liu et al.(2015); Sarminingsih et al.(2014)).

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In a disaster situation, various critical problems arise, including property damage, building collapse and infrastructure failure(Lindell and Prater 2003; Shaw 2006). One of the significant consequences of this impact is the generation of quite a lot of waste, so it must receive high attention from the community. Pelling et al.(2002)emphasized that among the negative impacts of disasters such as loss of life, injury, physical damage, economic disruption and social disruption, the destruction of buildings and infrastructure, which results in large amounts of building waste, is a matter of great concern. Managing this waste is a big challenge because it is mixed and difficult to separate(Kobayashi 1995).

Effective waste management is critical to recovery and rebuilding efforts after disasters. According to the United Nations Office for Disaster Risk Reduction (UNDRR), Indonesia often experiences natural disasters, including earthquakes, volcanic eruptions, floods and tsunamis. These events generate large amounts of waste, consisting of debris, hazardous materials, and solid waste. With Indonesia's diverse and densely populated geographical conditions, the task of post-disaster waste management becomes increasingly complex. Implementing efficient waste management systems and strategies is essential to mitigate environmental, social and health risks associated with waste buildup after disasters (UNDRR, 2021).

The case study we use is the disaster that occurred in Palu, Central Sulawesi, Indonesia in 2018. Geologically, Palu is located on the Palu-Koro fault where there should be no human activity.(Triyanti et al. 2022). This disaster claimed lives, damaged the environment and buildings, and brought in an abundance of rubbish(Paulik et al. 2019). Most disaster waste (such as mixed soil, building materials, debris, trees, ships, household waste, and hazardous waste) was found to be poorly managed. There were around 68,451 houses that were destroyed, leaving tons of mixed rubbish(Organization 2018). In urgent disaster and emergency situations, debris can block road access(Kobayashi 1995). The lack of an effective mechanism to provide warnings to the public when a disaster occurs in Palu has caused major damage; This is also due to the location of the city of Palu which is far away and separate from the country's capital island, Java Island, so that aid for advanced equipment is relatively slow to be distributed for post-disaster handling.

The presence of waste in the community also has the potential to pose a risk to public health. Organic waste and standing water (potentially caused by flow paths blocked by debris) can become breeding grounds for the vector(MT et al., 2019). Vector-borne infectious diseases are a common form of infectious disease that occurs after disasters, especially when large numbers of people are displaced. However, the risk of an outbreak is relatively low(Watson, Gayer, and Connolly 2007). In the long term, poor cleanup management can result in slow and expensive recovery. Prolonged contact with waste poses potential risks to public health and the environment, as identified by Srinivas and Nakagawa(2008)after the 2004 Box Day tsunami in Sri Lanka.

Post-disaster management in island areas such as Palu City is a challenge in itself. Post-disaster waste management carried out by local governments is collecting waste before transporting it to final disposal sites. The Provincial Government provides conventional trucks, excavators and bulldozers to facilitate the transfer of waste from temporary storage sites to final disposal sites(Astha, Alam, and Malik 2018). However, due to the limited number of personnel, machines and vehicles, the waste management process is hampered, resulting in the accumulation of waste in all areas. To reduce the waste collected, some organic waste is burned. Unfortunately, the impact of this disaster does not only affect humans, because many animals, such as cows and goats, are stranded and forced to consume the waste as their own food.(Fatimah et al. 2019).

The aim of this research is also to provide recommendations regarding disaster waste management models to the government. It is hoped that these recommendations can become a basis for the government in formulating regulations and public policies regarding

post-disaster waste management in developing countries, with a focus on a case study in the City of Palu, Indonesia. This research will identify the problems and challenges faced in the process of environmental management after natural disasters.

Methods

This research uses quantitative research methods with the aim of explaining the phenomenon of disaster waste management in Palu City(Astuti, Werdhiana, and Wahyono 2021). Palu City is a city located in Central Sulawesi, Indonesia. Palu City was chosen as the research location because in 2018 this city experienced a very powerful natural disaster, namely an earthquake and tsunami.(Syifa et al., 2019). This incident caused enormous losses in various aspects of life, including the problem of waste processing.

Palu is an isolated city, separate from the country's capital. The distance between the city of Palu in Central Sulawesi Province and the city of Jakarta, the capital of Indonesia on the island of Java, is around 1,900 kilometers.(Stolle et al. 2020). Connecting the two cities can be done through various transportation routes, whether by air, land or sea. Air transportation options can provide direct access with a flight duration of around 2-3 hours(Shafapourtehrany et al. 2023). Meanwhile, using land and sea routes takes longer and requires traveling across several provinces using various means of transportation such as buses, ships and ferries. This situation creates its own challenges in waste management, especially disaster waste(Private et al., 2021). Limited infrastructure, limited access, and limited human and financial resources are obstacles to waste management in this region(Antoine et al. 2020). As seen in the following image 1.

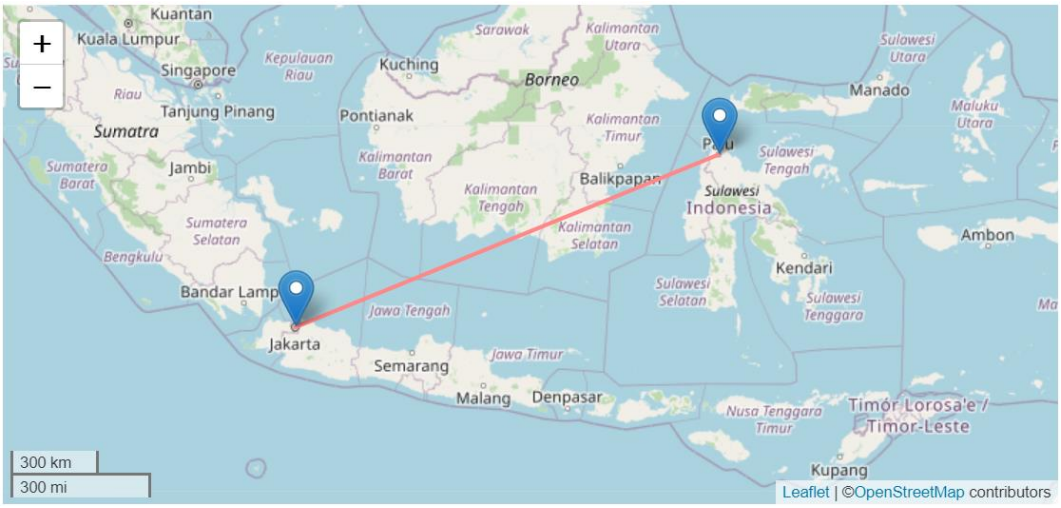


Figure 1. distance from the country's capital to the research location

Source: processed by researchers

This method involves collecting numerical data that can be analyzed statistically to provide a deeper understanding of the state of waste management in cities(Yulianto et al. 2021). In this case, a representative sampling technique will be used so that the research results can be generalized to a larger population, thereby providing broader and more significant conclusions.(Rajindra et al. 2019).

Study Design

The research samples that will be taken refer to the community groups that are the research subjects. The aim is to explore the concept of waste management practices currently implemented, as well as identify the challenges faced by the city in post-disaster waste management in Palu City.

Data and Sample Selection

The population in this study was taken from the total population in the Palu City area, so the total population in this study was 372,113 people. This population figure was taken based on 2020 population data issued by the Palu City Central Statistics Agency(BPS Palu City, 2020).

The sample selection method in this research used a purposive sampling technique, or sample selection was done deliberately(Andre, 2021). This method allows this research to determine respondents who meet the requirements or criteria that have been determined based on certain considerations regarding the role of the community in post-disaster waste management.(Farrugia 2019). This research did not use a random sampling method but deliberately selected samples that were considered most relevant to the research(Kegler et al. 2019).

This research uses the Krejcie and Morgan formula to determine a representative sample at the research location. This formula is widely known and is used to determine an accurate sample size based on the desired level of confidence and margin of error(Hameed, Waris, and Amin ul Haq 2019). The use of this formula ensures that the sample is relevant to the research objectives. The purposive sampling method was used to select respondents who had relevant knowledge and experience in post-disaster waste management in Palu City. The use of these formulas and methods increases research capabilities in collecting meaningful data and producing accurate conclusions regarding issues related to post-disaster waste management and community contributions.(Krejcie and Morgan 1970).

This formula can be used to determine the number of samples needed in research, taking into account the desired level of confidence and margin of error.(Nanjundeswaraswamy and Divakar 2021). By using this formula, this research can calculate the number of samples which can provide results that represent a larger population(Porrini et al. 2019). The use of the purposive sampling method in this research allows data collection from respondents who have relevant knowledge and experience regarding post-disaster waste management in Palu City. Thus, it is hoped that the results of this research will provide a deeper and more detailed understanding of problems related to post-disaster waste management and the community's contribution to this process.

Figure 1. Krejcie & Morgan formula.

$$\boldsymbol{s} = \frac{x^2.N.P(1-P)}{(N-1).d^2 + x^2.P(1-P)}$$

Information:

S = desired sample size

X2 = chi-square table value

N = population size

d = level of accuracy expressed by rate (0.05)

The calculation of the number of samples required for the population of West Palu Regency is determined using Figure 3.1. The following is the calculation of the number of samples needed as respondents in this study:

$$\boldsymbol{S} = \frac{3841(372.113)(0{,}5)(1-0{,}5)}{0{,}05^2(372.113-1) + 3841(0{,}5)(1-0{,}5)}$$

$$\boldsymbol{S} = \frac{355.441.683,625}{930,28 + 960,25}$$

$$\boldsymbol{S} = \frac{355.441.683,625}{1.890,53}$$

$$\boldsymbol{S} = 188.011,66 \approx 188$$

Taking a sample of 188 respondents in this context could be the right approach, especially if careful statistical calculations are carried out to ensure the desired level of accuracy. However, it should be noted that there are limitations regarding sample size in relation to larger population sizes(Lou et al. 2021). The greater the difference between the sample size and the population size, the more important it is to perform careful and careful statistical analysis in order to correctly interpret the results.(Hair Jr et al. 2021).

Although the number of respondents reaching 188 people can provide a relevant picture of community views and practices regarding post-disaster waste management in Palu City, this sample size must be studied with caution. Adequate statistical calculations, such as margins of error and confidence levels, can help measure the extent to which results from a sample are representative of the larger population.(BPS 2020).

In this context, the application of adequate statistical methods and a thorough understanding of the limitations and implications of sample size can ensure that the results of this research produce meaningful and reliable information, and make a significant contribution to post-disaster understanding. waste management in Palu City.(Chandler et al. 2019).

Measurement Instruments

At this stage the research identifies the variables that will be studied related to waste management resulting from disasters in Palu City. These variables come from research conducted by Charlotte Brown(2011). However, in this study the researcher only used 3 measuring instruments from the previous 6 measuring instruments because the researcher only used measuring instruments that were in accordance with the research objectives. These measuring tools include:

Waste processing options, namely as an indicator X1. This measuring tool uses a 5 point Likert scale. The instruments used to measure this aspect include an evaluation of the various waste treatment options available, such as recycling, incineration, chemical destruction or safe landfill disposal. This review considers factors such as environmental safety, efficiency, technology availability, and compliance with applicable regulations.

Social considerations, namely as an indicator X2 . This measuring tool uses a 5 point Likert scale. The instruments used to measure social consideration analysis take into account the social and public health impacts associated with disaster waste. This includes aspects such as public safety, community participation in decision making, meeting basic needs, and mitigating risks for vulnerable groups such as children, the elderly, and people with special needs.

Organizational aspects, namely as an indicator. This measuring tool uses a 5 point Likert scale. The instruments used to measure this review include identifying the roles and responsibilities of organizations involved in disaster waste management, whether at the government, non-profit or private sector level. This includes interagency coordination, private sector involvement, logistics planning, and effective operational monitoring.

These variables will be used in this research to identify the main problems and challenges related to post-disaster waste management in Palu City. By considering these variables, it is hoped that this research can produce a more comprehensive understanding of the waste management situation and provide appropriate recommendations for developing effective and sustainable waste management strategies in urban areas.(Serge Kubanza and Simatele 2020).

Data collection

This research is based on a strong quantitative approach, which has an important role in forming a comprehensive understanding of the problems and challenges related to post-disaster waste management in Palu City.(Rafliana et al. 2022). By systematically collecting numerical data, this research is able to reveal patterns and relationships between variables involved in post-disaster waste management.(Freddi et al. 2021). This approach allows researchers to identify factors that influence the effectiveness of waste management, as well as measure the impact of various mitigation actions taken.(Garfias Royo et al. 2022).

Through this quantitative approach, it is hoped that this research can provide deeper insight into various aspects of post-disaster waste management in Palu City. For example, to what extent the waste collection and processing system has been successfully implemented, what is the level of community participation in waste management programs, and the impact of waste management efforts on the environment and public health.(Opabola et al. 2023).

It is hoped that the results of this research will have a significant impact on the development of effective and sustainable waste management strategies in urban areas. The findings and recommendations from this research can be a basis for the government and other stakeholders in designing better waste management policies and programs. By understanding more deeply the dynamics of post-disaster waste management, it is hoped that the City of Palu can take more appropriate steps in facing waste management challenges, as well as creating a cleaner and more sustainable environment for the entire community.

Data collection in this research was carried out by distributing questionnaires. Researchers will send questionnaires to respondents selected purposively according to predetermined criteria(Surya et al. 2020). The questionnaire will contain a series of questions related to post-disaster waste management, including waste management strategies, community participation, infrastructure availability, and policies related to waste management.(Samaddar et al. 2021). Data obtained through questionnaires will provide an overview of perceptions, knowledge and practices related to waste management among respondents(Mahbubur Rahman, Sadequr Rahman, and Jerin 2023).

Apart from using questionnaires, this research will also collect data through documentation related to waste management programs that have been carried out in Palu City. This documentation includes reports, policies, waste management programs and other related data. Data from this documentation will provide further understanding of previous efforts in post-disaster waste management in the city, as well as the impact and effectiveness of these programs.

The use of various data collection methods is expected to provide a comprehensive and detailed picture of post-disaster waste management in Palu City. The data obtained will be the basis for analyzing and evaluating the waste management situation, identifying the problems and challenges faced, and formulating recommendations to improve the effectiveness and sustainability of post-disaster waste management in the region (Mamashli et al. 2021).

Data analysis

This research uses regression data analysis with SPSS software and structural equation modeling (SEM) (Hsu 2010). To provide valuable insight into the dynamics of post-disaster waste management, it is hoped that the City of Palu can take more appropriate steps in facing significant waste management and relationship challenges and create a cleaner and more sustainable environment for all Indonesian people.

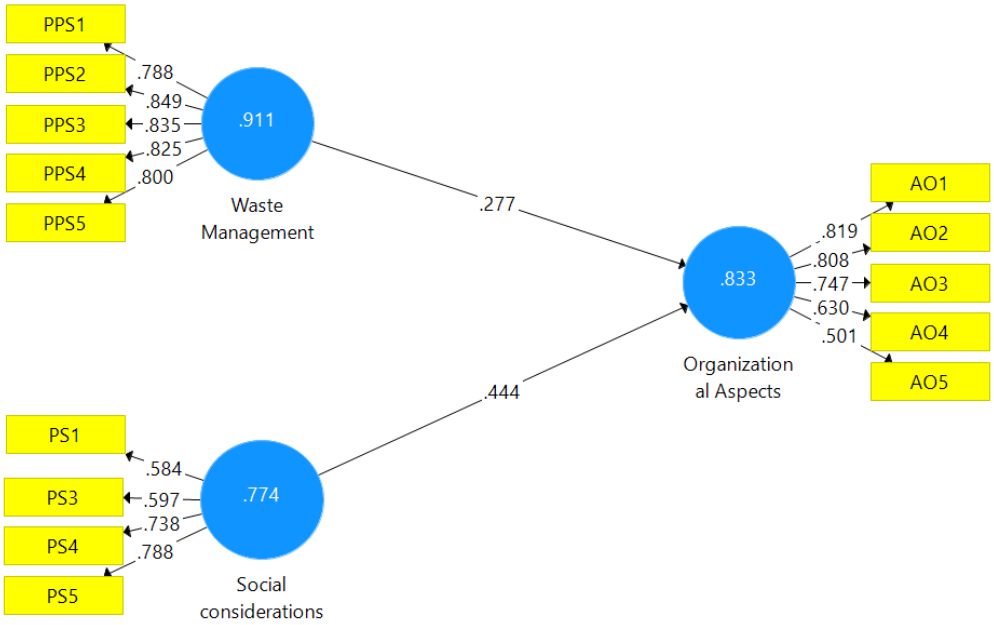
By conducting regression analysis, researchers can determine the strength, direction and importance of this relationship, providing quantitative evidence to understand the problems and challenges faced in the environmental management process after natural disasters. This analysis helps identify the specific contribution and importance of each variable (Rios and Gianmoena 2020). And provide recommendations regarding disaster waste management models to the government.

Structural equation modeling (SEM) is a powerful statistical technique that makes it possible to examine complex relationships between several variables simultaneously (Maccallum and Austin 2000). This can be used to build a comprehensive model between waste management options, social considerations and organizational aspects as latent variables. SEM allows estimation of direct and indirect effects, thereby enabling researchers to assess the mediating role (Adillah Ismail et al. 2019) of organizational aspects in the relationship between social considerations and waste management choices. This technique provides a deeper understanding of the mechanisms and pathways underlying the interaction of these variables (Baurley et al. 2010).

By using regression analysis with SEM, researchers can analyze and determine a significant relationship model (Stein, Morris, and Nock 2012) between waste management choices, social considerations and organizational aspects. This approach allows a comprehensive examination of the individual contribution of waste management choices, social considerations to organizational aspects, as well as the combined influence of both (Lebel et al. 2006). The results obtained from this analysis can provide information to policy makers and stakeholders regarding specific areas that need attention and improvement in improving recommendations regarding disaster waste management models to the government.

Results and Discussion

Based on the results of the measurement model analysis, it is known that there are several indicators whose values are below 0.5 so they must be excluded from the analysis, namely PS2. These five indicators have loading factor values below 0.50. The next step is retesting to see whether all indicators meet the standard value > 0.5. Convergent validity of PLS is also assessed with AVE (Average Variance Extracted). The rule of thumb used for convergent validity is AVE ≥ 0.50 (Hair et al., 1998).



After repeated testing, the results of the convergent validity test showed that the AVE value was greater than 0.50 for all variables Waste Management Options, Social Considerations and Organizational Aspects, so it was concluded that the convergent variables were valid. Based on the picture above, it can be seen that all indicators have an outer loading greater than 0.5, so they are concluded to be valid in reflecting the variables Waste Management Choices, Social Considerations and Organizational Aspects.

Composite Reliability Test

Based on the composite reliability test, it shows that the value of all variables is > 0.5. Therefore, it can be concluded that the variables tested are valid and reliable (Ghozali, 2005).

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Organizational Aspects	0,750	0,782	0,833	0,506
Social considerations	0,626	0,645	0,774	0.628
Waste Management	0,878	0,881	0,911	0,672

Inner Model Collinearity Test Analysis (Structural Model)

The results of the collinearity test show that in the path of influence of Waste Management Choices (X1) and Social Considerations (X2) on Organizational Aspects (Y), it is known that the collinearity values for the Waste Management Choices, Social Considerations and Organizational Aspects variables have the same collinearity values. The VIFs are all below 5, so water is said to be linearity free.

Independent variable	VIF	Conclusion
Organizational Aspects	2,962	Legitimate
Waste Management Options	1,872	Legitimate

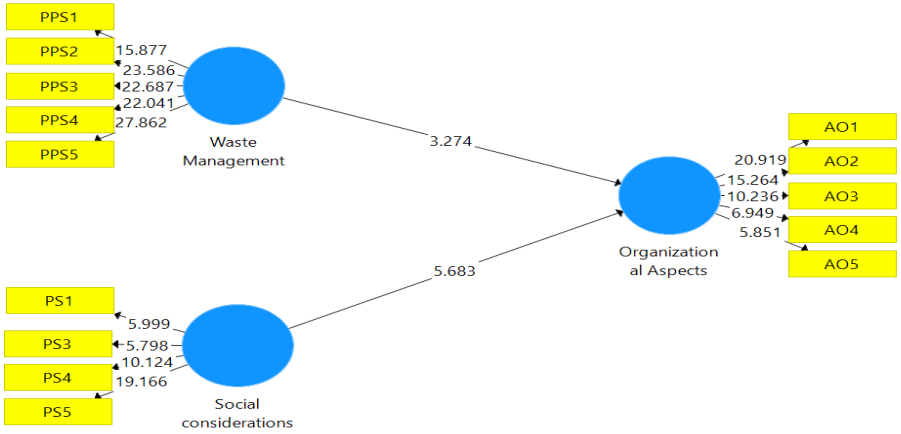
Social Considerations	1,782	Legitimate

Coefficient of determination test (R-Square)

The R2 value of Bureaucracy (Y) is 0.833, meaning that the percentage of Government Support (X1) and Resilience (X2) to Bureaucracy (Y) is 54%, while the remaining 43% is explained by other variables.

Indicator	R square	R Square Adjustable
Organizational Aspects	0.546	0.543

Test the path coefficient



	Original Sample (O)	Sample Mean (M)	Standard Deviation (Stdev)	T statistics (|O/Stdev|)	P value
Waste Management Options->Organizational Aspects	0.444	0.456	0.075	7,951	0,000
Social Considerations->Organizational Aspects	0.477	0.488	0.081	6,415	0.001

The test results show that the beta coefficient value of Waste Management Choices on Organizational Aspects is 0.456 and the t-statistic is 7.951. From these results, the t-statistic is significant. because >1.96 with a pvalue <0.05 so the Waste Management Option is accepted. Meanwhile, the test results show that the beta coefficient value for Social Considerations on Organizational Aspects is 0.488 and the t-statistic is 6.415. From these results, the t-statistic is significant. because it is >1.96 with a p value <0.05, then Social Consideration is accepted.

Model Fit Test (Model Fit)

The SRMR value limit below 0.12 indicates the model is fit or good, then a value below 0.12 indicates the model is still acceptable (marginal fit), whereas if the SRMR value is greater than 0.12 it indicates the model is not fit (poor fit or less fit). The results of evaluating the fit of the model with an SRMR of 0.121, the value is within the limit of 0.12, so it can be concluded that this research model has a marginal level of fit or what is called marginal fit.

	Saturated Model	Estimation Model
SRMR	0.121	0.121
d_ULS	1,529	1,529

d_G	0.640	0.640
Chi-Square	548,472	548,472
NFI	0.582	0.582

The results of this research reveal various responses from respondents regarding the environment, especially in the context of natural disaster waste management in developing countries, with a focused case study in Palu City. In analyzing waste management strategies during natural disasters, research data shows that society's response to the environment is greatly influenced by a number of factors. This study found that public perception and awareness of the importance of waste management due to natural disasters varies, and understanding the environmental impact of waste management is an important factor in determining the level of response.(Debrah, Vidal, and Dinis 2021). The data also shows that waste management choices also play an important role in the way the government takes policy steps in waste management for the community in responding to waste management strategies. People with economic limitations may be more likely to choose cheaper waste management options even though their environmental impact is greater.

Social considerations also have an influence on government decision making in waste management after natural disasters. This research reveals that the level of public knowledge about the impact of natural disasters on the environment plays an important role in determining how they respond to waste management strategies. These findings illustrate that educational efforts and increasing awareness of the environmental impacts of waste management after natural disasters have great potential to increase community participation and support acceptance of strategies that are more sustainable and have a positive impact on the environment. The research results also underline that the community's response to management waste after natural disasters is greatly influenced by factors such as environmental awareness, economic conditions, and their level of knowledge regarding the impact of natural disasters on the environment (Hussain et al. 2020). Therefore, in designing waste management strategies to deal with natural disasters in developing countries, it is necessary to pay attention to the importance of educational efforts and effective campaigns to increase public awareness. In addition, environmental aspects must be well integrated into the decision-making process and actions related to waste management. The case study in Palu City also provides valuable insight into the specific dynamics of community responses to the environment in the context of natural disasters in developing countries. need to pay attention to the importance of educational efforts and effective campaigns to increase public awareness. In addition, environmental aspects must be well integrated into the decision-making process and actions related to waste management. The case study in Palu City also provides valuable insight into the specific dynamics of community responses to the environment in the context of natural disasters in developing countries. need to pay attention to the importance of educational efforts and effective campaigns to increase public awareness. In addition, environmental aspects must be well integrated into the decision-making process and actions related to waste management. The case study in Palu City also provides valuable insight into the specific dynamics of community responses to the environment in the context of natural disasters in developing countries.

In the context of social considerations related to waste management selection, especially those related to organizational dimensions, this research describes the variation in responses observed from respondents, especially within the framework of post-natural disaster waste management strategies in developing countries with an emphasis on the City of Palu. The findings from this research provide in-depth insight into how communities respond to organizational factors including structures, processes and policies involved in waste management after natural disasters (Zorpas 2020). The case study in Palu City is a

significant reference in illustrating various organizational aspects that influence community responses to waste management strategies in the context of post-natural disaster situations.

In the context of social considerations related to waste management policy making by the government, human resource capacity is also a crucial factor in facing the challenges of post-disaster environmental management. Training and education for those involved in waste management, including field officers and decision makers, is very important to ensure effective and sustainable waste management. The environment is a big challenge in the context of post-disaster waste management in Palu City. Aspects such as infrastructure, technology, policies and human resource capacity must be addressed holistically to achieve sustainable and effective environmental management after natural disasters (Leal Filho et al. 2019). In this framework, collaboration between various parties, including the government,

The results of this research provide an in-depth view of natural disaster waste management strategies in developing countries, with a case study focused on Palu City. This research succeeded in identifying the problems and challenges faced in the process of environmental management after natural disasters. Various important aspects have been analyzed, including infrastructure, technology, policies and human resource capacity involved in post-disaster waste management (Benevolenza and DeRigne 2019). In the context of infrastructure, this study reveals the significant impact of natural disasters on infrastructure damage, which is a key aspect in waste management. Damage like this can hamper the efficiency of waste collection, transportation and processing. Technology is also identified as an important factor, where the application of appropriate technology can provide effective solutions in post-disaster waste management. However, the financial challenges in adopting this technology are a major concern.

Apart from that, policies also play a role in influencing disaster waste management strategies(Wassie 2020). In this case, this study recognizes the need for policies that support the allocation of adequate funds for post-disaster waste management. Policies that encourage sustainable approaches and active participation of various stakeholders were also identified as important factors. Human resource capacity is also the focus of this research. Training and education for those involved in post-disaster waste management is recognized as an important factor in overcoming the limited capacity of human resources affected by economic problems. And this research provides useful recommendations for the government in developing disaster waste management models. It is hoped that these recommendations will become the basis for the government in formulating regulations and public policies regarding waste management after natural disasters.

Conclusions

This research discusses waste management for earthquake disasters in Indonesia. This research bases its analysis on a number of independent variables covering three main dimensions, namely, waste management, social considerations, and organizational aspects. The main focus of this research is to test the hypothesis that has been proposed as the basis for the analysis. An explorative approach is the basis for these investigative steps. This research provides insight that post-earthquake waste management in Indonesia must consider various aspects, including government policy, strong collaboration, public awareness, and public safety and health priorities. Effective and sustainable waste management is very important to reduce the environmental and health impacts that can occur after an earthquake disaster. This study provides a clear picture of earthquake waste management in Indonesia. This research also uses strong statistical analysis methods to test the hypotheses that have been proposed. Apart from that, this research also provides

deeper insight into the dynamics of shifting views and perceptions among the respondent group, related to developments occurring in the societal context. However, there are also disadvantages. This research only focuses on case studies in Palu City, so the results may not be generalized to all of Indonesia. In addition, this research only uses an exploratory approach and limited statistical analysis methods, So further research may be needed to deepen understanding of earthquake disaster waste management in Indonesia. Suggestions for further research can be carried out to deepen understanding of earthquake disaster waste management in Indonesia. This research could involve more case studies in various regions in Indonesia to expand the scope of the research.

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