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Environmental and Health Risks of People Living in Batulayang Landfills, West Kalimantan Province, Indonesia

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ABSTRACT

Waste management activities at landfills negatively impact the environment and health risks for humans living around landfill sites. Of the many impacts produced, the perception of the community living around the landfill location is important in knowing the community's response to the effects produced. This research aims to analyze the perception of people living around the Batulayang landfill site, which has a distance of 100 to 2 km, regarding environmental and health problems. This research is a cross-sectional study. The data in this research were obtained from interviews using a questionnaire. This research has received ethical approval No. 13/KEPK-PK.PKP/VI/NP/2024 by the Pontianak Ministry of Health Polytechnic Research Ethics Review Commission. According to the research findings, public perception about property value decline showed a p-value of 0.018 (< 0.05), while public perception about the increase in mosquito populations near the Batulayang landfill had a p-value of 0.016 (≤ 0.05). This indicates a statistically significant difference between the two based on location or residential distance. Additionally, there is a statistically significant difference in health history between respondents from the two groups (p-value > 0.05), and for skin diseases, a significant difference was observed with a p-value of 0.005 (≤ 0.05). Government intervention with communities living close to landfill sites is critical to ensure their health and welfare.

Keywords: Dumpsite, Environmental health, Health risk, Landfill, Public Health

INTRODUCTION

Waste management is an essential element for the urban environment globally. Efficient waste management is crucial for protecting urban areas' environment, public health, and aesthetics (Abuhasel, 2023; Ramaiah et al., 2020). Developing countries must consider the importance of waste management in urban areas. Problems that generally occur are poor waste management planning, inadequate resources, changes in people's consumption patterns, and increasing urbanization (Babs-Shomoye & Kabir, 2016). These issues reflect the fundamental challenges faced in managing urban waste, especially in developing countries. Without effective solutions, these conditions can worsen negative impacts on the environment, public health, and quality of life in cities.

Poor waste management in urban areas can greatly impact public health, the environment, the economy, and social dynamics, so a thorough understanding of the impacts is needed (Srivastava et al., 2015). The landfill is a viable option for waste management. It processes waste safely and minimizes adverse impacts on the surrounding environment and humans (Pemerintah Republik Indonesia, 2020). However, landfills are also the most dangerous environmental waste management practice (T. Zhang, 2020).

Landfills are the main contributors to anthropogenic greenhouse gases. They produce CH4 and CO2, which originate from the waste degradation process in landfills (C. Zhang et al., 2019). Landfill activities are closely related to soil pollution caused by leachate, noise from bulldozer activity, solid odors, and bioaerosol emissions caused by the degradation of organic waste (De Feo et al., 2013; Ibtisam & Ghaffar, 2012; Yudhana et al., 2020). Factors that influence emissions from landfills include the age of the landfill, the amount and type of waste deposited, the climatic conditions at the landfill location, organic pollutants, heavy metals, the results of incomplete combustion (particulate matter), and gas pollutants (Njoku et al., 2018; Palmiotto et al., 2014). Gas pollutants from waste decomposition include gas (CH4) and Hydrogen sulfide gas (H2S), which can create an environment conducive to breeding disease-carrying vectors such as rats, mosquitoes, and flies (Axmalia & Mulasari, 2020). Continuous inhalation of CH4 gas can cause nausea, vomiting, and loss of concentration. Acid gases such as

sulfur dioxide, nitrogen dioxide, and halides have harmful effects on health (Public Health England, 2019).

Batu Layang landfill is a final processing site, located 15 km from Pontianak City with an area of 26.6 ha, started operating in 1966. Batu Layang landfill uses a waste management system with a controlled landfill which produces waste water or leachate. The Batulayang landfill is located close to residential areas, namely less than 1 km, this will certainly have an impact on the health of the local community (Kusdarini et al., 2019). Around the Batulayang landfill, there are community concerns about the environmental and health impacts caused by waste management activities. Several residents reported an increase in the number of mosquitoes, a decrease in environmental quality, and the risk of skin diseases. However, to date there has been no research that comprehensively measures community perceptions of these risks and links them to health data and environmental conditions around the landfill. This limited understanding hinders effective policy making and the implementation of appropriate risk mitigation strategies. Therefore, an in-depth analysis of community perceptions is needed to identify key issues, measure their impacts, and provide evidence-based recommendations for improving environmental management and improving community quality of life. Based on these problems, researchers researched the environmental and health risks of people living around the landfill through the perceptions of the surrounding community. Of the many impacts resulting from the existence of landfills, public perception plays a crucial ongoing role in the public's response to environmental exposure and its effects on health. Knowing the perceptions and experiences of the community is essential to understanding how big the presence of a landfill causes the impact of exposure to design effective interventions (Etea et al., 2021). By knowing public perception, we can encourage the community to actively contribute to producing effective solutions that are accepted by the community living around the Batu layang landfill.

This research aims to analyze the perceptions of the people living around the Batulayang landfill site regarding environmental and health problems, as well as their history and health symptoms.

METHOD

Study Design

The Batulayang landfill is close to residential communities and less than 1 km away. Therefore, this research aims to determine the perception of the environmental impact and health of the people living around the Batulayang landfill site. This research is cross-sectional.

Participants

This research involved 100 community respondents living around the Batulayang landfill location, which was determined based on sample calculations. Based on the results of the sample calculations, the samples were portioned or divided equally into two categories based on the distance between the location of the research respondents' residence at the Batulayang landfill location, namely research respondents who lived at a distance of at least 100 meters to <1 km from the Batulayang landfill as many as 50 people and research respondents who 50 people live 1 to 2 km from the Batulayang landfill. This research has received ethical approval No. 13/KEPK-PK.PKP/VI/NP/2024 by the Pontianak Ministry of Health Polytechnic Research Ethics Review Commission.

Study Variables

Research respondents who are willing to take part in the research have signed an informed consent form. Data collection was collected using interviews and observation using questionnaires. This research questionnaire uses a 5-point Likert scale consisting of 1: Strongly disagree (SD); 2: Disagree (DA); 3: Neutral (N); 4: Agree (A); 5: Strongly agree (SA). The questionnaire contains questions about the respondent's gender, age, occupation, highest level of education, length of stay, and topical issues regarding environmental problems, history, and health symptoms faced by people living around the Batulayang landfill site.

Summary of Research Questionnaire Questions on Environmental and Health Risks for Residents Living in Batulayang Landfill, consisting of : Public perception regarding concerns about housing conditions caused by waste management activities at Batulayang landfill ; Public perception of scattered rubbish causes discomfort ; Public perception regarding waste management activities at Batulayang landfill which disrupts comfort and quality of life ; Public perception regarding the unpleasant odor originating from waste management activities at the Batulayang landfill ; Public perception of leachate produced from piles of waste originating from waste management activities at the Batulayang landfill which pollutes water sources used by the community ; Public perception regarding noise from waste management activities at Batulayang landfill ; Public perception of flying dust in the residential areas of the community around the Batulayang landfill ; Public perception regarding the existence of Batulayang Landfill reduces the selling value of property for people living in the landfill in the future ; Public perception of waste management activities at Batulayang Landfill increases the number of disease vectors ; Public perception regarding the increasing number of mosquitoes originating from waste management activities at Batulayang Landfill ; Public perception Concern about future health conditions ; Public perception regarding Knowledge regarding the health impacts of the existence of Batulayang Landfill ; Public perception of the importance of government intervention ; Public perception of ease of access to information to minimize health impacts ; Public perception of government follow-up to address the impacts of the existence of the Batulayang landfill ; Public perception regarding the importance of health socialization for communities living around the Batulayang landfill.

Procedures

The procedure in this research starts from the preparation stage. It begins with a preliminary study

through previous research, submitting an ethical clearance, creating a questionnaire to collect data, and creating an informed consent letter that will be given to potential respondents. Then, according to (Beaton et al., 2000) the questionnaire was tested on 30 respondents who were not included in the primary research sample The ideal sample size for testing the questionnaire is 30. Then, the data will be analyzed using validity and reliability tests to ensure that each question on the questionnaire is measurable and consistent. The results of the validity test carried out show that the p-value is < 0.05 and the calculated r is > 0.361 so that the question items tested are valid, while the reliability test results show that the alpha value is 0.983 > 0.7 so that the questionnaire can be said to be reliable, this is by the opinion of Tavakol and Dennick (2011) If the Cronbach alpha value is > 0.7 then it can be said to be reliable.

Next is the implementation stage. When the researcher explains the purpose and benefits of the research to be carried out to the research subjects and asks about the research subjects' willingness to become research respondents, then the respondents are guided to fill out the available questionnaire.

Data Analysis

Likert scale analysis is analyzed by calculating the average (mean) of the scores given by respondents to the questions asked. The steps are to determine the score range, determine the length of the interval calculated by dividing the score by the number of categories, determine the interpretation criteria, namely: 0% - 20%: Strongly disagree; 21% -40%: Disagree; 41% -60%: Neutral; 61% -80%: Agree; and 81% -100%: Strongly agree. Then calculate the average score (mean) and then the average results for each question are then interpreted based on the specified interval.

The research data was then processed and analyzed descriptively to determine the distribution characteristics of each variable. This descriptive statistical analysis includes presenting data using tables and is equipped with simple calculations. Next, inferential analysis was carried out using measurements with estimation theory. The data was processed and analyzed using the Pearson Chi-Square Test statistical method to identify differences in the average and significance of the results obtained from 2 categories, namely people living around the Batulayang landfill location and distance 100 meters to < 1 km and 1 to 2 km. Statistical tests use a 95% confidence level to determine the relationship between research variables. Testing is carried out with a significance level (α=0.05). If the p-value <0.05, then the test results are significant.

RESULTS AND DISCUSSION

Social and Demographic Characteristics of Communities Living Around the Batulayang Landfill Site

The socio-demographic characteristics of the community living around the Batulayang landfill site in this study show more female respondents than male respondents in both categories due to the availability and readiness of female respondents to participate in this research. Respondents aged 35-44 years are the most dominant group in the category of people who live far from the Batulayang landfill (1 km to 2 km), while in the category of people who live close to the Batulayang landfill (100 m to < 1 km) are the research respondents who aged 25-34 years are the most dominant, namely 42%. Research respondents who live far from the Batulayang landfill (1 km to 2 km) work as entrepreneurs, breeders, and drivers, while 36% of people who live close to the Batulayang landfill and are respondents in this study do not work. More details regarding the socio-demographic characteristics of the people living around the Batulayang landfill site can be clearly seen in Table 1.

Table 1

Social and Demographic Characteristics of Communities Living Around the Batulayang Landfill Site

Characteristics	Living away from Batulayang landfill 1 km until 2 km		Living Closer to Batulayang Landfill 100 m until < 1 km	
	Number	Percentage	Number	Percentage
		Gender		
Male	21	42.0	18	36.0
Female	29	58.0	32	64.0
Total	50	100.0	50	100.0
		Age		
17-24 Years	4	8.0	4	8.0
25-34 Years	13	26.0	16	32.0
35-44 Years	19	38.0	15	30.0
45-54 Years	8	16.0	10	20.0
55-64 Years	6	12.0	5	10.0
Total	50	100.0	50	100.0

		Employment		
Doesn't work	16	32.0	18	36.0
Government employees	1	2.0	2	4.0
Private employees	4	8.0	2	4.0
laborer	3	6.0	10	20.0
farmer	5	10.0	14	28.0
Other	21	42.0	4	8.0
Total	50	100.0	50	100.0
		Educational attainment		
No formal education	1	2.0	8	16.0
Basic education	19	38.0	23	46,.0
Middle education	11	22.0	10	20.0
Higher education	14	28.0	7	14.0
Tertiary education	5	10.0	2	4.0
		Duration of residence time		
1-5 Years	1	2.0	6	12.0
6-10 Years	7	14.0	2	4.0
11-20 Years	10	20.0	19	38.0
>20 Years	32	64.0	23	46.0
Total	50	100.0	50	100.0

Perception of The Community Living Around The Batulayang Landfill Site Regarding Environmental and Health Problems

Table 2 shows the public's perception regarding the decline in property with a p-value of 0.018 < 0.05 and the public's perception regarding the increase in the number of mosquitoes due to the presence of the Batulayang landfill with a p-value of 0.016 ≤ 0.05 so that there is no statistically significant difference between the two based on location or the distance to where people live.

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Table 2

Perception of The Community Living Around The Batulayang Landfill Site Regarding Environmental and Health Problems

Characteristics	Living Closer to Batulayang Landfill 100 m until < 1 km					Living away from Batulayang landfill 1 until 2 km					Sig
	SD (%)	DA (%)	N (%)	A (%)	SA (%)	SD (%)	DA (%)	N (%)	A (%)	SA (%)	
Concerns about future environmental conditions	13 (26)	4 (8)	8 (16)	6 (12)	19 (38)	12 (24)	6 (12)	8 (16)	10 (20)	14 (28)	0.699
Scattered rubbish	7 (14)	10 (20)	8 (16)	10 (20)	15 (30)	6 (12)	4 (8)	10 (20)	10 (20)	20 (40)	0.465
The existence of a landfill disrupts environmental comfort	7 (14)	8 (16)	16 (32)	6 (12)	13 (26)	9 (18)	9 (18)	6 (12)	7 (14)	19 (38)	0.195
Bad odour	2 (4)	2 (4)	6 (12)	9 (18)	31 (62)	2 (4)	2 (4)	4 (8)	12 (24)	30 (60)	0.932
Water pollution	18 (36)	9 (18)	5 (10)	7 (14)	11 (22)	20 (40)	5 (10)	8 (16)	5 (10)	12 (24)	0.678
Noise pollution	26 (52)	7 (14)	9 (18)	6 (12)	2 (4)	27 (54)	2 (4)	9 (18)	6 (12)	6 (12)	0.309
Dust	25 (50)	9 (18)	4 (8)	4 (8)	8 (16)	23 (46)	6 (12)	11 (22)	6 (12)	4 (8)	0.224
Decrease in property value	23 (46)	16 (32)	7 (14)	2 (4)	2 (4)	37 (74)	9 (18)	1 (2)	0 (0)	3 (6)	0.018
Increase in the number of disease vectors	2 (45)	6 (12)	6 (12)	14 (28)	22 (44)	5 (10)	4 (8)	8 (16)	19 (38)	14 (28)	0.342
Increase in the number of mosquitoes	3 (6)	2 (4)	4 (8)	14 (28)	27 (54)	1 (2)	4 (8)	10 (20)	23 (46)	12 (24)	0.016
Concerns about future health conditions	15 (30)	12 (24)	11 (22)	1 (2)	11 (22)	20 (40)	8 (16)	9 (18)	8 (8)	5 (10)	0.052
Knowledge understanding oh health impacts of the presence of a landfill	20 (40)	15 (30)	10 (20)	2 (4)	3 (6)	20 (40)	13 (26)	8 (8)	4 (8)	5 (10)	0.821
easy access to information regarding health impacts	6 (12)	11 (22)	4 (8)	18 (36)	11 (22)	5 (10)	13 (26)	2 (4)	23 (46)	7 (14)	0.658
The importance of health outreach to the community	2 (2)	1 (2)	6 (12)	8 (16)	33 (66)	1 (2)	3 (6)	1 (2)	5 (10)	40 (80)	0.18

Table 2 above shows the influence of location or distance where people live on perceptions of environmental and health problems. The most significant percentage of perceptions regarding the importance of health campaigns or socialization is for people who live near the Batulayang landfill location with a distance of 100 to < 1 km, namely 66%, and people who live far from the Batulayang landfill location with a distance of 1 km to 2 km, namely 80 %, this is in line with Ngwu's research (Ngwu, 2017) Health campaigns or outreach are activities that need to be carried out to increase public awareness about the importance of implementing healthy living behaviors. This can also help and facilitate the community in making effective decisions to improve public health.

The perception of unpleasant odors originating from the Batulayang landfill is often felt by people who live at the Batulayang landfill with a distance of 100 to < 1 km, namely 62%, and people who live near the Batulayang landfill with a distance of 1 km to 2 km. Namely, as much as 60% of hydrogen sulfide contributes to odors originating from landfill sites. Unpleasant smells can be caused by ineffective landfill management (Njoku et al., 2018). Implementing the sanitary landfill method, a waste processing system that covers waste using soil every day can minimize unpleasant odors. This method is most widely applied by developed countries (Njoku et al., 2019). Apart from that, odors can be minimized with vegetation innovation or management or by using plants to reduce unpleasant odors and support aesthetic aspects (Jemali et al., 2022). The Batulayang landfill also implements this to minimize pollution and unpleasant odors by planting endemic plants such as bean trees, ferns, taro, pineapple, cassava, banana, corn, and various types of grass. Perceptions regarding the existence of the landfill contribute to the increase in the number of mosquitoes felt by people living near the Batulayang landfill with a distance of 100 m to < 1 km, namely 54%. The existence of the landfill creates conditions that are conducive to the breeding of disease vectors such as rodents and mosquitoes (Krystosik et al., 2020; Urme et al., 2021).

In the public perception of the decline in property obtained a p-value of 0.018 <0.05 meaning that there is no statistically significant difference according to the location or distance of the community's residence. Based on interviews with respondents living around the Batulayang landfill location, the existence of the Batulayang landfill does not affect the value of land and building property in the local area. According to the community, the price and value of land and buildings on Jalan Kebangkitan Nasional which is around the Batulayang landfill location increases every year. This is in contrast to research by Njoku, Edokpayi and Odiyo, (2019) and Nnamdi C, Maureen C and Omobolaji O, (2022) which states that the existence of a landfill can reduce the property value of land and buildings around it due to community concerns about the resulting environmental impacts, health risks, visual impacts, negative perceptions and disruption of quality of life. According to Abhyankar, Prakash and Singla, (2023) The negative impact of the decline in the value of land and building property from the existence of the landfill will not affect a distance of more than 10 km, to increase the value of land and building property in the area around the landfill, it is necessary to provide additional facilities such as entertainment facilities and recreational facilities. Based on interviews with the Batulayang landfill manager, the existence of the Batulayang landfill does not affect the value of land and building property in the local area because the condition of the road access on Jalan Kebangkitan Nasional is good and not damaged. In addition, the needs, types of buildings and income levels of the local community can also affect the value of land and building property at the landfill location. Therefore, the landfill does not have a negative effect and does not affect the value of land and building property (Nwosu & Olofa, 2015). Public perception regarding the increase in the number of mosquitoes due to the existence of Batulayang landfill with a p-value of 0.016 < 0.05 so that there is statistically significant difference by location or distance of people's residence around Batulayang landfill. Previous studies have shown that the presence of a landfill with a distance of 250 meters to 500 meters can cause significant water and air pollution (where the p-value is 0.230> 0.005). In addition, environmental problems such as the impact of the existence of a landfill on the environment and noise pollution also show statistically significant differences (with p-values of 0.551 and 0.247> 0.005) (Nnamdi C et al., 2022).

Health History and Symptoms of People Living Around the Batulayang Landfill

Table 3 shows the history and health symptoms experienced by community respondents living around the Batulayang landfill. The history of illnesses most commonly suffered by respondents who live close to the Batulayang landfill site (100 m to < 1 km) such as respiratory problems (12%), recurrent flu (28%), skin diseases (36%), typhoid fever (14%). Meanwhile, for respondents who live further from the Batulayang landfill location (1 km to 2 km). Such as recurrent flu (38%), typhoid fever (22%), and skin diseases (12%). In addition, there was no statistically significant difference in health history between respondents from both groups (where p-value > 0.05) except for skin disease (p-value 0.005 ≤ 0.05). There was a difference that achieved the goal, as seen in the table above.

Tabel 3
Health History and Symptoms of People Living Around the Batulayang Landfill

Characteristics	Living Closer to Batulayang Landfill 100 m until < 1 km				Living away from Batulayang landfill 1 until 2 km				Sig
	Yes	%	No	%	Yes	%	No	%	
Respiratory disorders	6	12.0	44	88.0	6	12.0	44	88.0	1.00
Recurrent flu	14	28.0	36	72.0	19	38.0	31	62.0	0.288
Eye irritation	1	2.0	49	98.0	3	6.0	47	94.0	0.307
Hearing disorders	2	4.0	48	96.0	7	14.0	43	86.0	0.081
Skin disease	18	36.0	32	64.0	6	12.0	44	88.0	0.005
Cough/TB	2	4.0	48	96.0	1	2.0	49	98.0	0.546
Asthma	0	0.0	50	100.0	3	6.0	47	94.0	0.079
Typhoid fever	7	14.0	43	86.0	11	22.0	39	78.0	0.298
Dengue fever	4	8.0	46	92.0	5	10.0	45	90.0	0.727
Other disease	7	14.0	43	86.0	11	22.0	39	78.0	0.298

Chi-square test, *Significance p-value ≤ 0.05

Studies show residents living near landfill sites are more susceptible to respiratory diseases (Kret et al., 2018; Njoku et al., 2019). Bacteria and volatile organic compounds originating from landfills cause respiratory problems. Emissions from waste cars, trucks, and bulldozers can also contribute to emissions from landfill sites (Vimercati et al., 2016). According Njoku et al., (2019) exposure to organic compounds and pathogenic bacteria such as bacteria and fungi originating from landfill can mix into the air, causing flu and coughs. According to Odonkor & Mahami, (2020) The number of bacteria and fungi at the landfill site and its surroundings is much higher. Chemical pollutants produced by landfill operations are chemical pollutants such as heavy metals (Cr, Fe, Cd, Ni, Zn, Mg, and Pb), methane gas (H_2S and CO), Microorganisms (Coliform and Clostridia fringes, Shygella dysentery) which can cause disease. Skin, eye irritation, digestive tract disorders, and allergies (Khoiron et al., 2020). Typhoid fever is caused by the bacteria Salmonella typhi, According Akullian et al., (2015) Typhoid fever is caused by poor environmental sanitation, environments with poor sanitation contribute greatly to the transmission of typhoid fever in children and adults. According to Omokaro et al., (2024), residents living within a 3 km radius of the landfill experience health symptoms, namely headaches, nausea, skin irritation, dysentery, diarrhea and air-related illnesses. Meanwhile, according to Iddrisu & Debrah, (2021), people who live 2 km from the landfill have higher health risks than people who live far from the landfill. These health risks include leukemia and nervous disorders.

This research uses a cross-sectional approach, where data is collected at only one point. This makes it difficult to draw definitive conclusions from the results. For example, research results show that people who live close to landfills have a higher risk of skin disease than those who live far from landfills. However, this study cannot confidently conclude that the presence of landfill directly causes skin disease. Other factors such as economic status, access to health services, living environmental conditions, air quality used for bathing, washing, toileting purposes, and personal hygiene also have the potential to influence.This research was conducted only in one location, so the results cannot be directly applied to the population living around the Batulayang landfill or other landfills. Data regarding health history and disease symptoms were obtained from research respondent reports. Some respondents may have reported the impacts of the Batulayang landfill excessively or inaccurately. Despite its limitations, this research provides valuable insight into the challenges faced by residents living around landfills. However, further research is needed to understand better the relationship between landfills' presence and the health impacts they cause.

CONCLUSION

The public's perception regarding the decline in property with a p-value of 0.018 < 0.05 and the public's perception regarding the increase in the number of mosquitoes due to the presence of the Batulayang landfill with a p-value of 0.016 ≤ 0.05 so that there is The no The statistically The significant difference between the two based on location. Or the distance to where people live and statistically significant differences in medical history between respondents from the two groups (where p-value > 0.05) except for skin diseases (p-value 0.005 ≤ 0.05). There were no significant differences.

Waste management practices are still a problem for cities in developing countries because they impact the environment and the welfare of the surrounding community. Through a cross-sectional survey, this study assessed the perceptions of people living around landfills and their impact on the environment and health. This research concludes that people who live far or close to landfills have high environmental impacts and health risks.

Government intervention with communities close to landfill sites is crucial to ensure their health and welfare.

SUGGESTION

Based on the findings of this research, several suggestions can be given for further research, namely case studies from different landfill locations, to understand what factors influence community perceptions as well as the history and health symptoms of people living in landfills. For example, socio-economic factors impact the environment resulting from the landfill's existence, access to health services, the conditions in which people live, and policies that influence the relationship between the landfill and the surrounding community.

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