

# The Community's Knowledge Concerning Waste Management in the Borobudur Cultural Heritage Park Environment

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**Abstract.** According to the Marketing Services and Development of PT TWC, waste around the Borobudur Temple Tourism Park area reaches 4 tons per day, consisting not only of organic waste such as leaves but also plastic waste. This issue is one of the causes of climate change that can trigger various environmental disasters if not managed properly. This research aims to determine the relationship between knowledge about waste and waste management among the community with waste management awareness in the Borobudur Temple Tourism Park. It is a quantitative study with a cross-sectional approach, sampling 375 people using random sampling. Data analysis was conducted using bivariate tests (Chi-Square). Variables related to waste management awareness include knowledge about waste (p-value = 0.0004) and knowledge about waste management methods (p-value = 0.0003). The conclusion of this research is that knowledge about waste and knowledge about waste management methods are associated with waste management awareness in the Borobudur Temple Tourism Park environment.

## 1 Introduction

The most dominant environmental issue in the past decade has been the issue of global warming along with its interconnected problems. Global warming causes climate change, triggering various environmental disasters, ranging from minor to catastrophic, which

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potentially threaten life on this planet. These disasters include increasingly severe storms from year to year, climate instability, rising air temperatures, sea level rise, polar ice melting, floods, and so on[1]. Waste is a part of human activities that plays a role in global warming by contributing greenhouse gases such as CH<sub>4</sub> and CO<sub>2</sub>. When waste is accumulated over time, it undergoes decomposition and releases gases into the air. The degradation process of organic waste produces CH<sub>4</sub> and CO<sub>2</sub> gases, where CH<sub>4</sub> has a greenhouse gas emission rate 21 times greater than CO<sub>2</sub> if released into the air without proper handling[2][3].

Municipal or rural solid waste is also usually dumped in low-lying areas, adding to greenhouse gas emissions, odor production, and fire hazards that will adversely affect the local ecosystem. Landfills contribute to CH<sub>4</sub> production and about 29% of all GHG emissions, which is more than 15% of the global average contribution[4].

The accelerating pace of climate change requires large-scale mitigation efforts to reduce emissions, both domestically and globally, to be undertaken promptly. Although its contribution is small in terms of total percentage, the accumulation of waste that generates methane gas also warrants significant attention in emission reduction mitigation efforts[4]. Data predicts that by 2030 and 2050, global GHG emissions will increase to 64% and 76% due to uncontrolled sewage systems[4][5].

Based on waste monitoring, Indonesia's waste generation in 2016 reached 66 million tons per year. This waste consists of organic waste (food scraps, wood, branches, leaves) at 57%, plastic waste at 16%, paper waste at 10%, and other materials (metals, textile fabrics, rubber, leather, glass) at 17%. From this data, it is evident that many people have not managed their waste properly, resulting in a very large amount of waste generation. Based on data from the Environmental Agency, waste in Indonesia in 2019 (29.14 million tons), in 2020 (32.82 million tons) in 2021 (21.45 -21, 88 million tons), in 2023 waste generation is 31,363,906.49 tons / year,

Waste criteria in Indonesia in 2021 achievements and handling of household waste with waste generation 18,172,377.98 tons / year, waste reduction 17.55% or 3,189,098.87 tons / year, waste handling 54.15% (9,840,983.20 tons / year), managed waste 71.7% (13,030,082.07 tons / year), unmanaged waste 28.3% (5,142,295.91 tons / year). Based on the order of provinces in Indonesia 21.45 million tons, as the largest waste producer, Central Java (3.17 million tons), (Mivan Mahdi,) (Dhini, 2022), in 2023 from the existing waste generation, the waste reduction process is 14.68% (4,604,066.38 tons/year), 49.99% waste handling (15,678,739.76 tons/day), 64.67% managed waste (20,282,806.14) and 35.33% unmanaged (11,081,100.35 tons/year).

Based on SIPSN data, the composition of waste in Indonesia in 2021 is food waste (27.2%), plastic (15.1%), wood, twigs or leaves (12.7%), paper or cardboard (11.9%), fabric, glass and metal waste around 7-8% and the rest are others. Waste management is minimal so it needs serious handling, plastic 45% of the 65 million tons per year of waste is not managed. Based on the estimation of the word economic forum 32% has polluted the plains and oceans. The amount of waste is increasing, waste management constraints[1][3].

Factors influencing the control of waste Data management systems include population density, social and economic factors, attitudes and behaviors of the community, culture, and community knowledge[4][6][7]. Plastic waste is an environmental issue faced by Indonesian and global communities. The problem of waste in Indonesia is complex due to the lack of public understanding of the consequences that can arise from waste, as well as the limited funds allocated by the government for the provision of adequate waste disposal systems that meet standards[8][9].

Another factor contributing to plastic waste is activities in cultural tourist areas in Indonesia. Plastic waste in Indonesia is one of the negative impacts of the increasing number of tourists in cultural areas. Indonesia is a country with many tourist destinations,

one of which is Borobudur Temple. Marketing, Services, and Development of PT TWC revealed that waste around the Borobudur Temple Tourism Park area reaches 4 tons per day, consisting not only of organic waste like leaves but also plastic waste. The situation will worsen if not managed properly as stipulated in the Waste Management Law Number 18 of 2008, which defines waste as the residue of human daily activities or solid waste from natural processes. In Indonesia, waste is commonly found on streets, public facilities, schools, and even in rivers. Waste in Indonesia is a very serious problem and also a social, economic, and cultural issue.

Minimizing waste volume efforts need to involve active participation from the community in the TWCB environment. Environmental education is the primary step needed to change people's behavior to be more environmentally conscious, and this must be supported by supportive policy implementation from relevant policymakers. Currently, waste issues are one of the important problems to address through proper management. If waste management is not done properly, various diseases may arise[10][11][12].

In general, the stages of waste management activities include collection, sorting, transportation, and disposal. The disposal stage includes landfilling, composting, open dumping, dumping in water, individual incineration, recycling, and salvaging.[13][14][15].

2 Methods

This research is a quantitative analytical study using a cross-sectional study design. The data used consist of primary and secondary data (from 20 villages in Borobudur, BPS Sub-district Data). Primary data collection was conducted using questionnaires. The sample in this study comprised 375 respondents from the Borobudur Cultural Heritage Park environment, selected using random sampling technique. The analysis conducted in this research is bivariate chi-square analysis ( $\alpha = 0.05$ ) to examine the relationship between community knowledge and waste management practices.

3 Result and Discussion

3.1 Result

Table 1. Cross-tabulation table of research variables with waste management awareness

| Variable                                   | Waste Management Awareness |      |     |      |       |     | p-value |
|--------------------------------------------|----------------------------|------|-----|------|-------|-----|---------|
|                                            | High                       |      | Low |      | Total |     |         |
|                                            | n                          | %    | n   | %    | n     | %   |         |
| Knowledge about waste                      |                            |      |     |      |       |     |         |
| 1. Low                                     | 95                         | 50.5 | 93  | 49.5 | 188   | 100 | 0,004   |
| 2. High                                    | 123                        | 65.8 | 64  | 34.2 | 187   | 100 |         |
| Knowledge about waste management practices |                            |      |     |      |       |     |         |
| 1. Incinerated                             | 126                        | 63.6 | 72  | 36.4 | 198   | 100 | 0,003   |
| 2. Buried                                  | 28                         | 54.9 | 23  | 45.1 | 51    | 100 |         |
| 3. Recycled                                | 64                         | 50.8 | 62  | 49.2 | 126   | 100 |         |

Bivariate analysis using Chi-Square and Odds Ratio. The Chi-Square analysis aims to determine whether there is a significant relationship between two variables in this study, namely knowledge about waste and knowledge about waste management processes as independent variables, and waste management awareness as the dependent variable. The Odds Ratio analysis is used to establish the magnitude of risk.

Knowledge about waste is categorized into two groups: poor and good, to examine its relationship with waste management awareness. Knowledge about waste has a significant relationship with waste management awareness. This is based on the results of the Chi-Square test with a p-value of 0.004.

Knowledge about waste management processes is categorized into three groups: incineration, burial, and recycling, to examine its relationship with waste management awareness. Knowledge about waste management processes has a significant relationship with waste management awareness. This is based on the results of the Chi-Square test with a p-value of 0.003.

### **3.2 Discussion**

The analysis results of the relationship between knowledge about waste and waste management awareness in TWCB show that respondents with high knowledge about waste have high awareness in waste management, totaling 123 individuals (65.8%), compared to respondents with low knowledge who have low awareness in waste management, totaling 93 individuals (49.5%). This indicates that the higher the community's knowledge about waste management, the higher their concern for waste management. This suggests that knowledge about waste can contribute to involvement in waste management. This study is also in line with research[16][17][18], which concludes that there is a correlation between knowledge and waste management. This is because waste can be managed properly if respondents' level of knowledge aligns with their attitudes and participation, and it also needs to be supported by the availability of waste management facilities. However, this contrasts with research[18][19][20][21] which states that there is no correlation between knowledge and waste management practices. In their study, they found that waste management practices among respondents were poor despite their high level of knowledge.

The statistical test results indicate a significant relationship between knowledge about waste management practices and waste management awareness, with a p-value of 0.0003. Meanwhile, the analysis results of the relationship with the highest knowledge about waste management practices, namely incineration, showing high awareness in waste management, with 126 respondents (63.6%). This can be interpreted as the most commonly practiced waste management method (incineration) leading to high community awareness in waste management. Knowledge is the result of understanding formed after observing a particular object. Without knowledge, one lacks the foundation to make decisions or take action on the issues at hand[22][3]. Environmental concern is an attitude and action that always seeks to prevent damage to the natural environment around it and to develop efforts to repair existing environmental damage[23][24][25][26]. Burning waste is one method of waste treatment, but usually, incineration is done in locations separate from residential areas. Attitudes towards waste have become ingrained in culture within society. This influences the community's mindset towards waste, often not aligning properly. An example is the sight of piled-up waste that disturbs the view and causes discomfort[27][28][29]. This study is relevant to the results conducted by Agboola O, abah E, Andrew O in the southern continent, especially Oktupo Nigeria, which states that 88.6% of open burning of waste despite the effects of environmental pollution from the smoke produced. Effective solid waste management can mitigate adverse health and minimize environmental impacts, conserve resources and improve the livability of its citizens[12]. Solid waste treatment can be applied using conversion technologies so that it becomes a valuable form of energy such as thermochemical, biochemical and mechanical physics techniques[30].

Another technique for dealing with waste can also be through the development of a waste management application tool as a provider of information about waste disposal, waste collection and management that can be updated regularly (Pardini K, 2020), besides

that waste management is also important to involve stakeholders, experts in various fields and policy support[31].

However, this is contrary to the findings of research, which states that there is no significant relationship between knowledge and management attitudes among their respondents. Good knowledge but poor attitudes towards waste management are caused by a lack of information about proper waste processing methods[32][33][34].

## 4 Conclusion

Based on the research conducted on 375 respondents regarding community knowledge and awareness of waste management in the Borobudur Temple Tourism Park, it shows a relationship between community knowledge about waste and knowledge about waste management with waste management awareness. Community awareness in managing waste is crucial in addressing the waste issues in the Borobudur Temple Tourism Park environment.

## References

- [1] L. Kusumaningrum *et al.*, “Comparison of Waste Management between Indonesia and South Korea,” vol. 1, no. 1, pp. 13–19, 2020.
- [2] B. K. Sovacool, S. Griffiths, J. Kim, and M. Bazilian, “Climate change and industrial F-gases : A critical and systematic review of developments , sociotechnical systems and policy options for reducing synthetic greenhouse gas emissions,” *Renew. Sustain. Energy Rev.*, vol. 141, no. August 2020, p. 110759, 2021, doi: 10.1016/j.rser.2021.110759.
- [3] A. F. Widiyanto, S. Pramatama, and M. Wijayanti, “Original article Waste handling model based on local wisdom system in Indonesia,” 2023, doi: 10.4081/jphia.2023.2590.
- [4] S. Mor and K. Ravindra, “Municipal solid waste landfills in lower- and middle-income countries : Environmental impacts , challenges and sustainable management practices,” *Process Saf. Environ. Prot.*, vol. 174, no. November 2022, pp. 510–530, 2023, doi: 10.1016/j.psep.2023.04.014.
- [5] A. A. Susanti, A. A. Antika, R. Pratama, and F. G. Pradana, “Implementasi dan Pengembangan Program Unggulan Kampung Iklim ( Proklim ) di Desa Kertonatan,” vol. 4, no. 1, pp. 58–68, 2022, doi: 10.23917/bkkndik.v4i1.19183.
- [6] U. Leknoi, A. Yiengthaisong, and S. Likitlersuang, “Social factors influencing waste separation behaviour among the multi-class residents in a megacity : A Survey analysis from a community in,” *Sustain. Futur.*, vol. 7, no. October 2023, p. 100202, 2024, doi: 10.1016/j.sftr.2024.100202.
- [7] N. B. Karnowati and T. Yuwono, “Identifikasi Faktor Eksternal Terhadap Peran Masyarakat Dalam Pengelolaan Sampah Plastik Pantai Teluk Penyus Cilacap,” *J. Ilmu Lingkung.*, vol. 21, no. 3, pp. 522–533, 2023, doi: 10.14710/jil.21.3.522-533.
- [8] B. Jit, A. Chakraborty, and R. Sehgal, “A systematic review of industrial wastewater management : Evaluating challenges and enablers,” *J. Environ. Manage.*, vol. 348, no. October, p. 119230, 2023, doi: 10.1016/j.jenvman.2023.119230.
- [9] E. Martiyani, S. Jaksa, J. Kh, A. Dahlan, and C. Timur, “Faktor-Faktor yang Berhubungan dengan Pengelolaan Sampah pada Pedagang di Pasar Sepatan Kabupaten Tangerang Tahun 2022,” vol. 3, no. 2, pp. 125–140, 2023.
- [10] E. Review, “Raising Awareness on Solid Waste Management through Formal

- Education for Sustainability : A Developing Countries,” 2021.
- [11] W. Fadhillah, N. Iffah, N. Imran, S. Norkhadijah, S. Ismail, and M. H. Jaafar, “Household solid waste management practices and perceptions among residents in the East Coast of Malaysia,” *BMC Public Health*, pp. 1–20, 2022, doi: 10.1186/s12889-021-12274-7.
- [12] I. R. Abubakar, K. M. Maniruzzaman, U. L. Dano, F. S. Alshihri, and T. I. Alrawaf, “Environmental Sustainability Impacts of Solid Waste Management Practices in the Global South,” 2022.
- [13] Z. Zhang *et al.*, “Science of the Total Environment Municipal solid waste management challenges in developing regions : A comprehensive review and future perspectives for Asia and Africa,” *Sci. Total Environ.*, vol. 930, no. February, p. 172794, 2024, doi: 10.1016/j.scitotenv.2024.172794.
- [14] A. Aprilia, “Waste Management in Indonesia and Jakarta : Challenges and Way Forward,” no. October, 2021.
- [15] I. P. Windiari and M. Salsabiela, “Persepsi Masyarakat dalam Pengelolaan Sampah di Kecamatan Indramayu,” vol. 13, no. 2, pp. 363–380, 2022.
- [16] G. H. Shoddo, “Heliyon Exposure , knowledge , and perceptions of hazards associated with solid waste management at the household level in jigjiga town , northeast Ethiopia,” *Heliyon*, vol. 10, no. 9, p. e29745, 2024, doi: 10.1016/j.heliyon.2024.e29745.
- [17] T. Sakcharoen, W. Niyommaneerat, and B. Faiyue, “Heliyon Low-carbon municipal solid waste management using bio-based solutions and community participation : The case study of cultural tourism destination in Nan , Thailand,” *Heliyon*, vol. 9, no. 11, p. e22025, 2023, doi: 10.1016/j.heliyon.2023.e22025.
- [18] S. Asnur and S. Mustafa, “Relationship Of Waste Management With Knowledge , Attitude And Participation Of Traders In The Traditional Terong Market In,” no. 2012, pp. 625–631, 2021.
- [19] G. Kabito, “Knowledge , Attitudes , Practices , and Determinants Towards Wastewater Management in Northwest Ethiopia: A Community-Based Cross-Sectional Study,” pp. 2697–2705, 2021.
- [20] H. Eshete, A. Desalegn, and F. T. Id, “Knowledge , attitudes and practices on household solid waste management and associated factors in Gelemso town , Ethiopia,” no. February, 2023, doi: 10.1371/journal.pone.0278181.
- [21] D. Sherpa and S. Pathak, “Knowledge and Practice regarding Waste Management among Community People of Gokarneshwor Ward-05, Nepal,” *Asian Community Heal. Nurs. Res.*, vol. 1, no. 2, p. 38, 2019, doi: 10.29253/achnr.2019.13825.
- [22] P. Program, P. Masyarakat, D. Pendidikan, and P. Sampah, “1 , 2 1-2,” vol. 12, no. November, pp. 677–686, 2023.
- [23] R. T. Sakao, N. Bocken, N. Nasr, Y. Umeda, and R. En, “Tag edAP R Fi ur Tag edAP R En CIRP Annals - Manufacturing Technology Tag edAP R Fi ur Tag edAP R En Tag edAP R H1 Implementing circular economy activities in manufacturing for environmental sustainability Tag edAP R En Tag edAP R En Tag edAP R Fi ur Tag ,” *CIRP Ann. - Manuf. Technol.*, vol. 73, no. 2, pp. 457–481, 2024, doi: 10.1016/j.cirp.2024.06.002.
- [24] D. Qin, P. Gao, F. Aslam, and M. Sufian, “Case Studies in Construction Materials Short Communication A comprehensive review on fire damage assessment of reinforced concrete structures,” *Case Stud. Constr. Mater.*, vol. 16, no. August 2021, p. e00843, 2022, doi: 10.1016/j.cscm.2021.e00843.
- [25] W. W. W. P. Net, “Environmental Care Attitude Analysis of Prospective Biology Teachers,” vol. 13, no. 2, pp. 72–78, 2023, doi: 10.47750/pegegog.13.02.09.
- [26] S. Korelasional, P. Mahasiswa, S. Melawi, A. Khoiri, and E. Rudiansyah, “1 , 2 1,2,”

- vol. 7, no. 2, pp. 12–18, 2019.
- [27] M. F. Oktarini, H. Hapsari, and W. Triyuli, “The Social And Cultural Aspects Of Waste Disposal Management In The Planning,” vol. 14, no. March, pp. 31–38, 2023, doi: 10.21512/humaniora.v14i1.7877.
- [28] H. Hu, X. Li, A. D. Nguyen, and P. Kavan, “A Critical Evaluation of Waste Incineration Plants in Wuhan ( China ) Based on Site Selection , Environmental Influence , Public Health and Public Participation,” pp. 7593–7614, 2015, doi: 10.3390/ijerph120707593.
- [29] M. Z. Elamin, K. N. Ilmi, T. Tahrirah, Y. Ahmad, and Z. Yanuar, “Analysis Of Waste Management In The Village Of Disanah , District Of Sreseh,” pp. 368–375, 2016.
- [30] A. D. Seboka, G. A. Ewunie, J. Morken, L. Feng, and M. S. Adaramola, *Potentials and prospects of solid biowaste resources for biofuel production in Ethiopia: a systematic review of the evidence*, no. 123456789. Springer Berlin Heidelberg, 2023. doi: 10.1007/s13399-023-04994-0.
- [31] D. Definitive *et al.*, “REPAiR REsource Management in Peri-urban AREas :,” no. 688920, 2020.
- [32] A. Qurrota, D. Noerjoedianto, and O. Lesmana, “Knowledge , Attitudes , Age , Education Level Factors to Waste Management,” vol. 4, no. 1, pp. 9–15, 2022.
- [33] L. Mufaridah and D. Handayani, “He Relationship Between The Level Of Knowledge And Attitudes With The Behavior Of Waste Management In Housewives In The Rural Village Of Sidoarjo Abstract : Garbage is the result of human activities that have lost their main function and are solid . Waste,” 2014.
- [34] Y. K. Ashar, D. K. Lingkungan, F. K. Masyarakat, U. Islam, N. Sumatera, and P. Sampah, “e-ISSN 2685-0389,” vol. 2, no. 1, 2020.