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ANALYSIS OF COMMUNITY PARTICIPATION IN 3R-BASED WASTE MANAGEMENT IN LHOKNGA SUBDISTRICT, ACEH BESAR REGENCY

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ABSTRACT

Waste management in Lhoknga Subdistrict, Aceh Besar Regency, continues to pose a significant environmental challenge requiring urgent attention. This study aims to analyze the level of community participation in 3R-based (Reduce, Reuse, Recycle) waste management and to examine the relationship between individual characteristics and participation levels. The study employed a quantitative approach using questionnaires distributed to 100 randomly selected respondents. The collected data were analyzed using descriptive and inferential statistical methods through Partial Least Squares Structural Equation Modeling (PLS-SEM) implemented in SmartPLS 4.0. The results indicated that the highest level of community participation occurred in labor contributions (70%), followed by material contribution (53%), waste management practices (51%), and ideas (47%), whereas skills-based participation was the lowest (37%). The SmartPLS analysis revealed that individual characteristics significantly influenced participation in ideas, labor, and skills, but had no significant effect on material contribution and waste management practices. These findings indicate that enhancing community participation in 3R-based waste management requires educational and community empowerment programs tailored to local community characteristics, supported by adequate waste management infrastructure and sustained government commitment.

Keywords : Community participation, Waste management, 3R, Individual characteristics, SmartPLS

ABSTRAK

Pengelolaan sampah di Kecamatan Lhoknga, Aceh Besar, masih menjadi permasalahan lingkungan yang memerlukan keseriusan. Penelitian ini bertujuan untuk menganalisis tingkat partisipasi masyarakat dalam pengelolaan sampah berbasis 3R (Reduce, Reuse, Recycle) serta mengkaji hubungan antara karakteristik individu dengan tingkat partisipasi tersebut. Penelitian ini menggunakan pendekatan kuantitatif dengan penyebaran kuesioner kepada 100 responden yang dipilih secara acak. Data yang diperoleh dianalisis menggunakan metode deskriptif dan inferensial dengan bantuan perangkat lunak SmartPLS 4.0 melalui pendekatan Partial Least Squares–Structural Equation Modeling (PLS-SEM). Hasil penelitian menunjukkan bahwa tingkat partisipasi masyarakat tertinggi terdapat pada aspek tenaga (70%), diikuti oleh partisipasi dalam bentuk harta benda (53%), pengelolaan sampah (51%), dan buah pikir (47%), sedangkan partisipasi dalam aspek keterampilan merupakan yang terendah, yaitu sebesar 37%. Hasil analisis menunjukkan karakteristik individu berpengaruh signifikan terhadap partisipasi dalam bentuk buah pikir, tetapi tidak berpengaruh signifikan terhadap partisipasi dalam bentuk harta

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benda dan praktik pengelolaan sampah. Temuan ini menunjukkan bahwa peningkatan partisipasi masyarakat dalam pengelolaan sampah berbasis 3R memerlukan program edukasi dan pemberdayaan masyarakat yang disesuaikan dengan karakteristik masyarakat, serta didukung oleh ketersediaan fasilitas pengelolaan sampah yang memadai dan keterlibatan pemerintah yang berkelanjutan.

Kata kunci : *Partisipasi masyarakat, Pengelolaan sampah, 3R, Karakteristik individu, SmartPLS*

Introduction

Waste management has become an increasingly critical environmental issue due to rapid population growth and expanding development activities. The continuous increase in annual waste generation necessitates an effective and sustainable waste management system. (Muchlis et al., 2023). According to data from the National Waste Management Information System (SIPSN) in 2023, the total waste generation in Indonesia reached 38,795,897.60 tons per year, of which only 62.13% was properly managed. These figures indicate that approximately 37.87% of generated waste remains inadequately managed. The government has made efforts to address this issue through the implementation of Law No. 18 of 2008 concerning Waste Management, which emphasizes the importance of the 3R principles (Reduce, Reuse, Recycle) and active community participation in waste management (Ivakdalam & Far, 2022).

However, in practice, community participation in waste management remains relatively low. Littering and open waste burning remain common practices, leading to environmental pollution and negative impacts on public health (Hanum et al., 2018). Poor environmental sanitation also create potential breeding grounds for pathogenic organisms and disease-spreading vectors (Khoiriyah, 2021). Preliminary field observations in Lhoknga Subdistrict revealed several challenges in waste management, including the uneven distribution of temporary waste collection sites (TPS), the inactivity of the local waste bank, limited waste collection services in several villages, and the presence of illegal dumping in vacant land. These findings indicate that community participation in 3R-based waste management remains limited and highlight the need to strengthen community involvement in achieving sustainable waste management practices.

Previous studies have examined community participation in waste management and the implementation of 3R practices across various regions of Indonesia. However, most have primarily focused on describing participation levels or identifying general influencing factors, while giving limited attention to the relationship between individual characteristics and different forms of community participation. In addition, empirical evidence from coastal tourism areas, such as Lhoknga Subdistrict, remains limited despite the unique waste management challenges associated with tourism activities. Therefore, this study addresses these gaps by examining the relationship between individual characteristics and five forms of community participation, namely ideas, labor, material contribution, skills, and waste management practices, in the implementation of 3R-based waste management. Using the SmartPLS approach, this study provides empirical evidence that can

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support the development of more targeted strategies to enhance community participation based on local community characteristics.

Methods

This study employed a quantitative approach with data collected through observations and questionnaires distributed to the community in Lhoknga Subdistrict, Aceh Besar Regency. The total population in this study was 17,392 people, while the number of respondents was determined using the Slovin formula with a margin of error of 10%. Based on the calculation results, a total of 100 respondents were selected as representative of the study population. Respondents were selected using a random sampling technique to ensure that every individual had an equal opportunity to be included in the sample.

In addition, this research used a cross-sectional approach, where data were collected at a single point in time. All questions in the questionnaire were designed to gather information about the respondents' current conditions and behaviors, such as waste sorting habits, involvement in 3R (Reduce, Reuse, Recycle) activities, and their perceptions of waste management in their surroundings. The collected data included the existing condition of waste management, community participation across five aspects (ideas, labor, material, skills, and management), as well as individual characteristics such as age, education level, occupation, income, and length of residence in the study area. The research instrument was a questionnaire developed using a Likert scale, where each response was assigned a score: "very often" (5), "often" (4), "rarely" (3), "seldom" (2), and "never" (1). This scoring system was used to convert qualitative data into quantitative form, facilitating the process of data analysis and statistical interpretation.

In this study, individual characteristics, including age, education level, occupation, income, and length of residence, were treated as the independent variables. These characteristics were collected through a structured questionnaire and categorized according to the respondents' demographic profiles. The dependent variable was community participation in 3R-based waste management, which was measured through five dimensions, namely participation in the form of ideas, labor, material contribution, skills, and waste management practices. These variables were selected to examine the relationship between respondents' characteristics and their level of participation in 3R-based waste management.

The obtained data were analyzed using descriptive and inferential methods. Descriptive analysis was applied to describe the existing condition of waste management and the level of community participation based on the mean score of each indicator. Meanwhile, inferential analysis was conducted to examine the relationship between individual characteristics and community participation in 3R-based waste management. The analysis was performed using SmartPLS 4.0 software with the Partial Least Squares–Structural Equation Modeling (PLS-SEM) approach. The measurement model (outer model) was evaluated using indicator outer loading values to assess the validity of the measurement model. Subsequently, the structural model (inner model) was evaluated using path coefficients, t-statistics, and p-values obtained through the bootstrapping procedure to determine the relationships between latent variables.

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Results and Discussion

Existing Condition of Waste Management

The observation results presented in Figure 1 indicate that waste management in Lhoknga Subdistrict has not been running optimally. Most residents still dispose of waste in open areas, along roadsides, and on vacant land without proper monitoring. Waste collection and transportation activities are provided irregularly due to limited numbers of vehicles and sanitation workers. In addition, waste management facilities such as waste banks and temporary disposal sites (TPS) are not yet functioning effectively.

This condition suggests that the waste management system in Lhoknga Subdistrict remains conventional and has not fully implemented the principles of Reduce, Reuse, and Recycle (3R). The lack of socialization and public education from local authorities has also led to a low level of community awareness regarding the importance of environmentally friendly waste management. Many residents continue to perceive waste management as solely the responsibility of the government rather than a shared obligation. As a result, community participation in waste sorting activities remains low, and there is minimal initiative for household-level waste processing.

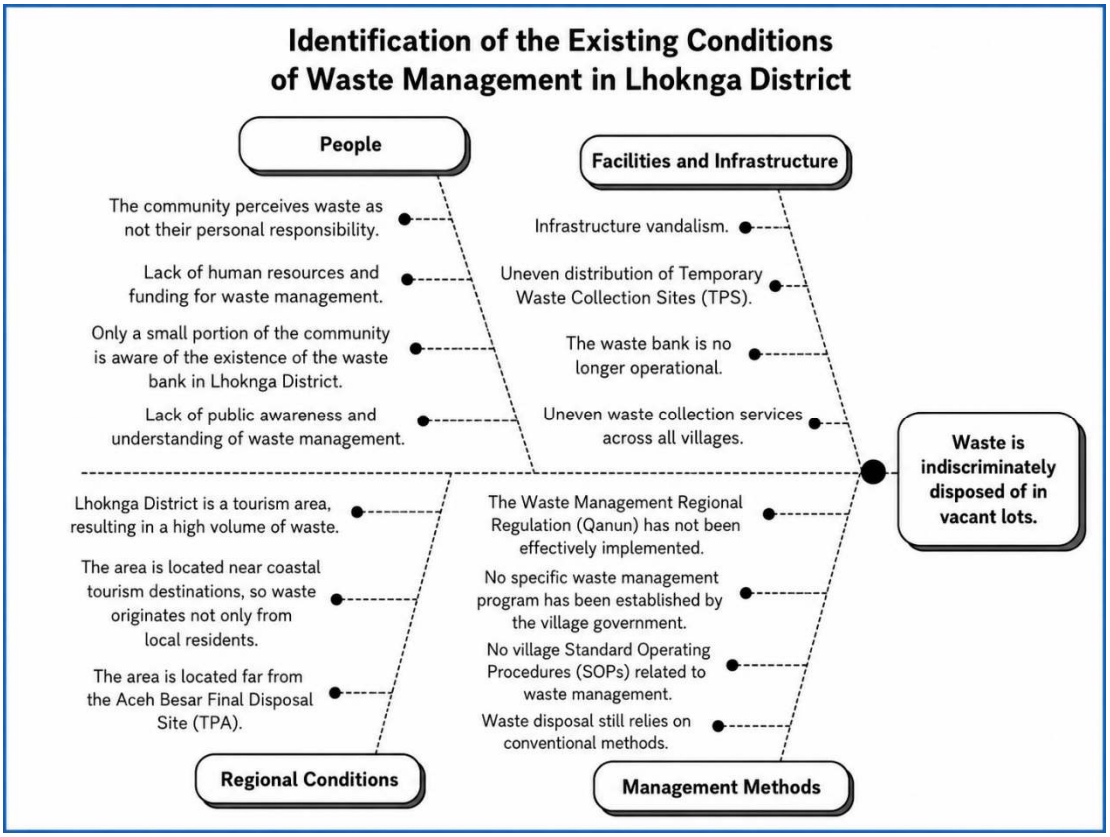

Figure 1. Existing Condition of Waste Management

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Participation in 3R-Based Waste Management

Community participation plays an essential role in supporting the success of environmental management programs, as active involvement of the community can enhance the effectiveness and sustainability of the implemented activities. In this study, community participation was analyzed to determine the extent of residents' involvement in various activities related to waste and environmental management within the study area. The analysis was conducted based on five main aspects that represent different forms of community contribution: participation in ideas, labor, materials, skills, and management activities. The results of the analysis of these five aspects are presented in Figure 2.

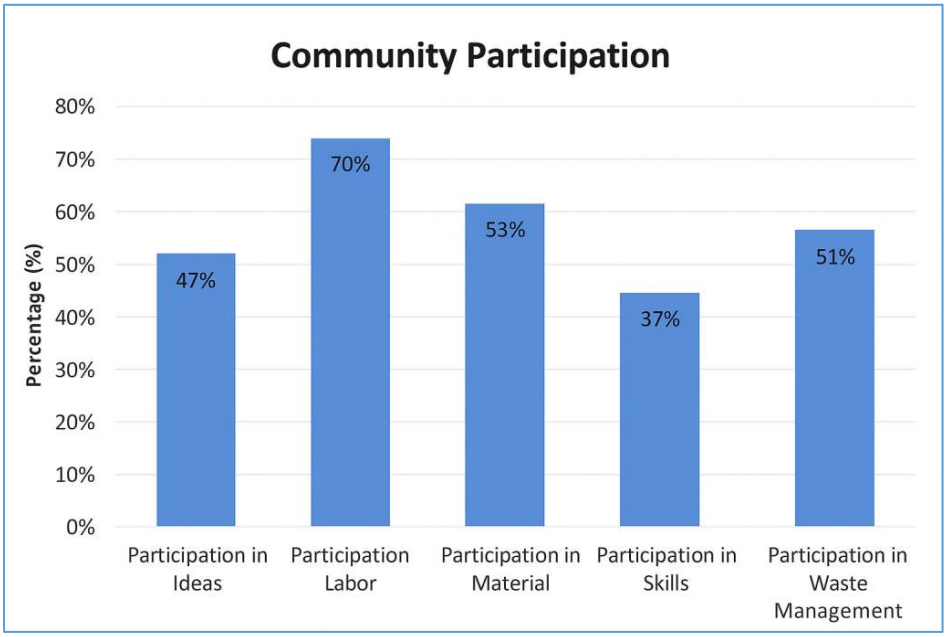

Figure 2. Participation in 3R-based waste management

Based on the survey results presented in the figure above, the level of community participation in environmental management activities varies across different forms of participation. The highest form of participation is labor-based participation, at 70%, indicating that most community members tend to be directly involved in physical activities such as community clean-ups, environmental sanitation, and waste collection. Meanwhile, participation in material contributions ranks second at 53%, followed by participation in waste management activities at 51%. This finding shows that the community also contributes by providing material support or by taking part in local waste management processes.

Participation in the form of ideas accounts for 47%, suggesting that some residents are still less active in offering ideas, suggestions, or opinions in environmental management activities. The lowest participation is in the skill aspect, at 37%, indicating that community contribution in terms of technical skills remains limited. Overall, these results show that community participation is more dominant in physical aspects than in non-physical aspects such as ideas or skills. This finding provides valuable insights for the government and program implementers to further

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encourage capacity-building initiatives in knowledge and technical skills to support the sustainability of environmental management programs.

Relationship Between Individual Characteristics and Community Participation

The relationship between individual characteristics and community participation illustrates how personal factors such as mindset, skills, and labor availability influence community involvement in waste management activities. The analysis was conducted using Partial Least Squares (PLS) through the SmartPLS application to determine both direct and indirect effects of individual characteristics on community participation. This approach was chosen because it can analyze models with a limited number of samples and latent variables. Understanding this relationship is essential to identify the most influential factors in promoting active public participation. The analysis results for Lhoknga Subdistrict are presented in Figure 3.

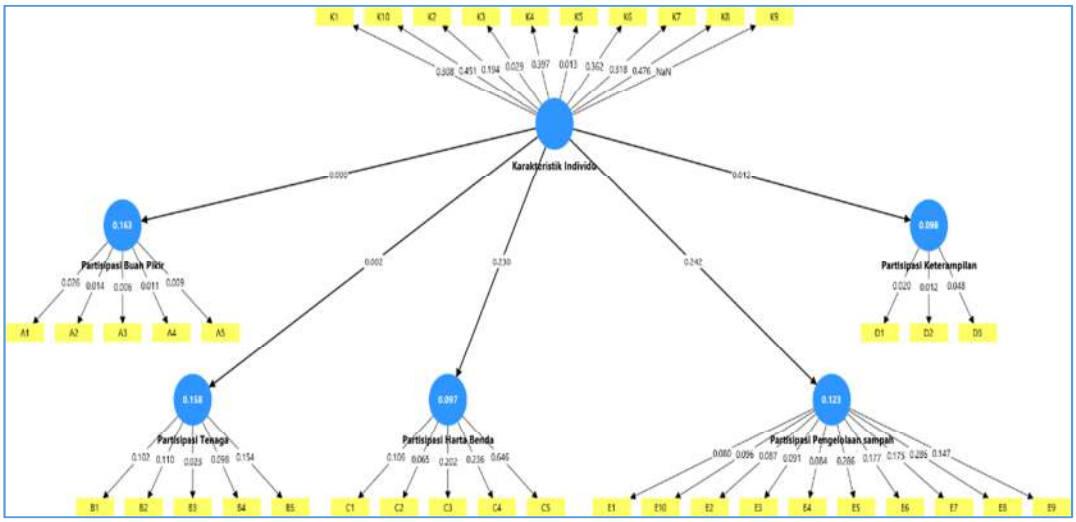

Figure 3. Analysis results for Lhoknga *Subdistrict*

Based on the Path Coefficients analysis using SmartPLS, the path coefficient values indicate the direction and strength of the relationship between individual characteristics and community participation levels in 3R-based waste management. A positive value indicates a direct relationship, while a negative value indicates an inverse relationship. The complete analysis results are presented in Table 1.

Tabel 1. Path Coefficients Analysis

Indikator Hubungan	*Original sample* (O)	*Sample mean* (M)	*Standard deviation* (STDEV)	*T statistics* (|O/STDEV|)	P *values*
Karakteristik -> Pemikiran	0.404	0.403	0.114	3.530	0.000
Karakteristik -> Material	0.312	0.338	0.260	1.199	0.230
Karakteristik -> Keterampilan	0.313	0.330	0.125	2.501	0.012
Karakteristik -> Pengelolaan sampah	0.351	0.322	0.299	1.171	0.242
Karakteristik -> Tenaga	0.397	0.447	0.126	3.157	0.002

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The analysis shows that individual characteristics significantly affect participation in the form of thinking, with a P-value of 0.000, indicating a strong and statistically significant positive influence. These findings suggest that individuals with higher educational attainment and greater experience are more likely to contribute ideas and participate in discussions related to waste management. This finding aligns with Akram et al. (2024), who found that environmental awareness, particularly within the context of the green economy, is shaped by knowledge, attitudes, and individual actions. People with good environmental understanding are more likely to contribute ideas, suggestions, and participate in awareness campaigns. Participation in the form of labor also shows a significant relationship, with a P-value of 0.002. This suggests that individuals in their productive age, particularly housewives without income, tend to be more willing to contribute physically to waste management activities in their communities. This is consistent with Wulandari et al. (2022), who reported that community participation in village development in Indragiri Hulu Regency is often reflected through physical involvement, especially in mutual aid (gotong royong) and infrastructure development.

Participation in the form of skills shows a significant relationship as well, with a P-value of 0.012, indicating a strong and positive correlation. This finding implies that individuals with higher education and experience are more capable of understanding and applying relevant waste management skills. This aligns with Nurfadillah et al. (2023), who found that the knowledge level of Bank Sampah BIC participants was moderate due to limited understanding of the 3R (Reduce, Reuse, Recycle) concept. Although some residents practiced 3R activities, they lacked comprehensive knowledge of waste processing methods. This limited understanding hinders the improvement of community skills in sustainable waste management.

On the other hand, participation in the form of material contribution did not show a significant relationship with individual characteristics (P-value = 0.230), exceeding the 0.05 significance threshold. This indicates that material contributions, such as donations of goods or money, are not directly influenced by socioeconomic background (education, occupation, or income). The questionnaire results indicated that material participation was relatively low, as reflected by the low percentage of respondents who reported contributing money or other material resources to waste management activities. These findings suggest that factors beyond individual socioeconomic characteristics may influence material participation. One possible explanation is the community's perception that waste management financing is primarily the responsibility of the government through the Village Revenue and Expenditure Budget (APBDes). This interpretation is supported by Wulandari et al. (2022), who found that such perceptions reduce residents' willingness to make financial contributions.

Lastly, participation in waste management activities also showed no significant relationship with individual characteristics (P-value = 0.242). This suggests that routine waste management actions are not directly influenced by variables such as age, education level, or occupation. Basic and operational waste activities are generally carried out voluntarily by residents, regardless of background. This finding aligns with Maghfiroh et al. (2024), who found that while most respondents had adequate knowledge of waste management, their actual behavior did not reflect that

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understanding. Approximately 84% of respondents had not practiced waste management at home, 54% still mixed organic and inorganic waste, and 60% continued to burn waste in their yards. These findings highlight that waste management behavior is influenced more by external factors such as habits, lack of facilities, and prevailing social norms rather than individual characteristics.

Conclusion

Based on the analysis results, community participation in 3R-based waste management in Lhoknga Subdistrict remains relatively limited due to low public awareness, inadequate resources, and the unequal distribution of waste management facilities, including temporary waste collection sites (TPS), waste collection vehicles, and operational waste banks. The highest level of participation was found in labor contribution (70%), while participation in ideas, management, and skills remained relatively low. SmartPLS analysis revealed that individual characteristics significantly influenced participation in the form of ideas ($P = 0.000$), labor ($P = 0.002$), and skills ($P = 0.012$), but had no significant influence on material contribution ($P = 0.230$) and waste management practices ($P = 0.242$). Therefore, strategies to enhance community participation should prioritize educational and empowerment programs tailored to community characteristics, particularly to strengthen participation in ideas, labor, and skills. These efforts may include environmental education, community-based waste management training, and greater involvement of local residents in planning and implementing 3R activities. Furthermore, improving the availability and accessibility of waste management facilities is essential to support sustainable community participation.

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