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Sustainable Waste Management Practices in Indonesia

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ABSTRACT: This study explores how social capital, community empowerment, and social entrepreneurship efforts impact sustainable waste management practices in Indonesia. A numerical method was used to survey 238 different villages in various areas. Key features, such as where the samples were located, how many people were involved, and their social and economic backgrounds, were thoroughly examined. Descriptive statistics, evaluation of the measurement model, and analysis of the structural model were conducted to understand the complex connections between the variables under investigation. The results show important and beneficial connections between social capital, community empowerment, social entrepreneurship projects, and waste management techniques. The model fit assessment attests to the validity of the proposed relationships. In addition, an obvious implication of this research is the increased awareness of each party be it the community, government and social enterprises. Community engagement through the level of social capital has been recognised in this study followed by statistical evidence, as well as community empowerment and social entrepreneurship. Effective waste management is generated by collaboration between all elements.

Keywords: Social Capital, Community Empowerment, Social Entrepreneurship Initiatives, Waste Management Practices, Sustainability in Indonesia

INTRODUCTION

Managing waste is a significant worldwide issue that Indonesia is dealing with, given its varied population and collection of over 17,000 islands. Indonesia is expected to become the fifth biggest trash-generating country globally, with a majority of its waste now being disposed of in landfills (Awino & Apitz, 2024). Proper waste handling methods including recycling, reusing, reducing, and incinerating are crucial for the progress of any nation (Harsono, 2023; Kumari & Raghubanshi, 2023). Yet, waste management in Indonesia might be enhanced, and it is important to explore further technologies beyond waste-derived fuels to maximize the utilization of waste for energy (Dissanayake et al., 2022). Issues in waste management in Indonesia are unplanned settlements,

political involvement, insufficient funding, and unauthorized dumps, which present significant economic and environmental risks (Abdulnabi Ali et al., 2023). To address these difficulties, it is crucial to use participatory methods and include all important stakeholders, along with suitable frameworks and government participation (Aziz et al., 2022). By putting in place a successful waste management system, Indonesia can decrease environmental pollution, protect the health of the country, and encourage economic growth.

Growing environmental worries and socio-economic effects necessitate a thorough grasp of the issues that affect sustainable waste management techniques. Studies in Indonesia have emphasized the significance of social aspects, like personnel and community involvement, in waste management (Budiman & Jaelani, 2023; Pangerani et al., n.d.). Community-based trash management projects, such waste banks and waste sadaqah, have been shown to have a good effect on waste management and help promote the circular economy (Yandri et al., 2023). Moreover, collaborative procedures with community groups, non-governmental organizations, and social businesses have been acknowledged as essential for efficient trash control in cities (Abdulnabi Ali et al., 2023; HARSONO, 2023). Enhancing social capital-based institutions, networking, and trust are important methods for enhancing the sustainability of waste management procedures (Kasjono et al., 2023). In general, a mix of social connections, community involvement, and social business efforts can help promote more lasting trash management methods in Indonesia.

The need to focus on sustainable waste management techniques in Indonesia is motivated by the negative effects of insufficient waste management on environmental sustainability, public health, and community well-being. Indonesia, as one of the most densely populated countries globally, encounters difficulties in efficiently handling waste. The current methods of handling garbage in Indonesia, like composting, landfilling, and waste-to-energy technologies, have varying effects on the environment and need enhancements in terms of technical aspects and policy consistency (Farahdiba et al., 2023; Mor & Ravindra, 2023; Ratnasari et al., 2023; Riristuningsia et al., 2017). Initiatives led by the community to manage garbage, including waste alms and waste banks, have demonstrated encouraging outcomes in benefiting the environment and promoting circular economy principles (Budiman & Jaelani, 2023; Yandri et al., 2023). In order to accomplish sustainable waste management, Indonesia must enhance waste treatment technology, apply circular economy principles, enhance policy consistency, and include local communities in waste management activities.

Social connections, community involvement, and social business projects are significant in changing waste management behavior. The study examined how social connections affect waste sorting habits and found that they have a favorable impact on how individuals separate their rubbish (Zhou et al., 2022). Moreover, social capital offers chances for social learning and enhances reputational impacts (Kasjono et al., 2023). Community involvement, supported by social entrepreneurship projects, is seen as a powerful strategy for addressing environmental problems, such as garbage management (Odoardi et al., 2023). Social entrepreneurs, with their understanding of local needs and entrepreneurial drive, have transformed waste management methods with creative solutions (Banerjee & Anand, 2021). The research also emphasizes the significance of improving institutions, creating networks, and fostering trust in waste management projects. In general, the results help to understand the particular functions of social capital, community

empowerment, and social entrepreneurship in influencing waste management behavior, offering guidance for policy decisions and the creation of sustainable waste management plans (Abdulnabi Ali et al., 2023). This study aims to address an important missing piece in the existing research and offer useful perspectives for decision-makers, environmental professionals, and communities engaged in waste management activities.

The importance of dealing with sustainable waste management techniques in Indonesia is very high. As the country deals with the negative effects of rising waste generation, which include harm to the environment and public health issues, the demand for practical solutions has become more pressing (Halide, 2023; Jumasa et al., 2023; Ratnasari et al., 2023; Riristuningsia et al., 2017; Wiradimadja et al., 2023; Yandri et al., 2023). Quick urban growth, industrial development, and population increase have made these issues worse, leading to a situation where poor waste management threatens the basis of a healthy and lasting future. Environmental damages can be seen in contaminated waterways, cleared landscapes, and disturbed ecosystems. Aside from environmental effects, incorrect garbage disposal also presents a significant danger to public health, as individuals may come into contact with harmful compounds, air pollution, and waterborne illnesses.

The urgency of this research is based on the importance highlighted by the economic impact of poor waste management, which results in communities having to pay for clean-up costs, healthcare, and the wider social and economic consequences of environmental damage. Indonesia's distinct geography, consisting of many islands with diverse communities, contributes to the challenges of waste management. The scattered character of waste management techniques in different regions requires a detailed understanding of local dynamics, which highlights the importance of interventions tailored to each situation.

The research was directed by the following aims to cover the different aspects of waste management: a) Evaluation of Social Capital: To assess the degree of social capital in Indonesian communities concerning waste management, with a focus on aspects like social connections, trust, and common norms. b) Assessing the Effects of Community Empowerment: To examine how community empowerment affects sustainable waste management practices, focusing on community involvement, information accessibility, and capacity building efforts. c) Evaluation of Social Entrepreneurship Projects: To assess how well social entrepreneurship projects contribute to sustainable waste management by investigating the extent and influence of entrepreneurial efforts within the community.

Social Capital and Waste Management

Social capital is significant in different areas of communal life, such as trash management. Social capital promotes collaboration, trust, and sharing of information, which are important for effectively carrying out and sustaining eco-friendly waste management methods (Barghi & Zakerinejad, 2023). Communities with robust social connections are more inclined to participate in ecologically friendly actions, such reducing waste and recycling (Kasjono et al., 2023). Social media platforms make it easier to communicate knowledge on waste management strategies, fostering a feeling of collective responsibility (Ataullah et al., 2023). Thus, there is a direct

relationship between social capital and the implementation of sustainable waste management techniques (Azis et al., 2022).

H1: There is a positive and significant relationship between the level of social capital in a community and the adoption of sustainable waste management practices.

Community Empowerment and Waste Management

Community empowerment is significant in waste management as it enhances communities' ability to make educated choices and work together (Cahyadi et al., 2023). This is accomplished through education, awareness programs, and community participation in the decision-making process (Subagyo et al., 2023). Engaging communities in decision-making on waste management will enhance ownership and dedication, resulting in sustainable practices in the long run (Yulis, 2023). Communities that feel empowered are more inclined to take proactive measures in waste reduction, which helps the overall success of waste management efforts (Juliana & Andriyus, 2023). The research highlights the significant importance of empowered communities in carrying out and maintaining efficient trash reduction and recycling programs.

H2: Communities with higher levels of empowerment show a greater propensity to engage in sustainable waste management practices compared to communities with lower levels of empowerment.

Social Entrepreneurship Initiatives and Waste Management

Social entrepreneurship includes creative and socially conscious company models that seek to tackle societal concerns (Khan et al., 2023). Social entrepreneurship has a key role in increasing community involvement, introducing new technologies, and supporting eco-friendly practices in garbage management (Bľanda & Urbančíková, 2020). Cooperative work among social entrepreneurs, local businesses, and communities has been proven to enhance trash management results (Chauhan & Ghai, 2023). Social entrepreneurship projects, when carefully combined with community requirements, have the potential to develop waste management solutions tailored to specific areas, creating economic opportunities and tackling environmental issues (Kalendzhjan & Kadol, 2023).

H3: The presence of social entrepreneurship initiatives in a community is positively correlated with the adoption of innovative and sustainable waste management practices.

Addressing Gaps in Existing Literature

There is a need for a more comprehensive approach to waste management that takes into account social capital, community empowerment, and social entrepreneurship in current studies. This study seeks to address this gap by thoroughly investigating how these three elements interact and impact waste management techniques (Kasjono et al., 2023; Odoardi et al., 2023; Sunarti et al., 2023). This research discovered that social capital, which includes elements like community initiative, education, communication, and skill development, is significant in waste bank (WB) administration

(Ramesh, 2016). Furthermore, the development of human skills and the sense of being part of the community, referred to as social connections, can help with garbage recycling, particularly in regions in Southern Indonesia (Furda, 2022; Harsono & Suprapti, 2024). Moreover, activities that involve learning from others, such learning through practice and discussions, have been proven to enhance individual waste management behavior, with facilities that provide support playing a crucial role. By taking all these elements into account simultaneously, a more thorough and efficient strategy for waste management may be created. This research attempts to offer a comprehensive knowledge of the interactions involved by using a combined viewpoint, illustrating how working together can enhance effectiveness in Indonesia's varied socio-cultural environment.

METHOD

Research Design

This study used a quantitative research method, where a survey was conducted to gather information from a varied group of 238 communities in both urban and rural regions of Indonesia. Opting for a quantitative method enables structured measurement and statistical analysis, which forms a solid foundation for comprehending the connection between social capital, community empowerment, social entrepreneurship efforts, and waste management methods.

Sampling

The group studied included several communities across Indonesia, representing the diverse socio-economic and cultural aspects of Indonesia. Due to the limited data to find the population size, stratified random sampling was used to ensure a good mix of people from different locations and demographic backgrounds. In addition, Hair (2019) suggests that research with SEM-PLS is better to multiply 5 to 10 of the total indicators to ensure data reliability. This study has 12 indicators so that multiplied by 10 means that the minimum sample for this study is 120, but the author to maintain data quality initially 250 data were distributed but the questionnaires that filled in completely were 238 and 12 others were incomplete. So that 238 were involved in this study.

Data Collection

A organized survey was the primary tool used to collect data. The survey form was created using predetermined scales and validated tools concerning social capital, community empowerment, social entrepreneurship, and waste management techniques. Before being fully put into use, the survey tool was tested beforehand to check its reliability and validity. Experienced researchers conducted the survey, making sure that the data collection method was consistent. The survey was created to gather numerical data, utilizing 1-5 Likert scale questions, along with open-ended questions to capture various viewpoints. The poll was carried out over a period of six weeks, starting on 14 December 2023 and ending on 10 February 2024.

Variables and Measurement

a. Social Capital: This variable was evaluated using indicators including social networks, trust, and norms associated with trash management. Questions on a scale of 1–5 gauge respondents' views and encounters by literature (Andriani & Christoforou, 2016).
b. Community Empowerment: Factors including community participation in decision-making, availability of information, and programs for developing skills are assessed using survey questions (López, 2008; Singgalen et al., 2022).
c. Social Entrepreneurship Initiatives: The poll looked into how entrepreneurial activities are dealing with waste management concerns, such as working with local businesses and how effective these efforts are regarded to be (Hussain et al., 2021; Somerville & McElwee, 2011; Ukil et al., 2023).
d. Waste Management Practices: This variable is assessed using indicators including trash reduction behavior, recycling rates, and community involvement in waste management programs (Harvey et al., 2020; Masud et al., 2023). Likert-scale and open-ended questions will be utilized to get numerical data.

Data Analysis

The statistical method that will be utilized in this study is Structural Equation Modeling with Partial Least Squares (SEM-PLS). This choice is made because SEM-PLS is capable of managing intricate models and data distribution that is not standard. Thus, SEM-PLS is seen as an appropriate technique for examining the various connections among social capital, community empowerment, social entrepreneurship efforts, and waste management techniques. During the analysis phase, Confirmatory Factor Analysis (CFA) was used to evaluate the reliability and validity of the measurement model, making sure that the chosen indicators accurately represent the underlying concepts. An analysis was performed to examine the connections between the hidden variables in a model, which involved looking at both the direct and indirect impacts of social capital, community empowerment, and social entrepreneurship on waste management behaviors. Bootstrapping methods were used to enhance the reliability of the results, giving more precise calculations of standard errors and confidence intervals. Furthermore, model fit measures, such Goodness-of-Fit Index (GFI) and Root Mean Square Error of Approximation (RMSEA), will be employed to assess the overall fit of the SEM-PLS model.

RESULT AND DISCUSSION

Sample Characteristics

The 238 villages that were studied had different features, giving a complete view of how garbage is managed in both urban and rural locations in Indonesia.

Table 1. Demographic Sample

Region	Number of Communities	Percentage
Java	80	34.78%
Sumatra	60	26.09%
Kalimantan	40	17.39%
Sulawesi	30	13.04%
Bali & Nusa Tenggara	20	8.70%
Maluku & Papua	8	3.48%
Population Size	Number of Communities	Percentage
Small (<5,000)	70	29.41%
Medium (5,000-20,000)	110	46.22%
Large (>20,000)	58	24.37%
Socio-economic Status	Number of Communities	Percentage
Low	80	33.61%
Moderate	100	42.02%
High	58	24.37%

Source: Data processed by the author (2024)

The settlements that were examined showed a wide variety of population sizes, reflecting the complex demographic makeup of Indonesia. By including people from different socio-economic backgrounds in the study, we were able to thoroughly investigate waste management habits and understand how economic considerations can impact these practices. The selected sample features have been intentionally chosen to cover a wide range, enabling a detailed understanding of waste management in various situations across communities in Indonesia. The upcoming analysis will use these various features to draw significant conclusions about how social capital, community empowerment, social entrepreneurship efforts, and waste management techniques interact.

Measurement Model Assessment

The Measurement Model Assessment includes Confirmatory Factor Analysis (CFA) to assess the reliability and validity of the measurement model. Factor loadings show how strong and in which direction each observable variable is related to its associated underlying construct. The values below show the importance of these relationships.

Table 2. Loading Factor

Variable	Social Capital	Community Empowerment	Social Entrepreneurship Initiatives	Waste Management Practices
Indicator 1	0.755	0.803	0.854	0.784
Indicator 2	0.824	0.757	0.783	0.726
Indicator 3	0.788	0.824	0.806	0.852

Source: Data processed by the author (2024)

All factor loadings are statistically significant, above 0.70, which suggests that the observed variables accurately assess their underlying components.

Cronbach's Alpha

Cronbach's alpha assesses how reliable the constructs are in terms of internal consistency. Alpha values above 0.70 suggest strong reliability.

Table 3. Cronbach's Alpha

Construct	Cronbach's Alpha
Social Capital	0.872
Community Empowerment	0.848
Social Entrepreneurship Initiatives	0.893
Waste Management Practices	0.881

Source: Data processed by the author (2024)

All structures show strong internal consistency, indicating that the components in each structure consistently measure the same underlying idea.

Average Variance Extracted (AVE)

AVE shows how much of the variance is accounted for by the construct compared to the overall variance caused by measurement error. AVE values more than 0.50 are deemed satisfactory.

Table 4. AVE Test

Construct	AVE
Social Capital	0.674
Community Empowerment	0.713
Social Entrepreneurship Initiatives	0.756
Waste Management Practices	0.693

Source: Data processed by the author (2024)

All structures have AVE values higher than the permissible criterion of >0.50, showing convergent validity.

Discriminant Validity

All structures have AVE values higher than the permissible criterion of >0.50, showing convergent validity.

Table 5. Discriminant Validity

Construct Pair	Correlation	Discriminant Validity
Social Capital vs. Community Empowerment	0.687	Yes
Social Capital vs. Social Entrepreneurship Initiatives	0.454	Yes
Social Capital vs. Waste Management Practices	0.397	Yes
Community Empowerment vs. Social Entrepreneurship Initiatives	0.556	Yes

Community Empowerment vs. Waste Management Practices	0.325	Yes
Social Entrepreneurship Initiatives vs. Waste Management Practices	0.494	Yes

Source: Data processed by the author (2024)

Discriminant validity is established, since the square root of AVE for each construct is greater than the correlation between that construct and others.

Structural Model Results

The Structural Model Results entail determining the connections between hidden constructs through Partial Least Squares (PLS) analysis. Path coefficients indicate the intensity and orientation of the connections between components. The values below show the importance of these relationships.

Table 6. Hypothesis Testing

Path	Path Coefficient	p-value
Social Capital → Waste Management Practices	0.428	0.000
Community Empowerment → Waste Management Practices	0.363	0.000
Social Entrepreneurship Initiatives → Waste Management Practices	0.317	0.001

Source: Data processed by the author (2024)

All route coefficients in the structural model are statistically significant, indicating strong evidence for favourable connections between social capital, community empowerment, social entrepreneurship efforts, and waste management techniques. The path coefficient of 0.428 for Social Capital → Waste Management Practices shows a positive and moderate relationship, with a very significant p-value (< 0.001), increasing confidence. Likewise, the relationship between Community Empowerment and Waste Management Practices has a coefficient of 0.363 and a very significant p-value (< 0.001). The correlation between Social Entrepreneurship Initiatives and Waste Management Practices is 0.317, and the p-value is statistically significant (< 0.01). In general, stronger social connections, community involvement, and social business projects are associated with better waste management methods, as indicated by very important p-values, indicating that these connections are probably not occurring by coincidence.

Table 7. Effect Sizes

	Effect Size
Social Capital → Waste Management Practices	0.634
Community Empowerment → Waste Management Practices	0.527
Social Entrepreneurship Initiatives → Waste Management Practices	0.454

Source: Data processed by the author (2024)

Effect sizes give us information about the practical importance of the relationships. They show the standardised strength of the routes. Greater effect sizes indicate a stronger impact of the predictor variable on the result. R-squared indicates the percentage of variability in the endogenous variable (Waste Management Practices) that is clarified by the exogenous variables (Social Capital, Community Empowerment, and Social Entrepreneurship Initiatives). The R-squared value of 0.55,5 suggests that 55,5% of the variation in waste management methods is accounted for by the collective impact of social capital, community empowerment, and social entrepreneurship projects. Q^2 assesses how well the model can predict the endogenous construct. A Q^2 value of 0.454 shows an acceptable level of predictive relevance for waste management strategies.

Model Fit Assessment

Model fit indices are important for evaluating how well the structural model matches the observed data, providing information about the overall fit of the model. The Goodness-of-match Index (GFI) shows that the model accounts for 82% of the variability in the observed data, suggesting a satisfactory overall match. The Adjusted Goodness-of-Fit Index (AGFI), which takes into account the number of estimated parameters, also indicates a satisfactory fit for the model with a value of 0.79. The Root Mean Square Error of Approximation (RMSEA) indicates a satisfactory match (0.08), taking into account the difference between the observed data and the model. The Comparative match Index (CFI) and Tucker-Lewis Index (TLI) values of 0.89 and 0.87, respectively, suggest a decent match, showing that the proposed model is better than a null model. Overall, the combined results of GFI, AGFI, RMSEA, CFI, and TLI indicate a good fit of the structural model to the data that was seen. These indicators confirm the accuracy of the suggested connections between social capital, community empowerment, social entrepreneurship projects, and waste management methods in the varied setting of Indonesia.

The Role of Social Capital

The strong connection between social capital and waste management practices highlights the significant role of social networks, trust, and shared standards in promoting a culture of responsible waste management. Studies have indicated that social capital, encompassing elements like human capital and social connections, can impact pro-environmental actions and waste management procedures (Odoardi et al., 2023). Social capital allows community members to share information and work together, which helps decrease harmful emissions from businesses (Ataullah et al., 2023). schemes that promote community involvement in waste management, like waste bank schemes, depend on social capital-based organisations such as networks and trust to remain viable (Kasjono et al., 2023). In areas with robust social connections, people collaborate to maintain cleanliness by utilising social networks and shared norms (Agustina & Meitasari, 2023). Public areas also contribute to waste management by promoting social contact and collective action, with social capital influencing the connection between public spaces and waste management practices (Xu & Miao, 2022). These results emphasise the significance of social capital and social networks in encouraging appropriate waste management practices.

Empowered Communities

Communities that are empowered tend to show improved waste reduction habits, highlighting the significance of community empowerment in promoting beneficial changes in waste management

methods. Community empowerment initiatives like the Gade Clean and Gold programmes at Bank Sampah have had notable effects on communities in terms of economy, ecology, and society (Cahyadi et al., 2023). Recycling programmes are also successful in altering community attitudes and actions about waste disposal, offering extra earnings and promoting a tidy and healthy environment (Darmayanti et al., 2023). Using ecobricks as a technique to manage plastic waste has effectively informed communities and encouraged them to take steps to decrease plastic waste (Andinar et al., 2023). Utilising community-led garbage management along with community empowerment has been successful in developing environmentally friendly and tidy villages, boosting income, and encouraging the 3Rs approach to rubbish management (Subagyo et al., 2023). Nevertheless, there are still obstacles in effectively including communities in waste management projects, underscoring the importance of ongoing initiatives in community empowerment (Juliana & Andriyus, 2023).

Impact of Social Entrepreneurship Initiatives

The strong connection between social entrepreneurship projects and waste management techniques emphasises the significance of entrepreneurial activities in bringing in new solutions and promoting community involvement. Social learning activities have been proven to have a considerable impact on waste management behaviour through emotional aspects, demonstrating the effectiveness of learning activities based on practice and discussion (Sunarti et al., 2023). Furthermore, the creation of socio-technopreneur platforms that combine educational and business elements has allowed people to participate in trash management, resulting in environmental conservation and extra earnings for communities (Nirad et al., 2022). Social entrepreneurs have had a significant impact on transforming waste management methods by introducing new and innovative technology, addressing local needs that were not being served, and creating widespread social benefits (Banerjee & Anand, 2021). Furthermore, social companies have used social innovation to support environmental sustainability, aiding in the accomplishment of sustainable development aims (Ambati, 2019). In general, the mix of social entrepreneurship and waste management strategies has been crucial in dealing with environmental issues and promoting sustainable community involvement.

Integrated Findings

The combined results highlight how social capital, community empowerment, and social entrepreneurship efforts are interrelated in promoting sustainable waste management methods. The interaction among these components helps in gaining a complete understanding of waste management difficulties.

CONCLUSION

Ultimately, this study provides important information on the elements that influence sustainable waste management methods in Indonesia. The varied sample characteristics and thorough evaluation of the measurement model guarantee the dependability and accuracy of this study. The important relationships found between social capital, community empowerment, social entrepreneurship projects, and waste management techniques highlight the complex nature of these interactions. The results of this study offer practical information for decision-makers,

environmental professionals, and community representatives. Approaches that aim to improve social relations, support local communities, and promote social business projects can play an important role in encouraging more sustainable waste management methods in Indonesia. Current constraints, such as the study's focus on a single point in time and the use of self-reported information, point to the need for further investigation. Longer-term studies and additional contextual elements may improve the understanding of the relationships examined in this study. In addition, an obvious implication of this research is the increased awareness of each party be it the community, government and social enterprises. Community engagement through the level of social capital has been recognised in this study followed by statistical evidence, as well as community empowerment and social entrepreneurship. Effective waste management is generated by collaboration between all elements.

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