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Rethinking the Measurement Architecture of Waste Bank Sustainability: A Pilot Study of Managers' Communication Competence

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Abstract
This pilot study examines the preliminary reliability and measurement structure of a multidimensional model linking member-related factors, institutional support, managers' communication competence, and three dimensions of waste bank sustainability economic, social, and environmental—in community-based waste banks in South Tangerang City, Indonesia. The study employed a quantitative cross-sectional design involving 32 waste bank managers from approximately 25 waste bank units. A total of 57 Likert-scale items across 12 sub-dimensions were examined using internal consistency analysis, item-total correlations, item purification, and principal component analysis (PCA) as an exploratory item-screening technique. The findings indicate that managers' communication competence demonstrated relatively strong internal consistency across confidence/initiative, knowledge, and communication skills, with Cronbach's alpha ranging from 0.78 to 0.95. In contrast, several institutional support dimensions required item refinement, while the current operationalization of economic sustainability did not provide sufficient evidence to support a coherent reflective measurement structure. After item purification, the two remaining economic sustainability items showed a perfect correlation (r = 1.00), suggesting substantial item redundancy rather than substantive evidence of reliability. The preliminary correlation pattern also indicates that the economic dimension may not align empirically with the social and environmental dimensions in this pilot sample. These findings suggest that future measurement models should distinguish demographic characteristics from participation-related constructs, further refine the economic sustainability indicators, and avoid assuming that triple-bottom-line sustainability necessarily forms a single reflective construct. The study provides preliminary evidence for revising the measurement architecture before a larger-scale validation and structural analysis.

Keywords:
Communication competence; Institutional support; Measurement model validation; Triple bottom line; Waste bank sustainability

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INTRODUCTION

Community-based waste banks (*bank sampah*) have become an important local approach to waste management in Indonesian cities. These initiatives combine waste reduction with community participation and, in many cases, economic and social activities at the neighborhood level. In South Tangerang City, waste banks are distributed across different communities and form part of broader local efforts to address waste-management challenges (Salam et al., 2025). However, the continued existence of waste banks cannot be assumed to indicate organizational sustainability. Their sustainability depends on the interaction between participation, institutional support, managerial capacity, community relationships, and the

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economic conditions surrounding recyclable materials.

Previous studies have emphasized the importance of participation, institutional support, and communication in community-based waste-management initiatives. Communication is particularly relevant because waste bank managers are required to coordinate members, disseminate information, maintain relationships, encourage participation, and interact with external institutions. Communication competence may therefore represent an important managerial capacity through which community participation and organizational processes are facilitated (Alkhajar et al., 2023; Agustina & Siswantini, 2024).

Despite this relevance, previous waste bank research has generally focused on participation, waste-management behavior, policy implementation, community empowerment, or communication strategies. Less attention has been given to the measurement of managers' communication competence as a distinct construct. This creates an opportunity to examine whether established communication competence dimensions can be meaningfully adapted to the context of environmental community leadership.

Communication competence can be understood through dimensions such as confidence or initiative, knowledge, and communication skills (Spitzberg & Cupach, 1984). In the context of waste banks, these dimensions may be relevant because managers need not only knowledge about waste management but also the confidence and interpersonal skills required to mobilize community members and coordinate with external stakeholders. Nevertheless, before communication competence can be incorporated into a larger explanatory model, its measurement properties need to be examined in the specific organizational context of community-based waste banks.

A second measurement issue concerns the operationalization of sustainability. The triple-bottom-line (TBL) framework commonly distinguishes economic, social, and environmental dimensions of sustainability (Elkington, 1997). Although these dimensions are frequently discussed together, they do not necessarily behave as statistically interchangeable components of a single reflective construct. In community-based and grassroots organizations, economic outcomes may depend on market conditions, resource availability, financial arrangements, and other external factors that differ from the mechanisms shaping social and environmental outcomes (Majeed et al., 2017; Kala & Bolia, 2024).

This issue is particularly relevant for waste banks because the economic value of recyclable materials is influenced by market prices and the structure of the informal recycling economy. Consequently, economic sustainability may not necessarily covary with community participation or environmental outcomes. Previous literature on social enterprises and grassroots sustainability has similarly discussed potential tensions or divergence between economic objectives and social or environmental missions (Davies, 2009; Liu & Zhuang, 2022; Khiawnoi et al., 2025). However, the present study does not directly test mission deviation. Instead, it uses the preliminary empirical pattern to examine whether the economic dimension should be operationalized separately from the social and environmental dimensions.

Based on these considerations, the present study has two objectives. First, it examines the preliminary reliability and measurement structure of a multidimensional model comprising member-related factors and participation, institutional/external support, managers' communication competence, and waste bank sustainability. Second, it explores whether the economic, social, and environmental dimensions of sustainability provide sufficient preliminary evidence to justify a unidimensional reflective specification.

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The study is explicitly positioned as a pilot phase preceding larger-scale data collection. Therefore, its purpose is not to establish population-level validity or causal relationships, but to identify problematic items, assess preliminary internal consistency, and provide evidence for refining the measurement architecture before the main study.

METHOD

Research Design And Participants

This study employed a quantitative cross-sectional survey design at the pilot stage of a broader measurement-development process. The respondents were waste bank managers in South Tangerang City, Indonesia, who participated voluntarily through an online questionnaire. A total of 32 respondents were recruited from approximately 25 waste bank units.

The respondents were predominantly female (81.3%, n = 26), while male respondents represented 18.7% (n = 6). Their ages ranged from 37 to 78 years, with a mean age of 50.1 years.

Most respondents held a bachelor's degree (62.5%). A purposive sampling technique was used to recruit active waste bank managers who were willing to participate. Because this was a pilot study, the sample was intended primarily to identify potential measurement problems and assess preliminary internal consistency rather than to support population-level inference or structural-model significance testing.

Measurement Instrument

The research instrument consisted of four main constructs represented by 12 sub-dimensions and 57 Likert-scale items. The response scale ranged from 1 to 4. The first construct, X1, was initially conceptualized as member characteristics and participation. It included demographic or experience-related characteristics and participation-related dimensions, including participation motivation and environmental awareness. The second construct, X2, represented institutional and external support and consisted of government support, program connectivity, facilities and infrastructure, and external partnerships. The third construct, Y1, represented managers' communication competence. It was adapted from the communication competence framework of Spitzberg and Cupach (1984), consisting of confidence/initiative, knowledge/understanding, and communication skills.

The fourth construct, Y2, represented waste bank sustainability based on the triple-bottom-line framework of economic, social, and environmental sustainability (Elkington, 1997). Because this study represents the pilot stage of instrument development, the findings are interpreted primarily as evidence concerning item behavior and preliminary internal consistency. Formal construct validation should be conducted using the larger dataset in the subsequent study.

Data Analysis

Analysis was conducted at the item level rather than exclusively using aggregate construct scores. The analytical procedure consisted of four stages. First, internal consistency was assessed for each hypothesized sub-dimension using Cronbach's alpha. Second, item-total correlations and alpha-if-item-deleted results were examined to identify potentially problematic items. Third, principal component analysis (PCA) was used as an exploratory item-screening technique. Component loadings on the first principal component were examined to assess the preliminary association between individual items and their hypothesized dimensions. These

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component loadings were treated as exploratory component statistics and were not interpreted as equivalent to PLS-SEM reflective outer loadings.

Fourth, item purification was conducted by removing items that showed negative loadings or item-total correlations below the 0.30 screening threshold. Reliability statistics were then recalculated after purification.

All analyses were conducted using Python with the pandas and NumPy libraries.

The pilot analysis was not intended to replace a full measurement-model assessment. In the subsequent larger-scale study, additional procedures such as composite reliability, convergent validity, discriminant validity, and HTMT should be applied where appropriate.

RESULTS AND ANALYSIS

Respondent Charateristics

Table 1 Respondent Characteristics (n = 32)

Characteristic	Category	n	%
Gender	Female	26	81.3
	Male	6	18.7
Education	Bachelor's degree	20	62.5
	Senior high school	6	18.8
	Diploma	3	9.4
	Master's degree	2	6.3
	Junior high school	1	3.1
Deposit frequency	< 1 time/month	17	53.1
	1-2 times/month	12	37.5
	> 2 times/month	3	9.4

Source : Primary Data, 2026

The respondents represented a predominantly female group of waste bank managers, with most holding a bachelor's degree. More than half reported depositing waste less than once per month.

Preliminary Reliability And Item Purification

Initial reliability analysis demonstrated substantial variation across the 12 hypothesized sub-dimensions. Table 2 presents the reliability statistics before and after item purification.

Table 2 summarizes reliability results before and after item purification.

Construct	Initial k	Initial α	Items removed	Final k	Final α
X1.4 Participation Motivation	5	0.850	1	4	0.890
X1.5 Environmental Awareness	5	0.833	0	5	0.833
X2.1 Government	4	0.956	0	4	0.956

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Support					
X2.2 Program Connectivity	4	0.106	2	2	0.652
X2.3 Facilities/Infrastructure	5	0.414	3	2	0.766
X2.4 External Partnership	5	0.561	2	3	0.852
Y1.1 Confidence/Initiative	5	0.780	1	4	0.918
Y1.2 Knowledge	5	0.945	0	5	0.945
Y1.3 Communication Skills	5	0.926	0	5	0.926
Y2.1 Economic	5	0.300	3	2	not salvageable*
Y2.2 Social	5	0.915	0	5	0.915
Y2.3 Environmental	4	0.706	1	3	0.837

Source : Data Analysis, 2026

Note: The two remaining Y2.1 economic sustainability items showed a perfect correlation (r = 1.00), indicating potential item redundancy. Therefore, the resulting reliability estimate was not interpreted as evidence of substantive construct reliability. The three communication competence sub-dimensions demonstrated relatively strong internal consistency. Confidence/initiative increased from α = 0.780 to α = 0.918 after the removal of one item. Knowledge and communication skills demonstrated high internal consistency, with α = 0.945 and α = 0.926, respectively.

The institutional support dimensions demonstrated greater heterogeneity. Program connectivity initially produced very low internal consistency (α = 0.106), which increased to 0.652 following item removal. Facilities/infrastructure increased from 0.414 to 0.766, while external partnership increased from 0.561 to 0.852.

The economic sustainability dimension presented the most substantial measurement problem. Its initial alpha was 0.300. Following item purification, only two items remained, and those two items were perfectly correlated (r = 1.00). This pattern is more appropriately interpreted as potential item redundancy than as evidence of a reliable two-item reflective scale

Preliminary Correlation Pattern

Table 3 presents selected inter-dimension correlations

Table 3 Selected Inter-Dimension Correlation Matrix (n = 32)

Indicators	**X1.1**	**X1.2**	**X1.3**	**Y1.1**	**Y1.2**	**Y1.3**	**Y2.1**	**Y2.2**	**Y2.3**
X1.1 (age)	1.00	-	-	0.29	0.31	0.15	0.05	0.14	0.07

		0.23	0.20						
X1.2 (education)	-0.23	1.00	0.17	-0.33	-0.10	-0.14	0.14	-0.15	-0.03
X1.3 (tenure)	-0.20	0.17	1.00	-0.34	-0.18	-0.38	0.39	-0.11	-0.07
Y1.1	0.29	-0.33	-0.34	1.00	0.65	0.74	-0.14	0.71	0.51
Y1.2	0.31	-0.10	-0.18	0.65	1.00	0.63	0.01	0.72	0.59
Y1.3	0.15	-0.14	-0.38	0.74	0.63	1.00	-0.23	0.65	0.58
Y2.1 (economic)	0.05	0.14	0.39	-0.14	0.01	-0.23	1.00	-0.11	-0.01
Y2.2 (social)	0.14	-0.15	-0.11	0.71	0.72	0.65	-0.11	1.00	0.60
Y2.3 (environmental)	0.07	-0.03	-0.07	0.51	0.59	0.58	-0.01	0.60	1.00

Source : Data Analysis, 2026

The pattern in Table 3 reveals a theoretically relevant double dissociation. The demographic-individual sub-dimensions (X1.1-X1.3) correlate weakly, or even negatively, with both communication competence and sustainability-indicating that individual characteristics such as age, education, and tenure are more appropriately specified as formative, rather than reflective, indicators of member participation, consistent with formative-reflective model specification guidance in the SEM literature (MacKenzie *et al.* 2005; Coltman *et al.* 2008). Treating such indicators as reflective risks biased parameter estimates and erroneous conclusions (MacKenzie *et al.* 2005).

Meanwhile, the economic sustainability dimension (Y2.1) consistently shows a correlation pattern that deviates from the social (Y2.2) and environmental (Y2.3) dimensions, as well as from communication competence (Y1). This pattern aligns with the social-entrepreneurship and grassroots-institution literature documenting the 'mission deviation' phenomenon-whereby economic outcomes proceed independently of social-environmental outcomes, due to resource constraints, the absence of integrated strategic frameworks, and measurement challenges (Davies 2009; Liu & Zhuang 2022; Khiawnoi *et al.* 2025). Waste banks' dependence on fluctuating recycling market prices and the fragility of the informal waste economy further help explain why this dimension tends to move independently of community social solidity (Majeed *et al.* 2017; Kala & Bolia 2024).

The communication competence dimensions demonstrated moderate-to-strong positive associations with each other, ranging from r = 0.63 to r = 0.74. They also showed positive associations with social sustainability (r = 0.65–0.72) and environmental sustainability (r = 0.51–0.59). By contrast, the economic sustainability dimension showed weak associations with social sustainability (r = -0.11) and environmental sustainability (r = -0.01). Its associations with communication competence were also weak or negative (r = -0.14, 0.01, and -0.23). Because the sample size is limited, these correlations should be interpreted as preliminary patterns rather than stable population-level relationships.

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Discussion

Communication Competence As A Promising Measurement Construct

The strongest preliminary measurement pattern was observed in managers' communication competence. The three dimensions confidence/initiative, knowledge, and communication skills demonstrated relatively high internal consistency after item screening.

This result suggests that the communication competence framework of Spitzberg and Cupach (1984) provides a potentially useful conceptual basis for examining communication among waste bank managers. The finding is particularly relevant because waste bank management involves continuous interpersonal communication with members and external stakeholders.

However, high internal consistency should not be interpreted as complete evidence of construct validity. The present study provides preliminary evidence that the items within these dimensions behave coherently in the pilot sample. Convergent and discriminant validity should be examined in the subsequent larger-scale study.

The relatively high alpha values for knowledge and communication skills also warrant attention. Very high internal consistency can sometimes indicate substantial similarity among items. Consequently, future item refinement should consider not only reliability but also whether each item captures a substantively distinct aspect of the construct.

Heterogeneity Of Institutional Support

The institutional support dimensions displayed substantially different reliability patterns. Government support demonstrated very high internal consistency, whereas program connectivity, facilities/infrastructure, and external partnership initially showed lower levels. The improvement following item purification suggests that institutional support may not constitute a homogeneous empirical domain. Government programs, physical infrastructure, and external partnerships represent related but conceptually distinct sources of support.

This finding indicates that future measurement should carefully distinguish between different forms of institutional support rather than assuming that all forms operate through a single reflective dimension. The finding also has practical implications for future research design. Instead of treating institutional support as a broad undifferentiated concept, researchers may need to specify the mechanisms through which each form of support contributes to waste bank sustainability.

Demographic Characteristics Should Not Automatically Be Treated as Reflective Indicators

The weak correlations among age, education, and tenure suggest that these variables should not be interpreted as reflective indicators of a common latent construct. However, the present findings do not by themselves establish that these variables constitute formative indicators. Their conceptual role needs to be reconsidered. Age, education, and tenure may function more appropriately as observed demographic or experience-related variables. They may be used as control variables or as antecedent characteristics in subsequent models.

This distinction is particularly important because demographic characteristics differ conceptually from participation motivation and environmental awareness. Combining these variables into a single reflective construct risks measurement misspecification. The pilot results

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therefore support reconsidering the architecture of X1 rather than simply changing the specification from reflective to formative.

Implications For Comm Implications For Communication Research Unication Research

The findings contribute to communication research by indicating that communication competence may represent an important measurement construct in community-based environmental organizations. The relevance of communication competence extends beyond message transmission. Waste bank managers must communicate information, maintain interpersonal relationships, encourage participation, coordinate activities, and interact with institutions.

The positive preliminary associations between communication competence and social and environmental sustainability are therefore theoretically plausible. However, the present cross-sectional pilot study cannot establish causal effects. Future studies should test whether communication competence predicts participation, trust, institutional coordination, and sustainability outcomes using larger samples and appropriate structural models.

CONCLUSION

This pilot study examined the preliminary measurement structure of a multidimensional model of waste bank sustainability, with particular attention to managers' communication competence. Three conclusions can be drawn from the pilot evidence. First, the three dimensions of managers' communication competence confidence/initiative, knowledge, and communication skills demonstrated relatively strong internal consistency. This provides preliminary support for further testing of the adapted communication competence instrument in a larger sample.

Second, the demographic variables age, education, and tenure should not automatically be treated as reflective indicators of member participation. Their conceptual role should instead be reconsidered, with future research potentially treating them as observed demographic or experience-related variables. Third, the current operationalization of economic sustainability did not provide sufficient evidence for a coherent reflective measurement structure. The perfect correlation between the two remaining economic items also indicates potential item redundancy. Therefore, the economic dimension requires broader and conceptually differentiated indicators before being incorporated into a comprehensive sustainability measurement model.

The findings should be interpreted cautiously because the study used a small pilot sample of 32 respondents from a single city. The results do not establish population-level validity, causal relationships, or the definitive superiority of one measurement specification over another. The principal contribution of the study is therefore methodological and exploratory: it identifies specific measurement problems and provides a basis for refining the instrument and measurement architecture before the larger-scale study.

Future research should employ a substantially larger sample and conduct comprehensive measurement-model assessment, including composite reliability, convergent validity, discriminant validity, and HTMT where appropriate. The revised economic sustainability construct should include broader indicators representing the financial and economic realities of waste banks. Future research should also examine whether managers' communication competence mediates or predicts relationships among institutional support,

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participation, and social-environmental sustainability.

Limitations

This study has several limitations. First, the sample consisted of only 32 waste bank managers and was designed as a pilot sample. The findings therefore should not be generalized to all waste banks in South Tangerang City or Indonesia. Second, respondents were recruited purposively and participated voluntarily through an online questionnaire, which may introduce selection and self-report biases. Third, the study was conducted in a single geographical context. The measurement properties identified here may therefore differ in other cities or community contexts. Fourth, the current economic sustainability items demonstrated evidence of redundancy after item purification. This indicates that the economic dimension requires further instrument development before being used in a larger structural model. Fifth, the exploratory PCA procedure used in this pilot study should not be interpreted as a substitute for a complete structural equation measurement-model assessment. The main study should apply an appropriate measurement-model framework using a larger sample.

Future Research

Future research should proceed in three stages. First, the instrument should be revised based on the item-level findings from this pilot study. Particular attention should be given to program connectivity, facilities/infrastructure, external partnership, and economic sustainability. Second, demographic variables should be conceptually separated from participation-related constructs. Age, education, and tenure may be included as observed characteristics or control variables rather than automatically being modeled as indicators of a latent participation construct. Third, the revised instrument should be tested using a substantially larger sample. The main study should evaluate the measurement model using appropriate reliability and validity criteria and subsequently examine the structural relationships among institutional support, participation, communication competence, and sustainability.

A future structural model may also test whether communication competence plays an intervening role between institutional support, participation-related factors, and social-environmental sustainability. However, such relationships should be treated as hypotheses for future empirical testing rather than conclusions from the present pilot study.

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