Waste Management Implementation as a Driver of Recycling Perception and Behavioral Intention

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Abstract. The increasing volume of waste in Indonesia is a serious and urgent issue. This is triggered by population growth, rapid urbanization, an increasingly consumerist life-style, as well as inadequate waste management and landfill sites. Waste management requires an integrated approach for effective mitigation. The role of the government is crucial, particularly in establishing proper waste management and developing technologies that support waste processing so that waste can be repurposed or destroyed, ultimately creating a better environment in the future. This study highlights the contradiction in the relationship between Perception of Recycling and Behavior Intention. The objective of this research is to analyze the implementation waste management variables that are expected to resolve this contradiction. Additionally, the study focuses on examining whether the variables Convenience of Recycling and Attitude Towards Recycling can enhance the Behavior Intention. The sample distribution was targeted at waste pickers in Central Java, using a purposive sampling technique. Model and hypothesis testing were conducted using Structural Equation Modeling (SEM) analysis with AMOS software.
Keyword: Waste Management Implementation, Recycling Behavioral Intention, Theory of Planned Behavior, Waste Pickers, Mediation Analysis

1 Introduction

The increase in national waste generation, which reached 19.45 million tons in 2022, indicates that waste management in Indonesia is ineffective, primarily due to low public understanding and participation, inadequate infrastructure, and suboptimal integration of the informal sector. This challenge is reinforced by the inconsistent findings of previous studies regarding the influence of Perception of Recycling on Behavioral Intention, with some studies finding a significant effect [1, 3], while others find no significant relationship [4, 5]. To address this inconsistency, the study adopts the Theory of Planned Behavior framework [6] which emphasizes the importance of attitude, subjective norms, and perceived behavioral control in shaping recycling intentions.

SEM analysis results of waste picker data in Central Java show that recycling perceptions significantly influence Waste Management Implementation (IWM), and IWM has a strong influence on behavioral intensity, convenience, and attitudes towards recycling [7, 8]. Attitudes have been shown to significantly influence behavioral intensity [9], while convenience has not been shown to influence behavioral intentions, in line with the findings of Afroz, et al. [10] who revealed that costs and structural barriers are often barriers to recycling participation.

Based on the phenomenon of increasing waste that is not in line with the intensity of people's recycling behavior, which has the potential to cause environmental damage, and the inconsistencies in findings regarding the influence

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of perceptions on recycling behavior, this study proposes waste management implementation as a mediating variable. Therefore, the research problem is formulated as follows: **How can we develop a theoretical approach that can explain the gap between the influence of recycling perceptions on the intensity of people's recycling behavior?**

2 Theoritical Framework

The This research is based on the Theory of Planned Behavior (TPB), which explains that human behavior is determined by three main components: intention, subjective norms, and perceived behavioral control. [6]. Intention reflects a person's motivation to perform a particular action and is influenced by beliefs about the outcome of that behavior, social support, and available resources. Subjective norms describe the social pressures that encourage or inhibit a person from acting, while perceived behavioral control assesses the ease or difficulty of acting in real-world situations. In the context of waste management, TPB serves as a theoretical framework capable of explaining how perceptions, attitudes, and structural factors shape the intensity of recycling behavior (Behavior Intention – BI). This study links Perception of Recycling (PoF) and Behavioral Intention by introducing Implementation Waste Management (IWM) as a mediator.

2.1 Perception of Recycling (PoF)

Recycling is a key strategy in addressing the increasing volume of waste. In Indonesia, this activity is dominated by the informal sector, which operates without adequate regulations and facilities, thus affecting public perceptions of the effectiveness of recycling [5]. The lack of education and access to information makes perceptions of recycling highly dependent on the role of the government. When the government provides facilities, regulations, and consistent outreach, public perception of the benefits and ease of recycling increases. Because perceptions have the potential to influence policy design, it is clear that PoF can trigger the implementation of waste management. The proposed hypothesis is:

H1: Perceptions of recycling influence the implementation of waste management.

2.2 Implementation Waste Management (IWM)

IWM serves as a bridge between public perception and action. The implementation of waste management systems in various countries shows that the level of formality of the waste picker sector significantly influences recycling effectiveness. Brazil, India, and Morocco have government-recognized and supported waste picker organizations. [7, 11], while other countries still face fragmentation of the informal sector despite its large contribution [8]. In Indonesia, scavengers often face illegal levies, limited disposal facilities, and health risks, necessitating a systematic approach through formalities and work protection.

The IWM in this study encompasses three aspects: (1) socialization and communication of the waste management system, (2) government-community collaboration, and (3) producer responsibility for product waste. Strong implementation will strengthen positive perceptions and encourage concrete community action.

Therefore, the following hypothesis is proposed:

H2: IWM influences the intention behavior.

H3: IWM influences the convenience of recycling.

H4: IWM influences attitudes toward recycling.

2.3 Convenience of Recycling (CoR)

Convenience is an important control factor in the TPB. However, limited facilities and illegal levies in Indonesia discourage people from recycling. Additional costs and time are also barriers [8]. The literature shows mixed results: some studies find that comfort increases the intensity of behavior [12, 13], while other studies report no significant effect [10]. Thus, the hypothesis is formulated as follows:

H5: Convenience of recycling influences the behavior intention.

2.4 Attitude Towards Recycling (ATR)

Attitudes reflect an individual's evaluation of the benefits and consequences of recycling behavior. A positive attitude is formed when someone understands that recycling can reduce environmental damage and increase sustainability [9]. Attitudes are influenced by knowledge, environmental values, and government facilities and policies [14, 15].

A positive attitude towards recycling is considered a primary driver of recycling behavioral intention.

H6: Attitudes towards recycling influence of behavior intention.

2.5 The Mediating Effect of Implementation Waste Management

Several studies have reported inconsistent relationships between Perception of Recycling and Behavioral Intention [1, 4]. This inconsistency can be explained by structural variables not included in previous research. In this research, Implementation Waste Management (IWM) is positioned as a mediator that clarifies how perceptions are translated into behavior. When public perceptions are positive, but the implementation of waste management does not provide adequate support, behavioral intention does not emerge. Conversely, positive perceptions that are reinforced by effective implementation waste management lead to a stronger intention to recycle. Accordingly, the following mediation hypothesis is proposed:

H7: Perception of Recycling influences Behavioral Intention through Implementation of Waste Management.

3 Discussion

This study involved 257 respondents and was analyzed using Structural Equation Modeling (SEM) with the assistance of the AMOS software to test the validity and reliability of the measurement instruments, assess model fit, and analyze causal relationships among latent variables. The analytical process began with the development of a theory-based model through an extensive literature review, followed by the construction of path diagrams and their conversion into structural equations and measurement models. Model estimation was conducted using a covariance matrix, accompanied by an evaluation of potential identification issues and an assessment of model adequacy through various goodness-of-fit indices, including Chi-Square, RMSEA, GFI, AGFI, CMIN/DF, TLI, and CFI.

Structural Equation Modeling (SEM) testing was conducted to assess the validity and reliability of the instrument, test the adequacy of the measurement and structural models, and analyze the relationships between latent variables. Based on the normality test, all indicators in the ATR, CoR, BIN, IMW, and POF variables had a critical skewness ratio within the limits of ±2.576, while the multivariate value of 2.009 was still acceptable [16, 17]. This indicates that the data met the assumption of normality and could be further analyzed using SEM. The results of the construct validity and reliability testing are detailed in **Table 1**, while the Inter-Construct Correlations and Square Roots of AVE are presented in **Table 2**.

Table 1. Results of Construct Validity and Reliability Testing

Contruct	Indicator	Std. Loading	Converging Validity (AVE)	Construct Reliability (CR)	Cronbach Alpha	Discriminan Validity
POF	POF1	0,547				
	POF2	0,59	0,366	0,854	0,69	0,605
	POF3	0,626				
	POF4	0,652				
IMW	IMW1	0,582				
	IMW2	0,603				
	IMW3	0,627	0,392	0,907	0,77	0,626
	IMW4	0,645				
	IMW5	0,669				
BIN	BIN1	0,748				
	BIN2	0,738	0,503	0,889	0,8	0,709
	BIN3	0,662				
	BIN4	0,686				
COR	COR1	0,709				
	COR2	0,647	0,479	0,812	0,73	0,692
	COR3	0,719				
ATR	ATR1	0,709				
	ATR2	0,699	0,497	0,817	0,74	0,705
	ATR3	0,706				

Table 2. Inter-Construct Correlations and Square Roots of AVE

Construct	Perception of Recycling	Implementation Waste Management	Attitude Towards Recycling	Convenience of Recycling	Behaviour Intention
Perception of Recycling	**0,3**				
Implementation Waste Management	0,219	**0,306**			
Attitude Towards Recycling	0,186	0,259	**0,379**		
Convenience of Recycling	0,169	0,236	0,2	**0,239**	
Behaviour Intention	0,256	0,356	0,35	0,276	**0,416**

The results of the construct validity test indicate that all indicators have loading factors above 0.50, demonstrating their ability to adequately reflect their respective latent constructs. Although the AVE values range from 0.366 to 0.503, they are still acceptable within the context of social research because they are supported by high construct reliability (CR) values, all exceeding 0.80 (for example, IMW = 0.907; BIN = 0.889). Additional reliability testing using Cronbach's Alpha further supports these findings, with all constructs showing values above 0.70, except for POF (0.69), which remains acceptable for behavioral research. Moreover, the discriminant validity results confirm that the square root of AVE for each construct is higher than its correlations with other constructs, indicating that each variable possesses distinct conceptual characteristics and does not exhibit problematic overlap.

With all criteria for validity, reliability, and discriminant validity satisfied, the measurement model in this study is deemed appropriate and can be used for the subsequent structural analysis, namely the testing of the full structural equation model. The complete path diagram for this model is visualized in **Fig 1**, while the detailed statistical results of the structural equation modeling are summarized in **Table 3**.

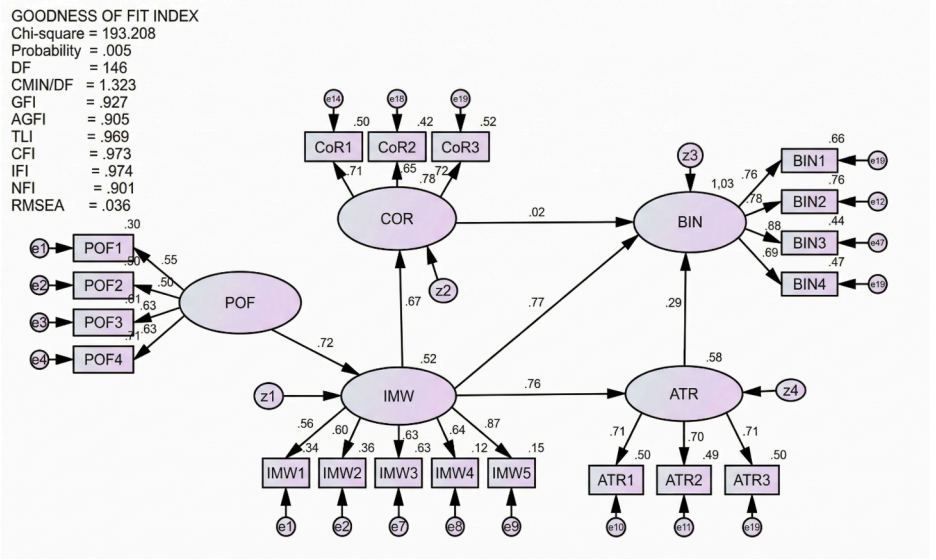

Figure 1. Full Structural Model

Table 3. Regression Weight Structural Equation Model

	Estimate	S.E	C.R	P	Result
IMW ← POF	0,73	0,105	6,93	***	Significant
BIN ← IMW	0,893	0,224	3,981	***	Significant
COR ←IMW	0,772	0,087	8,838	***	Significant
ATR ← IMW	0,848	0,105	8,055	***	Significant
BIN ← COR	0,022	0,203	0,11	0,912	Insignificant
BIN ← ATR	0,3	0,094	3,202	0,001	Significant

In Figure 1. the overall relationships among the variables are presented and can be summarized generally through the results shown in Table 3. The estimation results indicate that most of the proposed paths in the model are statistically significant, as detailed in Table 3 (Regression Weight Structural Equation Model). The hypothesis testing results show that perception of recycling significantly influences the implementation waste management (H1), as reflected by the path coefficient of 0.730 with a C.R. of 6,930 and $p < 0.001$. This indicates that the more positive the recycling perception among waste pickers, the stronger their drive to support a more structured implementation waste management. Furthermore, implementation waste management is proven to be a strong predictor of recycling behavioral intention (H2), demonstrated by a path coefficient of 0.893 and $p < 0.001$, suggesting that an effective implementation waste management enhances waste pickers' motivation to engage in recycling activities. Implementation of waste management also significantly increases the convenience of recycling (H3), as shown by the estimate of 0.772 with a C.R. of 8,838 and $p < 0,001$; this confirms that the availability of facilities, clear procedures, and supportive regulations make the recycling process easier and more comfortable.

Furthermore, the implementation of waste management has a significant effect on attitudes toward recycling (H4), with a coefficient of 0.848 and $p < 0.001$, indicating that an effective implementation waste management can foster more positive public attitudes toward recycling activities. However, convenience of recycling does not show a direct influence on behavioral intention (H5), as reflected by the coefficient of 0.022 and $p = 0.912$, suggesting that convenience alone is insufficient to motivate individuals to develop recycling intentions. Conversely, attitudes toward recycling significantly affect behavioral intention (H6), with a path coefficient of 0.300 and $p = 0.001$; the more positive an individual's attitude toward recycling, the stronger their intention to engage in recycling behavior. Overall, the results of hypotheses 1–6 demonstrate that implementation waste management and attitudes toward recycling are the two most influential factors in shaping recycling behavioral intention, whereas convenience does not play a significant role as a direct predictor.

Using the *causal step approach* [18], the mediation analysis was conducted to assess the role of Implementation Waste Management (IWM) in the relationship between Perception of Recycling (POF) and Behavior Intention (BIN). The structural framework of this partial mediation model is illustrated in **Fig. 2**, while the corresponding statistical results of the regression weights are summarized in **Table 4**.

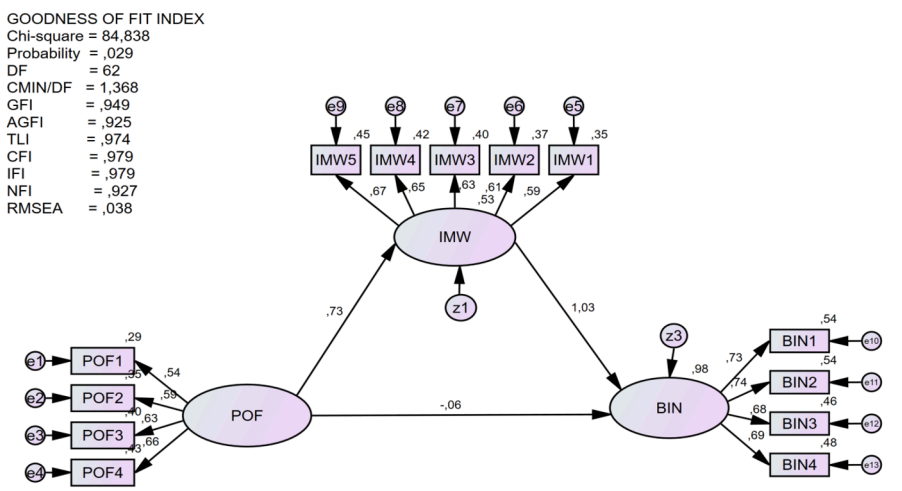

Figure 2. Testing the Partial Mediation Model of PoF, IMW, BIN

Table 4. Regression Weight Mediasi Parsial PoF, IMW, BIN

	Estimate	S.E	C.R	P	Result
IMW ← POF	0,74	0,108	6,836	***	Significant
BIN ← IMW	1,17	0,163	7,181	***	Significant
BIN ← POF	-0,066	0,129	-0,508	0,611	Insignificant

4 Results

Based on the hypothesis testing, it was found that perceptions of recycling significantly influence the implementation ofwaste management. Furthermore, the implementation waste management was shown to have a strong impact on behavioral intention, convenience of recycling, and attitudes toward recycling. These findings indicate that the implementation waste management not only affects the technical aspects of waste handling but also plays a pivotal role in shaping behavior intention and perceptions of recycling activities. However, the convenience of recycling was not found to have a direct effect on recycling behavioral intention, suggesting that convenience alone is not the primary driver of recycling behavior. The mediation analysis revealed a full mediation effect, meaning that perception of recycling does not directly influence behavioral intention without adequate support from the implementation waste management [18]. Therefore, attitudes towards recycling and the mediating implementation waste management in strengthening the influence of perceptions of recycling, confenience of recycling, and attitude towards of recycling, indicate that planned and structured management is an important link that transforms perceptions into real actions. Therefore, efforts to improve recycling behavior should primarily focus on enhancing the effectiveness of waste-management systems, as well as strengthening public perceptions and attitudes toward the importance of recycling.

These findings reinforce that recycling behavior cannot emerge solely from individual perceptions or preferences but is highly dependent on policy structures, available facilities, and systemic governmental support. The implementation waste management, including the provision of facilities, public education, formalization of the waste picker sector [11, 19], and cross institutional collaboration, serves as a critical factor in driving behavioral change toward sustainable waste management. Therefore, this study contributes theoretically by presenting IWM as an essential mediating variable and offers practical implications for strengthening national implementation waste management systems.

This study provides a theoretical contribution by affirming the role of *Implementation Waste Management* (IWM) as a full mediator in the relationship between *Perception of Recycling* and *Behavioral Intention*, thereby extending the application of the *Theory of Planned Behavior* (TPB) by demonstrating that individual perceptions alone are insufficient to shape behavioral intentions without adequate managerial and policy support. By incorporating IWM as a structural variable, this study also addresses inconsistencies in previous research regarding the influence of perceptions on recycling intentions. From a practical perspective, the findings emphasize that efforts to enhance recycling behavior should focus on strengthening waste-management systems through the provision of adequate facilities, sustained public education, formalization of the waste-picker sector, and cross-institutional collaboration, enabling IWM to function as a strategic policy instrument in promoting sustainable waste management.

5 Conclusion

This study successfully addresses the inconsistencies in previous research regarding the relationship between recycling perceptions and behavioral intentions by introducing Implementation Waste Management (IWM) as a critical structural variable. The findings demonstrate that Perception of Recycling does not directly drive the intention to recycle; instead, its influence is fully mediated by the actual implementation of waste management systems. This underscores that even highly positive public perceptions are insufficient to generate action without the

presence of adequate facilities, government-supported regulations, and the formalization of the informal sector, such as waste pickers.

Furthermore, while Attitude Towards Recycling remains a significant direct predictor of behavior, Convenience of Recycling was found to have no significant direct impact on intention in this context, suggesting that structural barriers and systemic support outweigh mere ease of access. Theoretically, this research extends the Theory of Planned Behavior by incorporating IWM as a necessary mediating link in environmental management. Practically, the results suggest that policy interventions should prioritize strengthening the technical and collaborative aspects of waste management—such as public education and cross-institutional collaboration to effectively transform community perceptions into sustainable recycling behaviors.

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