

Original Research

Household Behavioral Compliance in Waste Management Using the Extended Theory of Planned Behavior

Mary Ellen Camarillo†

Industrial Engineering Department, Cebu Technological University, Argao, Cebu, 6021, Philippines

†Corresponding author: Mary Ellen C. Camarillo; maryellencamarillo@gmail.com

ORCID IDs of Authors

Key Words	Waste management compliance, Extended theory of planned behavior, Behavioral compliance, Household waste management
DOI	https://doi.org/10.46488/NEPT.2026.v25i04.D1927 (DOI will be active only after the final publication of the paper)
Citation for the Paper	Mary Ellen Camarillo, 2026. Household behavioral compliance in waste management using the extended theory of planned behavior, <i>Nature Environment and Pollution Technology</i> , 25(4), D1927. https://doi.org/10.46488/NEPT.2026.v25i04.D1927

ABSTRACT

Despite the expansion of waste management infrastructure and regulations, behavioral compliance with proper waste management practices remains inconsistent, particularly in developing-country contexts. This study investigates the factors of household compliance with waste management practices by extending the Theory of Planned Behavior (TPB) to incorporate motivational and deterrence-related mechanisms. A quantitative research design was employed using survey data collected from 106 household respondents and analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS4. The measurement and structural models were evaluated to assess construct validity, reliability, and the significance of hypothesized relationships. PLS-SEM results revealed that motivation was the strongest predictor of behavioral compliance ($\beta = 0.xx$, $p < 0.001$). These findings indicate that motivation is the strongest predictor of behavioral compliance, while perception of the waste management system also exerts a significant positive influence. Penalty awareness does not directly affect compliance but significantly enhances motivation, which suggests an indirect deterrence mechanism. In contrast, attitude toward waste management practices does not demonstrate a significant effect on compliance behavior. Furthermore, the study contributes to the literature by empirically validating an extended TPB framework in a developing-country setting like the Philippines and demonstrating the importance of integrating penalty and motivational constructs in explaining behavioral compliance. The policy implications of this study emphasize the need for behavior-centered governance strategies that would complement infrastructure investments through visible enforcement, motivational interventions, and improved public perception of waste management systems.

1. INTRODUCTION

Effective waste management relies not only on infrastructure and enforcement but also on consistent compliance at the household level. (Jayaraman & Tripathi 2026). While many municipalities in the Philippines have invested in collection systems, segregation facilities, and the legal framework provided by the Ecological Solid Waste Management Act of 2000, which mandates source segregation, proper disposal, and community participation, improper waste handling remains widespread. This indicates that structural provisions and policy enforcement alone are insufficient to ensure compliance. Furthermore, although policy responses have focused on improving services, existing research shows that compliance varies significantly across communities with similar infrastructure and enforcement (Sobrino-Garcia 2025). Therefore, the success of waste management systems ultimately hinges on understanding the behavioral determinants that shape how individuals respond to policies and systems.

The concept of behavioral compliance in waste management differs from voluntary pro-environmental behavior because it occurs within a regulatory context in which adherence is expected, and noncompliance may carry consequences. Individuals weigh perceived benefits, social expectations, personal motivations, and awareness of penalties when deciding whether to follow prescribed waste management practices (Kim 2023). Previous behavioral research has shown that attitudes toward environmental practices and perceptions of policy effectiveness influence behavioral outcomes. However, compliance behavior is also shaped by motivational drivers and deterrence mechanisms that have received insufficient attention in community-level waste management studies (Ibokette et al. 2024).

It is critical to understand these behavioral determinants and their relationships because policy effectiveness depends not only on system design but also on citizen participation and rule adherence. If individuals perceive policies as ineffective, lack motivation to comply, or are unaware of enforcement consequences, compliance levels may remain low regardless of infrastructure availability (Simpson & Evens 2024), thereby affecting the community, as waste management is a critical component of local systems. Conversely, when regulatory awareness and motivational drivers align with positive attitudes and policy trust, compliance behavior may improve. To provide clearer policy guidance to encourage behavioral compliance among households and the community in waste management, this study examines the factors influencing household compliance with waste management practices. Specifically, it investigates the roles of attitude toward waste management, perception of policy effectiveness, motivation, and penalty awareness in shaping compliance behavior. By situating compliance decisions within both psychological and regulatory contexts, the study moves beyond purely voluntary models of environmental behavior to explain rule-adherent behavior.

The main methodology of this study is Partial Least Squares Structural Equation Modeling (PLS-SEM), which supports the study's aim of empirically evaluating the relative influence of these determinants on household-level compliance behavior in a developing country such as the Philippines. PLS-SEM was employed be-

cause the study seeks to explain and predict household behavioral compliance through an extended TPB framework, since this method is particularly suitable for exploratory and prediction-oriented contexts. Additionally, PLS-SEM places fewer restrictions on data normality, so the data is collected in its definitive state, which eliminates the need for subsequent processing. This will also enable simultaneous assessment of measurement reliability and structural relationships.

2. BACKGROUND RESEARCH

2.1. Behavioral Compliance in Waste Management

The public's compliance behavior at the household and community levels relies heavily on municipal waste management systems, their infrastructure, and policy enforcement. In the context of waste management, compliance behaviors include waste segregation, proper disposal, adherence to collection schedules, and avoidance of illegal dumping. In the study by Wang et al. (2018), it was found that only 36% of the sampled villages offered garbage collection and disposal services, and among those that did, only 81% of rural residents dumped garbage at designated dumping sites. This further demonstrates that household compliance is strongly influenced by the systems and policies in place. Furthermore, the study suggests that the presence of any organized garbage disposal site strongly encourages proper disposal behavior. Another study showed that compliance intention is motivated by perceived deterrent severity and perceived deterrent certainty, which positively influence waste separation compliance intention (Kim 2023). For more context, perceived deterrent severity increases the anticipated cost of non-compliance, while perceived deterrent certainty heightens the perceived likelihood of sanction. Together, these mechanisms and perceptions at play elevate the expected risk of rule violation, thereby strengthening compliance intentions. Furthermore, a recent study by Pulido et al. (2025) in the Philippine context identified factors contributing to non-compliance, including a lack of awareness or understanding of the waste management policies in place, insufficient resources, and a lack of training or guidance to support waste management practices. Based on the aforementioned studies, it is already evident that behavioral compliance revolves around both internal and external factors that influence individuals, households, and communities (Tate et al. 2015). Moreover, these findings suggest that non-compliance is not solely a matter of individual willingness but is shaped by informational deficits, structural constraints, and gaps in institutional support. This interplay of drivers or factors highlights the limitations of interventions that focus exclusively on infrastructure.

2.2. Extended Theory of Planned Behavior

The Theory of Planned Behavior (TPB) is among the most widely applied frameworks for explaining environmentally responsible behavior (El-Dorghamy 2018). It states that behavior is primarily predicted by behavioral intention, which in turn is shaped by attitude toward the behavior, subjective norms, and perceived

behavioral control (Liu 2025). Numerous environmental behavior studies have employed TPB to explain recycling participation, waste segregation, and sustainable consumption, demonstrating its utility across diverse socio-cultural contexts (Concur 2023; Esfandiar et al. 2023; Kumar 2019). By focusing on cognitive evaluation, social expectations, and perceived capability, TPB provides a simple and well-supported framework for understanding how intentions are formed.

However, despite its explanatory strength, TPB is insufficient to capture the realities of behavior compliance in waste management systems as it is embedded within systems of policy enforcement, monitoring, and institutional accountability. In such settings, behavioral decisions are influenced not only by attitudes, norms, and perceived control (original TPB), but also by cost–benefit evaluations associated with penalties, the perceived certainty of enforcement, and motivational dynamics that shape sustained adherence. In the study by Simpson and Evens (2024), it was found that individuals may comply not only because they view compliance favorably but also because non-compliance carries risks or penalties and internalized responsibility reinforces adherence to policies.

There are already several studies that have positioned TPB as an extended TPB that integrates deterrence and motivational mechanisms, and this study also aimed to adopt an extended TPB framework to provide a more accurate representation of compliance behavior in real-world conditions. However, this study offers contextual novelty by applying an extended Theory of Planned Behavior framework in a developing-country setting and testing it using structural equation modeling. The integration of deterrence and motivational factors with core TPB constructs is examined to determine whether these relationships better explain compliance behavior under the institutional and enforcement conditions of such contexts.

2.3. Latent Variables in the context of Behavioral Compliance in Waste Management

2.3.1. Attitude towards Waste Management Compliance

Attitude refers to an individual's overall evaluation of performing a behavior. In the waste management context, it captures whether individuals perceive compliance behaviors as beneficial, worthwhile, or inconvenient (Park & Spence 2022). Prior research consistently shows that positive environmental attitudes are associated with stronger intentions to recycle and segregate waste (Cheng et al. 2021). Those who perceive waste compliance as contributing to environmental protection, community cleanliness, and public health are more likely to engage in proper disposal practices, as demonstrated in a study by Nabila et al. (2020). Conversely, if compliance is viewed as time-consuming, inconvenient, or ineffective, participation declines.

More importantly, studies also note that favorable environmental attitudes do not always translate into compliance behavior, which indicates that attitudinal support is necessary but insufficient. This gap supports the need to consider additional cognitive and contextual factors.

2.3.2. Perceived Behavioral Control

Perceived behavioral control refers to an individual's perception of their ability to perform a behavior, considering available resources, knowledge, and situational constraints (Chen et al. 2023). In the waste management context, perceived behavioral control includes access to segregation bins, proximity to disposal facilities, clarity of guidelines, time availability, and perceived convenience (Cheng 2020). Furthermore, existing research consistently indicates that even when attitudes and norms are favorable, compliance declines if individuals perceive the behavior as difficult or inconvenient (Amir et al. 2025).

In several studies, households are more likely to comply when waste segregation systems are simple, collection schedules are reliable, and instructions are clear (Sahoo et al. 2022). Perception also functions as a direct predictor of behavior in TPB-based models, particularly when actual control conditions strongly influence behavioral execution.

2.3.3. Motivation

Motivation captures the internal and external drivers that energize or sustain behavior. In Romaniuc and Bazart's book, motivation is often conceptualized as intrinsic (e.g., environmental concern, moral obligation) or extrinsic (e.g., rewards, social recognition, avoidance of sanctions). Existing research indicates that intrinsic motivation supports sustained compliance behaviors, whereas extrinsic motivation may yield short-lived compliance when intrinsic commitment is weak (Izuakor et al. 2026). Studies suggest that combining intrinsic and extrinsic motivators can strengthen behavioral adherence, particularly during the initial adoption phase (Vorobeva et al. 2022). Motivation is therefore a critical extension to TPB when examining regulated environmental behaviors that involve both personal values and external drivers.

2.3.4. Penalty Awareness and Deterrence Mechanisms

Penalty awareness refers to an individual's knowledge and perception of sanctions associated with non-compliance. In regulatory compliance contexts, deterrence theory suggests that individuals are more likely to follow rules when penalties are perceived as certain, visible, and enforceable (Kim 2023). Several studies on environmental compliance indicate that enforcement visibility and awareness of penalties can significantly influence adherence to waste-disposal regulations. In the study by Amin et al. (2024), it was found that the more visible and pronounced the penalties and fines for improper waste disposal, the more established and enhanced the public awareness and education campaigns. The public awareness directly influenced compliance when they perceived a credible risk of fines and punishments.

However, literature, such as the study by Kardiat and Jamaruddin (2025), also suggests that penalties alone do not guarantee sustained compliance. This exemplified over-reliance on enforcement that may produce compliance driven by fear rather than internalized responsibility. Effective compliance strategies often combine enforcement with education, social norms, and motivational interventions (Khan et al. 2024).

2.3.5. Behavioral Intention and Compliance Behavior

Behavioral intention represents an individual's readiness to perform a behavior and is the immediate antecedent of action in TPB (Getahun & Mengstie 2024). Recent studies consistently demonstrate that intention predicts participation in recycling and waste segregation. However, the intention-behavior gap remains a persistent challenge in environmental compliance research (de Matos et al. 2025). These external constraints, convenience barriers, and enforcement conditions can prevent intentions from translating into behavior. As a result, models that incorporate perceived control, motivational drivers, and deterrence factors provide stronger explanatory power for compliance behavior (Love et al. 2024).

3. CONCEPTUAL FRAMEWORK

The conceptual framework hypothesizes that attitude, perception, motivation, and penalty awareness each directly influence behavior related to proper waste management practices. Penalty awareness is also posited to influence motivation and attitude, which serve as a mediating pathway that indirectly affects behavior.

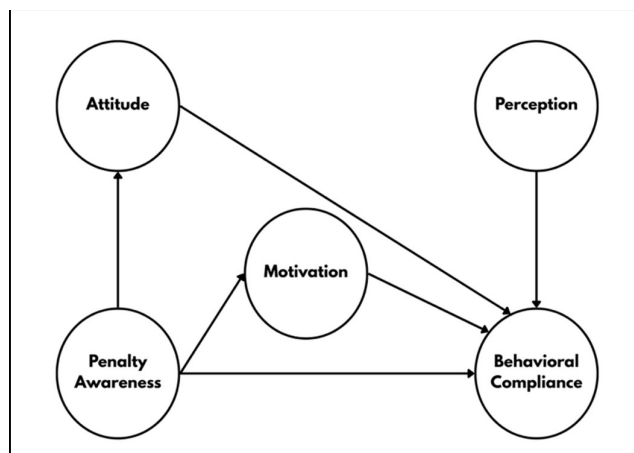


Fig. 1: Conceptual Framework of the extended Theory of Planned Behavior

Each hypothesis (H1–H6) represents a directional relationship between constructs as follows:

- Attitude → Behavioral Compliance (H1)

This hypothesis shows that individuals with more favorable attitudes toward waste management are expected to exhibit higher levels of behavioral compliance.

- Perception → Behavioral Compliance (H2)

This hypothesis shows that individuals with higher levels of perception when it comes to waste management are expected to manifest behavioral compliance.

- Motivation → Behavioral Compliance (H3)

This hypothesis shows that individuals with high motivation and understanding of waste management and its benefits are expected to show a high level of behavioral compliance.

- Penalty Awareness → Behavioral Compliance (H4)

This hypothesis shows that individuals with high awareness levels of deterrence mechanisms are also expected to show higher levels of behavioral compliance.

- Penalty Awareness → Motivation (H5)

This hypothesis exhibits that individuals with higher levels of penalty awareness are also expected to show higher levels of motivation towards behavioral compliance in the context of waste management practices.

- Penalty Awareness → Attitude (H6)

This hypothesis shows that those individuals with a high level of awareness of the waste management deterrence mechanisms, are also the ones expected to have positive attitude towards waste management practices or protocols in place.

4. RESEARCH OBJECTIVES

The main objective of this study is to examine the interrelationships among attitudinal, perceptual, motivational, and deterrence-related factors and their association with behavioral compliance in waste management at the household and community levels in the Philippines.

Specifically, the study aims to examine the influence of attitude, perception, motivation, and penalty awareness on behavioral intention, which translates into compliance in the context of waste management systems, and to evaluate the effect of penalty awareness, both directly and indirectly through motivation and attitude.

Moreover, the study intends to assess the overall explanatory power of the structural model using PLS-SEM. These objectives are aligned with the broader goal of identifying actionable insights to strengthen community-based environmental programs and policies. In the long term, the findings can inform the development of targeted interventions that enhance household and community adherence to waste management regulations, thereby reducing environmental health risks, improving the effectiveness of enforcement strategies, and fostering sustainable pro-environmental habits. Finally, such insights contribute to strengthening institutional capacity, promoting civic responsibility, and supporting more resilient and sustainable waste management systems in the Philippine context.

5. METHODOLOGY

This study adopts a quantitative, cross-sectional research design, using a structured survey questionnaire as the primary data collection instrument. The study population consists of households or individuals residing in a selected municipality that is covered by local solid waste management ordinances and practices. A sample size of 106 respondents was surveyed. The minimum sample size requirement for a PLS-SEM model is 50 since the nature of PLS-SEM is explorative, unlike its counterpart, CB-SEM, which is confirmatory in nature, which in turn requires a large sample size. The 106 respondents are the households that agreed to participate in the survey and seeing that it exceeds the minimum requirement, it indicates adequate statistical power.

The study's sampling technique is convenience sampling, and the data were collected from households that were accessible during the survey period and whose members voluntarily agreed to participate. Eligible participants were adults aged 18 years and above who were either household heads or individuals directly involved in managing household waste. This approach facilitated data collection within the available time and resource constraints while capturing responses from residents directly involved in household waste management activities. Furthermore, the respondents were selected from the municipality of Argao.

The survey instrument measures the constructs of attitude, perception, motivation, penalty awareness, and behavioral compliance using a 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree.' These measurement items were researcher-made, based on previously validated instruments in environmental behavior studies, and were pilot-tested to ensure content validity and clarity in the local context. Example items include: 'Proper waste disposal is beneficial for the community' (attitude), 'I believe waste management policies are effectively implemented' (perception), 'I feel encouraged to segregate waste due to community programs' (motivation),

'I am aware of fines for improper waste disposal' (penalty awareness), and 'I segregate my waste regularly at home' (behavior). Furthermore, the survey questionnaire of this study was adapted from previously validated instruments in environmental behavior. The questionnaire was designed to measure the constructs included in the extended TPB framework.

Additionally, a pilot test for content validation was conducted to further check for item clarity and validity. The pilot test was conducted by making 30 participants answer the first version of the questionnaire. After they answered, their responses were collected and processed in the SmartPLS software to test for construct validity and reliability through measurement model assessment using indicator loadings, average variance extracted (AVE), and Cronbach's Alpha scores. The pilot test responses, in terms of indicator loadings, AVE, and Cronbach's Alpha, showed significant results favoring reliability. After the pilot test, the survey period ran from January to February 2026. The survey questionnaires were administered through face-to-face interviews among the respondents. Before the interview was conducted, the respondents were informed of the purpose of the study, assured of the confidentiality of their responses, and advised that participation was voluntary.

The data analysis procedure was executed in several stages. The first stage involved data screening to identify missing data, outliers, and non-normality. Next, the measurement model was assessed for indicator reliability (outer loadings ≥ 0.70), internal consistency reliability (Cronbach's alpha and composite reliability ≥ 0.70), convergent validity (average variance extracted ≥ 0.50), and discriminant validity using both the Fornell-Larcker criterion. After a valid and reliable measurement model was established, the structural model was evaluated for path significance and R^2 . The last stage involved bootstrapping with 5,000 resamples to test path significance.

6. RESULTS AND DISCUSSION

To examine the significance and the magnitude of the relationships in the proposed conceptual framework, which is the extended TBP model applied in the context of the household waste management compliance in Argao, Cebu, as presented in Figure 2, a structural equation modeling (SEM) by using a partial least squares (PLS-SEM) approach was employed. The use of PLS-SEM allows for the simultaneous assessment of measurement model reliability and structural relationships among the latent variables, which makes it suitable for analyzing complex behavioral models involving multiple interrelated constructs. Using this method, the study evaluates the model's explanatory power.

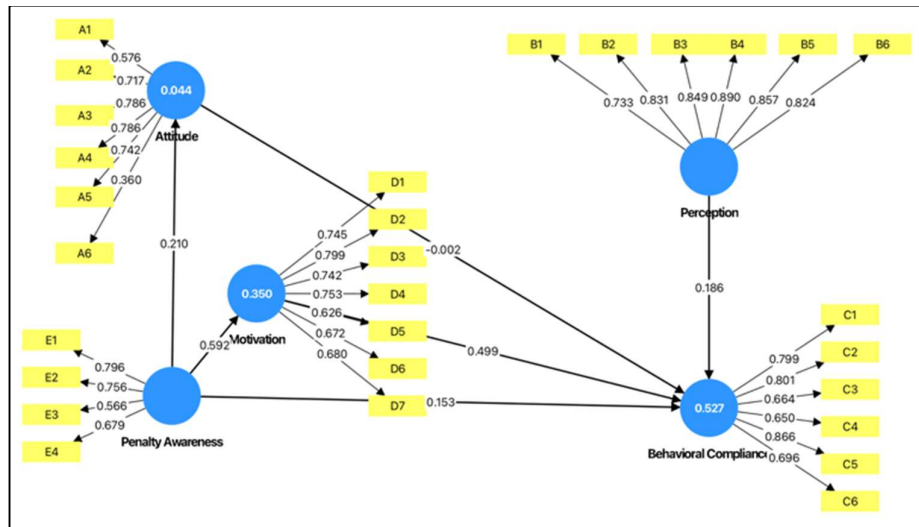


Fig. 2: Graphical output of the PLS-SEM Algorithm for the extended TPB

Furthermore, structural equation modeling can reveal the significance and validity of the relationships and the hypotheses (arrows) by extension. In this context, behavioral compliance is the endogenous dependent variable, meaning that all connections and structural relationships ultimately point to it as a latent variable.

6.1. Establishing the Measurement Quality of Behavioral Compliance Constructs

The measurement model was first evaluated to determine whether the observed indicators reliably represent the latent constructs included in the extended Theory of Planned Behavior framework. In this part of the assessment, it is paramount to first evaluate the reliability and validity of the construct measures. Establishing measurement reliability is necessary before examining structural relationships, as it confirms that the indicators (survey items) adequately capture the behavioral and perceptual dimensions underlying waste management compliance. This is captured in indicator reliability, internal consistency, and convergent validity. Indicator reliability was assessed using outer loadings from the PLS algorithm, while internal consistency and convergent validity were evaluated using Cronbach's alpha, composite reliability, and average variance extracted (AVE).

Table 1: Outer Loadings

	Attitude	Behavioral Compliance	Motivation	Penalty Awareness	Perception
A1	0.576				
A2	0.717				
A3	0.786				
A4	0.786				
A5	0.742				
A6	0.36				
B1					0.733
B2					0.831
B3					0.849
B4					0.89
B5					0.857
B6					0.824
C1		0.799			
C2		0.801			
C3		0.664			
C4		0.65			
C5		0.866			
C6		0.696			
D1			0.745		
D2			0.799		
D3			0.742		
D4			0.753		
D5			0.626		
D6			0.672		
D7			0.68		
E1				0.796	
E2				0.756	
E3				0.566	
E4				0.679	

The results indicate that the measurement indicators demonstrate satisfactory levels of reliability and internal consistency. Although there are indicator loadings that are slightly below the recommended threshold of 0.70, they were retained in the PLS-SEM model because their values remained above the minimum acceptable level and

contributed meaningfully to the theoretical representation of their constructs. As long as the composite reliability and convergent validity remain satisfactory, the indicator loadings between 0.40 and 0.70 may be retained. Furthermore, if these indicators are removed, there is a risk that the model will not holistically capture the important dimensions of household waste management behavior.

In the variable Attitude, two of the indicators have small outer loadings, which means that they do not represent the variable at a high level, and since these indicators are in a reflective measurement model, and using a threshold level of greater than 0.7. In the variable Behavioral Compliance, three of which were marked red because they were less than 0.7, which indicates that they do not represent the variable at a high level. In the variable Motivation, there were also three variables that were marked red. In the variable Penalty Awareness, two indicators did not seem aligned or representative of the concept, but their loadings were still considerably high, it just did not make it to the 0.7 cut. Finally, all the indicator outer loadings for the Perception variable all have greater than 0.7 outer loadings, which means that all the survey items under this construct adequately represent the concept expressed by the Perception variable.

Table 2: Construct Reliability and Validity

	Cronbach's alpha	Composite reliability (rho a)	Composite reliability (rho c)	Average variance extracted (AVE)
Attitude	0.765	0.803	0.829	0.460
Behavioral Compliance	0.842	0.856	0.884	0.563
Motivation	0.844	0.852	0.882	0.517
Penalty Awareness	0.662	0.682	0.795	0.497
Perception	0.910	0.917	0.931	0.692

Similarly, the internal consistency measures exceeded the commonly accepted benchmarks, indicating that the constructs are measured with acceptable reliability. Cronbach's alpha is the most traditional criterion for internal consistency as it provides an estimate of the reliability based on the intercorrelations of the observed indicator variables. Although Cronbach's alpha values for certain constructs were slightly below the conventional threshold of 0.70, the constructs demonstrated satisfactory composite reliability, which provides a more accurate assessment of internal consistency because it accounts for differing indicator loadings. The convergent validity measure, it refers to the extent to which a measure correlates positively with alternative measures of the same construct. This further validates a model and how it accurately measures the observed reality. Convergent validity is reflected in the average variance extracted.

Table 2 presents the model's construct reliability and validity, which shows that in the Cronbach's alpha measure, only the Penalty Awareness variable has a score below the 0.7 threshold, which simply suggests that the items under the Penalty Awareness may not be consistent with each other, or their representation is not consistent

with the concepts set by the other survey items. In the composite reliability measures, all of the latent variables or constructs were above the 0.7 threshold and suggest that the survey items showed reliability and validity of the model. On the other hand, the average variance extracted is shown in the last column of Table 2. Table 2 showed that the variables Attitude and Penalty Awareness were below the 0.5 threshold, which suggest that some of the indicators under these variables were not able to explain their corresponding latent variables. Even though some of the values were below the accepted threshold values, these values were high enough to be considered as accepted. Taken together, these findings indicate that the constructs representing attitudes, perceptions, motivations, and deterrence-related factors provide a reliable empirical representation of behavioral determinants associated with household waste management compliance.

6.2. Distinguishing the Behavioral Dimensions of Compliance

Discriminant validity is the extent to which a construct is truly distinct from other constructs by empirical standards. This measure further implies that a construct is different and unique from the other constructs of the model. In this study, the Fornell-Larcker measure was chosen to assess the discriminant validity of the model. The concept of Fornell-Larcker is that it compares the square root of the AVE values with the construct's correlations. This further looks at the model following the logic that a construct shares more variance with its associated indicators, or in this context, survey items. Another alternative to Fornell-Larcker is the cross-loadings, which also follow the same logic, only that it looks at loadings and not the AVE values.

In the context of waste management compliance, constructs such as attitude, perception, motivation, and penalty awareness represent different psychological and behavioral mechanisms. Therefore, it is necessary to establish discriminant validity to confirm that these constructs capture unique aspects of compliance behavior rather than overlapping concepts. To assess or look at discriminant validity in the form of a matrix result, the Fornell-Larcker score of a specific construct (diagonal values) must be larger than the nondiagonal values for that construct. Table 3 shows that, for each construct, the diagonal value is the largest in its respective column. In the Attitude variable, a Fornell-Larcker score or a correlation value of 0.678 is the highest among the values in the Attitude variable's column. This trend can also be observed among the other latent variables. The results indicate that the square roots of the AVE values exceed the corresponding inter-construct correlations, satisfying the Fornell-Larcker criterion.

Table 3: Discriminant Validity (Fornell-Larcker)

	Attitude	Behavioral Compliance	Motivation	Penalty Awareness	Perception
Attitude	0.678				
Behavioral Compliance	0.328	0.750			
Motivation	0.453	0.687	0.719		
Penalty Awareness	0.210	0.554	0.592	0.705	
Perception	0.386	0.537	0.530	0.575	0.832

These findings confirm that the behavioral determinants modeled in the extended TPB framework are empirically distinguishable from one another. This distinction is particularly important for understanding compliance behavior, as it suggests that attitudinal evaluations, motivational drivers, and deterrence perceptions operate as separate mechanisms influencing waste management practices.

6.3. Evaluating the Explanatory Capacity of the Extended TPB Model

After establishing measurement validity, the structural model was examined to evaluate the explanatory capability of the extended Theory of Planned Behavior framework in accounting for household waste management compliance. After evaluating the measurement models, which was done in Sections A and B of the results and findings, it is all clear now to proceed with structural model assessment, which is evaluating the inner model. Structural model assessment focuses on the predictive power of the model and the extent to which the included constructs explain variation in the endogenous variables. Key indicators used in this assessment include the coefficient of determination (R^2), predictive relevance (Q^2), and collinearity diagnostics.

The explanatory capacity can be best evaluated using the coefficient of determination (R-squared value). The coefficient of determination is a measure of the model's predictive power. The logic behind the coefficient of determination is that it is calculated as the squared correlation between a specific endogenous construct's actual and predicted values. The structural model explained 54.6% of the variance in behavioral compliance ($R^2 = 0.546$). According to Hair et al. (2022), R^2 values of approximately 0.25, 0.50, and 0.75 may be interpreted as weak, moderate, and substantial levels of explanatory power, respectively. Therefore, the R^2 value for this PLS-SEM model indicates a moderate level of explanatory capability, which suggests that the proposed predictors sufficiently explain household behavioral compliance when it comes to waste management.

Furthermore, the coefficient represents the exogenous constructs' combined effects on the endogenous construct, which is also why only the variables with an arrow going in have the R-square values. The coefficient represents the amount of variance in the main endogenous construct, which is the behavioral compliance. A value closer to 1 of R-square indicates a higher level of predictive accuracy.

Table 4: R-Square

	R-square	R-square adjusted
Attitude	0.044	0.035
Behavioral Compliance	0.527	0.508
Motivation	0.350	0.344

In Table 4, focusing on the R-square adjusted, the predictive power of the model when it comes to predicting the main endogenous construct, which is the behavioral compliance, is 0.508. This means that given the other variables and their predispositions, the extended theory of planned behavior can therefore predict the behavioral compliance of the households when it comes to waste management practice is 50.80%. This value is fairly high

given that in the model (refer to Figure 1), there are only four other variables that were considered to accurately predict its trend. Following that line of thought, this also implies that there is a considerable lack of variables to be considered in order to accurately predict the trend or progression of behavioral compliance. As it is about household waste management, there is a need to also consider other factors in the perspective of the household with regards to the systems and infrastructure in place. In the construction of the model, there is an understanding that the policies and infrastructures in place were not yet considered which also extend to the household's perspective on it. That lacking maybe the explanation why there the model only has a 50.80% predictive accuracy.

In addition to evaluating the coefficient of determination of the structural mode, there is also a need to evaluate collinearity. Collinearity diagnostics further confirm that multicollinearity does not pose a concern among predictor constructs. In order to achieve this, each set of predictor constructs must be examined separately for each subpart of the structural model. All the indicators have scored above the threshold. Overall, these results suggest that the extended TPB model provides an appropriate analytical framework for examining behavioral compliance with waste management practices in the study context.

Table 5: Collinearity VIF

	VIF
A1	1.450
A2	1.759
A3	1.730
A4	1.847
A5	1.380
A6	1.272
B1	1.809
B2	2.639
B3	2.757
B4	3.426
B5	3.142
B6	2.239
C1	1.860
C2	2.141
C3	1.470
C4	1.397
C5	2.663
C6	1.596
D1	1.931
D2	2.170
D3	2.117
D4	2.365
D5	2.210
D6	2.743
D7	2.230

E1	2.031
E2	2.055
E3	1.869
E4	1.870

6.4. Structural Relationships and Behavioral Pathways of Compliance

In the PLS-SEM model, the main thing that needs to be considered is the path coefficients. These paths or arrows represent the hypothesized relationships among the constructs. The path coefficients have standardized values approximately between -1 and +1. The higher the value of the path coefficients, the stronger the relationships or the higher the magnitude of the relationship. Within the extended TPB framework, these relationships represent the behavioral pathways that influence household compliance behavior.

Among the specified paths, the penalty awareness to motivation relationship has the highest path coefficient, with a value of 0.592. This stronger magnitude of influence implies that the penalty-based or punishment-based courses of action can strongly direct the household's motivation of practicing proper waste management. The awareness of the penalty can greatly influence the household's recycling intention and segregation as penalties can range to monetary fines to negative consequences such as withholding or delay of the waste collection schedules. This relationship further suggests that households may be more inclined to adhere to proper waste management practices when penalties are clearly communicated and consistently enforced, as such enforcement mechanisms appear to strengthen motivational drivers toward compliance. In this context, adherence to waste management policies appears to be shaped primarily by regulatory influence rather than internalized pro-environmental advocacy.

The path with the second highest path coefficient is the influence of motivation to behavioral compliance (0.499), which indicates that motivation is a strong direct contributor of behavioral compliance, which can be observed in reality. Motivation can come in forms of incentives, health benefits, daily consideration of the waste in their homes. A distinct motivation is that people's perception of the severity of the adverse consequences caused by the pollutants that would be released to the air if they do not dispose or properly handle their household waste. Although in this study, the variable motivation was not further categorized into internal motivation or external motivation, which may affect how the respondents may have responded to the variable's indicators.

The third path with the highest path coefficient is Penalty Awareness to Attitude, which further strengthens previous claims about the concept of penalties as the main driver of behavioral compliance, but the influence is amplified or muted in the Attitude and Motivation constructs. Since the variable Attitude can also carry other considerations such as their overall feeling of the whole system and it is heavily dependent on individual's personal stance of the subject. In the context of waste management, there are individuals that may have a negative attitude towards the whole practice of letting the local government authorities take charge of the waste disposal and management system because that may entail that a bulk amount of waste is collected and dumped on a large

landfill which may be unsustainable and there could be mismanagement of the wastes and may cause harmful effects to the region where the landfill is situated.

Among the paths, the relationship to have the least path coefficient and may also mean an inverse relationship, since it has a negative sign, is the influence of Attitude to Behavioral Compliance. This arrangement or phenomena can be explained in a way that Attitude on its own is not a sure guarantee that the households would comply with the waste management systems, especially, if there is no intervention of penalty awareness.

Table 6: Path Coefficients

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
Attitude -> Behavioral Compliance	-0.002	-0.002	0.101	0.023	0.982
Motivation -> Behavioral Compliance	0.499	0.504	0.101	4.926	0.000
Penalty Awareness -> Attitude	0.210	0.252	0.116	1.813	0.070
Penalty Awareness -> Behavioral Compliance	0.153	0.160	0.090	1.694	0.090
Penalty Awareness -> Motivation	0.592	0.602	0.069	8.555	0.000
Perception -> Behavioral Compliance	0.186	0.181	0.089	2.081	0.038

The magnitude of these relationships highlights the importance of considering not only attitudinal and perceptual factors traditionally emphasized in the Theory of Planned Behavior but also motivational drivers and awareness of enforcement consequences. The observed relationships provide an initial indication that compliance behavior emerges from a combination of internal behavioral motivations and external regulatory considerations and not just on a single driver.

Table 7: Bootstrapping results

	Path coefficients
Attitude -> Behavioral Compliance	-0.002
Motivation -> Behavioral Compliance	0.499
Penalty Awareness -> Attitude	0.210
Penalty Awareness -> Behavioral Compliance	0.153

Penalty Awareness -> Motivation	0.592
Perception -> Behavioral Compliance	0.186

The bootstrapping analysis was conducted to evaluate the statistical significance of the hypothesized relationships within the extended Theory of Planned Behavior (TPB) framework. As presented in Table 7, three structural paths were found to be statistically significant, while the remaining relationships did not reach significance at conventional thresholds. Among the tested relationships, motivation demonstrated the strongest and most significant positive influence on behavioral compliance ($\beta = 0.499$, $p < 0.001$). Motivation to Behavioral Compliance is significant because the variable Motivation reflects an individual's persistence in performing environmentally responsible actions, which supports the claim that households are more likely to comply when waste management behaviors are perceived as personally meaningful or beneficial. The strength of this relationship further implies that internal behavioral drivers can play a primary role in translating policy expectations into compliance towards the practices.

On the other hand, Penalty Awareness to Motivation is also a significant relationship ($\beta = 0.592$, $p < 0.001$) because awareness to penalties or deterrence strategies can further amplify the motivation of the households or the individuals to really follow the waste management policies or protocols. Rather than functioning solely, penalty awareness can shape behavioral readiness by increasing accountability and further reinforces the perceived importance of following the waste management practices and regulations. This significance of this relationship implies that awareness of the deterrence mechanisms can encourage internal motivational responses. Although the motivation must be existing already and penalty awareness can amplify it more so that it translates into voluntary compliance.

The last significant relationship is Perception to Behavioral Compliance ($\beta = 0.186$, $p = 0.038$). This finding indicates that households' interpretations and personal evaluations of the waste management system can play a meaningful role in shaping compliance behavior. The variable Perception considers how individuals cognitively interpret waste management structures and encompassed some aspects of motivation in a way that it looks at the systems and try to make sense of it in the context of cultural, social, or environmental impacts. For instance, when households perceive systems as functional and beneficial, they are more inclined to actively participate in compliance practices. Furthermore, this finding highlights that behavioral compliance is partly contingent upon how policies are experienced at the community level rather than solely on their formal role and existence.

6.5. Interpreting compliance behavior within the Philippine context

The findings provide insight into the behavioral dynamics underlying household waste management compliance within the municipality of Argao, Cebu. Although institutional policies and waste management infrastructure are formally established, the results indicate that compliance is shaped primarily by individual-level behavioral determinants rather than structural provisions alone. With the extended Theory of Planned Behavior (TPB)

as a guide, this study focuses on psychological and regulatory drivers such as motivation, perception, and penalty awareness rather than infrastructural performance itself. Nevertheless, the results imply that infrastructure functions indirectly by shaping how households experience and interpret waste management systems. When facilities and services are perceived as organized, accessible, and supportive of daily practices, they may foster intrinsic motivation and encourage compliance to prescribed waste management behaviors. This supports the broader premise that environmental policies achieve effectiveness not merely through institutional design but through how individuals cognitively and behaviorally respond to them in everyday contexts.

The role of enforcement perception further clarifies how compliance behavior manifests within regulated environmental settings. The structural model identifies the pathway Penalty Awareness → Motivation → Behavioral Compliance as the strongest mechanism explaining household behavior. This finding suggests that awareness of penalties and enforcement measures does not directly influence compliance. Instead, it operates by strengthening motivational readiness among households. In this context, deterrence or penalties appears to function less as a coercive force and more as a behavioral signal that emphasizes the seriousness and legitimacy of environmental regulations and urgency to follow the protocols. The result is aligned with prior studies highlighting that limited awareness and weak enforcement reduce policy effectiveness, particularly in developing-country settings where institutional implementation varies across communities. By demonstrating that penalty awareness significantly enhances motivation, which subsequently drives compliance, the study supports the extension of TPB to integrate regulatory and deterrence mechanisms that increases internal behavioral processes rather than relying solely on attitude change.

The concept of community dynamics also emerges as an important contextual layer that influences behavioral compliance. Household responses to waste management policies are embedded within shared social environments where collective attitudes, norms, and experiences can shape individual motivation. Community-level perceptions of fairness, accessibility, and consistency in policy implementation can either reinforce or undermine compliance efforts. For example, perceived inequities in waste collection services or exclusion from disposal facilities may generate resistance or disengagement among residents, which can weaken collective participation in waste management practices. These dynamics suggest that compliance is not purely an individual decision but is partly affected through social interaction and shared community experiences, which is consistent with TPB's emphasis on socially embedded behavior.

Household-level realities further contextualize the observed behavioral patterns. The existing variations in household structure, work arrangements, and daily routines may influence the capacity of residents to comply consistently with waste segregation and disposal requirements. Some practical constraints, such as absence during collection schedules or limited time for waste preparation, can hinder compliance even when positive attitudes or motivations are present. Recognizing these constraints highlights the importance of designing waste management policies that are responsive to diverse household conditions, which thereby reduces structural barriers that may unintentionally discourage participation.

Despite the contributions of this study, there are several limitations that should be reiterated. First, the study was conducted within a specific geographic area, which may have an influence on the generalizability of the findings to other communities with different socioeconomic, cultural, or environmental conditions. Second, the causal relationships among the variables cannot be established with certainty. Third, although the extended Theory of Planned Behavior model incorporated motivation and penalty awareness, other factors that may influence household waste management compliance, such as environmental knowledge, access to waste management facilities, institutional trust, and community participation, were not included in the present analysis. The viability of the discussion and recommendations should be able to address the limitations of future studies.

Overall, the findings suggest that improving waste management outcomes requires behavioral interventions that complement and support infrastructures and established policies. While infrastructure and regulatory frameworks remain necessary foundations, behavioral compliance actually strongly depends on how policies can switch on motivation, shape perceptions, and align with community and household realities. In the context of community-based waste management systems, strategies that enhance enforcement, strengthen motivational engagement, and address local social dynamics may be more effective in promoting sustained behavioral compliance than investing in and revisiting infrastructure and policies alone.

7. CONCLUSIONS AND POLICY INSIGHTS

This research indicates that to achieve better compliance with household waste management policies in the Philippines, there must be a phased approach based on behavioral change that will likely be more effective than using only infrastructure development or strict enforcement. The compliance behavior with household waste management policies is primarily motivated by individual and community perceptions of penalties; therefore, it is important for policy interventions to be designed in such a way as to gradually create improved compliance to the extent that it is within the current institutional constraints.

7.1. Short-Term: Low-Cost, Behavior-Oriented Interventions

In the short run, local government units (LGUs) and barangays can implement low-cost, readily implementable strategies that directly address the behavioral determinants of compliance. First, improving Information, Education, and Communication (IEC) campaigns to show individuals how proper waste management relates to their own cleanliness, health, and community order will increase motivation and promote compliance. Current IEC messages about the environment are often abstract. Using environments as a motivator will provide daily relevance for households and increase the likelihood that individuals will comply with the rules. In alignment with this, it is encouraged to do a quarterly barangay-based waste segregation workshop with attendance integrated into community environmental programs.

Second, improving the visibility of the enforcement of waste disposal rules and their consequences will help raise awareness of penalties for violations and further motivate compliance. When communicating waste disposal rules, penalties, and pickup schedules, LGUs should provide the information in a variety of ways (e.g., through

bulletin board postings and community-wide notices) and do so consistently and fairly. For a more concrete implementation, the municipality of Argao can be encouraged to introduce or strengthen incentive systems such as barangay recognition awards and waste exchange programs. Third, LGUs may enhance household compliance by providing basic household-oriented compliance supports (e.g., standardized guides on waste separation, color-coded guides, and reminders of the collection schedule). These methods will reduce the cognitive and physical burdens on families and increase the likelihood that they will comply with the rules.

7.2. Medium-Term: Strengthening System Credibility and Community Engagement

The medium-term policy efforts should include working on enhancing the perception of the system and increasing trust in the institutions involved, as these two items were shown to have a strong relationship to compliance behavior. Improving both reliability and accessibility of services is essential. Reliable collection times for waste and accessible disposal locations will directly affect how efficient a household perceives the municipal waste management service to be and are associated with higher rates of compliance. This indicates that both service performance is a technical and a behavioral issue. In the decision regarding the shifts, days of the week, or the collection times, the feedback of the households should be taken into account in order to properly corroborate and decide on the schedules that should be considered.

LGUs should develop a formal way for residents and communities to communicate with them, to provide feedback about the communities' waste management system. To do this, there needs to be consultation at the barangay level, a reporting procedure for complaints about waste management, and a periodic assessment of how waste is being managed throughout each community. Providing community members, the opportunity to provide feedback on the waste management system also allows for the tracking of system performance issues as well as increasing system responsiveness, thereby increasing community perception that they will receive equitable treatment because they use the waste management system. Similarly, local governments will need to enhance their enforcement of waste management rules by applying them consistently and transparently across all households. If there is the appearance of inequitable enforcement, then the community will be less likely to comply with the rules it has been given.

7.3. Long-Term: Institutionalizing Household-Sensitive and Adaptive Policies

Over time, waste management policies will evolve towards the creation of household-sensitive and adaptive systems that recognize how different types of households influence how they comply with their waste management responsibilities. Policies should take into account many of the factors that influence how households operate on a day-to-day basis and how these households may have an impact on waste policy. This may include the introduction of more flexible collection arrangements, localized service adjustments to accommodate work schedules, time availability, and space limitations, or differentiated assistance from local governments to help those households with structural limitations. By creating systems that are consistent with household realities, these solutions will reduce barriers to compliance and encourage long-term participation. Additionally, LGUs may begin to develop

participatory governance systems, where local communities participate in the design and assessment of waste management systems. Full co-governance may not be feasible in all communities immediately; however, incremental integration of community input can help increase accountability, ownership, and sustainable behavioral change.

7.4. Integrated Perspective: Waste Management as a Socio-Technical System

The results from this research across the four stages indicate that waste management systems must be understood as socio-technical systems; thus, technical infrastructure and human behavior are interdependent. To effectively develop waste management policies and systems requires integration of the following components: (a) motivational mechanisms that maintain long-term behavioral engagement; (b) visible and credible enforcement systems that reinforce compliance signals to participants; (c) reliable service delivery that is user oriented will enhance the perception of system effectiveness; (d) household sensitive adaptations that address practical constraints to waste management behavior. The integration of these elements will result in waste management policies that are operationally effective and behaviorally supportive, which increases the probability of long-term success.

The research concludes that it is possible to achieve successful behavioral change through phased behavior-focused interventions or policies in the Philippines. Short-term results can be achieved with low-cost behavioral interventions, but will require strengthening system credibility over the medium- & long-term to achieve effective results. By developing policies that reflect households' perceptions, experiences, and responses to waste management systems, LGUs will achieve greater effectiveness in their waste management practices through improved household compliance. Therefore, the success of a waste management program should not be based solely on the amount of infrastructure or regulation, but also on the program's ability to create consistent, scalable behavioral compliance among households.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Acknowledgments: The authors declare that no specific funding was received for this research from public, commercial, or not-for-profit funding agencies.

Conflicts of Interest: The author declares no conflicts of interest.

REFERENCES

1. Amin, A., Abdulrauf, A., & Isiaq, A. T. 2024. Strategies for the implementation of environmental protection regulations towards sustainable waste management in Oyo State. *Gusau International Journal of Management and Social Sciences*, 7(2), pp. 83-104. [<https://doi.org/10.57233/gijmss.v7i2.05>]

2. Amir, F., Miru, A. S., & Sabara, E. 2025. Urban household behavior in Indonesia: Drivers of zero waste participation. arXiv preprint arXiv:2505.17864. [<https://doi.org/10.48550/arXiv.2505.17864>]
3. Chen, J., Chen, J., Li, T., Li, T., You, H., You, H., Wang, J., Peng, X., & Chen, B. 2023. Behavioral interpretation of willingness to use wearable health devices in community residents: A cross-sectional study. *International Journal of Environmental Research and Public Health*, 20(4), p. 3247. [<https://doi.org/10.3390/ijerph20043247>]
4. Cheng, K. W. 2020. Attitude, perceived behavioral control, and subjective norms in waste segregation-at-source behavior: An empirical study. *Sustainable Business and Society in Emerging Economies*, 2(1), pp. 83-93. [<https://doi.org/10.26710/sbsee.v2i1.1312>]
5. Cheng, K. W., Osman, S., Jusoh, Z. M., & Lau, J. L. 2021. Multidimensional factors that influence the intention to practice segregation-at-source of solid waste: An empirical study. *Management Science Letters*, 11(2), pp. 379-390. [<https://doi.org/10.5267/j.msl.2020.9.031>]
6. Concari, A. 2023. Understanding waste separation behavior through the application of an extended form of the theory of planned behavior (TPB). [<https://doi.org/10.26481/dis.20230626ac>]
7. de Matos, C. A., Luppi, L., & Veiga, R. T. 2025. Assessing the intention-behavior gap in the pro-environmental behavior context: a longitudinal study about water conservation. *Journal of Cleaner Production*, 524, 146499. [<https://doi.org/10.1016/j.jclepro.2025.146499>]
8. Esfandiari, K., Pearce, J., Dowling, R., & Goh, E. 2023. The extended theory of planned behaviour model and national parks visitors' pro-environmental binning behaviour: A cross-cultural perspective. *Journal of Outdoor Recreation and Tourism*, 42, 100602. [<https://doi.org/10.1016/j.jort.2022.100602>]
9. Getahun, D., & Mengstie, M. 2024. Explaining motivational factors of employees' behavior towards customer satisfaction using the theory of planned behavior. *PLoS One*, 19(11), e0314431. [<https://doi.org/10.1371/journal.pone.0314431>]
10. Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. 2022. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*.
11. Ibokette, A. I., Aboi, E. J., Ijiga, A. C., Ugbane, S. I., Odeyemi, M. O., & Umama, E. E. 2024. The impacts of curbside feedback mechanisms on recycling performance of households in the United States. *World Journal of Biology Pharmacy and Health Sciences*, 17(2), pp. 366-386. [<https://doi.org/10.30574/wjbphs.2024.17.2.0102>]
12. Izuakor, C. F., Emeghebo, U. M., Nwakile, T. C., Omego, G. N., Odewale, O. T., Attah, B. I., ... & Ogbonna, I. J. 2026. Izuakor, C. F., Emeghebo, U. M., Nwakile, T. C., Omego, G. N., Odewale, O. T., Attah, B. I., ... & Ogbonna, I. J. 2026. Promotion incentives and the dynamics of research motivation among Technical and Vocational Education and Training lecturers in Nigerian universities. *Discover Education*, 5(1), p. 148. [<https://doi.org/10.1007/s44217-026-01201-w>]
13. Jayaraman, A., Tripathi, S., & Ramakrishnan, S. 2026. Regulatory Concerns for Solid Waste Management. *Solid Waste Management: Challenges, Sustainability and Advancements*, pp. 397-430. [<https://doi.org/10.1002/9781394267996.ch12>]
14. Kardiat, Y., Jamaruddin, J., & Saprudin, S. 2025. Civil Servant Behavior Towards Public Service Compliance: A case study in Makassar City. *Journal of Asian Multicultural Research for Social Sciences Study*, 6(3), pp. 83-97. [<https://doi.org/10.47616/jamrsss.v6i3.665>]
15. Kim, S. 2023. Antecedents of compliance intention and its impact on waste separation behavior: based on rational choice theory and deterrence theory. *Behavioral Sciences*, 13(5), p. 424. [<https://doi.org/10.3390/bs13050424>]

16. Khan, A. U., Hussain, U., Rashid, M., & Hameed, R. 2024. Social norms and legal compliance: Understanding the psychological factors influencing adherence to laws in educational settings. *Bulletin of Business and Economics (BBE)*, 13(3), pp. 326-332. [<https://doi.org/10.61506/>]
17. Kumar, A. 2019. Exploring young adults' e-waste recycling behaviour using an extended theory of planned behaviour model: A cross-cultural study. *Resources, Conservation and Recycling*, 141, pp. 378-389. [<https://doi.org/10.1016/j.resconrec.2018.10.013>]
18. Liu, Z. 2025. The Impact of Green Information Disclosure on Green Consumption Intention: Evidence from New Energy Vehicle Consumers in China Based on the Theory of Planned Behavior. *Sustainability*, 17(17), 7983. [<https://doi.org/10.3390/su17177983>]
19. Love, S., Larue, G. S., Rowland, B., & Davey, J. 2024. What influences intentions to offend? A systematic review and meta-analysis of the factors associated with the deterrence of drink-driving. *Transportation research part F: traffic psychology and behaviour*, 100, pp. 154-168. [<https://doi.org/10.1016/j.trf.2023.11.015>]
20. Nabila, S. H., Negoro, H. A., & Utari, D. 2020. The level of individual participation of the community in implementing effective solid waste management policies. [<https://doi.org/10.22034/gjesm.2020.03.05>]
21. Park, J., & Spence, C. 2022. The effect of perceived scarcity on strengthening the attitude-behavior relation for sustainable luxury products. *The Journal of Product and Brand Management*, 31(3), pp. 469-483. [<https://doi.org/10.1108/JPBM-09-2020-3091>]
22. Pulido, S., Bonador, M. A., Buban, K. J., Cailo, K. J., Furio, A., Libo-on, S. M., ... & De Silos, P. Y. L. Waste Disposal Methods, Compliance Behavior, and Factors Affecting Adherence to Waste Management of Microenterprises in Cupang, Muntinlupa City. *Small*, 1, pp. 36-750. [<https://doi.org/10.13140/RG.2.2.28964.39041>]
23. Romaniuc, R., & Bazart, C. 2026. Intrinsic and extrinsic motivation. In the *Encyclopedia of law and economics*. Cham: Springer Nature Switzerland, pp. 1423-1426. [https://doi.org/10.1007/978-1-4614-7883-6_270-1]
24. Sahoo, K. C., Soni, R., Kalyanasundaram, M., Singh, S., Parashar, V., Pathak, A., ... & Diwan, V. 2022. Dynamics of household waste segregation behavior in an urban community in Ujjain, India: a framework analysis. *International journal of environmental research and public health*, 19(12), 7321. [<https://doi.org/10.3390/ijerph19127321>]
25. Simpson, S. S., & Evens, J. 2024. Corporate environmental non-compliance and the effects of internal systems and sanctions. In the *Research Handbook on Environmental Crimes and Criminal Enforcement*. Edward Elgar Publishing. pp. 36-67. [<https://doi.org/10.4337/9781035309511.00011>]
26. Sobrino-García, I. 2025. European waste management regulations in Spanish local administrations: Compliance assessment and integration *Frontiers. Sustainable Development*, 33(2), pp. 2553-2565. [<https://doi.org/10.1002/sd.3258>]
27. Vorobeva, D., Scott, I. J., Oliveira, T., & Neto, M. 2022. Adoption of new household waste management technologies: The role of financial incentives and pro-environmental behavior. *Journal of Cleaner Production*, 362, 132328. [<https://doi.org/10.1016/j.jclepro.2022.132328>]
28. Wang, F., Cheng, Z., Reisner, A., & Liu, Y. 2018. Compliance with household solid waste management in rural villages in developing countries. *Journal of Cleaner Production*, 202, pp. 293-298. [<https://doi.org/10.1016/j.jclepro.2018.08.135>]

APPENDIX

Appendix A: Survey Questionnaire

Household Waste Management Questionnaire

Instructions: Please indicate the extent to which you agree or disagree with the following statements by checking the appropriate box.

A. Attitude Toward Household Waste Management

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I believe proper waste disposal is important for environmental protection.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel responsible for reducing the amount of waste I produce.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I consider the impact of my waste on the community.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I value recycling as part of my lifestyle.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Proper waste management is a sign of discipline and cleanliness.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think improper waste disposal harms public health.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

B. Perception of Waste Management Systems and Enforcement

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
My community provides sufficient support for proper waste disposal.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Most people in my neighborhood manage their waste properly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Local authorities are active in enforcing waste management policies.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There are enough accessible recycling and waste segregation facilities in my area.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Waste collection services in our area are reliable and consistent.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Waste management campaigns are visible and informative in our area.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

C. Waste Management Behavior

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I segregate my household waste regularly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I recycle or reuse items instead of throwing them away.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I properly dispose of hazardous household waste (e.g., batteries, chemicals).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I participate in community clean-up drives or related activities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I compost biodegradable waste at home.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

I follow my local government's waste disposal rules and schedule.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
---	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

D. Motivation Toward Waste Management

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I manage my waste properly because I care for the environment.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am motivated by the desire to set a good example for others.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel good when I manage my waste properly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My family encourages proper waste management at home.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rewards or incentives would encourage me to manage my waste better.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The fear of being fined encourages me to comply with waste management rules.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I will be more consistent if there is regular monitoring and feedback.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

E. Awareness of Penalties and Fines

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Penalties for improper waste disposal are clearly communicated in my community.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am aware of the fines or sanctions for violating waste disposal rules.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think penalties are necessary to ensure compliance with waste management practices.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The presence of fines motivates me to dispose of waste properly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>