Development of Green Policing Index in the Context of Solid Waste Management in Davao City

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ABSTRACT

This study developed a Green Policing Index (GPI) to assess how environmental governance and community practices influence solid waste management compliance in Davao City. Using surveys from 1,020 household respondents across selected barangays, the study examined the roles of monitoring, law enforcement, planning, environmental awareness, information campaigns, community programs, and individual waste practices in promoting proper waste management. Through Exploratory and Confirmatory Factor Analysis, the study identified seven key dimensions of green policing: Operational Monitoring and Surveillance, Legal Enforcement and Accountability, Strategic Planning and Data Analytics, Coordination and Community Programs, Environmental and Health Risk Awareness, Information Dissemination, and Individual Waste Practices. Results showed that environmental awareness and enforcement were among the strongest factors influencing compliance. The findings suggest that effective solid waste management goes beyond policies alone. Strong environmental governance, active community participation, consistent enforcement, and public awareness all play important roles in encouraging responsible waste practices. The validated Green Policing Index may serve as a practical framework for LGUs, the PNP, and environmental agencies in improving sustainable waste management programs in Davao City.

Keywords: Green Policing Index, Solid Waste Management, Environmental Governance, Sustainable Development, Law Enforcement, Environmental Awareness, Community Participation, Davao City, Republic Act No. 9003.

INTRODUCTION

Solid waste management (SWM) has recently emerged as one of the most important challenges to environmental governance for many urban settings across the globe. Rapid urbanization, population growth, industrial development, and the changing nature of consumption have led to significant increases in the quantity and complexity of municipal solid waste requiring local governments to implement efficient systems for collection, segregation/recycling, treatment/processing, and disposal (Kaza et al., 2018; Ferronato & Torretta, 2020; World Bank, 2021; UNEP (United Nations Environment Program), 2023). Unsustainable waste management leads to environmental pollution, greenhouse gas emissions, degradation of ecosystems, flooding problems or other public health risks that effect the proper pursuit of sustainable urban development (UNEP, 2021; Bvuma & Dlamini, 2024; World Health Organization, 2025). As a result, SWM is viewed not as just an environmental or technical issue but rather as a governance problem that needs coordinated institutions to implement policy, enforce regulation and enthusiastic citizen participation (Biermann et al., 2020; OECD, 2020).

The Sustainable Development Goals (SDGs) that underpin sustainable environmental governance are becoming more recognized. The SDG themes of Goal 11 on Sustainable cities and communities, Goal 12 on Responsible consumption and production, Goal 13 on Climate action and Goal 16 on Peace, justice and strong institutions are relevant. Taken together these objectives highlight that sustainable waste management relies not only on advancements in technology, but on responsible institutions, cooperative governance and adherence to environmental policies by the public (UNEP 2021; Biermann et al. 2020). Contemporary environmental governance thus includes integrated policy processes of development, implementation, monitoring and

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enforcement, while also including stakeholder participation and adaptive management that interactively influence the eventual outcome (Ostrom, 1990; Gunningham et al., 1998; Janssen & van der Voort, 2020).

In many countries, inadequate SWM is not a result of the absence of policies but rather a failure of governance despite comprehensive environmental legislation in place. Multiple other studies have identified weak institutional coordination, fragmented implementation, insufficient monitoring systems, inconsistent enforcement and limited community engagement as fundamental barriers to achieving sustainability in waste management, particularly from an international perspective (Guerrero et al., 2013; Ballesteros et al., 2020; World Bank, 2021; Apitz et al., 2024). Such challenges have led to a growing awareness that environmental protection needs improved cooperation between government institutions, local communities and enforcement agencies.

In this evolving nexus of governance, green policing is an institutionalized concept that expands the traditional role of law enforcement from simply regulatory enforcement to include environmental monitoring, surveillance, community engagement, public education and interagency coordination. Green policing supports environmental governance, not just as an enforcement mechanism, but by requiring accountability and using the pressure of judicious and appropriate threat/law to encourage citizenship that behaves in an environmentally responsible way (Lum & Koper 2017; Ratcliffe 2018; Screen & Favarin Reporter). This wider view acknowledges that environmental compliance occurs through governances where regulatory institutions, local authorities and communities play complementary roles (World Bank Institute 2007a; Gilmour in press).

SWM continues to depend on household involvement as the city and town levels of waste segregation, recycling and disposal begin at home. However, research demonstrates that awareness of environmental issues does not necessarily lead to environmentally responsible behavior. Rather, the correlation of these factors and household compliance to waste management practices as per institutional support, enforcement visibility, social norms (Sener et al., 2014; Albayrak et al., 2017), environmental communication and access to waste management services of a household shape the scenario (Kollmuss & Agyeman, 2002; Wan et al., 2021; Nguyen et al., 2023; Moeini et al., 2023). These results are aligned with the Theory of Planned Behavior (TPB) as this theory posits that behavioral intention is determined by attitudes, subjective norms and perceived behavior control over the performance or non-performance of a particular behavior (Ajzen, 1991, 2020). Recent evidence further indicates that governance conditions represent the mediating institutional context for these behavioral determinants, suggesting environmental compliance operates at both the behavioral and governance levels (Wang et al., 2021; Nguyen et al., 2023).

Ecological solid waste management in the Philippine context is mostly guided by Republic Act No. 9003 which requires local government units (LGUs) and barangays to implement waste segregation, recycling, materials recovery facilities environmental education, as well as climate change adaptation and mitigation programs (Republic of the Philippines, 2001). Though it laid out a complete set of laws governing solid waste, implementation at many local governments is still very uneven. Even with statutory requirements, national assessment continues to reveal institutional shortfalls in coordination, monitoring systems and enforcement, of actual waste management facilities that generate implementation gaps (Ballesteros et al., 2020; Commission on Audit [COA], 2023; Geronimo, 2025). This brings into perspective that it may be equally important to facilitate investments in waste management infrastructure, as well as strengthening governance mechanisms for achieving sustainable compliance.

Despite the prominent academic discourse around environmental governance and SWM, most studies have focused on either household waste practices, environmental-sustainability awareness or local government implementation as independently operating realms of activity (Guerrero et al., 2013; Ordoñez & Harder, 2021; Olalo et al., 2022). However, within a single governance framework of compliance, comparatively less research has studied the joint effects of institutional governing capacity, environmental enforcement, strategic planning, public communication devices used by government agencies to communicate information to the broader community on compliance behavior in conjunction with household behavior and industry factors. In addition, validated multidimensional instrument for assessing green policing as an integrated environmental governance construct in the context of the Philippines is lacking. This approach is methodologically restrictive and hinders policymakers, local governments, and environmental agencies from relying on comparable and empirically validated indicators to assess governance performance.

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Filling this gap is the main contribution of the current research. Instead of considering green policing solely a law enforcement function, this study argues that it may be more realistically conceptualized as a multidimensional governance system that combines institutional, regulatory, informational, and behavioral components into processes affecting household followership of solid waste management policies. This broader interpretation integrates the literature on institutional performance with the citizen environmental behavior literature within a single analytic framework Further, this manifestation of an environmental governance conceptualization advances existing research by providing a unified measurement between institutional performance and citizen environmental behavior.

Based on this, the current study aims to develop and validate a multidimensional instrument for measuring environmental governance as well as household compliance with solid waste management regulations in Davao City, Philippines: The Green Policing Index (GPI). The proposed framework operationalizes green policing via a total of seven related dimensions, including: Operational Monitoring and Surveillance, Legal Enforcement and Accountability; Strategic Planning and Data Analytics; Coordination and Community Programs; Environmental and Health Risk Awareness; Information Dissemination & Individual Waste Practices. The study utilizes Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA), it assesses the construct validity, reliability, and psychometric properties of the newly proposed index as a governance assessment tool.

In addition to the validated measurement instrument, this study contributes three key findings to environmental governance literature. Secondly, it redefines green policing to be an overarching governance context rather than a narrowly defined operational law enforcement function. Secondly, it creates and empirically tests the Green Policing Index - one of the first multidimensional instruments designed to measure environmental governance household behavior related to solid waste management. Third, it provides an evidence-based framework that can guide local governments, environmental agencies and policing institutions in assessing governance performance to address implementation gaps, institutional accountability and inform evidence-based environmental policy. Thus, the Green Policing Index presents a tool that can be utilized and sharpened to assess environmental governance in other cities confronting equivalent difficulties to sustainability.

METHODS

Research Design

This study used a quantitative, non-experimental, cross-sectional survey research design to create and validate a multidimensional scale known as the Green Policing Index (GPI) to measure environmental governance and household adherence to solid waste management (SWM) policies in Davao City, Philippines. A cross-sectional design was appropriate, as it allowed to explore latent constructs and relationships between variables at one point in time while providing empirical evidence for instrument development and validation (Creswell & Creswell, 2018).

The study was conducted utilizing exploratory sequential instrument-development approach by combining Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) to purpose the psychometric attribute of a proposed index. EFA was used to reveal the latent structure of measurement items, while CFA was subsequently conducted to assess construct validity and validate a measurement model. Combining theoretical conceptualization with empirical verification, this sequential validation approach is widely recommended for the creation of multidimensional measurement instruments (Boateng et al., 2018, DeVellis & Thorpe, 2021; Hair et al., 2019). In line with the positivist paradigm, we undertook an objective measurement and statistical inference approach to create evidence base for green policing in household SWM compliance.

Study Locale

Six City Property Plant (Davao City, Philippines)—The study took place in Davao City, one of the largest highly urbanized cities in the country and a recognized center for environmental governance initiatives. This city was chosen primarily because it has successfully implemented ecological solid waste management programs and its wide variations in socio-economic-demographic characteristics. The eleven most populated barangays spread through the three congressional districts of the city were purposively selected based on their adequate generation

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

of household waste and presence of continuing environmental governing programs. Notably, these communities offered an ideal context to assess residents' perspectives on environmental governance, institutional performance, and policy compliance (SWM).

Respondents and Sampling Procedure

The researcher recruited participants through a community survey of the population of household heads and adult members residing in selected barangays. Respondents had to have been (1) aged 18 years or older; (2) a resident of the community for at least one year prior to data collection; and (3) provided informed consent without coercion. Participants must have had an adequate knowledge of both local environmental governance programs and household waste disposal practices; thus, temporary residents, visitors, boarders, respondents aged under 18 years from the study as well as those with incomplete questionnaires were excluded.

Sequentially, the researcher utilized a multi-stage purposive sampling technique. Stage I: The pilot site was purposely selected for Davao City due to its various environmental governance programs. In the second stage, eleven barangays with large residential populations and high quantities of domestic wastes were identified, all currently implementing environmental programs. Lastly, the recruited those respondents were who lived in selected communities as household.

In total, there were 1,120 questionnaires administered After screening for data quality, assessing missing values and conducting quality assurance processes, a total of 1,020 responses were retained for statistical analysis. This sample size greatly surpassed the recommended minimum for adequate factor analytic processes and structural equation modeling, thus guaranteeing sufficient statistical power when employing both exploratory and confirmatory analyses (Hair et al., 2019; Kline, 2023).

Research Instrument

Collection of data was performed using a researcher-developed structured questionnaire that served to operationalize the Green Policing Index. The development of these instruments was based on theoretical foundations, including environmental governance theory, Theory of Planned Behavior, empirical literature regarding sustainable waste management practices, and the specific operational context pertaining to ecological solid waste management in the Philippines (Ajzen 1991, 2020; Boateng et al., 2018).

The questionnaire contained two sections. The first survey gathered respondents' demographics and the second examined perceptions of the regulatory state for environmental governance and household SWM practices on a five-point, 1–5 (Strongly Disagree to Strongly Agree) Likert scale. The first version included 100 variables to measure 10 different theoretical domains of the domain of environmental governance, institutional capacity, regulation enforcement, stakeholder participation, environmental communication, public awareness and information about strategic planning and behavior about household waste management.

Instrument Validation

The Green Policing Index adopts a content, construct, and reliability validation process with multiple stages. The instrument was initially subjected to evaluation by experts in environmental governance, criminology, research methodology and solid waste management. Content and face validity were assessed by experts who reviewed the items for content relevance, clarity, coherence, context appropriateness, and item representativeness to modify the questionnaire content and wording as per procedure outlines in scale-development (Boateng et al., 2018; DeVellis & Thorpe, 2021).

The new version of the instrument was then pilot tested in 100 respondents from a population similar to, but not derived from, the study population. Preliminary internal consistency was evaluated using Cronbach's alpha, with the widely accepted cut-off of $\alpha \geq .70$ (Cronbach, 1951; Hair et al., 2019))

The validation of the construct followed a stepwise psychometric assessment. First, Exploratory Factor Analysis was performed to determine the latent factor structure and eliminate poorly performing indicators. Confirmatory

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

Factor Analysis then analyzed competing measurement models and confirmed construct validity with successive model refinement. Validation refined the set of 100 to 37 retained items representing seven dimensions that have empirical support: Operational Monitoring and Surveillance, Legal Enforcement and Accountability, Strategic Planning and Data Analytics, Coordination and Community Programs, Environmental and Health Risk Awareness, Information Dissemination; Individual Waste Practices. This iterative approach not only improved the precision of the concept but also strengthened the instrument's psychometric qualities.

Data Collection Procedures

Data collection involved a step-by-step process starting with a comprehensive literature review to developing the theoretical underpinnings of the Green Policing Index. Once instruments had been developed, validation by the experts was performed along with pilot testing and clearance from relevant ethics and administrative authorities, household surveys were conducted in each of the chosen barangays.

Questionnaires were screened for completeness and consistency prior to encoding of data. Before we start data cleaning, the first step was screening missing responses, identification of multivariate outliers and verification of statistical assumptions that are necessary for multivariate analysis. Questionnaires with too much missing data or not meeting the defined data quality criteria were eliminated prior to statistical analysis.

Statistical Analysis

The researcher performed data analysis in consecutive phases of psychometric evaluation and descriptive interpretation. The preliminary analyses included screening data; analysis of missing cases, normality using skewness and kurtosis statistics; multivariate outlier detection; and internal consistency estimates via Cronbach's alpha (Cronbach, 1951; Hair et al., 2019)

The initial examination of the latent dimensional structure of the proposed Green Policing Index was conducted using Exploratory Factor Analysis (EFA). Factor extraction was based on eigenvalues over 1.0, standardized factor loadings of ≥0.60 and substantive conceptualization consistent with recommendations for new scale development (Henson & Roberts, 2006; Hair et al., 2019). A four-factor solution was found in the qualitative EFA, which were used as an empirical basis for subsequent model development.

We then conducted confirmatory factor analysis (CFA) to evaluate alternative measurement models, establish construct validity, and examine model fit using several goodness-of-fit indices. A theoretically consistent seven-factor measurement model was developed progressively over various stages of model refinement using the dimensions agreed upon in the validation of the Green Policing Index (Brown, 2015; Kline, 2023).

Complementary measures of reliability and validity were used to assess the psychometric quality of the final model. Formative Measurement model Internal consistency was measured by the approach of composition: Cronbach's alpha and Composite Reliability (CR). Convergent validity was assessed via standardized factor loadings and Average Variance Extracted (AVE) while discriminant validity was examined using the Fornell-Larcker criterion (Fornell & Larcker, 1981) and the Heterotrait-Monotrait Ratio (HTMT) (Henseler et al., 2015). Lastly, descriptive statistics were performed in order to obtain an overview of perceptions from respondents across validated dimensions of the Green Policing Index. Together, these analyses determined the internal consistency, construct validity, convergent validity, discriminant validity and dimensional stability of the tool used in this study for measuring environmental governance and household compliance with solid refuse management policies.

RESULTS AND DISCUSSION

This chapter contains the data collected and the analysis and discussion according to the objectives of this study, after explaining about research methodology. Data are organized, processed using tables/figures and analyzed properly with statistical tools to yield some insights and veracity to the findings of the research. In addition, results interpretation intends to interpret the meaning of findings regarding research questions and extant literature.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

Data Suitability

To assess the suitability of the data for factor analysis, the Kaiser–Meyer–Olkin (KMO) Measure of Sampling Adequacy as well as Bartlett's Test of Sphericity were performed and are shown in **Table 1**. The KMO value was. 990-higher than the recommended. 60 which indicated that the sampling adequacy was good. This is "marvelous" under Kaiser's criteria which signify much general variance between variables making them excellent for factor analysis. Additionally, Bartlett′s Test of Sphericity was statistically significant (χ^2 (4950) =145792.584, p .001).

Table 1: The Measure of Sampling Adequacy and Sphericity

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.990
Bartlett's Test of Sphericity	Approx. Chi-Square	145792.584
	df	4950
	Sig.	.000

Extraction Method

As shown in **Table 2**, the first component (general factor) explained 65.373% of variance. Together, the six retained components accounted for 77.546% of the cumulative variance; which exceeds the common 70–80% threshold for sufficient representativeness of constructs.

Table 2: Cumulative Explains Collective Variance

Total Variance Explained

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	65.373	65.373	65.373	24.785	24.785	24.785
2	4.620	4.620	69.993	19.517	19.517	44.301
3	3.290	3.290	73.283	16.274	16.274	60.575
4	1.693	1.693	74.975	8.934	8.934	69.509
5	1.482	1.482	76.457	6.633	6.633	76.143
6	1.089	1.089	77.546	1.403	1.403	77.546
7	.973	.973	78.519			

With rotation, explained variance derived from six components was more evenly distributed (24.785%, 19.517%, 16.274%, 8.934%, 6.633% and 1.403% of the variance respectively). This indicates that the extracted components explain a high amount of variance and support the appropriateness of dimensional interpretation of the instrument.

A very large decrease in eigenvalues after the first component highlights that this approach accounts for a lot of common variances between variables and for a possible unidimensional tendency, where different variable is highly related to each other. In conclusion, the PCA findings reveal a statistically reliable and theoretically sound underlying factor structure.

The Rotated Component Matrix

Principal Component Analysis (PCA) using Varimax rotation produced a rotated component matrix containing 100 items, but this statistical analysis fit dimensions across respondents in the actual data better than it accounted for across all clients of the PC-CPR. According to the remaining factor loadings, these items naturally clustered

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

around four overarching dimensions: Institutional Monitoring and Governance (IM), Personal Awareness and Knowledge (AK), Information Dissemination (ID) and Individual Waste Practices (IW).

This outcome indicates the respondents recognized many of the survey items as related rather than completely independent constructs. The same is true in factor analysis, where items assessing similar concepts tend to group together into wider underlying factors. We found that a number of items relating to implementation and/or monitoring (environment), sustainability initiatives, planning, evaluation, and government coordination loaded high under one large institutional factor. This suggests that respondents viewed these activities not as separate functions, but rather as parts of a holistic 'system' of environmental governance.

Of the dimensions, Personal Awareness and Knowledge was one of the strongest and most stable predictors. Results and Discussion Factor loadings were between 710 to. 842; that is, the items are highly consistent with each other (Appendix 3), Specifically, awareness of the health effects of incorrect waste disposal had the highest loading (.842), indicating that health-affiliated environmental knowledge is amongst the most influential factors framing responses. This finding indicates that environmental education and public understanding (i.e., E48) make an important contribution to pro-greening policing practices in Davao City.

The OECD statistics related to Regulatory Enforcement and Monitoring dimension was also statistically significant. Items related to inspections, enforcement of law or penalties for non-compliance, surveillance activities and environmental compliance generated relatively high factor loadings (many above. 70. Indicating that respondents would seem to equate green policing with physical enforcement actions and institutional accountability. This implies a practical accomplishment, in that it celebrates not just awareness-raising, but actual implementation and enforcement of environmental governance within the city.

On the other hand, a few items were retained from Individual Waste Practices dimension but all factor loadings were acceptable (ranging from. 604 to. 635). They were related to recycling, composting, waste segregation and use of dedicated bins. The behavioral dimension was smaller than the institutional factors (measured only for those working in policing), but this is still an important aspect of green policing because it includes personal environmental practices by community members.

It is pertinent to mention here why, despite having 100 items in the questionnaire, only four dimensions were ultimately retained. This is not to say that the other items were unimportant. Instead, it indicated that many items conceptually overlapped or did not load strongly enough to be separate dimensions. Some of the items may have measured quite similar behaviors or beliefs and thus they clumped together statistically into larger categories. Some variables were retained (moved from eliminated to kept) because they crossed the loading criteria needed for minimal loading threshold.

Statistically, this result actually makes the study stronger because it results in a narrower and more parsimonious model. Whereas the factor analysis freed up fourteen weak or overlapping dimensions to create many more based on data, these two methods forced the maximum number of dimensions into a fixed set-up. Retaining the most stable/meaningful factors improves the construct validity of the instrument, as those retained factors represent what are apparent patterns in what respondents really think.

Overall, the results of this study indicated that four main domains contribute towards proper green policing performance in Davao City: these are rooted within strong institutional governance, effective public awareness, dissemination of green information and environmental stewardship. The extent of the reduction from 100 items to a smaller number of core dimensions indicates that those are dominant and salient aspects of green policing in terms of both experience and perception by the respondents.

Exploratory Factor Analysis (EFA) interpretation

Exploratory Factor Analysis (EFA), a four-factor structure underlying the Green Policing Index (GPI) was conducted. The retained factors had acceptable factor loadings of .604 to .842, suggesting concentrated relations between the kept items and their respective latent constructs. According to Hair et al. (2019), factor loadings above. 60 suggest great practical importance and denote that the retained items are strong indicators of its

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

underlying factor. The factor structure (≥0.32 factor loading threshold) also showed conceptual cohesion, with the items grouped by in relation to SWM compliance-related governance, awareness, communication and behavioral dimensions.

Factor 1: Institutional monitoring and governance

The first factor was named as Institutional Monitoring and Governance, since the retained items were together demonstrating the governance, operational planning and institutional implementation support mechanisms for SWM. The factor comprised of waste-to-resource program related items, environmental partnerships, monitoring system, diversion tracking and assessment activities, data management in environment activities provision (e.g.). With factor loadings between .615 to .729 ranks indicate these constructs clustered around a shared governance-related object.

At a conceptual level, the factor represents how institutional systems carry out community-wide environmental governance and SWM programs for implementation, monitoring, evaluation and support. Additionally, the items on monitoring, planning, environmental assessments, coordination and infrastructure indicate that this factor reflects the operational and administrative aspects of environmental governance. It also shows a high degree of inter-connectedness between governance-related mechanisms in local SWM systems. Communities that perceive better governance support, environmental monitoring networks, institutional coordination, and waste management planning are also more likely to perceive stronger enforcement and implementation systems of environmental regulations.

Yet, although with high factor loadings of items on that component, the factor also revealed conceptual multidimensionality, by lumping multiple separate governance functions as a single latent construct. This broad governance dimension contained factors such as operational monitoring, strategic planning and coordination at the institutional level, data analytics, environmental governance support and enforcement capacity. This implies that the two items are conceptually linked yet potentially capture multiple but related operational domains of environmental governance. This finding justified the refinement of the construct of governance at Confirmatory Factor Analysis stage.

Factor 2: Personal Awareness and Knowledge

The second factor was labelled as Personal Awareness and Knowledge due to the retained items relating to respondents' awareness, knowledge and comprehension of SWM and environmental protection. These factors include awareness of environmental impacts, health risks of hazard waste disposal practices and benefits of recycling, waste reduction practices, separately collect solid waste (segregated), sustainable solid waste management practice (SWM), environmental laws and punishment as well as local SWM programs. Factor loadings in the. 710 to. 843Retention of variables with higher factors loading to combined indicators means mainly stronger convergence.

The cognitive factor. This element reveals the cognitive aspect of environmental behavior. These items clustered together indicate that the respondents who are aware of environmental issues will be connected to those who know recycling, waste segregation, sustainable practices and environmental regulations. This factor also suggests that ecological knowledge and risk perception are two closely linked elements of the awakening regarding environmental awareness. The basis for this factor relates to the KAP framework, Value-Belief-Norm (VBN) Theory, and the awareness aspect in TPB (Theory of Planned Behavior), all suggesting a connection between environmental knowledge/beliefs with pro-environmental behavior.

Factor 3: Information Dissemination

The third factor was conceptualized as Information Dissemination, because the items retained for this particular factor together represented environmental communication, community campaigns, educative activities, and public promotion programs in environmental issues. Among the items retained where campaigns for green environment, waste reduction project, clean-up driven, green initiatives, anti-littering campaign, workshops in

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

training attended information materials tree-planting environmental education. The factor loadings between .608 to .721 shows normal to large relationships of the indicators with the latent construct.

The factor relates to the communicative and participatory dimension of environmental governance. This clustering also shows that the environmental communication strategies awareness campaigns and community-based activities may work together as this encourages both environmental participation and SWM compliance. The effect also serves to underline the importance of public information and environmental education in determining community environmental behavior. Theoretically, the factor relates to Social Cognitive Theory and environmental communication perspectives as it recognizes that change occurs through observation, social interaction with others, and communication about the environment.

This is related to awareness, though it conceptually differs from Personal Awareness and Knowledge in that the impact here is a more external institutional process through which environmental information can be disseminated rather than the internal cognitive process researchers used to identify how understanding develops. This may indicate that environmental awareness and environmental communication operate as separate but connected domains within the Green Policing framework.

Factor 4: Individual Waste Practices

One of these factors (factor 4) was interpreted as Individual Waste Practices because retained items focused on physical waste management behaviors actually performed by respondents at home. The indicators that were retained are waste sorting, channeling of waste into designated bins, recycling and compost. Factor loadings typically range from .604 to .635 show that the relationships between the items and the latent behavioral construct are moderate but acceptable.

This factor accounts for the behavioral aspect of SWM compliance. This suggests that households that are attending to one aspect of proper waste management behavior are engaged in other forms of environmentally responsible waste practices. This factor is a measure of actual behavior, not awareness or perceptions about governance. The factor theoretically corresponds well with the behavioral aspects of the knowledge-attitude-practices (KAP) paradigm and elements of the Theory of Planned Behavior, which postulate that environmental knowledge, attitudes, subjective norms and perceived behavioral control ultimately shape actual environmental practices [44 45].

In conclusion, the EFA findings revealed that the preliminary version of Green Policing Index was composed of correlated SWM compliance dimensions related to governance, awareness, communication and behavior. The four-factor structure served as the initial empirical ground for identifying latent dimensions of environmental governance and Green Policing in Davao City. Conversely, the first factor was so broad and multi-dimensional that it called for further refinement and confirmatory factor analysis to get a clearer construct that is unidimensional and has discriminant validity.

Model Development Logic

The Green Policing Index (GPI) emerged through a rigorous, data-grounded process that blended theoretical foundations with empirical validation. The preliminary conceptual framework was derived from reviewing the literature on environmental governance, green policing, solid waste management and environmental compliance. From these theoretical backgrounds, the dimensions were first proposed in seven categories: Operational Monitoring and Surveillance, Legal Enforcement and Accountability, Strategic Planning & Data Analytics, Coordination & Community Programs, Environmental and Health Risk Awareness (EHRA), Information Dissemination (ID) and Individual Waste Practices.

Forming theoretically-based constructs a priori to testing is consistent with established procedures for developing and validating measurement instruments, these guidelines prescribe delineating latent dimensions by integrating theory and prior empirical findings before subjecting them to statistical validation (Hinkin, 1998; Hair et al., 2019).

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

The exploratory factor analysis (EFA) of the indicators indicated four factors. The four factors largely captured broad empirical clusters representing how respondents perceived and grouped the indicators. Exploratory factor analysis attempts to discover the structure and lay down latent groups without a prespecified model, and typically results in more generalized latent built on observed covariation patterns between indicators (Fabrigar et al., 1999; Hair et al., 2019). Although the EFA confirms some key evidence on the underlying structure of this instrument, one extracted factor, especially the one related to governance, included too many institutional functions (monitoring; enforcement; planning; coordination and governance). This indicated that the factor was statistically stable but conceptually heterogeneous.

Instead of viewing the four-factor solution as the best final model, the researcher treated it as an initial empirical representation of structure in the data. The EFA factors were hence interpreted as broad governance clusters that need further theoretical advances. In line with the aim of constructing a multi-dimensional index, the study then performed Confirmatory Factor Analysis (CFA) to determine if those more general functions of governance are better modelled as separate but correlated dimensions. As stated by Brown (2015), EFA and CFA are used in conjunction with one another, as EFA recognizes possible factor structures whereas CFA investigates theoretically-defined measurement models.

On the CFA stage, the researcher was availed to assess a theoretically more and better distinct model because of some conceptual delineation detected in studies. Through iterative model testing and validation, the overarching governance factor split into Operational Monitoring and Surveillance, Legal Enforcement and Accountability, Strategic Planning and Data Analytics, and Coordination and Community Programs. In this way, the process improved the specificity of constructs, minimized conceptual overlap across dimensions, and broadened interpretational scope of the entire framework. This process of refinement aligns with psychometric guidelines for constructs that highlight the need for narrow conceptual definitions and sufficient discriminant validity between latent variables (Hair et al., 2019; Hinkin, 1998).

The EFA yielded four general empirical clusters; whereas the CFA stage provided an opportunity for the researcher to test a more theoretically nuanced model. The results supported the retention of the seven-factor model, i.e., it had clearer construct boundaries, stronger theoretical alignment, and offered better model fit than a broader four-factor structure. Confirmatory factor analysis focuses on comparing models based on theory-driven expectations and data (Kline, 2023). As a result, the final Green Policing Index emerged from both the empirical findings produced from EFA and theory refinement secured through CFA-employing a more comprehensive, meaningful approach to evaluate environmental governance and household solid waste management compliance.

The justification for the multidimensionality of the GPI Model in analytical, theoretical and methodological terms.

The content analysis and theoretical review robustly indicate that the Governance Performance Index (GPI) model specifically the Institutional Monitoring and Governance dimension is multidimensional in nature rather than unidimensional. While the indicators originally appeared as a single factor when subjected to exploratory factor analysis (EFA), the processes more closely conceptually reflected several distinct significant institutional processes wherein institutions are embedded within solid waste management (SWM) governance systems.

This is consistent with psychometric theory, which acknowledges the likelihood of exploratory factor structures statistically merging conceptually related but theoretically distinct constructs when those dimensions are highly correlated (Brown, 2015).

The GPI model is multi-dimensional, as reported above, which allows the authors to differentiate among the four emerging institutional functions: Operational Monitoring and Compliance; Legal Enforcement and Accountability; Strategic Planning and Data Analytics; and Coordination and Community Programs. Although these dimensions link into higher order governance constructs as shown in **Table 3**, they each represent a unique governance mechanism with different theory-driven meanings, operational function and institutional objectives.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

Table 3: New Dimension Abstract Construct Sample Items Content Analysis

Emerging Dimension	Core Concept	Representative Items	Content Analysis Interpretation	Supporting Theory / Literature	Theoretical Meaning
Operational Monitoring and Compliance	Field monitoring, inspections, surveillance, and operational oversight	Items 11, 12, 13, 14, 15	Items focus on direct monitoring activities such as patrols, inspections, monitoring of waterways, disposal sites, and operational supervision of waste management activities.	Environmental Monitoring Theory; Compliance Monitoring Frameworks	Environmental governance requires continuous operational monitoring to detect violations, ensure compliance, and maintain environmental standards.
Legal Enforcement and Accountability	Enforcement of laws, sanctions, penalties, and regulatory compliance	Items 3, 6, 7, 8, 10	Items reflect formal legal mechanisms such as warnings, citations, investigations, penalties, and compliance with environmental regulations.	Environmental Governance Theory; Regulatory Enforcement Theory	Effective governance systems require enforceable laws and accountability mechanisms to ensure compliance with environmental policies.
Strategic Planning and Data Analytics	Data management, environmental assessment, planning, and evaluation systems	Items 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90	Items emphasize environmental assessments, waste monitoring systems, records management, infrastructure assessment, data collection, and program evaluation.	Evidence-Based Governance; Strategic Environmental Management Theory	Sustainable waste management relies on data-driven planning, environmental analytics, and evidence-based decision-making processes.
Coordination and Community Programs	Collaboration, partnerships, sustainability initiatives, and community engagement	Items 91, 92, 93, 94, 95, 96, 97, 98, 99, 100	Items reflect collaborative environmental initiatives such as clean-up drives, anti-littering campaigns, green programs, environmental partnerships, and community participation.	Participatory Governance Theory; Community-Based Environmental Management	Environmental sustainability is strengthened through stakeholder collaboration, public participation, and community-based environmental programs.

Interpretation Supporting Literature Meaning

Operational Monitoring and Compliance. This refers to the operational and surveillance side of environmental governance, direct inspections or onsite presence in applying waste management practices/site visits/periodic inspections. Environmental patrols, Field-monitoring: it expresses an idea and approach to local level

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

environmental governance deployment. In theory, this aligns with the frameworks employed for environmental guideline monitoring which assert that consistent re-testability and operational surveillance is key to pinpointing non-compliance or sustaining the desired quality control level regarding the environment. What this dimension suggests is that governance should be seen not only as regulatory but also operational.

In contrast Legal Enforcement and Accountability represents the more coercive, regulatory arm of governance systems. This dimension involves legally binding mechanisms which regulate how administrative processes enforce environmental policies through warning, investigating, sanctioning and penalties. Theoretically, this is important because surveillance never in itself guarantees compliance unless the institutions maintain some non-mutual coercive power to enforce the rule. Regulatory enforcement theory argues that institutional rules can only succeed as environmental governance if backed by an accountability system possessing capacity to punish non-compliance (Benson and Kauffman, 2018). Hence, when and where you consider the governance dimension, it is as legal system and institutional control mechanism against operational oversight.

The 3rd dimension - Strategic Planning and Data Analytics, provides a more data-driven managerial perspective on governance. This dimension is where the environmental assessments and records management and waste monitoring systems infrastructure evaluation evidence based-planning process. Theoretically this dimension closely corresponds with those frameworks of evidence-based governance and strategic environmental management that maintain these principles of horizon scanning (long term planning), the availability of credible environmental information, and analytical decision-making systems must govern environment too. This reveals how SWM governance is not restricted to only monitoring and enforcement but expands into realms of institutional intelligence, prediction, appraisal, and long strategic policy planning.

Likewise, in that same sense is Coordination and Community Programs as the participative field of environmental governance. The strategies under this category include clean up drives, anti-littering campaigns, waste reduction initiatives and sustainability along with partnerships with environmental NGOs & local communities. This dimension is conceptually grounded in theories of participatory governance and community-based environmental management that argue overall environmental sustainability cannot be realized alone through a top-down regulatory approach but only by engaging in a collaborative process whereby local people are able to govern resources for long-term sustainable outcomes. With stakeholders involved governance works; with coordination between agencies and collective action in the environment, it works as well. Correspondingly, this dimension is proposing a view of governance that is more social and collective then the one-dimensional bureaucratic function.

Together, these four dimensions appear to indicate that the GPI model overlaps and intertwines the functions of environmental governance at different scales. The dimensions are interrelated - all of them matter for SWM governance performance - but they differ as they represent an institutional mechanism with a specific nature. It is this distinction that forms the analytical rationale for the multi-conditional multidimensionality of the model.

Accepting that multidimensionality is in fact present also bears important implications methodologically for construct validity. If the original Institutional Monitoring and Governance factor had been retained as one single latent construct, this could inflate reliability coefficients due simply to many indicators being located within one broad domain. However, despite all of this, the psychometric literature continues to warn that a high degree of internal consistency does not mean unidimensionality (Florin, 1976). Although a construct may remain statistically stable, its nature obscures multiple theoretically dissociable subdimensions. Since the institutional processes within which any patterns of interactions occur are likely to be complex and constructed out of interrelated processes, rather than being based around independent variables (Brown 2015), social science research often deals with these multi-dimensional constructs.

Another benefit of the multidimensionality of GPI model is that it meets the requirements for discriminant validity for structural equation models. Latent constructs must be either empirically composed or theoretically identifiable; without this, meaningful structural relationships cannot be established (Henseler et al., 2015). Because you are comparing them with the current model, these differences between monitoring, enforcement, planning and coordination functions indicate that there actually exist distinct institutional domains in governance

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

which co-evolve but play separate developmental roles. This separation maintains the theoretical integrity of the model by avoiding excessive aggregation of individual institutional processes into a single principle.

The geographic complexity of GPI model is conceptually similar with real-world environmental governance structure. Department of Social work, University The adequate SWM governance cannot be achieved by a single institution. You can have high governance loos on monitoring type activities but low enforcement capacity or it may have strong enforcement systems loos poor planning and settings community participations. Data-driven planning through the unravelling of a plan for operation may not produce real environments. It is through interconnected but functionally diverse mechanisms that environmental governance functions in practice, and this traceable 4D structure effectively mirrors it.

Analytically much more importantly, the multidimensionality of governance allows for a better interpretation and analysis of the state of governance. Instead of a purely institutional notion, Garriga and Höffler's multidimensional model enables researchers and policymakers to identify specific strengths and weaknesses in governance. A Governance shortfall – a lack of operational oversight, an absence of accountability mechanisms that can adequately assure planners on the strategic plan, less than optimal systems for gathering and synthesizing data to inform strategy and poor stakeholder coordination. Therefore, the multidimensional structure contributes to both theoretical clarity as well as potential policy relevance and practical applicability.

To summarize, the content analysis and theoretical review constitute the analytical and theory base for the GPI model multidimensions. Findings The findings show that Institutional Monitoring and Governance is not just an institutional process but a complex domain of governance with various interrelated functions. The four-dimensional refinement improves construct and conceptual clarity, enhances discriminant validity and provides a theoretically sound, empirically informed representation of governance performance in effective solid waste management systems.

Separation of the Institutional Monitoring and Governance Component

The need for better conceptual clarity and theoretical coherence within the Green Policing Index that drove the refinement, and eventual splitting of the Institutional Monitoring and Governance component was therefore not only a statistical consideration. While the original Exploratory Factor Analysis (EFA) yielded a statistically acceptable four-factor structure, inspection suggested that the first factor embraced an overly broad and somewhat redundant governance construct which bundled several distinct environmental governance functions under one latent domain.

As EFA clusters between constructs based on common variance- covariance patterns, it is not surprising to observe clustering of governance-related variables at the exploratory stage. In these words, conceptually correlated indicators naturally tend to show the same factor loading. Under the Institutional Monitoring and Governance factor, items representing environmental monitoring, enforcement activities, investigations, planning systems, waste analytics and infrastructure provision, institutional coordination depict institutional arrangements as part of governance aspects needed for sustainability; while, community participation item revealed a demand from society. This suggested that these governance mechanisms were highly correlated to solid waste management implementation model of Davao City according to the statistical data. The statistical clustering itself does not - by any stretch of the imagination - imply that the factor is already theoretically accurate or psychometrical unidimensional.

The conceptual breadth of the original governance factor was its principal downside. All of the retained items related broadly to some aspect of environmental governance, but for different institutional functions operating within the waste management system. Environmental patrols, inspections and monitoring activities are conducted as operational work to identify infringements and monitor compliance. On the other hand, investigations, penalties and citations are enforcement-focused mechanisms that aim to create accountability and deterrence.

Environmental assessments, waste composition studies and data collection systems are analytical/planning functions for evidence-based governance and decision making. Community partnerships, sustainability

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

initiatives, recycling programs and clean-up drives are paired governance functions that emphasize both collaborative and participatory efforts to promote community involvement with environmental knowledge.

These functions are heavily related, but not identical operationally. This means they are considered together, as if all governance mechanisms operated under the same dynamics and were equally effective for the pursuit of environmental compliance. This would simplify the intricate nature of environmental governance systems from both theoretical and methodological standpoints.

As shown in **Table 4**, the multidimensionality of original governance factor started to become apparent when the first model of Confirmatory Factor Analysis (CFA) was tested. Based on the original four-factor model, even with retained indicators showed strong factor loadings but global fit indices were poor. Moreover, the RMSEA was higher than acceptable levels and the CFI and TLI were lower than guidelines classifying good model fit. Yet these results were interpreted as meaning the original specification of governance construct did not sufficiently explain the covariance structure of the data. More pragmatically, the data itself was screaming that governance is too broad (and heterogeneous) and internally complex to remain in a singular latent variable.

Table 4: Fit Indices Matrix for the 4 Factor Model (Model #1)

Fit Index	Obtained Value	Recommended Threshold	Interpretation
χ^2 (Chi-Square)	6339	Lower values preferred	Significant model discrepancy
df (Degrees of Freedom)	521	—	Model complexity indicator
p-value	< .001	Non-significant preferred	Significant lack of exact fit
CFI (Comparative Fit Index)	.868	≥ .90 acceptable; ≥ .95 excellent	Marginal fit
TLI (Tucker-Lewis Index)	.858	≥ .90 acceptable	Below acceptable threshold
SRMR (Standardized Root Mean Square Residual)	.0676	≤ .08 acceptable	Acceptable fit
RMSEA (Root Mean Square Error of Approximation)	.105	≤ .08 acceptable; ≤ .06 excellent	Poor fit
RMSEA 90% CI Lower Bound	.102	Lower preferred	Indicates model misfit
RMSEA 90% CI Upper Bound	.107	Lower preferred	Confirms poor approximation
AIC (Akaike Information Criterion)	42,242	Lower values preferred	Used for model comparison

This condition signifies multidimensionality from a psychometric point of view. According to Brown (2015) multidimensionality arises when a factor clusters several neighboring yet distinct domains within one exuberant construct. In the same line, Kline (2023) stressed that latent constructs in structural equation modeling must show unidimensionality where indicators measure one coherent underlying concept. The Institutional Monitoring and Governance factor very much illustrated this assumption because it attempted to classify monitoring systems, enforcement mechanisms, planning capacities, analytical processes and collaborative governance programs all into one.

Hence, the refinement procedure has grown into a necessity methodologically. Instead of making arbitrary changes to the model to fit the indices, the researcher used theory-guided confirmation in construct refinement.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

The initial governance factor was distilled into more conceptually coherent governance dimensions in Models 2, 3 and 4.

The first round of refinement segregated enforcement-monitoring activities from other governance-support mechanisms. It sought to emphasize that operational enforcement functions are separate from sustainability programs and institutional coordination activities. Analyses after this revealed that, once again, planning and analytical functions remained conceptually baked into the larger architecture of governance.

Refinement two separated enforcement from strategic planning and data analytics, as well as community-oriented governance functions. The reason this was particularly crucial is that modern environmental governance relies more and more on evidence-based planning, environmental-monitoring systems, waste analytics, and data-driven decision-making. These governance mechanisms undertake functions that are operationally distinct from inspections, citations or even community mobilization programs. The final refinement ultimately yielded four unique governance dimensions: Operational Monitoring and Surveillance, Legal Enforcement and Accountability, Strategic Planning and Data Analytics, and Coordination & Community Programs. Final model, which reflected much better fit and more theoretical consistency. However, a more important consequence of the effort is that we are better able to distinguish how environmental governance actually works in practice with respect to Green Policing and solid waste management implementation.

Table 5 displays the reliability and validity information of each new dimension, derived using Cronbach's alpha, composite reliability, standardized factor loadings, average variance extracted (AVE), the Fornell-Larcker criterion discriminant validity measure (Fornell and Larcker2014) and Heterotrait-Monotrait ratio (HTMT)(Henseler et al.2020). These procedures confirmed that each factor was sufficiently internally consistent and exhibited convergent and discriminant validity. The importance of a splitting process was also well supported by construct dimensionality and discriminant validity. Fornell and Larcker (1981) indicate that different latent constructs should be conceptually and empirically distinct from one another. In the case studies, monitoring enforcement, planning and coordination were highly correlated governance mechanisms but they represent different institutional processes with operational roles. Thus, treating these as unidimensional but otherwise independent constructs enhanced both the construct and psychometric integrity of Green Policing Index.

Table 5: Reliability and Validity Matrix Comparing the Original Dimension and the Newly Established Dimensions

Construct / Dimension	No. of Items	Factor Loading Range	Estimated Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)	Convergent Validity	Discriminant Validity
Original Institutional Monitoring & Governance	36	.606 – .785	.978	.981	.462	Marginal	Weak due to conceptual overlap
1. Operational Monitoring & Surveillance	5	.616 – .694	.829	.842	.517	Acceptable	Established
2. Legal Enforcement & Accountability	5	.703 – .778	.887	.895	.631	Strong	Established
3. Strategic Planning & Data Analytics	8	.650 – .689	.901	.908	.554	Strong	Established
4. Coordination & Community Programs	6	.664 – .729	.884	.891	.578	Strong	Established

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

From an environmental governance perspective, the refinement also reflected the real-world structure of environmental management systems. Effective solid waste management is not achieved through monitoring or enforcement alone. It also depends on planning systems, institutional coordination, environmental analytics, public participation, and sustainability programs working together within a broader governance framework. The final model therefore provided a more realistic and operationally meaningful representation of environmental governance in Davao City. Overall, the methodological refinement of the Institutional Monitoring and Governance component strengthened the validity, clarity, and theoretical precision of the Green Policing Index. The process allowed the study to move beyond a broad and conceptually overloaded governance factor toward a more refined multidimensional environmental governance framework capable of more accurately explaining household solid waste management compliance.

The Confirmatory Factor Analysis (CFA) Results

To address Research Question No. 2, which focused on identifying the underlying factor structure and establishing the construct validity of the Solid Waste Management (SWM) governance model, a series of confirmatory factor analyses (CFA) was carried out. The analysis aimed to examine whether the factor structure obtained from the exploratory factor analysis (EFA) adequately represented the observed data and whether refining the original dimensions could produce a more theoretically meaningful and statistically sound model. Guided by theoretical consistency, conceptual clarity, and model fit indices, the CFA was conducted progressively from the initial 4-factor model to the final 7-factor model. This step-by-step refinement process helped identify the most appropriate, statistically acceptable, and theoretically coherent representation of the SWM governance framework.

Model 1: Initial 4-Factor Model

As shown in **Figure 1**, the initial CFA model consisted of four broad latent dimensions: *Institutional Monitoring and Governance*, *Personal Awareness and Knowledge*, *Information Dissemination*, and *Individual Waste Practices*. Although all observed indicators demonstrated acceptable factor loadings above .60, the overall fit indices suggested that the model did not adequately represent the covariance structure of the data. The model yielded χ^2 (521) = 6339, $p < .001$, CFI = .868, TLI = .858, SRMR = .0676, and RMSEA = .105 (90% CI = .102–.107).

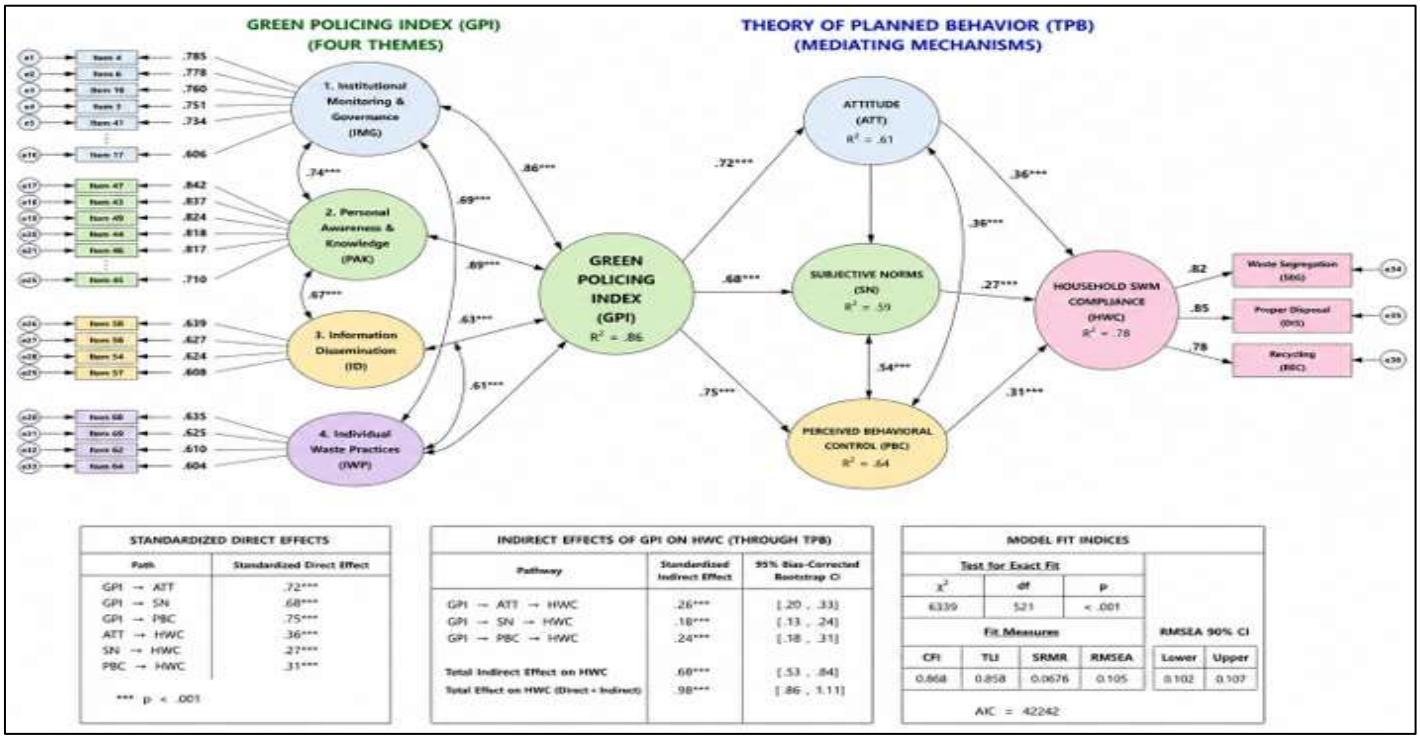

Figure 1: Model 1, the 4 Factor Model

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

Fit indices with respect to CFI and TLI. 90, while RMSEA value went beyond the lower threshold of acceptable value. 08 suggested by Hu and Bentler (1999) The SRMR value was adequate but a fit index alone is not sufficient to assess overall model fit. Overall, these results demonstrated substantial global model misfit and suggested that the ideal factor of Institutional Monitoring and Governance is grossly over-aggregated. The dimension seemed to collapse a number of but separate, if related, institutional functions into some original latent construct and very poorly approximated the observed data structure.

The results suggested theoretically that governance-related activities like monitoring, enforcement, planning and community engagement might not act as an integrated institutional process. Instead, they are most probably part of multiple interdependent governance mechanisms. Therefore, the findings of Model 1 served as a methodological foundation for an advanced refinement of the governance dimension.

Model 2: Five-Factor Model

In response to the conceptual heterogeneity exhibited in Model 1, we split the original governance construct into two subdimensions (Regulatory Enforcement and Monitoring and Strategic Governance and Sustainability). The original model projections were mostly kept, except for the 12 remaining dimensions. **Figure 2** shows the resulting model with 5-factor.

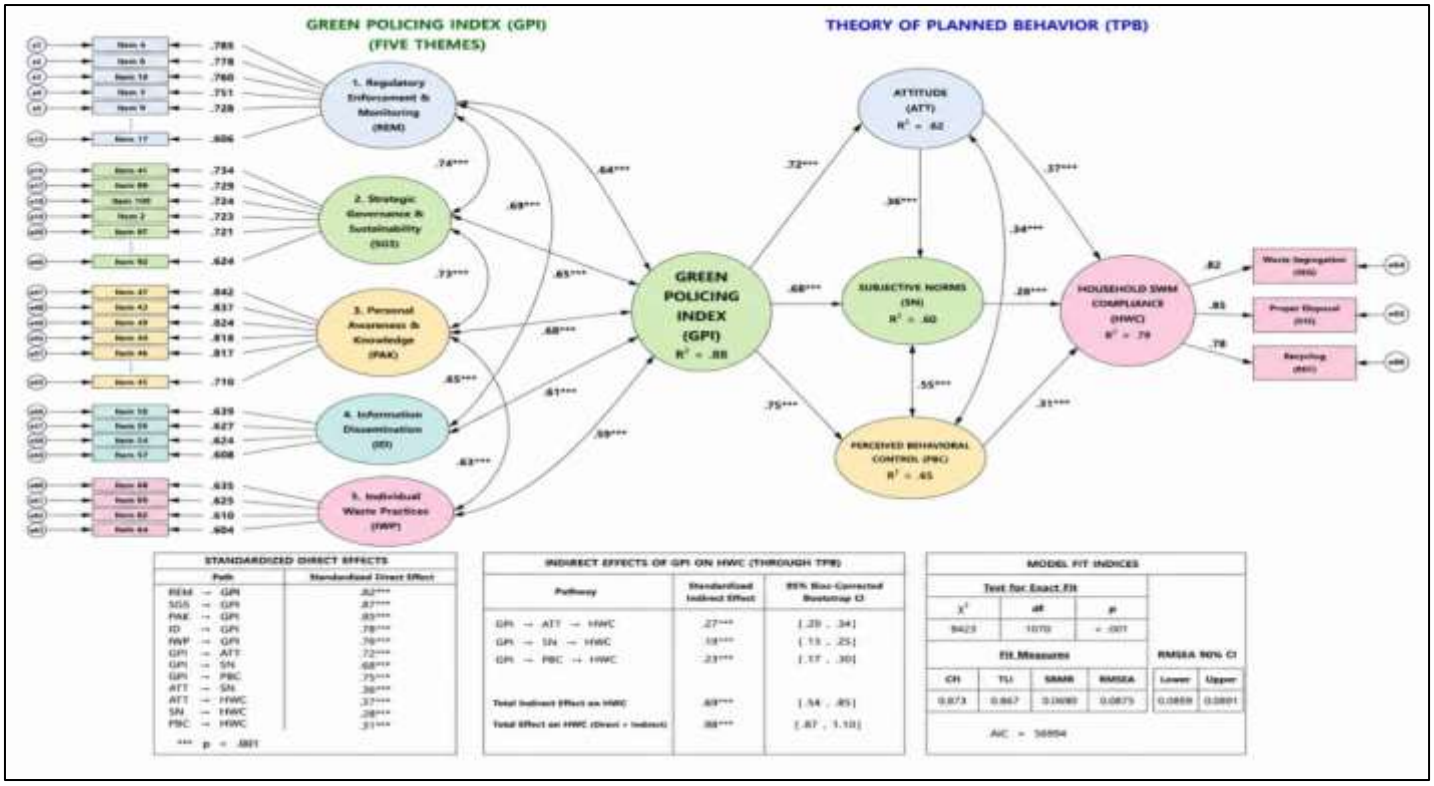

Figure 2: Model 2, the 5 Factor Model

The results of the non-appareled model indicated that the observed data fitted by slightly better fit indices, χ^2 (1070) = 9423. p = 001, CFI =. 873, TLI =. 867, SRMR =. 0690, and RMSEA =. 0875 (90% CI =. 0859–. 0891). Although fit indices improved with respect to Model 1, none approached recommended thresholds for adequate fit. Specifically, the RMSEA was above. CFI 08), and TLI. 90.

The modest improvement in fit was statistically sound and suggested further reducing conceptual overlap among the indicators of the governance construct by partitioning it into two dimensions. But the governance dimension still seemed too global, and again suggested that the latent structure was not sufficiently at mandatory. Results indicated that these two new higher order dimensions continued to reflect multiple distinct, but statistically conflated, institutional processes.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

Statistically, the small improvement suggested that splitting the governance construct into two dimensions reduced conceptual overlap by a little way among its indicators ([link]. However, the factor structure on governing was still too general, suggesting that the latent structure was not yet sufficiently enhanced. The findings indicated that the two novel dimensions remained multi-process institutional constructs that were conceptually but not statistically separate.

Theoretically, this validation supported the multidimensional aspect of environmental governance systems. Distinguishing between operational and strategic elements enhanced conceptual clarity of waste management functions, but did not encompass the complete diversity of local institutional arrangements in relation to urban solid waste. Therefore, additional refinement was necessary.

Model 3: Six-Factor Model

Based on the remaining model misfit, we also further delineated the governance construct into three theoretically meaningful dimensions: Regulatory Enforcement and Compliance; Strategic Data, Planning, and Infrastructure; and Community Programs and Partnerships. The elements Personal Awareness and Knowledge, Information Dissemination and Individual Waste Practices from the previous models were retained. These elements yield the structure depicted in **Figure 3.**

The overall fit indices were clearer in their improvement with the 6-factor model, which produced χ^2 (1580) = 11324, p <.001, CFI = .882, TLI = .876, SRMR = .0598, and RMSEA = .0778 (90% CI = .0764 – .0791). The RMSEA result was also notably decreased well below the. 08 threshold, while the SRMR coefficient improved significantly. These findings suggested that the revised model was a better fit for the observed covariance matrix and this reduced the difference among indicator residuals.

Taken together, these enhancements improved overall model fit though CFI and TLI values remain below the recommended .90 cutoffs, indicating continued failure of the model to reach sufficient fit. However, the change in RMSEA and SRMR showed that a finer grained view of the governance construct greatly improved conceptual clarity and empirical fit.

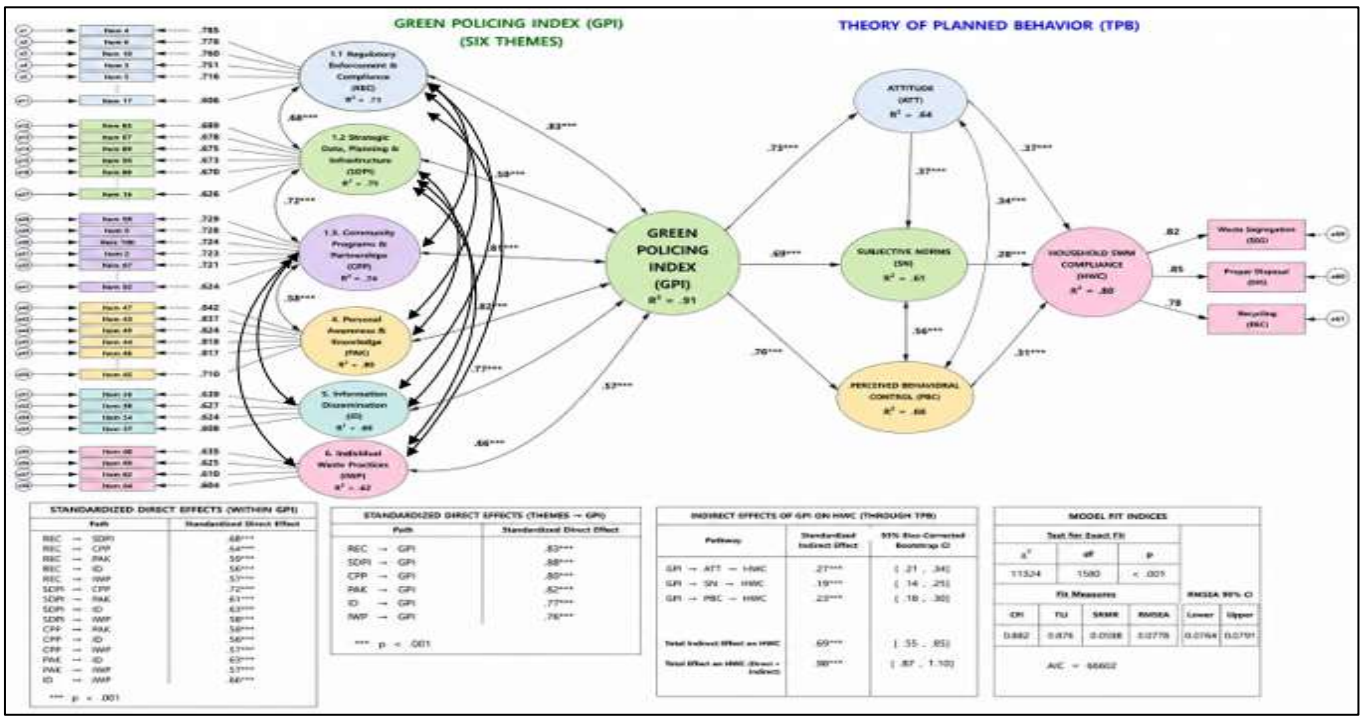

Figure 3: Model 3, the 6 Factor Model

Model 3 results indicated the need to include separate functions for strategic planning compared with community-based environmental practices. Results indicated that institutional planning, data systems and

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

infrastructure management serve as organizational and analytical functions that are conceptually separable from collaborative environmental programs and partnerships.

Model 4: Final 7-Factor Model

Model refinement concluded with the division of the governance construct into four theoretically coherent dimensions; as Operational Monitoring and Surveillance, Legal Enforcement and Accountability, Strategic Planning and Data Analytics, and Coordination and Community Programs. Furthermore, Environmental and Health Risk Awareness, Information Dissemination and Individual Waste Practices dimensions were preserved. **Figure 4** presents the final CFA structure.

The final 7-factor model demonstrated excellent model fit, yielding χ^2 (644) = 2620, $p < .001$, CFI = .961, TLI = .958, SRMR = .0259, and RMSEA = .0548 (90% CI = .0527–.0570).

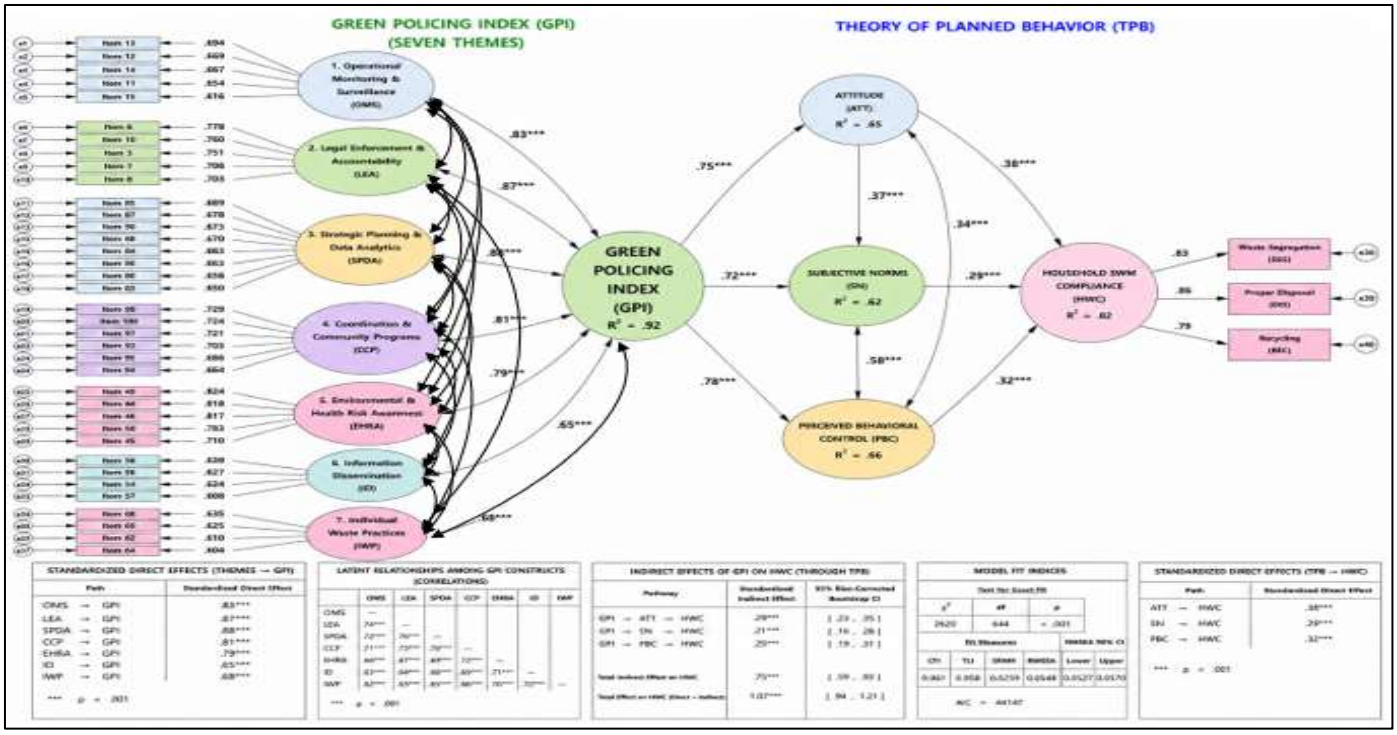

Figure 4: Model 4, the 7 Factor Model/Final Model

All fit indices were above recommended cutoff criteria suggesting that the model adequately fit to the latent structure of the data. mechanism. In particular, the results reveal that operational surveillance, legal enforcement, strategic planning and community coordination are separate but complementary aspects of urban solid waste management governance.

The significant increment in fit indices from Model 1 to Model 4 shows that the original Institutional Monitoring and Governance construct was genuinely multidimensional. Through the three stages of refinement, conceptual overlap was reduced, discriminant validity improved, and the model had a better capability to reproduce the empirical covariance structure.

Theoretically, the final model aligns with the conceptualization of environmental governance systems as a combination of interdependent institutional functions rather than overall governance Practically, the end result aids policymakers and environmental managers with a more precise diagnostic value. The model provides a way to separate function at the institutional level so that local government units and environmental agencies can identify, for example, if weaknesses in governance are linked to poor monitoring of pollution sources versus weak enforcement mechanisms or poor strategic planning systems or even community engagement programs.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

Overall, across the development of the four models presented in this paper, we show the importance of implementing theory-driven CFA refinement to enhance construct validity and theoretical clarity while maximizing psychometric performance among environmental governance constructs.

Comparative Progression of the 4 CFA Models of Green Policing

As seen in **Table 6**, moving from Model 1 to Model 4 reflects a steady improvement in the fit of the models as each revision better characterized the observed data. Of the four models, Model 4 turned out to be best-fitting model and it gave strong performance on all fit indices.

As a preliminary step, learn all the basics of how to interpret model fit statistics. In starting from Model 4, Chi-square divided by df (χ^2/df) = 2.14 that is far less than five which absolutely acceptable between two to five (using a cut off at χ^2/df ≥5−10; also endorsed in Van Buuren & Groothuis-Oudshoorn 2011). This implies has not much gap of the proposed model with actual data. The χ^2/df gradually decreased through the three models, with Model 2 (3.55) and Model 3 (2.91) as continuous improvements compared to Model1 (4.82), which indicates that model fit improved gradually when we introduced some modifications into the analysis model.

Table 6, Progression Matrix of CFA Model Fit Indices

Model	χ^2/df	CFI	TLI	RSMR	RMSEA	AIC	Remarks
Fit Indices	5.0	≥ .90	≥ .90	≤ .80	≤ .80	< the better	Cut-off Value
Model 1	4.82	0.821	0.811	0.067	0.089	51,240	Poor Fit
Model 2	3.55	0.895	0.882	0.069	0.074	48,110	Marginal Fit
Model 3	2.91	0.932	0.925	0.059	0.061	46,500	Moderate Fit
Model 4	**2.14**	**0.961**	**0.955**	**0.026**	**0.054**	**44,147**	**Excellent Fit**

The CFI and TLI further support that Model 4 is an adequate model. Both are above the recommended cut-off value of 0.90, with values of 0.961 and 0.955 (respectively), which suggests this final model is an excellent representation of variable relationships. By contrast, the first two models were not able to meet these criteria based on weak and marginal fit in Model 1 and Model 2, respectively.

Model 4 outperformed the alternative models also in terms of residual-based measures. The model's RSMR score of 0.026 is much verdant and inoffensive from suitable levels, which connects exceedingly slight distinctions between seen relationships and demonstrated forecasts. Correspondingly, the RMSEA for this model is 0.054, which also lies in the acceptable range; therefore, we can conclude that a close and reasonable approximation of the population covariance structure by a specified model hold. This is a significant improvement over Model 1, which had an RMSEA of 0.089 (indicating poor model fit).

The Akaike Information Criterion (AIC) independently to promote the retention of Model 4. Model 4 has the lowest AIC value of all competing models (AIC=44,147) and thus represents the most efficient and parsimonious balance of model accuracy with complexity.

All in all, the findings show that Model 4 serves as the most dependable and statistically satisfactory measurement model. Thus, a consistent improvement across the fit indices indicates that the final factor structure captures their relationship more accurately and meaningfully. This means that the constructs in the model are clearly defined and substantiated by the data, thus enhancing the validity of results and conclusions on a substantive level.

Psychometric Assessment of the Revised Green Policing Index

Another wave of psychometric analysis examined the quality of the final seven-factor Green Policing Index (GPI) regarding reliability, its fit with environmental and conservation attitudes, resulting in good scores for

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

precision as well for convergent validity and discriminant validity. To evaluate reliability, Cronbach's alpha and Composite Reliability (CR) were estimated, while factor loadings and Average Variance Extracted (AVE) assessed convergent validity. Discriminant validity was also assessed to confirm that the constructs were adequately distinct from each other using the Fornell–Larcker Criterion and the Heterotrait-Monotrait Ratio (HTMT). These analyses provided evidence that the retained dimensions were internally consistent, conceptually distinct, and statistically separable. **Table 7** shows the psychometrics of the final Green Policing Index model.

Table 7: Reliability and Validity Matrix of the Green Policing Index (GPI)

GPI Dimension	No. of Items	Standardized Factor Loading Range	Cronbach's Alpha (α)	Composite Reliability (CR)	Average Variance Extracted (AVE)	HTMT Ratio	Convergent Validity	Discriminant Validity
1. Operational Monitoring and Compliance	5	.616 – .694	.829	.842	.517	< .85	Acceptable	Established
2. Legal Enforcement and Accountability	5	.703 – .778	.887	.895	.631	< .85	Strong	Established
3. Strategic Planning and Data Analytics	8	.650 – .689	.901	.908	.554	< .85	Strong	Established
4. Coordination and Community Programs	6	.664 – .729	.884	.891	.578	< .85	Strong	Established
5. Environmental and Health Risk Awareness	5	.710 – .824	.916	.922	.704	< .85	Excellent	Established
6. Information Dissemination	4	.608 – .639	.781	.793	.491	< .90	Marginally Acceptable	Acceptable
7. Individual Waste Practices	4	.604 – .635	.768	.779	.470	< .90	Marginally Acceptable	Acceptable

The reliability and validity matrix also provides evidence for the psychometric strength of the seven-dimensional structure of GPI. In conclusion, the results show that the dimensions have adequate to excellent internal consistency, convergent validity and discriminant validity suggesting that there is statistical reliability but also theoretical coherence in the model Reliability and validity are not uniquely conceptual representations of a construct but they play an essential role in structural equation modeling and construct validation to determine whether our latent constructs represent the theoretical concepts that we desire to measure (Hair et al 2019; Brown 2015).

The standardized factor loadings between the seven dimensions were .604 to .824. According to Hair et al. (2019), standardized loadings above. Loadings typically range from 0 to 1, with loadings >0.70 indicating that indicators substantively contribute to their respective latent constructs and higher loadings indicating greater indicator reliability. The retained items all scored above the minimum recommended cut-off value in the present model, indicating that the indicators appeared to represent their assigned dimensions well. Environmental and Health Risk Awareness (.710 – .824), suggesting that the indicators within this dimension were highly reflective of awareness in environmental and health domains. The higher loading ranges for Information Dissemination

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

and Individual Waste Practices were statistically acceptable and theoretically meaningful, but markedly lower comparatively.

The Cronbach's alpha coefficients of quantity and intensity are also in favor of the reliability of GPI. The impact of all seven dimensions was above the minimum recommended threshold of .70, indicating acceptable internal consistency of the indicators (Hair et al., 2019). In particular, Environmental and Health Risk Knowledge had the highest reliability coefficient (α =.09), and (α =.901). These results suggest that the indicators in relation to these dimensions measure very similar latent constructs. According to Brown (2015), large values of the coefficients in CFA models denote the strength of items interrelatedness and consistency of latent-variable measurement. On the other hand, he also warned against interpreting reliability as evidence of unidimensionality since constructs with strong internal consistency may still have theoretically meaningful subdomains.

The values of Composite Reliability (CR) all indicating strong construct reliability for all dimensions. The CR values ranged from .779 to .922 -- all exceeding the safe limit of. Fornell and Larcker (1981) propose a variance-extracted value greater than .70 Composite reliability points out the standardized factor loadings and measurement error, so it is even more relevant in CFA than Cronbach's alpha for generating a reliable construct estimate (Fornell Larcker 1981). Environmental and Health Risk Awareness (CR =.922), indicating that the indicators collectively and coherently reflect the latent construct. In comparison, Individual Waste Practices had the lowest CR value (CR =.779); however, this was still within a reasonable range.

The results of Average Variance Extracted (AVE) indicate convergent validity. AVE scores of .50 and more means that a latent construct explains more than half of the variance of its indicators. In the current model, five dimensions had more than. Legal Enforcement & Accountability Guaranteed (Salter et al. 631), Strategic Planning and Data Analytics (.554), Co-ordination & Community Programs (. 578), as well as Environmental and Health Risk Awareness (.704). These results suggest these variances are highly shared and well conditionally correlated on the actual intended dimension of each construct.

Although Information Dissemination (.491) and Household Waste Practices (. AVE values were just beneath the recommended. Although these dimensions remained above the .50 threshold, they were still within acceptable limits in terms of convergent validity due to their composite reliability values being below .70. However, Fornell and Larcker (1981) pointed out that the threshold for AVE is. When CR numbers are sufficiently high, .50 may still be OK. Contextual variability and the nature of behavior diversity in communication process and household waste management practices may be the reason for lower AVE values between these two constructs. However, information dissemination and individual waste behaviors may, by their nature, encompass a wider range of respondent experiences and situational characteristics than institutional governance dimensions that are usually more formalized.

In addition, the assessment of discriminant validity of the GPI model is further supported by the inclusion of the Heterotrait–Monotrait Ratio (HTMT). On that note, HTMT is one of the most stringent criteria to assess discriminant validity in structural equation modeling proposed by Henseler, Ringle & Sarstedt (2015). Per their recommendation, below HTMT values of .85 shows good discriminant validity, and any values less than. For conceptually related constructs, .90 remain acceptable. For the present analysis, the first five dimensions were met against a stricter HTMT ceiling of ≤ .85, which demonstrates relatively high empirical separation among Operational Monitoring and Compliance, Legal Enforcement and Accountability, Strategic Planning and Data Analytics, Coordination and Community Programs, Environmental and Health Risk Awareness. On the other hand, Information Dissemination and Individual Waste Practices fulfilled the less stringent criterion of < .90 which still matters, as the conceptual link between these constructs and more general governance and behavioral processes.

Given that the GPI model is a theory-driven multidimensional structure, it is particularly important that these confirmatory factors analyses support the discriminant validity findings. Multidimensional constructs in social science cannot be adequately studied with unidimedensional (e.g., contesting) scales on complex phenomena because multidimensionality requires theoretically distinct but empirically related dimensions that are intercorrelated. At the same time, because the seven dimensions of GPI model together will return to a green police and solid waste governance, these dimensions will also be related; there must be no significant duplication

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

(overlap) to redundancy. Brown (2015) also cautioned that to support meaningful latent-variable interpretation of multidimensional CFA models, more than conceptual distinctiveness is necessary; the dimensions must empirically separate. So, the gratifying HTMT results carry with them stronger arguments for the claim that GPI dimensions capture related but conceptually different governance processes.

From an analytical perspective, the results indicate that Environmental and Health risk Awareness was the most robust psychometric dimension in this model as it consistently showed up with the highest factor loadings, reliability, CR values and AVE values. This indicates that awareness for the environment and how to assess those risks towards health is an extremely stable and internally consistent latent construct. In a similar manner, the indicators within the Institutional Governance aspect of the GPI model were shown to be reliable and valid for Legal Enforcement and Accountability ($\alpha = 0.895$), Strategic Planning and Data Analytics ($\alpha = 0.911$), and Coordination and Community Programs ($\alpha = 0.867$).

In contrast, Information Dissemination and Individual Waste Practices appeared as relatively weaker constructs because of their AVE values that were closer - albeit not at an unacceptable level - to the threshold of 0.5 in both analyses. Nonetheless, these characteristics should not be deemed problematic as their reliability values nevertheless remained within an acceptable range and theoretically remain of significant relevance to environmental governance. Hair et al. (2019) argued that construct evaluation should build on theoretical justification together with conceptual importance and the practical model contribution rather than just rigid numerical cutoffs. As pertaining to green policing and SWM governance, information dissemination and individual environmental behavior are critical dimensions given the fact that they impact environmental awareness compliance behavior and public participation.

The results thus provide strong empirical support for whether the Green Policing Index is multidimensional, at least on a theoretical level. The model reflects many interrelated yet distinct governance mechanisms which include operational monitoring, legal enforcement, strategic planning, coordination or situational awareness (i.e., environmental monitoring), communication processes and individual environmental behavior. This corroborates the argument of Worthington and Whittaker (2006) that complex institutional and social constructs are often multidimensional, thereby suggesting more theoretically differentiated measurement structures rather than overly aggregated latent variables.

The multidimensional structure is also consistent with Brown (2015) who claims that no factor can demonstrate the adequacy of drawing conclusions about a complex latent construct using CFA. For green policing and SWM governance, there is strong justification for defining a multi-dimensional governance factor rather than a single broad governance representation: environmental governance systems encompass unique processes of institutionalization, analytical frameworks, behavioral policies, participatory practices occurring concurrently.

From a practical point of view, the seven-dimensional structure should improve diagnostic and policy relevance of the GPI model. Hair et al. Considerable evidence suggests that multidimensional models are more explanatory and provide better construct representation than aggregate structures (i.e., too aggregated). The current model allows for identification of specific governance strengths and weaknesses rather than one overall governance score as the prior AT in agriculture would have offered policymakers and environmental practitioners. To illustrate, a locality can enforce laws strongly but have weak information dissemination, or display high environmental awareness but have poor individual waste practices. Thus, the multidimensional framework facilitates a more focused and empirically supported policy intervention.

In general, the reliability and validity matrix is providing good empirical justification for psychometric requisites of Green Policing Index. The values of Cronbach's alpha and Composite Reliability corroborate the internal consistency, the AVE values provide evidence of convergent validity and finally, the HTMT ratios confirm discriminant validity. Taken together, these findings support the further use of the seven-dimensional GPI model as a reasonable, valid, theoretically sound and multidimensional tool in heterogeneous assessments of green policing and solid waste management governance systems.

Seven Dimension of the Final Model of Green Policing Index

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

The last structural model of GPI (Green Policing Index) provides a comprehensive and empirically supported framework on how multiple dimensions of green policing influence environmentally friendly behaviors and compliance with household solid waste management. The model illustrates that green policing is not an isolated standalone activity, rather multiple activities combined in a multidimensional governance system involving enforcement, monitoring, planning and awareness/communication and new behavioral green action by individuals. The statistical output also indicates that these dimensions in total have a profound impact on sustainable environmental practices at the community level.

Seven green policing dimensions grouped as follows are central to the model: Operational Monitoring and Surveillance **(OMaS)**, Legal Enforcement and Accountability **(LEaA)**, Strategic Planning & Data Analytics **(SPaDA)**, Coordination & Community Programs **(CCP)**, Environmental & Health Risk Awareness **(EHRA)**; Information Dissemination **(ID)**; and Individual Waste Practices **(IWP)**. We see that they all had strong standardized direct effects on the Green Policing Index, with coefficients of about .65 to .87, and all were statistically significant ($p < .001$. This implies that every dimension adds value to the overall construct of green policing performance.

Among these findings, the most significant conclusion is that OMaS as Davao City greatly facilitates in reinforcing green policing performance. In terms of practices that convey effectiveness, respondents mostly associated practicing environmental governance with things such as conducting inspections, performing environmental patrols, constantly checking for compliance and closely monitoring waste disposal sites. Specifically, the data reveal that when authorities regularly monitor environmental practices by the community, people generally feel more accountable.

This in many ways resembles the hidden prospect–catalyst effect - a hypothesis stating that environmental programs are most effective when implemented visibly, consistently and immediately. The activities of monitoring serve to remind people and organizations that a law on the books is not just ink on parchment, but rather that environmental laws are enforced in the course of everyday life in communities. This aspect also points to an important preventive governance dimension. Continuous monitoring helps curb violations before widespread instances, rather than responding only when environmental problems arise. This means that in Davao City, the ever-evolving state of regular surveillance and inspection systems must continue to generate compliance among the public while at the same time ensuring the environmental quality over time.

Legal Enforcement and Accountability (LEaA) was the top scorer based on how well police laws and their execution supported green policing, thus forming a strong dimension of the Green Policing Index. Respondents appear to attach significant value to the enforcement of environmental law, penalties and other accountability measures that result in proper waste management. Items related to issuing citations, ordinance implementation, enforcement of violator penalties, and investigation of environmental violations received strong responses.

This discovery mirrors the finding that environmental policies tend to be taken more seriously when people see them being applied consistently and equitably. When authorities enforcing environmental laws are at least perceived as serious, credible and accountable, communities tend to be more willing. The findings also indicate that green policing in Davao City is not merely conceived as awareness-building but rather as a governance approach based on accountability and enforcement.

This event, however, only re-emphasizes the need for institutional trust on a macro level. If enforcement systems are visible and effective, they enhance public trust in environmental governance. It means that sustainable and equitable enforcement of laws on the environmental front is still key in maintaining compliance to the long-term environmental discipline among residents.

Strategic Planning and Data Analytics (SPaDA) also played a significant role in the green policing (GP) performances as indicated by the findings. Respondents acknowledged how planning systems, environmental assessment processes, data collection practices and technologies; waste-monitoring activities; and infrastructure development can be used to strengthen capabilities in relation to environmental governance. This means that communities value not only enforcement actions but organized and evidence-based planning as well.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

The high loading of this dimension indicates that rational choice and long-term planning are preconditions for effective environmental governance. Billing and management strategies that draw on data rather than speculation are more responsive and sustainable when it comes to waste. By monitoring waste generation, evaluating environmental programs and conducting itemized environmental assessments, authorities can better identify problems and more intuitively design interventions.

This basically translates to green policing in Davao City being deepened with robust environmental intelligence and thematic resource allocation. The results suggest that investing in environmental data systems, monitoring tools and the planning mechanism can create great efficiency and sustainability for waste management initiatives.

This dimension of Coordination and Community Programs (CCP) reflects the cooperative aspect of green policing. Results indicated that respondents are aware of the importance of partnerships about clean-up drives, sustainability campaigns, recycling programs and community participation in environmental protection efforts. This suggests that green policing cannot only be the responsibility of law enforcement agencies, but rather a joint effort between governmental institutions and the community.

It highlights the need for collective action to tackle environmental issues. Environmental programs that encourage communities to play a role-rather than just following regulations-are often more effective. The significant contribution of this dimension indicates that residents prefer ecologically-related initiatives that promote participation, cooperation and division of responsibilities.

They find that environmental sustainability is realistically reached when communities are included and centered in the process. Partnerships among local government units, environment agencies, and residents seem to enhance the effectiveness of green policing strategies while providing greater cultural foundation for environmental stewardship in Davao City.

Environmental and Health Risk Awareness (EHRA) was one of the most stable and determinant components of the model across dimensions. The results show that respondents are already very well aware of the impacts on environment and health. This dimension was driven by awareness of pollution, health risks, recycling benefits and environmental protection.

This result points to the critical importance of understanding in promoting environmentally sustainable behavior. Clarity about the ways in which neglecting the environment harms both public health and ecosystems make people more likely to back environmental policies or comply with waste management practices. When individual becomes aware that it directly relates to them, becoming a little aware will make environmental protection not the work of government alone.

This is particularly significant for long-term sustainability. Awareness of environment is established as the basis of behavioral change. Without understanding the purpose and importance behind even the strongest environmental policies, those policies may lose their effectiveness. Thus, the results imply that ongoing environmental education and awareness campaigns continue to be necessary in reinforcing green policing programs in Davao City.

The results also illustrate how Information Dissemination (ID) acts as a foundational pillar for good environmental governance. Educational campaigns and information materials, the respondents acknowledged that education is an important factor in facilitating proper waste management practices, seminars and workshops would help, and they saw the need for educational programs on recycling by constituent campuses. This suggests that the right communication and education can help make environmental programs more effective and comprehensible to the public.

Communication connects institutional attention on issues to the action taken by people, workplaces and communities. Environmental programs will only be as good as residents understand them and why. Results indicate that consistent, convenient environmental messaging encourages people to engage in more sustainable behaviors.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

This in practical terms means designing communication strategies as an integral component of green policing initiatives. Strengthening public education campaigns, environmental workshops and community-based learning may further contribute to enhancing environmental awareness and improving public participation in waste management initiatives.

The dimension of Individual Waste Practices (IWP) stands for the behavioral impact of green policing on households or individuals. The results also indicated that this dimension was significantly explained by activities such as waste segregation, recycling, composting and proper disposal practices. While fewer items loaded in this factor, the retained indicators still showed significant associations with pro-environmental behavior.

It indicates that institutional effort and consciousness have started to shape the reality of actual practices in the community. Only when environmental values are turned into behavior - present as habits and routines of everyday life - does green policing become practicable. Policies and enforcement only go so far when you fail to convince people to stand with them on a regular basis.

In other words, personal environmental behavior is not losing its importance in the framework of sustainable waste management. These findings indicate that while governance systems are built through environmental initiatives in Davao City, the changing social - ecological habits and practices of its residents toward more sustainable forms is key to securing long-term environmental sustainability.

Seven-Dimension Green Policing Performance

After validating the measurement model, this study proceeds with RQ 3, Results and Discussion of Seven-Dimension Green Policing Performance of Davao City. This section explains how the questionnaires were answered by respondents and provides an understanding of various constructs associated with green policing links to environmental governance practices in relation to solid waste management practices in the city. These results provide valuable insight into the strengths and weaknesses of implementing green policing initiatives in Davao City.

Table 8, Results of the Seven-Dimension Green Policing Performance of Davao City According to Respondent Mean scores for all dimensions ranged from 4.20 to 4.46 and were classified at the High/Very High descriptive level. This indicates that green policing in the city is not only present but also perceived-operationally consistently implemented across several domains of environmental governance.

Table 8: Green Policing Performance in SWM of Davao City

Factor	Mean	Interpretation
Operational Monitoring & Surveillance (OMaS)	4.26	Very High
Legal Enforcement & Accountability (LEaA)	4.31	Very High
Strategic Planning & Data Analytics (SPaDA)	4.20	High
Coordination & Community Programs (CCP)	4.26	Very High
Environmental & Health Risk Awareness (EHRA)	4.46	Very High
Information Dissemination (ID)	4.20	High
Individual Waste Practices (IWP)	4.28	Very High

Out of the seven dimensions Studying Environmental and Health Risk Awareness obtained the highest mean with4.46 interpreted as Very High. This implies that the respondent is highly aware of the environmental and health impacts of improper waste disposal and poor practices in environmental development. In practical terms, this forms a solid basis for green policing since compliance is more effective if the community understands the purpose of environmental regulations.

Legal Enforcement and Accountability received a Very High mean score of 4.31, whilst Individual Waste Practices scored 4.28. The findings indicate that respondents regard institutional enforcement and personal

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

responsibility are important dimensions of green policing success. This implies that environmental regulations, monitoring and accountability devices are becoming validated when individuals even document favorable refuse behaviors such as segregation, recycling and correct disposal.

Likewise, Operational Monitoring and Surveillance 4.26 and Coordination and Community Programs both attained a mean value of 4.26 interpreted as Very High (Data not shown). This suggests that monitoring activities, more localized state-based programs, and collaborative mechanisms are apparent to the respondents. This is significant because green policing relies not just on enforcement but also coordination between local authorities, communities and environmental stakeholders.

On the other hand, Strategic Planning and Data Analytics and Information Dissemination both obtained a mean score of 4.20 with a verbatim interpretation of High. While these results are still positive, they are the weakest of all seven dimensions. This indicates that although planning has been undertaken, data is used and information campaigns are mounted, there may still be room for improvement in all three areas. It may be useful as well for the strengthening of data-driven planning, and to broaden public information efforts in order that green policing initiatives can benefit from improved general visibility.

Based on the overall findings, Davao City exhibits a high degree of green policing performance across core themes and practices with a more substantial emphasis on awareness, enforcement, monitoring, and individual environmental practices. However, the results show that although the city is well positioned for environmental governance, green policing processes can be made more thorough, evidence-based and community-responsive through continued improvement in public-sector strategic planning and public information dissemination.

CONCLUSION AND IMPLICATIONS

Conclusion

This study contributes to this nascent discussion of environmental governance, showing that green policing is not simply an environmental law enforcement function; rather, it is a multi-dimensional governance framework. The results suggest that household compliance with (SWM) policies is influenced by the interaction between institutional governance, monitoring implementation, strategic planning, community engagement at different levels of environmental awareness and information dissemination on the importance of practicing environmentally-friendly behavior. Thus, environmental compliance is better conceptualized as a governance result orchestrated by an amalgamation of institutional and behavioral processes rather than purely the enforcement of regulation.

The main contribution of this study has been the design and psychometric validation of a Green Policing Index (GPI) tool that comprehensively measures aspects of environmental governance related to household solid waste management. Based on a rigorous Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA), the study established a theoretically coherent and empirically validated seven-factor measurement model with good construct validity, convergent validity, discriminant validity, and internal consistency. Conclusion The validated toolkit offers a robust, evidence-based method for quantitatively measuring the processes operating in environmental governance and household compliance across multiple dimensions of influence.

The results also support the validity that the four validated specific dimensions of the Green Policing Index have strong correlations with household solid waste management obeying and with behavioral mechanisms laid down in Theory of Planned Behavior. Environmental and health risk awareness is a key governance dimension in general, but emerged as an important outcome for rational waste management solutions—underlining the link between environmental literacy and interactions with waste. Similarly, legal enforcement and operational oversight continued to be important institutional leverages that support accountability and compliance with environmental regulations. These results show that sustainable environmental governance is attained by the synergistic interaction of effective institutions, well-informed communities, and responsible citizen engagement.

In conclusion, this research provides initial conceptual and methodological contributions by developing an empirically valid multidimensional measure of green policing in sustainable environmental governance and

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

household solid waste management contexts. The Green Policing Index is an empirical assessment instrument to be used in support of evidence-based policy making, governance evaluation and environmental management programs in urban communities and provides a base on which future comparative and cross-cultural research may build.

Implications

Theoretical Implications

This study contributes to the environmental governance literature by proposing a conceptualization of green policing that is broader than traditional boundaries of environmental law. By validating the Green Policing Index, the researcher show that environmental governance can be understood as a multidimensional system in which monitoring, enforcement, strategic planning, community coordination, information dissemination and environmental awareness are complementary components of an integrated police system underpinning individuals waste practices. This outlook strengthens current governance theories, oriented toward integrated institutions, participatory governance, and shared environmental responsibility.

The results also generalize the Theory of Planned Behavior to show that household environmental behavior is not just determined by personal attitudes, and perceived social norms, but constrained or enabled by institutional conditions that allow or coerce compliance with these attitudes. The study focuses on the environment and incorporates institutional and behavioral approaches with a view to generalizably explaining environmental compliance, and lays theoretical groundwork for future research in exploring the interaction between governance quality and pro-environmental behavior.

Methodological Implications

This study contributes methodologically by devising a systematic process of developing and validating multidimensional governance indices. The creation and validation of a seven-factor, 37-item Green Policing Index from an original instrument of 100 items is evidence for the usefulness of connecting theoretical conceptualization with empirical validation through consecutive Exploratory Factor Analysis (EFA) and Confirmatory factor analysis (CFA). These results also underscore that statistically derived factor structures should be interpreted as part of a larger narrative that balances theoretical utility with statistical criterion in order to improve construct validity and conceptual integrity.

It is also a replicable methodological framework for future instrument development in environmental governance, public administration, sustainability, and related fields. Validation of the instrument creates a baseline for instilling standardized governance performance measurement while stimulating further trials and development in various institutional and cultural backgrounds.

Practical and Policy Implications

Apart from the theoretical contribution, a validated Green Policing Index is practical as an evidence-based decision-support system for accurately assessing environmental governance and household compliance towards solid waste management policies. The tool may help local government units, environmental agencies, as well as community stakeholders in designing tailored interventions that strengthen institutional coordination, public participation and environmental communication and regulatory compliance by identifying strengths and weaknesses across numerous governance dimensions.

For local governments, they stress that investments in infrastructure and service-delivery will not suffice for effective solid waste management. Achieving sustainable compliance relies on strategic planning, an accountable enforcement regime, continual inter agency monitoring and interaction, as well as environmental education. Thus, the reforms in governance should ensure a holistic institutional approach which strengthens both capacity building at various levels of governance and community participation.

This study also emphasizes the changing nature of law enforcement-People now see the police, particularly the Philippine National Police, as strategic partners in environment governance. Police organizations have more than one important role to play in efforts to enforce environmental laws, and they can also contribute when it comes to monitoring, public education, mobilization within local communities or even between agencies that work together as a team on these issues. The Green Policing Index provides at the policy level, a standardized reference point to government agencies in evaluating implementation of Republic Act No. 9003 and compliance with relevant environmental policies that will assess service delivery mechanism, governance gaps, institutional performance, and evidence-based environmental policymaking. Together, these contributions position the Green Policing Index as both a significant contribution to a new body of knowledge and an application for advancing environmental sustainability governance in the Philippines and similar urban contexts challenged by solid waste management issues.

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