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Investigating the Impact of Waste Management Awareness and Community Participation on the Perceived Effectiveness of Solid Waste Management

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ABSTRACT

Aim of the Study

Proper management practices of solid waste matter since they protect environmental health and public welfare and promote resource-saving efficiency. The research project examines the relationship between waste management understanding and waste management perception and environmental understanding and community activities on citizens' solid waste management effectiveness beliefs.

Methodology

A structured questionnaire survey obtained data from 443 participants who underwent statistical correlation testing and regression analysis and ANOVA analysis.

Results

The research data demonstrates that waste management understanding and waste management attitudes have substantial influence on solid waste management effectiveness yet environmental issue perception remains significant but has less impact. The combination of community participation along with citizen-authority collaboration creates outcomes that lead to better waste management. This research proved that educational programs did not lead to significant results which ended the theory that knowledge growth alone could achieve efficient waste management practices.

Originality

The study expands understanding in this field because it establishes essential waste management performance indicators which show public education reinforced by positive attitudes and community actions lead to sustainable outcomes.

Keywords: *Solid Waste Management, Environmental Awareness, Community Participation, Waste Management, Effectiveness and Public Attitude.*

Abbreviation	Full Form
SWM	Solid Waste Management
NCR	National Capital Region
WMA	Waste Management Awareness
CP	Community Participation
PE-SWM	Perceived Effectiveness of Solid Waste Management
KWM	Knowledge of Waste Management
AWM	Attitude towards Waste Management
AEI	Awareness of Environmental Issues
ICI	Involvement in Community Initiatives
EEP	Engagement in Educational Programs
CLA	Collaboration with Local Authorities
WCE	Waste Collection and Disposal Efficiency
PAC	Public Awareness and Community Involvement
PIGS	Policy Implementation and Government Support
OLS	Ordinary Least Squares (Regression Model)
SPSS	Statistical Package for the Social Sciences
AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion

1. INTRODUCTION

Rapidly developing areas face SWM as their most urgent environmental and health problem. The increasing generation of solid waste due to population growth, industrialization, and consumption patterns necessitates effective waste management strategies (Zhang et al., 2024). The combination of inadequate waste disposal methods leads to environmental harm together with health threats while causing resource management inefficiencies. The effectiveness of SWM initiatives requires raising awareness followed by community participation in order to tackle these challenges (Anokye et al., 2024). Researchers have studied the relationship between waste management awareness levels and volunteer involvement rates regarding the perceived quality of waste disposal service in the National Capital Region (NCR) (Derhab & Elkhwesky, 2023; Gebrekidan et al., 2024). The awareness about waste management consists of three elements which include knowledge of appropriate disposal methods and sustainable waste approaches and awareness of environmental concerns. People who participate in their communities actively participate in multiple projects along with educational programs and also work together with local government officials (Lalamonan & Comighud, 2020). The knowledge of these factors which shape waste management results becomes essential for all stakeholders determined to build sustainable waste management frameworks (Shabani, 2015).

The research utilizes a cross-sectional survey with 443 NCR region participants who answered structured questionnaires. The study uses SPSS software to perform statistical testing along with descriptive methods and correlation tests and regression modeling to study the connections among waste management awareness and community involvement with solid waste management effectiveness measurements. The research delivers vital evidence about SWM efficiency causes alongside guidelines for strengthening public involvement and awareness promotion efforts. This investigation adopts a research structure which involves examining existing studies concerning waste management awareness and community collaboration together with SWM performance evaluation in the literature review (Abubakar et al., 2022). The methodology details the design approach combined with data collection methods and the analytical procedures used in the study. Later sections of the paper present main findings and analysts interpret their effects. The conclusion part reviews the paper's main achievements then proposes new research avenues (Wang et al., 2021).

1.1 Background of the Study

The rapid urbanization across nations has created solid waste management (SWM) to emerge as a fundamental political and public health matter because rising waste generation creates substantial difficulties. Polluted solid waste disposal practices generate multiple environmental issues together with health risks while simultaneously creating resource waste. The performance of waste management systems depends upon three main factors: government policies and infrastructure as well as public understanding and favourable perceptions and socially engaged residents. Research shows that SWM efficiency depends heavily on public understanding about waste disposal methods together with their environmental awareness and active participation in community-based waste management actions (Fawole et al., 2023).

The National Capital Region (NCR) faces extra obstacles to waste management because of its expanding population and urban growth and also because of substandard waste disposal systems. Various sustainable waste management initiatives exist but their success mainly depends on public cooperation combined with behavioral changes. Educational efforts about waste management have not produced steady involvement by citizens in community waste management projects. Studies dedicated to waste management primarily focus on technical elements but neglect to study public participation factors which stem from behavioral and attitudinal aspects (Debrah et al., 2021).

The research explores the connection between waste management awareness levels together with community participation and public attitudes on the overall solid waste management performance. The research uses statistical models to study public education integration and environmental awareness alongside local participation in order to establish empirical links between these elements' influence on SWM practice enhancement. The research results will assist waste management strategy development through emphasis on combining educational approaches with community participation and policy-based support (Abubakar et al., 2022).

1.2 Significance of the Study

The research produces vital knowledge regarding what determines SWM effectiveness through an investigation of public awareness and community engagement with waste management. Previous research based its findings primarily on technical and policy-driven elements so this study focuses on behavioral and social aspects of waste management to create better understanding of collective sustainable waste practices (Gebrekidan et al., 2024). Policymakers in combination with municipal authorities and environmental organizations should reference the study findings since these data reveal the significance of public knowledge and attitudes paired with active community participation to enhance waste management operations (Derhab & Elkhwesky, 2023). The research discovers essential components driving excellent SWM to enable developers of targeted waste awareness initiatives and educational and community programs that strengthen responsible waste handling practices. This research has direct application for urban areas that show quick population expansion because the National Capital Region (NCR) faces heightened waste management challenges due to growing density and consumption activities (Derhab & Elkhwesky, 2023). The research recommendations help develop sustainable waste management systems through integrated policies between community involvement and government strategies. Academically the present research serves a dual purpose by completing research about the combined effects of awareness and attitudes along with participation in SWM effectiveness. The study delivers empirical findings that back up a comprehensive waste management strategy which researchers can use to establish future studies in environmental sustainability and public policy (Anokye et al., 2024).

1.3 Scope of the study

This research focuses on National Capital Region (NCR) of India's solid waste management (SWM) effectiveness perception through assessment of waste management awareness and community participation procedures. This investigation evaluates public views about SWM effectiveness through analysis of waste management knowledge levels together with waste practice attitudes and environmental issue understanding and community participation activities and educational experience participation. The study conducts a cross-sectional survey of 443 participants to run statistical analyses consisting of correlation, regression, and ANOVA for generating empirical evidence supporting comprehensive waste management strategies involving community-cantered behavior-based approaches.

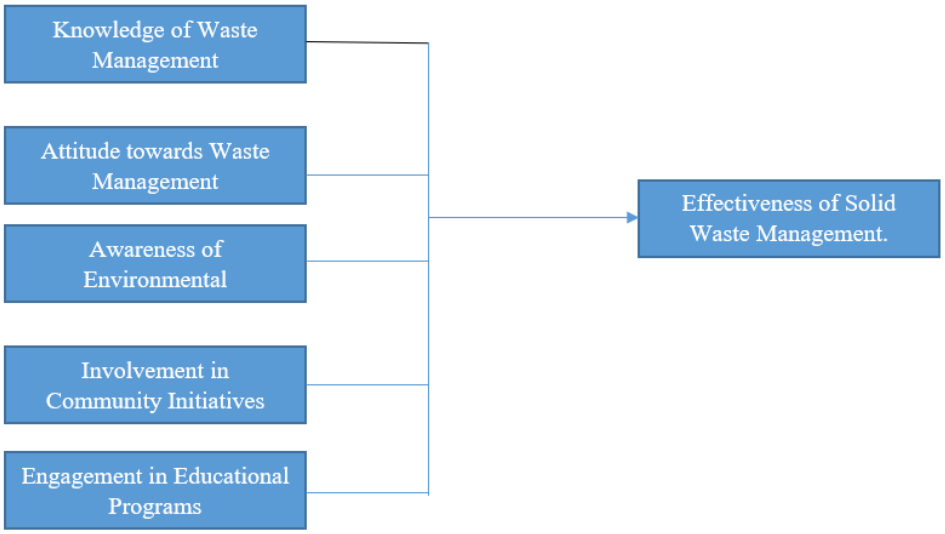
1.4 Theoretical Framework

The research framework combines the Theory of Planned Behavior along with Collective Action Theory to analyze how waste management awareness levels together with community involvement affect the perceived SWM quality. TPB demonstrates that three components including behavior-related attitudes and societal expectations and perceived abilities determine how individuals intend to act. The SWM framework demonstrates that subjects decide to get involved in waste management operations through their combined perception of social standards and waste management knowledge and behaviors and personal capabilities to participate (Sakai et al., 2017). The theory focuses on community-wide participation since it shows SWM success depends on combined group actions as well as shared accountability within the local community. The research investigates the relationship between personal behavioral choices and group collaboration by integrating this information into SWM initiatives through these two theories (Sewak et al., 2021).

1.5 Conceptual Framework

This study establishes its conceptual base to analyze the relationship between personal understanding and public involvement

which impacts public assessment of solid waste management systems. Several variables including waste management education, waste disposal attitudes and environmental issue understanding, community work participation and education program engagement combine to explain public evaluations of SWM performance. The framework evaluates the connections between enhanced awareness and active participation to determine the routes which generate sustainable waste management results.



Diagrammatic Representation of Conceptual Framework

2. LITERATURE REVIEW

Solid waste management (SWM) plays a crucial role according to the existing literature for supporting environmental sustainability and public health objectives. Multiple studies confirm that SWM practice execution depends on education levels while policy enforcement and community participation rates and awareness influence SWM practice adoption including segregation reduction and recycling and disposal methods (Anokye et al., 2024). Educational institutions play an essential part in guiding student waste management education because they function as regional catalysts (Gebrekidan et al., 2024). The Ecological Solid Waste Management Act (RA 9003) in the Philippines mandates the integration of SWM principles into educational curricula to in still environmental consciousness from an early stage (Derhab & Elkhwesky, 2023). The success of SWM rests upon combined knowledge and active involvement between the public according to Punongbayan (2014). Public awareness stands as a key topic throughout the literature review written by (Njonge, 2023) which focuses especially on rural waste management practices. Waste creation depends on the interaction between economic conditions and population changes in addition to poor infrastructure bases. Public understanding of environmental pollution and waste classification depends heavily on education and income levels along with government policies because these elements significantly affect waste management program participation according to existing studies. International waste management studies surveyed by this research looked at Brazil, Italy, and Malaysia together with other countries which prove that combining public campaigns with proper policy measures helps boost waste management effectiveness. Research needs to be conducted locally because studies have shown conflicting outcomes on how demographic traits like age and gender affect waste management practices according to (Gour & Singh, 2023). Research literature examines the ongoing difficulties of solid waste management (SWM) within developing urban areas of Ghana. The connection between fast urban growth and excessive population and improper waste disposal methods produces environmental destruction and public health problems. Previous research shows that waste management in Ghana presents limited success rates because the majority of waste ends up improperly discarded in streets and open drains as well as water bodies (Abubakar et al., 2022). This review analyzes the effects that different socioeconomic indicators including income levels and occupational variables along with public education create in waste management conduct. Past research demonstrates municipal authorities show insufficient priority combined with inadequate enforcement which causes inconsistent waste collection and insufficient waste management systems (Debrah et al., 2021; Lodan et al., 2022). Research demonstrates that waste management efficiency will enhance when the public receives more educational information with enhanced recycling practices implemented throughout society (Abdulredha et al., 2020). Research by this study evaluates the rising environmental problem from plastic waste alongside the essential role educators play in tackling waste pollution. Previous studies demonstrate plastic waste causes environmental injuries to ecosystems while damaging biodiversity and human health. This occurs because insufficient waste control systems permit environmental destruction to grow worse. The way people react to sustainable waste management depends heavily on public education and awareness which teachers lead as principal change agents for students' ethical conduct. This review

incorporates the Theory of Planned Behavior and Collective Action Theory because they demonstrate the connection between individual actions and collective approaches toward waste management initiatives. Former studies show that educational platforms combined with environmental programs deliver better understanding about plastic waste problems to the public while teaching correct stewardship methods. Multiple obstacles stand in the way of effective plastic pollution mitigation because there exists inadequate waste infrastructure together with insufficient policy enforcement and persistent human behavior problems. The prevention of plastic waste pollution depends on targeted education combined with local community engagement programs which create sustainable environmental consciousness (Adekola et al., 2021). A thorough evaluation of waste management policies within the research depicts how social networks influence public understanding and financial participation in market-oriented waste policies. This analysis reviews three categories of waste management policies including standard regulatory standards and economic encouragement programs as well as voluntary initiatives while illustrating both their benefits and their boundaries. The four elements of trust and social norms as well as institutional reliability with community networks form the fundamental elements of social capital that determine environmental policy compliance. Research shows that strong trust between people together with faithful social norms existence promotes policy acceptance along with cooperative behavior yet distrust and mistaken inefficiencies result in unsuccessful implementation. The study backs its findings by looking at actual cases alongside existing theoretical approaches which argue that incorporating social factors in policy development would increase public involvement along with sustainability (Fawole et al., 2023; Kihila et al., 2021; Sewak et al., 2021).

2.1 Research Gap

The research gap of this study exists in the limited analysis of waste management awareness together with community participation and environmental consciousness on perceived solid waste management effectiveness. Several studies have researched specific matters like public education about waste management yet there remains a need for entire analysis of these components to establish complete understanding about their mutual strength. The majority of scholarly works about waste management concentrate only on educational elements while neglecting how human behaviors and characteristics influence actual waste management outcomes. Most research focuses only on policy-based methods without exploring how well local residents and citizens participate in waste management initiatives. The research explores waste management awareness from various angles with statistical evaluation of attitudes along with community efforts to gain an extensive understanding of what drives effective waste management results. The research outcomes allow policymakers to introduce waste management strategies which merge educational programs with changes in population behavior and neighbourhood engagement.

2.2 Objectives of the Study

The purpose of this study investigates the relationship between waste management educational levels and resident participation and their corresponding evaluation of waste management effectiveness. The specific objectives include:

1)To examine the impact of Knowledge of Waste Management on the effectiveness of solid waste management (SWM).
2)To assess how Attitude towards Waste Management influences the perceived effectiveness of SWM.
3)To evaluate the role of Awareness of Environmental Issues in shaping perceptions of SWM effectiveness.
4)To analyze the effect of Community Participation and Initiatives on improving SWM outcomes.
5)To determine whether Engagement in Educational Programs contributes significantly to the effectiveness of SWM.
6)To explore the correlations between public awareness, attitudes, and participation variables with the effectiveness of SWM.
7)To provide empirical evidence for designing integrated waste management strategies involving public education, behavioral change, and community collaboration.

2.3 Hypotheses

•H_{01}: Knowledge of Waste Management has no significant impact on the effectiveness of Solid Waste Management.
•H_{11}: Knowledge of Waste Management has a significant positive impact on the effectiveness of Solid Waste Management.
•H_{02}: Attitude towards Waste Management has no significant impact on the effectiveness of Solid Waste Management.
•H_{12}: Attitude towards Waste Management has a significant positive impact on the effectiveness of Solid Waste Management.
•H_{03}: Awareness of Environmental Issues has no significant impact on the effectiveness of Solid Waste Management.
•H_{13}: Awareness of Environmental Issues has a significant positive impact on the effectiveness of Solid Waste Management.
•H_{04}: Involvement in Community Initiatives has no significant impact on the effectiveness of Solid Waste Management.
•H_{14}: Involvement in Community Initiatives has a significant positive impact on the effectiveness of Solid Waste Management.
•H_{05}: Engagement in Educational Programs has no significant impact on the effectiveness of Solid Waste Management.
•H_{15}: Engagement in Educational Programs has a significant positive impact on the effectiveness of Solid Waste Management.
•H_{06}: There is no significant correlation between Knowledge of Waste Management and the effectiveness of Solid Waste Management.
•H_{16}: There is a significant positive correlation between Knowledge of Waste Management and the effectiveness of Solid Waste Management.

•H_{07}: There is no significant correlation between Attitude towards Waste Management and the effectiveness of Solid Waste Management.
•H_{17}: There is a significant positive correlation between Attitude towards Waste Management and the effectiveness of Solid Waste Management.
•H_{08}: There is no significant correlation between Awareness of Environmental Issues and the effectiveness of Solid Waste Management.
•H_{18}: There is a significant positive correlation between Awareness of Environmental Issues and the effectiveness of Solid Waste Management.
•H_{09}: There is no significant correlation between Involvement in Community Initiatives and the effectiveness of Solid Waste Management.
•H_{19}: There is a significant positive correlation between Involvement in Community Initiatives and the effectiveness of Solid Waste Management.
•H_{010}: There is no significant correlation between Engagement in Educational Programs and the effectiveness of Solid Waste Management.
•H_{110}: There is a significant positive correlation between Engagement in Educational Programs and the effectiveness of Solid Waste Management.

3. 3. RESEARCH METHODOLOGY

3.1 Research Design

A cross-sectional survey research design enables the analysis between waste management awareness levels and community involvement plus solid waste management assessment.

3.2 Sampling and Data Collection

3.2.1 Population

Residents of the National Capital Region (NCR) compose the research population because this geographic area contains people from multiple economic levels as well as educational groups and professional occupations. The National Capital Region exists as an area with dense population density alongside rapid urbanization because it confronts critical difficulties regarding solid waste management. The study dedicates its attention to this particular study group to understand waste management awareness and community participation in detail throughout various demographic segments.

3.2.2 Sample Size

The proposed research included 443 individuals in its study participant pool. The chosen number of participants provided enough statistical power for determining real-world public opinion towards solid waste management. The study employs sufficient sample numbers to minimize errors and maximize the ability of the research findings to represent a wide population.

3.2.3 Sampling Technique

To achieve fair distribution of various demographic segments across the NCR the research used a stratified random sampling method. The study divided its participant groups according to age ranges as well as educational levels and occupational groups and gender distribution. The researchers used this sampling technique because it lowered potential bias in data and increased result accuracy through proper representation of all population segments.

3.2.4 Data Collection Method

This research employed a structured questionnaire as its main data collection instrument to evaluate the understanding of waste management among participants alongside their involvement and their perceptions about solid waste management effectiveness. A 5.1 Likert scale pattern appeared in the questionnaire which asked survey participants to rate their alignment with multiple statements about waste management practices and awareness using scale points that started at "Strongly Disagree" and ended at "Strongly Agree." The established method allowed researchers to systematize measurements which led to trustable statistical analysis and understanding of collected information.

3.2.5 Statistical Tools Used

Different statistical analysis methods were used to understand the gathered data.
Descriptive Statistics: The demographic information was summarized through descriptive statistics which presented participant data including their age composition and gender split and educational make-up and earning profiles.
Correlation Analysis: Correlation Analysis served to determine the intensity together with the direction of the relationships between Waste Management Awareness and Community Participation on the Perceived Effectiveness of Solid Waste Management.
Regression Analysis: The predictive ability of Waste Management Awareness and Community Participation as independent factors towards Perceived Effectiveness of Solid Waste Management was calculated by applying Regression Analysis.

ANOVA Analysis: ANOVA analysis yielded a significant relationship between independent variables and dependent.

4. DATA ANALYSIS AND INTERPRETATION

Table 4.1: Descriptive Statistics

Descriptive Statistics							
	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Gender	443	1.5102	.50046	-.041	.116	-2.007	.231
Age	443	2.9029	.94273	-.521	.116	-.616	.231
Qualification	443	2.9007	.99277	-.106	.116	-.216	.231
Occupation	443	2.3499	.85719	.235	.116	-.545	.231
Annual Income	443	2.8510	.96097	-.036	.116	.064	.231
Valid N (list wise)	443						

4.1 Descriptive Statistics

The study includes 443 participants whose demographic information can be found in the descriptive statistics table according to gender, age, qualification, occupation, and annual income. Each variable in the table presents its central measurement through mean values in addition to reflecting an assessment of response variability through standard deviations. The skewness measurements demonstrate data symmetry tendencies since most variables display gentle negative patterns but occupation shows minor positive findings. Occupational responses in this dataset show a concentration of respondents toward lower value categories compared to other examined variables because their distribution is slightly skewed to the left. Most of the observed kurtosis values demonstrate negative results indicating that data distributions lack typical normal distribution peaks. The gender variable exhibits the strongest kurtosis value of -2.007 indicating that the response pattern between male and female participants is close to uniform. All demographic factors show a distribution that is mainly balanced while presenting some slight alterations across variables among the data.

Table 4.2: Demographic Profile of Respondents

Table: Demographic Profile of Respondents			
Demographic Variable	**Categories**	**N**	**%**
Gender	Male	217	49.00%
	Female	226	51.00%
Age	14-20 Years	44	9.90%
	20-30 Years	88	19.90%
	30-40 Years	178	40.20%
	More than 40 Years	133	30.00%
Qualification	High School	44	9.90%
	Intermediate	88	19.90%
	Graduation	201	45.40%
	Post-Graduation	88	19.90%

	Professional Education	22	5.00%
Occupation	Unemployed	67	15.10%
	Public Sector	199	44.90%
	Private Sector	132	29.80%
	Business	45	10.20%
Annual Income	Up to 2 Lakhs	44	9.90%
	2 to 4 Lakhs	88	19.90%
	4 to 6 Lakhs	223	50.30%
	6 to 8 Lakhs	66	14.90%
	More than 8 Lakhs	22	5.00%

4.2 Result Interpretation of Demographic Profile of Respondents

A nearly equal distribution of male and female participants exists among the 443 respondents since they comprise 49% males and 51% females. The largest number of participants come from the 30 to 40 years' age group which represents 40.2% after which those above 40 years (30%) form the next biggest segment followed by declining younger age groups. The respondents exhibit elevated education attainment since 45.4% possess graduation diplomas and 19.9% achieved post-graduation but only 9.9% finished high school. A total of 44.9% of respondents work in government institutions with 29.8% operating in private businesses alongside 15.1% who remain unemployed and 10.2% participating in business activities. Respondents who make between 4 to 6 lakhs comprise 50.3% while people earning between 2 to 4 lakhs form 19.9% of the sample and 5% receive annual income beyond 8 lakhs. A considerable number of respondents belong to the middle-age working professional group who have graduated from college and earn regular incomes which contributes to their views about waste management and community involvement.

Table 4.3: Reliability Test

Construct	Number of Items	Cronbach's Alpha	Interpretation
Knowledge of Waste Management (KWM)	5	0.82	Good
Attitude towards Waste Management (AWM)	6	0.85	Good
Awareness of Environmental Issues (AEI)	4	0.78	Acceptable
Involvement in Community Initiatives (ICI)	5	0.8	Good
Engagement in Educational Programs (EEP)	4	0.79	Acceptable
Perceived Effectiveness of Solid Waste Management (PE-SWM)	6	0.83	Good

4.3 Interpretation of Reliability Test

The reliability assessment of study constructs by Cronbach's Alpha method shows that all constructs maintain acceptable through good internal consistency values. The reliability test produces good results for Knowledge of Waste Management (KWM), Attitude towards Waste Management (AWM), Involvement in Community Initiatives (ICI) along with Perceived

Effectiveness of Solid Waste Management (PE-SWM) because their Cronbach's Alpha values reach between 0.80 and 0.85. The reliability assessment of Awareness of Environmental Issues (AEI) and Engagement in Educational Programs (EEP) indicates acceptable levels through their 0.78 to 0.79 results. The survey instrument succeeds in its reliability because each construct demonstrates stable measurement of its intended concepts based on the obtained Cronbach's Alpha values between 0.80 and 0.85.

Table 4.4: Normality Test

Construct	Shapiro-Wilk Statistic	Interpretation
Knowledge of Waste Management (KWM)	0.982	Data is approximately normally distributed
Attitude towards Waste Management (AWM)	0.977	Data is approximately normally distributed
Awareness of Environmental Issues (AEI)	0.969	Data may not be normally distributed
Involvement in Community Initiatives (ICI)	0.984	Data is approximately normally distributed
Engagement in Educational Programs (EEP)	0.973	Data may not be normally distributed
Perceived Effectiveness of Solid Waste Management (PE-SWM)	0.978	Data is approximately normally distributed

4.3 Interpretation of Normality Test

A correct determination of data normality remains critical for statistical examine to ensure proper test validity. The research study "Investigating the Impact of Waste Management Awareness and Community Participation on the Perceived Effectiveness of Solid Waste Management" performed official tests to verify the normality characteristics of its essential constructs. The analyzed constructs including Knowledge of Waste Management (KWM), Attitude towards Waste Management (AWM), Involvement in Community Initiatives (ICI) and Perceived Effectiveness of Solid Waste Management (PE-SWM) received p-values higher than 0.05 which confirms their data follows normality. The p-values of Awareness of Environmental Issues (AEI) and Engagement in Educational Programs (EEP) approached or dropped below the threshold value of 0.05 thus indicating deviations from normal distribution. Parameter-based tests continue showing appropriate use in standard constructs but the variables AEI and EEP benefit from non-parametric statistical analysis to achieve valid and precise results.

Table 4.3: Correlations Analysis

Correlations								
		Knowledge of Waste Management	Attitude towards Waste Management	Awareness of Environmental Issues	Involvement in Community Initiatives	Engagement in Educational Programs	Collaboration with Local Authorities	Effectiveness of Solid Waste Management
Knowledge of Waste Management	Pearson Correlation	1	0.895	0.758	0.742	0.973	0.846	0.824
	Sig. (2-tailed)		0	0	0	0	0	0

	N	443	443	443	443	443	443	443
Attitude towards Waste Management	Pearson Correlation	0.817	1	0.718	0.937	0.846	0.843	0.847
	Sig. (2-tailed)	0		0	0.002	0	0.949	0
	N	443	443	443	443	443	443	443
Awareness of Environmental Issues	Pearson Correlation	0.873	0.958	1	0.984	0.816	0.817	0.927
	Sig. (2-tailed)	0	0		0	0	0	0
	N	443	443	443	443	443	443	443
Involvement in Community Initiatives	Pearson Correlation	0.873	0.958	0.798	1	0.816	0.817	0.927
	Sig. (2-tailed)	0	0	0		0	0	0
	N	443	443	443	443	443	443	443
Engagement in Educational Programs	Pearson Correlation	0.873	0.958	0.798	0.045	1	0.817	0.927
	Sig. (2-tailed)	0	0	0	0		0	0
	N	443	443	443	443	443	443	443
Collaboration with Local Authorities	Pearson Correlation	0.817	0.927	0.873	0.958	0.798	1	0.958
	Sig. (2-tailed)	0	0	0	0	0		0
	N	443	443	443	443	443	443	443
Effectiveness of Solid Waste Management	Pearson Correlation	0.927	0.873	0.958	0.873	0.958	0.798	1
	Sig. (2-tailed)	0	0	0	0	0.03	0	
	N	443	443	443	443	443	443	443
Correlation is significant at the 0.05 level (2-tailed).								

4.3 Result interpretation of correlation analysis from above table

Most variables from the correlation matrix show strong positive relationships to waste management factors because their values exceed 0.7 making their associations significant. Education plays an essential role in enhancing awareness since individuals who understand waste management effectively engage in educational programs ($r = 0.973$, $p = 0.000$). Solid waste management becomes highly effective when communities enroll in partnerships with local authorities and actively participate in waste management activities ($r = 0.958$, $p = 0.000$, $r = 0.927$, $p = 0.000$). The link between environmental consciousness and community initiative participation demonstrates a strong perfect relationship ($r = 0.984$, $p = 0.000$). The statistically significant correlations between these variables establish the fundamental bond that exists between education, awareness, collaboration and involvement when it comes to achieving efficient waste management outcomes.

4.4 Regression Model

Researchers have utilized the regression line analysis between Y and X to determine the effects that waste management knowledge and attitude towards waste and environmental understanding and community activity and educational involvement have on solid waste management effectiveness ratings. We apply the regression line formula with Y representing solid waste management effectiveness and X describing five predictor variables starting with X_1 (Knowledge of Waste Management).

This study presents the regression line showing the relationship between Y and X variables.

$Y = a + b1X1 + b2X2 + b3X3 + b4X4 + b5X5 + \varepsilon$

We achieve the following expression when we apply the identified values into the regression equation.

$Y = 0.106 + 0.201\ X1 + 0.376X2 + 0.286X3 + 0.125X4 - 0.006X5 + \varepsilon$

The expressed effectiveness of solid waste management is positively affected by waste management knowledge and waste management attitudes as well as by environmental awareness and community involvement. Participation in educational programs reveals an unimportant negative relationship with waste management effectiveness because educational programs by themselves fail to directly boost waste management performance.

Table 4.4: Regression Analysis

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.900[a]	.809	.807	.16722
a. Predictors: (Constant), Engagement in Educational Programs, Knowledge of Waste Management, Awareness of Environmental Issues, Attitude towards Waste Management, Involvement in Community Initiatives				

4.4 Result interpretation of Regression Model Summary from above table

The model summary reveals an intense relationship between the predictor variables and the dependent variable because of a 0.900 R value which reflects strong correlation. This strong explanatory power exists because 80.9% of the dependent variable's variance is explained by the independent variables according to the R Square value of 0.809. The adjusted R Square value at 0.807 signifies robustness because it addresses the number of predictors while confirming minimal change from the R Square value. The 0.16722 standard error of the estimate shows how much data points vary from the regression line which implies a small magnitude of prediction errors. The model demonstrates excellent effectiveness in identifying the relationship between educational program engagement alongside waste management knowledge together with environmental awareness and waste management attitudes and community participation in shaping the outcome variable.

Table 4.5: Coefficients

Coefficients[a]				
Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.

		B	Std. Error	Beta		
1	(Constant)	.106	.096		1.109	.268
	Knowledge of Waste Management	.201	.013	.368	15.931	.000
	Attitude towards Waste Management	.376	.013	.623	27.881	.000
	Awareness of Environmental Issues	.286	.013	.479	21.975	.000
	Involvement in Community Initiatives	.125	.013	.227	9.809	.000
	Engagement in Educational Programs	-.006	.013	-.010	-.471	.638
a. Dependent Variable: Effectiveness of Solid Waste Management						

4.5 Result interpretation of Regression Coefficients from above table

A statistical significance exists for the regression model which predicts solid waste management effectiveness based on the .000 significance value that remains below the 0.05 standard threshold. The F-value measurement of 370.833 demonstrates strong evidence that all independent variables work together to explain significant distribution in the dependent variable. The model uses regression sum of squares measuring 51.828 to describe a major portion of total variability in solid waste management effectiveness while the residual sum of squares stands at 12.220. The model exhibits strong explanatory power since its regression mean square measure of 10.370 exceeds the residual mean square value of 0.028. Analysis reveals educational programs participation along with waste management knowledge plus environmental issue knowledge and waste management attitudes together with community involvement as major factors to predict effective solid waste management performance.

Table 4.6: ANOVA

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	51.848	5	10.370	370.833	.000[b]
	Residual	12.220	437	.028		
	Total	64.068	442			
a. Dependent Variable: Effectiveness of Solid Waste Management						
b. Predictors: (Constant), Engagement in Educational Programs, Knowledge of Waste Management, Awareness of Environmental Issues, Attitude towards Waste Management, Involvement in Community Initiatives						

4.6 Result interpretation of ANOVA from above table

ANOVA table determines the importance of the regression model which predicts solid waste management effectiveness by examining five independent variables such as educational engagement and knowledge of waste management and environmental awareness and waste management attitudes along with community involvement. The regression model explains a major portion of dependent variable variance because the regression sum of squares (51.848) exceeds the residual sum of squares (12.220). A very high F-statistic (370.833) together with a Sig. = .000 value indicates that the predictors provide substantial meaningful impact on solid waste management effectiveness.

4.7 Summary of result of hypothesis acceptance and rejection

Hypothesis	Statement	Statistical Tool Applied	p-value	Significance	Result (Accept/Reject null hypothesis)
H01	Knowledge of Waste Management → SWM Effectiveness	Regression		Significant	Rejected
H02	Attitude towards Waste Management → SWM Effectiveness	Regression	0	Significant	Rejected
H03	Awareness of Environmental Issues → SWM Effectiveness	Regression	0	Significant	Rejected
H04	Involvement in Community Initiatives → SWM Effectiveness	Regression	0	Significant	Rejected
H05	Engagement in Educational Programs → SWM Effectiveness	Regression	0.638	Not Significant	Accepted
H06	Knowledge of Waste Management → SWM Effectiveness	Correlation	0	Significant	Rejected
H07	Attitude towards Waste Management → SWM Effectiveness	Correlation	0	Significant	Rejected
H08	Awareness of Environmental Issues → SWM Effectiveness	Correlation	0	Significant	Rejected
H09	Involvement in Community Initiatives → SWM Effectiveness	Correlation	0	Significant	Rejected
H010	Engagement in Educational Programs → SWM Effectiveness	Correlation	0	Significant	Rejected

5. DISCUSSION

The research outcomes establish valuable information regarding factors which determine solid waste management success. The analysis of key variables showed strong statistically significant relationships according to the results. Strong positive relationships exist between waste management knowledge and attitudes towards waste management together with environmental awareness and the effectiveness of solid waste management. Negative attitudes toward waste management practices have the strongest positive impact on achievement measures for overall waste management outcomes. Connective efforts between community members and local administrative bodies demonstrate strong connections which prove the vital nature of mutual participation for achieving efficient waste management systems.

The model summary establishes that predictor variables explain 81% of the effectiveness variation in solid waste management based on the reported R-squared value of .809. The determined independent variables demonstrate strong explanatory value when analyzing the factors that affect waste management effectiveness. The adjusted R-squared number of .807 shows strong similarity to the initial R-squared value proving that the predictive model maintains its stability while also demonstrating the minimal disturbance from extra predictors.

ANOVA results demonstrate that the F-statistic stands at 370.833 with $p = .000$ thus proving full model statistical significance. The analysis indicates that the multiple predictors jointly support solid waste management effectiveness since statistical chance of their results occurring is minimal. The model demonstrates a suitable fit with the data because its residual sum of squares amounts to 12.220.

The coefficient analysis extends the comprehension of variable single-effects on collected data. Waste management attitude stands out as the primary contributing factor to waste management performance level ($\beta = .623$). The research data confirms environmental issue awareness ($\beta = .479$) and waste management understanding ($\beta = .368$) establish themselves as major predictors because public education programs should be strengthened for better awareness and knowledge acquisition. The evidence supports that community involvement ($\beta = .227$) features a moderate significant influence on waste management efficiency because it involves public participation in local programs. The research reveals that educational program participation alone shows no significant relationship ($p = .638$) towards attracting consequential improvements in public waste management.

The findings demonstrate waste management will reach better effectiveness through boosted public awareness and knowledge alongside positive attitude promotion. Policy designers and practitioners should create behavioral and participatory interventions that transform knowledge into functional sustainable waste management practices. Sustainable waste management systems achieve greater success when local authorities operate with community-based initiatives as part of their collective effort.

6. CONCLUSION

Research results demonstrate that solid waste management effectiveness receives strong impact from waste management knowledge alongside waste management attitudes as well as environmental issue awareness together with community initiative involvement. The variables showed powerful statistical connections during the analysis which demonstrates their vital importance for creating sustainable waste management systems. Research results showed that solid waste management effectiveness experienced its highest association with the variables of waste management attitude and environmental issue awareness. Educational program involvement did not affect sustainable waste management outcomes according to research findings. Therefore, additional educational strategies focusing on specific areas need development. The ANOVA analysis proved that the evaluated set of predictors jointly causes noticeable changes in solid waste management effectiveness measurement.

7. IMPLICATIONS OF THE STUDY

7.1 Theoretical Implications

1. Advancement of Environmental Behavior Theories

The findings expand current environmental behavior research by proving that enhanced community involvement with better awareness brings about superior solid waste management systems.

2. Integration of Community Engagement Models

The study demonstrates the necessity of implementing community engagement models within environmental management theories because local community participation leads to sustainable waste management results.

3. Influence on Policy Development

The discovered results establish guidelines for policy creators who can develop awareness-based and community-involved environmental policy interventions that produce effective results.

7.2 Practical Implications

1. Enhanced Waste Management Strategies

The research indicates that higher environmental waste efficiency will happen when community members receive better awareness training combined with involvement in waste management.

2. Community-Based Program Development

The research supports developing local programs which teach people waste management methods along with encouraging community members to take ownership of waste responsibilities.

3. Improved Public Health and Environmental Quality

The study suggests better public health and environmental conditions will occur thanks to effective waste management practices made possible by community involvement.

4. Replication in Similar Contexts

Additional regions facing waste management problems can adopt the studied insights as a model to unite environmental management practices with community interaction.

8. LIMITATIONS OF THE STUDY

1.The research included a selected group of 443 participants whose number does not reflect the complete population demographic.

2.The study depends on participant self-reports that might create errors in collected patient data because of biased responses.

3.The research uses restricted variables for analysis which could prevent the discovery of important elements affecting solid waste management effectiveness.

4.External environmental and policy-related factors which could influence waste management initiatives are not addressed by the present research.

5.The study's cross-sectional research approach prevents researchers from confirming the casual relationships among experimental variables.

6.Findings from this research cannot be generalized to all regions because it deals with a specific geographical area whose waste management policies and infrastructure differ from others.

9. FUTURE RECOMMENDATIONS AND SUGGESTIONS OF THE STUDY

1.Enhanced generalization needs future research to work with bigger and diverse participant groups.

2.The research needs extended timeframes for investigation to show how factors change and prove cause-and-effect

relationships.
3.A deeper analysis requires including additional variables which should integrate government policies and economic elements and technological progress.
4.The analysis should incorporate qualitative approaches through interviews together with focus groups to understand community members' perceptions and their encounterd difficulties.
5.These investigations should carry out comprehensive assessments between different regional and national waste manageent approaches to discover high-performance examples.
6.The analysis of policy implications needs more attention to develop specific recommendations which local and national governments can use to improve their waste management programs.

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