RESEARCH ARTICLE

Management Insight, Vol. XXI , No. 2; 2025 Print ISSN: 0973-936X; Online ISSN: 2456-0936

From Awareness to Action: Evaluating Awareness, Attitude, Behaviour and Practices of Students towards Solid Waste Management in India

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Abstract

The purpose of this research paper is to assess the level of awareness regarding solid waste management (SWM) among university students in India. As SWM remains a major challenge globally due to urbanization, industrial growth, and evolving consumption habits, the study explores students' current practices, attitudes, behaviours, and awareness related to SWM. It specifically aims to identify the factors influencing students' awareness, examine how these factors impact awareness levels, and analyze the relationship between awareness and actual waste management behaviours. A quantitative methodology was adopted, utilizing a structured questionnaire distributed to a sample of 246 university students. Data analysis involved exploratory factor analysis and correlation analysis. Findings reveal that while students display strong attitudes and behaviours toward SWM, their awareness is only moderate and practices vary. Notably, awareness is significantly associated with behaviour and practice but shows a weak connection with attitude. The strong correlation between attitude and behaviour indicates that promoting positive attitudes could be more effective in fostering sustainable waste management behaviours.

Key Words- Solid Waste Management, Awareness, Attitude, Behaviour

Management Insight (2025). DOI: https://doi.org/10.21844/mijia.21.2.9

Introduction:

The accumulation of waste resulting from human activities has become a paramount environmental concern, exacerbating global warming, pollution, and ecosystem degradation. Suboptimal waste management practices, including disposal and storage, pose significant risks to environmental sustainability and public well-being. Consequently, there is an urgent need for alternative waste management strategies, as conventional methods such as landfills and incineration are increasingly recognized as insufficient. Waste need not be seen as a given or a side effect of economic growth. With sufficient awareness, planning, and creativity, it is possible to cut waste at the source. *(Lou, L. I. T., & Fabian, N. 2019)*.

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Email : bhavanasingh@smsvaranasi.com
How to cite this article: Singh B., Singh A., Verma N. (2025). From Awareness to Action: Evaluating Awareness, Attitude, Behaviour and Practices of students towards Solid Waste Management in India, Management Insight, 21(2) 110-127
Source of support: Nil
Conflict of interest: None
Received: 25.10.2025; **Accepted:** 30. 11. 2025; **Published:** 31.12.2025

Human activities create waste, and it is the way these wastes are handled, stored, collected and disposed of which can pose risks to the environment and public health *(Zurbrugg 2003)*. A better understanding of how waste picking is done is important because the activity is one step in recycle chains in the Global South. *(Putri, R.L. and F. Colombijn. 2025)*.

Waste can be understood in three interrelated

senses: ecological (from natural, repetitive processes), utilitarian (from human-made utilities), and moral-political (from symbolic social systems). Rather than fixed categories, these are interpretive frameworks shaped by human activity and value systems, revealing waste as a dynamic concept tied to meaning, identity, and social context**.** *(Reno, J. 2018).*

Waste management has always been a challenge to sedentary societies, threatening social norms of order as well as public health. *(Borowy, I. 2019).*

Solid waste management (SWM) is the process of collecting, managing, and disposing of solid waste generated by households, industries, commercial operations, and agricultural sectors. Effective solid waste management is critical to sustaining a clean environment, public health, and sustainable urbanisation. The continual expansion in human population and increasing industrialisation have resulted in ongoing global difficulties with improper garbage disposal *(Atienza, 2008)*. Ineffective garbage collection systems and inadequate disposal locations are key challenges in waste management, particularly in developing countries *(Reyes et al., 2013)*. Similarly, it has been argued that basic solid waste management (SWM) techniques are frequently overlooked on an individual level *(Licy et al., 2013)*. Although many people are aware of the detrimental effects of improper waste management on the environment, a lack of environmental knowledge and a negative attitude often led to bad environmental practices *(Licy et al., 2013).*

Focusing on household waste in a city in Western Switzerland, the research paper examined examines the practices of waste segregation in relation to the city's (organic) waste management system. *(Kakeu et al., 2023).*

The absence of household waste segregation in overcrowded urban areas is an obstacle for achieving the Sustainable Development Goal of reduced waste generation by 2030. *(Kadir, S. et al., 2024).*

Several community surveys have assessed students' knowledge, attitudes, and behaviours (KAP) on the environment. According to *(Ahmad et al. 2015),* students are seen as the nation's future, and schools aim to prepare them to be champions for a sustainable environment. Research indicates that students practise moderate to unsatisfactory waste management *(Desa et al., 2011; Adeolu et al., 2014; Ahmad et al., 2015).* This study assessed college students' knowledge, attitudes, and practices about solid waste management. This study aims to identify the core causes of solid waste problems and promote environmental integrity in the Municipality of Los Baños.

To address environmental issues, individuals must acquire attitudes that lead to ecologically responsible behaviour *(Ahmed & Mohammed Al-Mekhlafi, 2009).* People's attitudes evolve to meet their changing demands and interests. Education alone cannot change someone's attitude. Acceptance of a new attitude is influenced by who presents the knowledge, how it is delivered, the person's perception, the communicator's credibility, and the conditions under which the knowledge was obtained. Most municipal solid waste continues to be collected in an unsorted form, with the informal sector largely responsible for sorting the recyclable materials. *(Zhan, M. X., 2022).*

One important strategy to reduce the environmental impact of solid waste output is to implement the circular economies reduce, re-use, recycle, and recover principles. Educational institutions, particularly tertiary institutions, must pay special attention to developing students' attitudes and perspectives. Attitudes and perceptions influence students' environmental behaviour; hence it is critical to assess students' environmental

awareness in solid waste management at academic institutions. Regarding the waste 'crisis' in particular, responsibility is understood as pertaining to individual actors, thus undermining the prevailing perception of an interconnected world *(Eitel, K. 2022)*.

Students have an essential role in promoting sustainable development, and the time has come to fully realise their potential as change agents. The university is an effective institution for raising community knowledge about solid waste management. It's time to prioritise pupils in environmental education. To address waste, institutions should view it as a valuable resource rather than something to discard.

(Henderson and Dumbili 2021) explored how students in South-Eastern Nigeria interact with plastic waste, particularly from single-use sachet water. Despite awareness of environmental harms, social norms often discourage responsible disposal, leading to widespread littering.

There is less evidence to support students' understanding and application of environmental ideas, notably in a Diocesan School in the Province of Antique. Students are typically the most popular subjects in environmental surveys since they are regarded as the nation's future. The schools develop their environmental awareness and actions in support of sustainable environmental advocacy *(Ahmad, Noor, and Ismail, 2015)*.

Waste Disposal

In many developing countries across Asia, the adverse effects of open dumping and unmanaged waste on human health and social well-being were not fully recognized until these waste sites had grown into massive, unmanageable heaps. *(Pathak, G. 2023)*. Waste disposal practices often lag behind collection efforts, operating under the "out of sight, out of mind" mindset. Over time, environmental standards for incineration and landfilling have improved, and new methods for waste sorting and resource recovery have been introduced. Research has focused on landfill waste behavior, particularly the production of leachate and its potential to pollute water sources. Industrial and hazardous waste management has also emerged as a significant issue, leading to the development of complex legislation, control systems, and advanced treatment and disposal facilities. *(Wijekoon, P., et al., 2022)*.

Solid Waste Management

In its efforts to support solid waste management, the Department of Environment and Natural Resources (DENR), through its Environmental Education and Information Division (EEID) and in collaboration with the National Solid Waste Management Commission (NSWMC) Secretariat, organized a "National Communication and Education Planning Workshop on the Ecological Solid Waste Management Act" on April 12, 2002, at Century Imperial Suites.

Solid waste is also a contributor to climate change, primarily due to the release of methane gas, a greenhouse gas 21 times more potent than carbon dioxide, produced through the anaerobic decomposition of organic waste. This was highlighted by the Inter-Committee on Climate Change in the Philippines. *(Gautam, M., & Agrawal, M. 2020)*.

Under the Republic Act (R.A.) 9003, local government units (LGUs) now require citizens to practice waste segregation at the source, including from institutional, industrial, commercial, and agricultural sectors. Waste is categorized into four types: biodegradable, non-recyclable, recyclable, and special waste. However, waste segregation at the household level remains limited. Traditionally,

Filipinos tend to segregate only what they can sell, such as bottles and paper, to roaming waste buyers. *(Bharadwaj, A., et al., 2015).*

Solid waste management (SWM) in India has emerged as a critical environmental and public health concern, driven by rapid urbanization, population growth, and evolving consumption patterns. The nation generates approximately 62 million tonnes of municipal solid waste annually, with projections indicating a rise to 165 million tonnes by 2030. Despite initiatives like the Swachh Bharat Mission (SBM), which has improved waste treatment rates from 20% in 2014 to 54% in 2021, challenges persist, including inadequate infrastructure, limited public awareness, and inconsistent policy enforcement. *(Ganesh, S. V et al., 2024), (Samreen, S. et al., 2023)*

A significant portion of waste continues to be disposed of in open areas or poorly managed landfills, leading to environmental degradation and health risks. Studies highlight that only about 30-40% of urban households practice waste segregation at the source, impeding effective recycling and resource recovery efforts. Furthermore, the informal sector plays a substantial role in waste collection and recycling, yet it often operates without adequate support or recognition. *(Salve, P. S., & Mishra, U. S. 2024).*

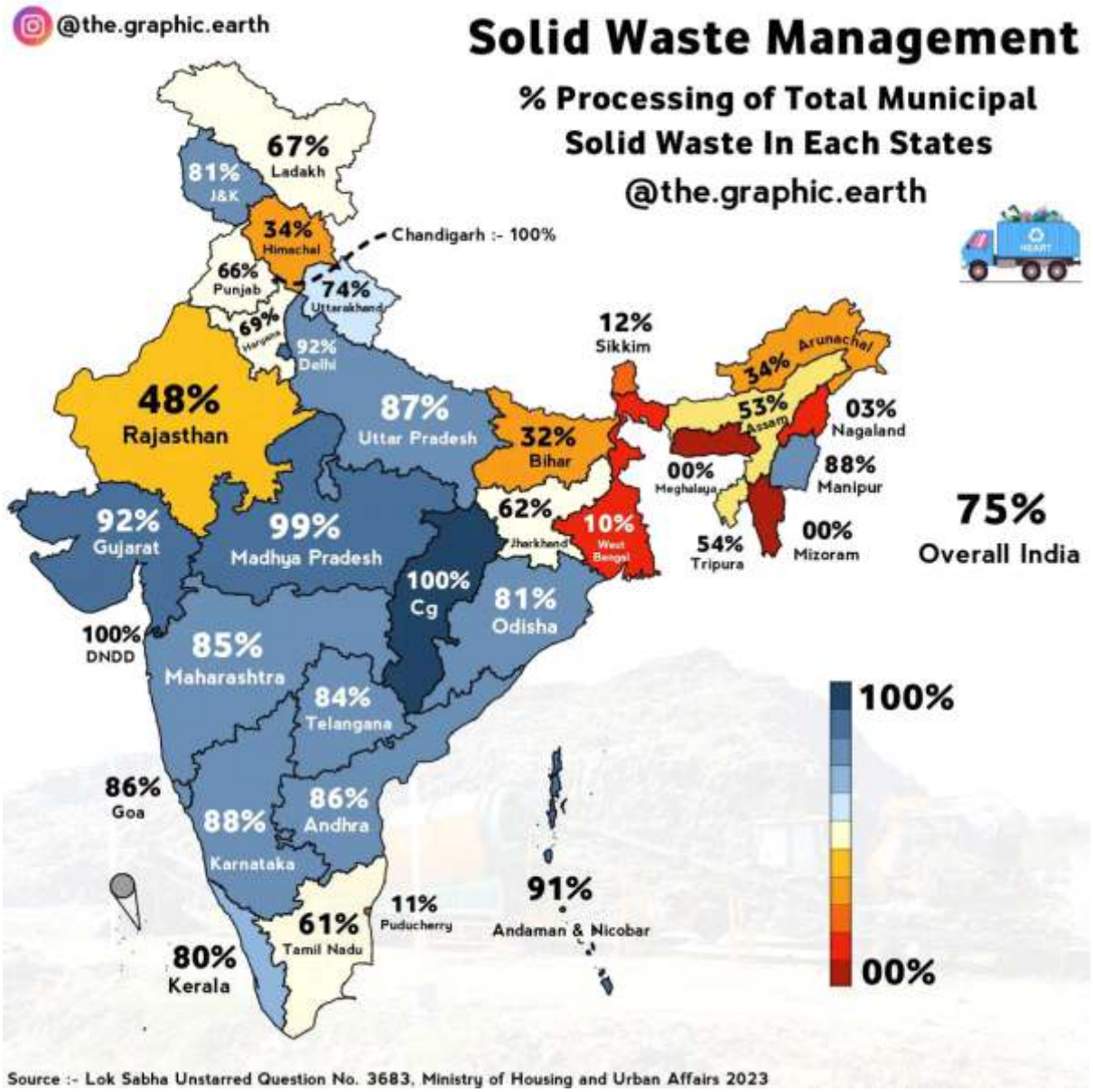
Addressing these challenges necessitates a multifaceted approach, encompassing technological innovations, community engagement, and robust policy implementation. Emphasizing decentralized waste management systems, promoting public-private partnerships, and enhancing citizen participation are pivotal for sustainable SWM in India. This research aims to delve into the current state of solid waste management in India, exploring the underlying factors contributing to its challenges and identifying potential pathways for improvement. *(Rengerla, A., & Angamuthu, P. 2025).*

Waste disposal in India

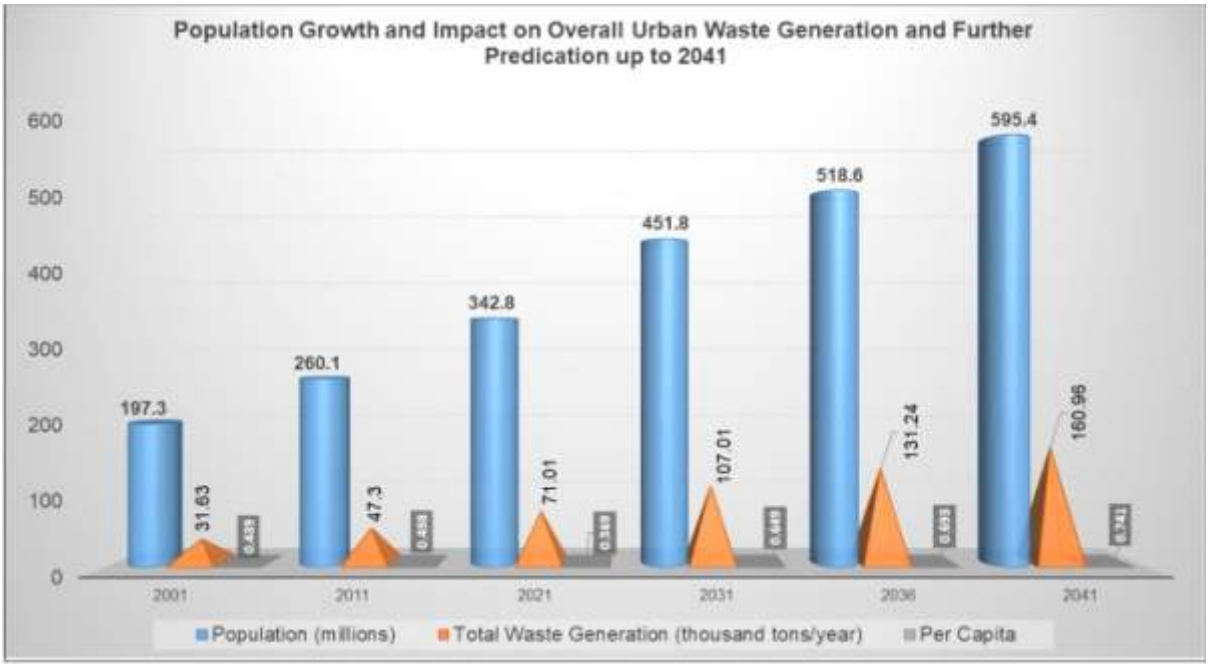
Waste disposal is an essential component of a comprehensive solid waste management system that prioritises waste reduction and recycling programs. At the same time, practical and achievable waste public health, environmental, and social problems caused by existing dumping practices can be achieved.

India being a developing country is still struggling with appropriate measures oif solid waste management due a lack of knowledgeperception, behaviour, attitude as well as willingness among citizens towards waste. Populations and urban growth in t he cities usually result in accumulation of solid waste.

Waste minimization and recycling programs should be given priority within an integrated solid waste management system, which includes waste disposal as a required component. At the same time, it may be possible to achieve the feasible and realistic implications of current dumping practices on public health, the environment, and society.



The map presents data on the proportion of municipal solid waste processed in various Indian states and union territories, as reported by the Ministry of Housing and Urban Affairs in 2023. Although the overall national average is 75%, there is considerable variation between regions. States such as Chhattisgarh, Madhya Pradesh, and Gujarat demonstrate strong waste management practices with processing rates exceeding 90%. Conversely, states in the Northeast like Mizoram, Meghalaya, and Nagaland show minimal progress, processing less than 5% of their waste. Southern states perform relatively well, while some northern and eastern states lag behind, emphasizing the need for targeted regional interventions.



Source-https://link.springer.com/article/10.1007/s12517-022-10414-w

Literature Review

SWM and Awareness

Solid waste management (SWM) awareness is crucial for effective implementation and public participation. Studies across different regions reveal varying levels of awareness and practices. In Mumbai, youngsters demonstrated high awareness of SWM issues and willingness to participate in cleanliness campaigns *(D. Lad et al., 2020)*. However, in Pol-e-Khumri, Afghanistan, 58% of participants showed weak general awareness, with education level positively correlating with awareness *(Parwiz Qaderi et al., 2021)*. In a Philippine university, students exhibited high awareness and good practices in segregation, reduction, and reuse, but fair practices in recycling and disposal *(Paghasian, 2017)*. An Ethiopian study found public awareness of SWM issues but noted inadequate disposal practices due to various factors, including labor shortages *(Aboma Fekadu Tsega & R. Reddy, 2013)*. These studies highlight the importance of education and integrated programs to enhance public awareness and improve SWM practices across different communities.

SWM, Awareness and Attitude

Recent studies have examined awareness, attitudes, and practices regarding solid waste management (SWM) in various settings. In educational institutions, both employees and students demonstrated high levels of awareness and positive attitudes towards SWM, with practices correlating significantly with awareness and attitudes *(Madrigal & Oracion, 2018;) (Reyes & Madrigal, 2020)*. These findings were consistent across different academic levels and genders. In community settings, more than half of residents in Trincomalee, Sri Lanka, were aware of SWM strategies, though awareness of e-waste disposal was poor *(Thiruketheeswaranathan, 2019)*. Similarly, in Dibrugarh, India, residents showed proper attitudes towards SWM but lacked in practice *(Sharma, 2020)*. Age, educational level, and religion were found to influence SWM awareness, attitudes, and practices *(Madrigal & Oracion, 2018)*. These studies highlight the

importance of environmental education in shaping behavior and suggest that while awareness and attitudes are generally positive, there is room for improvement in SWM practices.

SWM, Awareness and Practices

Solid waste management (SWM) awareness and practices have been studied across various educational institutions in the Philippines. Research consistently shows high levels of awareness among students, teachers, and administrators *(Ian Mark Ruiz et al., 2021); Dennis V. Madrigal & Enrique G. Oracion, 2018).* However, practices often lag behind awareness, particularly in areas like disposal and recycling *(Margarita Paghasian, 2017).* Factors such as age, educational level, and religion can influence SWM awareness and practices *(Madrigal & Oracion, 2018).* Importantly, a significant relationship exists between awareness and practices, suggesting that increased knowledge leads to improved SWM behaviour *(Janice U. Idul, 2023; Paghasian, 2017).* To enhance SWM practices, researchers recommend implementing educational seminars focusing on policies, proper disposal, segregation, and the 3R's (Reduce, Reuse, Recycle) *(Ian Mark Ruiz et al., 2021).* These findings underscore the importance of environmental education in fostering sustainable SWM practices within educational institutions.

Research Gap

In a country like India, which aspires to be a global economic giant, public health and quality of life are degrading everyday with the increasing gap between services required and those provided. India is also considered a sacred nation by the majority of its inhabitants but the streets and open lands in Indian cities are filled with untreated and rotting garbage. *(Annepu, R. K. (2012).*

The exponential population growth, high density of urban areas, diverse culture, changing food habits, and lifestyles have seen an unresolved problem in terms of Solid Waste Management (SWM) in India. Youth play a crucial role in solid waste management (SWM) through various avenues, from raising awareness to participating in community initiatives. Their engagement can lead to significant positive impacts on environmental sustainability. But the study, of *(Debrah, J. K., et al., 2021)* states that there is lack of awareness towards SWM in youth of the India.

This study tried to fill this gap by identifying the contributing factors of awareness and its relation with the SWM of students of India.

Research Methodology

This study employed a quantitative research survey design to evaluate awareness, attitudes, behaviors, and practices related to solid waste management awreness (SWM) among university students in India. A structured questionnaire, developed from existing literature and validated instruments, served as the primary data collection tool. It encompassed sections on demographics, awareness, attitudes, behaviors, and practices, with items measured on a 5-point Likert scale. Content validity was ensured through expert reviews, and a pilot study with 30 students yielded a Cronbach's alpha of 0.85, indicating acceptable reliability. A convenient sampling technique selected 246 students across various disciplines and academic years. The questionnaire was administered through google form and collected data from university students of India. Data were analysed, employing descriptive statistics, exploratory factor analysis, correlation analysis to examine relationships between awareness, attitudes, behaviors, and practices. This methodology provided comprehensive insights into factors influencing SWM awareness and practices among university

students, informing targeted interventions to enhance environmental sustainability in higher education institutions.

Research Questions

- What factors contribute to SWM awareness?
- Which factors interact most to influence SWM?
- What are the relation and association of awareness to SWM?

Objectives

- To identify the factors affecting awareness of solid waste management in university students.
- To study the influence of different factors on awareness of solid waste management in university students.
- To study the association of awareness with solid waste management in university students.

Framework of the Study

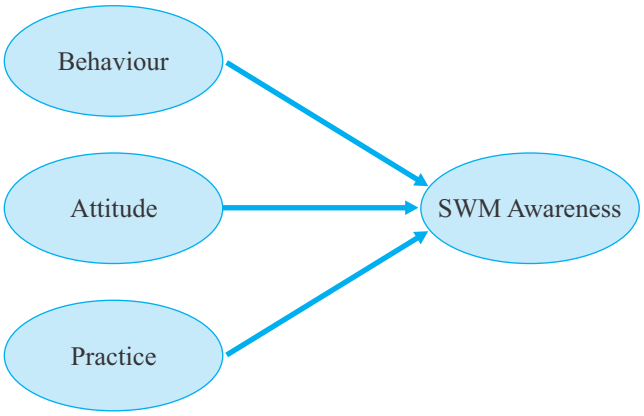
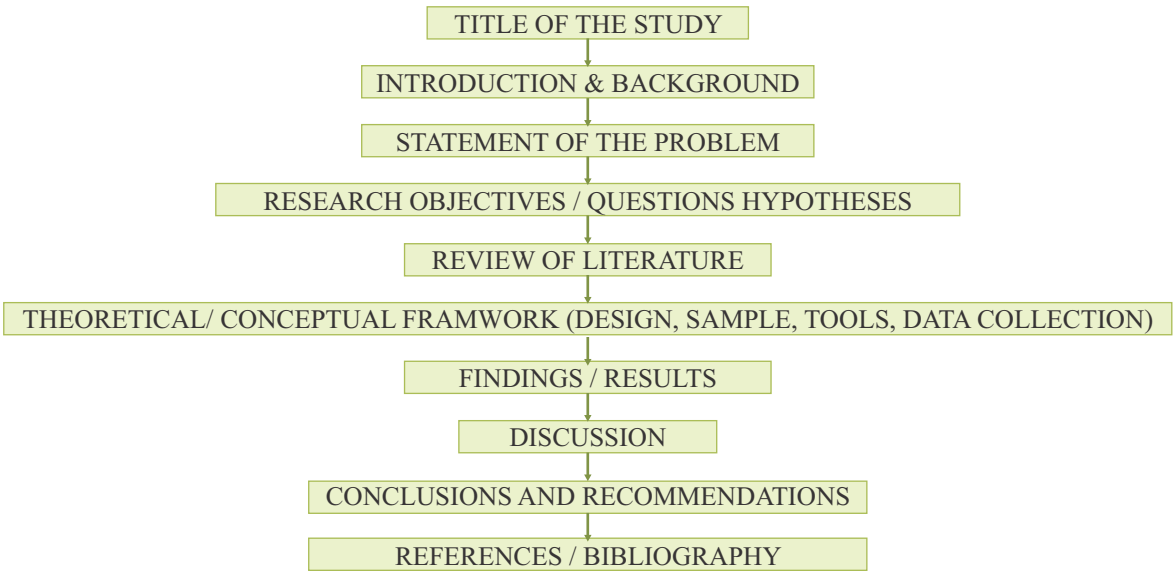


Fig-3- Framework of the Study

FLOW OF THE STUDY



Source- author

Flow of the study

Data analysis and interpretation

1. Age Group	Frequency
16-20	22
21-24	104
25 -29	55
Above 30	65
Total	246

2. Gender	Frequency
Male	170
Female	76
Total	246

3. Stream	Frequency
UG 1	35
PG 2	211
Total	246

4.Area of residence	Frequency
Urban	151
Semi-Urban	62
Rural	33
Total	246

5. Family type	Frequency
Nuclear	142
Joint	104
Total	246

Descriptive Statistics				
	Mean	Std. Deviation	Analysis N	Missing N
SWM AWARE 1	3.47	1.013	246	0
SWM AWARE 2	3.51	1.068	246	0
SWM AWARE 3	3.52	1.068	246	0
SWM AWARE 4	3.45	1.295	246	0
SWM AWARE 5	3.56	1.119	246	0
SWM BEHAV 1	4.15	.879	246	0
SWM BEHAV 2	3.78	1.087	246	0
SWM BEHAV 3	3.91	.921	246	0
SWM BEHAV 4	4.44	.684	246	0
SWM BEHAV 5	4.25	.894	246	0
SWM ATT 1	4.44	.741	246	0
SWM ATT 2	4.30	.856	246	0
SWM ATT 3	4.33	.818	246	0
SWM ATT 4	4.43	.707	246	0
SWM ATT 5	4.36	.768	246	0
SWM PRAC 1	3.78	1.002	246	0
SWM PRAC 2	3.62	1.069	246	0
SWM PRAC 3	2.15	1.269	246	0
SWM PRAC 4	3.70	1.069	246	0
SWM PRAC 5	3.90	.916	246	0

The data measures four different dimensions of Solid Waste Management (SWM) across 20 items: awareness, behavior, attitude, and practice. In terms of awareness (AWARE 1–5), the mean scores range from 3.45 to 3.56, reflecting moderate levels of awareness with standard deviations between 1.0

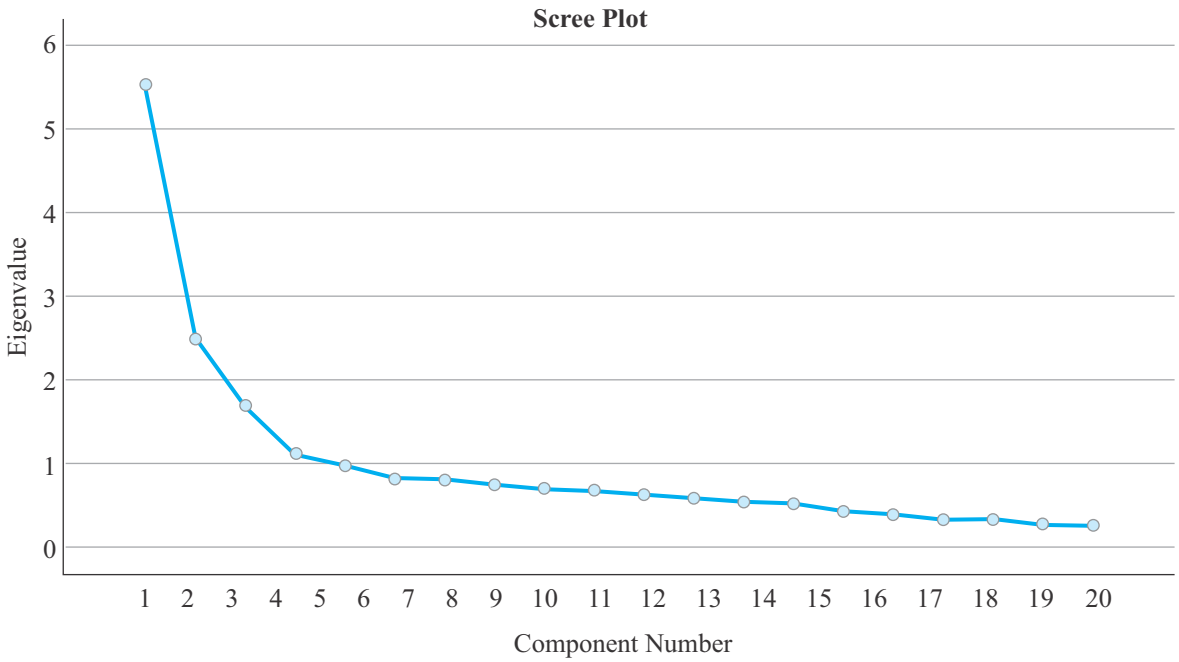
and 1.3, indicating some variability in responses. Behavior (BEHAV 1–5) shows higher means, ranging from 3.78 to 4.44, with SWM BEHAV 4 achieving the highest mean of 4.44 and lower standard deviations (0.68–1.09), suggesting generally positive and more consistent waste management behaviour. Attitude (ATT 1–5) emerges as the strongest dimension, with consistently high means between 4.30 and 4.44 and the smallest standard deviations (0.71–0.86), indicating very positive and uniform attitudes toward waste management. Practice (PRAC 1–5), however, is the most variable dimension, with a notable outlier: PRAC 3 has a mean of only 2.15, significantly lower than other practices, which range from 3.62 to 3.90. Standard deviations for practice items range from 0.92 to 1.27. Key observations include a consistent sample size (N=246) with no missing data. Overall, attitudes show the most positive responses, behaviour are generally good, awareness suggests room for improvement, and practices are mixed, with PRAC 3 indicating a particular weakness. These results imply that although participants have very positive attitudes and generally good waste management behaviour, there exists a gap between attitudes and actual awareness and practices, especially in specific actions like those measured by PRAC 3.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.844	
Bartlett's Test of Sphericity	Approx. Chi-Square	1620.713
	df	190
	Sig.	.000

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for this dataset is 0.844, which falls within the "meritorious" range, indicating that the sample size and the correlations among the items are sufficiently strong to proceed with factor analysis *(Kaiser, 1974)*. Typically, KMO values above 0.80 suggest that the items share enough common variance to yield reliable factors, and thus, factor analysis is appropriate. Additionally, Bartlett's Test of Sphericity yielded a chi-square value of 1620.713 with 190 degrees of freedom and a significance level of $p < 0.001$. A significant Bartlett's test ($p < 0.05$) confirms that the correlation matrix is not an identity matrix, meaning there are significant relationships among variables, further justifying the use of factor analysis *(Bartlett, 1954)*. Together, the high KMO value and the significant Bartlett's Test indicate that the data meets key assumptions required for exploratory factor analysis. These results suggest that proceeding with factor extraction is statistically sound, and meaningful underlying structures within the items are likely to emerge. Therefore, the dataset is considered highly suitable for factor analysis, ensuring that subsequent analyses will be based on a robust foundation *(Hair et al., 2010)*.

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.520	27.602	27.602	5.520	27.602	27.602	4.211	21.055	21.055
2	2.494	12.472	40.074	2.494	12.472	40.074	3.046	15.229	36.284
3	1.704	8.522	48.597	1.704	8.522	48.597	2.343	11.717	48.001
4	1.121	5.604	54.201	1.121	5.604	54.201	1.240	6.200	54.201
5	.981	4.907	59.108						
6	.834	4.172	63.280						
7	.815	4.076	67.355						
8	.756	3.778	71.133						
9	.711	3.553	74.686						
10	.686	3.430	78.115						
11	.638	3.191	81.306						
12	.596	2.978	84.284						
13	.550	2.748	87.032						
14	.529	2.647	89.679						
15	.436	2.180	91.860						
16	.397	1.984	93.844						
17	.340	1.700	95.544						
18	.337	1.686	97.230						
19	.287	1.434	98.664						
20	.267	1.336	100.000						

Principal Component Analysis (PCA) revealed that four components collectively explain approximately 54.2% of the total variance. Initially, the first component accounted for 27.6% of the variance, but after rotation, variance was more evenly distributed across the four components (21.1%, 15.2%, 11.7%, and 6.2%). According to the eigenvalue criterion (eigenvalues >1), retaining four factors is justified *(Kaiser, 1960)*. Rotation enhanced interpretability by clarifying the factor structure without altering the cumulative variance explained *(Hair et al., 2010)*. Overall, the results suggest that a four-component model adequately summarizes the dataset's underlying dimensions and provides a clearer, more interpretable structure.



Rotated Component Matrix				
	Component			
	1	2	3	4
SWM ATT 1	.806			
SWM ATT 4	.794			
SWM ATT 5	.768			
SWM ATT 2	.759			
SWM ATT 3	.641			
SWM BEHAV 4	.612			
SWM BEHAV 5	.520			
SWM BEHAV 3				
SWM PRAC 4		.805		
SWM BEHAV 2		.792		
SWM PRAC 1		.776		
SWM PRAC 2		.586		
SWM BEHAV 1		.519		
SWM PRAC 5				
SWM AWARE 3			.714	
SWM AWARE 5			.707	
SWM AWARE 2			.682	
SWM AWARE 4			.617	
SWM AWARE 1			.567	
SWM PRAC 3		-.549		

Principal Component Analysis with Varimax rotation revealed a clear four-component structure. Component 1, dominated by attitude items and some behavioral items, reflects positive attitudes toward solid waste management (loadings: .806 to .641). Component 2 combines practice and behavior items, representing practical engagement and action (loadings: .805 to .519). Component 3 is characterized by strong loadings from awareness items (loadings: .714 to .567), illustrating respondents' recognition of waste management issues. Component 4 contains only SWM PRAC 3 with a negative loading (-.549), suggesting it may capture a distinct or problematic aspect of practice behavior. Rotation converged in five iterations, providing a more interpretable factor structure **(Hair et al., 2010).** The results confirm the multidimensionality of the dataset, supporting a four-factor solution that aligns with conceptual distinctions among attitude, behavior, practice, and awareness. This structure can guide future improvements in the measurement instrument and enhance the understanding of SWM-related behaviour.

Component Transformation Matrix				
Component	1	2	3	4
1	.775	.553	.274	.136
2	-.553	.477	.670	-.135
3	.214	-.677	.689	.147
4	.218	-.091	.050	-.970

The Component Transformation Matrix from the Principal Component Analysis using Varimax rotation demonstrates how the original components are linearly transformed into the rotated components. Rotated Component 1 is primarily influenced by the original Component 1 (loading = 0.775), while Rotated Component 2 reflects mixed contributions, particularly a negative loading from Component 2 (-0.553) and Component 3 (-0.677). Rotated Component 3 is mainly shaped by positive contributions from Components 2 (0.670) and 3 (0.689). The fourth component shows minimal influence across all dimensions. This transformation redistributes the variance, enhancing interpretability by clarifying the relationships between original and rotated factors **(Hair et al., 2010).** Practically, the rotated structure facilitates clearer identification of underlying constructs within the dataset, linking the new factors back to the original dimensions assessed. Overall, the Component Transformation Matrix confirms that the Varimax rotation successfully produced a simpler, more interpretable factor solution, crucial for meaningful analysis and reporting.

Results of Correlation

Descriptive Statistics		
Mean	Std. Deviation	N
17.5163	3.73152	246
20.5325	3.10972	246
21.8537	3.03902	246
17.1423	3.20078	246

Component 3 shows the highest mean score (21.85), followed by Component 2 (20.53), while Components 1 and 4 have lower means (17.52 and 17.14 respectively). The standard deviations indicate relatively consistent variability across components, with Component 1 showing slightly more spread (SD = 3.73).

SWMAware	Pearson Correlation	1	.244**	.114	.277**
	Sig. (2-tailed)		.000	.074	.000
	Sum of Squares and Cross-products	3411.435	694.370	316.585	809.931
	Covariance	13.924	2.834	1.292	3.306
	N	246	246	246	246
SWMBehav	Pearson Correlation	.244**	1	.560**	.417**
	Sig. (2-tailed)	.000		.000	.000
	Sum of Squares and Cross-products	694.370	2369.240	1296.171	1017.362
	Covariance	2.834	9.670	5.290	4.152
	N	246	246	246	246
SWMAtti	Pearson Correlation	.114	.560**	1	.154*
	Sig. (2-tailed)	.074	.000		.016
	Sum of Squares and Cross-products	316.585	1296.171	2262.732	367.122
	Covariance	1.292	5.290	9.236	1.498
	N	246	246	246	246
SWMPrac	Pearson Correlation	.277**	.417**	.154*	1
	Sig. (2-tailed)	.000	.000	.016	
	Sum of Squares and Cross-products	809.931	1017.362	367.122	2510.020
	Covariance	3.306	4.152	1.498	10.245
	N	246	246	246	246

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

The correlation matrix reveals significant relationships among the four solid waste management (SWM) dimensions. SWMAware is moderately correlated with SWMBehav (r = 0.244, $p < 0.01$) and SWMPrac (r = 0.277, $p < 0.01$), suggesting that greater awareness is associated with improved behavior and practices. However, the correlation between SWMAware and SWMAtti is lower and not statistically significant (r = 0.114, p = 0.074). SWMBehav exhibits a strong positive correlation with SWMAtti (r = 0.560, $p < 0.01$), indicating that favorable attitudes are closely linked to proactive behaviour. Additionally, SWMBehav correlates significantly with SWMPrac (r = 0.417, $p < 0.01$), while SWMAtti and SWMPrac show a weaker but significant correlation (r = 0.154, p = 0.016). These results suggest that while awareness plays an important role, attitudes and behaviour are more strongly interconnected in influencing waste management practices *(Field, 2013)*. Understanding these relationships is essential for designing interventions that effectively enhance SWM behaviours.

Findings

The study reveals that university students

demonstrate high levels of attitude and behaviour toward Solid Waste Management (SWM), with mean scores above 4.0, indicating positive disposition and consistent practices. However, awareness levels are moderate, and practices are mixed—especially PRAC 3, which significantly underperforms (mean = 2.15), signalling a disconnect between attitude and action. Factor analysis confirms four distinct components: attitude, behaviour, awareness, and practice. Correlation results show that awareness is significantly related to behaviour ($r = 0.244$, $p < 0.01$) and practice ($r = 0.277$, $p < 0.01$), but not strongly linked to attitude ($r = 0.114$, $p = 0.074$). Behaviour and attitude, however, exhibit a strong association ($r = 0.560$, $p < 0.01$), suggesting that favourable attitudes may better predict behavioural change than awareness alone. This multidimensional structure supports targeted approaches to improve SWM through strengthening specific components.

Conclusion

This study explored the awareness, attitudes, behaviour, and practices related to Solid Waste Management (SWM) among university students. Descriptive statistics indicate strong positive attitudes and favourable behavioral tendencies toward SWM, but moderate awareness and variable practices—particularly a weak response in PRAC 3. Factor analysis supported a four-component structure representing distinct SWM dimensions, while correlation analysis showed significant positive relationships between awareness, behaviour, and practice. However, the link between awareness and attitude was weak. These findings suggest that although students hold favourable attitudes and exhibit good behaviour, a disconnect remains in translating awareness into consistent practice. Thus, while awareness is important, behavioural and attitudinal components have a stronger influence on actual waste management practices. The results fulfil the study objectives and confirm that enhancing specific aspects of awareness and reinforcing practical engagement are essential to achieving holistic improvements in SWM behaviour.

Recommendations

To strengthen SWM among students, targeted awareness programs should focus on bridging the gap between knowledge and action. Educational campaigns using real-life demonstrations, participatory activities, and sustainability workshops could enhance awareness and practical skills. PRAC 3's low score suggests a need for clearer communication and training on specific waste disposal methods. Integration of SWM topics into academic curricula and campus initiatives such as waste audits or eco-clubs can reinforce consistent behavior. Peer-led awareness initiatives may be especially effective, as behavioral influence often emerges from social learning. Institutions should also offer visible infrastructure—like segregated bins and signage—to reinforce practices. Collaboration with local municipal bodies could create internship or volunteering opportunities, linking theoretical knowledge to field experience. Finally, using digital platforms like mobile apps and gamified tools may help promote habitual engagement with waste management practices among tech-savvy students.

Implications

This study contributes to the understanding of how awareness, attitude, behavior, and practice interplay in shaping university students' engagement with SWM. Practically, it underscores that improving awareness alone is insufficient; interventions must also address behavioral and attitudinal components to drive sustainable waste practices. Academically, the findings validate a

four-dimensional framework for analyzing SWM engagement, offering a basis for future comparative or longitudinal research. Institutions and policymakers can use these insights to design more effective, behaviorally informed SWM education strategies. The strong link between behavior and attitude suggests that motivational and values-based interventions can significantly influence student actions. Moreover, this research highlights the importance of focusing on specific weak points in practice—such as the low-scoring PRAC 3 item—when designing interventions. Ultimately, the study provides actionable direction for building more sustainable campuses and communities by fostering comprehensive and consistent student participation in waste management efforts.

Limitations

While the study offers valuable insights into SWM among university students, several limitations exist. First, the sample is restricted to one academic setting, limiting the generalizability of the findings to other regions or demographics. Second, the study relies on self-reported data, which may be subject to social desirability or response bias, especially in items related to behavior and attitude. Third, while factor analysis confirmed a four-component model, further validation using confirmatory factor analysis (CFA) is needed to establish model robustness. Additionally, the study's cross-sectional design cannot determine causal relationships among the SWM dimensions. The relatively low score on PRAC 3 warrants further qualitative exploration to understand the specific challenges students face. Finally, cultural and infrastructural variables, which may significantly affect SWM behavior, were not assessed and should be considered in future research. Despite these limitations, the study provides a meaningful foundation for further investigation and practice in SWM education.

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