



## SOCIAL MEDIA AND SOLID WASTE MANAGEMENT IN PLATEAU STATE, NIGERIA: PERCEIVED EFFECTIVENESS, ATTITUDINAL INFLUENCE, AND THE ROLE OF INFLUENCERS

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### Abstract

Municipal solid waste management remains a major environmental and public health challenge in sub-Saharan Africa, where urbanisation has outpaced institutional capacity. Despite widespread social media use in Nigeria, its role in waste management communication and behaviour change remains underexamined. Against this background, the present study assessed the perceived effectiveness of social media campaigns in raising awareness of solid waste management, influencing waste disposal attitudes and behaviours, and promoting sustainable waste management practices through social media influencers in Langtang North and Langtang South Local Government Areas of Plateau State, Nigeria. A quantitative cross-sectional survey involved 330 respondents, comprising 289 residents and 41 municipal waste management staff, selected through multistage stratified and convenience sampling. Data were collected using a structured four-point Likert questionnaire and analysed using descriptive statistics and the Chi-square test of independence at  $\alpha = 0.05$ . Mean scores ranged from 2.50 to 2.80 for campaign effectiveness, 2.59 to 2.84 for attitudinal and behavioural influence, and 2.52 to 2.80 for influencer impact. Attitudinal influence ( $M = 2.84$ ) exceeded behavioural engagement ( $M = 2.59$ ), indicating an attitude-behaviour gap. The Chi-square test showed a significant association between respondent category and perceptions of social media's role ( $\chi^2 = 12.079$ ,  $df = 2$ ,  $p = 0.046$ ). The findings indicate that social media can strengthen awareness and attitudes, but sustained behavioural change requires complementary improvements in waste management infrastructure and institutional capacity.

**Keywords:** social medial campaign, municipal solid waste, waste management, public health challenges, Public awareness

### 1. INTRODUCTION

Municipal solid waste management remains one of the most pressing environmental and public health challenges confronting developing nations, particularly in sub-Saharan Africa, where rapid urbanisation, population growth, and changing consumption patterns have outpaced institutional capacities for waste collection, treatment, and disposal (Hoornweg & Bhada-Tata, 2012; Kaza *et al.*, 2018). Recent evidence continues to indicate substantial limitations in household access to formal waste-collection services in Nigeria. The Nigeria General Household Survey Panel 2023–2024 records household refuse-management arrangements that include

government and private collection, disposal at

designated public locations, burning, compound disposal, and informal disposal on land or into water bodies, demonstrating the continued diversity and informality of household waste-management practices (Ayotamuno & Gobo, 2004; Ogwueleka, 2009; Ngonso *et al.*, 2023). A recent World Bank assessment reports that waste collection rates remain low in several major Nigerian cities, with substantial differences among cities. It reports collection rates of approximately 20–30% in Lagos, 40% in Ibadan, and 45% in Abuja. The consequences of inadequate waste

management are manifold, encompassing environmental degradation, groundwater and surface water contamination, greenhouse gas emissions, and elevated public health risks, including the transmission of vector-borne diseases (Gutberlet, 2015; Oshim *et al.*, 2026). In Plateau State, where the present study was conducted, the challenges associated with municipal solid waste management include insufficient collection coverage, irregular collection services, improper disposal practices, limited recycling infrastructure, and low public awareness of sustainable waste management practices a profile that reflects broader national patterns (Ezeudu *et al.*, 2021a; Nwachi *et al.*, 2023). The importance of public awareness in shaping waste management behaviours has been well-established in the environmental psychology and sustainability literature (Barr, 2007; Schultz *et al.*, 1995). Awareness of the environmental and health consequences of improper waste disposal, knowledge of proper waste handling practices, and positive environmental attitudes have consistently been associated with more responsible waste-related behaviours (Miafodzyeva & Brandt, 2013; Xu *et al.*, 2017). However, awareness alone is insufficient to produce sustained behavioural change; the well-documented attitude-behaviour gap in environmental psychology suggests that knowledge and positive attitudes may not translate directly into action without enabling structural conditions and reinforcement mechanisms (Ajzen, 1991; Kollmuss & Agyeman, 2002). Within the Nigerian context, studies have demonstrated that while many residents possess awareness of proper waste management practices, actual behaviours are often constrained by limited access to collection services, inadequate disposal infrastructure, and weak institutional

enforcement (Salami *et al.*, 2019; Odoemelam & Hasan, 2021).

The emergence of social media as a dominant communication platform in the twenty-first century has created new opportunities for environmental education and behaviour change interventions (Song & Alivi, 2025; Schäfer & Metag, 2026). With over 2.9 billion monthly active users on Facebook alone and widespread adoption of platforms including WhatsApp, Instagram, and X (formerly Twitter) across Nigeria (Our History, 2023), social media has transformed the landscape of information dissemination, enabling rapid, interactive, and participatory communication that traditional media cannot replicate (Arbatani *et al.*, 2016). Uses and gratifications theory posits that individuals actively select media content to satisfy specific informational, social, and identity needs (Palmgreen, 1984), suggesting that social media may serve environmental communication functions by providing tailored content that addresses users' pre-existing concerns or curiosity about waste management issues (Schäfer & Metag, 2026). Also, the theory of planned behaviour (Ajzen, 1991) provides a framework for understanding how repeated exposure to environmental messaging on social media may shape attitudes, strengthen subjective norms through social reinforcement and peer observation, and influence perceived behavioural control through the dissemination of practical guidance (Arbatani *et al.*, 2016).

Despite the proliferation of social media use in Nigeria, its role in raising awareness of and shaping behaviours related to solid waste management has received relatively limited empirical attention (Sairaj & Aravind, 2025). While existing studies have examined environmental communication through traditional media channels (Nwachi *et al.*,

2023) and documented the activities of environmental non-governmental organisations on digital platforms (Sairaj & Aravind, 2025), few have systematically assessed the perceived effectiveness of social media campaigns or the influence of social media influencers as informal environmental educators in the Nigerian context (Oshim *et al.*, 2026). In particular, evidence remains limited regarding the differential influence of social media content on attitudinal change versus actual behavioural engagement, a distinction that is crucial for understanding the mechanisms through which digital communication may or may not contribute to sustainable waste management outcomes (Firmansyah & Sadono, 2025). Also, the perspective of municipal waste management authorities, whose knowledge of public communication and behaviour change is essential for designing effective interventions, has been largely absent from previous studies, creating a significant gap in the evidence base for evidence-based environmental communication policy.

The significance of addressing this knowledge gap extends across multiple domains. From a public health perspective, if social media can effectively promote proper waste disposal behaviours, the result would be reduced environmental contamination and diminished disease transmission risks in vulnerable communities (Gutberlet, 2015; Nwachi *et al.*, 2023). From an environmental management perspective, enhanced public awareness and engagement could support improved waste segregation, increased recycling participation, and reduced pressure on overburdened municipal collection and disposal systems (Ezeudu *et al.*, 2021; Mashi *et al.*, 2026). From a policy perspective, understanding the potential and limitations of social media as a communication tool would enable government agencies and municipal

authorities to more effectively integrate digital strategies into integrated waste management planning (Hoornweg & Bhada-Tata, 2012). From a theoretical perspective, examining the applicability of established behavioural models in the Nigerian context would contribute to the cross-cultural validation and refinement of theories of environmental behaviour change (Ajzen, 1991; Kollmuss & Agyeman, 2002).

This study therefore aimed to examine the role of social media in raising awareness of solid waste management and influencing waste disposal behaviours in Langtang North and Langtang South Local Government Areas of Plateau State, Nigeria. Specifically, the study investigated the perceived effectiveness of social media campaigns in raising awareness of solid waste management, assessed the influence of social media on attitudes and behaviours towards waste disposal, and examined the perceived impact of social media influencers on sustainable waste management practices. By including both residents and municipal waste management staff in the study sample, the research sought to capture complementary perspectives on the opportunities and constraints associated with social media-based environmental communication. Through its focus on the understudied context of Plateau State and its integration of multiple stakeholder perspectives, this study contributes empirical evidence that can inform the design of more effective, contextually appropriate waste management communication strategies in Nigeria and similar developing-country settings.

## **2. MATERIALS AND METHODS**

### **2.1 Study Area**

The study was conducted in Langtang North and Langtang South Local Government Areas of Plateau State, Nigeria (refer to Figure 1). The study area comprises urban and peri-

urban settlements with residential, commercial, and institutional land uses. The predominant economic activities include trading, agriculture, and public service employment. The area experiences challenges associated with municipal solid

waste management, including inadequate collection coverage, irregular collection services, improper disposal practices, limited recycling infrastructure, and low public awareness of sustainable waste management practices.

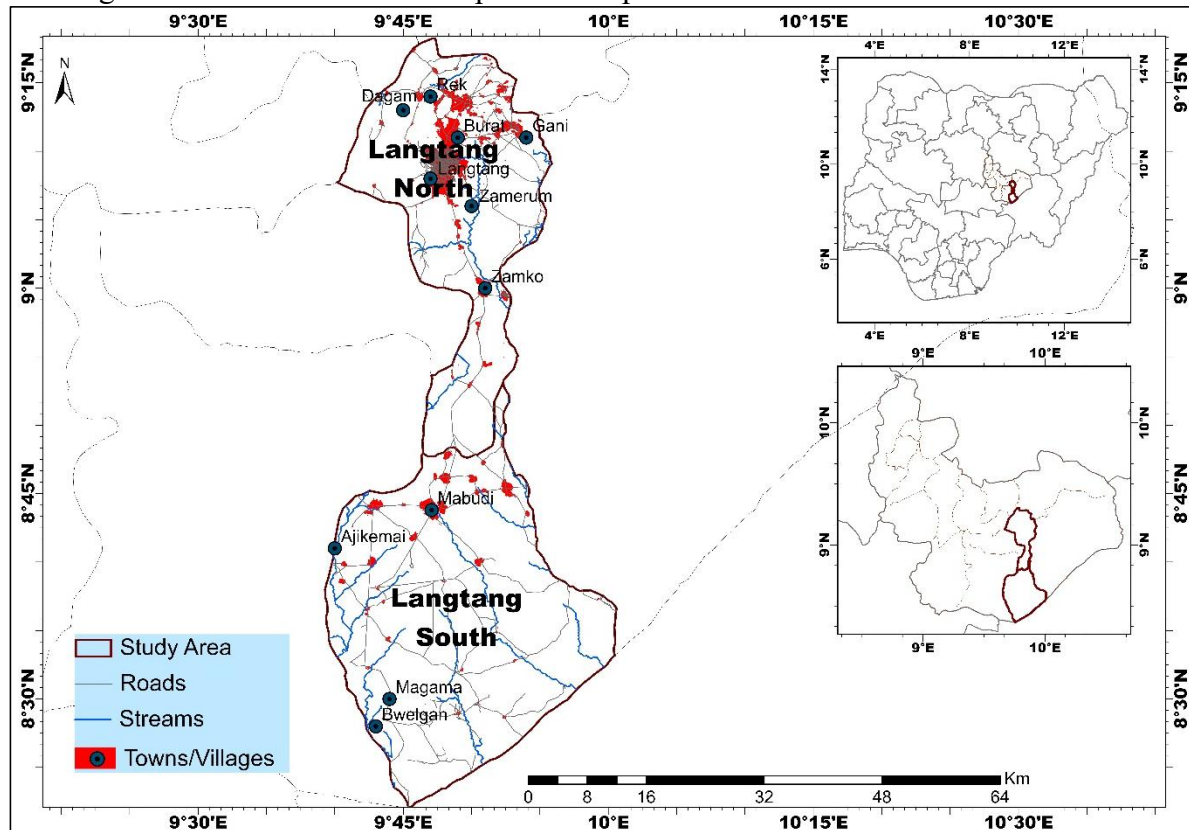


Figure 1: The spatial extent of the study area encompassing Langtang North and Langtang South Local Government Areas in Plateau State, Nigeria.

## 2.2 Research Design

This study employed a quantitative cross-sectional survey design to examine the role of social media in raising awareness and influencing behaviours related to solid waste management. Primary data were collected using a structured questionnaire designed to assess respondents' exposure to social media content, perceptions of social media campaigns, attitudes and behaviours towards waste disposal, and perceptions of the influence of social media influencers.

## 2.3 Study Population, Sampling, and Data Collection

The target population comprised residents aged 18 years and above and staff of municipal waste management authorities working in Langtang North and Langtang South Local Government Areas. The unit of analysis was the individual respondent. Eligible residents were required to have lived in the study area for at least six months, while municipal waste management staff were required to have been employed in their current roles for at least one year. All participants were required to provide

informed consent and be able to understand and respond to the questionnaire.

The sample size was determined using the Taro Yamane formula Ben-Enukora *et al.*, 2025 with a 5% margin of error and a 95% confidence level. Using the reported population estimate of 2,387 residents for Langtang North, the minimum sample size was calculated as 343 respondents.

A multistage sampling approach combining stratification and convenience sampling was used. Participants were stratified into two

groups: residents of the study area and staff of municipal waste management authorities. Approximately 87.5% of the intended sample was allocated to residents and 12.5% to municipal waste management staff, resulting in an intended distribution of approximately 300 residents and 43 staff members. Within each stratum, eligible and willing participants were recruited through convenience sampling from residential areas, workplaces, municipal waste management offices, operational sites, and community settings.

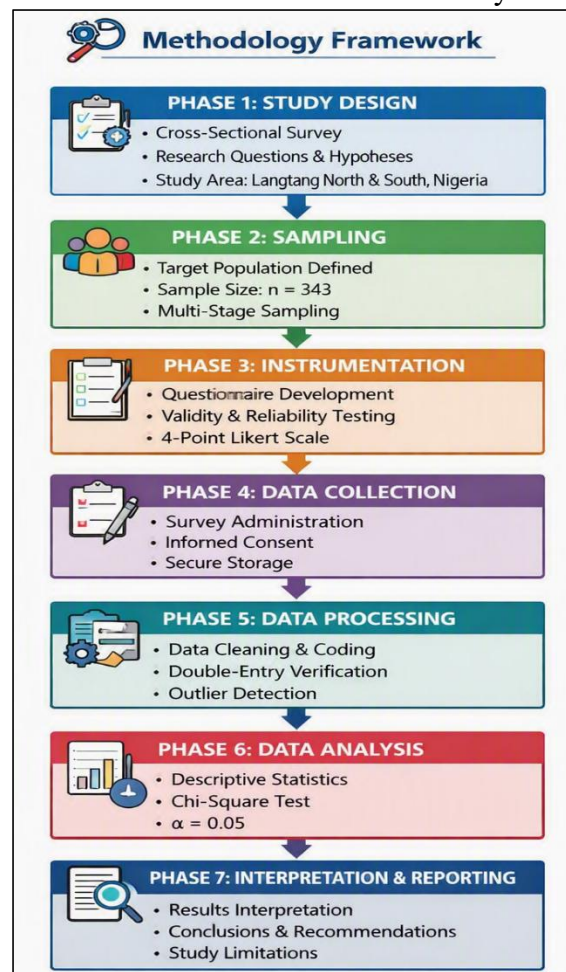


Figure 2: Methodology framework illustrating the sequential phases of the research process, from study design through interpretation and reporting.

Five locally recruited research assistants received two days of training on the study objectives, questionnaire administration, informed consent procedures, ethical requirements, data recording, and quality assurance procedures. A field supervisor

monitored data collection activities and conducted spot checks to ensure consistency. A total of 343 questionnaires were distributed. Of these, 330 were successfully retrieved and validated, representing a reported response rate of 96%. The final sample comprised 289

residents and 41 municipal waste management staff. Questionnaires were administered through self-completion or researcher-assisted completion where participants required reading assistance. Completed questionnaires were reviewed for completeness at the point of collection and stored securely before data processing.

#### **2.4 Research Instrument and Measurement of Variables**

Data were collected using a self-structured questionnaire developed specifically for the study. The instrument comprised two sections. Section A collected demographic information on gender, age, educational level, marital status, and respondent category. Section B assessed the relationship between social media and solid waste management through three four-item constructs: perceived effectiveness of social media campaigns in raising awareness, influence of social media on attitudes and behaviours towards waste disposal, and perceived influence of social media influencers on sustainable waste management practices.

Responses to Section B were measured using a four-point Likert-type scale: strongly agree, agree, disagree, and strongly disagree, coded as 4, 3, 2, and 1, respectively. Mean scores of 2.50 or above were interpreted as acceptance or positive perception, whereas scores below 2.50 were interpreted as rejection or negative perception.

Awareness of solid waste management was operationalised using responses to the four social media campaign effectiveness items. Behavioural change towards waste management was measured using responses to the four items assessing the influence of social media on attitudes and waste disposal behaviours. Perceived social media influencer impact was assessed using four items relating to the influence of social media

influencers on environmentally responsible waste management practices. Higher mean scores indicated stronger perceived awareness, behavioural influence, or influencer impact.

For Chi-square analysis (Leech *et al.*, 2011), respondents' mean scores were categorised as positive or yes for scores of 3.00 or above, undecided for scores between 2.00 and 2.99, and negative or no for scores below 2.00.

#### **2.5 Validity, Reliability, and Data Quality Control**

The questionnaire underwent face and content validity assessment by the project supervisor and experts in environmental science, waste management, and research methodology. The reviewers assessed the relevance of questionnaire items to the study objectives, clarity of wording, adequacy of content coverage, appropriateness of response categories, and comprehensiveness of the instrument. Feedback from the review process informed the refinement of questionnaire items and instructions.

The instrument was pilot tested with 10 individuals who were not included in the final study sample to identify practical difficulties related to administration, comprehension, and completion. Test-retest reliability was assessed by administering the questionnaire to 10 individuals with characteristics comparable to the study population and repeating the administration after a one-week interval. The two sets of responses were compared using Spearman's rank-order correlation coefficient.

Data quality was maintained through standardized training of research assistants, pilot testing, standardized questionnaire administration, immediate review of completed questionnaires, daily debriefing sessions, and supervisory spot checks. After data collection, returned questionnaires were

reviewed for completeness, consistency, and legibility. Responses were coded according to a predefined coding scheme. A second researcher verified the coding process.

Questionnaires with incomplete responses to Section B were excluded from the final analysis. Thirteen incomplete questionnaires were excluded, leaving 330 validated questionnaires. Data were entered into IBM SPSS Statistics (Leech *et al.*, 2011). A random sample of 20% of data entries was verified against the original questionnaires. Data were also screened for potential outliers using boxplots and z-scores, with absolute z-scores greater than 3.29 considered potential outliers.

## **2.6 Ethical Considerations**

The study followed established ethical principles for research involving human participants. Participants received information about the purpose and procedures of the study and were informed that participation was voluntary. Written or verbal informed consent was obtained before questionnaire administration. Participants were informed of their right to decline participation, refuse to answer any question, or withdraw from the study without penalty. Questionnaires were anonymous and did not collect personally identifiable information. Completed questionnaires were securely stored, while electronic data were maintained on password-protected computers accessible only to the research team. Data were coded and reported in aggregate form to protect participant confidentiality. Institutional approval and permission from relevant local and municipal waste management authorities were reported as part of the study procedures, although the approving body and approval reference details were not specified in the source document.

## **2.7 Data Analysis**

Data analysis was conducted using descriptive and inferential statistical techniques in IBM SPSS. Frequencies and percentages were used to summarise respondents' demographic characteristics and the distribution of responses across questionnaire categories. Mean scores and standard deviations were calculated for the questionnaire items to summarise central tendency and response variability.

The study hypothesis was tested using the Chi-square test of independence at a significance level of  $\alpha = 0.05$ . The analysis examined the association between respondent category, comprising residents and municipal waste management staff, and perceptions of the role of social media campaigns in raising awareness and influencing behaviours towards solid waste management. The null hypothesis was rejected when the p-value was less than 0.05. Before analysis, the data were screened to ensure that the assumptions of independence of observations and adequate expected cell frequencies were satisfied.

## **3. Results and Discussion**

### **3.1 Social Media Campaign Effectiveness in Raising Awareness**

Analysis of responses to the four-item construct assessing social media campaign effectiveness revealed mean scores ranging from 2.50 to 2.80 (threshold = 2.50), indicating moderate-to-strong positive perceptions. The highest endorsement was for the item "social media has played a key role in raising awareness about environmental issues in my community" ( $M = 2.80$ ,  $SD = 0.828$ ), followed by "social media campaigns have increased my knowledge about proper waste management practices" ( $M = 2.70$ ,  $SD = 0.882$ ). Respondents also reported frequently encountering waste management content on social media ( $M = 2.62$ ,  $SD =$

0.781). The lowest-scoring item, "social media campaigns effectively communicate the consequences of poor waste disposal" (M = 2.50, SD = 0.679), still exceeded the acceptance threshold.

Table 1: Summary of the Chi-square test whether social media campaigns have a significant role in raising awareness and changing behaviours towards solid waste management in Nigeria

| Variables    | Observed F | Expected F | Df | X <sup>2</sup> | P-value |
|--------------|------------|------------|----|----------------|---------|
| Yes          | 159        | 110        | 1  | 12.079         | 0.046   |
| No           | 93         | 110        |    |                |         |
| Undecided    | 78         | 110        |    |                |         |
| <b>Total</b> | <b>330</b> |            |    |                |         |

These findings align with Schäfer & Metag (2026), who argued that social media shapes environmental thought and behaviour through social supervision and socialisation functions. Consistent with uses and gratification theory (Palmgreen, 1984), respondents appear to actively select social media content to satisfy informational needs related to waste management. Sairaj & Aravind (2025) similarly documented that Nigerian social media platforms serve as effective conduits for the dissemination of environmental information.

The comparatively low endorsement of consequence communication (M = 2.50) may reflect the complexity of conveying environmental risks, including greenhouse gas emissions, pollution, and disease transmission, within the constraints of social media formats United Nations Environment Programme [UNEP], 2024. This finding suggests that while awareness-raising is achievable, risk communication may require more nuanced strategies.

### 3.2 Influence of Social Media on Attitudes and Behaviours

Responses to the four-item behavioural influence construct yielded mean scores from 2.59 to 2.84. The highest endorsement was for "social media has influenced my attitude towards adopting proper waste disposal practices" (M = 2.84, SD = 0.983), followed by "my perception of waste disposal changed positively after engaging with educational content" (M = 2.72, SD = 0.813). Respondents also reported being more likely to dispose of waste properly after viewing waste management posts (M = 2.66, SD = 0.780). The lowest-scoring item "social media content encourages me to participate in community cleanup activities" (M = 2.59, SD = 0.681) confirmed a measurable but relatively weaker influence on behavioural engagement.

The finding that attitudinal influence (M = 2.84) exceeded behavioural engagement (M = 2.59) is consistent with the well-documented attitude-behaviour gap in environmental psychology (Ajzen, 2002). The theory of planned behaviour (TPB) posits that behavioural intention is shaped not only by attitudes and subjective norms but

also by perceived behavioural control the individual's confidence in their ability to perform the behaviour. In the Nigerian context, barriers such as limited waste collection services, inadequate recycling infrastructure, and insufficient community-based programmes may constrain perceived behavioural control (Salami *et al.*, 2019; Mashi *et al.*, 2026 ). Firmansyah & Sadono (2025) similarly observed that translating online engagement into offline action requires additional motivational and logistical support.

The mechanisms underlying this influence can be understood through TPB and uses and gratification theory. Repeated exposure to environmental content fosters attitude formation (Ajzen, 2002), while the interactive nature of social media facilitates peer-to-peer knowledge transfer and strengthens subjective norms through social reinforcement (Ada *et al.*, 2026). Users who follow environmental accounts may have pre-existing environmental concerns, and this motivated exposure enhances receptivity to behavioural messages (Palmgreen, 1984).

### 3.2.1 Impact of Social Media Influencers

Analysis of responses to the four-item influencer impact construct revealed mean scores from 2.52 to 2.80. The highest endorsement was for "social media influencers play a significant role in encouraging others to adopt better waste disposal practices" ( $M = 2.80$ ,  $SD = 0.828$ ), followed by "posts by influencers motivate me to adopt environmentally friendly practices" ( $M = 2.68$ ,  $SD = 0.750$ ). Respondents reported learning practical waste management tips from influencers ( $M = 2.64$ ,  $SD = 0.739$ ). The lowest-scoring item, "influencers promoting sustainable waste management inspire me to take action" ( $M = 2.52$ ,  $SD = 0.699$ ) suggested that while

influencers inform and motivate, the translation of inspiration into sustained action is less pronounced.

The pattern reveals an interesting hierarchy: influencers' role in encouraging others received the strongest endorsement, while personal inspiration to action received the weakest. This may reflect the social nature of influencer effects; perceived community impact may be more readily acknowledged than personal susceptibility to influence. Still, the finding that respondents learn practical tips from influencers ( $M = 2.64$ ) is particularly significant, as actionable guidance reduces barriers to behaviour change by addressing the perceived behavioural control component of TPB (Ajzen, 2002).

Ada *et al.* (2026) observed that social media platforms facilitate policy discussions and hold authorities accountable, with influencers serving as key actors in these advocacy efforts. The present findings extend this evidence by demonstrating that influencer influence extends to individual-level practice adoption. Sairaj & Aravind (2025) documented that environmental activists and NGOs in Nigeria have effectively utilised social media for public education; the present study suggests that individual influencers, rather than only organisational actors, play a significant role in this educational function. This aligns with the broader social media literature emphasising the authenticity and relatability of user-generated content (Govender & Mzizi, 2025).

In the Nigerian context, with over 2.9 billion monthly active users on Facebook and widespread use of WhatsApp, Instagram, and Twitter (Our History.fb, 2023), influencers represent a powerful communication channel that traditional media cannot match. In communities where institutional waste management services are inadequate,

influencers may serve as informal educators, filling communication gaps (Ezeudu *et al.*, 2021).

### 3.3 Hypothesis Testing

The Chi-square test of independence examining whether social media campaigns have a significant role in raising awareness and changing behaviours yielded  $\chi^2 = 12.079$ ,  $df = 2$ ,  $p = 0.046$  (Table 1), leading to rejection of the null hypothesis at  $\alpha = 0.05$ . This result provides inferential support for the alternative hypothesis: social media campaigns have a significant role in waste management awareness and behaviour change in Nigeria.

The significant  $p$ -value, while close to the 0.05 threshold, suggests a moderate association rather than a strong one consistent with the descriptive findings where mean scores generally exceeded acceptance thresholds but did not reach very high levels ( $M = 2.50$ – $2.84$ ). Several cautions temper interpretation: the cross-sectional design precludes causal inferences; the threshold of 3.00 for categorisation as "yes" is somewhat arbitrary; and the  $p$ -value would not meet more stringent significance criteria ( $p < 0.01$ ). Still, the finding reinforces the descriptive evidence that social media represents a valuable environmental communication tool in Nigeria.

#### 3.3.1 Synthesis and Implications

Three key patterns emerge from the integrated findings. First, attitudinal influence consistently exceeded behavioural engagement, suggesting that while social media effectively shapes environmental attitudes, translating these into sustained behaviour change requires complementary structural interventions (Ajzen, 2002; Mashi *et al.*, 2026). Second, influencers play a distinct role through both social norm diffusion and practical skill development,

addressing both normative and instrumental aspects of behaviour change. Third, the statistically significant Chi-square result supports the overall proposition that social media campaigns play a meaningful role in waste management outcomes.

The findings have several implications for policy and practice. Government agencies should integrate social media campaigns into official waste management programmes, collaborating with platforms and influencers to design targeted campaigns that include direct calls to action (Ada *et al.*, 2026). Campaigns should address the attitude-behaviour gap by providing practical guidance on waste collection points, recycling facilities, and waste sorting techniques. Partnerships with credible influencers should be considered as part of integrated waste management strategies, with messages tailored to Nigerian cultural and social contexts.

From a theoretical perspective, the study provides empirical support for TPB (Ajzen, 2002) in the Nigerian context: social media influences attitudes, perceived norms, and behavioural intentions, but underscores that perceived behavioural control plays a crucial mediating role. The study also supports uses and gratification theory (Palmgreen, 1984) by demonstrating that social media satisfies informational needs related to waste management that may not be adequately fulfilled by traditional media (Nwabueze, 2019).

**Limitations:** The cross-sectional design precludes causal inference; self-reported measures are subject to social desirability bias; findings from Plateau State may not generalise to other Nigerian regions; and the  $p$ -value of 0.046 warrants cautious interpretation.

#### 4. Conclusion

This study demonstrates that social media has a meaningful role in raising awareness and influencing waste disposal attitudes and behaviours among residents and municipal waste management staff in Langtang North and Langtang South LGAs of Plateau State. Social media campaigns were perceived as moderately to strongly effective, particularly in increasing general environmental awareness. However, communication of the consequences of poor waste disposal was less strongly endorsed, indicating a need for more targeted risk communication.

The findings also reveal an attitude-behaviour gap. Social media exerted stronger influence on attitudes than on actual waste management practices. This suggests that positive attitudes may not translate into sustained behaviour where structural constraints such as inadequate waste collection, recycling facilities, and community programmes persist. The significant Chi-square result ( $\chi^2 = 12.079$ ,  $df = 2$ ,  $p = 0.046$ ) provides evidence of an association between social media engagement and waste management awareness and behaviour, although the cross-sectional design limits causal interpretation. Social media influencers were also perceived as useful in encouraging sustainable practices and reinforcing environmental norms, but their influence on personal action remained comparatively limited. The study contributes empirical evidence from an under-researched Nigerian context and demonstrates the value of integrating resident and municipal stakeholder perspectives. The findings also support the applicability of the Theory of Planned Behaviour and Uses and Gratifications Theory to environmental communication in Nigeria.

The study recommends integrating social media into municipal waste management

strategies, with emphasis on actionable information, waste sorting, collection points, and recycling opportunities. However, digital communication should complement rather than replace improvements in waste management infrastructure and institutional capacity. Future research should use longitudinal designs, objective behavioural measures, and comparative studies across Nigerian states to strengthen causal and generalisable evidence.

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