

Environmental Factors Influencing Poor Waste Management amongst Inhabitants in Western Area Rural in Sierra Leone

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Abstract

Background: Waste management in Western Area Rural (WAR), Sierra Leone, is plagued by infrastructural and socioeconomic challenges, leading to environmental and health hazards such as flooding, air pollution, and vector-borne diseases. Despite awareness campaigns, informal methods like open dumping and burning dominate. This study applies the **Theory of Planned Behaviour (TPB)** to analyse how attitudes, subjective norms, and perceived behavioural control influence waste management practices and barriers to proper disposal with potential solutions. **Methods:** A quantitative approach was employed, using stratified random sampling and structured questionnaires to collect data from 333 participants across ten communities in Western Area Rural (WAR). Data were analyzed using descriptive and inferential statistics to examine the relationship between socio-demographic variables and waste management practices. **Results:** While 98.2% of respondents acknowledged the importance of waste management, limited **perceived behavioural control** driven by financial constraints (83.8%), inadequate education (83.2%), and insufficient infrastructure (66.4%) hindered effective waste disposal ultimately linking health and environmental risks, such as flooding and marine pollution from plastic waste. Most respondents (68.8%) lacked access to formal waste services, with disposal occurring primarily via open dumping (62.9%) and burning (17.9%). Subjective norms reinforced informal disposal, as community waste-burning remained an accepted practice. Women were disproportionately affected due to economic constraints and larger household sizes. Despite these challenges, 93.1% were willing to engage in community clean-up efforts, indicating strong pro-environmental attitudes constrained by structural barriers. **Conclusion:** Findings underscore the need for integrated

waste management strategies informed by TPB, targeting attitudes through education, reshaping social norms through community-driven initiatives, and enhancing perceived behavioural control by improving infrastructure and financial accessibility. Addressing gender disparities, strengthening public-private partnerships, and expanding recycling and composting programs can foster sustainable waste management in resource-constrained settings.

Keywords

Waste Management, Theory of Planned Behaviour, Environmental Health, Gender Disparities, Recycling, Community Engagement, Infrastructure, Public-Private Partnerships

1. Introduction

Waste management in Sierra Leone is directly linked to climate change and health consequences [1]. Although the country's contribution to greenhouse gas emissions is deemed negligible, solid waste in urban areas is one of its major emission sources. Moreover, the continual burning of waste is already causing major air pollution, and sometimes reducing visibility in the neighborhood, and causing health risks to the residents [1]. Recent disaster incidents show that when solid wastes are not managed properly, they can pose many environmental and human health risks [2]. For instance, refuse blocking storm drains causing flooding in 2022 affecting 12,903 people (1817 households), with 8 deaths, 79 injured, and 4 missing. A total of 17.7% of the population across the 18 communities lost their assets to flood waters and mud, and over 14% of the affected population had their livelihoods destroyed [3].

Consequently, the location of the landfill sites close to watercourses amplifies flood risks during the rainy season [4]. Those who consume food grown in contaminated areas face risk of health problems [5]. Homes built on reclaimed land of compacted waste (banking) can collapse more easily than those build on solid land using established building techniques [6].

Waste management practices in Sierra Leone are based more on indiscriminate disposal in gutter or in any free "hidden" corner in the neighborhood awaiting construction. The communities practice includes door-to-door collection of solid waste by local private agencies or by individuals with tricycles. It can also be in the form of single person pick up in rice bags or the collection of waste at designated locations using trucks.

Waste management in Western Area Rural (WAR) is very appalling and there is only a recently designated official landfill sites for waste. Huge quantities of waste are disposed of through burning, dumping in bridges or streams, or by simply dropping it anywhere signifying that the generation of wastes far surpasses the official collection and disposal systems. A study in 2018 identified around 500

informal waste accumulation points throughout the city but their management was found to be largely ineffective [7].

Since 2016, a series of initiatives were introduced such as Operation Clean Freetown (2016-2018) [8] with funding by Department for International Development (DFID); “Cleaning Saturday” (every first Saturday in the month) introduced by the central government in 2018 but discontinued in 2020 and the current “Transform Freetown Agenda” which was launched by the Freetown Mayor in 2019. The later proposes several requirements which households and businesses must observe in the containment of waste in both the city and WAR [9].

Access to waste collection and disposal services in rapidly urbanizing WAR is challenging with equipment such as skip trucks and front-end loaders and their spare parts are lacking which means that the current waste management process is being carried out at a very basic level. According to Statistics Sierra Leone, only 11.6% of households in Freetown take their refuse to bins managed by formal providers, whereas the majority (53%) have their waste collected by private individuals. Also, 19.6% of households dump their waste at waterside, and 13.1% burn it [10].

Access to waste collection services is largely affected by road accessibility. The big trucks and tricycles which do the collection are only able to collect waste from homes situated along the main highway which leaves several homes unserved. Houses in mountainous areas mostly practice burning, dumping in a dug hole, and houses closer to wharf or coastal or riverine dump their refuse in to the water way. The ocean is most vulnerable to plastic waste with 12.7 million tonnes reaching the ocean and contributing to the death of over 100,000 marine mammals every year [11]. Plastic waste is a major problem especially in slum’s communities. Water sachets (commonly used as drinking containers in the country), empty bottles and jerry cans litter the streets can clog up drains, causing flooding in disaster-prone areas [12]. Plastic/garbage can be seen everywhere, scattered, or in small or large piles on the street causing serious traffic especially during the rainy season. Waste generation in WAR far outstrips its collection and transport.

Studies have shown that 80% of WAR and Freetown’s waste could be recycled or used as compost [12]. In 2021, UNDP Sierra Leone launched a skills training on waste recycling for 150 youths (120 women and 30 men) in 8 slum communities around Freetown, with the aim to empower them financially and ultimately allow them to afford decent housing out of the slums. With UNDP support, the associations also develop strategies with plastic producing companies for safe disposal. Around 28 women and youth were trained on how to weave plastic waste to produce bags, purses, tiles, and bio charcoal briquettes. This serves as an employment opportunity for youths [12].

With support from Foreign, Commonwealth & Development Office (FCDO) through GOAL, Freetown City Council completed construction the first liquid waste treatment plant in Sierra Leone that utilises innovative Geobag de-watering technology which separates liquid waste from solid waste. As of June 2022, the

plant had processed 1500 truckloads of faecal sludge—15% of Freetown’s liquid waste. Over 11 Kt of sludge has been processed so far, saving a vast amount of liquid waste from contaminating the environment and reducing risk hazards for the communities [13]. Progress are being made to improve solid and liquid waste management by the establishment of commercially viable bio-digesters piloted in Aberdeen [9] that would be able to process 600 kg waste per day and provide energy and compost to nearby customers. Another bio-digester in the Mabella community near Douff Cut market is being planned in collaboration with United Nations Office for Project Services (UNOPS) and Save the Children.

The aim of this research is to assess the environmental factors influencing poor waste management in Western Area Rural.

Research Questions: Understanding waste disposal methods? What are the services available in communities for waste management? Challenges faced by people in managing waste? How can waste management be improved in the communities?

2. Methods

This research employed a quantitative approach to investigate waste management practices in Western Area Rural (WAR), Sierra Leone. Data were collected using structured questionnaires designed to assess attitudes toward waste management (e.g., perceived benefits of proper disposal), subjective norms (e.g., perceived community expectations regarding waste disposal), and perceived behavioural control (e.g., access to waste disposal services and financial constraints). This alignment with the Theory of Planned Behaviour (TPB) [14] enabled a systematic analysis of the psychological and structural factors influencing waste management behaviours in WAR.

A stratified random sampling technique was used to ensure representativeness of participants from diverse socio-economic backgrounds across ten communities in WAR: Jui, Hastings, Yams Farm, Deep Eye Water, Waterloo, Tombo, Regent, Funkia, Adonkia, and Lakka. The sampling method was executed by visiting the areas of interest and establishing a random starting point. A pen spin or coin toss was used to determine the starting end of the street. From the chosen starting point, every alternate house on the left side of the street was sampled until the end of the street. Upon reaching the end, the researcher turned left and continued the same process in subsequent streets. This methodology ensured an unbiased and systematic approach to participant selection [15].

2.1. Sample Size

Using the Lemeshow’s sample size formula ($n = (Z^2 \cdot p \cdot q) / E^2$) and the finite population correction: $n' = (n \cdot N) / (n + N)$ [16], where n represents the required sample size, Z — Z -Score (1.96); p —Standard deviation = 0.5; $q = 1 - p = 0.5$; E —the margin of error = 0.5; and N is the targeted population reflective of the sample size.

Integrating the population size in WAR with regards waste management, which stands at 2503 residents [17]. Therefore, the sample size for this study was 333 across 10 communities in Western Area Rural, thus the number of respondents recruited.

Data collection occur through structured questionnaires administered to selected households, covering demographic information, waste management practices, environmental awareness, attitudes towards waste disposal, and barriers to effective waste management.

2.2. Data Analysis

Descriptive statistics was used to summarize the demographic characteristics of the sample and waste management practices. For statistical significance between respondents and different parameters collected, inferential statistical methods, such as regression analysis, and Chi Square Tests employed to identify factors and determine whether there is a significant association between two categorical variables with waste management practices.

3. Results

A total of 333 respondents participated in the study, with 67% being female ($p < 0.0204$). The majority (55.3%) were aged 25 - 45 years, with females outnumbering males in this age category (active work demography) by nearly 20%. In terms of education, 50.2% attained secondary-level education, followed by 18.3% with tertiary education. However, a significant gender disparity was evident, as 16.8% of females had no formal education compared to only 4.2% of males as shown in **Table 1**.

3.1. Religion and Employment

A higher percentage of respondents are Muslim 60.1% followed by Christians. Regarding employment, entrepreneurship was the leading occupation 33.6%, with 24.6% of females and 9% of males engaged in small businesses. Teaching 22.5% and construction/manual labor 16.5% were other common occupations, with males predominantly represented in construction/manual labor 12.6% compared to females 3.9%.

3.2. Marital Status and Income

A large majority of respondents were married or cohabiting 66.1%, while 25.2% were single and 6.9% were widowed. In addition to the methodology reflecting a significantly more female demography sampled (more women were met at home during the study) compared to males, monthly income levels revealed significant economic disparities. Nearly half (47.7%) earned below the minimum wage (SLe 600), with women disproportionately affected - 36% of females fell into this income range compared to 11.7% of males ($p < 0.0226$). Additionally, fewer females earned above the minimum wage compared to males ($p < 0.0293$).

Table 1. Demographic for waste management.

| Characteristic | | Female n (%) | Male n (%) | Total n (%) |
|-----------------------|--------------------------------|-----------------|---------------|----------------|
| Sex | Female | 223 (67) | (-) | 333 (100) |
| | Male | (-) | 110 (33) | |
| Age | >45 years | 60 (18) | 36 (10.8) | 96 (28.8) |
| | 15 < 25 years | 38 (11.4) | 15 (4.5) | 53 (15.9) |
| | 25 < 45 years | 125 (37.5) | 59 (17.7) | 184 (55.3) |
| Education | No formal education | 56 (16.8) | 14 (4.2) | 70 (21) |
| | Islamic education | 9 (2.7) | 5 (1.5) | 14 (4.2) |
| | Primary education | 18 (5.4) | 3 (0.9) | 21 (6.3) |
| | Secondary education | 104 (31.2) | 63 (18.9) | 167 (50.2) |
| | Tertiary education | 36 (10.8) | 25 (7.5) | 61 (18.3) |
| Religion | Christian | 89 (26.7) | 44 (13.2) | 133 (39.9) |
| | Muslim | 134 (40.2) | 66 (19.8) | 200 (60.1) |
| Employment | Teaching | 40 (12) | 35 (10.5) | 75 (22.5) |
| | Business | 23 (6.9) | 0 (-) | 23 (6.9) |
| | Homemaker | 10 (3) | 6 (1.8) | 16 (4.8) |
| | Employed (full-time/part-time) | 25 (7.5) | 10 (3) | 35 (10.5) |
| | Entrepreneurship | 82 (24.6) | 30 (9) | 112 (33.6) |
| | Construction/Manual Labor | 42 (12.6) | 13 (3.9) | 55 (16.5) |
| | Retired | 0 (-) | 9 (2.7) | 9 (2.7) |
| | Student | 1 (0.3) | 6 (1.8) | 7 (2.1) |
| | Unemployed | 0 (-) | 1 (0.3) | 1 (0.3) |
| Marital Status | Married/Cohabiting | 143 (42.9) | 77 (23.1) | 220 (66.1) |
| | Separated/Divorced | 3 (0.9) | 3 (0.9) | 6 (1.8) |
| | Single | 57 (17.1) | 27 (8.1) | 84 (25.2) |
| | Widowed | 20 (6) | 3 (0.9) | 23 (6.9) |
| Monthly Income | <600 | 120 (36) | 39 (11.7) | 159 (47.7) |
| | 600 - 2500 | 63 (18.9) | 41 (12.3) | 104 (31.2) |
| | 2500 - 5000 | 29 (8.7) | 17 (5.1) | 46 (13.8) |
| | 5000 - 7200 | 4 (1.2) | 10 (3) | 14 (4.2) |
| | >7200 | 7 (2.1) | 3 (0.9) | 10 (3) |

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|----------------|---|------------|-----------|------------|
| Household Size | 1 - 2 | 15 (4.5) | 11 (3.3) | 26 (7.8) |
| | 3 - 5 | 51 (15.3) | 28 (8.4) | 79 (23.7) |
| | ≥5 | 157 (47.1) | 71 (21.3) | 228 (68.5) |
| Shelter Type | Fenced Flat/Apartment building | 36 (10.8) | 23 (6.9) | 59 (17.7) |
| | Mud House/Dirt block | 27 (8.1) | 12 (3.6) | 39 (11.7) |
| | Temporary Shelter (e.g., tents/makeshift) | 4 (1.2) | 3 (0.9) | 7 (2.1) |
| | Unfenced Flat/Apartment building | 129 (38.7) | 54 (16.2) | 183 (55) |
| | Vacant or Abandoned Building | 6 (1.8) | 6 (1.8) | 12 (3.6) |
| | Zinc/'Pan body' | 21 (6.3) | 12 (3.6) | 33 (9.9) |

3.3. Household Size and Shelter Type/Living Conditions

Most households with over five members were common 68.5%, with females more likely to reside in larger households 47.1% than males 21.3%. The majority of respondents lived in unfenced flats/apartment buildings 55%, while 17.7% resided in fenced flats.

3.4. Attitudes (Beliefs about Waste Management)

The study revealed that 98.2% of respondents recognized the importance of proper waste management, indicating overwhelmingly positive attitudes toward the practice. Health promotion and maintaining a clean, aesthetically pleasing environment were cited as the main motivators, with 42.9% of respondents emphasizing the prevention of illness and 12.9% highlighting the importance of a clean environment. Additionally, 97.9% acknowledged personal responsibility for waste management, and 93.1% believed it to be a shared responsibility, reflecting a strong communal attitude toward maintaining cleanliness.

However, despite these positive attitudes, the actual practice of waste management was limited. Only 21.3% of respondents actively participated in waste segregation, and 17.4% engaged in recycling. This gap between attitudes and practice suggests that while awareness and intentions are high, external barriers such as financial constraints and lack of infrastructure prevent individuals from acting on their positive beliefs.

3.5. Subjective Norms (Community Influence on Waste Practices)

The study found that 93.1% of respondents believed waste management to be a shared responsibility, indicating strong social norms favoring communal efforts. However, informal disposal methods such as open dumping (62.9%) and burning (17.9%) remained prevalent, suggesting that these practices are socially accepted within the community. The persistence of these behaviors, despite awareness of their negative impacts, aligns with TPB's assertion that when negative behaviors

are perceived as normative, they are more likely to persist.

Furthermore, the practice of selling plastics for recycling, motivated by financial incentives, highlights how economic pressures and community practices influence waste management behaviors. Collectors purchase plastics at SLe 2 per kilogram and resell them for SLe 3, with the materials transported to Guinea for recycling into products like slippers. This practice, while economically driven, also reflects a community norm of resourcefulness in waste management.

3.6. Perceived Behavioural Control (Structural Barriers to Waste Management)

The study identified significant structural barriers that limit individuals' ability to engage in proper waste management. 68.8% of respondents lacked access to formal waste services, and only 11.4% benefited from regular waste collection services. Financial constraints were a major barrier, with 83.8% of respondents citing affordability as a challenge, despite 84.6% finding the cost of waste collection affordable (typically 1 - 10 SLe per 50 kg bag). Inadequate infrastructure (66.4%) and lack of awareness (83.2%) further hindered access to reliable waste management options.

These barriers led to widespread improper disposal methods, including open dumping on streets (62.9%), in water bodies (31.9%), and burning (17.9%). Uncollected waste often accumulated in open areas such as roadsides, gullies, and markets, causing blocked drains, air pollution, and increased vector-borne diseases like malaria. Coastal residents frequently dumped waste into the sea, while burning was common in poorer neighborhoods, exacerbating pollution and health risks.

Proximity to dumpsites also posed challenges, with 19.5% of respondents living near waste disposal areas, exposing them to heightened environmental and health risks. Despite these challenges, 93.1% of respondents were willing to participate in community cleanup efforts, indicating a strong desire to improve waste management practices if structural barriers were addressed.

3.7. Environmental Impacts and Suggested Solutions

The community recognized several environmental impacts of improper waste disposal, including bad odors (11.7%), flooding (24.6%), harm to biodiversity (7%), gutter blockages (7%), health hazards (20.7%), and vector-borne diseases (24.6%). These findings underscore the urgent need for improved waste management systems.

Proposed solutions included providing bins and dumping sites (35.1%), enforcing waste management laws (26.7%), and promoting community sensitization (11.1%). Respondents also emphasized the need for infrastructure improvements, such as the construction of toilets and wash facilities, the reintroduction of street waste bins, and the establishment of transfer stations for waste sorting. Innovative ideas, such as producing coal from fecal sludge for sustainable energy, were also discussed (See [Table 2](#)).

Table 2. Common variables to waste management.

| Characteristic | | Female n (%) | Male n (%) | Total n (%) |
|--------------------------------------|----------------------------------|-----------------|---------------|----------------|
| Knowledge | Segregate | 44 (13.2) | 30 (9) | 74 (22.2) |
| | Recycle | 42 (12.6) | 37 (11.1) | 79 (23.7) |
| Practice | Segregate | 46 (13.8) | 25 (7.5) | 71 (21.3) |
| | Recycle | 36 (10.8) | 22 (6.6) | 58 (17.4) |
| Access to Formal WM | No | 162 (48.6) | 67 (20.1) | 229 (68.8) |
| | Yes, Irregular | 39 (11.7) | 27 (8.1) | 66 (19.8) |
| | Yes, Regular | 22 (6.6) | 16 (4.8) | 38 (11.4) |
| Frequency of waste collection | Daily | 8 (7.7) | 0 (-) | 8 (7.7) |
| | Monthly | 4 (3.8) | 3 (2.9) | 7 (6.7) |
| | Three-times weekly | 3 (2.9) | 2 (1.9) | 5 (4.8) |
| | Twice weekly | 1 (1) | 0 (-) | 1 (1) |
| | Weekly | 45 (43.3) | 38 (36.5) | 83 (79.8) |
| Cost/5Kg bag | 1 - 10 | 48 (46.2) | 36 (34.6) | 84 (80.8) |
| | 11 - 25 | 9 (8.7) | 4 (3.8) | 13 (12.5) |
| | 26 - 50 | 2 (1.9) | 2 (1.9) | 4 (3.8) |
| | >50 | 2 (1.9) | 1 (1) | 3 (2.9) |
| WC Affordable | Yes | 51 (49) | 37 (35.6) | 88 (84.6) |
| Common challenges with WC | Cost | 5 (4.8) | 5 (4.8) | 10 (9.6) |
| | Deceptive (they leave waste) | 4 (3.8) | 1 (1) | 5 (4.8) |
| | Delayed payment from proprietors | 1 (1) | 0 (-) | 1 (1) |
| | Disrespectful | 1 (1) | 1 (1) | 2 (1.9) |
| | Fuel/Vehicle breakdown | 1 (1) | 1 (1) | 2 (1.9) |
| | Improper waste disposal | 4 (3.8) | 3 (2.9) | 7 (6.7) |
| | Irregular | 18 (17.3) | 8 (7.7) | 26 (25) |
| | No Fuel/Vehicle breakdown | 8 (7.7) | 0 (-) | 8 (7.7) |
| | No PPE/inadequate working tools | 3 (2.9) | 3 (2.9) | 6 (5.8) |
| | Theft | 13 (12.5) | 4 (3.8) | 17 (16.3) |

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| No waste collection, how do you dispose | Burning | - (-) | - (-) | 41 (17.9) |
| | Burying in Pit/Landfilling (including non-biodegradable materials) | - (-) | - (-) | 20 (8.7) |
| | Composting (Organic waste) | - (-) | - (-) | 1 (0.4) |
| | Open dumping-street | - (-) | - (-) | 144 (62.9) |
| | Open dumping-water/stream/gutter | - (-) | - (-) | 73 (31.9) |
| Toilet Availability | Yes | 203 (61) | 108 (32.4) | 311 (93.4) |
| Type | Septic-Pit/Local latrine | 120 (38.6) | 60 (19.3) | 180 (57.9) |
| | Septic-VIP flush | 79 (25.4) | 46 (14.8) | 125 (40.2) |
| | Stream/river | 4 (1.3) | 2 (0.6) | 6 (1.9) |
| WM Satisfaction | Dissatisfied | 42 (12.6) | 19 (5.7) | 61 (18.3) |
| | Neutral | 68 (20.4) | 19 (5.7) | 87 (26.1) |
| | Satisfied | 90 (27) | 50 (15) | 140 (42) |
| | Very dissatisfied | 18 (5.4) | 16 (4.8) | 34 (10.2) |
| | Very satisfied | 4 (1.2) | 6 (1.8) | 10 (3) |
| Live close to dumpsite | Yes | 45 (13.5) | 20 (6) | 65 (19.5) |
| Adequate WC points | Yes | 34 (10.2) | 20 (6) | 54 (16.2) |
| Type of Waste Generated | Bulky items (chairs, beds, refrigerators etc) | - (-) | - (-) | 1 (0.3) |
| | Glass (used bottles, etc.) | - (-) | - (-) | 16 (4.8) |
| | Household hazardous wastes (bleach, toilet detergents, batteries etc.) | - (-) | - (-) | 8 (2.4) |
| | Paper, cardboard, cartoons | - (-) | - (-) | 166 (49.8) |
| | Plastic (drinking water, black plastic, etc.) | - (-) | - (-) | 50 (15) |
| | Wood (Charcoal/Ash) | - (-) | - (-) | 84 (25.2) |
| How Imp. Prop WM for community | Highly important | 218 (65.5) | 109 (32.7) | 327 (98.2) |
| Feel Responsible | Yes | 218 (65.5) | 108 (32.4) | 326 (97.9) |
| Why | Prevent Sickness/promote good health | 85 (25.5) | 58 (17.4) | 143 (42.9) |
| | Clean surrounding (Aesthetic, Smell etc.) | 31 (9.3) | 12 (3.6) | 43 (12.9) |
| | Duty to keep surrounding clean | 74 (22.2) | 22 (6.6) | 96 (28.8) |
| | Prevent Disaster | 4 (1.2) | 0 (-) | 4 (1.2) |
| | Council/Govt action needed | 20 (6) | 13 (3.9) | 33 (9.9) |

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|--|---|------------|------------|------------|
| Common responsibility | Yes | 210 (63.1) | 100 (30) | 310 (93.1) |
| Why | Government and Council involvement | 26 (7.8) | 14 (4.2) | 40 (12) |
| | Keep a clean, healthy and hygienic environment | 33 (9.9) | 19 (5.7) | 52 (15.6) |
| | Lack of awareness/Improper disposal | 3 (0.9) | 0 (-) | 3 (0.9) |
| | Lack of interest/Unity | 7 (2.1) | 7 (2.1) | 14 (4.2) |
| | Our responsibility to keep community clean and safe | 129 (38.7) | 57 (17.1) | 186 (55.9) |
| | Prevent disasters | 20 (6) | 11 (3.3) | 31 (9.3) |
| | Religion stipulates cleanliness | 1 (0.3) | 0 (-) | 1 (0.3) |
| Believe Local authorities are giving adequate | Yes | 101 (30.3) | 43 (12.9) | 144 (43.2) |
| Env Impacts of Imp disposal | Bad odour | 26 (7.8) | 13 (3.9) | 39 (11.7) |
| | Bush fires | 0 (-) | 1 (0.3) | 1 (0.3) |
| | Cholera | 3 (0.9) | 2 (0.6) | 5 (1.5) |
| | Diarrhea | 9 (2.7) | 9 (2.7) | 18 (5.4) |
| | Disaster | 3 (0.9) | 5 (1.5) | 8 (2.4) |
| | Disease outbreak | 5 (1.5) | 4 (1.2) | 9 (2.7) |
| | Erosion | 10 (3) | 6 (1.8) | 16 (4.8) |
| | Filthy environment | 5 (1.5) | 6 (1.8) | 11 (3.3) |
| | Flooding | 52 (15.6) | 30 (9) | 82 (24.6) |
| | Gutter blockages | 14 (4.2) | 8 (2.4) | 22 (6.6) |
| | Harm biodiversity | 16 (4.8) | 6 (1.8) | 22 (6.6) |
| | Malaria | 40 (1.2) | 12 (1.5) | 52 (2.7) |
| | Nuisance | 4 (6.3) | 5 (-) | 9 (6.3) |
| | Pollution | 21 (16.5) | 0 (8.1) | 21 (24.6) |
| | Vectors/vector borne diseases | 55 (-) | 27 (-) | 82 (-) |
| | (blank) | | | |
| Willing to clean | Yes | 207 (62.2) | 103 (30.9) | 310 (93.1) |
| Income vs WM | Yes | 194 (58.3) | 95 (28.5) | 289 (86.8) |

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|-----------------------------|---|------------|-----------|------------|
| Solutions | Community sensitization | 20 (6) | 17 (5.1) | 37 (11.1) |
| | Employ youth for that | 3 (0.9) | 5 (1.5) | 8 (2.4) |
| | Free collection/disposal | 2 (0.6) | 0 (-) | 2 (0.6) |
| | Municipality/Govt. to enforce the laws & Take action | 61 (18.3) | 28 (8.4) | 89 (26.7) |
| | Proper disposal and regular cleaning by community | 30 (9) | 11 (3.3) | 41 (12.3) |
| | Proper/Regular sanitary inspection | 0 (-) | 2 (0.6) | 2 (0.6) |
| | Provide bins, dumping sites pickup services | 78 (23.4) | 39 (11.7) | 117 (35.1) |
| | Recycle/segregate waste | 19 (5.7) | 6 (1.8) | 25 (7.5) |
| Availability & WM behaviour | Yes | 148 (44.4) | 77 (23.1) | 225 (67.6) |
| Challenges | Financial constraints in accessing waste services | 179 (53.8) | 100 (30) | 279 (83.8) |
| | Social or cultural practices that hinder proper waste management | 113 (33.9) | 57 (17.1) | 170 (51.1) |
| | Insufficient waste collection infrastructure | 145 (43.5) | 76 (22.8) | 221 (66.4) |
| | Lack of awareness or education on proper waste disposal | 185 (55.6) | 92 (27.6) | 277 (83.2) |
| | Limited access to formal waste collection services | 157 (47.1) | 75 (22.5) | 232 (69.7) |

4. Summary of Findings in TPB Framework and Insights

The findings align with the Theory of Planned Behaviour (TPB), highlighting the interplay between attitudes, subjective norms, and perceived behavioural control in shaping waste management practices in Western Area Rural (WAR), Sierra Leone.

4.1. Attitudes

While 98.2% of respondents recognized the importance of proper waste management, only a small fraction actively practiced segregation (21.3%) or recycling (17.4%). This gap highlights the influence of external barriers on behavior despite positive attitudes. The community's motivation for health and cleanliness aligns with broader goals of sustainable urban development and environmental health.

4.2. Subjective Norms

The strong belief in communal responsibility (93.1%) reflects positive social norms, but the persistence of open dumping (62.9%) and burning (17.9%) indicates that these practices remain socially accepted, reinforcing poor waste

management behaviors. This underscores the need for community-driven initiatives to reshape social norms and promote better practices.

4.3. Perceived Behavioural Control

Structural barriers such as limited access to formal waste services (68.8%), financial constraints (83.8%), and inadequate infrastructure (66.4%) significantly reduce individuals' ability to engage in proper waste management. These challenges, coupled with irregular waste collection and proximity to dumpsites (19.5%), exacerbate environmental and health risks, including flooding, vector-borne diseases, and air pollution.

The data also underscores significant gender and socioeconomic disparities, particularly in education, employment, and income, which further influence waste management practices. Women, who are disproportionately affected by financial constraints and larger household sizes, face additional barriers to adopting proper waste management practices. Despite these challenges, there is a strong communal sense of responsibility, with 93.1% of respondents willing to participate in cleanup efforts, provided there is better government support and infrastructure.

Strategically, addressing these issues requires a multi-faceted approach that targets all three dimensions of TPB: strengthening positive attitudes through continued education and awareness campaigns, reshaping subjective norms by promoting community-led waste management initiatives and fostering a culture of responsibility, and increasing perceived behavioural control by improving infrastructure, expanding access to affordable waste management services, and addressing financial barriers. By integrating these strategies, policymakers and stakeholders can create an enabling environment for behavioral change, fostering long-term improvements in waste management practices and enhancing the quality of life in WAR.

4.4. Discussion

The findings of this study offer a detailed socio-demographic profile, highlighting gender, age, education, and employment patterns in Western Area Rural (WAR), Sierra Leone. Women represented the majority of respondents (67%), reflecting common gendered participation in community activities. Educational attainment was predominantly at the secondary level (50.2%), but with notable gender disparities—16.8% of women lacked formal education compared to 4.2% of men. These gaps impact awareness and practices related to waste management, consistent with studies linking education to better environmental health outcomes [18]. Most respondents (55.3%) were aged 25 - 45 years, aligning with trends in Sierra Leone and Nigeria, where this economically active age group dominates [19] [20]. The findings underscore persistent gender inequalities in education, driven by socio-economic and cultural barriers, as observed in similar studies across Africa [21].

The study's findings align with the **Theory of Planned Behaviour (TPB)**, demonstrating that while attitudes toward proper waste management are largely positive, actual practice is constrained by social and structural barriers. **Subjective norms** reinforce informal disposal methods, as waste burning and open dumping remain widely accepted within communities. Furthermore, limited access to formal waste management services and financial barriers reduce **perceived behavioural control**, limiting the ability of individuals to adopt better practices despite their awareness. These findings suggest that effective waste management interventions in WAR must go beyond awareness campaigns and address social norms and systemic barriers to create an enabling environment for behavioural change.

The study highlights significant environmental impacts from improper waste disposal, with flooding, health hazards, and vector-borne diseases identified as major concerns. Despite these challenges, **93.1%** of respondents were willing to participate in cleanup efforts, and **86.8%** acknowledged income levels as a significant factor influencing waste management practices. Entrepreneurship (**33.6%**), particularly among women (**24.6%**), dominates occupations, reflecting limited formal employment opportunities. Widespread financial constraints are evident, with nearly half of respondents earning below **SLe 600** monthly, of which a greater proportion are women (**11.7%**), echoing Sierra Leone's national waste management strategy, where economic barriers hinder access to proper waste services. This mirrors findings in sub-Saharan Africa, where large household sizes (**68.5%** with over five members) and extended family structures are common [22] [23].

Awareness of proper waste management is high (**98.2%**), yet practical knowledge remains low, with only **22.2%** aware of segregation and **23.7%** of recycling, and even fewer actively practicing them. This gap is consistent with Sierra Leone's Integrated National Waste Management Strategy and similar findings in Ethiopia, where financial, infrastructural, and cultural barriers hinder effective practices [24] [25]. Waste management services receive mixed feedback. While some are satisfied, a significant proportion express dissatisfaction due to cost, unreliable providers, and irregular services. Only **26.4%** find waste collection affordable. The reliance on open dumping (**62.9%**) and burning (**17.9%**), particularly near dumpsites (**19.5%**), highlights substantial environmental and health risks, including flooding and disease outbreaks. These patterns mirror trends in rural African communities, where formal services are limited [26] [27].

Improved waste management infrastructure, increased education, and community engagement are critical to addressing these issues. Women, who face significant barriers such as financial and infrastructural constraints, bear a disproportionate burden of waste management responsibilities. Bridging the gap between awareness and effective practice requires targeted interventions, emphasizing gender-inclusive approaches, better access to affordable services, and stricter enforcement of waste policies. These measures align with the TPB framework, which emphasizes the need to address **attitudes**, **subjective norms**, and **perceived behavioural control** to foster sustainable behavioral change.

Overall, the study underscores the need for integrated solutions combining community participation, infrastructural improvements, and sustainable waste management practices to mitigate risks and enhance urban environmental health. By addressing the systemic barriers identified in this study, policymakers and stakeholders can create an enabling environment for long-term improvements in waste management practices in WAR.

5. Conclusion

The result from this study highlights significant disparities in waste management practices, driven by socioeconomic, gender, and infrastructural constraints. Financial limitations and limited formal waste services exacerbate improper disposal practices, posing severe environmental and public health risks. Despite widespread awareness of proper waste management, practical adoption remains low due to systemic barriers. Addressing these issues requires integrated approaches, including affordable waste services, enhanced public education, and stricter enforcement of waste management laws. Gender-inclusive strategies and community participation are vital to bridging the gap between awareness and effective waste management.

6. Recommendations

The suggested solutions, including the provision of bins and dumping sites and enforcement of waste management laws, underscore the community's call for structural and regulatory interventions. These recommendations align with best practices identified in Ghana and Ethiopia, where targeted investments in infrastructure and community sensitization have shown significant improvements in waste management outcomes [28] [29].

Infrastructure Development: Invest in formal waste collection systems, transfer stations, and recycling facilities to reduce reliance on open dumping and burning. Ensure these services are accessible to all households, including those in remote and low-income areas [30].

Community Education and Sensitization: Implement awareness campaigns to promote waste segregation, recycling, and hygienic disposal practices, aligning with local cultural contexts and needs.

Policy Enforcement and Monitoring: Strengthen the enforcement of existing waste management bylaws, reintroduce sanitary inspectors, and impose fines for non-compliance to improve accountability and community adherence.

Gender-Inclusive Strategies: Design interventions addressing the specific challenges faced by women, such as financial constraints and lack of resources, to enhance their participation in waste management initiatives.

Public-Private Partnerships: Collaborate with private firms to improve efficiency, expand coverage, and introduce innovative waste management solutions, such as bioenergy from waste.

Community Engagement: Encourage organized cleanup days and provide

resources like bins and tools to support community-driven efforts in maintaining sanitation and cleanliness.

Adopting these measures will address the systemic barriers to effective waste management, fostering a healthier environment and improving the quality of life in WAR.

Availability of Data and Materials

Throughout the research process, stringent data security measures are upheld, including the secure storage of audio recordings and any associated notes. All response and analysis are available (<https://drive.google.com/drive/folders/1wk52-RDfbhCagWcNyzGc6iWS-dLsuTB1?usp=sharing>). The Centre for Development and Food Safety (SL) Limited, archives all responses on site, which will not be shared to maintain confidentiality.

Ethics Approval and Consent to Participate

Ethical clearance was obtained from the Sierra Leone Ethics and Scientific Review Committee at the Ministry of Health and Sanitation. The optional nature of the study (that participants could refuse to answer questions if they were uncomfortable, that from the study at any time in which case none of their data would be used) was explained verbally. All the respondents granted informed written consent to participate and all data was anonymized. Confidentiality was assured.

Authors' Contributions

HT designed and conducted the study. HT, AKK, students (JVSK, SSJ, IM, FSC, and EOHJ) participated in the fieldwork and compiled the data. AKK analysed and interpreted the data. HT and PJK drafted, reviewed and revised the manuscript. All authors have read and approved the final manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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