Assessment of the Nature of E-Waste Generated by Hotels in Naivasha Sub-County, Kenya

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ABSTRACT

Electrical and electronic waste (e-waste) presents growing environmental and public health challenges, especially in developing countries with inadequate recycling infrastructure and weak institutional capacity. This study classified e-waste generated by classified hotels in Naivasha Sub-County, Kenya, and examined its relationship with effective e-waste management. An explanatory sequential mixed-methods design was adopted, involving 69 stratified randomly selected hotels and five purposively selected key informants. Quantitative data were analyzed using descriptive statistics, Pearson's correlation, hierarchical multiple regression and ANOVA, while qualitative data were subjected to thematic analysis and the two datasets integrated through triangulation. The study identified 53 of the 54 e-waste categories recognized under the United Nations University (UNU) global framework. The most prevalent items were: bulbs, switches and sockets (97.1%), LED lamps and electric kettles (92.8%), electric irons (87.0%), televisions (85.5%), toasters (82.6%), batteries and straight tube fluorescent lamps (78.3%). Moderately generated categories included: calculators (75.4%), microwaves (73.9%), monitors (71.0%), routers (69.6%), office printers (66.7%) and refrigerators (52.2%) while the relatively uncommon categories were: mobile phones (14.5%), digital cameras (11.6%), tablets and electrical toys (7.2%), heat pumps (4.3%), GPS devices (1.4%), medical electronic devices (1.4%) and electronic notebooks (1.4%). No hotel reported disposing of dehumidifiers. The nature of e-waste had a moderate positive relationship with effective management ($r = .453$, $p < .01$) and significantly predicted management effectiveness in Model 1 ($\beta = .340$, $p = .002$). However, its effect became insignificant after controlling for institutional factors ($\beta = .076$, $p = .421$). Regulatory frameworks emerged as the strongest positive predictor ($\beta = .561$, $p < .001$), with the final model explaining 69.6% of the variance. The study highlights the importance of strengthening regulatory enforcement, recycling infrastructure, access to licensed recyclers, organizational capacity and economic incentives to advance sustainable e-waste management and circular economy initiatives in the hospitality sector.

Key Words: E-Waste; E-Waste Generation; E-Waste Management; Barriers; Naivasha Sub-County.

INTRODUCTION

Electrical and electronic waste (e-waste) is among the fastest-growing solid waste streams globally, driven by rapid technological advancement, increasing consumption of electrical and electronic equipment (EEE), shorter product lifecycles, and accelerated technological obsolescence (Parajuly et al., 2019; Forti et al., 2020). E-waste comprises discarded electrical and electronic equipment containing circuitry or battery-powered components that have reached the end of their useful life. Although it contains valuable recoverable materials such as gold, silver, copper, aluminium, nickel, palladium and zinc (Roy 2023), its improper disposal releases hazardous substances such as lead, cadmium, mercury, and persistent organic pollutants, posing significant environmental and public health risks (Dias et al., 2022).

Global e-waste generation continues to increase at an estimated annual rate of 3–5% and is projected to exceed 120 million metric tonnes by 2050 (Liu et al., 2023). However, formal collection and recycling systems remain inadequate in many developing countries, where e-waste is commonly managed through open dumping alongside other wastes, uncontrolled burning, and informal recycling, leading to environmental contamination

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and inefficient resource recovery (Maes & Preston-Whyte, 2022). Consequently, strengthening e-waste management has become central to sustainable development and circular economy initiatives aimed at minimizing pollution while promoting resource efficiency (Murthy & Ramakrishna, 2022). The hospitality industry is an important yet understudied contributor to this challenge. Hotels rely extensively on electrical and electronic equipment for accommodation, food production, communication, security, lighting, climate control, and digital service delivery.

Continuous technological upgrades, smart building systems, energy-efficient technologies, and periodic renovations have increased both the volume and diversity of hotel-generated e-waste (Reijnders, 2024; Vishwakarma et al., 2023). Although approximately 58.5% of hotel waste is biodegradable and 25.8% recyclable, hotels also generate hazardous e-waste, including batteries, computers, cooling equipment, solar panels, lighting equipment, and mobile devices, which require specialized handling and disposal (Singh & Kumar, 2025; Sobti *et al.,* 2024). However, because e-waste constitutes a relatively small fraction of total hotel waste, it is frequently subsumed within general municipal or residential waste statistics, resulting in limited sector-specific indicators, inadequate monitoring, and lower recycling rates within the hospitality industry (Diaz-Farina *et al.,* 2020). Despite its relatively smaller volume, e-waste presents disproportionately greater environmental and health risks because of its hazardous constituents and the potential release of toxic substances when improperly handled (Kazancoglu *et al.,* 2022; Zhang *et al.,* 2022).

The nature of e-waste generated by hotels has increasingly attracted scholarly attention due to the sector's rapid adoption of information and communication technologies, energy-efficient systems, and guest-oriented electronic amenities. Hotel e-waste comprises a diverse range of electrical and electronic equipment (EEE) originating from guest rooms, kitchens, administrative offices, security systems, communication infrastructure, and recreational facilities. According to Orfanou *et al.* (2025), the type and quantity of waste generated by hotels depends on hotel size, its classification, service area, and the effectiveness of existing waste management systems. Reijnders (2024), identified computers, laptops, routers, televisions, printers, ICT equipment, kitchen appliances, electronic locks, security systems, cartridges, and batteries, among others as the predominant e-waste items generated by hotels.

Kenya generates approximately 53,000 metric tonnes of e-waste annually, increasing at an estimated rate of 8–12%, yet only about 5% enters formal recycling systems (Mungai & Maina, 2025), with hotels contributing substantially to this waste stream through the continual replacement of EEE and other electronic infrastructure required for quality service delivery (Karemeri et al., 2024). However, existing studies in Kenya have primarily focused on general environmental management in hotels, including solid waste, wastewater, procurement, and food waste management (Osiako & Kummitha, 2020; Chiro et al., 2020; Odeny et al., 2020; Ndung'u & Magaju, 2024), while e-waste research has largely been confined to households, schools and universities, and healthcare facilities (Kamweru, 2019; Kiplagat et al., 2017; Getonto et al., 2021). This leaves the hospitality sector largely unexplored despite evidence that hotels continue to generate a growing amount of varied e-waste types and employ inappropriate waste management practices (Agesa *et al.,* 2022).

Naivasha Sub-County, one of Kenya's leading tourism destinations, has experienced rapid expansion of hotels and tourism infrastructure, increasing the use of electronic equipment and the potential generation of e-waste. Understanding the nature of e-waste generated is important for promoting sustainable tourism and supporting the transition towards a circular economy through increased reuse, repair, refurbishment, and material recovery. Accordingly, this study classified the nature of e-waste generated by classified hotels in Naivasha Sub-County, Kenya. The findings provide sector-specific empirical evidence to guide policy and regulatory interventions and promote environmentally sound and sustainable e-waste management within the hospitality industry.

METHODOLOGY

Study Area

The study was conducted in Naivasha Sub-county, Nakuru County, Kenya. The County, one of the 47 Counties in Kenya, bordering 8 other counties: Laikipia to the North-East, Kericho to the West, Narok to the South-West, Kajiado and Kiambu to the South-East, Baringo to the North, Nyandarua to the East and Bomet to the West,

covers an area of 7,504Km^2. It is divided into 11 Sub-counties and 55 electoral wards, located between Longitudes 35.41º East or 35º 24' 36" East and 36.6º East or 36º 36' 0" East and Latitude 0.23º North or 0º 13' 48" North and 1.16º South or 1º 9`36" South. Naivasha Sub-county, covering an area of 1,685Km^2, is divided into 8 electoral wards: Biashara, Maiella, Mai Mahiu, Viwandani, Hells Gate, Olkaria, Naivasha East and Lake View Wards (Mekolela et al., 2025). The Sub-county, bordering Gilgil Sub-county to the west, Narok County to the South-West, Kajiado, and Kiambu Counties to the South-East, and Nyandarua County to the East, with a population of 355,383 (KNBS, 2019), is the biggest in Nakuru County, both by size and population.

Economic Drivers of the Study area

The export of horticulture, tourism and hospitality, energy, and fisheries sectors are the leading economic drivers of the Naivasha Sub-county economy in that order, earning and employing significantly more than their national share, within Naivasha Sub-county (Mengich et al., 2025). The Sub-county had 102 classified hotels as of the year 2024, defined by accommodation, food and beverage services (TRA, 2024). The key socio-economic activities of Naivasha Sub-county include; Agriculture and Horticulture, Tourism, Livestock Farming, Trade and Commerce, and Real Estate development (CGoN, 2023). The upper reaches of the Sub-county are characterized by smallholder farming involving the cultivation of maize, beans, and vegetables, while the mid reaches comprises of mixed farming, with large scale livestock ranches, and farming enterprises, culminating to the lowlands dominated by horticulture farming, especially around Lake Naivasha to a radius of approximately 50Km^2 (Onyango *et al.,* 2023).

Population of the Study

The population of the study was all the classified hotels within Naivasha Sub-county, offering at least accommodation, food and beverage services. An exhaustive list of 102 hotels and their bed capacities was obtained from the Tourism Regulatory Authority (TRA), comprising of 34 hotels along Moi South Lake Road, 47 within Naivasha Town, 6 at Kinamba area, 4 each along North Lake Road, Nairobi – Nakuru Highway, and at the Police Line area, and 1 each at Karai, South Lake Junction, and Karagita areas (TRA, 2024). Upon scrutiny, 16 facilities were excluded because they were either temporary camping sites, seasonal utilities like Airbnb, had been double-listed, or were not operational at the time of the study due to various reasons, leaving a total of 86 hotels making up the target population.

Research design

The study adopted an explanatory sequential mixed-methods design in which quantitative data were collected and analyzed first, followed by qualitative data to explain, contextualize, and enrich the quantitative findings. The design enabled the integration of numerical trends with participants' perspectives, providing a more comprehensive understanding of the nature of e-waste generated by hotels (Leavy, 2022). Quantitative methods established the magnitude and relationships among the study variables, while qualitative interviews explored the underlying institutional, technical, economic, and behavioral factors shaping these relationships. The findings from both phases were integrated through triangulation to enhance the validity, depth, and interpretation of the results (Manzoor, 2020).

Sample size determination

The study adopted proportionate stratified random sampling, for sample size determination. The 86 classified hotels were stratified into five categories based on 100% bed capacity as provided by NEMA in the Eleventh Schedule of the Environmental Management and Coordination (Water Quality) Regulations, 2024 (NEMA, 2024). These categories are; Category 1 (≤ 25 Persons Bed Capacity), Category 2 (≥ 26 ≤ 50 Persons Bed Capacity), Category 3 (≥ 51 ≤ 75 Persons Bed Capacity), Category 4 (≥ 76 ≤ 100 Persons Bed Capacity), and Category 5 (≥ 101 Persons Bed Capacity). The choice of bed capacity for stratification was based on the fact that it is a reliable indicator for hotel size, operational complexity, resource consumption, and the volume of electrical and electronic equipment used, hence the potential e-waste generation. This stratification was targeted towards ensuring that the sample adequately captures the diversity of hotels, and improves the

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representativeness and precision of the study findings. For the stratified sample size determination, the researcher applied the Cochran's formula (finite population version).

$n_0 = \frac{z^2 p\,(1-p)}{e^2}$ where;

Z = Z-Score (1.96 for 95% confidence level),

p = Estimated proportion of the population with the characteristic (assumed 0.5 for maximum variability),

e = Margin of error (0.05 for ±5% error),

N = Total number of hotels in the population.

$n_0 = \frac{1.96^2 x 0.5 x 0.5}{0.5^2} = \frac{3.8416 x 0.25}{0.0025} = \frac{0.9604}{0.0025} = 384.16$

The value obtained was then applied for the finite population N, which in this case was 86, to get the final sample size.

$$n = \frac{n0}{[1+\left[\frac{(n0-1)}{N}\right]}$$

$$n = \frac{384.16}{[1+\left[\frac{(384.16-1)}{86}\right]]} = \frac{384.16}{[1+\frac{383.16}{86}]} = \frac{384.16}{(1+4.455)} = \frac{384.16}{5.455} = 70.4$$ **(Approx. 70)**

Sampling technique

After the sample size determination, proportionate allocation was applied across the five strata using simple random sampling within each stratum to select the participating hotels, using the formula, nh = (Nh/N) × n,

Where;

nh = Sample size for stratum h,

Nh = Population size of stratum h,

N = Total population, and,

n = Total Sample Size calculated above.

The results obtained were as shown in Table 1;

Table 1: Table of Stratified Sample Size

Hotel Category	**Hotels in Population**	**Sample size (nh)**
1 (≤ 25 Persons Bed Capacity)	17	14
2 (≥ 26 ≤ 50 Persons Bed Capacity)	26	21
3 (≥ 51 ≤ 75 Persons Bed Capacity)	12	10
4 (≥ 76 ≤ 100 Persons Bed Capacity)	16	13
5 (≥ 101 Persons Bed Capacity)	15	12
Total	**86**	**70**

The calculation and distribution of the sample across hotel categories yielded a target sample size of approximately **70 hotels**. However, during the sampling and participation process, **69 hotels were successfully selected and included in the final study sample**, representing **80.2% of the total population of 86 classified hotels**. The achieved sample was therefore only one hotel below the calculated target and retained approximately **98.6% of the statistically calculated sample requirement**. Given the small difference between the calculated target and the achieved sample, the final sample of 69 hotels was considered adequate for the study. The purposively selected sample of key informants was; One (1) National Environment Management Authority (NEMA) Officer, One (1) County Government Environment Officer, One (1) Public Health Officer, One (1) Information and Communication Technology (ICT) Officer, and One (1) Tourism Regulatory Authority (TRA) Officer. The quantitative analysis was based on the 69 hotel respondents while the qualitative analysis involved responses from the 5 key informants.

Operationalization of Variables

Table 2 presents the variables as operationalized, the measuring indicators and measurement unit.

Table 2: Variables, Measuring Indicators and Measurement Scale/Unit

Variable	Measuring Indicators	Measurement Scale/Unit
Nature of e-waste generated by hotels (Independent Variable)	Types of electrical and electronic equipment disposed; sources of e-waste generation; areas of e-waste generation within the hotel	Frequency (Number and Percentage of responses)
Effective e-waste management (Dependent Variable)	Presence of a hotel e-waste management policy; e-waste segregation; use of licensed e-waste recyclers; participation in take-back programmes	Frequency (Number and Percentage of responses)
Regulatory frameworks and hotel sustainability practices (Intervening Variables)	Awareness of Extended Producer Responsibility (EPR) Regulations; establishment of e-waste collection, recycling, and disposal systems; environmentally friendly procurement; e-waste inventory and tracking; guest engagement; reuse and refurbishment of electrical and electronic equipment	Frequency (Number and Percentage of responses)

Data collection procedure

Data collection followed a structured and technology-assisted procedure to ensure accuracy, completeness, and consistency. The sampled hotels were geo-referenced and mapped using **ArcGIS**, enabling verification of their spatial distribution across the study area and facilitating GPS-assisted navigation during fieldwork. This approach minimized location errors and ensured that data were collected exclusively from the selected hotels. Quantitative data were collected using a structured questionnaire developed and deployed through **KoBo Toolbox**, a secure mobile data collection platform that supports real-time data capture, automated validation, and encrypted data storage. The digital platform minimized data entry errors, improved response completeness, and enhanced the overall quality and integrity of the dataset. Questionnaires were administered to management-level staff in the sampled hotels by the principal researcher, with assistance from a trained research assistant where necessary. Prior to data collection, respondents were informed of the study objectives, procedures, and their rights as participants, after which written informed consent was obtained. Qualitative data were collected through semi-structured interviews with purposively selected key informants representing relevant environmental, public health, tourism, and regulatory institutions. Interview appointments were scheduled in advance, and all interviews were conducted by the principal researcher following informed consent. The quantitative and qualitative data collection phases were implemented sequentially in accordance with the explanatory sequential mixed-methods design.

Data Analysis and Presentation

Data analysis followed a rigorous mixed-methods approach consistent with explanatory sequential design. Quantitative data were analyzed using IBM SPSS Statistics. The analysis began with data cleaning, coding, and screening for completeness, outliers, and consistency. Descriptive statistics (frequencies and percentages) were used to summarize the prevalence of various types of e-waste as categorized by the United Nations University (UNU) classification developed by Forti *et al.* (2018). Inferential analysis was conducted in stages, with Pearson's correlation analysis being used to determine the direction and strength of relationships between the nature of e-waste generated and its effective management. Hierarchical multiple regression analysis was then employed to determine the predictive power of the independent variables, entered in blocks to assess incremental explanatory contribution. The first model included operational variables (nature of e-waste generated, current management practices and barriers to effective e-waste management), while the second model introduced institutional and policy-related variables (regulatory frameworks and hotel sustainability policies). Model fit was evaluated using $\mathbf{R^2}$, adjusted $\mathbf{R^2}$, F-statistics, and analysis of variance (ANOVA), with statistical significance set at $p < 0.05$.

Qualitative data from key informant interviews were transcribed verbatim, coded inductively, and analyzed thematically. Emerging themes were categorized into institutional, technical, economic, and behavioral dimensions. Triangulation was applied to integrate quantitative and qualitative findings, enhancing validity and providing a more comprehensive explanation of observed statistical patterns. Data were presented using a structured combination of tables, figures, and narrative descriptions. Quantitative findings were organized into three main categories: descriptive statistics on the nature of e-waste generated; correlation analysis results, and hierarchical regression outputs. Tables were used to present frequencies and percentages of identified types of e-waste, while regression coefficients, significance levels, and model summaries were systematically reported to support inferential interpretation.

Sample, Response Rate and Reliability of the Research Instrument

A total of 102 classified hotels in Naivasha Sub-county, as of 2024, were identified from records held by the Tourism Regulatory Authority, together with their bed capacities and specific locations. Upon scrutiny, 16 facilities were excluded because they were temporary camping sites, seasonal utilities such as Airbnb listings, double-listed, or not operational at the time of the study, leaving a target population of 86 hotels. Using Cochran's formula (finite population version) for stratified sample size determination, the target sample size was set at 70 respondents at a 5% margin of error and 95% confidence level. A total of 69 management-level hotel staff and 5 key informants provided valid entries for quantitative and qualitative analysis respectively, representing an effective response rate of 98.6% for valid questionnaires, as summarized in Table 2.

Table 3: Response Rate of Administered Questionnaires

Administered questionnaires	Questionnaires filled and valid	Response rate (%)
70	69	98.6

Data were collected through face-to-face interviews using a structured questionnaire and a key informant interview guide, supported by a trained research assistant who guided respondents where necessary. Response rates above 80% are considered exceptional and required for publication purposes (Taherdoost & Madanchian, 2024). The 98.6% rate achieved in this study was therefore satisfactory and robust. Prior to analysis, diagnostic checks were performed to confirm the completeness, consistency, and suitability of the datasets for statistical processing. The data were screened for missing values, entry errors, and outliers, ensuring that only high-quality responses were subjected to descriptive and inferential analysis in SPSS (Izah et al., 2024). To further guarantee accuracy and reliability, the questionnaire was pretested and refined, with internal consistency confirmed by a Cronbach's Alpha coefficient, with the help of the IBM Statistical Package for Social Sciences (SPSS) on the questionnaire, through a pilot study, involving 10 hotel managers and 3 key informants. The Cronbach's alpha was computed using the formula: $\alpha = \frac{k}{k-1}\left(1 - \frac{\sum \sigma_i^2}{\sigma_T^2}\right)$, where: k is the number of items, $\sum \sigma_i^2$ is the sum of

the item variances, and σ_T^2 is the variance of the total scores. A value of 0.7 – 0.9, if obtained indicates acceptable internal consistency hence reliability of the instrument being tested. An alpha coefficient of 0.76 was achieved for this study, indicating acceptable internal consistency hence reliability of the questionnaire.

Descriptive Analysis of the Nature of E-waste Generated by Hotels

The study sought to classify the nature of e-waste generated by hotels in Naivasha Sub-county. To obtain this information, the study investigated whether the respondents were aware of what constituted e-waste, whether the hotel uses electric/electronic equipment, the specific types of electrical and electronic devices that the hotel had disposed of over the last one year, the sources of e-waste in the hotel, areas of e-waste generation within the hotel, the frequency of generating e-waste, and estimated amounts generated per month. The results in Table 3 indicate that a majority of hotel respondents were aware of what constitutes e-waste (84.1%), while only 15.9% were not aware. Similarly, nearly all hotels (98.6%) reported using electrical and electronic equipment, with only one hotel (1.4%) indicating otherwise. These findings demonstrate that electrical and electronic equipment is almost universally used within hotels, making e-waste generation inevitable across the hospitality sector.

Table 4: E-Waste Generation in Hotels

Variable	**Category**	**Frequency (n)**	**Percentage (%)**
E-waste awareness	No	11	15.9
	Yes	58	84.1
Use of EEE	No	1	1.40%
	Yes	68	98.60%

Pearson's Correlation Analysis

The correlation analysis was conducted to examine the strength and direction of the linear relationships between the study variables. The analysis was considered appropriate for determining whether changes in one variable were associated with corresponding changes in another variable, without implying a causal relationship. The results obtained are presented in Table 4.

Table 4: Pearson's Correlation Matrix for IV, DV & IV {Correlation is significant at 0.01 level (2-tailed)}**

Correlations							
		Nature of e-waste generated	Current e-waste management practices	Applicable regulatory frameworks	Barriers to effective e-waste management	Effective e-waste management	Hotels' sustainability policies
Nature of e-waste generated	Pearson correlation	---					
	N	69					
Current e-waste Management Practices	Pearson correlation	.464**					
	Sig. (2-tailed)	0					
	N	69	69				
	Pearson correlation	.458**	.581**				

Applicable Regulatory Frameworks	Sig. (2-tailed)	0	0				
	N	69	69	69			
Barriers to effective e-waste management	Pearson correlation	-0.184	-.638**	-.576**			
	Sig. (2-tailed)	0.13	0	0			
	N	69	69	69	69		
Effective e-waste management	Pearson correlation	.453**	.520**	.800**	-.589**		
	Sig. (2-tailed)	0	0	0	0		
	N	69	69	69	69	69	
Hotels sustainability policies	Pearson correlation	.578**	.311**	.547**	-0.222	.558**	
	Sig. (2-tailed)	0	0.009	0	0.067	0	
	N	69	69	69	69	69	69

Hierarchical Multiple Regression Analysis

Hierarchical multiple regression analysis was performed to examine the extent to which the study variables predicted effective e-waste management among classified hotels. Variables were entered sequentially to evaluate their independent and incremental contributions to the explained variance in the dependent variable. In Model 1, the predictor variables comprised the operational variables (nature of e-waste generated, current e-waste management practices, and barriers to effective e-waste management) while Model 2 incorporated the institutional and policy-related variables (applicable regulatory frameworks and hotels' sustainability policies) to determine whether they significantly improved the explanatory power of the model beyond that of the primary predictors.

Regression Model Summary

The regression model summaries are presented in Table 5. Model 1 was statistically significant, $\mathbf{F}$ (3, 65) = 19.22, $p < 0.001$, explaining 47.0% of the variance in effective e-waste management ($\mathbf{R^2}$ = 0.470; Adjusted $\mathbf{R^2}$ = 0.452). This indicates that the combined effects of the nature of e-waste generated, current management practices, and barriers to effective e-waste management provided a moderate level of explanatory power. The inclusion of applicable regulatory frameworks and hotels' sustainability policies in Model 2 significantly improved the model's explanatory capacity. The final model was statistically significant, $\mathbf{F}$ (5, 63) = 28.84, $p <$ 0.001, and accounted for 69.6% of the variance in effective e-waste management ($\mathbf{R^2}$ = 0.696; Adjusted $\mathbf{R^2}$ = 0.672). Compared with Model 1, the increase in explained variance demonstrates that regulatory and organizational factors contribute substantially to understanding effective e-waste management beyond the influence of operational factors alone. These findings underscore the importance of incorporating institutional and policy-related variables, beyond the nature of e-waste generated, when modelling e-waste management performance in the hospitality sector.

Table 5: Summary of Multiple Regression Analysis Models

Model	R	R square	Adjusted R square	Std. Error of the Estimate
1	.686[a]	0.47	0.446	0.20462
2	.834[b]	0.696	0.672	0.15742

a. Predictors: (Constant), Barriers to effective e-waste management, Nature of e-waste generated, current e-waste management practices.

b. Predictors: (Constant), Barriers to effective e-waste management, Nature of e-waste generated, current e-waste management practices, hotels' sustainability policies, applicable regulatory frameworks.

Analysis of Variance (ANOVA)

The ANOVA results confirm that both regression models provide statistically significant prediction of the dependent variable. Model 1 was significant, $F(3, 65) = 19.215$, $p < 0.001$, indicating that the set of three independent variables collectively predicts effective e-waste management. Model 2 was highly significant, $F(5, 63) = 28.843$, $p < 0.001$, confirming that the addition of the two intervening variables strengthens the overall prediction. In both models, at least one predictor has a statistically significant effect on the outcome variable, as shown in Table 6.

Table 6: Model-Comparison ANOVA Analysis

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.414	3	0.805	19.215	.000[a]
	Residual	2.722	65	0.042		
	Total	5.135	68			
2	Regression	3.574	5	0.715	28.843	.000[b]
	Residual	1.561	63	0.025		
	Total	5.135	68			

a. Dependent Variable: Effective E-Waste Management,

b. Predictors: (Constant): Barriers to Effective E-Waste Management, Nature of E-Waste Generated, & Current E-Waste Management Practices.

c. Predictors: (Constant): Barriers to Effective E-Waste Management, Nature of E-Waste Generated, Current E-Waste Management Practices, Hotels' Sustainability Policies, And Applicable Regulatory Frameworks.

Regression Coefficients Analysis

The regression coefficients were examined to determine the direction, magnitude, and statistical significance of the influence of each predictor variable on effective e-waste management in hotels, with two regression models being estimated. Model 1 assessed the effects of the three independent variables, while Model 2 examined the influence of the independent variables together with the intervening variables. The standardized beta coefficients (β) were used to compare the relative importance of each predictor because they are measured on the same standardized scale. The results of this analysis are presented in Table 7.

Table 7: Coefficients Analysis

Coefficients[a]								
		Unstandardized Coefficients		Standardized Coefficients			95% Confidence Interval for B	
		B	Std. Error	Beta (β)	t	Sig.	Lower Bound	Upper Bound
Mode								
1	(Constant)	0.872	0.242		3.607	0.001	0.389	1.355

	Nature of e-waste generated	0.564	0.171	0.340	3.292	0.002	0.222	0.906
	Current e-waste management practices	0.072	0.212	0.045	0.342	0.733	-0.350	0.495
	Barriers to effective e-waste management	-0.959	0.229	-0.497	-4.183	0.000	-1.417	-0.501
2	(Constant)	0.509	0.193		2.628	0.011	0.122	0.895
	Nature of e-waste generated	0.127	0.156	0.076	0.811	0.421	-0.185	0.438
	Current e-waste management practices	-0.082	0.167	-0.051	-0.492	0.624	-0.415	0.251
	Barriers to effective e-waste management	-0.476	0.192	-0.247	-2.487	0.016	-0.859	-0.094
	Applicable Regulatory Frameworks	0.573	0.107	0.561	5.378	0.000	0.360	0.786
	Hotels' sustainability policies	0.161	0.089	0.168	1.800	0.077	-0.018	0.339

a. Dependent Variable: effective e-waste management

RESULTS

Descriptive Analysis Results of the Nature of E-waste Generated by Hotels

The findings presented in Table 8 show that hotels generated an extensive range of electrical and electronic waste. The most commonly disposed items included: sockets, switches, and bulbs (97.1%), electric kettles, and LED lamps (92.8%), electric irons (87.0%), televisions (85.5%), toasters (82.6%), batteries and straight tube fluorescent lamps (78.3%). Moderately generated categories included: calculators (75.4%), microwaves (73.9%), monitors (71.0%), routers (69.6%), office printers (66.7%) and refrigerators (52.2%) while the relatively uncommon categories were: mobile phones (14.5%), digital cameras (11.6%), tablets and electrical toys (7.2%), heat pumps (4.3%), GPS devices (1.4%), medical electronic devices (1.4%) and electronic notebooks (1.4%). No hotel reported disposing of dehumidifiers. Overally, the findings indicate that hotels generate nearly all categories of electrical and electronic waste associated with accommodation, food production, housekeeping, administration, maintenance and guest services.

Table 8: Specific Types of E-Waste Disposed of by hotels

Item	**No**		**Yes**	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
Sockets	2	2.9	67	97.1
Switches	2	2.9	67	97.1
Bulbs	2	2.9	67	97.1
Electric kettles	5	7.2	64	92.8
LED lamps	5	7.2	64	92.8
Electric irons	9	13	60	87
Televisions	10	14.5	59	85.5

Toasters	12	17.4	57	82.6
Batteries	15	21.7	54	78.3
Clocks	15	21.7	54	78.3
Straight tube fluorescent lamps	15	21.7	54	78.3
Calculators	17	24.6	52	75.4
Microwaves	18	26.1	51	73.9
Monitors	20	29	49	71
Routers	21	30.4	48	69.6
Office Printers	23	33.3	46	66.7
Telephones	29	42	40	58
Electric stoves	31	44.9	38	55.1
Refrigerators	33	47.8	36	52.2
Personal computers	36	52.2	33	47.8
Carpet cleaners	37	53.6	32	46.4
Ventilation equipment	39	56.5	30	43.5
Vacuum cleaners	39	56.5	30	43.5
Monitoring instruments (CCTVs)	39	56.5	30	43.5
Electric ovens	40	58	29	42
Solar panels	41	59.4	28	40.6
Electric musical instruments	42	60.9	27	39.1
Electric shavers	44	63.8	25	36.2
Small power tools (power banks)	44	63.8	25	36.2
Washing machines	46	66.7	23	33.3
Watches	46	66.7	23	33.3
Electrical tools	46	66.7	23	33.3
Clothes dryers	49	71	20	29
Freezers	51	73.9	18	26.1
Pocket calculators	52	75.4	17	24.6
Electric scales	53	76.8	16	23.2
Air conditioners	53	76.8	16	23.2
Large printing machines	55	79.7	14	20.3
Large copying equipment	55	79.7	14	20.3
Smoke detectors	55	79.7	14	20.3
Sports equipment	55	79.7	14	20.3
Laptops	55	79.7	14	20.3
Dishwashing machines	57	82.6	12	17.4
Radio sets	58	84.1	11	15.9
Liquid crystal display photo frames	58	84.1	11	15.9
Mobile phones	59	85.5	10	14.5
Digital cameras	61	88.4	8	11.6
Electrical and electronic toys	64	92.8	5	7.2
Tablets	64	92.8	5	7.2
Heat pumps	66	95.7	3	4.3
Others	66	95.7	3	4.3

Electric medical devices	68	98.6	1	1.4
Global Positioning System (GPS) devices	68	98.6	1	1.4
Electronic Notebooks	68	98.6	1	1.4
Dehumidifiers	69	100	0	0

Inferential Analysis Results

Through Pearsons correlation, the results presented in Table 7 showed a moderate positive and statistically significant relationship between the nature of e-waste generated and effective e-waste management ($r = .453$, $p < .01$). This implies that hotels generating more identifiable and manageable e-waste streams are more likely to achieve effective e-waste management. The hierarchical regression modelling demonstrated that the nature of e-waste generated significantly predicted effective e-waste management in Model 1 ($\beta = .340$, $p = .002$). However, after introducing the intervening variables (regulatory frameworks and sustainability policies), the relationship became statistically insignificant ($\beta = .076$, $p = .421$), suggesting that institutional factors explain much of the influence initially attributed to the nature of e-waste.

The findings of Model 1 coefficients analysis presented in Table 7 confirm that the nature of e-waste generated had a positive and statistically significant effect on effective e-waste management ($\beta = 0.340$, $t = 3.292$, $p = 0.002$). The positive beta coefficient indicates that an increase in the diversity or characteristics of e-waste generated is associated with an improvement in effective e-waste management, after controlling for the other variables in the model. The unstandardized coefficient ($\beta = 0.564$) further suggests that a one-unit increase in the nature of e-waste generated corresponds to an increase of 0.564 units in effective e-waste management. The 95% confidence interval (0.222–0.906) does not include zero, providing additional evidence that the relationship is statistically significant. These findings suggest that hotels generating a broader range of electronic waste are more likely to adopt improved management approaches, possibly because the complexity and volume of e-waste necessitate more structured management systems and greater awareness of appropriate handling procedures.

After controlling for the intervening variables in Model 2, the nature of e-waste generated was no longer statistically significant ($\beta = 0.076$, $t = 0.811$, $p = 0.421$). The reduction in the beta coefficient from 0.340 in Model 1 to 0.076 in Model 2 indicates that the positive effect observed in the first model is largely explained by the inclusion of regulatory frameworks and sustainability policies.

This finding suggests that the influence of the type and diversity of e-waste generated depends largely on the institutional environment within which hotels operate.

Qualitative Analysis Results

The thematic analysis revealed that hotels in Naivasha generate a broad spectrum of electrical and electronic waste covering virtually every operational department within hotel establishments. As summarized in Table 9, respondents consistently identified eight major categories of e-waste generated by hotels, namely ICT and office equipment, guest room electronics, lighting waste, kitchen and laundry appliances, cooling and ventilation equipment, power and energy devices, security and surveillance equipment, and communication devices. These categories were reported across nearly all key informants, demonstrating substantial agreement regarding the diversity of e-waste streams generated within hotels. The findings indicate that ICT equipment, including computers, laptops, printers, networking devices, point-of-sale (POS) systems, routers and intercoms, constitute an important component of hotel e-waste because of the increasing digitalization of hotel operations.

Guest room electronics such as televisions, telephones, electric kettles, microwaves, mini-fridges and wall clocks were also frequently cited, reflecting the hospitality industry's dependence on electronic equipment to deliver accommodation services. Similarly, lighting waste comprising LED bulbs, fluorescent lamps, switches and sockets emerged as one of the most prevalent categories owing to their widespread use throughout hotel facilities. Kitchen and laundry operations were identified as another significant source of e-waste, particularly

washing machines, dishwashers, ovens, stoves, tea urns and toasters. Informants further highlighted cooling and ventilation equipment such as refrigerators, freezers and air conditioners together with power-related

equipment including batteries, chargers, solar panels, power banks and uninterrupted power supply (UPS) units. Although security equipment such as CCTV systems and communication devices including mobile phones were also identified, respondents noted that personal devices such as laptops and mobile phones were comparatively uncommon in hotel waste streams because they retain resale value or are individually owned rather than hotel assets. A recurring pattern emerging from the interviews was the distinction between small and large e-waste items.

Informants observed that small items including bulbs, switches, sockets and chargers are typically discarded immediately and often mixed with general waste, whereas bulky equipment such as refrigerators, televisions, photocopiers and freezers tends to remain stored within hotel premises for prolonged periods while awaiting resale or disposal. This finding suggests that the physical characteristics and residual economic value of electronic equipment strongly influence subsequent management decisions. Overall, the qualitative findings corroborate the quantitative results which established that hotels generate nearly all categories of electrical and electronic equipment recognized under international e-waste classifications. Together, these findings demonstrate that hotels are significant generators of highly diversified e-waste streams, necessitating equally comprehensive management systems capable of addressing both small frequently discarded items and larger durable equipment.

Table 9: Nature of E-waste Generated by Hotels

Sub-Theme/Code	Evidence from KIIs	Source (KII)
ICT & Office Equipment	Computers, laptops, printers, networking devices, POS systems, intercoms, routers	K1, K2, K3, K5
Guest Room Electronics	TVs, telephones, electric kettles, microwaves, mini-fridges, wall clocks	K1, K2, K4, K5
Lighting Waste	Bulbs (LED, fluorescent), switches, sockets	K1, K2, K4, K5
Kitchen & Laundry Appliances	Washing machines, dishwashers, ovens, toasters, tea urns, stoves	K1, K2
Cooling & Ventilation Equipment	Air conditioners (ICs/fans), refrigerators, freezers	K2, K5
Power & Energy Devices	Solar panels, batteries, UPS, power banks, chargers	K1, K2, K5
Security & Surveillance	CCTVs, electric tools	K5
Communication Devices	Mobile phones (rare), old telephones	K1, K4, K5

DISCUSSION

The findings demonstrate that hotels generate a highly diverse range of e-waste, spanning nearly the entire spectrum of the 54 United Nations University (UNU) classification framework categories except dehumidifiers. Both quantitative and qualitative findings indicate that hotels are significant institutional generators of e-waste due to their extensive reliance on EEE for virtually every aspect of hotel operations, including accommodation, food production, administration, communication, security, entertainment, housekeeping, and facility maintenance. The convergence of evidence from both datasets strengthens the conclusion that hotel-generated e-waste is multi-dimensional and largely operationally driven.

Unlike households, whose e-waste is dominated by personal consumer electronics, hotels generate e-waste from commercial infrastructure, service equipment, ICT systems, and building installations. This finding aligns well with the argument by Baričević *et al.* (2024) that institutional e-waste has unique characteristics shaped by

sector-specific operational functions and therefore requires targeted management interventions specifically designed for them rather than generalized municipal waste approaches. The qualitative findings further enrich this finding by illustrating that hotels perceive e-waste as an inevitable by-product of modern hospitality operations. Key informants consistently identified ICT equipment, guest room appliances, kitchen equipment, lighting infrastructure, power systems, and security equipment as routine sources of e-waste, confirming that its generation permeates every operational department within the hotels. This institutional perspective validates the quantitative finding that almost every UNU e-waste category was represented within the sampled hotels.

Operational Characteristics shape the Composition of E-Waste in Hotels

The dominance of bulbs, switches and sockets (97.1%), LED lamps and electric kettles (92.8%), electric irons (87.0%), televisions (85.5%), toasters (82.6%), fluorescent lamps, clocks and batteries (78.3%) indicate that hotels' e-waste mainly emanates from guests' accommodation and permanent building infrastructure. These assets exist in large numbers throughout hotel premises, experience continuous daily use, and are periodically replaced due to wear, technological upgrade, refurbishment or changing customer expectations. Qualitative interviews support this interpretation, with respondents highlighting televisions, electric kettles, microwaves, telephones, wall clocks, lighting systems, and kitchen appliances as the most common obsolete equipment encountered during hotel operations. Their observations suggest that these items, besides being numerous, also have relatively short replacement cycles as they directly influence guest satisfaction and service quality.

These findings correspond closely with Baldé *et al.* (2024), who identified lighting equipment, small personal equipment, and temperature exchange equipment as among the fastest-growing global e-waste categories owing to rapid technological changes, growing electrification, and shorter equipment life cycles. Similarly, Forti *et al.* (2020), had earlier observed that lighting equipment represents one of the largest contributors to global e-waste because of widespread replacement of conventional lighting technologies with more energy-efficient alternatives. The findings therefore suggest that improvements in hotel energy efficiency, while being environmentally beneficial through reduced electricity consumption, may unintentionally accelerate future e-waste generation through more frequent replacement of lighting technologies. This illustrates one of the emerging sustainability trade-offs within the hospitality industry, where energy conservation initiatives simultaneously increase electronic waste volumes unless accompanied by effective end-of-life management systems (Lakhmiri *et al.,* 2026).

Service Quality Requirements Accelerates Equipment Replacement in Hotels

The high prevalence of guest service appliances such as televisions, electric kettles, irons and toasters illustrates that the nature of hotel e-waste is closely linked to service quality and market competitiveness. Hotels operate in an environment where customer satisfaction is key and depends heavily on functional, aesthetically acceptable, and technologically current facilities. As a result, equipment replacement tends to occur before complete mechanical failure. Qualitative interviews conducted for this study supported this view by highlighting that hotels continuously invest in ICT infrastructure, guest room electronics, CCTV systems, point of sale (POS) machines, networking equipment, and administrative electronics to support efficient service delivery. The informants emphasized that technological upgrading has become a routine operational requirement rather than an occasional investment.

These observations support the finding by Awasthi & Pandey (2026), who held that hospitality establishments generate substantial quantities of e-waste because refurbishment programmes and technology upgrades occur more frequently compared to many other commercial sectors. Similarly, Sundar *et al.* (2023) observed that commercial enterprises increasingly replace functioning electronics to improve operational efficiency, reduce energy consumption, and satisfy changing customer needs. Considered together, the quantitative and qualitative findings point to the fact that technological obsolescence rather than equipment failure has become an increasingly important driver of e-waste generation within hotels. Consequently, strategies aimed at extending equipment lifespan may have limited effectiveness unless procurement decisions incorporate repairability, upgradeability, and circular economy principles.

ICT Infrastructure Represents a growing Source of E-Waste in Hotels

Although lighting equipment and guest room appliances dominate the quantitative findings, qualitative evidence indicates that ICT infrastructure constitutes another significant component of hotel e-waste. Key informants consistently identified computers, laptops, printers, routers, networking devices, POS systems, CCTV equipment, and communication technologies as essential operational assets that periodically become obsolete and are disposed. This finding reflects the growing digitalization of hospitality operations. Modern hotels rely extensively on information technology for reservations, inventory management, electronic payments, customer relations management, security surveillance, accounting, internet connectivity, and internal communication. Consequently, digital transformation inevitably expands the volume and diversity of ICT-related e-waste (Bekele *et al.,* 2024). The qualitative findings therefore broaden the quantitative results by demonstrating that the growing digital infrastructure within hotels contributes substantially to institutional e-waste generation, even where ICT equipment represents smaller numerical quantities than guest room appliances.

Hazardous Components increase E-Waste Management Complexity in Hotels

The widespread occurrence of batteries (78.3%) in hotel e-waste deserves particular attention because batteries contain hazardous substances including lead, cadmium, lithium, nickel, cobalt, and other toxic materials capable of contaminating soils and groundwater if improperly managed. Key informant Interview participants identified batteries, Uninterrupted Power Supply (UPS) systems, chargers, and solar energy equipment as common waste streams associated with power supply and backup systems. Their responses indicate that hotels are increasingly depending on alternative energy technologies and emergency power systems, further increasing battery-related waste. These findings are consistent with Gohoungodji & Chembessi (2026), who has identified batteries as one of the world's fastest-growing e-waste streams arising from renewable energy adoption, and digitalization across multiple economic sectors. The finding therefore suggest that batteries should receive priority attention within hotel e-waste management programmes because they combine relatively high generation rates with disproportionately high environmental and public health risks. Unlike many other electronic products, battery disposal requires specialized storage, transportation, recycling, and emergency handling procedures to minimize risks associated with leakage, fire, heavy metal contamination, and chemical exposure (Mishra *et al.,* 2026).

E-Waste Composition in Hotels is Influenced by Operational Needs and Local Context

The low occurrence of notebooks, GPS devices, tablets, medical devices, and electronic toys indicates that these products are not core operational assets within most hotels. Their limited presence reflects the organizational structure of hospitality businesses, where administrative activities occupy relatively small portions of hotel infrastructure compared with guest accommodation and service delivery functions. Similarly, the complete absence of dehumidifiers appears to reflect the climatic characteristics of Nakuru County, where naturally moderate humidity reduces demand for humidity control equipment. Hotels instead appear to rely primarily on natural ventilation and conventional air-conditioning systems.

The qualitative findings complement this observation by indicating that mobile phones and laptops were uncommon within hotel disposal streams because these devices are usually personally assigned to employees or privately owned. The informants noted that such devices are often repaired, retained, transferred, or resold rather than discarded through institutional waste channels. This observation agrees with Baldé *et al.* (2017), who reported that portable electronic devices generally remain in secondary markets for extended periods before entering formal waste streams. Collectively, these findings demonstrate that institutional e-waste composition is shaped not only by operational requirements but also by climatic conditions, organizational practices, equipment ownership patterns, and technological adoption.

Disposal Behaviour is Influenced by Equipment Characteristics in Hotels

One of the most important insights emerging exclusively from the qualitative findings concerns the influence of equipment size and perceived value on disposal behaviour. The informants consistently distinguished between small, low-value electronic items and large capital equipment. Small items such as chargers, bulbs, switches, sockets, cartridges, and cables were frequently reported to be discarded together with general waste,

while larger items including refrigerators, televisions, photocopiers, freezers, and washing machines were more likely to be retained in hotel storage awaiting repair, resale, auction, or eventual disposal. This behavioural distinction extends the quantitative findings by explaining why different categories of e-waste may experience different management pathways despite being generated within the same hotel.

The findings are consistent with Bretschneider (2025), and Forti *et al.* (2020), who observed that equipment size, residual economic value, and ease of transportation significantly influence institutional disposal decisions. Larger equipment generally possesses greater recoverable value and therefore remains within organizational custody for longer periods, whereas smaller items are more vulnerable to informal disposal because they are perceived as having minimal economic worth (Derks et al., 2024). This finding has important implications on e-waste management because it suggests that improving collection systems requires addressing behavioural and economic incentives alongside technical waste management procedures.

Diversity of E-Waste Categories Increases Management Complexity in Hotels

The quantitative findings demonstrated that hotels generate virtually all UNU e-waste categories, while the qualitative interviews corroborated this finding. The categories encompass lighting systems, ICT equipment, guest appliances, kitchen equipment, power systems, communication devices, and security infrastructure. Such diversity substantially increases management complexity as different products contain different hazardous substances, recoverable materials, dismantling requirements, storage conditions, and recycling technologies. For example: Fluorescent lamps require mercury-safe handling, Batteries require specialized hazardous waste management, Televisions may contain leaded glass and hazardous circuit boards, ICT equipment contains valuable precious metals alongside hazardous chemicals, while solar panels and UPS systems require specialized recovery processes.

The findings support Xu *et al.* (2021), who held that effective institutional e-waste management depends majorly upon accurate classification and segregation at source. Without appropriate categorization, hotels risk environmental contamination, reduced material recovery, regulatory non-compliance, and increased disposal costs (Onzere & Mose, 2025). The qualitative findings reinforce this argument by demonstrating that hotel managers already recognize the diversity of equipment types, although this awareness does not necessarily translate into differentiated disposal practices.

Relationships Between the Nature of E-Waste and Effective Management in Hotels

The inferential analysis provides important evidence regarding the practical significance of understanding e-waste composition. Pearson's correlation revealed a moderate positive relationship between the nature of e-waste generated and effective e-waste management ($r = 0.453$, $p < 0.01$), while the initial regression model demonstrated that the nature of e-waste significantly predicted management effectiveness ($\beta = 0.340$, $p = 0.002$). These findings suggest that hotels generating more diverse and identifiable e-waste categories are more likely to establish organized management practices because the complexity of their waste streams necessitates structured handling procedures as earlier argued by Juvan et al. (2023). The qualitative findings support this statistical relationship. The informants demonstrated detailed awareness of the various categories of e-waste generated within their facilities and recognized differences in how different products should ideally be handled. Such awareness likely facilitates inventory management, segregation, and identification of appropriate disposal options.

However, the regression analysis further revealed that once regulatory frameworks and sustainability policies were introduced into the model, the predictive influence of e-waste composition became statistically non-significant ($\beta = 0.076$, $p = 0.421$). This finding indicates that although knowledge of e-waste categories contributes to management, effective implementation depends more heavily on institutional governance, regulatory enforcement, and organizational capacity. This finding highlights an important theoretical implication, which aligns well with the findings by Newaz & Appolloni (2024). The characteristics of waste determine what management approaches are required, but institutional and regulatory systems determine whether those approaches are actually implemented. As a result, improving e-waste management in hotels

requires integrating technical knowledge of waste composition with supportive governance structures, regulatory compliance mechanisms, and organizational commitment.

Implications for Sustainable Hotel E-Waste Management

In summary, the quantitative and qualitative findings in this study demonstrate that hotel-generated e-waste is characterized by considerable diversity, operational specificity, and increasing technological complexity. The convergence between the two datasets strengthens the view that hotels are important institutional sources of lighting waste, guest room appliances, ICT equipment, kitchen electronics, power systems, and security technologies. The findings further indicate that hotel e-waste management should move beyond generalized waste disposal approaches toward integrated systems incorporating source segregation, asset inventory management, category-specific storage, hazardous waste handling, and partnerships with licensed recyclers. The qualitative evidence also suggests that interventions should address behavioural factors influencing disposal decisions, particularly the tendency to discard small electronic items with general waste while indefinitely storing bulky equipment.

Finally, the inferential findings demonstrate that while understanding the nature and diversity of e-waste is an essential prerequisite for effective management, sustainable outcomes ultimately depend on robust institutional capacity, effective regulatory implementation, and supportive organizational policies. Consequently, future interventions should combine accurate e-waste characterization with strengthened regulatory enforcement, enhanced staff training, improved inventory control, and expanded access to formal recycling infrastructure. Such an integrated approach would enable hotels to manage increasingly diverse e-waste streams safely, recover valuable materials, minimize environmental contamination, and contribute to the transition toward a circular economy within the hospitality sector.

CONCLUSION

The study concluded that classified hotels in Naivasha generate a wide range of e-waste, covering nearly all categories identified under the global framework for e-waste statistics – guidelines on classifications, reporting and indicators. The principal sources of e-waste include; damaged or unserviceable equipment, equipment replacement arising from frequent upgrade policies, high repair costs, obsolete electrical and electronic equipment, energy inefficiency, and electronic items left behind by guests. The major points of e-waste generation are maintenance operations, kitchens and restaurants, administrative offices, and guest rooms. The study further concludes that the nature of e-waste generated significantly influences the effectiveness of e-waste management. However, when institutional factors are considered alongside operational factors, applicable regulatory frameworks exert a stronger influence on effective e-waste management than differences in waste composition, underscoring the importance of an enabling regulatory environment.

RECOMMENDATION

Strengthen the Implementation and Enforcement of Existing Regulatory Frameworks: National and County regulatory agencies, particularly NEMA, should strengthen the implementation and enforcement of the Sustainable Waste Management Act, 2022, the Environmental Management and Coordination (Waste Management) Regulations, 2024, and the Sustainable Waste Management (Extended Producer Responsibility) Regulations, 2024. This should include regular compliance inspections, clear enforcement mechanisms, strengthened monitoring systems, and enhanced coordination among government agencies, hotels, producers, and licensed recyclers to promote compliance with environmentally sound e-waste management requirements.

ETHICAL CONSIDERATIONS

Ethical Approval

Ethical approval for this study was obtained from the Kabarak University Ethics Review Committee (KUREC) in accordance with the national research ethics guidelines. Research authorization was subsequently granted by the National Commission for Science, Technology and Innovation (NACOSTI) under license number

NACOSTI/P/26/4186063, covering the administration of survey-based questionnaires involving human participants, within Naivasha Sub-county.

Conflict of Interest

The authors affirm their complete impartiality, declaring that no conflicts of interest exist, thereby reinforcing the credibility, transparency, and integrity of the research findings.

Data Availability

The datasets generated and analyzed during this study are available from the corresponding authors upon reasonable request.

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