# CLIMATE CHANGE MITIGATION POTENTIAL OF REDUCING FOOD WASTAGE IN CLASSIFIED STAR HOTELS IN NAIROBI CITY COUNTY, KENYA

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## ABSTRACT

*Food waste is on the verge of becoming the world's number one engine for global warming as a result of the level of Methane and Carbon Dioxide gases emitted from decomposition at landfill sites. Global food wastes have continued to contribute to approximately 8% of the greenhouse gas emissions annually. In view of this, the researcher purposed to realize this objective through both the quantitative and qualitative analyses of the following indicators: major reasons the facilities use to minimize food waste; actions practiced at the hotels to reduce food waste; strategies facilities use to implement reduction of food waste; and management of food waste based on reduce, reuse, and recycle. The findings revealed that, the respondents had the knowledge of the major reason that made the facilities reduce food waste, where majority (66.7%) cited government regulatory framework as the key reason, while others (29.2%) cited the strategic framework of the hotel. The results also showed that (75%) of the hotels considered portion size for customers through pricing mechanisms as one of the key practices to reduce food waste. The study concluded that reducing food waste had a significant potential to mitigate climate change.*

**Keyword:** - *Food Waste, Climate Change Mitigation, Waste Management.*

## 1. INTRODUCTION

Food waste is on the verge of becoming the world's number one engine for global warming as a result of the level of Methane and Carbon Dioxide gases emitted from decomposition at landfill sites [5] and [17]. The minimisation of food wastage and its resulting GHG emissions ensures a higher potential for climate change mitigation [19] [6] and [14]. The idea of mitigating climate change is centred on reducing the release of greenhouse gas emissions that are warming our planet.

Significant studies have been undertaken to tackle the issue of climate change mitigation potential of renewable energy [12], fossil fuels [1], and oil consumption [11] just to mention a few. Global food wastes have continued to contribute to approximately 8% of the greenhouse gas emissions annually [4]. Considering that the amount and level of food waste will tremendously increase owing to among other factors, continued urbanization and the shift in diets among the people, reduction of biomass loss related to food production is of utmost necessity. The potential for climate change mitigation for food waste in the hotel sector is substantial that it has the capacity to contribute considerably to national greenhouse gas (GHG) mitigation goals.

Despite the several research streams that have offered considerable scientific insights into the mitigation potential of reducing these variables, the literature is highly skewed. This condition has awakened the need to assess the mitigation of climate change through a reduction in food waste in Nairobi City County's classified star hotels through this present study.

### 1.1 Problem Statement

Reviewed literature indicates that comprehensive studies on food loss and waste have been conducted, especially from the retail and consumer levels in developed countries, including the USA, Canada, Switzerland, Australia, Turkey, and South Korea. There equally exist high-level estimations of the volume of food that is wasted around the world. In the case of Africa, limited data on food waste exist due to the dearth of research on the subject. The few studies which exist examined the amount of food waste generated; the quantity of the valued post-consumer food waste generated at the household level; the amount and types of food waste generated in households; food waste by income level; and the reasons for wasting food in South Africa. In these studies, food wastage in the foodservice industry was not taken into consideration.

Additionally, the researchers fell short of demonstrating the link between the quantity of food waste generated to GHG emissions, which significantly contributes to climate change. As with many previous researchers, they recommended that more research be carried out using primary data to verify their results and hence the need for this current research.

## 2. REVIEWED LITERATURE

A report by [8] gave detailed revelations on how food waste relates to climate change. The report highlighted related impacts and outlined the recent global frameworks such as reduction at the source, feeding those who are hungry, feeding animals, industrial use and composting, just to mention a few that the international community has adopted. These frameworks are reflected in national priorities and objectives. They eventually identified tools and enablers to minimise food loss and waste as part of collective efforts to improve climate action. It was concluded that addressing the challenges of food loss and waste presents a crosscutting opportunity to advance the fight against climate change by reducing GHG emissions and strengthening the resilience and productivity of food systems. This present study is premised on the collective effort to minimise food loss and waste in the hotel industry to achieve the objectives of SDGs by 2030, more specifically goals 2, 12 and 13.

[15] investigated how hotels managed food waste using semi-structured interviews to collect data from 32 employees and hotel management in Orlando, Florida. The results revealed that food wastage predominantly occurs during food preparation and consumption stages. Key reasons that explain waste generation include excessive customer ordering, inventory management errors, personnel errors in food preparation, and food safety practices. The study suggests in the bid to reducing food waste, projects such as training of employees, use of appropriate equipment, improvement of menu planning practices, accurate forecasting of demand, and effective storage practices. The study also recommends that the education of customers with attractive, informative and innovative portion guides can also reduce food waste from control and excessive consumption.

In a recent paper, [9] synthesised the emission mitigation potentials for food consumption, housing, transportation and other consumption. The paper systematically reviewed 6990 documents from the Web of Science Core Collections and Scopus. The review by researchers was limited to (1) review papers on the issues of life-cycle evaluations and (2) multi-regional input and output studies on household consumption which were published after 2011 in English. The study further selected based on predetermined eligibility benchmarks and quantitative results synthesised from 53 research papers in a meta-analysis and identified 771 original options, summarised and showcased in 61 consumption preferences with potential for positive mitigation. The role of contextual factors such as geographic, technology and/or socio-demographic was investigated with the help of fixed-effect model to obtain the outcome variable (i.e., per capita mitigation potential) in consumer choices. The study established consumer choices with a high mitigation potential which were measured in tonnes of $CO_2$eq/capita/yr. The study also found that in the transportation sector, the options with the greatest mitigating potential include being without a car/vehicle, switching to a battery-powered electric vehicle as well as reducing long return flights with a median reduction potential of more than 1.7 t$CO_2$eq/cap. In terms of food, the largest carbon reduction results from the changes in diets, including adopting a vegan diet which has an average and median mitigation potential of 0.9 and 0.8 tCO2eq/cap, respectively. In concluding, the top ten consumption options as indicated by the study have a mean mitigation potential of 9.2 tCO2eq/cap, which indicates a substantial contribution to the achievement of the 1.5 C–2 C target, more especially in the context of high income.

### 2.1 Significance

The study will significantly benefit scholars and researchers in the thematic area of food waste and its linkages to climate change. The findings will also support and enrich the concepts, theories and models related to food waste, such as the Anthropogenic Global Warming theory and the Food-Availability Decline theory.

## 3. MATERIALS AND METHODS

Nairobi is among the few cities in the world that has a national park within its boundaries, making it a tourist destination of choice and several other tourist attractions. There are numerous hotels in Nairobi, including 5-star, 4-star and 3-star luxury hotels. Nairobi is the capital of Kenya, with its location in the southern centre of the country, in the high plateau of about 5500 feet (1680 meters). Nairobi is located 480 km northwest of Mombasa, the most important port city of Kenya on the Indian Ocean.

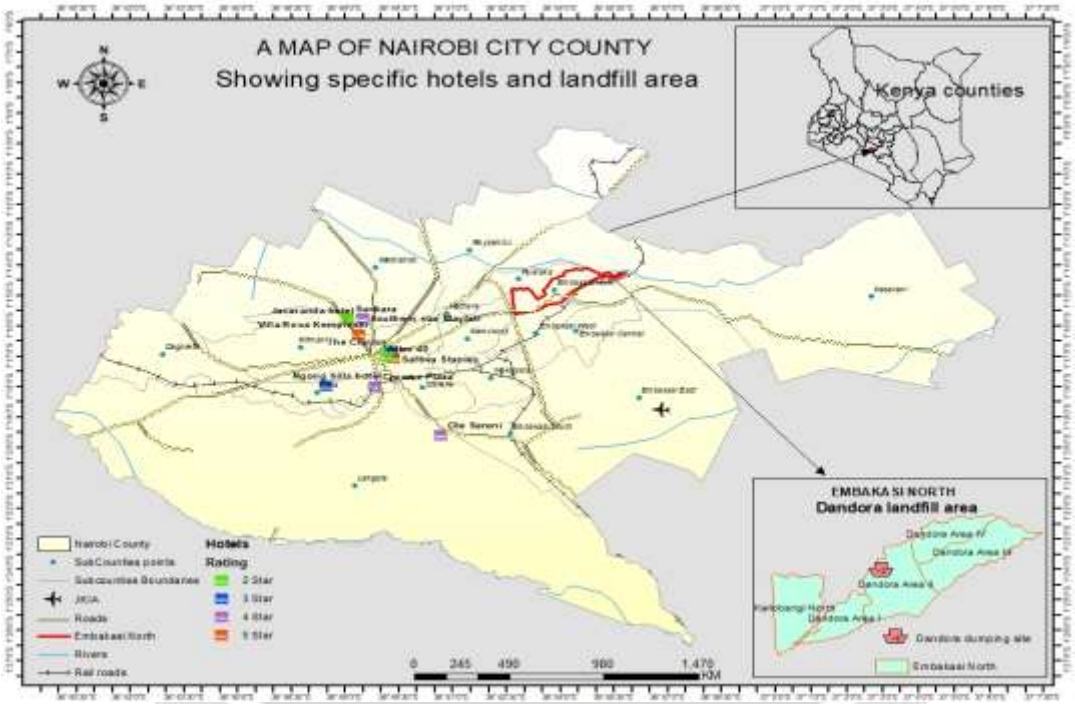


**Fig -1**: Study Area Map
**Source: Author's Construct (2022)**

### 3.1 Research Methodology and Design

A mixed research approach was employed for this study. As a result, data collection and analysis followed the principles of both quantitative and qualitative methods. Specifically, a descriptive survey design was employed to enhance understanding of the concepts under review through the nomothetic scientific inquiry method. A parametric test was conducted on the study dataset, with data presented in graphs, tables and charts.

### 3.2 Data Source and Materials

For this research's objective to be achieved, the following procedures were taken. The study employed the use of primary data, which was complemented with secondary data to arrive at the final results. The primary data was collected from all the 28-star hotels within the study area, while books, journals, and online repositories were the source for the secondary data.

### 3.3 Sampling

A census survey technique was employed to collect data from all the 28-star hotels for one week (7 days). The hotels grouped into strata based on their categorisation for quality and standardisation in the hospitality industry include four categories from 2-5 stars, as shown in the table below. A purposive sampling technique was employed to select two (2) key informants from NEMA. Two key informants from NEMA and 28 hotel managers, making thirty (30) people, were interviewed in a nutshell.

**Table -1:** Sample frame for the list of Hotels in Nairobi City County

| **Hotel Category** | **Total number** |
|---|---|
| Five Star | **8** |
| Four Star | **9** |
| Three Star | **5** |
| Two Star | **6** |
| **Total** | **28** |

**Source: [3]**

### 3.4 Data Analysis

Data collected were analysed quantitatively using Statistical Package for Social Sciences and complimented with Microsoft Excel 2016. Qualitative data from the interviews were analysed and results realised through desktop analysis of related literature.

## 4. RESULTS AND DISCUSSION

The previous chapter dealt with the materials and methods used in carrying out this research. In this chapter the data analysis, findings and interpretations are discussed. The study interviewed representative of the selected classified star hotels on the climate change mitigation potential of food waste reduction in classified star hotels in Nairobi City County. Data was analysed using descriptive and inferential statistical methods and presented through frequencies and percentages using pie charts and tables.

### 4.1 Response Rate

Response rate is an important element of this study as it helped the researcher to particularly describe the representation from participants and the method used to derive the responses from the study participants for effective interpretation of data [2]. Results of response rate are shown in Figure 2.

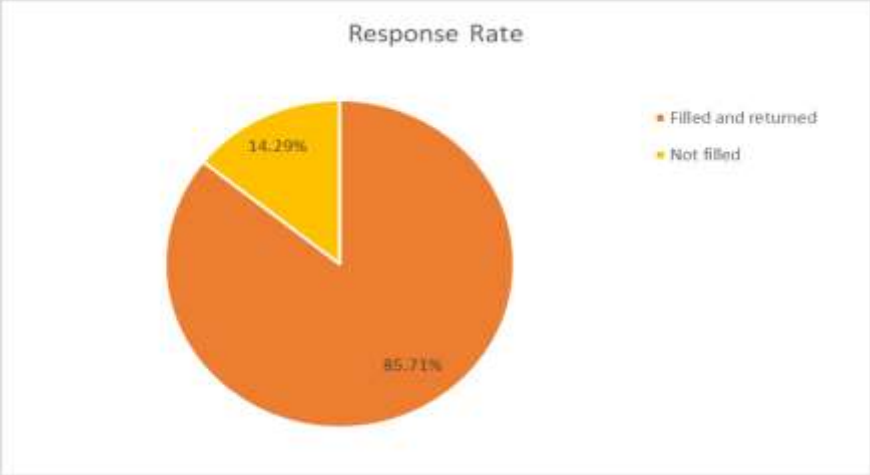


**Fig -2**: Response Rate

The results from Figure 2 indicated that, overall, (24 out of 28) instruments were duly filled and returned, thereby representing a response rate of 85.71% of the total study respondents. [16], considered a response rate of above 70% as excellent. As such, this response rate was deemed valuable to the study as it confirmed a willingness of the respondents in the selected classified hotels to participate in the study and affirm the credibility of the research findings.

In assessment of the climate change mitigation potential of food waste reduction in classified star hotels of Nairobi City County, the study sought to describe the profile of the classified star hotels by their category as follows:

**4.2 Hotels' Distribution Category**

The category of hotels is a crucial factor in the bid to analyse the relationship between climate change mitigation potential and the food waste. The study sought to establish the category of the classified star hotels and the results is shown by Figure 3.


**Fig -3**: Distribution of Classified Star Hotels

From Figure 3 it is indicated that majority (33.33%) of the classified star hotels were five-star category, followed by (25%) under the four-star category, whereas, both the three star and two-star categories comprised of (20.83%) of

the classified star hotels selected for the study. From the results, it is evident that all the categories were represented in the study to guarantee a comprehensively objective finding.

A descriptive analysis was conducted to establish the major reason that encourage the classified star hotels to minimize or reduce food waste. The results are presented in the Table 2

**Table -2:** showing major reason that encourage the classified star hotels to minimize or reduce food waste

| Which of the following is the major reason that encourage your facility to minimize/reduce food waste? | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Government Regulatory Framework | 16 | 66.7 | 66.7 | 66.7 |
| | Industry/Sector Standard Guidelines | 1 | 4.2 | 4.2 | 70.8 |
| | Strategic Framework of the hotel | 7 | 29.2 | 29.2 | 100.0 |
| | Total | 24 | 100.0 | 100.0 | |

The results in the table 2 reveal that (66.7%) of the respondents indicated that the government regulatory framework was the major reason that encouraged the specific facilities to reduce food waste; (29.2%) of the respondents stated that the strategic framework of the hotel was a major reason that encouraged the specific facilities to reduce food waste; whereas (4.2%) of the respondents argued that the major reason that encouraged the specific facilities to reduce food waste was the industry or sector standard guidelines.

On the question about the actions the facilities are currently practicing to reduce food waste, the study did a further descriptive analysis and the findings were as shown in Figure 4.

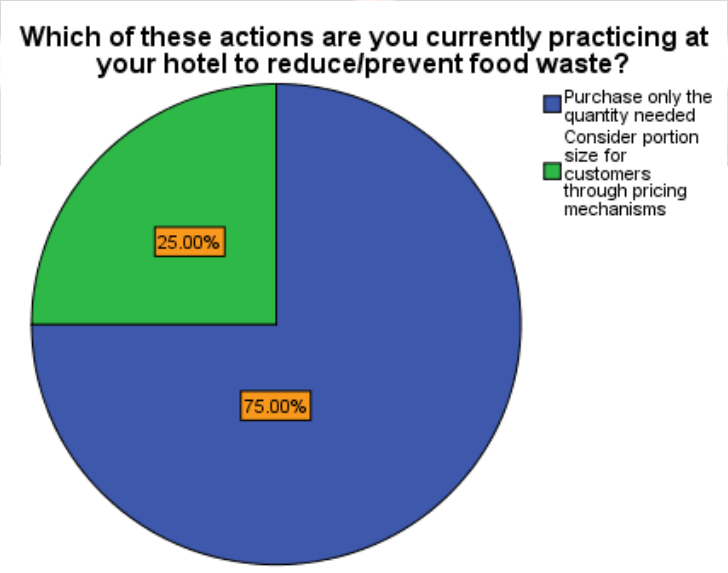


**Fig -4**: showing the actions the hotel facilities are practicing to reduce/prevent food waste

From the results in the Figure 4 above, the study established that majority (75%) of the respondents revealed that the actions their facilities practice to reduce/prevent food waste, was purchasing only the quantity needed, while (25%)

of the respondents stated that the facilities consider portion size for customers through pricing mechanisms as one of the actions the classified star hotels are practicing to reduce or prevent food waste.

Further, an analysis was conducted to establish the strategies the facilities were implementing to reduce the amount of food waste generated, and the findings were as shown in Table 3.

**Table -3:** showing the estimated daily energy consumed to prepare food at the hotel

| Which of the following strategies is your facility implementing to reduce the amount of food waste generated (select two most employed at the hotel) | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Conducting food waste audit on a daily basis | 7 | 29.2 | 29.2 | 29.2 |
| | Maximizing shelf life of food by avoiding wastage of ingredients | 11 | 45.8 | 45.8 | 75.0 |
| | Creating a plan for leftovers through monitoring, regulating and encouraging customers to carry leftovers home | 6 | 25.0 | 25.0 | 100.0 |
| | Total | 24 | 100.0 | 100.0 | |

The results indicated the majority (45.8%) of the respondents that maximizing the shelf life of food by avoiding wastage of ingredients as the strategy that the facilities implemented to reduce the amount of food waste generated. Similarly, (29.2%) of the respondents revealed that the strategy the facilities implemented to reduce the amount of food waste generated, included conducting food waste audit on a daily basis, while (25%) of the respondents confirmed that the facilities created a plan for leftovers through monitoring, regulating and encouraging customers to carry leftovers home, as the main strategy implemented to reduce the amount of food waste generated.

On the question about the specific strategies the facilities were implementing to reduce the amount of food waste generated, a further descriptive analysis was conducted by the study to seek the respondent's perspectives and the results presented in Figure 5


**Fig -5:** showing the actual strategies employed by the hotel facilities and implemented to reduce/prevent food waste generated

The findings of the study showed through the majority (50%) of the respondents that the facilities maximize the shelf life of food by avoiding wastage of ingredients as a strategy implemented to reduce the amount of food waste generated, as (20.8%) of the respondents stated listed creation of plan for leftovers through monitoring, regulating and encouraging customers to carry leftovers home, and creating awareness on food and drink wastage at the facility on the need to reduce food waste respectively, while (8.3%) of the respondents listed conducting food waste audit on a daily basis as a strategy implemented to reduce the amount of food waste generated in the facilities.

On the question of what would assist the facilities to reduce the amount of food waste disposed of daily, a descriptive analysis was conducted by the study and the findings presented in Table 4**.**

**Table -4:** *showing the activities that assist the facility to reduce the amount of food waste disposed of daily*

| Which of the following would assist your facility to reduce the amount of food waste disposed daily? | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Access to an organic waste collection service | 20 | 83.3 | 83.3 | 83.3 |
| | Access to appropriate tools for conducting food waste audit | 4 | 16.7 | 16.7 | 100.0 |
| | Total | 24 | 100.0 | 100.0 | |

From the findings in the Table above, (83.3%) of the respondents indicated that access to an organic waste collection service would assist their facilities to reduce the amount of food waste disposed of daily, whereas (16.7%) of the respondents stated that access to appropriate tools for conducting food waste audit would help assist their facilities to reduce the amount of food waste disposed of daily.

A further descriptive analysis was conducted to establish how the respondents individually rated their facilities management of food waste based on reduce. The results were revealed in the Figure 6

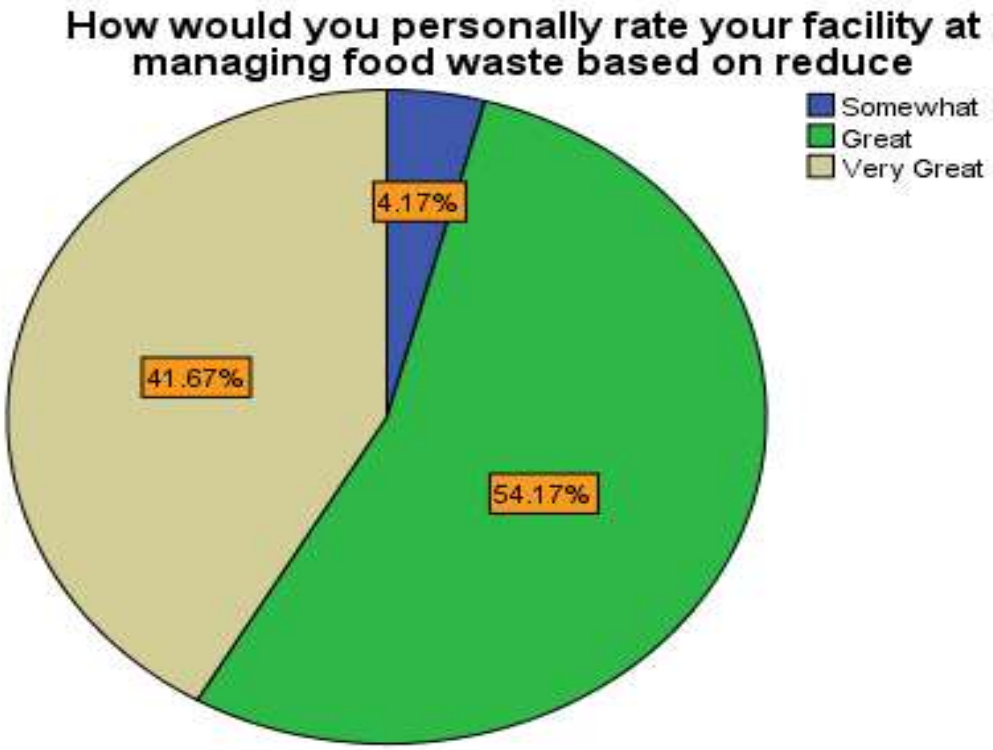


**Fig -6:** showing how the respondents personally the facilities at managing food waste based on reduce

The findings of the study showed through the majority (54.2%) of the respondents that they greatly rated the facilities' management of food waste on reduce while (41.7%) of the respondents very greatly rated the facility's capacity to manage food waste based on reduce, whereas (4.2%) of the respondents somewhat rated the facilities' capacity to manage food waste based on reduce.

On the question of how the respondents rated their facilities management of food waste based on reduce, a descriptive analysis was conducted by the study and the findings presented in Table 5

**Table -5:** showing how the respondents personally rate the facilities at managing food waste based on reuse

| How would you personally rate your facility at managing food waste based on reuse | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Very Poor | 2 | 8.3 | 8.3 | 8.3 |
| | Poor | 13 | 54.2 | 54.2 | 62.5 |
| | Somewhat | 9 | 37.5 | 37.5 | 100.0 |
| | Total | 24 | 100.0 | 100.0 | |

The findings of the study showed through the majority (54.2%) of the respondents that management of food waste on reuse at the facilities was poor, while (37.5%) of the respondents somewhat rated the facility's capacity to manage food waste based on reuse, whereas (8.3%) of the respondents very poorly rated the facilities' capacity to manage food waste based on reuse.

On the question of how the respondents rated their facilities management of food waste based on recycle, a descriptive analysis was conducted by the study and the findings presented in Figure 7

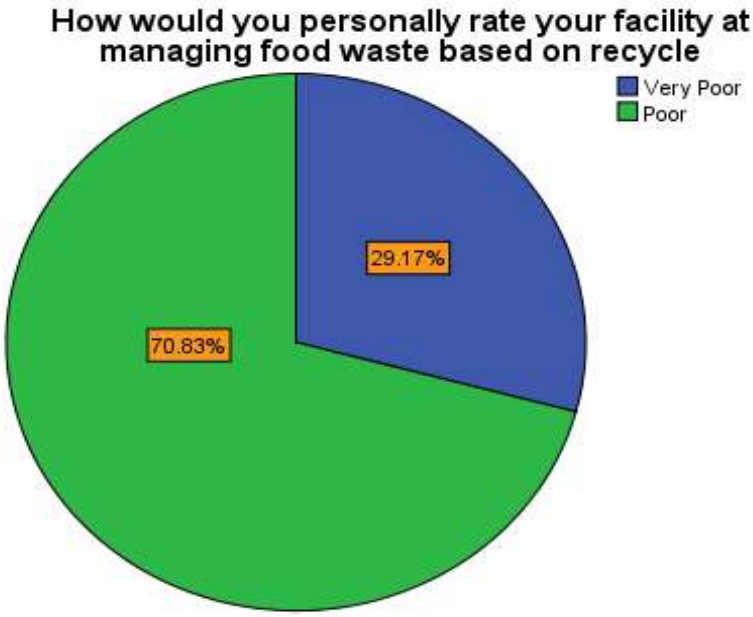


**Fig -7:** showing how the respondents personally the facilities at managing food waste based on recycle

The findings of the study showed through the majority (70.83%) of the respondents that management of food waste on recycle at the facilities was poor, while (29.17%) of the respondents very poorly rated the facility's capacity to manage food waste based on recycle.

On the question of how the respondents addressed mitigation of food wasted, a descriptive analysis was conducted by the study and the findings presented in Table 6.

**Table -5:** showing how the respondents personally the facilities at managing food waste based on reuse

| Mitigation of food wasted | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Great | 10 | 41.7 | 41.7 | 41.7 |
| | Very Great | 14 | 58.3 | 58.3 | 100.0 |
| | Total | 24 | 100.0 | 100.0 | |

The results of the study indicated through the majority (58.3%) of the respondents that mitigation of food wasted was very great, while (41.7%) of the respondents stated that mitigation of food wasted was great.

To confirm and support the respondents' positions, the study interviewed key informants from the National Environment Management Authority on what mechanism is put in place to measure compliance of the Cleaner Production principles by the business (hotels) entities in Nairobi City County for the purposes of mitigating. The respondent stated that;

> *"Kenya has an elaborate policy, regulatory and institutional structure in place. This includes the Environmental Management and Coordination Act 1999, Climate Change Act 2016, and the Kenya Climate Action strategy, and the Constitution of Kenya 2010."*

On the question to ensure the organization's compliance with monitoring the product life cycle (food waste) from beginning to the end to mitigate the adverse impact of climate change generated by the product, the respondent said;

> *"Carbon footprint reduction in the hotel sector is not a regulated in Kenya since we are a developing country without mandatory emission reduction targets. Hotels are thus mandated to adhere to the laid down standard guidelines to mitigate the adverse effects of climate change."*

On the question to ensure that the organizations integrate and mainstream climate change actions and interventions in their waste disposal activities, the respondent stated the following;

> *"National Environmental Management Authority [NEMA] has mainstreamed climate change in the Environmental Impact Assessment and Audit Regulations which requires climate change vulnerability and risk analysis of any projects or practices. Waste separation, recycling, composting, efficient water use, installation of intelligent energy management systems, installation of efficient boiler systems and other eco-friendly hotel practices are part of the conditions for licensing issued to hotels."*

On the question of mechanisms that should be put in place to ensure business entities reduce and/or control the amount of waste generated from their facilities, the respondent stated the following;

> *"Effective planning, implementation, continuous monitoring of hotel processes and continuous improvement are key in waste management. The food and beverage departments of hotels should manage food best through green procurement where food is sourced from sustainable farms, only well-planned number-led cooking is done to avoid food and beverage wastes, investing in efficient cooling and storage systems etc. The building and maintenance sections should be able to management efficiency in water use, lighting, solid waste management etc. Continuous training of staff and guests is key in success of these measure*s."

On the question of the monitoring/regulative mechanisms put in place to ensure the generated waste that reaches disposal sites does not present any health and environmental hazards to the public as in the case of food waste which generates high levels of methane which is a major contributor to climate change, the respondent said the following;

> *"Waste management is a devolved county function. The National government in this case NEMA regulates the sector through licensing, monitoring and enforcement. The hotels, based on their license conditions are to ensure they contract licensed waste handlers to collect their waste from the hotels and dispose them in licensed facilities. The waste handling company is obligated through the waste tracking system to take the waste to the designated site and the tracking document must be signed by the site managers. Organic waste must be handed over to a composting company and so is it the same for plastics, paper, scrap metal and others. Waste water must be disposed into the sewer and where lacking sewer the hotel must have a waste water treatment facility within site and also contract a licensed exhauster services company to exhaust the waste from the septic tank and dispose it off to the licensed waste water treatment company."*

On the question of what the Authority does to ensure effective recovery, recycling and reuse of waste generated (food waste) from the various hotel facilities in Nairobi City County for the purposes of mitigating climate change, the respondent stated the following;

> *"Through licensing, monitoring and enforcement."*

On the question of the challenges facing the Authority in relation to waste management practices among organizations (hotels), the respondent stated the following;

> *"The challenges range from; inadequate staff, finances and other means of implementation to effectively and efficiently undertake monitoring, inspection and enforcement. General Citizen's poor attitude towards waste management."*

The findings are in agreement with study conducted by [7] that evaluated carbon footprint and energy use of food waste management options for fresh fruit and vegetables from supermarkets. The study findings indicated that food waste can be managed in many different ways. However, there was a trend for decreasing climate impact with higher priority levels in the waste hierarchy. The results of the study demonstrated that there is great potential for reducing greenhouse gas emissions and primary energy use by changing the waste management of surplus fruit and vegetables to more favorable options in the waste hierarchy. The potential of energy recovery alternatives (incineration and anaerobic digestion) in reducing Global Warming Potential was found to be in the range 0.04 to _0.23 kg $CO_2$e/FU and the potential of re-use alternatives (conversion and donation) was in the range _0.35 to _0.98 kg $CO_2$e/FU. The corresponding range for PEU was 1.2 to _1.2 MJ/FU for energy recovery and _5.1 to _16 MJ/FU for the re-use options.

[13] study on Climate Change and Sustainable Development which sought to raise critical issues on the nexus between climate policy and sustainable development. The results indicated that a number of policies aligned to Kyoto protocol have been designed to address climate change, both at the international and national levels, and geared towards adaptation and mitigation. The results presupposed that climate policy should emphasize on investment programs and their benefits to the communities and the ecosystem; and provision of public goods to mitigate the climate crisis by states and other independent economic actors.

The results were also aligned to the research by [18] that investigated food security through food waste and loss control mechanism in Kenya. Of particular interest is the study findings on the food waste and loss control measures within the hospitality's sector. The results highlighted the potential for food waste prevention and control within the larger restaurant operations including. These included menu planning and service, including menu design, portion choices and customized dishes as well as smaller plates and/or tray-less dining, and procurement and supply chain, optimize quantities, produce specifications, and waste tracking analytics.

## 5. CONCLUSIONS

The findings of the study indicated that the respondents had the knowledge of the major reason that made the facilities reduce food waste, where majority (66.7%) cited government regulatory framework as the key reason, while others (29.2%) cited the strategic framework of the hotel. The results also showed that (75%) of the hotels considered portion size for customers through pricing mechanisms as one of the key practices to reduce food waste. The findings indicated that the strategies implemented to reduce the amount of food waste generated included maximizing shelf life of food by avoiding wastage of ingredients, conducting food waste audit, and creating a plan for leftovers by monitoring, regulating, and encouraging carrying of leftovers home.

The study therefore concludes that climate change mitigation potential of reducing food waste affects the volume of carbon footprint. This is informed by the realization that the hotels had the knowledge and significance of impact of the various standard guidelines including government regulatory framework, and strategic framework and how they affected the capabilities of the classified star hotels to reduce food waste generated. As such, the study concluded that reducing food waste had a significant potential to mitigate climate change. There is need for classified star hotels in Nairobi City County to adopt food waste management practices that encompass waste collection, and disposal, food waste reduction, recycling and reuse, as well as waste composting.

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