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ASSESSMENT OF SOLID WASTE MANAGEMENT IN KEFFI TOWN, NASARAWA STATE NIGERIA.

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ABSTRACT

This study examines the challenges of solid waste generation and disposal in Keffi, where households produce 1-5kg of waste daily. Recycling and the 3R (Reduce, Reuse, Recycle) approach are highlighted as effective strategies, providing employment for scavengers and supporting local industries. It combines survey data, direct field observation and GIS to illustrate the generation and management of solid waste of keffi town. A random sample of about 30 houses were selected for a key informant interview. Factors like population growth, urbanization, and improved living standards contribute to increased waste. Insufficient dumping sites and hazardous waste, such as medical refuse, pose risks to health and the environment. Findings showed an average disposal rate of 3.5kg per husehold daily. The study recommends expanding waste collection systems to ensure sustainable urban development and environmental preservation.

Keywords: Solid waste, Generation, Recycle, Environment, Management, Urban development.

INTRODUCTION

Solid waste management involves the collection, processing, disposal, transport, and treatment of waste. Key challenges include poor management, uncoordinated approaches, population growth, unhealthy attitudes, and non-mechanized methods, particularly in Nigerian cities like Port Harcourt (Ayotamuno & Gobo, 2004). Modern societal habits, driven by luxury lifestyles, have increased waste generation, with significant environmental and health consequences (Leton & Nweke, 2003). Poorly managed waste, particularly household waste, can spread diseases, as seen in outbreaks like the Surat plague. Open burning of waste releases harmful chemicals such as mercury and cyanides, posing severe health risks. Improper disposal of waste near dumpsites or rivers contaminates soil and water sources, introducing heavy metals like manganese and nickel, as

observed in Southeastern Nigeria (Nduka et al., 2008). In cities like Zaria Nigeria, pathogenic substances contaminate well water due to the proximity of dumpsites (Yahaya et al., 2011). In Swaziland, households near dumpsites experience health risks and negative attitudes towards waste disposal (Abul, 2010). Rapid urbanization and rural-urban migration are driving solid waste generation, especially in cities like Lagos, which generates about 10,000 tonnes daily. Socio-economic factors such as education, awareness, and income levels influence waste management practices in cities like Ibadan (Babanyara & Bogoro, 2011). In a similar vein, a study by Eze et al. (2021) found that over 60% of households in Keffi dispose of their waste in open spaces, drainage systems, or burn it, contributing to environmental degradation and flooding which forms the basis of why this study was illicited. Public-private partnerships (PPP) have been encouraged for waste collection in some cities, demonstrating a willingness to pay for services (Rahji & Oloruntoba, 2009). Waste is often dumped in open dumps or poorly controlled landfills, which are not suitable for refuse management (Babayemi & Dauda, 2009). Urban areas face environmental risks due to inadequate waste segregation, burning, and contamination during composting. This highlights the urgent need for sustainable and coordinated waste management practices, public awareness, and stricter regulations to mitigate health and environmental hazards.

STATEMENT OF THE RESEARCH PROBLEM

Improper solid waste management is a significant challenge in Keffi town, Nasarawa State, and many Nigerian cities. Reckless dumping of waste, including garbage, plastics, and glass, is common due to a lack of proper disposal sites and urban planning. Local authorities rely on cheap labor for waste collection, but disposal remains a major issue. This situation leads to numerous negative effects, including health risks, blocked drainage systems, urban flooding, road inaccessibility, disease outbreaks, water pollution, and foul odors. Despite several attempts by successive administrations, the menance of solid wastes remains and persist in the study area, thereby prompting this research to examine the root cause and knowledge gap between waste producers and waste mangers.

Research Question

The following research questions were raised to enable the researcher identify the root causes of solid wastes generation and management;

1. What are the various methods used for disposing of refuse?

2. What are the impacts of solid waste generation on the environment and society?
3. How do we control urban wastes disposal effectively?

Research Objectives of the Study

This study aims to assess waste characterization, evaluate current disposal methods, explore sustainable technologies like biogas, and propose effective strategies to mitigate waste management issues in the town, which serves as a critical case study for medium-sized Nigerian towns. The objectives of the study includes; 1. Analyzing the various methods of refuse disposal and their effectiveness in waste management; 2. Assessing the environmental, social and economic impacts of solid waste generation and 3. Identifying and proposing strategies for effective management and control of urban waste disposal systems.

LITERATURE REVIEW

Solid waste management (SWM) is an integral aspect of urban governance, particularly in developing countries like Nigeria, where rapid urbanization and population growth have intensified waste-related challenges. Keffi, a growing urban area in Nasarawa State, faces similar challenges in waste management, characterized by inadequate infrastructure, poor enforcement of regulations, and lack of public awareness. This literature review examines prior studies and available data on solid waste management practices, challenges, and prospects in Keffi and similar settings in Nigeria. Nigeria generates an estimated 32 million tons of solid waste annually, with only 20-30% being collected and properly managed (Ogwueleka, 2009). The situation is exacerbated in smaller towns like Keffi, where the waste management systems are less developed compared to major cities like Lagos and Abuja. Several studies highlight the role of socioeconomic factors, population growth, and urban sprawl in escalating waste management issues (Adewale, 2011). Studies on waste management in Nasarawa State reveal systemic challenges, such as inadequate funding, insufficient waste disposal facilities, and a lack of technical expertise (Ogundele & Akinwale, 2020). In Keffi, these challenges are further compounded by weak policy implementation and insufficient public participation. According to Abdullahi et al. (2022), the town relies heavily on open dumping and poorly managed landfill sites, which pose significant environmental and public health risks. Waste collection in Keffi is primarily handled by local government agencies, private operators, and informal waste pickers. However, the collection coverage is limited, leaving

large portions of the town underserved. A study by Eze et al. (2021) found that over 60% of households in Keffi dispose of their waste in open spaces, drainage systems, or burn it, contributing to environmental degradation and flooding. Public awareness and participation are critical to the success of any waste management system. In Keffi, low levels of environmental awareness and poor waste disposal habits hinder the effectiveness of SWM programs. Research by Yakubu and Sabo (2018) underscores the need for public education campaigns and community-driven initiatives to promote waste segregation and recycling practices. Several opportunities exist to improve SWM in Keffi, including the adoption of integrated waste management systems, public-private partnerships, and the use of technology for waste tracking and recycling. Policies promoting waste-to-energy initiatives and incentivizing recycling could also enhance the town's waste management outcomes (Adewale, 2011). Furthermore, the enforcement of environmental regulations and investment in modern waste management infrastructure are essential to achieving sustainable waste management. The assessment of solid waste management in Keffi Town highlights critical gaps in infrastructure, public awareness, and policy implementation.

METHODOLOGY

Research Design

This study employs a mixed-methods approach to assess solid waste management in Keffi Town, focusing on waste generation, disposal practices, challenges, and solutions. Data were be collected through questionnaires, interviews, field observations, and document reviews from households, businesses, and stakeholders. Quantitative and qualitative data were analyzed using statistical and thematic methods, respectively, with findings expected to inform strategies for improving waste management systems in the town.

The Study Area

Nasarawa State was formed from the west of Plateau State on 1 October 1996 is located in central Nigeria, bounded by latitude 7°45'N to 9°25'N and longitude 7°E to 10°E. It is accessible through Benue State to the south, Kogi State to the west, the Federal Capital Territory (FCT) Abuja to the northwest, Kaduna and Plateau States to the northeast, and Taraba State to the southeast. Nasarawa State consists of 13 local government areas divided into three senatorial districts: Nasarawa West, Nasarawa North, and Nasarawa South. The state has an estimated total area of 27,117 square

kilometers with Lafia as the state capital located in the east of the stateKeffi Local Government Area, located in Nasarawa State, North Central Nigeria, lies within latitudes 8°50'40"N and 8°47'50"N, and longitudes 7°39'13"E and 7°37'48"E. Covering a total area of 138 km², it is situated within the Nigerian Basement Complex and is approximately 50-68 kilometers from Abuja.

Map of the Study Area

Keffi Local Government Area (LGA) in Nasarawa State, Nigeria (figure 1), serves as the focus of a study on solid waste management, highlighting challenges such as indiscriminate dumping, inadequate disposal systems, and limited environmental awareness. As a rapidly growing urban center located approximately 58 kilometers from Abuja, the Federal Capital Territory, Keffi's increasing population and proximity to Abuja drive heightened waste generation (figure 2). Characterized by residential, commercial, and institutional areas, Keffi faces significant environmental and public health risks due to improper waste disposal. This study aims to assess waste characterization, evaluate current disposal methods, explore sustainable technologies like biogas, and propose effective strategies to mitigate waste management issues in the town, which serves as a critical case study for medium-sized Nigerian towns.

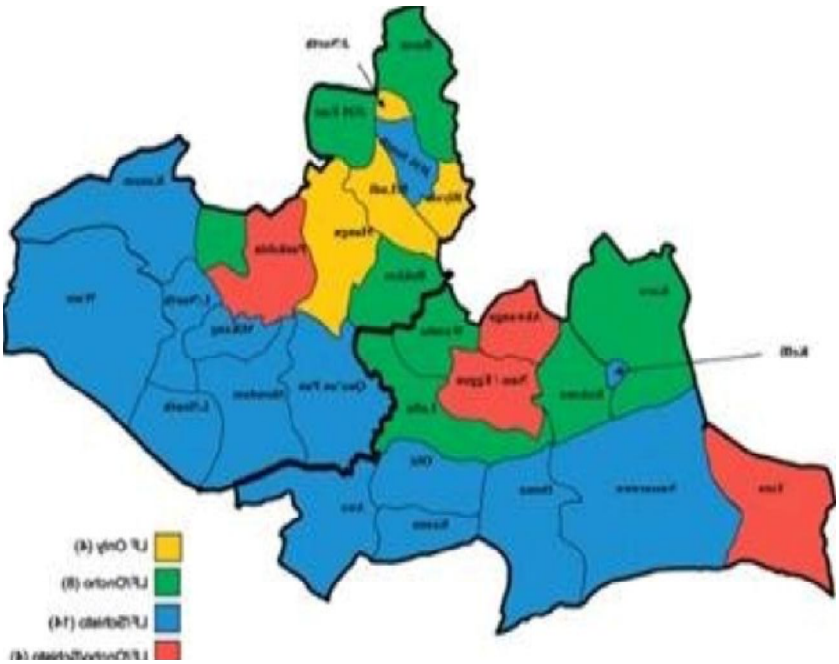

Figure 1: map of Nasarawa State showing the Study area
Source: Nasarawa State Gazette

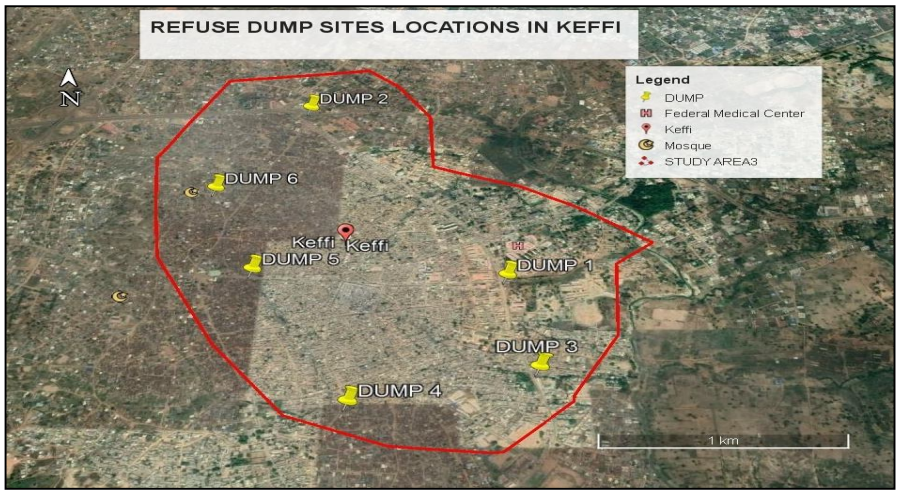

Figure 2: Satellite mapping of the Study Area Keffi Town

LOCATIONS

Refuse Dump Site 1= LAT 8°50'39.52"N, LONG 7°53'2.77"E

Refuse Dump Site 2=LAT 8°51'21.64"N, LONG 7°52'31.38"E

Refuse Dump Site 3=LAT 8°50'20.44"N, LONG 7°53'6.82"E

Refuse Dump Site 4=LAT 8°50'13.65"N, LONG 7°52'40.90"E

Refuse Dump Site 5=LAT 8°50'40.64"N, LONG 7°52'25.71"E

Refuse Dump Site 6=LAT 8°50'59.91"N, LONG 7°52'18.27"E

The total distance of the study area 8 Kilometers

Climate and Vegetation

Generally, the topography of Nasarawa State is undulating hills, with lowlands and plains. The soil is hydromorphic and the climatic characteristics fall within A_w of the Koppen classification of climate. Annual

rainfall ranges between 1200 to 2000mm with 6 to 7 months of raining season. Temperature is moderate due to January Harmattan between 22°C to 28°C. Humidity is generally found to be high especially during the raining rainy seasons. The vegetation is characterized by dry woodland Savannah and southern Guinea savannah with pockets of gallery forest found around the valley and hills. Most of the trees are economically useful and contribute greatly to the control of the Nasarawa State climate (Binbol & Marcus, 2010).

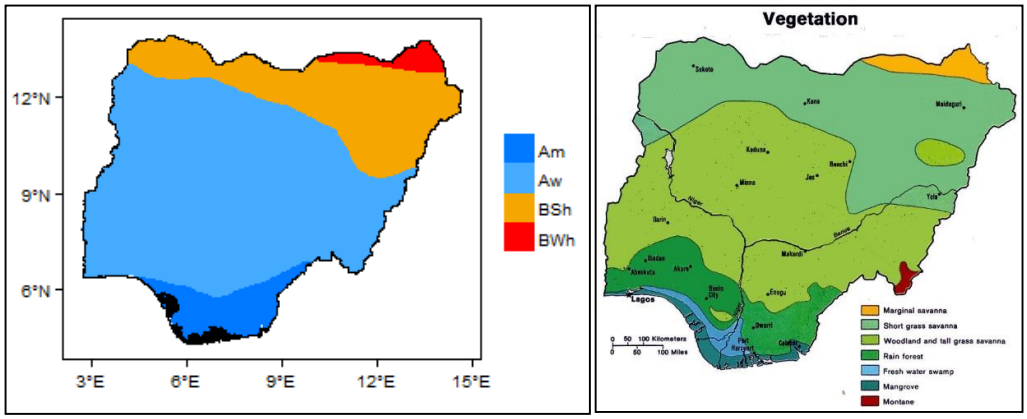

Figure 3: Climate and Vegetation of Nigeria, (Source, BGS Earthwise - British Geological Survey)

Techniques for Data Analysis

This employs the use of appropriate statistical analysis to obtain the results. It is expected to observe high generation and disposal of refuse as solid wastes, based on the population of people per household and the nature of the location and the income of the individual in the study area.

Data Presentation

The study involves the collection of data and the reconnaissance survey. The field data is located at the following points.

Data Analysis and Results

Figure 1 below is the data presentation of the age group in the study area. The highest age class is between the age of 21 to 30, followed by 31-40. This indicates that the population composition of Keffi town is at the youthful stage with active, reproduction and productive capacity.

S/no	Occupations	Respondents
1	Civil Servant	22
2	Farming	9
3	Business	9
4	Students	50
5	Others	8
Total		100

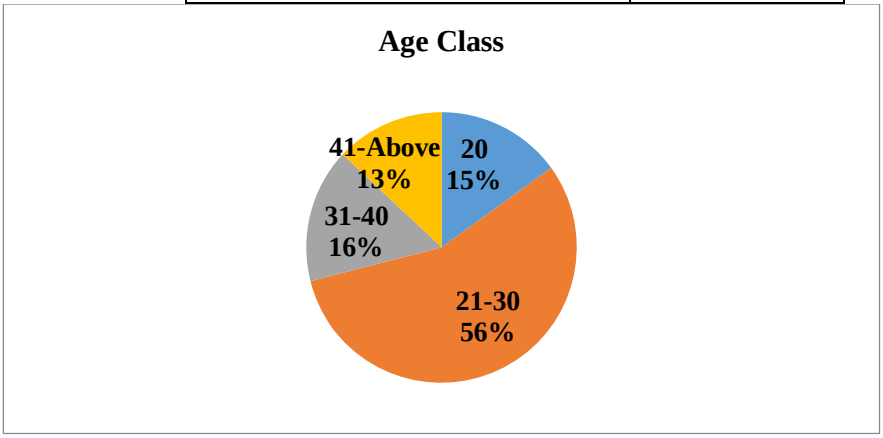

Figure 4: Age classes of the respondent in Keffi

Table 1: Occupational Status of people Disposing of Refuse in Keffi
Source: Field survey 2023

Table 1, indicates the data of occupational status in Keffi that generate and dispose of solid waste. The highest occupation is students due to proximity to schools around the study area. Followed by a civil servant (see figure 5).

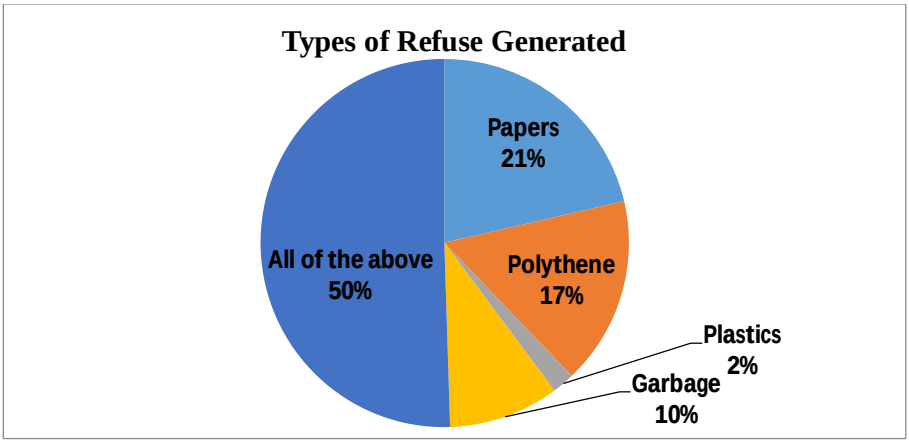

Figure 5: Percentages of Refuse Generation types in Keffi

Presents the data about refuse generation in Keffi. Most of the waste consists of papers, polythene, plastics and Garbage. About 50% of the refuse generated contained mixed types of solid wastes in Keffi. 21% are papers, 17% are polythene, and Garbage has 10%.

Figure 6 below, is the percentage of the solid waste generated, 64% is the highest response which generates refuse daily in the study area. While 26% of the responses were generating refuse weekly, where as monthly and hourly produces refuse with 5% each.

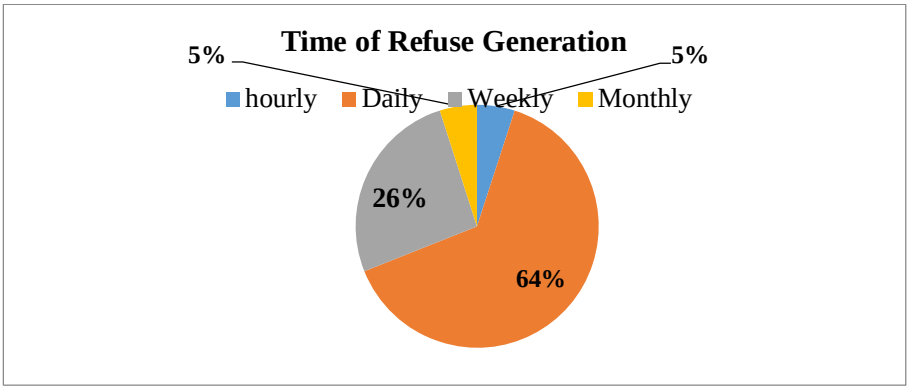

Figure 6: Percentages of frequencies of Refuse generation in Keffi

Number of people involved in Recycling

Most people in the study area are not interested in recycling their waste. Figure 7, presents the data of those who engaged in recycling and those who are not.

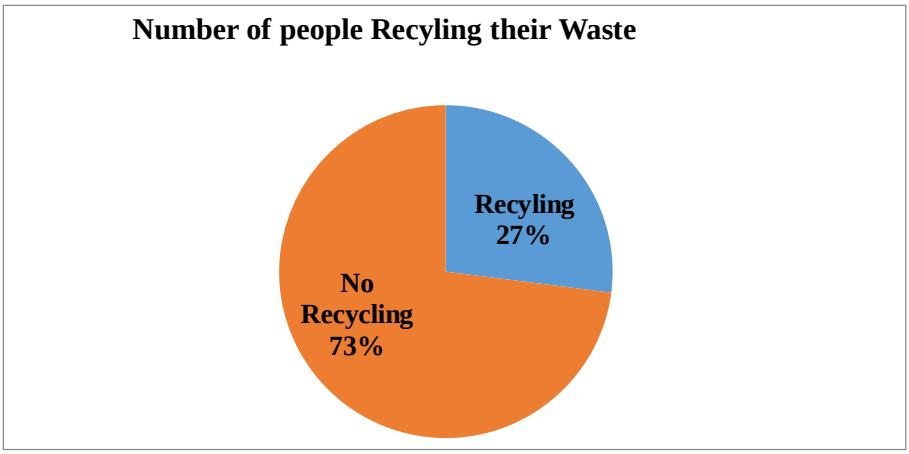

Figure 7: Percentages of people Recycling the waste in Keffi

About 73% of the respondents were not engaged in solid waste recycling. While over 27% have been recycling their refuse. The idea of recycling is to limit cost and sort out trashes that can be reused. Almost all developed industrial countries recycle their waste material and manufacture it again. The issue in Keffi is that few individuals act as scavengers and pick up waste metals, iron and plastics for recycling (Baban Bola).

Table 2: Methods of Refuse Disposal in Keffi

S/no	Method of Disposal	Respondents
1	Open Burning	63
2	Land Filling	16
3	Burying	10
4	Composting	11
Total		100

Source: Field survey 2023

The results presented in Table 2 is the methods of refuse disposal in Keffi showing different categorize of refuse being disposed of. These include open burning which stands at 63%, landfilling 16%, burying 10% and composting 11%.

DISCUSSIONS

The percentage of composition of each of the component of refuse can be calculated below

Percentage composition of waste fraction;

$$= \frac{Weight\ of\ separated\ waste}{The\ total\ of\ mixed\ waste\ sampled} \times 100$$

1. 20/35×100 = 51kg
2. 10/45×100= 22kg
3. 5/15×100 = 33kg
4. 2/5×100 = 40kg

51kg+22kg+33kg+40kg = 146kg

The total refuse disposed in Keffi is **146kg** by **100** persons

The per capita generation was also determined as per the mixed or the total waste collected in a day and also the separated fractions using this formula:

Per capita waste generation

$$= \frac{Weight\ of\ MSW\ generated\ at\ Household}{Total\ number\ of\ persons\ in\ the\ household} \times$$ Total number of generation days;

1. 146/35×20 = 83kg (1person = 4kg)
2. 146/45×15 = 48kg (1 person = 3kg)
3. 146/15×10 = 96kg (1 person = 10kg)
4. 146/5×5 = 146kg (1 person = 29kg)

Per capital Disposal by **100** households is **373kg**
Per capita Disposal **373/100** = **3.7kg**
Therefore the total per capita disposal in Keffi is **3.7kg**

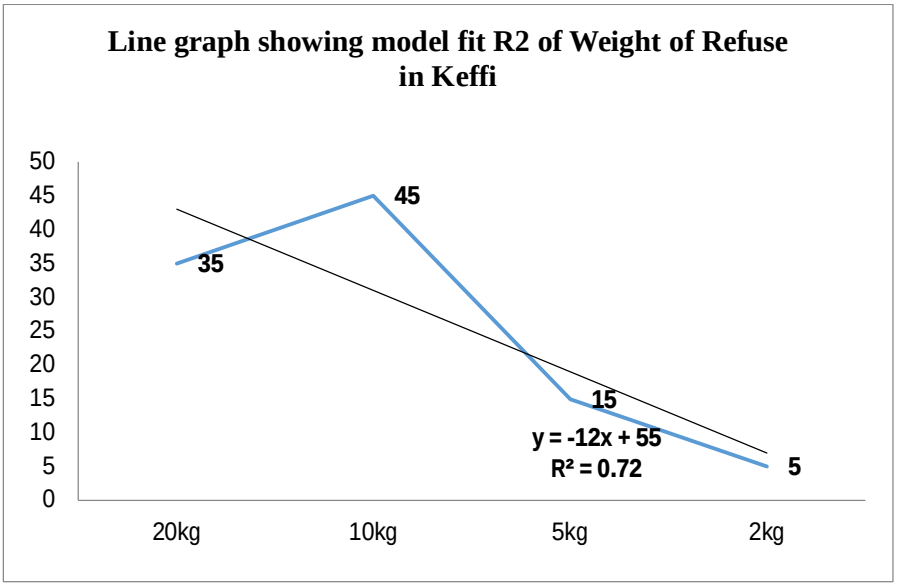

Figure 9: Line graph showing R2 with the model fit of 0.041

CONCLUSION

People in Keffi generate and dispose of refuse daily from their household to dump sites. The total disposal of refuse from 100 households is 146kg per day. That is each individual household generate about 14.6kg equivalent to 15kg per day. 35 houses generated and disposed about 51kg, 45 houses, generated and disposed 22kg, and 15 houses, generated and disposed about 33kg and only 5 houses including commercial areas generated and disposed 40kg. The total per capita generation of the municipal solid waste of Keffi was also calculated with 35 houses having 83kg, 45 houses have 48kg, 15 houses have 96kg and 5 houses have generated 146kg.

RECOMMENDATIONS

The following recommendation is to create a sustainable and efficient waste management system in Keffi.

1. The relevant authority are strongly adviced to expand waste collection coverage, establish sanitary landfills and recycling centers, and invest in waste-to-energy technologies.
2. Educate residents on proper waste disposal, introduce recycling programs, and incentivize sustainable waste practices.
3. Enforce waste management regulations, develop localized policies, and foster public-private partnerships for improved efficiency.
4. The use of digital tools for waste tracking, optimize collection routes, train waste management personnel, and monitor program effectiveness is highly recommended.

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