INT'L JOURNAL OF RESEARCH EDUCATORS AND SCIENTIFIC DEVELOPMENT
(ISSN) Print: 2992-5665 and Online: 2992-5673
Impact Factor: 5.5 || https://www.ijresd.net
Vol 8 Issue 1. JUN, 2025

CONVERSION OF SOLID WASTE TO WEALTH IN UDU LGA OF DELTA STATE, USING JACOBI'S ITERATIVE MODEL

BY

Engr. Prof. L.C. Eme
Department of Civil Engineering, Faculty of Engineering,
Chukwuemeka Odemegwu Ojukwu University

And

Nzeri Kenneth C.
Department of Civil Engineering, Faculty of Engineering,
Chukwuemeka Odemegwu Ojukwu University.

ABSTRACT

This study focuses on the conversion of solid waste to wealth in Udu Local Government Area of Delta State, using Jacobi's Iterative Model. Solid waste has become a major environmental problem in the area due to poor disposal methods and lack of recycling systems. The research aims to explore how solid waste, if properly managed, can become a source of income and job creation for the people in the community. The study also examined the socio-economic and demographic characteristics of Waste Management Entrepreneurs (WMEs) in the study area. Jacobi's Iterative Model, a numerical method used for solving systems of linear equations, was applied in this study to analyze waste generation, classification, and conversion patterns. By using this model, the research was able to predict and estimate how much waste can be converted into useful products over a given period. The model also helped in identifying the types of solid waste that are most suitable for recycling and the best ways to handle them for economic gain. The study involved field visits, interviews, and data collection from households, market places, and industries in Udu LGA. Information was gathered on the quantity of waste produced daily and how it is managed. The data collected was used in the Jacobi model to calculate how much waste could be turned into useful materials like compost, plastic pellets, or recycled metals. The model showed that with proper planning, up to 60% of the solid waste in Udu could be converted into wealth. Findings from the research revealed that most residents are not aware of the economic benefits of waste recycling. Lack of awareness, poor infrastructure, and weak government policies were identified as major challenges. However, the results showed that if the community adopts modern waste management methods supported by mathematical models like Jacobi's, solid waste can become a valuable resource that supports local development and environmental sustainability. The study concluded that the government should provide training programs to teach people how to recycle and turn waste into useful products. This will help them gain skills and start small businesses from

waste materials; waste collection systems should be improved so that people can easily separate waste into plastic, metal, paper, and organic materials. This will make recycling easier and more effective; and public awareness campaigns should be organized to educate people about the benefits of turning waste into wealth. When people understand the value of waste, they will be more willing to take part in recycling activities

INTRODUCTION

Solid waste is a major environmental concern because of the large amounts produced daily and the way it is often poorly managed. When not properly handled, it can lead to pollution, spread diseases, and affect both land and water quality. One of the main causes of solid waste is the increase in population and urbanization. As more people move to cities, the amount of waste being generated also increases. According to Uloko (2022), solid waste refers to any type of garbage or refuse that is discarded by households, businesses, or industries. It includes items like food scraps, paper, plastic, glass, metals, and worn-out appliances. Many households and businesses rely on packaged goods, which often come with plastic, cardboard, or metal wrapping. These packaging materials quickly become waste after use. According to Nwankwo (2020), the rise in consumer lifestyle has led to more waste being produced than in previous decades.

Improper disposal of solid waste can harm the environment and human health. When waste is dumped in open spaces or rivers, it pollutes the environment and becomes a breeding ground for pests and diseases. In some areas, burning waste is common, which releases harmful gases into the air. Uchegbu (2019) noted that this kind of pollution contributes to respiratory problems and other health challenges among people, especially children and the elderly. The problem of solid waste in society has become a serious concern due to rapid urban growth and changing lifestyles. As more people move to cities and towns, the amount of waste they produce increases. This waste, if not properly managed, causes pollution and harms the environment. According to Okonkwo (2019), most urban areas in developing countries struggle with poor waste management systems, leading to large heaps of waste on streets and in open spaces.

Solid waste can affect public health in many ways. When waste is left uncollected or poorly disposed of, it attracts flies, rodents, and other pests that spread diseases. This puts the health of people, especially children and the elderly, at great risk. Ezeh (2021) explained that poor waste handling can lead to the spread of diseases such as cholera and typhoid, especially in places with poor drainage and sanitation. This problem, according to Oluwale (2023), can be traced to waste management in Nigeria.

Urban solid waste management in Nigeria is constitutionally the responsibility of the third tiers of government that is the local government (Federal Republic of Nigeria 1999). Financial, material and human resources that have been committed to waste management by this tier of government have not matched this responsibility. This is evident by the reason indicated earlier, the poor management of many landfill sites and soil and ground water pollution due to often mixing of household, industrial and toxic waste (UNEP, 2000). In view of the environmental situation described above in many urban area, many Nigeria cities have

been described as dirty, unsanitary, and aesthetically displeasing in the world (Mabogunje, 1996).

As a result of the failures recorded by Local government in solid waste management, many state government have put in place bodies that are regional in outlook (that is covering more than one local government) for example in Delta state the Warri waste management Authority was established in (1996); Asaba Waste disposal board Authority was established in 1989. The desire of the Asaba State government to derive value from waste while at the same time effectively protecting the environment led to the creation of the State Integrated Waste Recycling and Treatment project. This mandate involves designing and promoting policies and programmes to encourage Source Separation, the development of pilot schemes to encourage and promote waste recycling, the building of local/national markets for recycled products, and collaboration with other appropriate government agencies to regulate the safe handling, disposal and treatment of different waste within the state. The result expected is to mitigate the soil, water and air pollution that is usually associated with improper hand.

Additionally, specific technical expertise and related general repair and maintenance technology are often absent in developing nations for example, incineration in Africa would be infusible if the waste stream include 70% wet organic content under these conditions. Incineration is likely to be energy consuming rather than energy producing option. There are environmental health problems associated with incineration. When conditions are not optimal, incineration volatilizes many compounds, such as dioxins, Sulphur dioxide and carbon monoxides which are potentially harmful to human health, atmosphere, plants and animals (Maryanhaire et al 2009)

In the past few years, research on SWM in Nigeria has focused essentially on contextualizing waste recycling as an approach to urban environmental management and livelihood (Adeyemi, Olorunfemi and Adenoye, 2001; Agunwamba, 2003; Nzeadibe and Eziuzor, 2006; Nzeadibe and Iwuoha, 2008). Unfortunately, SWM appear to have received little attention from Nigeria Scientist especially from the view point of the socially related Millennium Development Goals (MDGs) (Nzeadibe, 2009).

Environmental concerns and sustainable development are germane to MDGs, which makes an investigation into how wealth generated from waste helps in sustainable environmental management an appropriate subject of inquiry in gaining personal revenue through different waste highlighted in this paper as seen in the later.

STATEMENT OF THE PROBLEM

(I) In the pursuit of sustainable wealth creation through waste generation, the first priority is how to prevent waste generation, then gather the solid waste of various constituents within the enabling environment to a safe disposable dumping site.

(ii) Identifying the most useful solid waste that could be much more beneficiary in wealth creating by recycling and to the enabling environment.

(III). The foregoing review demonstrates that waste to wealth creation has multiple socio-economic and environmental benefits yet it has not been systematically examined in Udu, L.G.A of Delta State. The dearth of such

work is an important research gap needed to be urgently filled.

RESEARCH QUESTION

The research questions posed are as follows:

1. The sources and destinations of recyclable municipal solid waste in Udu L.G.A of Delta State?
2. The socio-economic and demographic characteristics of Waste Management Entrepreneurs (WMEs) in the study area

AIM AND OBJECTIVES

The aim of the study is to;

1. Evaluate the potential for municipal solid waste re-use/recycling as waste management strategies for waste creating in Udu L.G.A of Delta State Metropolis.

The specific objectives are to;

1. To create wealth and promote a sustainable environment.

2 .Examine the socio-economic and demographic characteristics of Waste Management Entrepreneurs (WMEs) in the study area.

3. Identify the source and destinations of recyclable municipal solid waste in Udu metropolis.

1. Identifying the town enveloped largely with refuse dump with the L.G.A.
2. Analyzing the quantity of waste materials (metal scraps, plastic etc.) reserved, re-used and transported for recycling.

JUSTIFICATION FOR THE STUDY

There are several reasons for continuous research on waste problem at local, national and global levels. The earths natural resources are fast dwindling. Hence, the need to conserve the resources. The study, therefore will be useful to the government, the society, manufacturers, students, future researchers, use simple grammar.

For the government, it will help them see better ways to manage waste and turn it into something valuable. With the right ideas from this study, the government can make new policies that encourage recycling and waste-to-wealth programs. This can help reduce the amount of waste in cities and towns, save money on waste disposal, and create job opportunities for people.

The society will also benefit from this study. When waste is properly managed and used to create useful products, the environment becomes cleaner and safer. This helps to reduce the spread of diseases that come from dirty surroundings. People can also earn a living by collecting, sorting, and selling waste materials, which improves their standard of living.

Manufacturers can use the results of this study to find cheaper and more eco-friendly ways to get raw materials. Instead of relying only on new materials, they can use recycled items to produce new goods. This can lower their production costs and help them support the environment by reducing pollution.

Students will find the study helpful because it will give them knowledge about solid waste management and how it can help the economy. It will also show them new business ideas, such as how to create products from waste. This can inspire them to

be more creative and think about how to solve real-life problems in their communities.

Future researchers will benefit from this study because it will serve as a useful reference. It will give them background knowledge, ideas, and data that they can use to do more studies on waste management and related topics. They can also build on this research to find new and better ways to turn waste into wealth.

SCOPE AND LIMITATION OF THE STUDY

The purpose of this study is to evaluate the potential for solid waste re-use and recycling as a management strategy to create wealth and promote a sustainable waste management using Jacobis iteration. The spatial scope of the work are towns in Udu L.G.A of Delta State which include: Orhuwhorun and, Opete Ovwian and Aladja, Ekete and DSC Ujevwu , otor- udu, Egini and ugbogo, etc

The study therefore examined recovery, re-duce and recycling of waste materials. The focus was also on metals, ceramics, plastics and electronic waste etc. using only Jacobi's Iterative method as tool for judgement for data collected through the procedure of 6 months (March 2023 to August 2023).

LITERATURE REVIEW

CONCEPTUAL FRAMEWORK

SOLID WASTE

Solid waste has been defined in different ways by scholars, researchers, and environmental agencies. Generally, it refers to materials that are discarded after use and are no longer considered useful. According to Ogwueleka (2019), solid waste includes non-liquid materials that result from domestic, commercial, industrial, or agricultural activities. This definition highlights the different sources of waste and the fact that solid waste does not include liquids or gases.

EMPIRICAL FRAME WORK

The articles were reviewed under different sub headings: Africa, Asia and Europe

COMPARATIVE ANALYSIS OF SOLID WATSE IN NIGERIA.

Waste has been an issue in Nigeria and across thße globe and the government has taken serious measure to regulate waste generated; Morrissey and Brown, (2019). It was added that these are several components of waste that are considered to be potential income provider; Murray (2012). The quest for this one made Ondo State Integrated Waste recycling and treatment project to be established in June, 2006; (John, 2012) waste and recycling treatment plant. The project was aimed at minimizing solid waste in Akure and it's environs since it's inception.

It has been recorded that they have been huge successes in transforming the waste generated to wealth by the development of various valuable products, using the basic concept of sustainability, social progression, technical and technological improvements, environmental protection and economic development (Oluwatosin, 2013). Environmental Impact assessment in Ondo State.

Comments

i. All solid waste can be adopted depending on the availability.

ii. For effective comparative Analysis recycling, techniques should be more considered here.
iii. Both heavy and light weight solids should be considered herein for effective and maximal wage.

ANALYSIS OF PROBLEMS ON SOLID WASTE IN NIGERIA

The problem of solid waste disposal has become one of the most serious environmental problems facing many cities in Nigeria. Ibekwe and Adefemi et al (2004); In recent years, there has been a phenomenal increase in the volume of waste generated daily in the country. This is due to the population growth rate; increasing urbanization, industrialization and economic growth, Adewumi; (2009) waste management in Nigeria.

Mabogunje and Ayidele et al (2000), added that most Nigerians lack effective waste management system, because of this household resort to the haphazard dumping, burning and burying of solid waste.

The few urban communities where the system is in place, and Akintola (2005) added that waste management authorities should be at alert to collect this refuse from households and public centers on regular basis using collection trucks.

Combustion:

The problems of solid waste in Nigeria results from poor waste management system, high population growth, industrialization amongst others.

Comments:

i. Mabogunje and Ayodele et al (2000); Nigeria lack effective waste management and because of this household and market trader amongst lack waste dump culture.
ii. Adefemi and Akintola et al (2004); Local government council as third tie of the government is sole responsible for community waste management.
iii. The annual waste generation reserves the best opportunity to utilize it in wealth creation and power generation.

UTILIZATION OF RENEWABLE ENERGY FOR AN IMPROVED POWER GENERATION IN AFRICA USING LAND FILL GAS.

Municipal solid waste landfills are the largest sources of human created methane are emission (Erikson 1999); a methane emission from landfills has a significant energy resource. Landfill gas (L.F.G) are created by from solid waste decomposition. Land fill gas is about 40% - 60% methane, with the remainder being mostly carbon dioxide (Co_2). Land fill gas also contains varying amount of Nitrogen, Oxygen, water, vapor, Sulphur and hundreds of other contaminants such as tritium (radio active hydrogen) have been found in landfill gas. Methane is important for electrical generation by burning it as a fuel in a gas turbine or steam boiler.

Biogas (such as methane) is ranked low priority in Nigeria energy policies; Coals and Bollera et al (1999).

Meanwhile, biogas activities are yet to begin, but lot of research has been conducted on the development of small scale digester using biogas (Wolkowski, R., 2003)

If the total potential of methane were exploited it is estimated that the research area

could produce 30% of its present electricity of 30% of wealth through waste generated

Comment

i. According to (Erikson 1999) municipal solid waste landfill are the largest sources of human created methane emission.
ii. Landfill is a significant energy resources where solid waste decomposes to about 40% to 60% methane gas.
iii. Biogas activities are yet to be conducted on small scale digestor (Wolkowski R, 2003)

SOLID WASTE COLLECTION PRACTICES IN EUROPE

With the creation of the Mexican Waste Integrated recycling treatment project, Morrison B.; (2008); the already house hold solid waste collection system was utilized. House hold collection was divided into 2 types; door to door and transfer point collection.

In high income areas, the collection was mainly door to door and transfer point collection. In high income areas; the collection was mainly door to door.

During typical solid waste collection, one of the collector crew walks along the street alerting households by using an alarm or an alarm sounded from the truck; for household to bring their waste out for collection. The crew member loads the truck from the respective waste bin and containers and return the containers to the owners. The waste is later transported to the landfill site at Latoh Josiah and Vint et al (2007); for sorting and recycling. The collection activities are usually carried out by house servants under supervision of women or the women themselves. The charge incurred for the service is the responsibility of households. Households are charged depending on house/property type, for waste collection and transportation; but for waste disposal/treatment no fee is being charged or paid.

Comment

i. For high income areas; the collection was from door to door and transfer point collection.
ii. Household refuse collecting system was well utilized.
iii. Collecting crew members walks along the street with alarm blown collecting solid waste from house to house. Households aren't charged for waste disposal or treatment but rather for the type of house or property(ties).

COMPARATIVE ANALYSIS OF ENERGY RESOURCES IN AFRICA

According to Tarek M. Khali, (1981). He reviewed that energy shortage is becoming one of the major problems threatening continued improvement in quality of life of modern societies. Limited resources of known developed energy. Sources and a high rate of consumption by industrialized countries combine in creating very serious conditions undermining the economic base of development. The energy used by society in the form of heat light, mechanical power, etc known as basic energy forms, comes from primary and secondary sources. Primary energy resources are natural sources such as wood, coal, wind, crude oil, Uranium, geothermal, natural gas and solar radiation. Secondary energy is converted technologically from primary sources and include electricity, gasoline, fuel, oil, hydrogen and methanal.

The team final energy is used to indicate primary and/or secondary energy sources after transportation losses have been taken into consideration. The distribution to region and from country to country.

He further reviewed the energy demand as consumed in United States as at 1973, rate of energy consumption indicate an average level of $2.5x10^{12}$ Watts or approximately 7300 trillion BTU per year. The most popular final energy forms have been electricity, oil, gas and coal. Consumption of these forms vary by the consumer sector. The three major sectors are household and commercial, transportation and industrial. Household and commercial sector: take account of 30% of the final energy total consumption. The transportation sector: takes account of 30% of the final energy consumption. The Industrial Sector: Takes account of 40% of the final energy total consumption in the United States.

Energy Availability: It's roughly estimated that the world is consuming fossil fuel at a rate of one million times faster than they are produced with the limited resources of fossil fuels and the increasing demand of energy consumption. It is likely that these resources will be exhausted.

Alternative Energy Sources: Several alternative energy sources are frequently mentioned. These includes; Wind power, water power, low temperature solar energy, solar power through photosynthesis, solar electric generation, Tidal power, geothermal power, fission energy (without breeding) fission energy (with breeders), coal, ocean thermal energy conversion (OTEC). The alternative Energy sources contains both renewable and non-renewable sources such as; Solar and wind, coal and geothermal respectively. In comparing alternative energy sources, the following factors should be considered;

- Availability, Rate of Energy Production, Economic Competitiveness, Characteristics of energy produced, Life span of the source, Environmental and Safety Considerations, political consideration, psychological barriers for change. Root's finding indicated that the alternative sources that are large enough to supply us energy needs are coal, nuclear fission with breeders and solar electric generation. All other sources together could not supply energy at the current U.S consumption rate.

Viability of Solar Energy: The ideal characteristics in a future form of energy are;
- It should be abundant and preferable renewable

- It should be clear so it will not cause pollution or produce waste.
- It should be safe in production, utilization and disposal.
- It should be economically competitive.

He continued, the economic evaluation of the alternative energy sources comparative economic analysis of alternative energy sources is a prerequisite for rational planning and for making strategies of substitution of one form of energy with another. Criteria such as, objectively, consistency, completeness, realizing such determine the cost analysis evaluation; time frame and time value of money, inflation and escalation, Tax Structure, tac incentives and depreciation, discount rates, levelization and financial equivalence, externalities and other.

In conclusion: Industrial Engineers and economists have a large role to play in studying the economics and policy of alternative energy sources. They should become increasingly involved in applying their knowledge and techniques towards solving the extremely important world wide problems of energy shortage.

Comments:

i. Alternative energy resources, can be a major source of energy in a country.
ii. Comparative Economic analysis is a prerequisite for planning an alternative energy sources.
iii. Solar energy as green energy should be safe in production, utilization and disposal

DATA ANALYSIS

The study was done using quantitative and qualitative analysis for data collection. Data collected during the study were analyzed using relevant economic and other statistical tool in other to achieve the desired goal.

Sampling Technique and Size

The concept of sampling is most fundamental in the conduct of my research and interpretation of research result. In many cases compact coverage of the population might not be possible but an approximate could be obtained. In this research work random sampling technique were employed in ensuring a good spread of respondents. This random sampling techniques served as a guide in the choice of population of target for generalizing sample findings to the true representation of the population which happens to be the key characteristics of all probability sampling techniques.

At first level, sampling procedure is obtained within Udu Local Government Area of Delta State were eight (8) major communities within the L.G.A was selected due to their high disposal of refuse dump and their increased population growth according to last population census conducted in 2006.

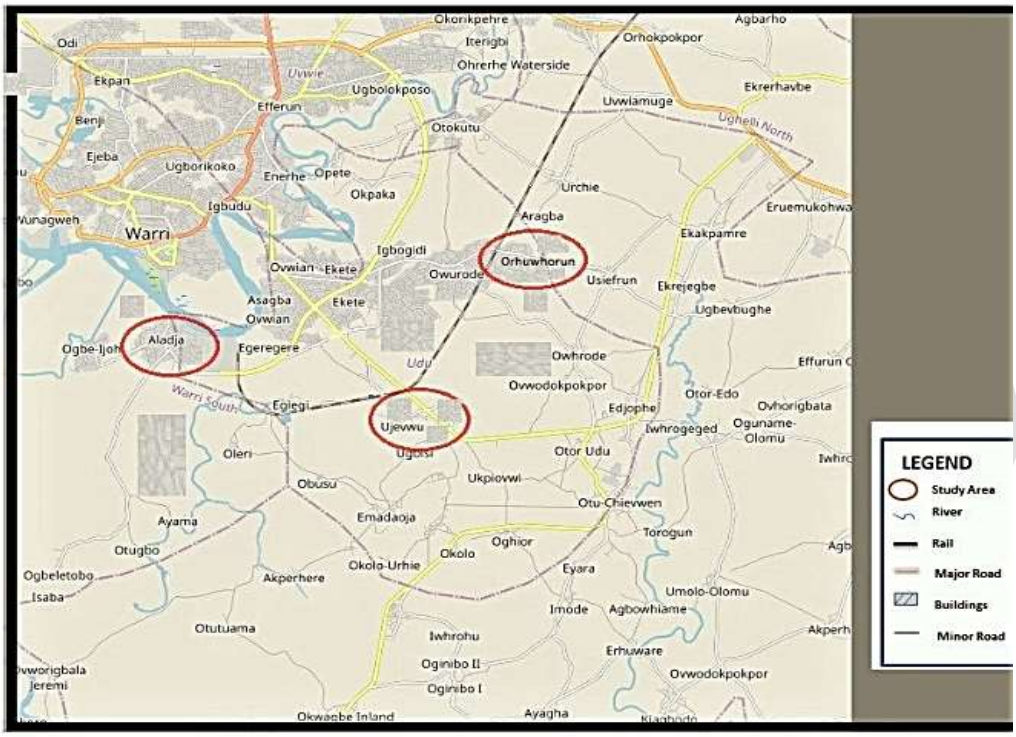
AREA OF STUDY

Udu Local Government Area is in Delta State, Nigeria. The local government headquarters is located at Otor-Udu. It had a population of 249,155 at the 2006 census.Another population census ought to be conducted in 2016 , but unfortunately wasn't conducted .An estimated population of 945,519 person was used in estimating the waste generated in 2024

Udu LGA covers an area of 435 km^2;. The postal code of the area is 332. With 8(eight) town and villages. The underlined are the towns while the remaining are the villages includes Town (A)Aladja and Oleri (B) ,Ovwian, and Ekete , (C) Orhuwhorun.and Usiefurun (D),Otor- udu, Egini, Opete and Okpaka Others are villages e.g Emadadja, Obubu, Ukpiovwin, Ukperheren, Ayama, Ekrota, Ugbisi, Owhrode, Okolo, Ovworhokpokpo, Erhiephiho, Egiegi, Epkrakpame, Oghior, Ohwase. Udu LGA is bordered by several other Local Government Areas, including Ughelli North, Warri South, Warri North, Ethiope West, Ughelli South, Sapele, and the Warri River to the east.

INT'L JOURNAL OF RESEARCH EDUCATORS AND SCIENTIFIC DEVELOPMENT
(ISSN) Print: 2992-5665 and Online: 2992-5673
Impact Factor: 5.5 || https://www.ijresd.net
Vol 8 Issue 1. JUN, 2025

Research Towns in Udu local government Area of delta state



Prior to this information, visit was made to these town/ communities in Udu L.G.A of Delta State to carrying out a general survey in the adverse effect and usefulness as it affects the environment and standard of living of inhabitants within the locality.

The survey visit was unannounced and was carried out weekly per location, within a time frame of 3pm - 6pm daily. This was to ensure that respondents would have been back from their work or business. A cover letter was attached to the questionaire as a prove to respondent that it's purpose was used strictly for academics.

INSTRUMENT FOR DATA COLLECTION

The major instrument chosen for this study is the questionnaire. A uniform set of questionnaires was administered to respondents within the selected communities of the study area, comprising of 200 questionnaires. The questionnaire of open and close ended items that were related to the study theme. Information soughted from the respondents include sources and destination of solid waste recycling, social economic characteristics of waste management entrepreneurs (WME), changes in government policies as it affects solid waste within the location. The level of waste management and wealth creation within the study area and possible solution that could sustain the wealth creation in waste. The questionnaire have a standard response pattern of (i) Strongly Agree (ii) Agree (iii) Undecided (iv)Disagree and (v) Strongly Disagree.

VALIDITY OF RELIABILITY OF INSTRUMENT

The questionnaire system was adopted the Eme (2009); so as to make sure that the pattern was valid and reliable to measure opinion on the research topic. However, the reliability of the instrument was determined using Jacobi's Iteration as a model tool for obtaining a reliability coefficient of 0.95. this process helped to write whether to accept or reject the null hypothesis.

METHOD OF ANALYSIS

In analyzing the data, the researcher made use of mean score to answer the research question that aided the study. In doing this at cut off mean score of 3.0 and above was regarded that the usage of turning waste in wealth is more beneficiary compared to just disposing it in a dump ground or site while a mean score less than 3.0 shows that disposing of refuse was beneficiary to the community(ies) since it maintains a good and balanced healthy environment which may in turn promote good living of inhabitants in these study areas. In calculating the mean score, the five-point rating scale was given the following value by the researcher.

(i)	Strongly Disagree (S.D)	1 point
(ii)	Disagree (D)	2 point
(iii)	Undecided (U)	3 point
(iv)	Agree (A)	4 point
(v)	Strongly Agree (S.A)	5 point

Where

X = summation or zigma

E = frequency

X = individual occurrence

N = sample number

Decision Rule: The decision rule poses that the cutoff point which is 3.0 shows that any response mean(x) that is equal to or greater than 3.0 was accepted as agreed, while responds less than 3.0 was regard as disagreed.

TEST FOR NULL HYPOTHESIS

Contingency Coefficient: A contingency test is carried out on the null hypothesis based on the questionnaire data obtained to access the relationship and test the null hypothesis and to check the validity of the hypothesis generated so as to validate the relationship to the research.

DUMP SITES COLLECTION AND METHODS

The method employed in collecting data's for the different scraps i.e Metals (X1) , Ceramics (X2) , Plastics(X3) and Electronic waste (X4) from ten(10) dump site was by selective method.It is categorized into four locations as A(Aladja and oleri) ,B(Ovwian and Ekete, C (Orhuwhorun

and Usiefurun) and D(Opete ,okpaka , oror-udu and egini) towns or communities.For each dump site or locations, metals ,ceramics ,plastics and electronic waste were brought out and weighed with scale and results were obtained in (kg) and converted to metric tons .

INSTRUMENTS / MATERIALS

(i) Weighing scale

(ii) Weighing pan

(iii) Hand gloves

(iv) Nose mast

(v) Coverall

(Vi) Safety boot

(Vii) Selecting rod

(Vii) Wheel barrow etc

Calculations :

W3= weight of pan and scrap (kg)

W2= weight of scrap (kg)

W1= weight of empty pan (kg)

Actual weight of scrap(W2) = W3 - W1(kg)

Mean Average was taken to authenticate results i.e

W2 =(W3- W1) +(W3- W2)

2. =X (Kg)

Allowing for 2% over site in proper quantity selection for each total measurements= 0.02

0.02 × total waste = y

Therefore , Y+ X = actual Total (Z)

According to ;Joe Sexton et al ,in converting kilograms to a measurement in metric tons, divide the weight by the following conversion ratio:

1,000 kilograms/metric ton.

Since one metric ton is equal to 1,000 kilograms,we can use this simple formula to convert: metric tons = kilograms ÷ 1,000

INT'L JOURNAL OF RESEARCH EDUCATORS AND SCIENTIFIC DEVELOPMENT
(ISSN) Print: 2992-5665 and Online: 2992-5673
Impact Factor: 5.5 || https://www.ijresd.net
Vol 8 Issue 1. JUN, 2025

PICTURES SHOWING THE DIFFERENCE LOCATIONS (A – D) IN THE STUDY AREA

Location A (Aladja and Oleri)

Location B (Ovwian and Ekete)

INT'L JOURNAL OF RESEARCH EDUCATORS AND SCIENTIFIC DEVELOPMENT
(ISSN) Print: 2992-5665 and Online: 2992-5673
Impact Factor: 5.5 || https://www.ijresd.net
Vol 8 Issue 1. JUN, 2025

Location C (Orhuwhorun and Usiefurun)

Location D (Opete, Okpaka , Otor-Udu and Egini)

The picture below shows the measuring scale in (kg)

The figure below shows the weighing process , W1, W2 and W3

PRESENTATION AND DISCUSSION OF RESULT

Research Question 1: To what extent does sources and destination affect recyclable municipal and solid waste

Table 4.1: Analysis whether sources and destination would heavily affect recyclable municipal, solid waste by the households.

Item	Description	Score
1.	Purchase of less throwaway product helps to reduce the amount of waste	3.25
2.	Waste dump collecting site demands one to transport or walk longer miles.	3.13
3.	Individuals partake in returning waste to the company e.g plastics, e-waste, metals, ceramics etc if paid	3.32
	Ground mean (x)	3.23

Discussion: Data in table 4.1 shows that with item 1, generated mean mark of 3.25 shows that purchase of less throwaway product reduces waste, item 2, was show to be 3.13 shows that was dump site isn't relatively accessible making individuals to more miles away or pay transport to dispose their waste; item 3, has a mean of 3.32 indicates that individual would like to partake in returning waste to companies if given the opportunity. Consequently the grand mean was 3.23 which shots above the cutoff of 3, shows that sources and destination of solid waste has heavily affected household users as affirmed by 6.47% of those living in their houses.

Table 4.2: Analysis whether sources and destination would heavily affect recyclable municipal solid waste by traders.

Item	Description	Score
1.	Purchase of less throwaway product helps to reduce the amount of waste	3.12
2.	Waste dump collecting site demands one to transport or walk longer miles.	3.02
3.	Individuals partake in returning waste to the company e.g plastics, e-waste, metals, ceramics etc if paid	3.41
	Ground mean (x)	3.18

Discussion: Data in table 3.2 shows that item 1, generated a mean mark of 3.12, shows purchase of less throwaway product to reduce waste; item 2, shows a mean of 3.02, indicates that waste dump collecting site demand individual to transport or walk miles; item 3, shows that a mean of 3.41, indicates that individuals partake in returning waste to company e.g plastics, e-waste, metals, ceramics, etc if they were paid.

Consequently, since the cutoff was 3 and the 3 items surpasses it; then we conclude that sources and destination of solid waste has heavily affected traders as affirmed by 63.7% of the traders within the research area.

Research Question 2: To what extent does the socio-economic and demographic characteristics of Waste Management Entrepreneur affects the populace in wealth creation.

Table 4.3: Analysis of whether socio-economic and demographic characteristics of waste management entrepreneur would affect in wealth creation of household individuals.

Item	Description	Score
4.	Waste management board (WMB) allows waste management entrepreneur (WME) operate free in the community.	2.91
5.	Waste management board monitor indiscriminate dumping of refuse,	3.06
6.	Waste management entrepreneur indulge in theft in the process of picking scraps.	3.18
	Ground mean (x)	3.04

Source: Field Survey, 2025.

Discussion: Data in table 3.3 shows that item 4,5 and 6 has a grand mean of 3.04 which is higher than the cutoff of 3.0. This shows that socio-economic and demographic characteristics of waste management entrepreneur will affect individuals and their enabling environment due to the quest for wealth through waste; which is agreed by 33.22% of individuals living in their houses.

Table 4.4: Shows Analysis whether socio-economic and demographic characteristics of waste management entrepreneur would affect wealth creation traders in the market.

Item	Description	Score
4.	Waste management board (WMB) allows waste management entrepreneur (WME) operate free in the community.	3.05
5.	Waste management board monitor indiscriminate dumping of refuse,	3.04
6.	Waste management entrepreneur (WME) indulge in theft in the process of picking scraps.	3.40
	Ground mean (x)	3.16

Discussion: Data Analysis shows that socio-economic and demographic characteristics of waste management entrepreneur will affect individuals and their enabling environment and 65% of the individual traders. This is because the grand mean is 3.16, which is above the cut off mark which is 3.

4.6 Test of Reliability of the Experiment

The test for reliability of the coefficient was determined using Pearson's product moment correlation. The reliability coefficient was found out to be 0.9929.

Table 4.9: show Data for household individuals (x) and trader (y) in the study area.

Research question	1	2	3	4
Household individuals (x)	3.23	3.04	3.53	3.19
Traders/market sellers (y)	3.18	3.16	3.61	3.37

Test Hypothesis (I)

The experiment is tested at 0.05 level of significance with a degree of freedom of (r-i) (i-i); (4-1) (2-1) = 4 and the critical value from the table is 0.045 calculated or obtained a value of 0.953, since the obtained value is greater than 0.045, therefore the null hypothesis is rejected.

Test of Hypothesis (II)

The t-test is head for sample size less than the thirty (n<30) when two mean are significantly different. Independent sample are random formed because the number of the group, (household) and (traders) were selected from the populations. The test of independent sample is used to determine if these are probably a significant difference between the mean of the two sample.

Using the relation for t-test independent sample

$$t = \frac{X_1 - X_2}{\sqrt{\frac{S^2_1 + S^2_2}{n_1 + n_2}}}$$

where X_1 and X_2 are the mean of group 1 and group 2 tentatively

S = Standard deviation

n = number of subjects in each group

Group 1 (household) = 3.23, 3.07, 3.53, 3.19

Group 2 (traders) = 3.18, 3.16, 3.61, 3.37

Table 4.11

N	Group 1 (X_1)	Group 2 (X_2)
1	3.23	3.18
2	3.04	3.16
3	3.53	3.61
4	3.19	3.37
	$\Sigma = 12.99$ $x = 12.99/4 = 3.24$	$\Sigma = 13.32$ $x = 13.32/4 = 3.33$

To calculate S_1^2 is by subtracting the (x) value from the (x) score, then square each of the derivatives then add the square root derivative that is the standard derivation of S^2.

Table 4.12

N	Group 1 (X_1)	$X_1 - X$	$(X_1-X)^2$
1	3.23	-0.01	0.0001
2	3.04	-0.20	0.0400
3	3.53	0.29	0.0241
4	3.19	-0.05	0.0025
	12.99	0.03	0.1267

4.7 Analysis of the total solid waste generated in Delta State Urban using forecast for the period generated.

The waste was generated from four locations as at August 2023 = 2,432,000kg/day = 2,432 tons/day

The population projection based on the 2006 population census of 945,519 persons generated waste. i.e.

2,432,000kg/day = 2.572kg/person/day
945,519 persons

With the projected population of 1,984,403 in 2063 based on the next 40years from 2006 census adjusted for each of the four locations we have 1.053,984 kg/day as stated above.

The total waste generated as per projected population in 2063 is

$$\frac{1984,403}{945,519} \times \frac{2,432,000 \text{ kg/day}}{1}$$

= 5104147.136kg/day

$$\frac{5104147.136}{4}$$

= 1276036.784kg/day

We use this, to derive the **table 4.1** below shows the quantities of options/day/tons

Table 4.14 Show Cost Benefit Analysis on Recycling Option

S/N	Materials type/option	Cost/Kg (N)	Cost per ton (N)
1.	Metals = 856x1.5 (X_1) = N1284	$\frac{1276036.74}{884} \times \frac{1284}{1}$ = 1853428.93	1853
2.	Ceramics = 994x1.5 (X_2) = N1491	$\frac{1276036.74}{884} \times \frac{1491}{1}$ = 2152228.14	2152
3.	Plastics = 704x1.5 (X_3) = N1056	$\frac{1276036.74}{884} \times \frac{1056}{1}$ = 1524315.382	1524
4.	E-waste = 3320x1.5 (X_4) = N4980	$\frac{1276036.74}{884} \times \frac{4980}{1}$ = 7188532.766	7188

The cost per tons stated in table 4.1 will be used to formulate objective function to prove its maximization. Using the forgoing questionnaire field and data, problem resulting in optimization can be written in the form of; Maximize, $Z = N1853x_1 + N2152x_2 + N1524x_3 + N7188x_4$ (objective function)

Subject to: $122x_1 + 108x_2 + 2x_3 + 41x_4 \leq 1142$ - (1)

$39x_1 + 174x_2 + 94x_3 + 36x_4 \leq -1329$ (2)

$111x_1 + 107x_2 + 118x_3 + 59x_4 \leq -1831$ (3)

$149x_1 + 49x_2 + 109x_3 + 174x_4 \leq 1467$- (4)

$X_1 \geq 0, X_2 \geq 0, X_3 \geq 0, X_4 \geq 0$ (Non Negative Condition)

Where;

Z = profit/day/ton/1,582,403 (Population)

X_4 = tons of optimal quantity of e-waste

X_3 = tons of optimal quantity of plastics

X_2 = tons of optimal quantity of Ceramics

X_1 = tons of optimal quantity of metals

This linear programing can be formulated using Jacobi's method (Jack 2001)). We start with an approximation to the true solution, and by applying it's method repeatedly we can get a better approximation till an accurate solution is actualized; we refer to this as Iterative method or indirect method.

Table 4.4 shows a summary of waste generated

S/N	Daily waste per ton (N)	Weekly waste per ton (N)	Waste generated per year
1	33,471,123 33.47 million	234,297,86 234.29million	1218,348,877 1.218 billion

The table above shows the summary of daily , weekly and yearly waste generated per ton and it was found out that waste generated within the study area is very large

Table 4.5 Shows a summary of revenue generated.

S/N	Daily revenue (N)	Weekly revenue (N)	Yearly revenue
1	80.330 billion/day	512.314billion	29.240 trillion

The table above shows the summary of revenue generated daily, weekly and yearly in the research area , It was turned out to be venue huge

Table 4.6: Questionnaire responses on way refuse are disposed by respondents

S/N	**Areas**	**Use of central dump site**	**Burning of refuse**	**Burying of refuse**	**Other uncomfort ways**	**Total respondent**
A	Aladja (M) Oleri (H)	14 7	5 5	- 3	1 -	20 15
B	Ovwian (M) Ekete (H)	22 15	3 4	- 3	2 3	27 25
C	Orhuwhorun (M)and Usiefurun	08	2	2	2	14 14

	Opete (M)	11	3	-	-	27
D	Okpaka (H)	19	7	1	-	16
	Otor-Udu (M)	06	6	2	2	15
	Egni (H)	10	2	2	1	27
		18	7	1	1	
	Total	130 (65%)	44(22%)	14(7%)	12(6%)	200(100%)

Discussion

The analysis of the questionnaire responses in the assessment of waste management practice in UDU L.G.A of Delta State urban shows that those in the major markets e.g. Otor-udu market, Egini, market, opete market and Okpaka market dispose their waste at the designated waste management dump sites. Table 4.6 shows that ;

(i)130 respondents represent 65% of the entire study population use central waste dump sites to dispose their wastes;

(ii)22% represents 44 of the respondents dispose their waste by burning; and

(iii)7% dispose their waste by burying them, which represent

(iv)14 respondent and 6% represent those that dispose their waste by dumping them carelessly within this areas.

The information is represented in the pie chart above. It also depicts that respondents in market dump their waste at collecting site while house hold keeps theirs by either burning.

DATA COMPUTATION FROM FIELD WORK ON SOLID WASTE i.e. (Metals, Ceramics, Plastics, and electronic waste)

2.7 Result for Location A (Aladja and Oleri Communities) accused for 2% error

S/N	Material type/option	Aladja site tons	Aladja site tons	Oleri site tons	Oleri site tons	Total
1	Metals (x_1)	36.80	19.4	28.02	35.34	122
2	Ceramics (x_2)	26.9	28.7	32.4	17.84	108
	Plastics (x_3)					
3	Electronic waste	0.64	0.39	0.42	0.539	2.0
4	(x_4)	3.38	16.9	8.8	11.1	41

Discussion: from table 4.7 above; the total forms the first equation of the model used by Jacobi's Iteration as; $122x_1 + 108\ x_2 + 2\ x_3 + 41\ x_4$

4.8 Result for Location B (Ovwian and Ekete Communities) accused for 2% error

S/N	Material type/option	Ovwian site dump (tons)	Ovwian dump site (tons)	Ekete dump site (tons)	Ekete site tons	Total
1	Metals (x_1)	9.9	8.02	11.4	8.9	39.0
2	Ceramics (x_2)	42.5	32.8	57.82	37.4	174.0
3	Plastics (x_3)	28.32	15.8	22.9	25.1	94
4	Electronic waste (x_4)	9.28	6.24	3.4	11.3	35

Discussion: from table 4.8 above shows the second solution of the model by Jacobi's Iteration which was used to obtain optimum solution as $39x_1 + 174x_2 + 94x_3 + 36x_4$

Foregoing Analysis and Information Obtained by the Researcher Indicates that;

(i) A Environmental education is one of the essential issues that has been solved through public participation in waste management obtained from the questionnaire responses.

(ii) Sufficient and regular solid waste collecting system makes waste expositors not to dump their waste in open spaces and access roads or water way channels which contributes to health hazards.

(iii) Individuals living within the premises would find it easy to dispose their refuse, if the dump site is fixed at strategic locations.

(iv) Traders can easily access the dump site than household individuals as seen from the questionnaires.

(v) Ignorance of some enabling legislation on waste management and lack of manpower and political will to implement them, hamper improvement on the development and planning of waste management.

(vi) The volume of waste generated during comparison from the questionnaire was found that more waste are generated from market region and more dustbins, waste collecting vehicles and dumpsite should be situated at strategic positions within the terrain.

(vii)Adequate training of DSWMB: staff of the needs to be trained and retrained to improve their skills on recovery, reducing and recycling techniques

(viii) Government could set up security agencies to monitor agencies and picking scraps and scavengers so as not to steal valuables from the households.

(Ix) Respondents are of the opinion that public or (private contractors) should be engaged to assist in scraps like plastics, metals etc by returning it to thee company or manufacturers if they were paid.

(X) Much attention should be given to solid waste to generate revenue just as seen from the cost benefit analysis on how ceramics, metals, plastics and e-waste could erradicate abject poverty from an individual, community, state or country if attention is given.

(Xi) From the questionnaire, it is deduced that burning of dirt within the environment would be curbed completely if inceneration and refuse collectors are on standby.

SUMMARY

From the above observations analysed so far, we can deduce that

(I) Waste management strategy practiced by the Delta state waste management board (DSWMB) is still very poor and insufficient that huge waste dumps are found in most available dump site and much volume of refuge are constantly found littered all over the street environment.

(ii) The government needs to look into such bulky waste generated can generate revenue in billion through the three R's i.e recovery , reducing and Recycling.

(III) The health of individual within the study area cannot be left out: refuse close to household should be taken off within the shortest time frame: environment should be fumigated against offensive odour and bacteria.

(iv) Individuals picking scraps should be monitored as lots of complain of theft involve commodities and adopting little children as recorded. (iv)Individuals within the household should burn refuse is encouraged not to burn refuse but rather use incinerators so as to reduce environmental pollution and greenhouse gas effect, instead of arresting them.

CONCLUSION

The conversion of solid waste to wealth in Udu Local Government Area of Delta State shows that waste, when properly managed, can become a valuable resource. Instead of being seen as a problem, solid waste can be used to create jobs, generate income, and improve the environment. The people of Udu LGA have begun to understand the importance of recycling and reusing waste materials, which helps reduce pollution and promote cleaner surroundings. This study also reveals that with proper support and awareness, more residents can take part in waste-to-wealth programs. When people are educated about how to sort and manage waste, it becomes easier to turn these materials into useful products such as compost, plastic items, and even building materials. This process helps reduce the amount of waste dumped in the streets and rivers, protecting both health and nature.

Moreover, converting waste to wealth can boost the local economy. It creates opportunities for small businesses and local entrepreneurs to invest in waste collection, recycling, and production. This can also reduce unemployment in the area and help young people become self-reliant. With the right policies and training, Udu LGA can become a model for other communities in Delta State and beyond. The success of turning solid waste into wealth in Udu LGA depends on cooperation among the people, government, and private sectors.

RECOMMENDATION

1. The government should provide training programs to teach people how to recycle and turn waste into useful products. This will help them gain skills and start small businesses from waste materials.
2. Waste collection systems should be improved so that people can easily

separate waste into plastic, metal, paper, and organic materials. This will make recycling easier and more effective.

3. Public awareness campaigns should be organized to educate people about the benefits of turning waste into wealth. When people understand the value of waste, they will be more willing to take part in recycling activities
4. .

REFERENCES

Adebayo, A., & Ilemobade, A. (2018). *Solid waste management in Nigeria: Issues and challenges*. Lagos: Green Earth Publishers.

Adefemi, A., & Akintola, O. (2004). Urban waste management and the Nigerian local government system. *Environmental Management Journal*, 8(2), 55–63.

Adewumi, T. (2009). *Waste management in Nigeria*. Ibadan: Spectrum Books.

Adeyemi, A. S., Olorunfemi, J. F., & Adenoye, A. O. (2001). Waste management practices in Nigeria: Problems and prospects. *The Environmentalist, 21*(2), 125–131.

Agunwamba, J. C. (2003). Analysis of scavengers' activities and recycling in some cities of Nigeria. *Environmental Management, 32*(1), 116–127.

Akinwale, M. A. (2018). The challenges of solid waste management in Nigerian cities. *Journal of Environmental Studies, 12*(1), 44–52.

Al-Khatib, I. A. (2017). Solid waste management concepts and definitions. *International Journal of Environmental Science*, 12(1), 22–29.

Chika, A., & Philip, O. (2014). Waste transformation and recycling techniques. *Nigerian Journal of Sustainable Development*, 6(1), 77–84.

Erikson, E. (1999). Methane emission and energy generation from landfills. *Renewable Energy Review*, 3(4), 101–112.

Etim, D., Udofia, J., & Ekong, U. (2013). Waste segregation and energy utilization in Nigeria. *Journal of Environmental Science and Policy*, 9(2), 45–53.

Ezeh, P. N. (2021). Solid waste and public health: A Nigerian perspective. *Nigerian Journal of Public Health, 9*(3), 77–89.

Fabulous, Y. L. (2005). Recycling and waste management policies in Asia. *Asian Journal of Environmental Policy*, 10(1), 33–41.

Federal Republic of Nigeria. (1999). *Constitution of the Federal Republic of Nigeria*. Abuja: Government Press.

Ibekwe, O., & Adefemi, A. (2004). Environmental challenges in Nigerian cities. *African Urban Studies*, 5(3), 120–135.

John, O. (2012). Integrated waste recycling and treatment in Ondo State. *Nigerian Environmental Studies Review*, 7(1), 68–75.

Johnson, L. (2014). Environmental impact assessment in Ibadan. *Sustainable Development Reports*, 11(3), 91–98.

Latoh, J., & Vint, M. (2007). Waste collection practices in Europe. *European Journal of Waste Management*, 6(4), 201–213.

Mabogunje, A. L. (1996). The crisis of urban development in Africa. *Keynote Address at the 1996 Urban Research and Policy Dialogue Conference*. Ibadan: University of Ibadan.

Mabogunje, A. L. (1996). Urban waste and environmental sanitation in Nigeria. *Journal of Nigerian Environmental Studies*, 4(2), 14–26.

Mabogunje, A. L., & Ayidele, S. A. (2000). Solid waste management systems in Nigeria. *Environmental Review Series*, 3(1), 48–57.

Maryanhaire, T., Chikowore, G., & Chikodzi, D. (2009). Incineration and environmental health: The African context. *Journal of Environmental Science and Health, 7*(1), 23–33.

Morrison, B. (2008). Household waste collection models. *Journal of Public Health and Sanitation*, 10(2), 37–44.

Morrissey, A. J., & Brown, B. M. (2019). Global perspectives on waste regulation. *Waste Policy and Governance*, 15(2), 65–78.

Murray, R. (2012). Economic value of waste and recycling opportunities. *Journal of Environmental Economics*, 6(3), 102–111.

Nwankwo, C. J. (2020). Consumer lifestyle and waste generation in urban Nigeria. *International Journal of Environmental Studies, 15*(2), 101–113.

Nzeadibe, T. C. (2009). Solid waste reforms and informal recycling in Enugu urban area, Nigeria. *Habitat International, 33*(1), 93–99.

Nzeadibe, T. C., & Eziuzor, D. N. (2006). Urban solid waste generation and management in Nigeria: Issues and challenges. *Nigerian Geographical Journal, 4*(2), 27–33.

Nzeadibe, T. C., & Iwuoha, H. C. (2008). Informal waste recycling and rural-urban livelihood in Nigeria. *Environment and Urbanization, 20*(1), 23–37.

Ogwueleka, T. C. (2019). Overview of solid waste in Nigeria. *Nigerian Journal of Environmental Studies*, 11(1), 1–12.

Okonkwo, O. C. (2019). Urban waste and environmental degradation in Nigeria. *African Journal of Environmental Research, 5*(1), 55–65.

Oluwale, F. T. (2023). Waste management systems in Nigeria: Challenges and policy implications. *Nigerian Journal of Policy and Development Studies, 11*(1), 34–49.

Oluwatosin, F. (2013). Sustainability in waste-to-wealth initiatives in Nigeria.

Journal of Sustainable African Development, 5(2), 27–35.

Tarek, M. K. (1981). Comparative energy resource analysis in Africa. *Energy Development Journal*, 2(1), 13–19.

Tarrus, B., & Tije, R. (2014). Waste-to-wealth economic indicators in Asia. *Asia-Pacific Journal of Economic Development*, 9(2), 55–63.

Uchegbu, S. N. (2019). Environmental management and protection. Enugu: Spotlite Publishers.

United Nations Environment Programme (UNEP). (2000). *Waste management in Africa: The challenges and prospects*. Nairobi: UNEP.

United Nations Environment Programme (UNEP). (2000). *Waste pollution and landfill management*. Nairobi: UNEP Publications.

United Nations Environment Programme (UNEP). (2021). *Definition and classification of solid waste*. Nairobi: UNEP Publications.

World Health Organization (WHO). (2020). *Global definition and categorization of waste*. Geneva: WHO Press.