AN EVALUATION OF THE EFFECTIVENESS OF ENUGU WASTE MANAGEMENT SYSTEM.

BY

NWOZOR CHRISTIANA CHINWEOKE
[PG/MPH/12/63468]

A DISSERTATION SUBMITTED TO THE UNIVERSITY OF NIGERIA IN PARTIAL REQUIREMENT FOR THE DEGREE OF MASTERS IN PUBLIC HEALTH (MPH)
DEPARTMENT OF COMMUNITY MEDICINE

COLLEGE OF MEDICINE

UNIVERSITY OF NIGERIA

ENUGU CAMPUS

SUPERVISOR: DR. (MRS.) U. EZEOKE

NOVEMBER, 2015.

DEDICATION

This piece of work is dedicated to my lord Jesus Christ, to my darling husband and children for their unrelenting support and prayers towards the completion of this work.

ACKNOWLEDGEMENT

The successful completion of this work came about as a result of a massive contribution made by several people; without which the work would not have been materialized. I therefore, deem it necessary to express my profound gratitude to the following people;

Firstly, i express my profound gratitude to my dynamic, hardworking and never failing supervisor of the department of community medicine, Dr. Mrs. U. Ezeoke who was like a mother to me and did not only encourage me to write on the topic but also supervised and guided me through at no cost.

My thanks also goes to my colleague and friend ñCosmos Ogbonnaya", who in diverse ways has contributed to the successful completion of this work. I really appreciate him for he has been so wonderful to see that this work was a success.

I equally express my gratitude to Nandi Ebuka for all his effort to see that the questionnaires were administered. I am so grateful for their assistance.

DECLARATION

I declare that this dissertation herein presented for the
Degree of master in public health has not been previously submitted either wholly or in part for any other degree at this or any other university nor is it being currently submitted for any other degree.

SIGNED----------

NWOZOR CHRISTIANA,C.

APPROVED BY ----------

DR.U.EZEOKE
SUPERVISOR

APPROVAL

This dissertation of Nwozor Christiana is approved as fulfilling part of the requirements for the award of the degree of master in public health by the University of Nigeria.

SIGNATURES:

SUPERVISOR: DR.(MRS.).U.EZEOKE

HEAD OF DEPARTMENT
COMMUNITY MEDICINE

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ESWAMA	_	Enugu state waste management Authority.
EPA	_	Environmental protection Agency.
ISWM	--	Integrated Solid Waste Management.
LGA	_	Local Government Area.
H.O.D	_	Head of Department
H_2O	---	Water
GRA	---	Government Reserved Area

ABSTRACT

INTRODUCTION: The paper examined the patterns of solid waste management in Enugu metropolis, Nigeria. Wastes are useless, unwanted and discardedmaterials. Solid waste problem started with urban growth resulted partly from national increase in population,No towns in Nigeria especially the urban and semi-urban centers of high population density can boast of having found a lasting solution to the problem of filth and huge piles of solid waste, rather the problem continues to assume monstrous dimensions. To urban and city dwellers, public hygiene starts and ends in their immediate surrounding and indeed the city would take care of itself. The situation has so deteriorated that today the problem of solid waste has become one of the nationôs most serious environmental problem.

METHODOLOGY: The study is a cross sectional descriptive observational survey in which participants were interviewed to determine the pattern of solid waste management in Enugu metropolis. This was done by administration of questionnaires. Site visits, personal observation and in depth interviewwere also used to obtain data. This is because the sampling is done from a universe of clusters (streets), each street serving as a unit of sampling. The average weight of waste per house hold in the city were also assessed.

RESULT: The study reveals that majority of the respondents were ignorant of the rate at which ESWAMA collect wastes from the streets. Awareness and attitude of individuals towards waste management is a critical step towards overcoming the challenges of solid waste management. There was no statistically significant difference in the opinion of respondents regarding the buildup of waste on the streets prior to disposal, across the three LGAs studied. Majority of participants had no idea where the final destination of waste that ESWAMA collects was disposed of, this exposes the nonchalant attitude of the coal city populace to environmental issues, particularly waste management problem, in the city. Most of the respondents did not know whether wastes are disinfected by ESWAMA or not however key informer's interview revealed that the waste agency does not disinfect waste in any way. Wastes are simply collected and dumped at the dumpsites without treatment. This is a dangerous practice as it exposes the public to all types of risks especially when medical wastes are dumped at the same site.

CONCLUSION: Therefore the paper recommends that government should increase the number of ESWAMA personnel, staff, number of waste bin, compactor truck, provide waste bags to the society.

More so ESWAMA should pay attention in every areas in terms of prompt collection of waste from dumpsites and not focus in some areas and finally, public enlightenment and participation in waste management enhances effectiveness in the generation, collection, storage and disposal of waste therefore all sections of the society must be educated and brought together to work as a team to experience neat environment.

CHAPTER ONE
BACKGROUND

1.1 INTRODUCTION

The environment of man lies at the mercy of both natural disaster and negligence on the part of man in the course of controlling the gifts of nature. The later, takes the form of dumping solid/ industrial waste in an uncompromising, desert encroachment, erosion, depletion of ozone layer, depletion of natural resources, pollution of land, rivers, seas the air and generally the environment. Waste is an unavoidable consequence of the need for survival. In order to live, we eat, drink and provide other necessities of life. In the process of trying to satisfy these needs, we create waste in early times (pre-colonial days up till 1970s, the disposal of refuse and other wastes did not pose any significant problem[1]. The population was small and enough land was available for assimilation of wastes. Solid waste problem started with urban growth resulted partly from national increase in population and more importantly from immigration[1]. No towns in Nigeria especially the urban and semi-urban centers of high population density can boast of having found a lasting solution to the problem of filth and huge piles of solid waste, rather the problem continues to assume monstrous dimensions[1]. To urban and city dwellers, public hygiene starts and ends in their immediate surrounding and indeed the city would take care of itself. The situation has so deteriorated that today the problem of solid waste has become one of the nationôs most serious environmental problem. Problem with the disposal of solid waste in Enugu State of Nigeria especially in Enugu Urban could be traced to the period of the military rule. When the Military took over leadership in 1984, it established a full-fledged Agency called Anambra State Environmental Sanitation Agency to deal with the problem of solid waste[1]. This is to show the importance of solid waste management to ensure the good health of the citizenry. In a survey conducted in 15 Nigerian towns in March 2002, a total of 600 people were asked to define precisely what they understand as ówasteô, definitions received include óunwanted materialsô (8%), useless object (20%), garbage (22%), rubbish (7%), dirt (15%), refuse (28%)[2]. wastes are useless, unwanted and discarded materialsô ówaste is material which arises from animal and human life and activities and is discarded as useless and unwanted.[1] Number 16 of Lagos State Environmental Sanitation Law of 1984 defines ódomestic wasteô órefusesô and section 27 defines waste as:

- waste of all descriptions,
- any substances which constitute scrap material or an efficient or other unwanted,
- surplus substances arising from application of a process, and
- any substance or article which requires to be disposed of as broken, worn out or otherwise spent.
- The United States Environmental Protection Agency defines solid waste as any useless, unwanted or discarded material with insufficient liquid content to be free flowing. While, the need for healthy environment is important to everybody; it may differ from place to place, not in the fundamentals but in complexity[3].

1.2 Statement of problem

Inadequate solid waste management which was relatively bearable in Enugu State, especially in Enugu Urban before 1980, became impossible now especially with the growing of urbanization, rural urban migration and sitting of buildings and other infrastructures in areas designated as solid waste disposal points[3].

Furthermore the proliferation of public and private schools, market people, hospitals and eating houses generate more than ninety-five (95%) of the refuse especially in Enugu Urban centre. Problem with the disposal of solid waste in Enugu State could be traced to late 70s when rural poverty increased which caused high rural-urban migration[1].

In most parts of Enugu urban, there are no public facilities for disposing refuse within reasonable distance. Dump sites or waste bins are into existent and where dumps are sited overflow with refuse, constituting health/fire hazards[4].

However, the Government of Enugu State of Nigeria adopted different methods of solid waste disposal. One time, the incinerator machines were used and recently solid waste conversion vehicles are used and yet solid waste still constitute a major health hazard in the Enugu Urban. It is believed that the refuse disposal vehicles are insufficient[5]. The areas that are more susceptible to the endemic problem are Abakpa Nike, Obiagu, Uwani, and Achara layout zones. Some people who were arraigned in the Environmental Court on waste disposal related offences

oftentimes claimed that they were not properly sensitized or educated on how to dispose or manage their solid waste[5]. The Enugu State Waste Management Agency has been indicted by many citizens and groups as not doing their work well. This resulted to frequent change of leadership of the Agency. In spite of the frequent change in leadership of ESWAMA the problem of solid waste and its attendant health and fire hazard is still there. There is no gain saying that problem resulting from poor solid waste management has retarded the development of Enugu State in particular and Nigeria at large[5].

1.3 Justification/Rationale

In Enugu metropolis waste management has been a problem in the sense that in every nooks and crannies one can find wastes pile up in the dumpsite and constitute hazards before they are disposed of, and the issue of waste building up for long periods in collection points in our cities has been reported by various researchers. [6]Cases of mountain-like waste dumps in residential areas, though they attributed this to dumping of waste in unauthorized dumpsites. This presents environmental risk in that it causes a lot of ills in the society. Among the ills are :Flooding, vehicular accidents, Foul smell, blockage of the motor ways leaving to traffic jams, spreading of diseases through the bleeding of rodents and flies around the waste dumps[7].

1.4 General objectives

- To ascertain the pattern of solid waste management in Enugu metropolis

1.5 Specific Objectives

- To ascertain the average weight of solid waste generated per day, per household in Enugu metropolis.
- To determine the frequency of solid waste collection by the authorities.
- To ascertain people's perception ofESWAMAsolid waste management practices.
- To assess solid waste management practices in Enugu metropolis.

1.6 Research Hypotheses

- Solid waste is properly managed in Enugu Metropolis
- The residents of Enugu metropolis are aware of environmental and public health implications of solid waste management.

1.7 Alternative Hypothesis

- Solid waste is not adequately managed in Enugu metropolis
- The residence of Enugu metropolis are not aware of environmental and public health implications of solid waste management

1.8 Research Questions

- **Is** solid waste properly managed in Enugu metropolis?
- Are the residents of Enugu metropolis very aware of environmental and public health implications of solid waste management?

CHAPTER TWO

LITERATURE REVIEW

2.1 DEFINITION OF SOLID WASTE

Solid waste is defined as solid material which is discarded[8]. This definition ignores the relevant issue of the usefulness, value, or desirability of the matter in question, but in as much as discarding is an intentional act, it implies that the discarded judges the material to be of relatively little current value to him. Contends that waste management is a systematic control of generation, storage, collection, transportation, separation, processing, recovery and disposal of solid waste. In the smallest of places, solid waste management is accepted as a major aspect of the indigenous community organization and traditional home management; hence every house/compound has a designed area for solid waste collection/disposal and or incineration[9].

In East Africa , the storage, collection, transportation, and final disposal of wastes are reported[8] to have become a major problem in urban centre. The composition of wastes generated by East African urban centers is mainly decomposable organic materials based on the urban community consumption that generates much kitchen wastes, compound wastes and floor sweepings.solid waste management is a global issue that is growing source of concern in developed and developing countries due to increase urbanization; changes in consumer pattern and industrialization, which all directly influence solid waste generation.[10]

In Nigeria, wastes are generated in homes, commercial, industrial sites, hospitals, schools, on streets and even religious activities. Solid waste problem started with the rapid increase in urban growth resulting partly from increase in population and more importantly with the increase in its immigration status, no town in Nigeria can boast of haven found a lasting solution to the problem of filthy and huge piles of solid waste, rather the problem continues to assume monstrous dimension. to urban and city dwellers public hygiene start and ends in their immediate surrounding and indeed the city could take care of itself. The situation has so deteriorated that today the problem of solid waste has become one of the nation's most serious environment problem[9].

Waste management in Enugu city is becoming an increasing problem daily and a complex task. the Enugu state waste management agency(ESWAMA) was to develop and implement policies on the management of solid and liquid wastes that would promote their health and wellbeing of the people to this end, ESWAMA has the responsibility to ensure effective and efficient collection, removal, treatment and disposal of all kinds of wastes it also has the mandate to check the illegal dumping of refuse at roadsides, streams, in neighborhoods and in drains. The agency is further empowered to prosecute defaulters of laws while providing waste management facilities. The states sanitation laws compel residents to cooperate with ESWAMA in efforts to keep the environment clean. This they are required to do by cleaning up their environment, bagging wastes and disposing them at nearby designated dumpsites. The residents are also required to pay approved sanitation rates through designated banks in various zones[5].

In a paper titled "involving women in solid waste processing and resource recovery. Towards cleaner urban environment" analyzed the situation of urban solid waste generation and management in three Enugu areas[11]. The household solid waste characterization analysis showed 58% composition of the waste it be food waste/foliage (decomposable) while 42% composition was for the remaining components(non-decomposable).[11]

2.2 CLASSIFICATION OF WASTE

Waste was classified into two types-organic and inorganic wastes. Inorganic waste includes: cans used for different packages like bottles and all sort of metals dumped as litters in cities.[11]

Organic waste can be divided into three broad areas Viz: industrial, urban and agricultural waste, Residential (domestic or household) [12].

Industrial wastes: these are wastes from factories e.g. rubber factory, producing residual NH_4 and dissolved carbohydrates.

Urban wastes: In urban areas, wastes (including human faeces) are discarded from households and institutions like schools as well as human faeces and hospital waste.[12]

Agricultural waste: in agriculture, crops are produced such as maize, wheat cassava, etc. solid wastes are got from those crops which are either burnt or left to decay e.g. cocoa produces the

straw etc. The livestock sector of agriculture produces waste in the form of manure and litter, dead animals, feathers, blood, offal's, rejected egg shells and hatching wastes.

2.3 SOLID WASTE MANAGEMENT – ETYMOLOGICAL DISCOURSE

In 2009 the amount of waste generated by human population was very insignificant[13]. This was due to the size of the population and the spread of population around the world, coupled with the fact that there was very little exploitation of natural resources. Common wastes produced during the early ages were mainly ashes and human wastes; these were released back into the ground, which did not cause any harm to the environment. Before the invention of metals, wood was widely used for most application[14].

However, the reuse of wood has been well documented. Best example being the reuse of timbers for shipbuilding purposes. With the invention of metals Viz: bronze and iron, their use became common in most applications[14].

Nevertheless, it is once again well documented that reuse and recovery of such metals have been carried out by early humans. With the advent of industrial revolution, waste management became a critical issue. This is owing to the increase in population and massive shifts in population from rural areas to industrial towns and cities during mid 18thcentury. There was a consequent increase in industrial and domestic wastes posing threat to human health and environment. By mid 19thcentury, considerable efforts had begun towards managing wastes. Incinerators were first used during late 19th century in United Kingdom, but they were opposed on the grounds of emissions, which fell unto the surrounding residential areas. Further to this a series of legislations were passed in response to concern over human health and environment[15].

In United States, the Environmental Protection Agency (EPA) is the national agency that works to protect human and the natural environment. Environmental Protection Agency (EPA) established and enforces national environmental protection standards, conducts research on environmental problems, and assists other organizations in protecting the environment through grants, technical assistance and other programmes.[16] The following descriptions introduce and define the main activities classifies under Integrated Solid Waste Management (ISWM).

Waste prevention: Waste prevention often called source reduction means reducing waste by not producing it. Example of waste prevention would include purchasing durable, long lasting goods and seeking products and packaging that are as face of toxic substances as possible. It can be as simple as switching from disposal to reusable products, or as complex as redesigning from a product to use fewer raw materials or last longer[15].

The following descriptions introduce and define the main activities classified under I.S.W.M.

Waste prevention: Waste prevention often called source reduction, means reducing waste by seeking products and packaging that are as free of toxic substances as possible. It can be as simple as switching from disposable to reusable products, or as complex as redesigning a product to use fewer raw materials or to last longer .Because waste prevention actually avoids waste generation, it is the preferred waste management activity. Waste prevention conserves resources, protects, the environment, and prevents the formation of greenhouse gases[16].

Recycling: Recycling makes use of materials that otherwise would become waste by turning them into valuable resources. Recycling helps reduce greenhouse gas emission, in part, by diverting waste from landfills.

In some countries, a great deal of recycling occurs before the waste reaches the landfill. Scrap dealers buy directly from households and business, waste pickers of scavengers collect material from waste bin, and waste collectors separate materials that can be sold as they load their truck[16].

Composting: Another form of recycling is composting the controlled aerobic biological decomposition of organic matter such as food scraps and plant matter into humus, a soil-like material compost acts as a natural fertilizer by composting providing nutrients to the soil, increasing beneficial solid organisms and suppressing certain plant diseases thereby reducing the need for chemical fertilizers and pesticides in land scraping and agricultural activities[13]. Organic material often comprises a large portion of the solid waste stream, particularly in communities that rely heavily on tourism. Composting can be particularly, helpful to communities managing their waste and thus reducing their waste and thus reducing greenhouse gas emissions[16].

Combustion: Combustion is the controlled burnings of waste in a designated facility to reduce its volume and in some cases, to generate electricity. Combustion is an I.S.W.M. option for waste that cannot recycle or composted and is sometimes selected by communities where landfill space is limited. While the combustion process can generate toxic air emission, installing control equipment such as acid gas scrubbers and fabric filters in combustors. Combustion of solid can help reduce amount of waste going to landfills. They also can reduce reliance on coal, one of the fossil fuels that produces greenhouses goes when burned[16].

Land filling: Uncontrolled dumping of waste can contaminate ground water and soil, attract disease carrying rats and insects, and even cause fires. Properly designed, constructed, and manage the landfills provide a safe alternative to uncontrolled dumping.

For instance, to protect groundwater from the liquid that collects in landfills, a properly designed landfill has an earthen or synthetic liner. As waste decomposes, it emits methane, a greenhouse gas that can also cause fires. To prevent fires, a properly designed landfill should have a way to vent, burn, or collect methane. Landfill operators can also recover this methane thereby reducing emissions and generate electricity from the captured gas.[16]

2.4Functional Elements of Solid Waste Management

There are six functional elements in the activities associated with the management of generation to final disposal site. These are

- waste
- on site handling (sorting and processing)
- collection
- Transfer and transport
- processing and recovery
- Disposal

Description of the six main functional elements of solid waste management system:

Waste Generation: Those activities in which materials are identified as no longer being of value and are either thrown away or gathered together for disposal.

On-site handling, storage and processing: Activities associated with the handling, storage, and processing of solid waste at or near the point of generation.

Collection: Those activities association with the gathering of solid wastes and the hauling of wastes to the location where the collection vehicle is emptied.

Transfer and transport: Those activities association with

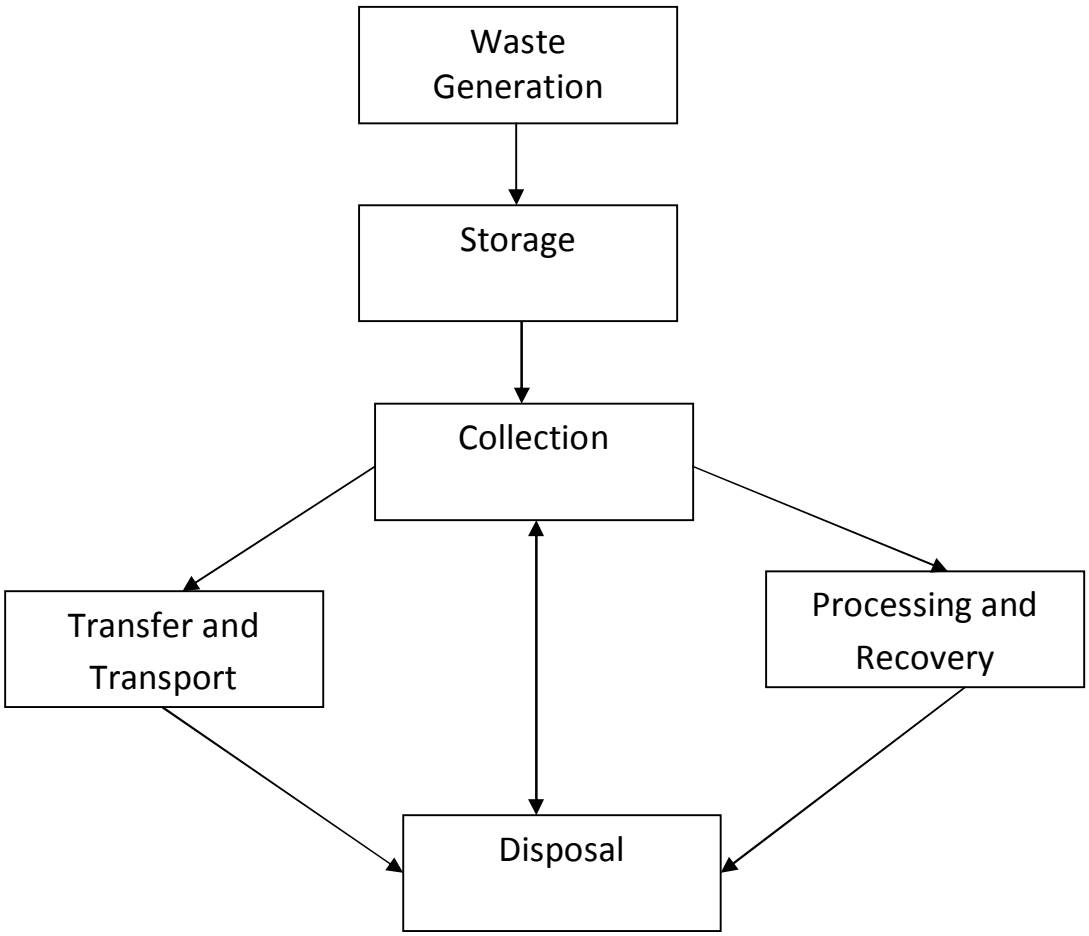
- The transfer of wastes from the smaller collection vehicle to the larger transport equipment and
- The subsequent transport the wastes, usually over longer distance, to the disposal site.

Processing and Recovery: Those techniques equipment and facilities used both to improve the efficiency of the other functional elements and to recover useable materials, conversion products, or energy from solid wastes.

Disposal: Those activities associated with ultimate disposal of solid wastes.

Interrelationship of functional element comprising a solid waste management[12]

Waste Generation[12]



2.5 METHODS OF WASTE DISPOSAL

Waste disposal is a growing problem worldwide and is directly connected to industrial development and population growth. Since early modern times, disposing of waste has been an important concern for individual and community officials.[17]

- Prevention and Reduction: the best method of managing waste is prevention and reduction, which can be achieved in a number of ways like recycling and making use of secondhand items.

- Energy Recovery: energy recovery is a promising form of waste disposal it works by recycling some forms of waste into a fuel source for heating, cooking and powering turbines.
- Biological Reprocessing: Biological reprocessing methods such as composting can be used for organic waste like food, paper and plant materials.
- Sanitary Landfill: Sanitary landfill disposal is convenient but may experience a lot of growth and require manpower to maintain.
- Incineration: In Japan, incineration is popular due to the minimal land available for disposal, but there is some concern about the release of micro-pollutants like dioxins from incinerator stacks.
- Ocean Dumping: The waste may provide nutrients for some sea life; itôs widely believed that the harmful effects would outweigh any benefits.

  Besides, proper disposal of refuse makes a healthier world for us to live in[18].

  Community health is based on the view that all agencies and individuals have a role to play in promoting, maintaining and improving the health and well-being of people[19].

2.6 PROBLEMS OF SOLID WASTE MANAGEMENT

It is a common thing to notice heaps of refuse almost blocking roads and gutters in Enugu. These breed rodents, mosquitoes, and pathogens and therefore keep the transmission of communicable disease on increase. The problem of refuse disposal is an obstacle in a developing world. Everything modern men touch, including themselves turns to be waste product sooner or later.

That recent rapid growth of population together with industrialization and new technology has produced waste in much greater quantities and variety than ever before. Consequently, more land has been needed for rubbish tips and industrial spoil and bodies of H_2O have made increasingly filthy by the discharge of more sewage and other effluents[20].

The inefficient and ineffective method of refuse disposal in Enugu urban has settled in an unsanitary condition in the urban town. A casual observer may not only notice liters along the streets and illegal dumping of waste material but also perceive the harsh odour of polluted air in parts of Enugu as a result of decomposed waste, faces and poorly kept and drained gutter or drainage channels lining the side of the streets. In spite of the various anti-garbage campaigns by

the government agencies in the state, yet the aesthetic quality of our city is still being disfigured due to the indiscriminate dumping of refuse by masses[20].

However, as human society became more complex and settlement increased because the natural agent of decay were unable to keep pace with accumulations. This led to increase in vermin, parasite, tape warms and outbreak of cholera and plague in medieval town.[21]

Therefore the main challenges facing solid waste management in developing countries and for that matter Nigeria, Enugu to be precisely includes: Inadequate funds to support waste management, inadequate equipment to support waste storage, collection and disposal, low collection coverage and irregular collection services, crude open dumping and burning without air water pollution control[5].

Most of us take the removal and disposal of refuse from our home for granted where as it is a problem which deserve close examination. Refuse not only smells badly, it also contains millions of bacteria. Many of these bacteria, if they get into food or in water will cause serious illness which may include food poisoning, diarrhea etc. It could be remembered that it was in an effort to solve the problems of refuse that the Buhari/indiagbon regime launched the war against dirt [21.]. The administration of general Babangida did not abandon the policy. It was mandated that every last Saturday of every month is for national clean-up, but the present government abandoned clean-up. So up till now, the war against dirt has not been won[22].

The public should be made aware of the effect of improper disposal of refuse and considers sanitary inspectors very essential in controlling this so as to limit the outbreak of disease.[15]

2.7 COMPONENT OF SOLID WASTE

Solid waste consists of many different materials. Some can burn, some cannot, some can be recycled, some cannot .Therefore, a detailed understanding of the composition of solid waste will indicate the management methods that will be used. Solid waste is composed of combustibles and non-combustible materials. The combustible materials include paper, plastics, yard debris, food waste, wood textiles, disposable diapers, and other organics. Non-combustible also include glass, metal bones, leather and aluminium[5].

2.8 SOLID WASTE MANAGEMENT FOR SUSTAINABLE DEVELOPMENT

Sustainable development is most often defined as ódevelopment that meets the needs of the present without compromising the ability of future generations to meet their own needsõ[23]. Although sustainable development means different things to environmental planners, ecologists, economists and environmental activists, it is important to recognize that, the fulfillment of human needs also depends on environmental factors such as availability of pure water, clean air, adequate living space, and in many circumstances, peopleôs ability to maintain a spiritual, cultural and aesthetic relation with their environment. This calls for management of the environment as it affects solid waste management. If solid waste disposal is not managed properly it affects underground water, affect the aesthetic condition of our environment and causes health hazards. Again, before sustainable development can be achieved, a clear understanding of its political economy will be necessary. But in Nigeria, it has been found that there are no clearly formulated policies aimed at coordinating and monitoring the relationship between environment and economic development. Rather, there are a number of poorly articulated programmes, rules and legislations which when reviewed and analyzed may help to reveal the directions as well as the limitations of environmental and natural resource management[24]. Thus, the goal of sustained development and healthy economic growth inherently requires careful attention to the environment which includes proper management of solid waste.

2.9 THE NEED FOR ENVIRONMENTAL EDUCATION, AWARENESS AND PUBLIC PARTICIPATION.

Environmental education is necessary for improving environmental quality[16].

The challenges of waste management in Enugu State

Traditional solid waste management practices such as waste burning, indiscriminate open dumping of waste, ecological ideals and government regulations often arouse conflict[3]. Enlightened debates, public awareness and even outright opposition can promote a forum for dialogue and conflict resolution which can lead to balanced policies which will enhance public commitment. Such a system that involves peopleôs participation is democratic. A better understanding of solid waste management and its attendant problems will enhance the effective use of the environment. Although people are capable of influencing their environment in both

constructive and destructive ways, yet, much of the influence has been in the service of making the environment less attractive. People are depleting natural resource and polluting the environment at an alarming rate and it is, therefore, important to educate people better in order for them to have positive attitude, commitment, and motivation to adopt sound techniques in managing their waste products.

Environmental education and awareness among decision makers will help in a better integration of environmental issues into development planning, budgeting and policy formulations[25]. This will be reflected in the attitude and actions of government functionaries.

Furthermore, the Nigerian populace, both in urban and rural areas, no matter their socio-economic status, need to be sensitized to solid waste management issues and problems. Without proper education, orientation and public awareness at all levels of society; it will be difficult to manage solid waste.

Thus, environmental education among the people would generate environmental concerns which could lead to the formation of groups concerned with how to protect the potentials of the environment and avoid or minimize the hazards of environmental pollution and degradation -for instance, environmental groups in the more advanced countries like the Green Peace, the Friends of the Earth, the Sierra Club, and many others, have fought great battles to preserve and protect various species of plants and animals[25].

Finally, and very importantly, environmental education and public participation in the long run can be cost-saving as expected attitude and commitment to the environment change for better, Hazards of pollution would not only be minimized but the cost of control will also reduce.

2.9.1 MANAGEMENT IMPLICATION

The Agency of Enugu State Government that is in charge with solid waste management suffers from acute shortage of skilled manpower and purposeful leadership. The little skilled manpower in the Agency are not adequately motivated to challenge them to put in their best.[26] The Government in their yearly budget scarcely allocates sufficient funds in the area of staff training. Management decision making is another important area of management that ought to be properly considered but has been awfully neglected[27].

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Study Area

The study area is Enugu State. Enugu State was created in August 1991 from the old Anambra State in Nigeria. It is situated in the eastern part of the country with the city of Enugu being the capital. Enugu state shares it borders with Abia State to the South, Anambra to the west, Kogi State to the northwest, Benue State and Ebonyi State to the east. There are 17 local government areas in the state with a population of approximately 3.9 million people according to the 2006 census findings.[28] Enugu urban is made up of three local government areas namely; Enugu North, Enugu South and Enugu East and these account for 22% of the population of Enugu. The other 14 local government areas have varying population densities between 60 persons per square km in places like Igbo-eze in the north west of the state. Up to 47% of the populations are predominately males while 53% are females, of which women of child bearing age (15-49yrs) account for about 40% of the total population.[29] Economically, the state is predominantly rural and agrarians with a substantial proportion of its working population engaged in farming although trading (18.8%) and services (12.9%) are also important activity in the state [30].

The annual climatic condition shows that the hottest month in Enugu State is February with a temperature of about 30.64^0C (87.16^0F) while the month of November has month of July with about 35.7 cubic centimeters while the lowest rainfall of about 0.16 cubic centimeters is normal in the month of February. Enugu state remains the home of Igbo of south East Nigeria[29].

3.2 RESEARCH DESIGN

This study is a cross-sectional,descriptive, observational survey in which participants were interviewed to determine the pattern of solid waste management in Enugu metropolis.This was done by the administration of questionnaires. Site visits, personal observation and in-depth interview were also used to obtain data. All data were collected between 20th of February and 27th of March, 2015.

3.2.1 SAMPLE SIZE DETERMINATION

No sample proportion (p) from any previous study was found; therefore, 50% sample proportion (p) was used.

The formula for the estimation of the minimum sample size (n) is given by the relation.

$N = Z^2 \times p\ (I-P)$ where[31]

D2

Z = standard normal deviate = 1.96 (95%) confidence level.

P = sample proportion = 50% = 0.5

D = degree of accuracy desired = 5% = 0.05

Therefore the minimum sample size (n)

$$= \frac{1.96^2 \times 0.5\ (1-0.5)}{0.05^2} = \frac{3.8416 \times 0.25}{0.0025}$$

$$= \frac{0.9604}{0.0025} = 384.16 = 384$$

To compensate for possible non-respondents, 10% of 384.16 will be added to the sample size.

The new sample size (n) becomes

10% x 384.16 + 384.16= 38.416 + 384.16 = 422.576

The number (422.576) was rounded off to 430 for convenience.

3.2.2 SAMPLE PROCEDURE

Cluster sampling method was used to obtain primary data for this study. This is because the sampling is done from a universe of clusters(streets), each street serving as a unit of sampling. There are three Local Governments Areas in Enugu metropolis: Enugu North, Enugu South and Enugu East. Streets were selected randomly from each LGA. Then simple random sampling wasemployed to select participants in each street.

ENUGU NORTH --Coal Camp, Ogui/Obiagu , Independence Layout, G.R.A, New Haven**.**

ENUGU SOUTH--Gariki Awkunanaw,Achara Layout, Mary Land,Uwani.

ENUGU EAST---Emene Nike, Abakpa Nike, Trans Ekulu,New Artisan Area.

This is a total of 13 locations and their streets making up a total of 475 streets. 475 streetsform the sampling frame from which the desired number of streets were randomly selected.Then 5 streets were randomly selected from each location. Five streets were used so as to represent North, South, East, West and Center of each location such that the total number of streets will truly represent the location in terms of necessary data on waste management. That is a total of 65 streets in all (5 streets ×13location=65 streets). But the sample size is 430 respondents. Therefore the number of respondents per street was:

$$= \frac{430 \text{ respondents}}{65 \text{ streets}} = 6.6 \text{ respondents per street.}$$

3.3 DATA COLLECTION / DURATION

Questionnaires were administered to 430 respondents in the study area. It was interviewer administered. The distribution and collection of questionnaires took one month - from 20th ofFebruary to 20th ofMarch, 2015.The site visits (visiting the ESWAMA dump sites) in the selected areas and the final ESWAMA dump site at Ugwuaji, took place simultaneouslywith questionnaire administration.Key informantsô interview at the EWSAMA office took two days, from 2ndto 4th ofMarch, 2015. Therefore the study duration was approximately five weeks - from 20thof February to 27thof March, 2015.

3.4 DETERMINATION OF AVERAGE WEIGHT OF WASTE PER HOUSEHOLD IN THE CITY.

Sixty five (65) households were randomly selected for the measurement of average waste per household per day. That is to say, one household per street (65 streets).

The total weight of waste generated was determined per day for 3 days in each of the 65 households. Then the average of the three weights was taken. The values obtained in all the 65 households were summed up and divided by 65. This gave the average weight of waste generated per household per day in Enugu metropolis.

This figure multiplied by the total number of households in the city will give the total weight of waste generated in Enugu metropolis.

3.5 DATA ANALYSIS

Data generated was analyzed using SPSS version 20. Test of statistical significant difference between subgroups (LGAs, Sexes, Age groups etc.) was determined at 5% level of significance using Chi Square. Tables and figures were used to present data.

3.6 ETHICAL CONSIDERATION

Prior to the commencement of this research, ethical clearance was obtained from the research ethics committees of the university of Nigeria teaching hospital, Enugu state following enclosed application letter including project proposal and other repaired details. Moreover, permission to carry out the research was obtained from the H.O.D of department of community medicine. Finally informed consent from prospective subjects was obtained after having explained the

objective and relevance of the study and selected subjects was used to thumb print or sign the consent form provided.

LIMITATIONS OF THE STUDY

Some limitations and constraints were encountered during this study. The participantswere not co-operative; they found it hard to respond to the questionnaires. In determination of average weight of waste per house hold in the city,the families involved kept giving excusesto always replace into a new waste bag for waste collection each dayas they were instructed for the weight taken, a time they said they forgot to be putting in another bag the next day. During the key informant interview at the ESWAMA office, members who were involved refused to participate .Their reasons were that they have already given their time to some other people that carried out similar research and that they do not have time to sit down and listen to another. However, most of these limitations were overcome by giving incentives such as refreshments, money,useful items like; pen, jotters and handkerchiefs.

CHAPTER FOUR

4.0 RESULTS

Estimation of Average Weight of Waste Generated by each Household in Enugu Metropolis

Total of average weights generated in three days in each of the selected sixty five households in the city was 116.6kg.

Therefore average weight of waste generated per household = 116.6/65 = 1.79kg = 1.8kg approximately.

Therefore the estimated average waste generated per household per day in Enugu metropolis is 1.8kg

Table 1: Demographic Characteristics of Respondents in Enugu South, Enugu North and Enugu East LGAs

Variables	Enugu South (n=142) Frequency (%)	Enugu North (n=140) Frequency (%)	Enugu East (n=120) Frequency (%)	Total	χ^2 Value	P-Value
Age (Yrs)					**15.126**	**0.004**
18-29	**69 (48.59)**	**39 (27.86)**	**48 (40.00)**	**156 (38.81)**		
30-40	**36 (25.35)**	**61 (43.57)**	**43 (35.83)**	**140 (34.83)**		
41 and above	**37 (26.06)**	**40 (28.57)**	**29 (24.17)**	**106 (26.37)**		
Total (%)	**142 (35.32)**	**140 (34.83)**	**120 (29.85)**	**402 (100)**		
Sex					**0.446**	**0.800**
Male	**66 (46.48)**	**61(43.57)**	**57 (47.50)**	**184 (45.77)**		
Female	**76 (53.52)**	**79 (56.43)**	**63 (52.50)**	**218 (54.23)**		
Total (%)	**142 (35.32)**	**140 (34.83)**	**120 (29.85)**	**402 (100.00)**		
Education					**6.961**	**0.324**
No formal Education	**29 (20.42)**	**42 (30.00)**	**31 (25.83)**	**102 (25.37)**		
Primary	**6 (4.20)**	**3 (2.14)**	**5 (4.17)**	**14 (03.48)**		
Secondary	**48 (33.80)**	**38 (27.14)**	**44 (36.67)**	**130 (32.34)**		
Tertiary	**59 (41.55)**	**57 (40.71)**	**40 (33.33)**	**156 (38.81)**		
Total (%)	**142 (35.32)**	**140 (34.83)**	**120 (29.85)**	**402 (100)**		
Years of Experience in their occupation mentioned					**10.378**	**0.035**

0-5	**63 (44.37)**	**40 (28.57)**	**40 (33.33)**	**143 (35.57)**		
6-10	**41 (28.87)**	**61 (43.57)**	**41 (34.17)**	**143 (35.57)**		
Above 10	**38 (26.76)**	**39 (27.86)**	**39 (32.50)**	**116 (28.86)**		
Total (%)	**142 (35.32)**	**140 (34.83)**	**120 (29.85)**	**402 (100.00)**		
Occupation					**27.052**	**0.003**
Student	**54 (38.03)**	**21 (15.00)**	**32 (26.67)**	**107 (26.62)**		
Civil Service	**26 (18.31)**	**31 (22.14)**	**26 (21.67)**	**83 (20.65)**		
Trading	**41 (28.87)**	**66 (47.14)**	**48 (40.00)**	**155 (38.56)**		
Farming	**13 (9.16)**	**9 (6.43)**	**11 (9.17)**	**33 (8.21)**		
Others	**7 (4.93)**	**11 (7.86)**	**2 (1.67)**	**20 (4.98)**		
Business	**1 (0.70)**	**2 (1.43)**	**1 (0.83)**	**4 (1.00)**		
Total (%)	**142 (35.32)**	**140 (34.83)**	**120 (29.85)**	**402 (100.00)**		

*Statistically significant at p-value <0.05

There is a significant difference (P<0.05) in the distribution age groups of respondents across the three LGAs with ages 18-29 being the highest in population (48%) of respondents in Enugu South LGA while age group 30-40 was the highest in number (43%) in Enugu North LGA. Generally, age group 18-29 accounted for 38.81%, age group 30-40, 34.83% and age group 41 and above, 26.37% of the entire number of respondents in the study. Thus most of the respondents are in the age groups 18-29 and 30-40.

The population of females (54.23%) was higher than that of males (45.77%) in the study though there is no significant difference (P>0.05) between the sexes in terms of population. Females were more in population than males in all three LGAs.

There is no significant difference (P>0.05) among the respondents across the three LGAs in terms of level of education attained by each respondent. However, those with tertiary education accounted for 38.81 % of the total number of respondents in the study; those with secondary education, 32.34%; those with no formal education, 25.37% and those with primary education, 3.48%. It is safe to say that most of the respondents were people who attained either tertiary or secondary education.

There is a significant difference (P<0.05) in work experience among respondents across the LGAs. Respondents with 0-5 years of work experience accounted for44.37%of respondents in Enugu South LGA whereas those in Enugu South LGA accounted for (28.57%) of respondents there, making them the least in population in the three LGAs . Those with 6-10 years of work experience made up 43.57% of respondents in Enugu North LGA while those in Enugu South accounted for 28.87%of respondents there, being the least in the three LGAs**.**Those with above 10 years of work experience were highest in population (32.50%) in Enugu East LGA whereas those in Enugu South were the least in population (26.76%). Therefore, most of the respondents had either 0-5 years (35.57%) or 6-10 years (35.57%) of work experience

There is a significant difference (<0.05) among the respondents in terms of type of occupation. Traders were the highest in population (38.56%), followed by students (26.62%) and Civil Servants (20.65%), the least being other occupations put together (5.98%).

Table 2: Promptness of Waste Disposal by ESWAMA

Variables	Enugu South (n=142) Frequency (%)	Enugu North (n=140) Frequency (%)	Enugu East (n=120) Frequency (%)	Total (%)	χ^2 Value	P-Value
How often does ESWAMA clear Waste from dumpsite in your street						
Everyday	23 (16.2)	14 (10)	11 (9.2)	48 (11.9)	27.737	0.015
Once in a week	51 (35.9)	39 (27.9)	22 (18.3)	112 (27.9)		
Twice in a week	14 (9.9)	28 (20)	22 (18.3)	64 (15.9)		
I donôt know	50 (35.2)	52 (37.1)	52 (43.3)	154 (38.3)		
Others	1 (0.7)	1 (0.7)	2 (1.7)	4 (1.0)		
Once in a month	0 (0)	2 (1.4)	1 (0.8)	3 (0.7)		
Twice in a month	1 (0.7)	1 (0.7)	1 (0.8)	3 (0.7)		
None	2 (1.4)	3 (2.1)	9 (7.5)	14 (3.5)		
Total (%)	142 (35.3)	140 (34.8)	120 (29.9)	402 (100)		
Do Waste Build up on the ground before Disposal by ESWAMA					8.235	0.221
Yes	76 (53.5)	64 (45.7)	56 (46.7)	196 (48.8)		
No	15 (10.6)	11 (7.9)	17 (14.2)	43 (10.7)		
Sometimes	37 (26.1)	40 (28.6)	35 (29.2)	112 (27.9)		
I don't know	14 (9.9)	25 (17.9)	12 (10)	51 (12.7)		
Total (%)	142 (35.3)	140 ()34.8	120 (29.9)	402 (100)		

*Statistically significant at p-value <0.05

There is a significant difference (P<0.05) in respondentsô opinions about the rate at which ESWAMA disposed of wastes. Respondents who were of the opinion that waste bins were emptied by ESWAMA once every week constituted the highest number in each LGA. They made up 35.9%, 27.9% and 18.3% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively. On the whole, this category of respondents made up 27.9% of the total number of respondents in the study (402). Next in number are those who were of the opinion that wastes were disposed twice in a week (15.9%), followed by those who said ESWAMA collected wastes every day (11.9%). However, this might not have reflected the true situation since 35.2%, 37.1% and 43.3% of respondents in Enugu South, Enugu North and Enugu East respectively, indicated not having knowledge of the rate of waste collection by ESWAMA. Those who said ESWAMA collected waste every day, once in a week and twice in a week, constituted 11.9%, 27.9% and 15.9% respectively, of the total number of respondents in the study.

There is no significant difference among respondents with respect to whether waste bins usually overflow with wastes before ESWAMA collects them. 53.5%, 45.7% and 46.7% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively, were of the opinion that wastes overflow the waste bins before collection by ESWAMA whereas those who said wastes do not overflow the bins made up 10.6%, 7.9% and 14.2% of respondents in Enugu South, North and East LGAs respectively. 9.9%, 17.9% and 10% of respondents in Enugu South, North and East LGAs respectively, did not know whether wastes are allowed to build up by ESWAMA before disposal. On the whole, 48.8% of respondents in the study said wastes overflow the waste bins and constitute hazards before they are disposed; 27.9% said the overflow only happened sometimes, 12.7% had no idea and 10.7% said wastes do not overflow the waste bins before they are disposed of.

Table 3: Respondent's Perception of Enugu State Waste Management Practices

Variables	Enugu South (n=142) Frequency (%)	Enugu North (n=140) Frequency (%)	Enugu East (n=120) Frequency (%)	Total (%)	χ^2 Value	P-Value
People's Perception Of Enugu state Waste Management Practices					15.211	0.055
Very Poor	20 (14.1)	21 (15.0)	24 (20.0)	65 (16.2)		
Poor	47 (33.1)	54 (38.6)	36 (30.0)	137 (34.1)		
Good	52 (36.6)	58 (41.4)	41 (34.2)	151 (37.6)		
Very Good	16 (11.3)	4 (2.9)	16 (13.3)	36 (9.0)		
Excellent	7 (4.9)	3 (2.1)	3 (2.5)	13 (3.2)		
Total (%)	142 (35.3)	140 (34.8)	120 (29.9)	402 (100)		

*Statistically significant at p-value <0.05

There is slightly no statistically significant difference (P=0.055) among respondents in their rating of ESWAMAôs performance in waste management in Enugu metropolis. Those who scored ESWAMA ñGoodò were in the majority in each LGA with 36.6%, 41.4% and 34.2% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively, being in this category of respondents. On the other hand, 33.1%, 38.6% and 30% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively, rated ESWAMA ñPoorò in waste management.

Table 4: Participants' Response on Final Disposal of waste in Enugu Metropolis

Variables	Enugu South (n=142) Frequency (%)	Enugu North (n=140) Frequency (%)	Enugu East (n=120) Frequency (%)	Total (%)	χ^2 Value	P-Value
Do you know the final disposal of Wastes Collected from the Enugu Metropolis					10.878	0.092
ESWAMA dump site	58 (40.8)	35 (25.0)	39 (32.5)	132 (32.8)		
Burial site	7 (4.9)	5 (3.6)	2 (1.7)	14 (3.5)		
Land Filling Site	10 (7.0)	12 (8.6)	9 (7.5)	31 (7.7)		
I don't	67 (47.2)	88 (62.9)	70 (58.3)	225 (56.0)		
Total (%)	142 (35.3)	140 (34.8)	120 (29.9)	402 (100)		

*Statistically significant at p-value <0.05

There is no statistically significant difference (P=0.092) among respondents with respect to the final destination of municipal wastes. Those who said that ESWAMA dump site was the final destination of wastes were by far the highest in number in each LGA, constituting 40.8%, 25% and 32.5% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively. Nevertheless, those who had no idea of the final destination of wastes from the city were 47.2%, 62.9% and 58.3% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively. On the whole, 32.8% of the total number of respondents indicated that dump sites were the final destination of wastes from the city whereas 56% of the respondents said they do not know the destination of wastes from the city.

Table 5: Participants' Knowledge of various waste management Practices in Enugu Metropolis

Variables	Enugu South (n=142) Frequency (%)	Enugu North (n=140) Frequency (%)	Enugu East (n=120) Frequency (%)	Total (%)	χ^2 Value	P-Value
Do you think ESWAMA Segregate Waste before disposal					14.004	0.007
Yes	12 (8.5)	31 (22.1)	19 (15.8)	62 (15.4)		
No	45 (31.7)	26 (18.6)	35 (29.2)	106 (26.4)		
I don't know	85 (59.9)	83 (59.3)	66 (55.0)	234 (58.2)		
Total (%)	142 (35.3)	140 (34.8)	120 (29.9)	402 (100)		
Does ESWAMA distribute Waste bags in your street					3.595	0.464
Yes	62 (43.7)	52 (37.1)	41 (34.2)	155 (38.6)		
No	56 (39.4)	60 (42.9)	59 (49.2)	175 (43.5)		
I don't know	24 (16.9)	28 (20.0)	20 (16.7)	72 (17.9)		
Total (%)	142 (35.3)	140 (34.8)	120 (29.9)	402 (100)		
What treatment does ESWAMA give waste before final disposal					21.333	0.002
Burning	19 (13.4)	14 (10.0)	6 (5.0)	39 (9.7)		
Disinfection	18 (12.7)	19 (13.6)	6 (5.0)	43 (10.7)		
Incineration	14 (9.9)	13 (9.3)	3 (2.5)	30 (7.5)		
I don't Know	91 (64.1)	94 (67.1)	105 (87.5)	290 (72.1)		
Total (%)	142 (35.3)	140 (34.8)	120 (29.9)	402 (100)		
Have you witnessed any environmental hazards due to poor waste management in Enugu metropolis					19.489	0.147

None	58 (40.8)	38 (27.1)	43 (35.8)	139 (34.6)		
Vehicle Accident	20 (14.1)	22 (15.7)	11 (9.2)	53 (13.2)		
Flood	19 (13.4)	19 (13.6)	22 (18.3)	60 (14.9)		
Traffic Jam	18 (12.7)	28 (20.0)	17 (14.2)	63 (15.7)		
Strong Odour	17 (12.0)	12 (8.6)	13 (10.8)	42 (10.4)		
Flies and Rodents as Nuisance	10 (7.0)	16 (11.4)	11 (9.2)	37 (9.2)		
Others	0	2 (1.4)	0	2 (0.5)		
All of the above	0	3 (2.1)	3 (2.5)	6 (1.5)		
Total (%)	142 (35.3)	140 (34.8)	120 (29.9)	402 (100)		
What type of Materials do you use for ESWAMA Waste Collection					4.463	0.347
Polythene Bags	30 (21.1)	32 (22.9)	22 (18.3)	84 (20.9)		
Plastic Containers	23 (16.2)	12 (8.6)	15 (12.5)	50 (12.4)		
ESWAMA Bags	89 (62.7)	96 (68.6)	83 (69.2)	268 (66.7)		
Total (%)	142 (35.3)	140 (34.8)	120 (29.9)	402 (100)		
Where do you dispose of Waste					9.905	0.129
ESWAMA Dumpsite	120 (84.5)	102 (72.9)	87 (72.5)	309 (76.9)		
Neighborhood Dumpsite	14 (9.9)	25 (17.9)	23 (19.2)	62 (15.4)		
Street Gutter	1 (0.7)	6 (4.3)	3 (2.5)	10 (2.5)		
Nearby Bush	7 (4.9)	7 (5.0)	7 (5.8)	21 (5.2)		
Total (%)	142 (35.3)	140 (34.8)	120 (29.9)	402 (100)		

What Method Do you Use in Waste Disposal					9.153	0.01
Emptying unto the Ground	8 (5.6)	18 (12.9)	21 (17.5)	47 (11.7)		
Dumping in Tied Materials	134 (94.4)	122 (87.1)	99 (82.5)	355 (88.3)		
Total (%)	142 (35.30	140 (34.8)	120 (29.9)	402 (100)		

*Statistically significant at p-value <0.05

There is no statistically significant difference (P<0.05) among the respondents with regard to waste segregation in the city. However, most of the respondents indicated that they do not know whether ESWAMA segregated wastes or not. 59.9%, 59.3% and 55% of respondents in Enugu South, Enugu North and Enugu East said they had no knowledge of whether ESWAMA segregates wastes or not. On the other hand, 8.5%, 22.1% and 15.8% of respondents in Enugu South, Enugu North and Enugu East LGAs indicated that wastes are segregated to different types by ESWAMA before disposal. More participants than not said ESWAMA does not segregate wastes. 31.7%, 18.6% and 29.2% of them in Enugu South, Enugu North and Enugu East LGAs respectively said there was no segregation of wastes. 58.2% of the total number of participants did not know whether ESWAMA segregated waste or not; 26.4% said there was no segregation while 15.4% said ESWAMA segregated waste.

There is no significant difference (P>0.05) in respondentsô opinions on distribution of waste bags by ESWAMA. 43.7%, 37.1% and 34.2% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively, were of the opinion that waste bags are distributed to the residents by ESWAMA. On the other hand, 39.4%, 42.9% and 49.2% of respondents in Enugu South, Enugu North and Enugu East LGAs said the agency does not distribute waste bags. On the whole, 38.6% of the total number of respondents said ESWAMA distributed waste bags; 43.5% said there was no distribution of waste bags and 17.9% did not know whether ESWAMA distributed waste bags or not.

There is a great significant difference (P=0.002) among respondents regarding the treatment of waste by ESWAMA before disposal. This difference was accounted for by the large number of respondents who did not know whether ESWAMA treated waste before disposal or not. 72.1% of all respondents said they did not know whether ESWAMA treated waste before disposal. 9.7%, 10.7% and 7.5% said ESWAMA burnt, disinfected and incinerated waste respectively.

Table 5 shows respondentsô opinions on the type of hazards or environmental problems caused by the buildup of wastes in the streets. There is no significant difference (P>0.05) in this across the LGAs. The greatest number of respondents (34.6%) said that waste buildup did not cause any disturbances on the streets. However, 13.2%, 14.9%, 15.7%, 10.4% and 9.2% of the respondents said that waste buildup caused vehicle accidents, diversion of runoff water into households, traffic jam, strong odour and flies and rodents nuisance respectively.

There is no significant difference (P >0.05) in respondentsô opinions about the type of materials used for collection of wastes in the city. The greatest majority of the respondents (66.7%) said they used ESWAMA bags in the collection of wastes while 20.9% and 12.4% said they utilized polythene bags and plastic containers respectively, in the collection of wastes.

There is no statistically significant difference (P>0.05) among the respondents with respect to their opinions on the site of disposal of municipal waste. An overwhelming number of the respondents (76.9%) said that ESWAMA dumpsite at Ugwuaji is the final destination for all wastes from Enugu metropolis. However, 15.4%, 2.5% and 5.2% of respondents said that neighborhood dumpsites, street gutters and nearby bushes respectively, is the final destination of wastes from the city.

There is a statistically significant difference (P>0.05) among the respondents with regards to manner of household waste disposal. 94.4%, 87.1% and 82.5% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively, said wastes are put in waste materials, tied and dumped on the waste dump sites around the city. The rest of the respondents in each LGA were of the opinion that wastes are emptied unto the ground on the waste dump sites. On the whole, 88.3% of respondents said wastes are dumped on the dump site in tied waste materials while 11.7% said wastes are emptied unto the ground

KEY INFORMANT INTERVIEW

Four people were interviewed at the ESWAMA office, the officerin charge of dumping site and the three workers in charge of loading the waste.

TRAINING ON WASTE MANAGEMENT

They were asked whether they received training on waste management from time to time. officer in charge of dumping site said yes "But only when we have new workers we train them on how to pack the waste into the compactors". The three workers in charge of collecting the waste into the compactor answered yes."but that was when we were newly employed".

HEALTH RISKS ASSOCIATED WITH SOLID WASTE

They were asked again if they were aware of the risks associated with solid waste. The officer says yes "That is the reason we provided hand gloves and always ask them to wear protective shoes, face masketc.ò. Three of the workers answered yes but when they asked whether they wereputting them on while working. Two answered yes while the other one said no, he said "ESWAMA did not provide for us and we are not paid enough money that can enable us buy them".

FINAL DESTINATION OF WASTE FROM THE CITY

The final disposal of waste in Enugu metropolis by officer in charge of dumping site "ugwuaji is the final dumping site of ESWAMA and that was where the wastes were finally burnt, "

TREATMENT OF WASTE BY ESWAMA

Does ESWAMA disinfect waste before disposal?The three workers answered "we don't know our only duty is just to be sure that the wastes were send to Ugwuaji".

The ESWAMA Officer answered "we do not disinfect waste in any way"

CHAPTER FIVE

5.0 DISCUSSION

5.1 Frequency of waste disposal by ESWAMA

The study reveals that majority of the respondents were ignorant of the rate at which ESWAMA collected wastes from the streets. 35.2%, 37.1% and 43.3% of respondents in Enugu South, Enugu North and Enugu East respectively, indicated not having knowledge of the rate of waste collection by ESWAMA. This is a worrisome situation as it shows very low level of awareness of members of the public toward waste management and underscores the poor attitude of individuals to the environmental threat posed by waste in the society. Awareness and attitude of individuals/groups towards waste management,[7]according to Agwu(2012), it is a critical step towards overcoming the challenges of solid waste management. Public enlightenment and participation in waste management enhances effectiveness in the generation, collection, storage and disposal of waste. It is therefore worthy of note that urban solid waste management should adopt a multi-pronged approach in which all sections of the society must be educated and brought together to work like a team[32].

On the other hand, 35.9%, 27.9% and 18.3% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively, were of the opinion that the waste agency removed wastes from the streets once every week. Participants having this opinion constituted 27.9% of the entire study population while 15.9% of them said disposal was done twice every week and 11.9% opined that ESWAMA cleared their street of waste every day. These reflect the discrepancies in the manner of collection of waste across the LGAs by ESWAMA. This is suggestive of inadequacy of personnel or equipment for the job, which has been variously associated with poor management of solid waste in the country.[7]According to Agwu(2012),Poor funding and inadequate facilities contributed immensely to poor waste management in Port Harcourt, another Nigerian city. Shortfalls in personnel and equipment constitute a serious setback in governmentôs effortsto establish better and more satisfactory methods of waste management in Enugu metropolis[7].

5.2 Waste Build Up on the Streets before Disposal by ESWAMA

There was no significant difference in the opinion of respondents regarding the buildup of waste on the streets prior to disposal, across the three LGAs studied. 53.5%, 45.7% and 46.7% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively, were of the opinion that wastepile up and threaten the environment before being disposed by ESWAMA.Site visits revealed that this was the case in many of the dump sites, especially those located in densely populated areas.On the whole, 48.8% of respondents in the study said wastes overflow the waste bins and constitute hazards before they are disposed; 27.9% said the overflow only happened sometimes, 12.7% had no idea and 10.7% said wastes do not overflow the waste bins before they are disposed of. The issue of waste building up for long periods in collection points

in our cities has been reported by various researchers.[6]Kadafa et al (2013)reported case of mountain-like waste dumps in residential areas, though they attributed this to dumping of waste in unauthorised dumpsites.This presents environmental risk in that it causes a lot of ills in the society. Among the ills are: flooding, vehicular accidents, foul smell, blockage of the motor ways leading to traffic jams, spreading of disease through the breeding of rodents and flies around the waste dumps[7].

Management of municipal waste in Enugu state has been given a boost by the Governor Sullivan Chime administration. The boost was in the form of 15 waste compactor trucks and 1000 dumpsters[32]. This has led to a tremendous improvement in waste management in the city. However, more needs to be done as there seems to be a noticeable insufficiency in the number of personnel doing the work and in the number of compactor trucks available for waste disposal. This has made the agency to pay more attention to some areas while some other areas receive less attention as indicated in this study. Furthermore, some remote locations in the city seem to have been forgotten by the waste agency such that waste becomes mountainous in size before being removed as shown in the attached photograph.

5.3 Participants'Rating of Enugu State Waste Management Practices

There is no significant difference in respondentsô rating of ESWAMAõs performance in waste management. 36.6%, 41.4% and 34.2% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively, rated ESWAMA ñgoodò while 33.1%, 38.6% and 30% of respondents in the same order rated ESWAMA ñPoor.ò Here again, the responses reflect the inconsistency in the level of attention ESWAMA pays to different areas in terms of prompt collection of waste from dump sites.

5.4 Destination of Wastes Collected from Enugu Metropolis

Majority of participants (47.2%, 62.9% and 58.3% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively) had no idea where the final destination of waste that ESWAMA collects was. This exposes the nonchalant attitude of the coal city populace to environmental issues, particularly waste management problems, in the city. This situation has always constituted an obstacle to effective waste management in Nigeria.

However, a large number of the respondents (constituting 40.8%, 25% and 32.5% in Enugu South, Enugu North and Enugu East LGAs respectively) indicated that the final destination of waste in the city was the ESWAMA dumpsite at Ugwuaji where wastes are dumped and continuously burnt. Further investigation revealed that some scavengers besiege the site to collect some of the wastes for possible recycling. Nevertheless, the recycling is not properly organized hence the sheer volume of waste at the site precludes individual scavengers from getting back all the recyclable wastes. Only a tiny percentage of the recyclable waste is recovered from the dump site. This is supported by the work of Eltren Brings[33]who reported that the absence of recycling constituted an impediment to satisfactory waste management.

5.5 Segregation Waste by ESWAMA

More than half the number of respondents in each LGA (59.9%, 59.3% and 55% of respondents in Enugu South, Enugu North and Enugu East respectively) had no knowledge of whether ESWAMA segregates waste or not.On the other hand,31.7%, 18.6% and 29.2% in the same order, said wastes were not segregated. In line with this, fieldvisits and observations revealed that wastes are not segregated either at the point of generation (homes) or at ESWAMA dumpsites.All types of wastes are simply collected and dumped at the dumpsites.This waste management practice has also been reported by Kadafa et al (2013)[6]who said that the common waste management practice in Nigeria involved the collection of a mixture of wastes and dumping them at the dumpsites.[6]Similarly,Adekunle et al (2011) reported that it was not a practice in the country to segregate waste at any point in its management.Segregation is very important in that it reduces the volume of waste and enhances proper recycling of the recyclable parts of waste. Without segregating wastes into different types before final disposal, the volume of waste becomes very high, rendering proper management cumbersome and effectively limiting the amount of reusable waste that can be recycled.

5.6 Distribution of Waste bags by ESWAMA

Respondentsô opinions were sharply divided on the distribution of waste bags by the waste agency. 43.7%, 37.1% and 34.2% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively, were of the opinion that waste bags are distributed to the residents by ESWAMA. On the other hand, 39.4%, 42.9% and 49.2% of respondents in Enugu South, Enugu North and Enugu East LGAs said the agency does not distribute waste bags. This reflects inconsistency in the distribution, forcing waste generators to use unsuitable but available materials for waste collection. The result is that wastes are emptied unto the ground at the dumpsites so that the waste bins used in the collection of the wastes could be reused. This practice constitutes a major threat as flies and rodents breed in the wastes. Also, pouring waste to the ground exposes malodorous parts of the waste which form a big nuisance to the public. The study found out that wastes are more properly managed in areas where ESWAMA distribute waste bags in that they are neatly tied in these bags and dumped at the dumpsites. This makes it difficult for flies and rodents to feast on the waste thereby, constituting public nuisance. In addition, odour is greatly reduced at the waste collection points.

5.7 Treatment of Waste by ESWAMA

Mostof the respondents did not know whether wastes are disinfected by ESWAMA or not. Seventy two percent of all respondents said they did not know whether ESWAMA treated waste before disposal. 9.7%, 10.7% and 7.5% said ESWAMA burnt, disinfected and incinerated waste respectively. However, key informersô interview revealed that the waste agency does not disinfect waste in any way. Wastes are simply collected and dumped at the dumpsites without treatment.

This is a dangerous practice as it exposes the public to all types of risks especially when medical wastes are dumped at the same site.

Many of the respondents (34.6%) said that waste buildup did not cause any disturbance on the streets while 13.2%, 14.9%, 15.7%, 10.4% and 9.2% of the respondents said that waste buildup caused vehicle accidents, diversion of runoff water into households, traffic jam, strong odour and flies and rodents nuisance respectively. Likewise, the greatest majority of the respondents (66.7%) said they used ESWAMA bags in the collection of wastes while 20.9% and 12.4% said they utilized polythene bags and plastic containers respectively, in the collection of wastes. Therefore the public should be encouraged, by the government through the provision of waste bag on a daily basis for waste collection.

An overwhelming number of the respondents (76.9%) said that ESWAMA dumpsite at Ugwuaji is the final destination for all wastes from Enugu metropolis. However, 15.4%, 2.5% and 5.2% of respondents said that neighborhood dumpsites, street gutters and nearby bushes respectively, is the final destination of wastes from the city. Since majority of the public indicated that they were aware of the final destination of waste this will change their negative attitude towards overcoming the challenges of solid waste management in Enugu city.

Ninety four percent, 87.1% and 82.5% of respondents in Enugu South, Enugu North and Enugu East LGAs respectively, said wastes are put in waste materials, tied and dumped on the waste dump sites around the city. The rest of the respondents in each LGA were of the opinion that wastes are emptied unto the ground on the waste dump sites. On the whole, 88.3% of respondents said wastes are dumped on the dump site in tied waste materials while 11.7% said wastes are emptied unto the ground. This is supported by Barbalace,(2003) who argues for the importance of adequate waste removal and management facilities to improve the health and wellbeing of the city's population.[9]

CHAPTER SIX

6.0CONCLUSION AND RECOMMENDATION

Based on the findings, It is fair to say that solid waste management is properly managed in Enugu, although there is still some work to be done in terms of the following;

- Increase in number of ESWAMA workers.
- Provision of more adequate skips and waste bins.
- Provision of more compactor truck and provide waste bags to the society.
- There should be regularity in waste collection by ESWAMA workers.
- Separation of waste into their various componentsbefore final disposal is very necessary.

Therefore the paper recommends that ESWAMA should be regular in the waste collection particularly in highly populated areas like Agbani road,Obiagu,Coal camp and Abakpa Nike areas to avoid heaping of waste and over flowing of skips with solid waste. At least, waste should be collected four times a week in these areas and thrice in the high class residential areas like G.R.A.

Secondly, there should be regular monitoring of waste collection by the ESWAMA officers in charge of waste collection, this will keep the place constantly clean and save the residence of Enugu metropolis that were not aware of environmental implications of solid waste management the possible outbreak of communicable diseases such as cholera and typhoid through the breeding of rodents and flies and other ills like flooding, vehicle accidents, foul smells, blockage of the motor ways leading to traffic jams.

Additionally there is need to separate waste into their various component before final disposal because segregation reduces the volume of waste and enhances proper recycling of the recyclable parts of waste.

Finally, the public enlightenment and participation in waste management enhances effectiveness in the generation, collection, storage and disposal of waste. Therefore, all sections of the society must be educated and brought together to work as a team to experience a neat environment.

REFERENCES

1. Joy Ugwu et al; Management and development implication of solid waste management in Nigeria(2012).WWW.Maxwellci.com.Accessed 05/09/2015 page 352-355
2. Emma chukwuemeka etal. Lopsidedness in solid waste management in Nigeria. Obstacle to sustainable development,2012

3. Aniukwu Bartholomew Chinedu; Evaluation of effectiveness of ESWAMA collection on solid waste and the level of environmental awareness of populace in Enugu state of Nigeria. 2013 pg.10-12

4. Health Impacts of health Care waste .WWW.who.int.10460-1-pdf. accessed 29/06/14
5. Titus E. Amalu et al; Appraisal of Solid Waste Management Practices in Enugu City, Nigeria. Journal of Environment and earth sciences. www.iiste.org. Accessed 30/06/2014.2014 page 97-99
6. Kadafa etal ; Current status of municipal solid waste management practices in FCT.Abuja. v5-295-304.pdf.www.maxwellsci.com.2013 page294-299
7. Agwu .Issues and challenges of solid waste management practices in Portharcourt city, Nigeria-a behavior perspective.2012 AJSMS-3-2-83-92.pdf.www.scihub.org.
8. Graiser, s. the best way to manage solid waste in development nations. International Journal of environment, 2007. 4(3) 39-40.
9. Ikemike Dolfina.O.Effective solid waste management ;A panacea to disease prevention and healthy environment in Bayelsa state, Nigeria 2015 page 66-67
10. Sanda, L. the Organizational and efficiency of solid waste collection. Toronto: Lexington Books. 2008.
11. Onyema Augustine.I; Solid waste management of Achara layout area of Enugu city 2004 page 32-35
12. Esayas Alemayehu. Solid and liquid waste management for health extension workers 2004 www.LN-HEW-solid-waste-final.pdf
13. Ezema, T.O. the problems of managing solid waste in depressed economy. Journal of sustainable development, 2009. 5(2) 45- 55.
14. Tiki wiki cms groupware;Open collaborative solutions for societal challenges 2012.www.open collaborative.org.Accessed02/09/2015
15. Johnson, W. Principles of environmental management London rout ledge 2009.
16. E.P.A. (2002). Solid waste management: A local challenge with global impacts 2002. www.EPA.govt/global warming. accessed 15/06/2014 page3-4
17. Partha, D.S. Solid waste Disposal. A burning problem to be resolved to save environment.www.saferenvironment.wordpress.com 2009 solid-waste-disposal accessed 15/06/2014.page 2-8
18. Tim, S.R. the principles of waste management in development nation. International journal. Journal of policy:2008

19. Mba, S.O. Fundamentals of Public health for the tropical: Personal and community perspectives. Owerri: Oni publishers. 2003.
20. A study on the constraints difficulty and contribution of ESWAMA in management of solid waste in Enugu Urban. www.freeplace.orgaccessed 25/06/2014.
21. Takele Tadesse. Solid waste management www.cartercenter.org2004accessed 01/07/2014.
22. Madukovich; Ignorance is bliss madukovich's cogitations paper 2 www.madukovich.wordpres s.com/author/12 2014 accessed 21/06/2014
23. depweb.(2001) world bank group. What is sustainable development. www.world bank.org.>>>>Depweb accessed 25/06/2014.
24. Chukwuemeka E,O;The challenges of waste management to Nigeria sustainable development :A study of Enugu state 2012 page 81-83
25. Institutional aspect of sustainable development in Nigeria www.un.org/ess/agenda 21 inst. htm sourced 26/06/2014.
26. Titus E.Amalu.et al; Appraisal of solid waste management practices in Enugu city,Nigeria.2014 page 97-99
27. Maxwell Scientific Organization, (2012) management and development implications of solid waste in Nigeria www.maxwellsci.com accessed 01/07/2014.
28. Enugu State ministry of health (Enugu) (SMOH). Health Services Directory 2008:7.
29. Okaro, J. Umezurike, A. Etal. Maternity mortality in the university of Nigeria teaching hospital, Enugu. Available at http//www.ajo.info/index.php/ajrh.
30. http://en. wikipedia.org/ wiki/ Enugu State. Sourced 05/03/2013.
31. Onwasigwe C, Principles and methods Epidemiology. 2nd edition. ELDERMAK publication, 2010. Enugu, Nigeria. Page 144-145.
32. Uwadiegwu etal .Strategies for effective urban solid waste management in Nigeria 2013,896-2692-1-P.pdB.pdf.eujournal.org.
33. Elfren Brings paz,Sustainable sorting, Recycling and Disposal of solid waste,2006 page 133-137

QUESTIONNAIRE I (for the general populace)

My name is Mrs. Christiana Nwozor, a Master of Public Health student in the University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu State. I am conducting a research on pattern of solid waste management in Enugu metropolis. Pursuant to this, I would like to obtain some information on the generation and disposal of solid waste in your area. Rest assured that your responses would be held highly confidential; so please co-operate and be honest with me.

Tick as appropriate

A. Demographic Characteristics

1. Age: (a) 18-29 ☐ (b) 30-40 ☐ (c) 41-above ☐

2. Sex: (a) Male ☐ (b) Female ☐

3. Level of Education: (a) None ☐ (b) Primary ☐
   (c) Secondary (d) Tertiary ☐ ☐

4. Occupation: (a) Student ☐ (b) Trading ☐
   (c) Civil Service ☐ (d) Farming ☐
   (e) Others specifyé é é é é é .

5. Years of experience on the j (a) 0-5 ☐ (b) 6-10 ☐ (c) Above 10 ☐

B. General House Hold Waste Management Practices

6. What do you use for waste collection? (a) Polythene bags ☐ (b) Plastic containers ☐ (c) ESWAMA bags ☐ (d) Others specify é é é é ..

7. Do you always close (tie up) the lids (covers) of the waste bin mentioned above? (a) Yes ☐ (b) No ☐

8. Where do you dispose of waste? (a) ESWAMA dump site (b) Neighborhood dump site (c) Street gutter (d) Nearby bush (e) Others specifyé é é é .....

9. How do you dispose of waste? (a) Emptying unto the ground (b) Dumping in tied materials

10. How often do you dispose of waste? (a) Every day (b) In two days (c) In three days (d) Weekly (e) Others specifyé é é é

11. Apart from dumping, what other waste disposal method do you use? (a) Burning (b) Burial (c) Controlled tipping (d) Incineration (e) Othersé é é é é é é é é é é é é é é é é ...

12. Do children and scavengers access waste where you dispose of it? (a) Yes (b) No

13. Do you separate dried solid waste from semi-liquid waste? (a) Yes (b) No

14. Does your waste produce foul odour and attract flies and rodents before disposal? (a) Yes (b) No

16. What quantity of waste do you generate per day? (a) é é é é é é ESWAMA bags (b) é é é é é é .polythene bags (c) é é é é .. Plastic containers (d) é é é é é é number of other containers, specifyé é é é é é ..

C. ESWAMA Waste Management Practices

17. How often does ESWAMA clear waste dump sites on your street? (a) Every day (b) Once in eek (c) Twice in a week (d) I donôt know (e) Others specifyé é é é é é é é é é é é

18. Does waste fill the receptacles and build up on the ground before the dump site is cleared of waste by ESWAMA? (a) Yes (b) No (c) Sometimes (d) I donôt know

19. Do you think ESWAMA separates wastes into different types before disposal?
(a) Yes ☐ (b) No ☐ (c) I don't know ☐

20. Do ESWAMA workers wear protective devices (face masks, hand gloves, waste booths etc.) while clearing waste dump sites on your street? (a) Yes (b) No (c) I don't know ☐ ☐

21. Does ESWAMA distribute waste bags in your street? (a) Yes (b) No (c) I don't know ☐ ☐

22. If yes, how often? (a) Monthly ☐ (b) Bi-monthly ☐ (c) Quarterly (d) Every 6 months (e) I don't know (f) ☐
Others specify..

23. What treatment does ESWAMA give waste before final disposal?
(a) Burning ☐ (b) Disinfection ☐ (c) Incineration ☐
(d) I don't know ☐

24. What is the final destination of wastes from the city?
(a) ESWAMA dump site ☐ (b) Burial site ☐
(c) Land filling site ☐
(d) I don't know ☐

25. Have you witnessed any environment hazardsq2 due to poor waste management in your str? (a) Yes ☐ (b)No

26. If yes, specify (a) vehicle accidents caused by blockage of road by waste dumps (b) Flood occasioned by blockage of water ways (gutters) by solid waste. (c) Hold-up due to blockage of road by municipal waste dumps (d) String odour caused by dumped municipal waste (e) Nuisance due to flies attracted to dump waste. (f) Others specify.....

27. How would you rate the overall waste disposal system in Enugu metropolis?
(a) Very poor ☐ (b) Poor ☐ (c) Good ☐ (d) Very good ☐
(e) Excellent ☐

28. Please suggest better ways of managing waste in the city

é é
é é
é .

Overflow waste not collected when due by ESWAMA during the field investigation it was observed that a lot of skips were overflowing with uncollected for days in Agbani road residential areas.

FIGURE 1-Solid waste container overflowing with waste at Agbani road

FIGURE 2 Burning at landfill site Ugwuaji, the final disposal of waste collection.

FIGURE 3: Sample of waste for weight measurement.