

**ANALYSIS OF DOMESTIC SOLID WASTE MANAGEMENT STRATEGIES IN  
TUNGA, CHANCHAGA LOCAL GOVERNMENT AREA, NIGER STATE,  
NIGERIA**

**BY**

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## **DECLARATION**

I declare that the work in this thesis entitled Analysis of Domestic Solid Waste Management Strategies in Tunga, Chanchaga Local Government Area, Niger State, Nigeria has been performed by me in the Department of Geography under the supervision of Dr. J.O Folorunsho and Dr.(Mrs) B. Abdulkarim The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other Institution.

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\_\_\_\_\_  
Date

## CERTIFICATION

This thesis titled “Analysis of Domestic Solid Waste Management Strategies in Tunga, Chanchaga Local Government Area, Niger State, Nigeria” by Mary Ogogome MUDIARE meets the regulations governing the award of the degree of Master of Science (Environmental Management) of the Ahmadu Bello University, and is approved for its’ contribution to knowledge and literary presentation.

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## **DEDICATION**

This work is dedicated to my husband and friend, Engr. Adokiye Douglas and my parents

Prof. and Dr.(Mrs) O.J Mudiare

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My profound gratitude goes to my team of supervisors; Dr. J.O Folorunsho and Dr. (Mrs.) B. Abdulkarim, thank you for your patience, painstaking corrections and incisive comments. I am indeed grateful for all you have done to make me a better environmentalist. I cannot thank you enough, may God bless and reward you.

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## ABSTRACT

*Solid waste management has become the greatest problem facing many urban and semi-urban areas in Nigeria. The management of solid wastes in recent time has become a very big challenge. The problem of waste generation, handling and disposal has reached a disturbing level in Nigerian urban centers. The study analyzed domestic solid waste management strategies in Tunga, Chanchaga Local Government, Niger State, Nigeria. This was achieved through characterizing the types of domestic solid wastes generated in the study area, examining the domestic solid waste management strategies employed in the study area, identifying the key players in domestic solid waste management in the study area, examining the frequency of waste generated and waste disposed and ascertaining the effectiveness of the domestic solid waste management strategies employed in the study area. The primary data used in this study was obtained by direct field observations, questionnaire administration, oral interviews, images and photos of the study area. 327 out of 2040 households were sampled. The research questions were answered using tables of frequencies and percentages, bar and pie charts, Chi Square and Kruskal Wallis tests. The results showed that the kinds of domestic solid wastes generated in the study area were mainly organic, paper, plastic, old and rusted metals and textile wastes. The domestic solid waste management strategies in place were burning, open dumping and burying, with open dumping being the most common domestic solid waste management strategy practiced in the study area (about 72%). The key players involved in the management of solid wastes were the government and individual households. The daily generation of waste (about 74%) exceeded the daily disposal of wastes (about 49%) in the study area. 63% of the respondents reported that burning of domestic solid waste is effective, 84% reported that burying domestic solid wastes is effective while 14% reported that open dumping of domestic solid wastes is effective. The Chi Square analysis showed a significant difference between the frequency of wastes generated and waste disposed in the study area with an alpha value of 0.01, while the Kruskal Wallis H test showed no significant difference in the effectiveness of the domestic solid waste management strategies in the study area ( $\alpha=0.646$ ). The findings of this study showed that the methods of waste management adopted in the study area do not conform to sustainable waste management practices. This implies that much attention has not been given to domestic solid waste management in the study area. The study thus recommended Public Enlightenment and Education on issues of waste management and a better public awareness strategy on the subject matter, Increase in Waste Collection Frequency and the adoption of composting as a method of waste management since majority of the domestic solid waste generated is organic in nature.*

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## CHAPTER ONE

### INTRODUCTION

#### 1.1 BACKGROUND TO THE STUDY

Waste management is a global environmental challenging issue that is severe especially in developing countries where increased urbanization, poor planning and lack of adequate resources contribute to the poor state of Municipal Solid waste management (Mwanthi *et al*, 1997). Proper management of solid waste has been established to be critical to the health and well being of urban residents (World Bank, 2013).

According to the Federal Ministry of Environment waste is any damaged or useless material produced during or left over from human activities. The United Kingdom Environmental protection Board (1990), defines waste as any substance, a scrap material or an effluent or other unwanted surplus substance arising from the application of any process. Rushton (2010), sees waste from a different view, according to him, one person's waste could be another person's valuable material, due to changing technologies, availability and cost of input materials, the demand and need to use recovered waste is changing; waste can therefore be defined as something that nobody wants at a particular point in time and needs to be disposed of. USEPA (2006) observed that this majority of substances are municipal solid waste which includes: paper, vegetable matter, plastic, metal textiles, rubber and glass

Aliyu (2010) classified wastes into three basic types; solid, liquid and gaseous which could be biodegradable, semi biodegradable and non-biodegradable. Based on land use and practices in the human environment, there are seven major sources of waste according to Ayo, Ibrahim and Mohammed, (2010), namely; domestic/ residential, commercial, agricultural, construction and demolition, mining, industrial and institutional wastes.

Industrial and domestic/residential wastes have the highest volume of wastes generated worldwide.

The Federal Ministry of Environment (2012), divided urban solid wastes into three main categories; Municipal solid wastes which comprise domestic waste, trade and commercial refuse (from schools, hospitals and clinics) and street cleansing waste; industrial wastes, consisting of refuse generated from industrial operations and by solidification of liquid and gaseous effluents and building construction wastes, which are mainly inert from demolition, excavation and construction activities. Waste management, according to Wokekoro, (2007) as cited by Uchegbu, (1998), in all its ramifications, is a planned system of effectively controlling the production, storage, collection, transportation, processing and disposal or utilization of wastes, in a sanitary, aesthetically acceptable and economical manner. It includes all administrative, financial, legal and planning functions as well as the physical aspects of waste handling.

Onu *et al* (2001) referred to solid waste management as the application of techniques that ensures the orderly execution of the functions of collecting, transfer, processing, treatment and disposal of solid wastes. Major global techniques of waste management were listed by Rushton (2010) to include: recycling, composting, sewage treatment, incineration and landfill. While recycling is the recovery of materials from products after usage, composting is the aerobic biological process of degradation of biodegradable organic matter; sewage treatment is a process of treating sludge to produce a non toxic effluent discharged into rivers or sea and the semi-sludge, which can be used for soil amendments. Other techniques include incineration and land filling; Incineration is a process of combustion

designed to recover energy and reduce the volume of waste being disposed and land filling is the deposition of waste in a specially designated area.

Agbede and Ajagbe (2004), reported that improper handling storage and disposal of wastes are major causes of environmental pollution which provides breeding grounds for pathogenic organisms and encourages the spread of infectious diseases as well as the generation of green house gases from landfills, health and safety problems such as diseases, spread of insects and rodents attracted by garbage etc. Similarly, Portal, Milani, Lazzarino, Perucci and Forastiere (2009), reported that both landfills and incinerators have been associated with some reproductive and cancer outcomes (cancer of the skin and the pancreas) as well as respiratory ailments. Mwanti *et al*, (1997), in the same vein reported that many authors attribute the prevalence of parasites, tetanus, malaria, hook worm, cholera and diarrhea which are common in this part of the world to unsanitary conditions caused by wastes simply strewn around. Odukoya *et al* (2002), also noted that leachates from wastes at a dump site, are potential sources of contamination to both surface and ground water.

The sanitary state of an area is largely influenced by the waste handling practices of the residents and the measures in place for safe waste evacuation and disposal. Household solid waste is one of the most difficult sources of solid waste to manage because of its diverse range of composite materials, that are hardly sorted out prior to disposal which include garbage , plastics, paper, glass, textiles, cellophane, metals and some hazardous waste from household products such as paint, garden pesticide, pharmaceuticals, personal care products, batteries containing heavy metals and discarded wood treated with dangerous substances such as antifungal and anti termite chemicals which are hardly sorted out prior to disposal (Onu *et al*, 2001). The ever increasing global concern on environmental health



demands that wastes be properly managed and disposed off in the most friendly and acceptable way, this is to minimize and where possible eliminate its potential harm on plants, humans, animals and natural resources. The problem of solid waste is a historical one because man's existence is inextricably linked to the generation of waste. The problem is becoming intractable as many cities in developing countries cannot keep pace with urbanization, pollution, and the increasingly concomitant generation of garbage due to changing life styles and consumption patterns (Momodu, *et al*, 2011). Globally, waste generation is on the increase and constitutes risks to both human health and the environment. According to the OCED (2002) report on municipal waste generation rate for member countries, the rate is expected to rise from 100 million tonnes annually in 1980s to approximately 168 million tonnes by 2015 and 250 million tonnes in 2030. On a global scale, calculating the amount of waste being generated presents a problem. There are a number of issues including lack of reporting by many countries and inconsistencies in the way countries report (definitions and surveying methods employed by countries vary considerably). However, despite these shortcomings in calculating waste generation rate statistically, a cursory observation across one's immediate environment will reveal a gradual and steady growth in waste size.

The ever increasing global concern on environmental health demands that wastes be properly managed and disposed off in the most friendly and acceptable way. This is to minimize and where possible eliminate its potential harm on plants, humans, animals and natural resources (Onu *et al*, 2001). In developing countries, there exists the disparity between rapid population growth and sanitation infrastructure. This disparity is worsened by the challenges of poor waste management practices impacting on the deteriorating

ecosystems on the rapidly transforming cities which result in a catalogue of overcrowding growth in illegal settlements, uncollected household waste and the absence of water, sanitation and other basic facilities which are typical of many urban centres in Nigeria (Modebe, *et al* ). The quantity and rate of waste generation in cities according to Anthony (2011), is a function of the population, level of industrialization, socio-economic status of the citizens and the kind of commercial activities that take place. For instance, Sridhar and Adeoye (2003), reported than an overview of some selected developed and developing countries figure show that the United States. Canada and United Kingdom in 2002 recorded 760kg, 640kg and 560kg per capita per year respectively; but the figures for developing countries like China, India, Nigeria/ other Sub Saharan African countries in 2012 were approximated at 277kg, 237kg and 212kg per capita per year respectively.

The World Health Organization (WHO 2004) and United Nations International Children Education Fund (UNICEF 2004) joint report in August 2004 as cited by Uwaegbulam (2004), revealed that: “about 2.4 billion people will likely face the risk of needless disease and death by the target of 2015 because of bad sanitation”. The hardest hit by bad sanitation is rural poor and residents of slum areas in fast-growing cities, mostly in Africa and Asia. The report also noted that bad sanitation – decaying or non-existent sewage system and toilets- fuels the spread of diseases like cholera and basic illness like diarrhea, which kills a child every 21 seconds. The hardest hit by bad sanitation is rural poor and residents of slum areas in fast-growing cities, mostly in Africa and Asia (Uwaegbelun, 2004). The indiscriminate dumping of municipal solid waste is increasing and is compounded by a cycle of poverty, population explosion, decreasing standards of living, poor governance, and

the low level of environmental awareness .Hence, these wastes are illegally disposed of onto any available space, known as Open-dumps (Izugbara and Umoh,2004).

In some developing countries, waste management agencies are not able to develop functional and sustainable waste management systems and strategies. The affected governments spend between 20-50% of their annual budget on waste management but only 20-80% of the waste is effectively managed. The main reason for this inability to manage waste is due to rapid population growth coupled with the expansion of cities, diminishing financial resources and poor urban planning. Their low priority on environmental governance has further compounded the waste management challenges associated with domestic wastes (Choguill, 1996; Achankeng, 2003; Bolaane and Ali, 2004; Pokhrel and Viraraghavan, 2005; Abdulkarim *et al*, 2009).

In sub-Saharan Africa, particularly Nigeria, refuse generation and its likely effects on the health, quality of the environment and the urban landscape have become burning national issues. In the same vein, waste management in Nigeria and other developing countries in Africa have remained chaotic in spite of both institutional and legal frameworks, and other interventions initiated to check the menace. Major cities in sub-Saharan Africa are grappling with mounting heaps of wastes dumped indiscriminately. These wastes emanate from household or domestic sources, markets, shopping and business centers, schools, etc. Also pathetic is open defecation on roads, street corners, water channels and, haphazard dumping of hazardous commercial and industrial wastes (Anchor and Nwafor, 2014).

The solid waste problem in Nigeria started with the rapid increase in urban growth resulting partly from the 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 dimensions (Okpala, 2002). 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 nation's most serious environmental problem (Titus *et al*, 2014). The poor state of solid waste management in urban centres of developing countries is now not only an environmental problem but also a social handicap. Solid waste management in Nigeria is characterized by inefficient collection methods, insufficient coverage of the collection system and improper disposal despite huge budgets that are committed to solid waste management (Ogwueleka, 2003).

The management of solid wastes stands as the most visible environmental problem facing Nigerian cities. The problem is growing daily as a result of increasing urbanization. The solid waste problem is visible in most parts of the cities on the roads, within the neighborhoods and around residential buildings. The existing capacity for addressing the problem is low at all levels of government especially at the city level since solid waste management is the responsibility of the local government. The problem is such that the United Kingdom Department of International Development through its State and Local Government Program (SLGP) supported the Nigerian Government on reforms of solid waste management (Sanusi, 2010).

The management of solid wastes has become increasingly a difficult task locally and globally with increase in population and high consumption patterns among urban dwellers in Nigeria. In most urban cities, solid wastes are thrown away indiscriminately in any available space without care of the negative impacts it has on the environment. This poses serious

threat to human health and the environment. The presence of solid wastes in a society is a great problem if not well managed due to its ability to induce environmental degradation. Improper management of solid wastes defaces the environment, spreads disease, and contaminates ground water, air and land quality. It is a major environmental concern to many nations especially the developing countries. These wastes are usually mixed together without sorting and dumped indiscriminately in the environment and as a result, poses a lot of problems for effective management of wastes which could be attributed to lack of education on the types of wastes, characteristics of wastes and methods of solid waste disposal as well as the effects of improper wastes disposal on human beings. Even when the bins for separation are provided, different categories of wastes are still lumped together and disposed at the same point. This practice results from lack of knowledge and skills needed for segregation of wastes at the source of generation and carefree attitude towards solid wastes management on the part of the citizens (Festus and Ogoegbunam, 2012).

The generation and disposal of household solid waste have become an increasing problem in urban areas due to increasing population, high density, urbanization, industrialization, the inefficiency of the collecting systems, and lack of political will on the part of the government. Akinsulire (2005) observed that recent events in major cities in African countries have shown that the problems of waste management have become a monster that has thwarted most efforts made by international, federal and state governments, as well as city authorities and professionals alike. The pursuit of environmental sustainability is an essential part of human well being (UNEP, 2004), and achieving it requires carefully balancing human needs with maintaining functioning ecosystems and curbing environmental pollution. This is the goal of safe and proper disposal and management of solid waste

(Westlake, 1995). According to WHO (1997) the disposal of solid waste appears to defy any national solution in Nigeria, with the indiscriminate dumping of waste on sewers, stream channels, open spaces, drainages, etc.

Little attention is given to waste management practices as it is common to see heaps of waste in the major cities littering the streets, dumped indiscriminately in drainages, vacant plots and open space especially in the developing world. This has contributed not only to the spread of communicable diseases in the affected areas; it has effect on flooding and other environmental problems. A typical solid waste management system in developing countries displays an array of problems among which include low collection coverage and irregular collection services (Omran *et al*, 2007). It is fast becoming a difficult task which must be surmounted by developing countries especially Nigeria if she is to realize the reduction of solid waste in the cities by 75% as proposed by Millennium Development Goals (MDGs) in 2015. The growth of human population couple with increased economic activities has resulted into high rate of solid waste generation, this call for careful planning and adequate resource allocation to bridge the gap between the rate of waste generation and that of collection and disposal. The ways to handle and dispose waste varies considerably within and between cities, regions and nations; therefore, waste is a matter of place and time (Ojemudia and Ojigi, 2006).

A research carried out by Sridhar and Adeoye (2003) puts the daily solid waste generation rate per person as 0.58kg which is remarkably high when multiplied with 170 million inhabitants in Nigeria today. To make matters worse, waste management usually has a low priority on the political agenda of most developing countries as they are struggling with other important issues such as hunger, health problems, water shortages, unemployment

and civil war. Thus, it is easy to understand why waste problems have a tendency to grow steadily. The Environmental Performance Index puts Nigeria at number 126 out of 146 countries with a score of 56.2. The rankings show that developed countries have higher rankings than developing countries. The first three countries were Switzerland, Sweden and Norway with scores of 95.5, 93.1 and 93.1 while the last three countries were Sierra-leone, Angola and Niger with scores of 40.0, 39.5, and 39.1 respectively. This shows that developed countries pay more attention to their environment when compared to their developing counterparts. In order to tackle the issue of waste management, the Federal Government introduced the monthly environmental sanitation in the early seventies. States and Local Governments were expected to take a cue and evolve Solid Wastes Management (SWM) strategies based on the peculiarities of their environment. Each state had in the process of mitigating urban solid wastes, set up Wastes Management Boards (WMB) in attempts to tackle the occurrence of wastes and their hazards to society as a whole. While the unhealthy aspects of abandoned solid wastes can be contained, the more avoidable features of blocked drains, traffic impedance and floods have yet to be fully tackled. One resonant feature common in the wastes build-up and emanating environmental degradation scenarios is the high cost or capital intensive nature of its amelioration as well as tackling the solid wastes menace. It requires a lot of financial and human capital to minimize and attempt to eradicate the adverse effects of exposed and untreated solid wastes in our urban centers

(Abdulkarim *et al*, 2009; Momodu *et al*, 2011).

The National Waste Management Policy is embodied in the National Policy on the Environment which was formulated in 1989 and revised in 1999. The policy was developed to study the most reliable treatment systems appropriate for domestic and industrial wastes,

to provide and utilize information on the appropriate methods and technologies for the treatment, reuse and disposal of wastes, to encourage source reduction, reuse, recycling of wastes as well as the recovery of valuable products from wastes among others. At the state level, the Niger State Ministry of Environment is charged with the responsibility of domesticating the Waste Management Policy by ensuring that appropriate programs are drawn up for the handling and disposal of wastes and the supervision of waste management and sanitation and to mobilize grassroots participation in solid waste management as well as sanitation. Solid waste management in Niger State has traditionally been undertaken by the Niger State Environmental Protection Agency (Federal Ministry of Environment, 2012).

An environment with a high standard of sanitation that is both clean and beautiful has a great influence on our psychological, emotional and social wellbeing. It enhances public health and quality of living. Therefore, to ensure a healthy environment, solid waste needs to be properly managed to control or limit pollution (Agbede and Ajagbe, 2004). The need for better environmental management strategies in Nigeria grow with increased urgency of the perceived environmental problems, and the progressive nature of the threats to sustainable development that these problems pose. Solid wastes in Nigeria was identified as a major pollutant in the vision 2020 blue print which this study shall examine in relation to the strategies of domestic solid waste management in the study area. Manaf *et al*, (2009), reported that the population growth in Tunga is higher than the average of the whole country in Nigeria because of its proximity to Abuja. The population drift in Tunga is also associated with job opportunities in the Federal Capital Territory where it is proximally located. However, more people means more waste, and more waste means more resources needed for waste management. The increase in consumption of resources has resulted in large volume of



wastes from domestic activities which have resulted in significant threats to human health and the environment (Ayo *et al*, 2010).

## **1.2 STATEMENT OF THE RESEARCH PROBLEM**

The problems associated with solid waste generation and its management has been the focus of considerable environmental attention during the last quarter of the twentieth century as communities all over the world over have begun to recognize the hazards that its management entails (Onu *et al*, 2001). In developing countries, millions of people live without a waste management system, wide spread dumping of waste in water bodies and uncontrolled dumpsites aggravates the problem of generally low sanitation, which pose serious threat to the surrounding environment and are a health risk to the population, causing contamination of the drinking water and soil (Anthony, 2011).

Agbede and Ajagbe (2004) researched on solid waste management in Ibadan North using critical observation, questionnaires and literature review. Structured questionnaires were administered to a hundred households, thirty traders and ten industries to obtain information about solid waste management as practiced by individuals, households and market traders. Their findings revealed that no effort was made at treating different types of wastes differently for disposal purposes. The methods of waste disposal were sanitary landfill, composting and incineration. They also reported that the Solid waste management authority, the only institution responsible for the management of solid waste in the study area has not been successful in getting rid of solid waste.

Similarly, Efe (2010) examined the problem of solid waste generation and management in Ughelli using direct field measurement and questionnaire administration.

One hundred questionnaires were administered to households, schools and markets to determine the sources of waste, frequency and methods of waste disposal, those responsible for the collection of household waste and the effect of the waste in the area. The results revealed that there were no authorized dumpsites in the area and the major method of waste disposal are open dumping, land filling and dig and bury. Wastes are generated mainly by households, markets, industries, schools and other establishments. In addition, He reported that there is no solid waste management agency established by government.

Aondoakaa and Ishaya (2009) assessed people's perception of the impact of urban generated solid waste on the environment in Gboko, Benue State using 200 questionnaires which were administered to the inhabitants of the town. The major waste generated were household discarded materials and food remains while in the less developed areas, majority of the respondents expressed that most of the solid waste generated are from agricultural activities. They reported that most people in the study area have low knowledge of the impact of solid waste disposal on the environment and they feel they are not responsible for the management of the waste they generate. Their findings reveal that majority of the respondents that were aware that solid waste has an impact on the environment were educated.

Aliyu (2010) analyzed solid waste management in Kano metropolis, Nigeria using data gotten from government agencies, interviews and field surveys in three residential zones that are representative samples of the city, reported that about 3085 tonnes of solid waste were generated each day and the largest amount of waste generated comes from households in the study area. Also, the waste is not properly managed and thus has grave implications on the environment in the study area.

From the foregoing, all the literatures reviewed were carried out outside Tunga. Furthermore, none of the studies reviewed have been able to appraise the strategies of domestic solid waste management on the method of waste collection, transportation and disposal which imposes great burden on the environment. Thus, this study seeks to assess the sustainable compliance of handling Domestic Solid waste in the study area and will address the following research questions:

- i. What categories of domestic solid waste are generated in the study area?
- ii. What are the waste management strategies employed in the study area?
- iii. Who are the key players in domestic solid waste management in the study area?
- iv. What is the frequency of waste generated compared to the waste disposed in the study area?
- v. How effective are the levels of domestic waste management strategies employed in the study area?

### **1.3 AIM AND OBJECTIVES OF THE STUDY**

The aim of this research is to examine the domestic solid waste management strategies in place in Tunga, Niger State. This would be achieved through the following objectives which are to:

- i. categorize the types of domestic solid wastes generated in the study area.
- ii. examine the domestic solid waste management strategies employed in the study area.
- iii. identify the key players in domestic solid waste management in the study area.
- iv. examine the frequency of waste generated and disposed in the study area.
- v. ascertain the effectiveness of the domestic solid waste management strategies employed in the study area.

#### **1.4 HYPOTHESES**

- i. Ho. There is no significant difference between the frequency of waste generated and the frequency waste disposed in the study area.
- ii. Ho. There is no significant difference in the effectiveness of the domestic solid waste management Strategies in the study area

#### **1.5 SCOPE OF THE STUDY**

The study is focused on investigating the domestic solid waste management strategies in Tunga, Chanchaga Local Government Area, Niger State. It was based on the analysis of data from selected households in Tunga, the study area. According to Niger State Environmental Protection Agency, Tunga is made up of the following areas: Ntieco, LowCost, Sauke-Kahuta, Farm Center, Aero-Park, NSTA Garage, Top Medical, Maje and Abdulsalam Garage. Thus, structured questionnaires that included information on the socioeconomic characteristics of the respondents, the types of domestic solid wastes generated, waste management strategies and the frequency of disposal using these strategies were drafted and administered to residents in these areas. This is because all households produce domestic solid wastes and therefore have an equal chance of being selected to provide answers to the research questions. This research took place between October, 2014 and March, 2015.

#### **1.6 JUSTIFICATION FOR THE STUDY**

The 2006 National Population Census (NPC) reported that the population of Chanchaga Local Government Area as 201,429 1/3<sup>rd</sup> of the target population live in the study area (Niger State Planning Commission, 2011). This therefore shows that the study area is

residential in nature. It is in view of this fact that the study seeks to analyze the domestic solid waste management strategies in place in Tunga. Humans produce waste in their residents or at places of work. Rapid urbanization, industrialization, population growth, poor living standards in developing countries have generated refuse that pose health hazards to communities.

Dashe, (1997) noted that without the perception of a guide into the future environmental program, a crash is inevitable. Therefore, there is need to understand the various ways individuals participate in environmental protection and waste management especially at the house hold level with a view to integrating them into the environmental management program since it is generally believed and accepted that domestic solid waste constitutes the second most contributing source of waste generated anywhere, anytime worldwide. The study would be relevant to decision and policy makers on environment, stakeholders and the general public because it is expected that the domestic solid waste management strategies in the study area would be adequately analyzed at the end of the study. This study would serve as a reference material to researchers, NGO's and public institutions. The study would however open up areas that were not fully covered by this research to those willing to undertake further studies.

## **CHAPTER TWO**

### **CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

This section presents various concepts and theoretical frameworks on the subject of study. Similarly, it includes a review of literatures which provides suitable information for this study such as the concept of waste, composition and source of waste generation, solid waste generation, solid waste management in developing countries, Nigeria and Niger State, health and environmental impacts of solid waste, sustainable waste management, factors that influence waste generation and institutional and policy framework for solid waste management in Nigeria.

#### **2.2 CONCEPTUAL FRAME WORK**

##### **2.2.1 Solid Waste**

Contemporary definitions of solid waste are converging on the essential ingredients of the definition for example origin or sources of the material, characteristics and potential to cause harm to the environment. According to the World Health Organization Expert Committee in 1995, waste is defined as unwanted or discarded materials that arise from man's activities. The Department of the Environment (DoE, 2000), also defined waste as "any substance which constitute scrap material or an effluent or other unwanted surplus substance arising from the application of a process, or any substance or article which requires to be disposed of as being broken, worn out, contaminated or otherwise spoiled. Furthermore, the European Union Framework Directive on Waste (91/156/EEC) adopted the definition of

waste as “any substance or object which the holder discards or intends to discard and which falls into one of the following categories:

- Production or consumption residue.
- Product whose date for appropriate use has expired.
- Contaminated or soiled materials.
- Substances that no longer perform satisfactorily” (Europa, 2006).

Generally, Waste creation by man is inevitable as far as the manipulation of the environment continues, (Danbuzu, 2011, Adewole, 2009). As a result of our daily activities to survive, we produce waste in millions of tons annually (Hammed, 2006). Waste is either an asset or liability depending upon our attitude to it. To some because of its menace, waste is more of a liability. However the best and the most rewarding attitude to waste is to see it as an asset. With this kind of attitudes waste can be better planned for man’s benefits.

The principal sources of Solid Waste in an urban area according to Isirimah, (2002), are: Municipal, (from street sweeping, sewage, waste from schools, markets and other institutions); Domestic, (garbage, rubbish and often large waste from homes); Commercial (from stores and offices); Industrial (from manufacturing plants); Mining, (from coal mining, strip mining etc.) Construction and Demolition, (new construction sites, road repairs, renovation sites razing broken pavements) and Agriculture.

Gobo & Ubong, (2001), gave a detailed classification of solid wastes as follows:

- **Garbage;** these are putrescible waste from food, slaughter houses, canning and freezing industries, etc

- ii. **Rubbish-** non putrescible wastes, either combustible or non-combustible. Combustible wastes, either combustible or non-combustibles would include metals, glass, ceramics, stones, dirt, masonry and some chemicals.
- iii. **Ashes** - residues (such as cinders and fly ash) of the combustion of solid fuels, for heating and cooking or the incineration of solid waste by municipal, industrial and apartment house incinerators.
- iv. **Large wastes** from demolition and construction rubble, automobiles, furniture, refrigerators, and other home appliances, furniture, refrigerators, and other home appliances, trees, tires, etc.
- v. **Dead animals** – household pets, birds rodents, zoo animals, etc
- vi. **Hospital Waste** – anatomical and pathological wastes from hospitals.
- vii. **Sewage treatment process solids** – screenings, settled solids, sludge
- viii. **Industrial solid waste** – chemicals, paints, and explosives.
- ix. **Mining Waste** – tailings, slag heaps, culm piles at coal mines.
- x. **Agricultural wastes** – farm animal manure, crop residues etc.

### 2.2.2 Municipal Solid Waste

Municipal Solid Waste, has been defined as household waste and any other waste collected by a Waste Collection Authority (WCA) or its agents, including waste from parks, beaches, commercial establishments, offices, industries and fly tipping (Read, 1999). Other experts insist that Municipal Solid Waste includes all non-air and sewage emissions created within and collected by private as well as public authorities in any municipality from domestic, commercial and industrial (non-hazardous) sources (Cointreau, 1982; Igoni *et al.*,



2007). Article 2(b) of the European Union Landfill Directive (EU Landfill Directive, 1999) broadened the definition further by defining MSW as waste arising from households as well as other wastes, which because of their nature and composition are similar to waste from households (EEA, 2003). This implies that MSW may often include biodegradable components such as paper, wood, textiles, food and garden waste, as well as non-degradable fractions such as glass, plastics, tyres and bottles. The various sources of these wastes in any community may include: residential houses, institutions, commercial organizations, municipal services, allotments and treatment sites (Ezeah, 2006). In essence, Municipal Solid Waste would normally include all wastes from the neighbourhood except industrial, agricultural and hazardous wastes (Tchobanoglous *et al.*, 1993).

### **2.2.3 Waste Management**

Onu, Price, Surendran and Ebie (2001) defined waste management as the application of techniques that ensures the orderly execution of the functions of collecting, transfer, processing, treatment and disposal of wastes. Waste management, according to Wokekoro, (2007) as cited by uchegbu, (1998), defined waste management as a planned system of effectively controlling the production, storage, collection, transportation, processing and disposal or utilization of wastes, in a sanitary, aesthetically acceptable and economical manner. It includes all administrative, financial, legal and planning functions as well as the physical aspects of waste handling.

Waste management can also be regarded as a process of treating, handling of refuse, sewage and other wastes that arise from human activities without endangering human health and the environment. The solid waste management techniques are waste reduction, reuse and recycling. This is referred to as the 3R's of waste management. The most favoured option

being waste reduction (waste prevention and minimization). The least favoured option is sending wastes to landfills. Solid wastes segregation technique which enables individuals to segregate wastes at the source of generation is also an important technique that should be developed in individuals in order to attain effective management of wastes in Nigeria. Solid waste disposal methods which are mostly preferred and considered as environmentally friendly in waste management business are incineration, composting, dumping in approved dumpsites and land filling. However, littering, open burning and open dumping of solid wastes which are practised by many individuals are not environmentally friendly because they aid in the spreading of diseases and the pollution of the environment.

Tchobanoglous et al., (1993) defined Solid waste management as the discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid waste in a manner that is in accord with the best principles of public health, economic, engineering, conservation, aesthetics and other environment consideration that is also responsive to public attitudes. The primary objectives of effective solid waste management as highlighted by Oreoyomi (1998:2) are:

- a. The elimination of health hazards in the community by removing all the physical, biological and chemical agents like bottles, vectors or diseases and toxic substances that are harmful to man in his environment.
- b. To protect the natural environment being polluted or damaged. This is achieved by discouragement of wastes being dumped indiscriminately on either land or river.
- c. To provide gainful employment for many young men who would have been jobless.
- d. Enhancement of regular supply of raw materials to industries through salvaging and

recycling of materials of economic value from wastes. Effective solid waste management by adult citizens will entail reduction of wastes, segregation of wastes into degradable and non-degradable materials, reuse, composting and recycling of wastes. The dumping of wastes in the designated collection centres is equally needed in order to maintain a clean and healthy environment.

### **2.3 COMPOSITION AND SOURCE OF WASTE GENERATION**

Waste composition indicates the components of the waste stream given as a percentage of the mass or volume. The main constituents of solid wastes are similar throughout the world but the proportions vary widely from country to country and even within a city, because the variations are closely related to income level. Waste generated in developing countries contains a large percentage of organic materials, usually three times higher than that of industrialized countries. The waste is also more dense and humid, due to the prevalent consumption of fresh fruits and vegetables, as well as unpackaged food. First World residents consume more processed food and packaged in cans, bottles, jars and plastic containers than those in the developing world. As a result, waste generated in the former contains more packaging materials than in that of the latter. Higher volumes of wastes and a changing composition have a profound impact on waste management practices (Cointreau – Levin, 1997).

Urban solid waste is a heterogeneous material and its generation rate and composition vary from place to place and from season to season (World Resources Institute, 1998; Gidarakos *et al*, 2006). The composition and volumes differ between high and low-income locations (UNEP, 2002). According to Ogwueleka (2009), solid waste is wetter, heavier and more corrosive in developing nations, making its management more difficult. Affluent

communities contain large proportion of papers, polythene, plastic, metals and glasses. While the waste in low income communities are predominantly organic in nature.

According to the World Bank (2001), waste generation is greatly influenced by a country's development. the more economically prosperous a country is, the more waste it generates per capita but the factor that seem to bridge the gap between waste generation and it's resultant effect is the method or efficiency of waste management strategy adopted by such country (Titus *et al*, 2014) For example, comparing the waste situation in developed countries like; Britain, United States of America, Canada where there exist much economic activities that generate more waste but with a corresponding well organized waste management system compared to the situation in developing countries like; Nigeria, Ghana and Cameroun with their steady increase in population and a corresponding increase in their rate of waste generation from industrial and human activities but without an efficient waste management system.

Ogwueleka (2009) reported that the phenomenon of waste generation is common to all communities and often linked to urbanization process, especially when both the natural and the migratory net gains are relatively large. Thus, man's activities on domestic, commercial and industrial processes produce some undesirable effects, which are pollutant of all categories. Certain factors determined the rate and characteristic of waste generated. These include the level of economic activities, the pattern of consumption, income level, culture, population size and the level of economic development. However, personal income has been found to have the most significant effect on waste generation, this is due to its impact on individual consumption pattern. Also the rate of solid waste generation per capital increase as the standards of living improves (UNCHS, 1992).

Neal and Schubel (1987), in a study reported that without populations there would be no pollution and that pollution is the price of progress” that the spatial variation of socio - economic and demographic characteristic as well as the level of technological development of our environment influence waste generation. Adedibu (1983) noted that the economic activity of any community will determine to a great extent the quality and type of waste generated by the people. In an agrarian economy for instant, the common type of waste are usually in the form of leaves, food remnants, harvest wastes among others. In industrial economy, tin cans, plastic packages among other are common. In as much as the generation of waste is inevitable, therefore the need to protect our environment becomes paramount. Mabogunje (1980) futher argued that the incidence of a population explosion in an area enlarge the size of households, and thus translating into heavy waste generation. He also noted that the source of waste generation is a function of many interacting variables such as economic activities, the pattern of consumption, income level, culture, population size and the level of economic development.

#### **2.4 SOLID WASTE GENERATION**

Globally, Solid Waste generation has continued to increase in line with growth in other socio-economic parameters such as population, personal income and consumption patterns (Achankeng, 2003). In the last two decades, per capita waste generation in the developed economies has increased nearly threefold (AfDB, 2002). According to the same study, waste generation in the developing nations is growing rapidly and may double in aggregate volume within this decade, driven largely by growth in population and improvements in living standards. If current trends persist, a fivefold increase in global Solid Waste generation is probable by the year 2025 (AfDB, 2002).

Waste generation is drawing increasing attention as citizens observe that too much garbage is lying uncollected on the streets, for instance, an overview of some selected developing and developed countries figures reveal that the United States, Canada and United Kingdom (developed countries) in 2002 recorded 760kg, 640kg and 560kg per capita/ per year respectively; but the figures for developing countries like China, India and Nigeria in 2012 were approximated at 277kg, 237kg and 212kg per capita/ per year respectively (OCED Environmental Data Compadium, 2012; Hoornweg and Bhada- Tata, 2012; Sridhar and Adeoye, 2003). Although, the developed countries having larger mass of waste, they have developed strong institutional framework to manage their wastes effectively.

Generally, the more economically prosperous a country is, the more waste it generates per capita but the factor that seem to bridge the gap between waste generation and it's resultant effect is the method or efficiency of waste management strategy adopted by such country. A typical example could be seen when comparing the waste situation in developed countries like; Britain, United States of America, Canada where there exist much economic activities that generate more waste but with a corresponding well organized waste management system compared to the situation in developing countries like; Nigeria, Ghana and Cameroun with their steady increase in population and a corresponding increase in their rate of waste generation from industrial and human activities but without an efficient waste management system. It is realized that the waste situation in developed countries are much better than that of the developing countries irrespective of the volume of waste they generate due to the waste management strategy they practice or employ.

## **2.5 MUNICIPAL SOLID WASTE MANAGEMENT IN THE UNITED KINGDOM**

There are four waste management strategies in the UK. England, Wales, Scotland, and Northern Ireland have each developed a National Waste Strategy outlining ways of dealing with waste generated within their jurisdiction. The 'National Waste Strategy 2007 - England' (Defra, 2007) described the vision for managing waste and resources and sets out the changes needed to deliver more sustainable development in England. Where appropriate, this document will be used as the basis for comparison and illustration of best practice in the UK.

### **2.5.1 Overview of MSW Composition and Management in England**

The growing profile of municipal solid waste management in England is best mirrored by the level of activity generated within the sector in the past decade. Within this period, there have been three strategy consultation documents, two waste strategies, and a plethora of implementation programmes in response to European Directives (Audit Commission, 1997; Read, 2001). Since the publication of the Waste Strategy for England and Wales 2000, significant progress has been recorded particularly in England. In absolute terms, waste growth is reducing, growing slightly slower than the economy by 0.5% per year (Defra, 2007). Average percentage of total MSW land filled has equally reduced from 78% in 2000/01 to 65% in 2005/06. During the same period, average recycling rate has grown fourfold to 25% in 2005/06 while recycling of packaging waste increased from 27% to 56% in the same period (Defra, 2007).

Drivers that helped achieve these significant growths include changes in policy, such as the Landfill tax escalator, the introduction of the Landfill Allowance Trading Scheme (LATS), additional funding for Local Authorities, rigorous implementation of EU wide directives and targets on specific waste sectors such as vehicles, Waste Electrical Electronic Equipments (WEEE) and packaging. Other delivery structures that have equally facilitated recent growths include: the Waste Implementation Programme (WIP), the Waste and Resource Action Programme (WRAP) and the Business Resource Efficiency and Waste (BREW) programme (Defra, 2007). As in most countries, MSW management in England is a shared responsibility. While the Environment Agency holds overall responsibilities for environmental regulation, County Councils have the function of Waste Disposal Authorities. Within a County, the District or Borough Councils serve as Waste Collection Authorities dealing with the collection and transportation of MSW. In the case of Unitary Authorities, the functions of the Disposal and Collection Authority are combined under one layer of local government rather than the more common two-tier approach (Phillips *et al.*, 1999). In many cases certain levels of regional organizations and/or quasi-governmental structures exist, facilitating effective service delivery (Read, 1999). The white paper “Making Waste Work” marked the paradigm shift in MSW management in the England (DoE, 1995). The White Paper fundamentally re-focused the national psyche on the imperatives of more sustainable approach for waste management in line with the Bruntland Report (WCED, 1987). Since then, two other strategy documents i.e. Waste Strategy for England and Wales (DETR, 2000) and Waste Strategy for England (2007) have been published outlining the essential composition of municipal waste arising in England while at the same time road mapping the overall national MSW management objectives.



### **2.5.2 Waste Management Strategies and Policy Objectives in England**

Though significant progress has been made since the publication of Waste Strategy 2000, the UK's overall performance continues to lag behind many mainland European nations. For instance, of the 27.3 million tonnes of MSW produced in England in 2008/09, 50.3% was sent to the landfill compared with 37% in France, 18% in Germany and less than 3% in The Netherlands. UK central government targets reducing the quantity of waste sent to landfills. The realization of this target is hinged on making waste management a shared responsibility for every section of society (Defra, 2007):

- A. Producers will seek to redesign their production processes with the aim of making products that are less wasteful and take responsibility for adverse environmental impacts of their products throughout the product's life. Producers to aim at using more recycled materials and less new extracted raw materials as industry best practice.
- B. Retailers will have to reduce packaging, prefer to market products from eco-friendly producers and educate their customers to choose likewise.
- C. Consumers – Businesses as well as households to seek all avenues to generate less waste, separate their waste at source for easy recycling thereby lessening adverse environmental impacts.
- D. Local authorities to provide residents with adequate education on how to reduce waste and provide convenient and sustainable waste management options for unavoidable waste.
- E. Waste management industry to access and invest in new technologies that emphasize

waste avoidance and re-use while providing convenient service options for their customers where waste production is unavoidable.

- F. Central government will provide the enabling environment for all stakeholders in waste/resource management to take responsibility and show leadership through appropriate actions for sustainable waste management (Defra, 2007).

## **2.6 OVERVIEW OF MUNICIPAL SOLID WASTE MANAGEMENT IN DEVELOPING COUNTRIES**

The challenges of waste management in developing countries continue to generate thoughts, interest and research.( Ogbe, 2014) The odour emanating from such heaps constitute nuisances and the heaps constitute a breeding ground for disease vectors, like mosquitoes, cockroaches, rodents, reptiles, and even human scavengers (the mentality ill) among others (Izugbore and Umoh 2004; Lelege and Ogean, 2003 and Mebogunje, 1974). Municipal solid waste (MSW) disposal is an enormous concern in developing countries across the world, as poverty, population growth and high urbanization rates combine with ineffectual and under-funded governments to prevent efficient management of wastes (UNEP 2002, Doan 1998, Cointreau 1982).

There are several factors that set MSW management in developing countries apart from management in industrialized countries. First, the types of materials that compose the majority of the waste are different. In developing, there is a much higher proportion of organic, and considerable less plastics (cointreau 1982). The large amount of organic material makes the waste denser, with greater moisture and smaller particles size (cointreau 1982). A second difference is that technologies used in industrialized countries are often

inappropriate for developing countries. Even garbage trucks are less effective because of the much heavier, wetter and more corrosive quality of their burden (cointreau 1982). Other technologies such as incinerator, are often far too expensive to be applied in poor nations. Thirds, developing countries' cities are characterized by unplanned, haphazardly constructed, sprawling slums with narrow roads that are inaccessible to collection vehicles (UNESCO 2003, Daskalopoulos, 1998). Finally, there is often a much smaller stock of environmental and social capital in developing countries. People are unaware or uncaring of cradle-to-grave solid waste management needs, being more concerned with more immediate problems such as disease and hunger.

### **2.6.1 Municipal Solid Waste Management in Sub-Saharan Africa**

Until the late 1980s MSW management in most parts of SSA had practically no nationally co-ordinated institutional or policy framework to rest on (AfDB, 2002). Though Municipal Authorities were often required by law to carry out this function, most of them lacked the capacity to do so (Akpofure and Echefu, 2001; Walling *et al.*, 2004). Quite often therefore waste management is very low in their priority list. In the few cases where supervisors were assigned MSW management functions within local authorities, they seldom had the full compliment of qualified staff, such as planners, managers or field and technical staff to work with (Agunwamba, 1998). Since most MSW personnel in these organizations were almost always low cadre staff, they lacked the capacity to influence funding decisions. This often results in severe inadequacies in funding and consequently diminished operational capabilities (Henry *et al.*, 2006). The consequence is that wastes are quite often dumped at any convenient location by residents and overtime they accumulate into open dumps that have become ubiquitous in many cities in SSA. Lately, as a result of increasing awareness of

the deleterious effects waste has on the environment and positive changes in the socio-economic circumstances of some countries in the region, governments are beginning to put in place policies, programmes and institutions to enhance the management of MSW at all levels

(Olowomeye, 1991; Chokor, 1993; IPCC, 2006). To fully understand current MSW characteristics and management practices across the region, a country based-review is necessary in line with key objectives of this research. Consequently, Municipal Solid Waste composition and management in three countries representing the major regions of Sub Saharan Africa: South Africa, Ghana and Nigeria have been reviewed.

### **2.6.2 Municipal Solid Waste Management in South Africa**

South Africa's premier policy document on integrated pollution and waste management, "White paper on pollution and waste management" was published via Government Gazette No. 227 in March 2000. This document encapsulated the overall waste management objectives of the country (South Africa, 1998; AfDB, 2002). Though the document had a clear strategy for the management of unavoidable waste, the cardinal policy thrust of the document is based on the concept of waste prevention, minimization and resource efficiency. Before the adoption of this policy document, overall responsibility for the implementation of South Africa's waste policy was scattered amongst several governmental institutions sometimes with conflicting interests and objectives. This piecemeal implementation strategy had often proved counterproductive (AfDB, 2002).

Under the new policy a nationally co-ordinated approach to waste management has been adopted thereby streamlining waste legislation and implementation by various organs of government. As part of this reform the Ministry of Environment with a subdepartment, dealing with pollution and waste management, has been created as the apex governmental

organization on waste related issues. Equivalent structures now exist in the provinces. Further to these changes South Africa has committed itself to the implementation of an ambitious integrated municipal waste management programme via the Polokwane Declaration in September, 2001 (Polokwane Declaration, 2001).

## **2.7 SOLID WASTE MANAGEMENT IN NIGERIA**

From an American perspective (warren and Holland, 2004), the sheer magnitude of the solid waste problem in Nigeria is hard to comprehend. There is no public waste bins, as the amount of trash that accumulates in a matter of hour would be more than waste collectors could haul in a day. Nigeria garbage “dumps” are located on the sides of the high way at the fringe of cities and slums. Since there are no means for containment, trash often spreads into the roads, blocking traffic and drainage. (Onibokun and Kumuyi, 1999) noted that problems in Nigerian cities have become burdensome despite efforts being made by city authorities and governments. The problems of solid waste such as inadequate service coverage, irregular waste collection, waste spill over from bins and storage containers, and lax attitude of people towards indiscriminate disposal on unauthorized places and waste littering are common.

Nigeria is a nation that exemplifies chronic solid waste management problems in conjunction with population growth. It is the most populous country in Africa, with over 120 million residents (World Bank 2000), Nigerian cities in recent time have witnessed rapid population growth resulting from influx of migrants from rural area to the cities. This brings about the concentration of industrial, commercial, infrastructural, administration and government activities in urban centers. Thus, as the population of cities grows, the rate of waste generation also increases leading to increase burning of refuse (in the developing

countries) and high rate of air pollution. (Adeshina, 1993). All these activities generate one form of waste or the other. And the volume of waste generated has also increased tremendously. The implication of this is that we have more waste to cope with (Adesina, 1993).

The Federal government has very little control over environment regulations as a whole. The federal Environment protection Agency (FEPA) was established in 1988 to control the growing problems of waste management and pollution in Nigeria (Onibokun and Kumuyi 2003). Vision 2010 was FEPA's attempt to address environmental problems in the nation. The report proposed goals to be accomplished by the year 2010 that would lead toward sustainable development. In regard to solid waste management, the report says the goal is to "achieve not less than 80 percent effective management of the volume of municipal solid waste generated at all sound management" (vision 2010, 2003). Strategies to achieve this goal include education and awareness programs, developing collaborative approaches to integrative management of MSW, stretching existing laws and ensuring compliance, and encouraging local and private sector participation. Although this represents a positive, though some what undefined, approach to solid waste management, the reality of poverty and government corruption has prevented effective implementation of these plans. There is little to hold the government or the public accountable to the regulations developed by FEPA and vision 2010 (Bankole 2004).

In Nigeria, the situation is such that no organization is willing to take responsibility for regulation of waste management. For example, in Ibadan in the western part of the country, jurisdiction over waste management has changed hands several times since the late 1980s; although local governments are intended to fund solid waste disposal, less than a

quarter of the necessary money was collected in 1994 (Onibokun and Kumuyi, 2003). Since state resources are often extremely limited. Private companies will often be contracted for waste disposal. However, these companies are frequently no more effective than the state - in Ibadan in 1992, there were twenty three (23) registered private waste collectors, but only ten (10) were found to be operational (Onibokun, 1999).

### **2.7.1 Solid Waste Management in Niger State**

The Niger State Ministry of Environment is charged with the responsibility of domesticating the Waste Management Policy by ensuring that appropriate programs are drawn up for the handling and disposal of wastes and the supervision of waste management and sanitation and to mobilize grassroots participation in solid waste management as well as sanitation. Although Niger State has not been mentioned prominently as a state with acute waste management problem, there is however a growing evidence that the little that is being generated is not been properly managed. This has raised some concern among planners and decision makers. To further consolidate its efforts in getting rid of solid waste in its urban centres, the government of Niger state sought and obtained the assistance of the United Nation Development Programme (UNDP) to facilitate a process that would lead to the development of a sustainable strategy for solid waste management in the main urban centers of the state. The main objectives of the support was in preparation of a state strategy for waste management. The process followed from the development of the strategy include:

- Undertaking a survey of waste generation and management in the four most populous cities in the state.
- Evaluating the current institutional arrangement for waste management in the state.
- Developing a training module on waste management.

(Environmental care project - Minna, 2006).

Despite various efforts, it is becoming clear that present system of waste management have not been able to satisfy community needs for an acceptable clearing level as well as in reducing the general health and environmental impacts of waste. Moreover, national and state efforts have not been able to improve the general aesthetic appearance of city landscape. Evidence of increasing frustration is the indiscriminate and open waste dumping with its attendant high environmental and health risks, and persistent waste accumulation that is evidence in various locations of the main urban centers of the state. These locations are consistently liable to various vectors (rodents and insects) and foci to severe environmental pollution, repulsive and very bad smells and disgusting appearance. When burnt on dump locations, these accumulations have negative environmental and health impacts and implications. Effort were made by the past administrators in the state, in launching war against indiscriminate dumping of waste and giving priority to solid waste management. Adequate funds and logistics were made available. However problem of waste began when the regime elapsed, which result to non-funding of the appropriate organization. This resulted to indiscriminate dumping wastes in every nook and crannies of the state.

## **2.8 INSTITUTIONAL AND POLICY FRAMEWORK FOR SOLID WASTE MANAGEMENT IN NIGERIA**

Adelagan (2004), traced the history of environmental policy and legislation in Nigeria to the earliest days of colonial rule around the early 1900s and revealed that the formative years of environmental legislation and management in Nigeria has all along been characterized by absence of clearly laid out objectives and strategies to achieve stated



objectives efficiently. The researcher contended that there are no clearly formulated policies in Nigeria aimed at coordinating and addressing the harmful consequences of industrial development on the environment. According to the Federal Ministry of Environment (2012), the National Waste Management Policy is embodied in the National Policy on the Environment which was formulated in 1989 and revised in 1999. The policy was developed to study the most reliable treatment systems appropriate for domestic and industrial wastes, to provide and utilize information on the appropriate methods and technologies for the treatment, reuse and disposal of wastes, to encourage source reduction, reuse, recycling of wastes as well as the recovery of valuable products from wastes among others.

In 1988, the Federal Government of Nigeria (FGN) established the Federal Environmental Protection Agency (FEPA) in response to the serious challenges posed by environmental degradation, exemplified by the dumping of hazardous waste substances by an unidentified naval vessel around Koko port in the Niger Delta region. The Agency was mandated by the FGN decree 58 of 1988 to among other functions:

- Advise the Federal government on national environmental policies and priorities and on scientific and technological activities affecting the environment.
- Prepare periodic master plans for the development of environmental science and technology and advise the Federal government on the financial requirements for the implementation of such plans.
- Promote co-operation in environmental science and technology with similar bodies in other countries and with international bodies connected with the protection of the environment.

- Co-operate with Federal and state ministries, local government councils, statutory bodies and research agencies on matters and facilities relating to environmental protection.
- To carry out such other activities as are necessary or expedient for the full discharge of the functions of the agency under this decree (FGN, 1988).

Agunwamba (1998; 2003) and Onibokun and Kumuyi (1999) dwelt extensively on the structure and relationships between various state agencies saddled with waste management responsibility and highlights areas of successes and major barriers militating against their efforts at sustainable management of municipal solid waste in the country. Olowomeye (1991) is of the opinion that many important structures required for the efficient management of solid waste in the country are still missing from the Federal through to the local government levels, Agunwamba, (1998) and Onibokun and Kumuyi (1999) argued that current operational difficulties in waste management in the country are reflective of the general state of infrastructural and economic decay in Nigeria. In this respect, they advocate that Government must begin to adopt integrated waste management solutions that are private sector driven as they have greater potential for long term desirable environmental and economic improvements.

## **2.9 HEALTH AND ENVIRONMENTAL IMPACTS OF SOLID WASTE**

Assessing the impacts of municipal solid waste management involves consideration of a large number of components. Health impacts include exposure to toxic chemical through air, water and soil media; exposure to infection and biological contaminants; stress related to odor, noise, vermin and visual amenity; risk of fires explosions and subsidence among others (Dolk 2002). Environmental impacts can be clustered into: global warming, photochemical-

oxidation creation, abiotic resource-depletion, acidification, eutrophication, and ecotoxicity of water (Seo, 2004).

Landfills are associated with a plethora of health and social effects such as odor nuisance; ozone formation (from reaction of  $\text{NO}_x$  and non-methane organic compounds with sunlight) that causes pulmonary central nervous system damage; fire and explosion-hazards from build-up of methane; and increase in the number of vermin (bird, rodents and insects) which act as disease vectors; and ground and air pollution from leachate and landfill gases (Daskalopoulos, 1998). Water contamination by leachate transmits bacteria and diseases. Leachate from landfills can enter ground water system, leading to increase in nutrient levels that cause eutrophication (El-fadel, 1997). Bioaccumulation of toxins and heavy-metals can also occur.

Incineration impacts society by production of odor and in the unsightliness of the facility (Garrod and Willis 1998). There is also the potential for surface water pollution from waste water (used for quenching hot ashes before transport) (EPA 1995). The most important health and environmental impact is from air emissions, which include particulate  $\text{CO}$ ,  $\text{CO}_x$ , acid gases (Chlorides and sulfides), volatile organics and mercury. These compounds contribute to bioaccumulation of toxics and acid rain (Daskalopoulos, 1998, EPA, 1995). Inhalation of particulate matter poses a health danger, as it destroys lung tissues (Neal and Schubel, 1987).

Health and social impacts of composting/Anaerobic Digestion include noise, odor, and unsightliness (Garrod and Willis, 1998). Many of the micro-organisms found in compost are known respiratory sensitizers that can cause a range of respiratory symptoms including allergic rhinitis, asthma, and chronic bronchitis (Swan, 2002). Both composting and

anaerobic digestion produce biogases, through less than landfills, composting is aerobic and produces primarily carbon dioxide while anaerobic digestion produces methane. Both gases contribute to global warming.

Recycling also pose health and environmental risks. Sorting facilities contain high concentration of dust bio-aerosols and metals. Workers commonly experience itching eyes, sore throats and respiratory diseases (Gladding 2002). Environmental speaking, recycling uses a large amount of energy resources. Health and social side effects are equally as important as environmental impacts when considering MSW management. For people in developing countries, bodily well-being is a far more pressing concern than the fact that opens burning of garbage contributes to acid rain or global warming. Outrage over health issues of poor waste management could therefore be a motivating factor towards more sustainable environmental practices. Other negative environmental effects of indiscriminate dumping of refuses, is in the area of social economic aspect of a nation as it affects its tourism potential and its aesthetic standard.

## **2.10 STRATEGIES FOR EDUCATING AND RAISING AWARENESS ON SOLID WASTE MANAGEMENT**

In order to control the manner in which solid wastes are handled by individuals and authorities concerned with solid waste management, there is the need to educate the citizens and raise awareness on the negative impacts of improper management of solid wastes. This is supported by Ribble Valley Borough Council (2009) which asserts that adopting a waste awareness and education strategy would clearly indicate commitment to raising public awareness on waste. It also considered that such a strategy would provide an ideal educational framework that will lead to consistency of information and identify more

practical activities that can be undertaken by individuals and authorities concerned with wastes management. The strategies are discussed below:

**i. Infusion of solid wastes management themes into academic curricula**

The infusion of Solid wastes management themes for environmental sustainability into the academic curricula at all levels of education will contribute immensely to the citizen's perception and attitudinal change towards waste management. Waste management themes can be infused into traditional subjects like science, social studies, Geography and English. Adekunle *et al*, (2012) noted that if citizens are mobilized at a tender age, by infusing solid waste management themes into their curricular, safe waste disposal of materials will become a natural habit as their hearts and minds will be captured early in life. This will promote a sense of responsibility and best practices of managing wastes.

**ii. Establishment of environmental clubs and programmes**

Establishment of environmental clubs and programmes on solid waste management in primary, secondary and tertiary institutions will equally enhance proper management of wastes. Through this medium, knowledge and understanding of solid waste management will be developed, positive attitudes, values, care and concern for the environment will be attained. In the same vain, appropriate skills and competences needed for segregation, reduction, reuse, composting and recycling will be inculcated in the citizens that will enhance active participation of people in solid wastes management (Festus and Ogoegbunam, 2012).

**ii. Informal and non- formal education strategy**

Individuals in the society that cannot be reached in the formal school system can be educated informally and non-formally. This could be achieved through the print and audio visual media and the internet. Educating the people through these media will enhance better practices of solid wastes segregation, reduction, composting and recycling of solid wastes (Festus and Ogoegbunam, 2012).

**iii. Public awareness on solid waste management**

The creation of awareness on the negative impact of improper management of solid wastes is of great importance in motivating individuals to participate in waste management. In order to increase household participation in recycling, Omran *et al* (2007) state that the message of recycling as an appropriate waste management technique needs to be adequately communicated to the public. This will enable residents to change their habits, behaviour and traditions towards recycling for the better. The message can be created through various strategies. This could be carried out through advertisements in the newspapers, television, radio, billboards and the use of leaflet. Enlightenment campaigns, clean up campaigns are other avenues of creating awareness on waste management. Abdelsner *et al* (2006) in Omran, *et al* (2007) observe that the integrated use of all media can increase public participation in recycling of solid wastes. The organization of workshops, seminars on environmental issues and solid waste management in particular can equally be employed.

**iv. Use of environmental educational materials**

End-user Environmental Adult Educational materials like posters, fliers located at strategic locations in various parts will constantly keep the citizens informed about appropriate attitude and proper methods of handling the wastes they generate daily.

End-user environmental adult education materials as noted by Mbalisi (2009:17) are “materials which the target audience require no further interpretation to understand and assimilate the information”.

The use of local languages in the dissemination of information on how to manage wastes properly is paramount in the sustainable solid waste management so as to reach out to the citizens that do not understand English language. These materials therefore can be prepared in different languages so as to enable the target audience comprehend the messages they convey. The activity based environmental education materials like curriculum guides, reference materials and policy documents can also be utilized. Mbalisi (2009) also noted that activity based materials are those environmental adult education materials which require further interpretation before the target audience could understand and assimilate the information they contain. These materials can be used in schools, workshops, seminars, presentations and group discussions (Festus and Ogoegbunam, 2012).

## **2.11 SUSTAINABLE SOLID WASTE MANAGEMENT**

Over the years, the problem associated with solid waste management is more acute in developing countries of the world than the developed world (Zerborck, 2003). Many Developing Countries are still struggling with solid waste collection and management (Wilson, 2007), and Nigeria is no exception. Solid Waste is waste generated and discarded as useless or unwanted from activities in homes, institutions, public and commercial places, and industries, though it is also a resource for reuse, recycle, and recovery (Tchobanoglous et al., 1993). According to Mary and Barbara, (2005) waste management is the collection,

transportation, processing, treatment, recycling or disposal of waste materials to reduce their adverse effect on humans' health or amenities.

A sustainable solid waste management system encompasses a system that is environmentally, financially, and socially appropriate and acceptable, and meets the criteria of sustain-able development, development that meets the needs of the present generation without compromising the ability of future generations to meet their needs (World Commission on Environment and Development, 1987) Environmental sustainability requires that solid waste collection and disposal which imposes great burden on the environment and resources, be transformed into a closed-cycle system (closing the loop) restoring various natural cycles, thus preventing the loss of raw materials, energy, and nutrients.( Schmidt, 2011).

## **2.12 FACTORS THAT INFLUENCE WASTE GENERATION**

A good study of household solid waste requires the assessment of the factors that influence the generation and disposal of wastes for a proper and sustainable management of urban household wastes. According to Hardoy, Mitlin and Satherthwaite, (2001), cities are regarded as the most efficient agents of production with increase in population. This population increase compounds the problems of solid waste management. Urban land use over the years have become complex as the city grows in population and physical size and so does the solid waste generation increase in volume an varieties. Urban land uses vary from residential, commercial, industrial, institutional; and others, with each category generating its own peculiar type of solid waste. However, residential land use constitutes the single most important generator of solid waste in Nigeria urban areas (Adegoke, 1990; Ogwuche 2011).



Because of the complexity of the household wastes, the socio-economic structure of the urban population becomes a major determinant of the spatial structure of solid waste problems in our cities. Uwadeigwu (2003) in a study noted that the quantity of municipal solid waste produced depends upon the living standard of the residents, urbanization and industrialization.

Okoye (2004), identified household size, income level, level of technological advancement and socio-economic status as factors that affect the quantity of solid waste generation, but however, noted that a single factor may not on its own constitutes a difference in the quantity of waste generated by a household. Also Afon and Okewole (2007), in a study of waste generation in Oyo State, Nigeria discovered that as education, income and social status increase, per capital waste generation declines. This according to him is partly influenced by the differences unemployment/livelihood pattern in the area.

### **2.13 LITERATURE REVIEW**

Nigerian cities generate solid waste at an alarming rate such that in most cases, the volume of waste generated is often more than what the city system could absorb or handle. The characteristics of their problems range from inadequate housing, lack of potable water leading to un- sanitary neighborhoods. Several studies have taken different lash at issues that concerns waste at large.

Efe, (2010) examined the problem of waste disposal and management in Ughelli. A field survey was undertaken to determine the types, volume, effects and methods of managing solid waste in the Ughelli. The volume of waste was measured at dumpsites in the four existing quarters and from household bins. Appropriate waste characterization methods

were employed in classifying the waste into various components on weekly basis. Eighty and twenty questionnaires were administered to households' heads and industries respectively and summarized with descriptive statistics. The results revealed an increase in the volume of solid waste generated over the years with 15,540 Kg mean annual volume of solid waste generated in Ughelli at dumpsites, and 1104.7 Kg mean volume of solid waste generated per households that never arrives at dumpsites.

The composition of solid waste generated and disposed in Ughelli were predominantly food items, bottles/cans and plastics, paper/carton and nylon of sachet water, which were mostly found in market places. The most widely adopted method of waste disposal is open dumping, land filling, dig and bury. It is therefore recommended that government should adopt an appropriate waste collection and disposal agency and also more government approved dumpsites should be established in the area.

Agwu (2012) examined the relationship between individual background (sex, age and social class) and the level of awareness, knowledge and practices of solid waste management in Port-Harcourt city residents. The research was based on Ajzen (1991) theory of planned behaviour which states that attitude towards behaviour, subjective norm, and perceived behavioural control, has influence in predicting the behavioural intention and actual behaviour of individuals when participatory decisions are voluntary and under an individual control.

The research assumes that some demographic information (sex, age and social class) of Port-Harcourt city residents influences their attitude, subjective norm and perceived behavioural control thus determining the behavioural intention/actual behaviour i.e. level of awareness, knowledge and practices of solid waste management. 800 Port-Harcourt city

residents were randomly surveyed from the two local government areas of the city (Port-Harcourt city and Obio/Akpor LGAs) using structured questionnaire. Data collected were subjected to percentage, mean, standard deviation, t-test and chi-square statistical analyses.

Findings revealed that Port-Harcourt city residents from the sampled zones are aware of solid waste management problems in their environment but possessed poor waste management practices. The study showed that the propensity for solid waste management practices differed by background (sex, social class and age) of residents. Significant relationships were observed between respondents' sex, age and social class and their level of awareness, knowledge and practices of solid waste management. This research therefore recommends among others: sensitization of Port-Harcourt city residents on the dangers of poor solid waste management, provision of near-by solid waste collection points, enactment of waste management laws with stiffer penalties on offenders, establishment of solid waste recycling plants, effective monitoring of waste contractors, provision of more waste evacuation equipment, provision of more solid waste dump sites and effective monitoring of monthly clean-up activities.

According to Ogwueleka (2009), municipal solid waste management has emerged as one of the greatest challenges facing environmental protection agencies in developing countries. He studied the municipal solid waste characteristics and management in Nigeria. He examined the current solid waste management practices and problems in Nigeria and reported that solid waste management is characterized by inefficient collection methods, insufficient coverage of the collection system and improper disposal.

Abul (2010) carried out a research to examine the environmental and health effects of solid waste disposal at a dumpsite in Swaziland, 78 out of 121 households were surveyed

using self administered questionnaires, a comparison between the nearby and far away residents was done, 39 households close to the dumpsites and 39 households far away from the dumpsite.. The result shows that both residents were affected by the location of the dumpsite closer to their settlements. It was also noted that the residents whose houses are less than 200 meters from the dumpsite are victims of malaria, chest pains, cholera, and diarrhea. While residents whose houses are more than 200 meters were also affected with the chest pain and bad smell from the dumpsite, but mainly when wind is blowing in their direction.

Amalu and Ajake (2014) examined solid waste management practices in Enugu city with special interest in the techniques employed by the waste management agency in the state. Data for the study were collected through questionnaire survey, interviews, field inventory and participatory rural appraisal methods. The result of study revealed that the techniques of waste management were inadequate with the use of a central waste collection method and pattern; and that the population of the study area produced much more waste than the waste dump sites can accommodate. They recommended the employment of a door to door waste collection system and that government should ensure accessibility to homes by constructing roads across the city and a reduction of the waste levy on residents in the area.

Ifegbesan (2010) carried out a research to explore the understanding of waste management and practices in secondary schools in Ogun State, Nigeria, using a structured self administered questionnaire. A total of 650 students were surveyed from six secondary schools in two of the four educational zones in the state. The findings revealed that secondary school students from the sampled zones were aware of waste problems in their school compounds, but possessed poor waste management practices. The study showed that propensity for waste management practices differ by sex, class and age of the students.

Significant relationships were observed between student's ages, class and their level of awareness, knowledge and practices of waste management.

Aondoakaa and Ishaya (2009) assessed people's perception of the impact of urban generated solid waste on the environment in Gboko, Benue State using 200 questionnaires which were administered to the inhabitants of the town. The major waste generated were household discarded materials and food remains while in the less developed areas, majority of the respondents expressed that most of the solid waste generated are from agricultural activities. They reported that most people in the study area have low knowledge of the impact of solid waste disposal on the environment and they feel they are not responsible for the management of the waste they generate. Their findings reveal that majority of the respondents that were aware that solid waste has an impact on the environment were educated. They thus recommended strong environmental campaign and an enactment of environmental laws in Gboko town.

Afangideh, Kinuabeye and Atu, (2012), examined the attitude of urban dwellers to waste disposal and management. One hundred and fifty copies of questionnaire were administered to residents in the area. Information such as the various classes of waste, frequency of waste disposal and methods of waste evacuation were obtained from the questionnaire. Finding revealed that family size has a great influence on waste disposal and generation which was evidence in the hypothesis with a calculated value of 7.32 greater than the critical value of 2.43 at 0.05 level of significance. Besides, environmental enlightenment has changed people's attitude towards waste generation and management in the area. This was affirmed in the calculated f-value of 3.18 greater than critical t-value of 1.97 at 0.05 level of Significance. However, this result indicates that effective environmental

enlightenment would help avert the attitude of urban dwellers to waste disposal and management in the area.

## **CHAPTER THREE**

### **THE STUDY AREA AND METHODOLOGY**

#### **3.1 INTRODUCTION**

This section provides the background information of the study area to facilitate discussion of results and these include; the location, climate, geology and drainage, soils and vegetation, people and occupation. In addition, the methodology employed to answer the research questions of this study in the study area such as reconnaissance survey, the type and sources of data, sampling design and sampling techniques, instruments of data collection, validity and reliability of the instruments and data analysis in Tunga, Chanchaga Local Government Area, Niger State were discussed.

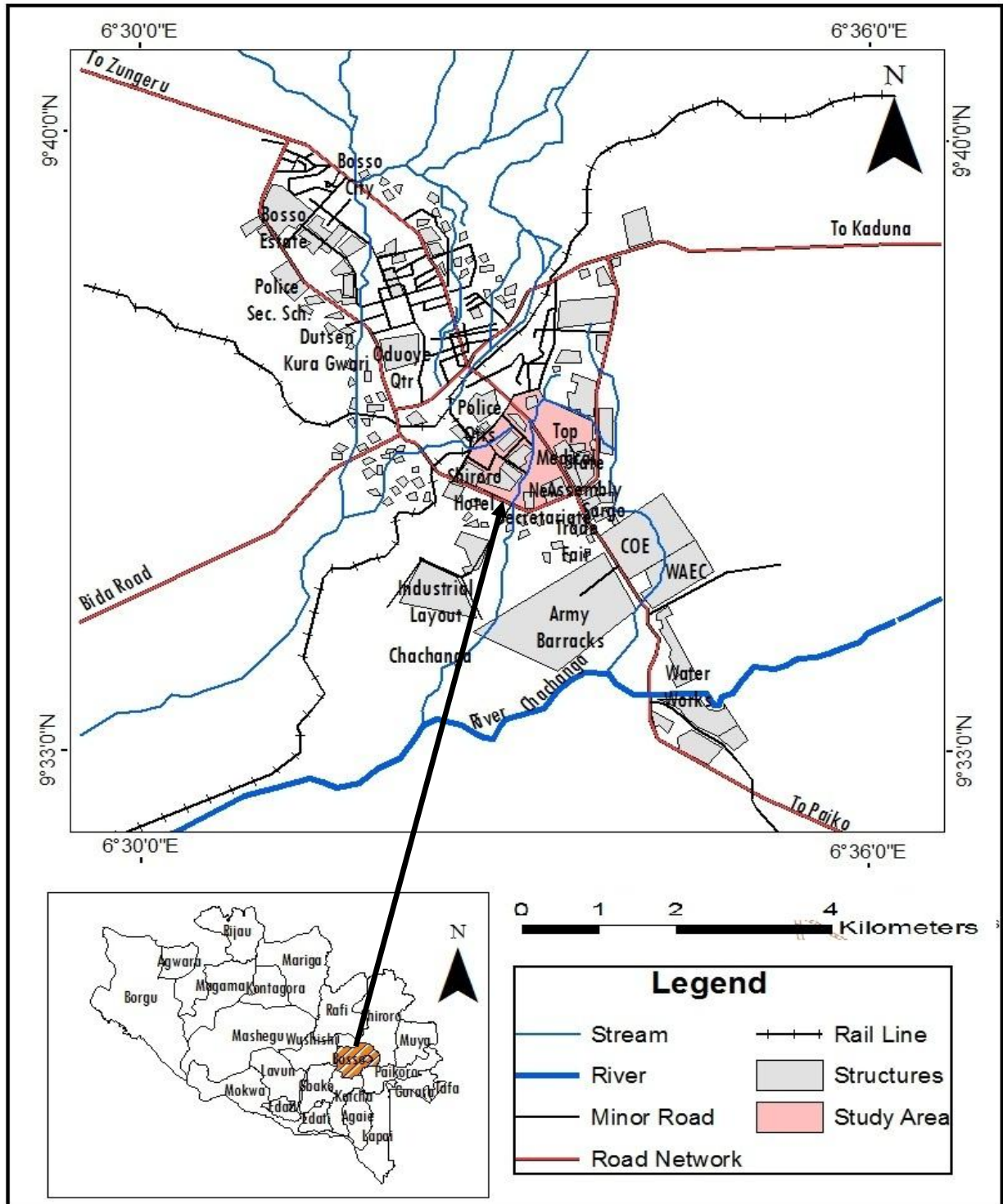
#### **3.2 THE STUDY AREA**

##### **3.2.1 Location**

Tunga is located in Chanchaga Local Government Area of Niger State, in the Northern Guinea Savanna and North- Central Nigeria. It lies within Latitude  $9^{\circ} 37'$  -  $9^{\circ} 61'$  North and Longitude  $6^{\circ} 33'$  -  $6^{\circ} 56'$  East of the Greenwich Meridian (Maxlock, 1979). Tunga is located at the south eastern part of Minna, the capital of Niger State (see Figure 3.2.1). Tunga is estimated to have covered about one third of the total land area of Minna which is 76,363 square km (UNDP/NISEPA, 2009; Lawal, 2010).

##### **3.2.2 Climate**

The climate of the study area is influenced by two monsoons or trade winds; the south-west and north – east. The south west trade wind is humid and rain bearing and the duration of its prevalence decreases from the coast inland,



**Figure 3.2.1: Minna Showing the Study Area**

Source: Ministry of Lands and Survey Minna (2012).



while the north east trade wind is dry and blows over Nigeria with intensity and duration increasing from north to south. The study area falls within the Aw climate type according to Koppen's classification scheme. The study area experiences two distinct seasons, dry and wet. The average temperature remains high throughout the year, hovering between 32- 35°C, particularly in March and June. However, the lowest minimum temperatures between 26- 28°C occur in December and January when the town comes under the influence of the tropical continental air mass which blows from the north. The town experiences an annual average rainfall of 1334 mm and daily average humidity at 44.4%. The rainy season starts around April and last till October. The month of September normally records the highest rainfall while the dry season commences in October and lasts till March. The mean monthly temperature is highest in March and lowest in January (UNDP/NISEPA, 2009). According to Butu, Ageda, and Bichi, (2013), the climate affects waste management because wastes can be easily burnt during the dry season as compared to the rainy season and the amount of leaves that fall is higher during the dry season compared to the rainy season.

### **3.2.3 Geology and Drainage**

The study area is on a geological base of undifferentiated basement complex of mainly gneiss and magmatite, a steep outcrop of granite occurs in the north- eastern part of the study area. It is an area of low topography with intermittent hills. The area lies on a basement complex rock situated at the base of the Minna Gwari hill to the North and East in an undulating plain. The highest points are located at the western part toward chanchaga with hills of about 250m above sea level. The landscape of Tunga is generally low lying between 60-80 metres above sea level and about 200- 250 meters above sea level towards the western part with intermittent hills (Maxlock, 1980). A few streams flow through the study

area, they include bosso, Shango, Chanchaga, Ekpa, Suka and Gora. These serve as sources of water supply to the study area and its environs (UNDP/NISEPA, 2009).

#### **3.2.4 Soils and Vegetation**

Soils in the study area represent an interface between intensive chemical weathering of rocks and an active surface and sub surface denudation system and belong to the ferruginous tropical soil class based on the CCTA classification system. Hydromorphic soils occupy few depression areas and valley bottom positions while those around inselbergs, mesas and other residual hills and at the bed of rivers are weakly developed soils (Keay, 1959). The area has mainly lateritic and sandy soil, except along river channels, which has alluvial deposits. The soil has a fine texture which favours the growth of yams, guinea corn and millet (Niger state regional plan, 1980).

The study area lies in a natural vegetation characterized with scattered trees and tall grasses a typical guinea savanna vegetation composed of shrubs, few short trees with grasses between the heights 0.5-2.5m. The trees with an average height of about 10 meters. The vegetation implies a woodland vegetation type dominated by *isoberlina doka*, *i. tomentosa* and *uapaca togoensis*, tree species and *Andropogon* herbs (Keay, 1959). However due to the population pressure in this area, human activities have fondly modified the local vegetation. The vegetation of the study area is significant because it is a likely source of biodegradable waste to be managed. More so, the greater the vegetation, the greater the amount of waste that would be gotten from leaf droppings especially during the dry season.

#### **3.2.5 People and Occupation**

The predominant economic activities in the study area include commerce, service sector (civil service) and agriculture. Commerce and civil service make up a higher

proportion of the population. Agriculture is practiced on a small scale, although the study area is situated in an agricultural belt, agricultural land use has tremendously reduced, while commercial land use is rapidly developing due to the population up surge in the area. The implication of all these to the physical environment is the increase in solid waste generation from these activities.

The 2006 National Population Census, Chanchaga Local Government Area recorded a population of 201,429. The people are Muslims and Christians with few Traditional Religionists and Atheists. Although there are three major ethnic groups (Nupe, Gbagyi, and Hausa) in the State, other tribal groups include - Kadara, Koro, Baraba, Kakanda, GanaGana, Dibo, Kambari, Kamuku, Pangu, Dukkawa, Gwada and Ingwai. Though the area is mainly Gwari settlement, it has since become heterogenous in terms of people of various and diverse ethnic, religious and cultural background. Diversity of ethnic composition due to the immigration has impacted on housing type in the area (Niger State Planning Commission, 2011).

### **3.3 METHODOLOGY**

#### **3.3.1 Reconnaissance Survey**

In view of the objectives of the study, a reconnaissance survey (visual survey) of the study area was carried out to enable the researcher get acquainted with the study area, observe and study the physical characteristics of the area in relation to waste generation, types, mode of collection and disposal. This gave the researcher an insight on various solid waste management facilities in the study area.

### **3.3.2 Types of Data**

Two types of data were used in this research: Primary and Secondary data respectively.

The primary data for the study included:

- i. Socio-economic characteristics of the respondents such as sex, age, marital status, household size, level of education, income and occupation.
- ii. Characterization of domestic solid wastes generated in the study area.
- iii. Waste management methods and frequency of disposal in the study area.
- iv. Domestic solid waste management strategies available in the study area.

### **3.3.3 Sources of Data**

The primary data used in this study was obtained from first- hand information that was through held observations, subjects' responses, images, photos among others. Similarly, the secondary data was obtained from books, journals, published and unpublished texts, documents, magazines, conference articles, government ministries and agencies such as the N.P.C. for population and household Census of 2006, National Bureau of Statistics and related websites.

### **3.3.4 Sampling Size and Sampling Techniques**

The questionnaire was drafted to provide required responses from target population to obtain data in critical areas of waste management in the in the study area to provide answers to the research questions. Niger State Environmental Protection Agency (2013), reported that there are a total of 2040 houses in the study area. To determine the sample size for this research, Krejcie and Morgan's (1970) method of determining sample size was used which states that: for an area with a population between 2000-2200, the sample size to be used is

327. Thus, a total number of three hundred and twenty seven (327) Households in the study area were sampled with the view of analyzing the domestic solid waste management strategies in the study area. According to Niger State Environmental Protection Agency (2013), the study area Tunga is made up of nine areas which are Niteco, Lowcost, Sauke-Kahuta, Farm Center, Aero-Park, NSTA Garage, Top Medical, Maje and Abdulsalam Garage respectively. Table 1 below shows the distribution of the sample size by households in the study area. Table 3.3.4 below shows the distribution of the sample size by households.

**Table 3.3.4: Distribution of Sample Size by Households**

Name of Area	Number of Houses	Sample Size	Percentage (%)
Niteco	640	103	31.5
Low Cost	480	77	23.5
Sauke- Kahuta	100	16	4.9
Farm Center	178	29	8.9
Aero- Park	176	28	8.6
NSTA Garage	167	27	8.3
Top Medical	105	17	5.2
Maje	112	18	5.5
Abdulsalam Garage	77	12	3.7
<b>Total</b>	<b>2040</b>	<b>327</b>	<b>100</b>

Source: Field Survey, 2015

### 3.3.4 Instrument of Data Collection

- i. Digital Samsung camera for taking photographs, especially open dump sites in the study area.
- ii. Structured questionnaire for subject responses
- iii. Global positioning system (GPS) for taking coordinates

### 3.3.5 Validity and Reliability of Instruments

Pilot study was conducted to establish that the questionnaire was well designed and was able to achieve all the data gathering objectives of the main survey and to ensure validity

of responses. The content validity of the research instrument was validated by group of experts in Geography Department, Ahmadu Bello University, Zaria. The items in the instruments were found to be valid. During pilot testing, the instrument was subjected to Krudan Richardson's test of reliability. The reliability coefficient was calculated as ( $r = 0.89$ ).

### **3.3.6 Procedure for Data Collection**

The primary data was obtained through the use of 327 structured questionnaires that were designed by the researcher based on the research questions and administered to households in the study area to provide answers to the research questions.

### **3.3.7 Method of Data Analysis**

The data obtained from the respondents was be analyzed to achieve the stated objectives which are to;

- i. *categorize the types of domestic solid waste generated in the study area:* The data required to achieve this objective was gotten from field survey/ observation and questionnaire administration. The results obtained were presented and explained using a table of frequencies and percentages.
- ii. *examine the domestic solid waste management strategies employed in the study area.*  
The data for this objective was gotten from field survey and questionnaire administration, while the results obtained were presented in a table of frequencies and percentages.
- iii. *identify the key players in domestic solid waste management in the study area;* The data required to achieve this objective was gotten from field survey/ observation and

- questionnaire administration, while the results obtained was presented and explained using pie charts and percentages.
- iv. *examine the frequency of waste generated and disposed in the study area.* The data required to achieve this objective was gotten from field survey/ observation and questionnaire administration. The results obtained were presented and explained using a table of frequencies and the hypothesis was tested using chi square with Statistical Package for Social Sciences (SPSS).
  - v. *ascertain the effectiveness of the domestic solid waste management strategies employed in the study area;* The data to achieve this objective were gotten through personal interviews and the administration of questionnaires to households using a three-point Likert scale with “very effective”, “effective” and “not effective” was used in the rating. The data obtained was analyzed using tables of frequency and percentages. In addition, Kruskal Wallis test was used to check for a difference in the effectiveness of the domestic solid waste management strategies in the study area using Statistical Package for Social Sciences (SPSS).

## **CHAPTER FOUR: RESULTS AND DISCUSSION**

### **4.1 INTRODUCTION**

This section provides a summary of the results obtained from the administration of questionnaires in order to analyze the domestic solid waste management strategies in the study area. It includes a summary of the demographic and socio economic characteristics of the respondents, types of domestic solid wastes generated in the study area, domestic solid waste management strategies employed in the study area, key players in domestic solid waste management in the study area and effectiveness of the domestic solid waste management strategies employed in the study area

### **4.2 DEMOGRAPHIC AND SOCIO ECONOMIC CHARACTERISTICS OF RESPONDENTS**

#### **4.2.1 Sex Distribution of the Respondents**

The data gotten from the field is shown in table 4.2.1 below. From the table, 58% of the respondents are males while 42% are females. This pattern could be traced in part to social and religious factor as a result of less dominant role performed by women especially in Northern Nigeria which coincides with the study Area of this research work. According to Jiggins (1994) women's perspectives and values for the environment are somewhat different than men's. Women give greater priority to protection of and improving the capacity of nature. Dankelman and Davidson (1998) also observed that women play a key role in managing their natural surroundings and adopt several mechanisms to deal with the kinds of environmental crisis they face.



**Table 4.2.1: Sex Distribution of the Respondents**

Area	Male	Female	Total
Niteco	48	55	103
Low Cost	41	36	77
Sauke- Kahuta	12	4	16
Farm Center	21	8	29
Aero Park	25	3	28
NSTA Garage	19	8	27
Top Medical	6	11	17
Maje	11	7	18
Abdulsalam Garage	5	7	12
<b>Total</b>	<b>188</b>	<b>139</b>	<b>327</b>
<b>Percentage%</b>	<b>58</b>	<b>42</b>	<b>100</b>

Source: Field Survey, 2015.

In addition, Akwa (2009) noted that women are generally responsible for human waste disposal of children and cleanliness of latrines and other facilities. Men, on the other hand, tend only to handle waste when they are paid for it, or when it is specific to their activities (Anne, Maria and Evgenia (1999).

#### 4.2.2 Age Distribution of the Respondents

Table 4.2.2 below shows the age distribution of the respondents. This showed that 8% were less than twenty years of age, 22.3%, 39.1%, 23.5% and 7.0% were between 20 -30, 31-40, 41- 50 and above 50 years of age respectively. This showed that majority of the respondents (about 92%) were above 20 years of age and were able to provide the information necessary for the study. Olorunfemi (2009), in the same vein noted that adults can speak authoritatively on behalf of their family members on issues relating to waste generation and management.

**Table 4.2.2: Age Distribution of the Respondents**

Area	< 19 Years	20-30 Years	31-40 Years	41- 50 Years	>50 Years	Total
Niteco	8	17	43	30	5	103
Low Cost	6	11	31	27	2	77
Sauke- Kahuta	1	9	6	0	0	16
Farm Center	2	7	5	10	5	29
Aero Park	1	8	8	8	3	28
NSTA Garage	5	5	14	1	2	27
Top Medical	0	6	6	1	4	17
Maje	3	3	12	0	0	18
Abdulsalam Garage	0	7	3	0	2	12
<b>Total</b>	<b>26</b>	<b>73</b>	<b>128</b>	<b>77</b>	<b>23</b>	<b>327</b>
<b>Percentage%</b>	<b>8</b>	<b>22.3</b>	<b>39.1</b>	<b>23.5</b>	<b>7.0</b>	<b>100</b>

Source: Field Survey, 2015.

### 4.2.3 Educational Level of the Respondents

The data on the educational qualification is presented in table 4.2.3 shows that the respondents who have attained quranic and primary education constitute 37% while the respondents who have attained secondary and tertiary education constitute 63%.

**Table 4.2.3: Educational Level of the Respondents**

Area	Quaranic	Primary	Secondary	Tertiary	Others	Total
Niteco	21	14	38	25	5	103
Low Cost	2	11	27	33	4	77
Sauke- Kahuta	3	4	1	8	0	16
Farm Center	5	7	1	14	2	29
Aero Park	1	6	2	19	0	28
NSTA Garage	3	11	2	8	3	27
Top Medical	5	8	0	2	2	17
Maje	2	3	9	4	0	18
Abdulsalam Garage	4	4	3	0	1	12
<b>Total</b>	<b>46</b>	<b>68</b>	<b>83</b>	<b>113</b>	<b>17</b>	<b>327</b>
<b>Percentage%</b>	<b>14.1</b>	<b>20.7</b>	<b>25.4</b>	<b>34.6</b>	<b>5.2</b>	<b>100</b>

Source: Field Survey, 2015.

This shows that the level of literacy in the study area is high due to the concentration of higher institutions of learning and the migration of educated people in search of employment opportunities and this could have a positive impact on their perception of waste and its management.

#### 4.2.4 Occupational Distribution of the Respondents

Table 4.2.4 below shows that the occupational distribution of the respondents.

**Table 4.2.4: Occupational Distribution of the Respondents**

Area	Farmers	Businessmen	Civil Servants	House Wives	Others	Total
Niteco	19	52	14	4	14	103
Low Cost	7	23	30	6	11	77
Sauke-Kahuta	1	7	1	4	3	16
Farm Center	5	9	14	0	1	29
Aero Park	2	15	9	1	1	28
NSTA Garage	2	11	13	2	1	27
Top Medical	4	4	2	4	3	17
Maje	1	8	6	1	0	18
Abdulsalam Garage	3	3	5	0	1	12
<b>Total</b>	<b>44</b>	<b>132</b>	<b>94</b>	<b>22</b>	<b>35</b>	<b>327</b>
<b>Percentage%</b>	<b>13.4</b>	<b>40.4</b>	<b>28.7</b>	<b>6.7</b>	<b>10.7</b>	<b>100</b>

Source: Field Survey, 2015.

From the table, about 13% of the respondents are farmers, 40%, 28%, 6% and 10% of the respondents are businessmen, civil servants, house wives and other activities such as carpentry, driving and welding. This shows that they are engaged in one form of activity or the other that could generate waste.

#### 4.2.5 Income Level of the Respondents

Table 4.2.4 below shows that the income level of the respondents.

**Table 4.2.5: Income Level of the Respondents**

Area	< ₦ 20,000	₦ 20,000 - ₦ 39,000	₦ 40,000- ₦ 59,000	> ₦60, 000	Others	Total
Niteco	11	27	53	10	3	103
Low Cost	8	19	34	15	1	77
Sauke- Kahuta	4	3	4	3	2	16
Farm Center	5	7	9	7	1	29
Aero Park	6	9	6	7	0	28
NSTA Garage	3	2	12	10	0	27
Top Medical	0	5	6	5	1	17
Maje	1	2	8	6	1	18
Abdulsalam Garage	4	3	5	0	0	12
<b>Total</b>	<b>42</b>	<b>77</b>	<b>136</b>	<b>63</b>	<b>9</b>	<b>327</b>

Source: Field Survey, 2015.

The level of income an individual earns could greatly influence the amount of waste generated. Thus, the information on the respondent's monthly income showed that about 12% of the respondents earn below ₦ 20,000; 24%, 42% and 19% of the respondents earn between ₦ 20,000- ₦ 39,000, ₦ 40,000- ₦ 59,000 and earn above ₦60, 000 respectively. Their income levels show that over 50% of the respondents earn above ₦ 50,000 and therefore have the capacity to generate household solid wastes. According to Adedibu and Okekunle (1989) personal income influences waste generation due to its impact on individual consumption pattern. In addition, the rate of solid waste generation per capital increase as the standards of living improves (UNCHS, 1992).

### 4.3 TYPES OF DOMESTIC SOLID WASTES GENERATED IN THE STUDY AREA

In order to achieve the first objective of the study, the results on the types of domestic solid wastes generated in the study area is shown in table 4.3 below. From the table, it was observed that about 72% of all the domestic solid waste generated in the study area were mainly organic wastes in nature, while 23.24%, 2.75%, 1.22%, 0.92% were from paper, plastic, metal and textile wastes respectively. The paper waste can be attributed to the presence of Niger state College of Education in the study Area, as students tend to generate paper waste from photocopied materials and other sources. This means that a very large percentage of the domestic solid wastes generated in the study area are biodegradable (about 96%) compared to the non-biodegradable wastes generated in the study area (about 4%), this means that the biodegradable wastes can be decomposed and used for other purposes.

**Table 4.3: Types of Domestic Solid Wastes Generated in the Study Area**

Area	Paper	Organic	Plastic	Metal	Textile	Others	Total
Niteco	29	72	0	1	0	1	103
Low Cost	22	55	0	0	0	0	77
Sauke-Kahuta	4	10	1	0	1	0	16
Farm Center	9	19	1	0	0	0	29
Aero Park	4	23	1	0	0	0	28
NSTA Garage	3	22	0	1	1	0	27
Top Medical	0	13	2	1	1	0	17
Maje	2	14	1	1	0	0	18
Abdulsalam Garage	3	6	3	0	0	0	12
<b>Total</b>	<b>76</b>	<b>234</b>	<b>9</b>	<b>4</b>	<b>3</b>	<b>1</b>	<b>327</b>
<b>Percentage%</b>	<b>23.24</b>	<b>71.56</b>	<b>2.75</b>	<b>1.22</b>	<b>0.92</b>	<b>0.31</b>	<b>100</b>

Source: Field Survey, 2015.

Afangideh, Kinuagbeye and Atu (2012), in the same vein reported that majority of the wastes generated in Calabar are biodegradable waste compared to non-biodegradable waste which when decomposed can be harmful to human health.

#### **4.4 DOMESTIC SOLID WASTE MANAGEMENT STRATEGIES EMPLOYED IN THE STUDY AREA**

In order to achieve the second objective of the study, the results on the various strategies employed in the study area is shown in table 4.4 below. The information shows that the major domestic waste management strategies employed in the study area are open dumping (see figure 4.4), burning and burying. About 62% of the respondents dump their wastes openly, about 22% bury their wastes while about 16% burn their wastes. Efe (2010) in the same vein reported that there were no authorized dumpsites in Ughelli and the major method of waste disposal are open dumping, land filling and dig and bury.

**Table 4.4: Types of Domestic Solid Waste Management Strategies in the Study Area**

Area	Burning	Burying	Open Dumping	Other	Total
Niteco	20	29	54	0	103
Low Cost	3	4	70	0	77
Sauke	2	3	10	1	16
Kahuta					
Farm Center	5	2	22	0	29
Aero Park	3	4	20	1	28
NSTA	9	8	10	0	27
Garage					
Top Medical	3	7	7	0	17
Maje	5	8	5	0	18
Abdulsalam	2	6	4	0	12
Garage					
<b>Total</b>	<b>52</b>	<b>71</b>	<b>202</b>	<b>2</b>	<b>327</b>
<b>Percentage%</b>	<b>23.24</b>	<b>71.56</b>	<b>2.75</b>	<b>1.22</b>	<b>100</b>

Source: Field Survey, 2015.

This is an indication that most residents dump their domestic solid wastes on the streets, gutters or any available open space. Open dumping could be a source of health problems for the residents and can make roads inaccessible by obstructing the free flow of traffic. It can also lead to flooding due to blockage of gutters and other water channels during the rainy season.



**Figure 4.4: Dumpsite behind Alovera Hotel in Tunga**

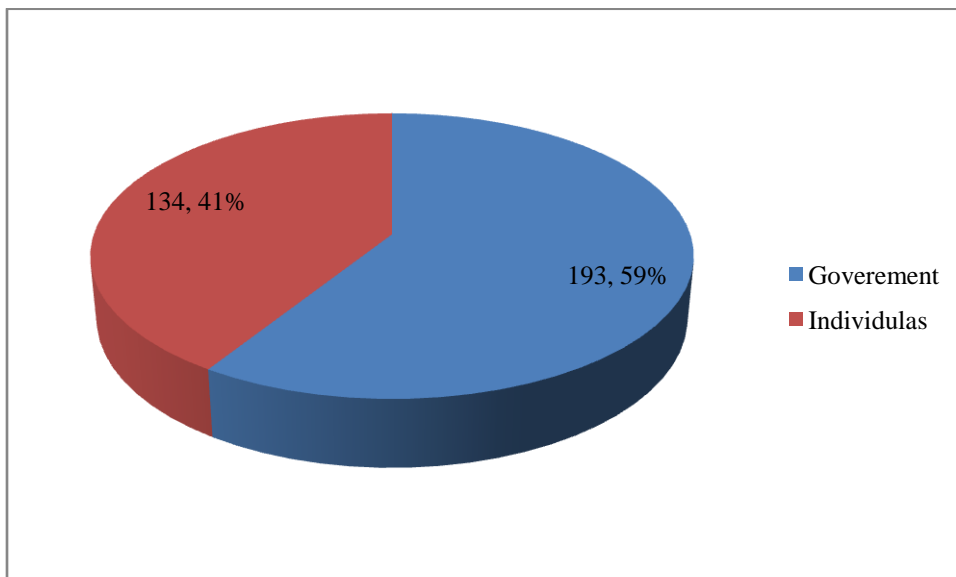
Source: Field Survey, 2015.

Burying is also carried out in the area, all the residents have to do is to dig a hole and throw their wastes there and cover it when it is filled up. Some of the residents reported that burning their wastes is convenient for them but it causes air pollution. This shows that modern means of managing domestic solid waste such as recycling, composting and

incineration are not carried out in the study area and the exploration and use local initiatives and strategies which could go a long way to improve solid waste management is not carried out in the study area. It is also an indication that the domestic solid waste management strategies in the study area do not conform to sustainable waste management strategy. According to Ayo, Ibrahim and Mohammed, (2010), the domestic solid wastes management strategies in place would result in significant threats to human health and the environment in the study area.

#### **4.5 KEY PLAYERS IN DOMESTIC SOLID WASTE MANAGEMENT IN THE STUDY AREA**

In order to achieve the third objective of the study, the results on the Key Players in domestic solid waste management in the study area is shown in the Figure 4.5 below.



**Figure 4.5: Pie Chart Showing Key Players in the Domestic Solid Waste Management in the Study Area**

Source: Field Survey, 2015.



From the chart above, 59% of the respondents reported that the government plays the key role in managing domestic solid waste in the study area through the Niger State Environmental protection Agency (NISEPA) while 41% of the respondents reported that individual households play the key role in managing domestic solid waste in the study area through different avenues like the use of trucks and wheel barrows. Scavengers also operate in the study area, picking recyclable materials as they are thrown away. Agunwamba, (2003), noted that this group is also largely made up of uneducated young men who commute daily from neighboring slums and satellite towns to dumpsites and are more organized, as their activities are regulated by the leadership of their association.

#### **4.6 FREQUENCY OF WASTE GENERATED AND DISPOSED IN THE STUDY AREA**

In order to achieve the fourth objective of the study, the results on the the frequency of waste generation and disposal in the study area is presented in table 4.6.1 below. The table shows that about 74% of the respondents generate their wastes daily, while about 49% of the respondents dispose their wastes daily; about 24% of the respondents generate their wastes twice a week, while about 32% of the respondents dispose their wastes twice a week; about 2% of the respondents generate their wastes once a week and 18% dispose their wastes once a week. This implies that the rate of waste generation is greater than the rate of waste disposal. It also shows that the residents in the study area are exposed to domestic solid wastes for longer periods of time than necessary. According to Agbede and Ajagbe (2004), these wastes could provide breeding grounds for pathogenic organisms, attract insects and

rodents and cause health problems to these residents. Table 4.6. below shows the frequency of waste generated and disposed in the study area.

**Table 4.6: Frequency of Waste Generation and Disposal in the Study Area**

Area	Daily		Twice a week		Weekly		Others	
	Generatio n	Disposa l	Generatio n	Disposa l	Generatio n	Disposa l	Generatio n	Disposa l
Niteco	87	67	16	30	0	6	0	0
Low cost	56	46	21	29	0	2	0	0
Sauke Kauta	11	5	5	7	0	3	1	0
Farm Center	20	10	8	8	1	11	0	0
Aero Park	21	9	7	6	0	13	0	0
NSTA Garage	17	10	10	12	0	3	2	0
Top Medical	12	3	3	5	2	8	1	0
Maje	12	5	5	2	1	11	0	0
Abdulsalam Garage	7	4	3	5	1	2	1	1
Total	243	159	78	104	5	59	5	1
Percentage	<b>74.31</b>	<b>48.62</b>	<b>23.85</b>	<b>31.80</b>	<b>1.53</b>	<b>18.04</b>	<b>1.53</b>	<b>0.31</b>

Source: Field Survey, 2015.

The first hypothesis (there is no significant difference between the frequency of waste generated and the frequency of waste disposed in the study area) was tested using Chi Square at 0.05 level of significance. The result obtained is presented in table 4.6.1 below.

**Table 4.6.1: Chi-square Analysis of the Frequency of Wastes Generated and Waste Disposed in the Study Area**

Chi Square Analysis	Value	Degrees of Freedom	Significance
Pearsons Chi Square	126.186	24	0.01
Likelihood Ratio	108.875	24	0.01
Linear –by Linear association	57.317	1	0.01

Source: Author’s Analysis, 2015

From the table above, the result obtained showed that the Alpha value of 0.01 is lower than 0.05, the implication of this is that the null hypothesis which states that there is no significant

difference between the frequency of waste generated and the frequency of waste disposed in the study area was rejected and the test concluded that there is a significant difference between the frequency of waste generated and the frequency of waste disposed in the study area. This is an indication that the rate of waste generation does not determine the rate of waste disposal in the study area

#### **4.7. THE EFFECTIVE LEVELS OF THE DOMESTIC SOLID WASTE MANAGEMENT STRATEGIES IN THE STUDY AREA**

In order to achieve the fourth objective of the study, the responses on the assessment of the domestic solid waste management strategies in the study area is discussed below.

##### **4.7.1 Respondents' Assessment of Burning as a Domestic Solid Waste Management Strategy**

**Table 4.7.1: Assessment of Burning as a Domestic Solid Waste Management Strategy**

Area	Not Effective		Effective		Very Effective	
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Niteco	48	14.68	31	9.48	24	7.34
Low Cost	32	9.79	34	10.40	11	3.36
Sauke	5	1.53	6	1.83	5	1.53
Kahuta						
Farm	10	3.06	12	3.67	7	2.14
Center						
Aero Park	8	2.45	13	3.98	7	2.14
NSTA	8	2.45	16	4.89	3	0.92
Garage						
Top	8	2.45	5	1.53	4	1.22
Medical						
Maje	10	3.06	4	1.22	4	1.22
Abdulsalam	9	2.75	2	0.61	1	0.31
Garage						
Total	138	42.20	123	37.61	66	20.18

Source: Field Survey, 2015.

The response on the assessment of burning as a domestic solid waste management strategy in the study area is shown in table 4.7.1 above. The assessment shows that about

42% of the respondents reported that burning of domestic solid waste is not effective while about 38% and 25% reported that burning of domestic solid waste is effective and very effective in the study area. The result shows that the respondents are not aware of the health implication of burning domestic solid wastes in the study area. Burning causes air pollution; it increases the concentration of carbon (IV) oxide and contributes to global warming.

#### 4.7.2 Respondents' Assessment of Burying as a Domestic Solid Waste Management Strategy

Table 4.7.2 below shows the response on the assessment of burning as a domestic solid waste management strategy in the study area.

**Table 4.7.2: Assessment of Burying as a Domestic Solid Waste Management Strategy**

Area	Not Effective		Effective		Very Effective	
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Niteco	8	2.45	66	20.18	29	8.87
Low Cost	15	4.59	36	11.01	26	7.95
Sauke	2	0.61	10	3.06	4	1.22
Kahuta						
Farm	10	3.06	13	3.98	6	1.83
Center						
Aero Park	8	2.45	14	4.28	6	1.83
NSTA	3	0.92	11	3.36	13	3.97
Garage						
Top	2	0.61	13	3.98	2	0.61
Medical						
Maje	1	0.31	12	3.67	5	1.53
Abdulsalam	1	0.31	9	2.75	2	0.61
Garage						
<b>Total</b>	<b>50</b>	<b>15.29</b>	<b>184</b>	<b>56.27</b>	<b>93</b>	<b>28.44</b>

Source: Field Survey, 2015.

The table shows that 50 respondents (about 15%) are of the view that burying of domestic solid waste is not effective, 184 respondents (about 56%) think that burying of domestic solid waste is effective while 93 respondents (about 28%) think that burying of

domestic solid waste is very effective. This shows that a large percentage of the respondents see burying as an effective method of managing domestic solid waste.

#### 4.7.3 Respondents' Assessment of Open Dumping as a Domestic Solid Waste Management Strategy

The table on the respondent's view on open dumping is presented I table 4.7.3 below. The table shows that about 86% reported that open dumping is not an effective method of managing domestic solid waste, while about 10% and 4% feel that open dumping is effective and very effective in managing domestic solid waste in the study area. This is because open dumping pollutes the environment; it can make roads inaccessible by obstructing the free flow of traffic. It can also lead to flooding due to blockage of gutters and other water channels during the rainy season.

**Table 4.7.3: Assessment of Open Dumping as a Domestic Solid Waste Management Strategy**

Area	Not Effective		Effective		Very Effective	
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Niteco	89	27.22	10	3.06	4	1.22
Low Cost	67	20.49	8	2.45	2	0.61
Sauke	13	3.98	3	0.92	0	0
Kahuta						
Farm	26	7.95	2	0.61	1	0.31
Center						
Aero Park	24	7.34	4	1.22	0	0
NSTA	23	7.03	2	1.61	2	0.61
Garage						
Top	16	4.89	1	0.31	0	0
Medical						
Maje	13	3.98	3	0.92	2	0.61
Abdulsalam	11	3.36	1	0.31	0	0
Garage						
Total	282	86.24	34	10.40	11	3.36

Source: Field Survey, 2015.

The second hypothesis (there is no significant difference in the effectiveness among the domestic solid waste management strategies in the study area) was tested using Kruskal Wallis at 0.05 level of significance. The result obtained is presented in table 4.7.3.1 below.

**Table 4.7.3.1. Kruskal Wallis H Analysis of the Effectiveness of the Domestic Solid Waste Management Strategies**

<b>Kruskal Wallis</b>	<b>H</b>	<b>Df</b>	<b><math>\alpha</math></b>	<b>Remark</b>
Value	6.014	8	0.646	Significant

Source: Author's Analysis, 2015

From the table the assumed significance for the domestic solid waste management Strategies in the study area is 0.646. The result obtained showed that the Alpha value ( $\alpha= 0.646$ ) is greater than p 0.05. Therefore, the null hypothesis was accepted. This shows that there is no statistically significant difference in the effectiveness among the domestic solid waste management strategies in the study area. It also indicates that the domestic solid waste management strategies are not effective in managing domestic solid wastes in the study area.

#### **4.7.4 Respondents' Assessment of Niger State Environmental Protection Agency in Domestic Solid Waste Management**

The respondents' assessment of the Niger State Environmental Protection Agency (NISEPA) is shown in table 4.7.4 below. About 54% of the respondents feel that Niger State Environmental Protection Agency (NISEPA) is not effective in managing domestic solid waste, while about 43% and 4% feel that NISEPA is effective and very effective in the management of domestic solid wastes in the study area.

**Table 4.7.4: Assessment of NISEPA in Domestic Solid Waste Management**

Area	Not Effective		Effective		Very Effective	
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Niteco	69	21.10	34	10.40	0	0
Low Cost	35	10.7	42	12.84	0	0
Sauke	8	2.45	57	2.14	1	0.31
Kahuta						
Farm	15	4.59	13	3.98	1	0.31
Center						
Aero Park	13	3.98	14	4.28	1	0.31
NSTA	11	3.36	15	4.59	1	0.31
Garage						
Top	10	3.06	5	1.53	2	0.61
Medical						
Maje	9	2.75	6	1.83	3	0.92
Abdulsalam	6	1.83	4	1.22	2	0.61
Garage						
Total	176	53.82	140	42.81	11	3.36

**Source: Field Survey, 2015.**

This assessment shows that more than half of the respondents do not think that the management of domestic solid waste by NISEPA is effective in the study area. The assessment of NISEPA in the study area shows that more has to be done on waste collection and disposal. According to a similar study by (Onibokun and Kumuyi, 1999), problems in cities have become burdensome despite efforts being made by city authorities and governments in the country. The problems of solid waste such as inadequate service coverage, inadequate finance, irregular waste collection, waste spill over from bins and storage containers, and nonchalant attitude of people towards indiscriminate disposal on unauthorized places and waste littering are common. Jha and Murthy, (2002) suggested that modern waste management presents a high level of complexity that requires many aspects to be considered for a suitable solution that encapsulates both the current state of the environment as well as its potential to provide support for future generations.

Similarly, Onibokun and Kumuyi (1999) noted that problems in cities have become burdensome despite efforts being made by city authorities and governments. Sustainable development according to World Commission on Environment and Development, (1987) refers to development that meets the needs of the present generation without compromising the ability of future generations to meet their needs. For sustainable development to take place, it means that wastes need to be managed effectively. Thus, it entails a sustainable solid waste management system that is environmentally, financially, and socially appropriate and acceptable.



## **CHAPTER FIVE**

### **SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS**

#### **5.1 INTRODUCTION**

This section gives a summary of the study carried out by the researcher, the conclusions based on the findings from the study, as well as the recommendations from the study for further research and policy development for sustainable environmental management.

#### **5.2 SUMMARY OF FINDINGS**

The results gotten from the field show that the kinds of domestic solid wastes generated in the study area were majorly organic, paper, plastic, metal and textile wastes. About 72% of all the domestic solid waste generated in the study area were mainly organic wastes. The domestic solid waste management strategies in place were burning, open dumping and burying. Open dumping was found to be the most common domestic solid waste management strategy practiced in the study area. The key players involved in the management of solid wastes were the government and individual households and the rate of waste generation was found to exceed the rate of waste disposal in the study area because the frequency in which the residents generate domestic solid wastes was higher than the frequency in which they dispose the domestic solid wastes generated. The difference between the frequency of waste generated and the frequency of waste disposed in the study area was tested using chi square at 0.05 level of significance. The result showed a significant difference between the frequency of wastes generated and the frequency of waste disposed in the study

area with an alpha value of 0.01. The response on the assessment of burning as a domestic solid waste management strategy in the study area shows that 42% of the respondents feel that burning of domestic solid waste is not effective while about 38% and 25% reported that burning of domestic solid waste is effective and very effective in the study area. About 15% of the respondents feel that burying of domestic solid waste is not effective, about 56% of the respondents think that burying of domestic solid waste is effective while about 28% of the respondents think that burying of domestic solid waste is very effective. A very high percentage (about 86%) of the respondents reported that open dumping is not an effective method of managing domestic solid waste, while about 10% and 4% feel that open dumping is effective and very effective in managing domestic solid waste in the study area. In addition, Kruskal Wallis H test was used to test for a difference in the effectiveness of the domestic solid waste management strategies in the study area. The result showed that the Alpha value obtained ( $\alpha = 0.646$ ) is greater than  $p > 0.05$ . Therefore, the null hypothesis was accepted. This shows that there is no significant difference in the effectiveness among the domestic solid waste management strategies in the study area. It also indicated that the domestic solid waste management strategies are not effective in managing domestic solid wastes in the study area. 50% of the respondents feel that Niger State Environmental Protection Agency (NISEPA) is not effective in managing domestic solid waste, while the others feel that NISEPA is effective in managing domestic solid wastes in the study area. The assessment of NISEPA in the study area shows that more has to be done on waste collection and disposal.

### **5.3 CONCLUSION**

The findings of this study showed that the method of waste management adopted in the study area does not conform to sustainable waste management strategy which results in environmental degradation and health risks. This implies that much attention has not been given to domestic solid waste management in the study area. To ensure a healthy environment, domestic solid wastes need to be properly managed to control or limit pollution; this therefore calls for urgent precautionary measures to protect the population against the adverse impacts of pollutants as well as degradation of the environment. The findings conform to those of Achankeng (2003), who reported that most African countries do not have a firm grip on sustainable method of managing solid waste; Ayo, Ibrahim and Mohammed, (2010); Agbede and Ajagbe (2004) who reported that the solid waste management agency had not been successful in the management of solid waste in Ibadan North and Aliyu (2010) who reported that wastes were not properly managed in Kano Metropolis and thus had grave implications on the environment.

### **5.4 RECOMMENDATIONS**

Based on the findings of this study the following recommendations have been put forward.

- i. The first thing that needs urgent attention is in the area of public enlightenment and environmental and health education. Without grassroots environmental education and enlightenment, enforcement of environmental sanitation and waste disposal laws has a very little prospect of success. The public needs to be enlightened on proper waste generation and disposal practices including sorting of wastes. This can be achieved through enlightens campaign on TV, radio and postal to educate the citizen on it

- (WHO 2006). There is also a need to introduce solid waste management in the primary school curriculum so that they could be informed on the need to maintain a clean and healthy environment.
- ii. The Niger State Ministry of Environment should review the existing laws and regulations guiding environmental sanitation and health it should also be enforced with stiffer actions in order to make them more effective. Providing legal procedures that impose restrictions on waste disposal in unauthorized places and designated land fill sites should be should be provided (Ezeah, 2006).
  - iii. More attention should be given to waste disposal management through adequate funding by providing residential neighborhoods with properly designed waste disposal points in order to protect the environment from pollution. As a short term measure, there is a need to upgrade existing facilities at major open dumpsites in the City by providing access roads, security fencing, temporary shelters and other utilities to make for a better environment (Festus and Ogoegbunam, 2012).
  - iv. The Niger State Ministry of Environment and Information should advise the residents and the general public to separate domestic solid wastes at source, this helps to reduce the time used in sorting at the wastes disposal and recycling site.
  - v. The frequency of collection needs to be increased and also should be consistent by NISEPA. To do this serious efforts should be made at raising the availability ratio of vehicle through improved and prompt maintenance services. Budgetary allocation of NISEPA should be increased by the Niger State Ministry of Environment to cope with scope of the problem especially in mobilizing modern waste management facilities as well as adequate man power.

- vi. Composting as a method of waste management should be adopted since majority of the domestic solid waste generated is organic in nature. In addition, the use of organic fertilizers should be promoted in the state and country at large.

**The following are recommended for further studies**

- i. Researchers willing to carry out further studies can analyze barriers and success factors affecting the adoption of sustainable domestic solid waste management strategies in the study area.
- ii. Analyze the effect of domestic waste management strategies on air and water quality.
- iii. Develop an action plan or domestic solid waste management model to facilitate sustainable waste management in the study area.
- iv. Analyze Domestic Solid Waste Management Strategies in other parts of the country.

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## APPENDIX

i. Dear Sir/Ma,

I am a post-graduate student of Geography department in Ahmadu Bello University, Zaria carrying out a research on “**Analysis of domestic waste management strategies in Tunga, Chanchaga Local Government Area of Niger State.**” Please kindly answer the questions below. All Information supplied would be used mainly for academic purposes and shall be treated highly confidential.

Thank you.

Researcher

### Section A: General Information

**Please tick the applicable option**

1. Age (years); A. <19 [ ] B. 20-30 [ ] C. 31-40 [ ] D. 41-50 [ ] E. above 50 [ ]
2. Sex; A. Male [ ] B. Female [ ]
3. Highest Educational Qualification; A. Qur’anic [ ] B. Primary [ ] C. Secondary [ ]  
D. Tertiary [ ] E. Others Specify.....
4. Occupation; A. Farmer [ ] B. Businessman [ ] C. Civil Servant [ ] D. Others  
Specify.....
5. Income; A. less than 20,000 [ ] B. 20,000-39,000 C. 40,000-59,000 D. 60,000 and  
above

### Section B

1. For how long have you lived this community? A. < 1 Year [ ] B. 1-3 Years [ ] C. 4-6  
Years [ ] D. 7 -9 Years [ ] E. 10 Years and above [ ]

2. What type of household solid wastes do you generate? a. Paper waste [ ] b. Organic waste [ ] C. Plastic waste [ ] D. Metal waste E. Textile waste [ ] F. Others specify
3. How often do you generate these household solid wastes? A. Daily [ ] B. Twice a week C. Weekly D. Others specify.....
4. How do you dispose these wastes? A. Burning [ ] B. Burying [ ] C. Open dumping [ ] D. Others specify.....
5. How often do you dispose these wastes? A. Daily [ ] B. Twice a week C. Weekly D. Others specify.....
6. Who is responsible for disposing the wastes? .....
7. How efficient do you think burning of domestic solid wastes is?  
A. Not efficient [ ] B. Efficient [ ] C. Very Efficient [ ]
8. How efficient do you think burying of domestic solid wastes is?  
A. Not efficient [ ] B. Efficient [ ] C. Very Efficient [ ]
9. How efficient do you think dumping of domestic solid wastes openly is?  
A. Not efficient [ ] B. Efficient [ ] C. Very Efficient [ ]
10. Do you encounter any challenges in disposing your wastes? A. Yes [ ] B. No [ ]  
If yes, please specify such challenges.....
11. In what ways can household waste collection and disposal be improved in your area?  
.....

**Section C**

1. Is there any Government or private Agency or institution responsible for the collection and disposal of domestic solid waste in your area? A. Yes [ ] B. No [ ]
2. If yes to question 13 above, what is the name of the agency or institution?

3. How do they collect these wastes? A. Wheelbarrows [ ] B. Trucks [ ] C. Others Specify.....

4. How do they dispose these wastes? A. Incineration [ ] B. Burying [ ] C. Open dumping [ ] D. Others specify.....

5. How often do they collect and dispose the wastes? A. Daily [ ] B. Twice a week C. Weekly D. Others specify.....

6. How efficient do you think they are?  
A. Not efficient [ ] B. Efficient [ ] C. Very Efficient [ ]

7. Are the institutions managing the domestic solid wastes very well? A. Yes [ ] B. No [ ]

8. If no to question 18 above, what do you think is the problem with the institutions?  
.....

9. Suggest possible solutions to the problems stated above  
.....  
.....  
.....  
.....