

AN EVALUATION OF REFUSE MANAGEMENT SYSTEM
IN GARKI, FEDERAL CAPITAL TERRITORY, NIGERIA.

BY

NDUKWE, CHIOMA CORDELIA

(M.TECH/SSSE/2006/1544)

DEPARTMENT OF GEOGRAPHY,
FEDERAL UNIVERSITY OF TECHNOLOGY,
MINNA, NIGERIA.

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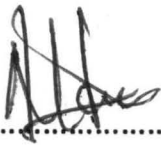
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DECLARATION

I, Ndukwe, Chioma Cordelia, hereby declare that this work was carried out by me. All data generated and analysed to raise the results and discussions, the summary, conclusions and recommendations of this dissertation were not submitted before for similar award, and except the Secondary Sources were handled by myself.



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Ndukwe, Chioma Cordelia
M.Tech/SSSE/2006/1544

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Date

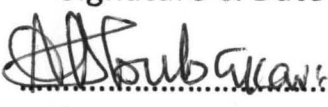
CERTIFICATION

This thesis titled: **An Evaluation of Refuse Management System in Garki, Federal Capital Territory, Nigeria** by: **Ndukwe, Chioma Cordelia (M.Tech/SSSE/2006/1544)** meets the regulations governing the award of the Degree of Master of Technology (M.Tech), of the Federal University of Technology, Minna and is approved for its contribution to scientific knowledge and literary presentation.

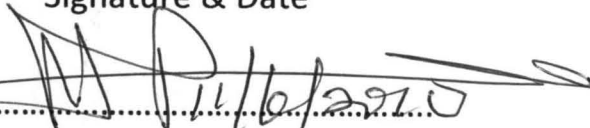
Dr . P . S . Akinyeye
Name of Supervisor

 10/5/2010
Signature & Date

Dr. A .S. Abubakar
Name of Head of Department

 10/05/2010
Signature & Date

Prof.M. Galadima
Name of Dean, School of Science
and Science Education

 11/6/2010
Signature & Date

Prof. S.L. Lamai
Name of Dean, Postgraduate School

 18/06/2010
Signature & Date

DEDICATION

This Thesis is heartily dedicated to my Late Father Mr. Samuel Ndukwe, my Mother Mrs. Esther Ndukwe who prayerfully and financially supported me and to my brothers Mr.Ezenwa and Alexander Ndukwe, and to my Sisters Regina,Ifeyinwa,Njideka, Nonye and Ogochukwu all all of Ndukwe's.

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ABSTRACT

The Study has evaluated the efficiency and effectiveness of refuse management system in Garki .Using structured questionnaires and field assistants, responses from government refuse management board, private firms, scavengers and residents was harmonized to address the three functional aspects of management (refuse collection, transportation and disposal). With the help of an adopted map, samples were selected using systematic random sampling method in the entire Garki district. Photograph was used to depict the practical field activities. The research shows that the existing refuse management in Garki is under influence of an unfavorable socio-economic, physical, legislative, technical and operational constraints resulting to drainage blockage, littering the surrounding, inhibiting free flow of traffic and emission of offensive odour. Also, there were observed gross inadequacies in refuse disposal systems and management. It is therefore suggested that refuse should be out- sort at source, reuse, reduced and recycle while the volume can be reduced both at depots and landfills by incineration (burning) and compression (burial).It was recommended that Government should properly control the use of unauthorized change of use of Infrastructure and Public enlightenment should be vigorously pursued consistently by government and private refuse management agencies.

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CHAPTER ONE

INTRODUCTION:

1.1 GENERAL INTRODUCTION

Within the last few years, the problem of refuse has become a live issue in Nigeria. In city after city, mountains of refuse are to be seen along streets, in backyards as well as in markets and in several other parts. These wastes disfigured the city image and not only create an eye sore but pose tremendous health hazards. It is possible to argue that things have not always been so in the country. During the colonial days, the problem of waste was far better managed although, it is true that the magnitude of the problem was far less than it is now (Filani and Abumere,1983).Inadequate management and disposal of refuse is an obvious cause for the degradation of the environment in most cities of the developing world. Many cities face serious environmental degradation and health risks due to uncollected domestic refuse on streets and in public areas, clogged urban drainage systems by indiscriminately dumped refuse, and by contamination of water sources near uncontrolled dumping sites (Roland and Werner, 1994). Today, the problem of waste generation and management (collection, transportation, treatment and disposal) is perhaps one of the most commonly discussed local, national and international problems in the face of the ever-increasing demand for a healthy environment. Its causes and effects have been on the increase in recent decades and a lot of attention has been drawn to it. The management (collection, transportation, treatment and disposal) of refuse is a time dependent process due primarily to its association with various activities of man within and between his far and immediate environment. Thus, refuse management generally changes with time and over space due to varying factors. Therefore, the understanding of the nature (composition) and characteristics of refuse generation and management can be seen to be a very dynamic process.

1.2 DEFINITION OF TERMS

Strictly Speaking, "Refuse" is a relative term, which takes up different meanings among different people. The definition of refuse primarily depends on individual's predilections as well as the ideological orientation.

Environmental pollution is a term that refers to all the ways that human activity harms the natural environment. Most people have witnessed environmental pollution in the form of open garbage dumps, factories emitting black smoke. Pollution can also be invisible and odourless. Thus, environmental pollution is one of the most serious problems facing humanity and other life forms globally.

To a layman, refuse may simply imply household or occupational materials that have outlived their usefulness, for example food scrapes, plastics, papers, broken glasses etc. But Henstock (1983) defines waste as that which is cheaper to throw away than to utilize. Though, this does not mean that waste is intrinsically valueless, some of it would have value if it were in some other locations. As such, refuse can be divided into different types. The most common method of classification is by their physical (appearance), Chemical (composition of chemical element) and biological (composition of life) characteristics and very often by their consistency (trend / pattern)

Starting from the above refuse classification, Basis (1999) pointed out that refuse materials are those that contain less than 70% water. These include materials such as household garbage, industrial wastes, mining waste and oil field waste. However, in-between solid and liquid wastes are sludge. They usually contain 3% and 25% refuse while the rest of the material is water dissolved material.

Sources of refuse are, in general, related to land use such as residential, commercial, industrial, open areas, and recreational areas. Each source has different facilities, activities, location and type of waste ranging from food wastes (Which are highly putrescible and would decompose rapidly) to

rubbish such as papers, plastics, broken glass, tin can, wood ashes and residues, demolition, and construction wastes and special waste from industrial and treatment plants.

1.3 STATEMENT OF THE PROBLEM

Garki was designed as a satellite town to maintain socio-economic and physical balance in the entire Federal Capital territory. This has encouraged an influx of people of various socio-economic statuses into the territory. Currently, Garki is under siege of invasive solid wastes which are devastating the natural ecosystem, drainage, channels, farmlands, homesteads and recreational facilities. Heaps of refuse with non-homogenous composition are conspicuously seen lying, littering and taking over spaces. The wastes now constitute an environmental menace being not only an eye sore, but sending out offensive odour polluting soil and nearby water sources and blocking the roads, thereby hindering free flow of traffic. It is such that solid waste management within Garki has become a cause for concern and it is this concern that motivated this study.

HYPOTHESIS: Refuse is not properly managed in Garki.

1.4 AIMS AN OBJECTIVES

1.4.1 AIM:

The aim of this research is to evaluate the efficiency and effectiveness of refuse management system (collection, transportation and disposal) In Garki

1.4.2 OBJECTIVES:

In achieving the aim, the study objectives are:

1. To examine the waste collection, transportation and disposal system practiced;
2. To identify the cost of refuse management.

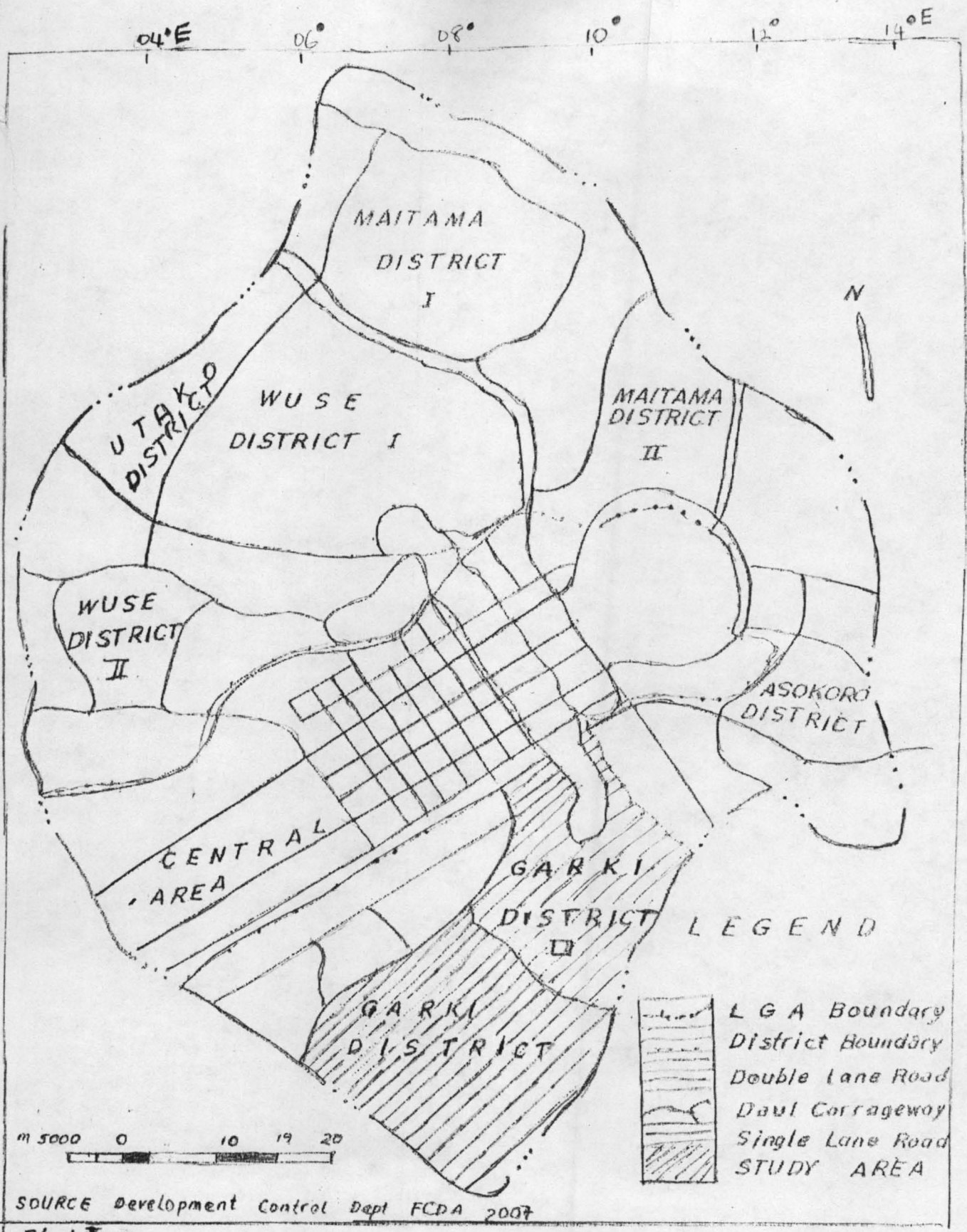


Fig. I

ABUJA PHASE ONE SHOWING DISTRICTS

3. To identify the problems and prospects of refuse management with respect to the existing facilities for waste management;
4. To proposed strategies for more efficient and effective refuse management for sustainable environmental quality.

1.5 THE STUDY AREA

1.5.1 LOCATION AND SIZE:

Garki is a full-fledged municipal district sub-divided into (area 1 to 11) for various activities with a land use capacity of eight hundred and sixty five (865 Ha) hectares devoted to the following operations; residential estates, institutional areas, commercial ventures, Workshops and open spaces/green belts (areas). The layout and streets are characterized by the type of activities therein (Abuja Handbook, 1998).

1.5.2 TOPOGRAPHY:

Garki is generally low and undulating but dotted with rock outcrops. The slopes range from one to ten percent (1-10%) except in rocky out-crops and valley sides where the slopes range from 20-30'. Generally, the entire area slopes in a southward direction.

1.5.3 GEOLOGY:

The major units underlying the Federal Capital Territory and city center in particular are briefly described in the below three categories igneous, sedimentary, and metamorphic rocks.

Igneous Rock consist of biotite granite Coarse porphyritic) large intrusive masses commonly elliptical in shape found in Zuma-Bwari –Aso Hills and out crops of the Gwagwa plains, Biotitic granite (fine to medium grained), forms ridge lines trending northeast –southwest through the city site; Rhyolite, forming small round intrusive surrounded by porphyritic gneiss in the usuman valley in the northwestern portion of the city.

Sedimentary Rock including alluvium, located in stream beds throughout the territory. It consists of largely sand, with rare gravel beds and local deposits of clay particles.

Metamorphic Rock including biotitic-muscovite schist, limited to four narrow outcrop bands along ridge tops at the eastern edge of the site. Magmatic, underlying majority of the city site; porphyritic genesis underlying usuman river valley in the northwest portion of the city and granitic gneiss.

The above rock structures has not presented any major geotechnical constraints to the type of structure proposed for the new city over most of the site and built up areas. Migmatite, gravitic gnesis, and biotitic granite underlying the majority of the city site are rocks of medium to high strength. The rocks are expected to present a minimum of engineering problems and should provide suitable locations for engineering structures in and around the Abuja City center. (Abuja Handbook, 1998).

1.5.4 DRAINAGE

The Garki site is traversed from the north-east to south by the Usuman River. The numerous tributaries of Usuman River notably Sudan and Gurudna provide national drainage channels north to south throughout the area. The Usuman River dammed up-stream provides water to Abuja City.

1.5.5 WEATHER AND CLIMATE;

Garki experiences two weather conditions in the year; the rainy and the dry seasons. The rainy season beings around March and runs through October, while the dry season, usually characterized by bright sunshine, begins from October and ends in March.

Between October and March there is a brief interlude of harmattan occasioned by the north –east trade wind, with the main features of dust haze and

intensified coldness and dryness. Rainfall in the FCT reflects the territory's location on the windward side of the Jos Plateau and at the zone of rising air masses. The annual total is in the range of 1100mm to 1600mm. It exhibits a spatial pattern, showing an increase from the south-west to the north-east. The duration of the rainy season, however, decreases from about 240 days in the Southern parts to 190days in the northern areas (Abuja Handbook, 1998).

1.5.6 TEMPERATURE-HUMIDITY:

In human terms, the net radiation is felt as air temperature, the response to which is greatly influenced by the humidity condition in the air. The Federal Capital Territory records its highest temperature during the dry season when there are few if any clouds, changes in temperature as much as 17*c in July through August as recorded by the meteorological department of Nnamdi Azikiwe International Airport, Abuja.

1.5.7 VEGETATION:

Generally Speaking, the vegetation of the capital city falls within the savannah vegetation zone of West Africa. Riverine depressions are typically skirted by fringes of thickets and high trees. There are occasional patches of forest or heavily wooded areas, especially on the mountainous/hilly areas of the F.C.T. within the site of the city itself, the objective of the vegetation is to protect stream water course for watershed management.

Savannah woodland occurs mostly in the rugged and less accessible parts of Garki especially on the Gurara and surrounding hills. The more common trees include-Azizelia Africana, Anogeisus, Leiocapus, Vitex Doniana etc. Shrub savannah in rough terrain close contain such tree species as Antiaris Africana, Anthrocleista Nobils, Ceiba Pentandra etc.

1.5.8 SOILS:

The soils in most part of the FCT are typically deep and well drained having only local constraints where they are high in clay or stones .Generally, Garki soils are found to contain large amount of humus which make it considerably fertile and hence suitable for farming.

1.5.9 WIND:

The wind of the Federal Capital Territory are dominated by two major air masses namely the tropical maritime is formed over the Atlantic Ocean to the south of the country and is therefore warm and moist .It moves in land generally in a southwest to northeast direction .The tropical continental air mass produces the highly seasonal characteristics of weather in the country. The tropical continental mass is associated with the dry season, and the tropical maritime mass is associated with the wet season, and the tropical maritime mass creates the wet season. (Abuja Handbook, 1998).

1.6.0 LAND USE:

Land use and Solid wastes are non-static concepts. They change overtime in accordance with changes in the factors interacting with them such as, population increases and changes in level of technology. The land use co-habits activities like commercial ventures, cottage industries, Institutions and green belt as well. The city of Garki settlement is more or volume of services.

1.6.1 LAND USE TYPE:

The high influx of people of various socio – economic status to Garki is an evidence of multiple Land – uses in the area. Thus, the rate and volume of solid waste generation and accumulation commensurate with the type /nature of land use, which has been categorized into the under listed land use types.

1.6.2 RESIDENTIAL:

Within the area one to eleven (FCDA staff, NNPC, CBN Quarters) and extended to Apo Legislative and Military (Zone C) quarters respectively, there are areas with different types of houses; ranging from well structured houses (private and official) to housing estates (owner – occupier). During the reconnaissance survey and the fieldwork, it was realized that the composition of residents cuts across socio- economic, religious and educational status.

1.6.3 COMMERCIAL:

Garki serves to maintain socio-economic and physical balance in the federal capital city. Thus, a considerable number of trade centers and outfits such as corner shops, pharmaceutical stores, supermarkets, bookshops, saloons and a host of others are conspicuously seen all over the town .

1.6.4 INSTITUTIONAL:-

Garki is composed of numerous institutions (Government and Non – Governmental) ranging from offices, schools, health centers, law enforcement outposts and worship centers (churches and mosques). All forms of waste emanate from these areas and their compositions vary from one institution to another.

1.6.5 POPULATION:-

The total number of people living in an area is a strong possibility of multiple land uses. Population census revealed that as at 1990 – 1991 Garki had about 300,000 people. However, during the research, it was updating, an official statement pertaining to the actual or estimated population of Garki cannot be ascertained as various factors such as squatter phenomenon had contributed significantly to population increase.

1.6.6 AGRICULTURE;-

The farms and gardens are located in close proximity to residential areas and are mostly small scaled. The type of waste that emanate from farms and gardens include – vegetables/ spinach, cabbage, tomatoes, garden egg etc. However, these residual wastes are largely and highly putrescible. (bio-degradable).

1.6.7 AREAS OF MIXED USES:

In the quest for satisfying the ever-increasing needs and aspirations of man, various structures within Garki are used for more than what it has been approved or recommended for. Hence, one sees a building meant for residence being used at the same time for providing other auxiliary services.

These services include retail shop for common household needs, pharmaceutical stores, photocopying center and barbing salon or audio cassette recording and rental shops. The composition of solid wastes emanating from such land use pattern is unimaginable.

CHAPTER TWO

REVIEW OF RELATED LITERATURE.

2.1 INTRODUCTION:

Human beings have always caused environmental pollution of all sorts. Since prehistoric times, people have created wastes through numerous land related activities. Like garbage today, this waste was either burned, tossed into waterways, buried or dumped above ground. However, the waste of early peoples was mostly food scraps and other substances that broke down easily by natural decay processes. Prehistoric populations were also much smaller and were spread out over large areas. As a result, pollution was less concentrated and caused few problems.

The problem of waste management and disposal becomes increasingly pressing as human population; industrial activities and material consumption expand. To most Americans, collection and disposal of municipal waste pose the most visible and costly refuse management problems (Mantel, 1975).

Basically, management of refuse should be such that it reflects each country's environmental parameters or local socio-economic circumstances. This is quite important and necessary because each volume of refuse treatment and disposal is proportional to the type of activity taking place. In other words, the composition of solid wastes and management differs from one locality to the other.

In the light of the above, within this complexity of what refuse constitute, many apparent differences in concepts of refuse management and its intrinsic and extrinsic importance to man's livelihood becomes glaring, most especially taking into cognizance the relevance of refuse as a sustainable resource to man and his environment. However, to be more pragmatic and realistic, stemming

from different ways of translating similar concepts of refuse management into simple reasoning, we always need to reiterate the fact that solid waste generation, composition, and management are a non-static concept. They change in accordance with changes in the factors interacting with them, which makes refuse management a continuous dynamic process.

2.2 EFFECTS OF REFUSE MANAGEMENT

In an attempt to justify the basis for refuse management either locally, nationally or even internationally, a glimpse of the effects of refuse management are residential, commercial, industrial or agricultural wastes, should be understood. Suffice it to say that an in-depth knowledge on the effects, paves way for treatment and management of waste on the basis of waste characteristics.

Pavoni et-al (1975) pin-pointed that the residential and commercial wastes of municipalities cause problems of litter, open dumps, air pollution from burning wastes and wasted resources.

By using refuse urban wastes as fertilizers on farm lands, literatures have reported that these wastes could pollute the land or soil. Soil pollution inturn leads to the pollution of nearby water sources, the plants growing in the fields may also be affected. On the other hand Davies, et-al (1982) observed that solid sludge which is of potential value to the farmer as an organic manure rich in Nitrogen and Potassium, is also potential hazard when metals are present in large amounts, because once a soil is contaminated by metals, it remains so indefinitely as the metals are strongly absorbed and they do not leach to any extent. The cumulative effect of this will be reflected on man's health who feeds on the flora and fauna growing in the soil, drinks from the nearby water sources and respire on the surrounding air (Fitzpatrick, 1982 and Roger et-al 1989).

It is a truism that any particular soil polluted by hazardous substances will obviously have an adverse effect upon both the plants and animals that depend on soil for growth; especially plants. This is supported by Roger et-al (1989) when he warned that domestic refuse can cause significant environmental pollution and any also contain small quantities of hazardous substances such as mercury (Hg) from dry cell batteries, solvents from paint residues, heavy metal sludge and solutions, especially those containing the toxic metals like: cadmium, chromium, lead, mercury, Nickel and curium are all wastes generated from a wide range of manufacturing processes, including homes and commercial centers.

Roland and Werner (1994) evaluated that inadequate collection and disposal of refuse is a major factor in the spread of gastrointestinal and parasitic diseases, primarily caused by the proliferation of insects and rodents vectors.

In a nutshell, the aforementioned reviewed literature indicates that refuse have adverse effect directly and indirectly on soil, water, air, and plants, etc, as much the management of refuse need to be tackled with all seriousness and commitment as it poses danger to man and the environment in which his livelihood depends.

2.3 REFUSE MANAGEMENT IN DEVELOPED COUNTRIES.

The disposal of garbage in the world is a problem that continues to grow with the development of industrialization and the growth of population; it is therefore pertinent to look for a way by which the increasing magnitude of refuse generation could be controlled.

In the United Kingdom refuse is collected mostly by house to house methods, while the remaining (a small percentage) is by special collection arrangement from markets and civic amenity points, (Holmes, 1983). Ideally, it is the responsibility of the municipal authorities to dispose garbage as well as

encourage residents to deposit their wastes in a manner that would reduce costs.

Considering the various forms of refuse management strategies, cost-benefits implications, technology, environment and waste composition, developed countries are finding management of municipal refuse expensive. Therefore, they are still searching for ways and means of reducing cost. Thus, each country devices a workable solution that will conform to its waste composition, environment and economic viability (Jensen, 1990).

In a broader view of waste management, Johnson (2000) pin-pointed that much emphasis should be on the importance of the waste hierarchy which has four steps namely: Source reduction which refers to any practice which eliminates or reduces the volume of material produced. Another step towards waste management is Re-Use, that is the repeated use of an item in the same form. Due to the level of technology in developed countries, a prominent method of waste management is recycling; which is the separation of a product no longer useable in its present form from the waste stream, so that it can be used in the manufacture of a new product. Disposal is another refuse management practiced, which is the release of material into the environment.

In addition to the aforementioned, Bassis (1999) identified sanitary landfill and two other common methods of waste disposal. The land fill probably accounts for more than 90% of Americans municipal refuse, while the later (the biological treatment of organic waste) can divert up to 50% of municipal solid waste from other disposal routes and can make a valuable contribution to sustainable waste management practices. The third is pumping of hazardous waste into deep wells. However, this method is strongly opposed, because of the apparent explosion and even earthquakes that have resulted from waste injection techniques.

According to cook (1983), the developed countries use incineration. Incineration is a hygienic method of reducing waste volume and weight which also reduces the potential of waste to pollute. However, incinerators are more expensive means of disposal of municipal solid wastes even though it is a safer method of disposal than landfill. Other advanced techniques of wastes management include pyrolysis, chemical and physical treatment, encapsulation, dilution, delay and dispersal and sea disposal (cook, 1983).

In view of the cost of waste management in developed countries, the emphasis now is on waste minimization and reduction (which does not form part of waste disposal).

They are in fact another part of waste management (cointreau, 1982). However, three major factors or attributes of the developed countries to make the issue of refuse management not a mere mirage are societal enlightenment, dedication and commitment of getting rid of unwanted waste by exportation and the syndrome of turning garbage into wealth through recycling (Roland and Werner,1993).

2.4 REFUSE MANAGEMENT IN DEVELOPING COUNTRIES

Today, Urban refuse management is considered to be one of the most immediate and serious environmental problems confronting urban governments in developing countries. This is mainly due to the rapid urbanization- taking place on an enormous scale in Asia, Africa and Latin American (Roland, Werner, 1994). Thus, disposing refuse economically, without harming or endangering the environment is a problem shared by both developed and developing countries alike but pose many more formidable challenges to developing countries. While some affluent countries can contemplate investing in modern, less polluting incinerators to destroy waste surpluses, poverty severely limits the range of options open to cities in the developing world. Thus, in many developing countries, disposal of refuse created by household consume up to half of municipal budgets (Olaore, 1995).

Inadequate management and disposal of refuse is an obvious cause for the degradation of the environment in most cities of the developing world. Many cities face serious environmental degradation and health risks due to uncollected domestic refuse on streets and in public areas, clogged urban drainage systems by indiscriminately dumped refuse, and by contamination of water sources near uncontrolled dumping sites (Roland and Werner, 1994).

Paradoxically, while the developed countries experiment and pontificate on the desirability of refuse recycling and reclamation of waste as a potent strategy towards waste management, the practice is much higher in the poorer parts of the developing world: here, scavengers and beggars perform very efficiently by sorting out recyclable items from landfill sites or dumps to be sold to waste dealers.

In most of the literature on resource recovery, there has been a tendency to argue that the slum dwellers is there not simply because he loves it, he earns his living by collecting, sorting and utilizing waste materials from land fill sites or dumps. (e.g selling discarded bottles or plastics to garbage processors). To buttress the aforementioned, Meyer (1983), pointed out that mountains of refuse on the outskirts of Lima, Lagos, Calcutta or Manila with rugged children, youths, men and women rummaging through refuse for usable materials is a picture or scene which probably almost everyone has come across in different variations again and again in magazines, books and films.

Holmes (1983) reported equally that recycling is one of the cardinal strategies in managing solid waste in most developing countries like India, Brazil, Mexico, Columbia, Phillipine etc.

Waste collection, sorting and utilization has been an age (old) profession and also a system of managing solid waste in some developing countries. For

instance literature has shown that waste recycling in Cairo dates back to at least 1880's. At that time the first migrants from the Oasis depression of Dachla in the western desert of Egypt, had come to Cairo and had begun to work as refuse collectors (Meyer, 1933). This is also supported by Roland and Werner (1993), where they ascertained that resource recovery (scavenging) is a well-known system operated by the zabbalin (an ethnic group specialized in recycling in Cairo).

Suffice it to say that, in spite of the various systems of managing solid wastes, an important refuse management often recommended for most developing countries is composting.

The waste in many developing countries is ideal for conversion into organic fertilizer and economic factors favour composting in those countries, where high food production is of great importance. Thus, composting is by far the most viable technical solution for many developing countries (Holmes, 1983).

The cardinal fact of life in urban waste management is that only a part of the problems can be tackled by direct house-to-house collection of waste. This system, using side and rear-end loading vehicles and tippers are possible, only in city centers and in the middle and upper income suburbs where good access and western housing standards allow their efficient use.

Roland and Werner (1993) pointed out that some problem areas have been identified with respect to solid waste management. They are inadequate coverage of the population to be served, operational inefficiencies of municipal solid waste services and management, unlimited utilization of the informal and formal private sector in recycling management of (non-industrial) hazardous waste (Roland and Werner, 1993).

2.5 PROBLEMS OF REFUSE MANAGEMENT

The management of refuse globally cannot be free from physical, socio – economic, population, Legislation, custom/tradition, technology, operational, administrative and technical constraints. Though, the heterogeneity in refuse generation, composition and management strategy between one geographical entity to another is prevalent. The perception of refuse generators and the associated waste management problems world –wide largely depend on environmental variables / parameters that contribute either positively or negatively to the generation and management of refuse. In other words, problems of refuse management cannot be homogenous even within the context of the smallest locality in a given area.

2.6 PROSPECT OF REFUSE MANAGEMENT IN GARKI.

In order to combat the growing problems of refuse, reduce littering, conserve and preserve national resources (man inclusive), decrease pollution and save energy, the Federal Government of Nigerian established a body charged with the responsibility of addressing environmental issues.

Within the state and local level, state environmental protection agencies and health department are being charged with the responsibility of maintaining a standard of environmental hygiene and safety. With particular reference to the study area a body named the Abuja Environmental Protection Board has been the sole body responsible for refuse evacuation within the territory, refuse bin distribution and outright disposal of waste material. The task of managing refuse in the study area is seeing a change through refuse collection Agents and Public enlightenment.

2.6.1 REFUSE COLLECTION AGENTS.

Since the establishment of AEPB as far back as 1989, the collection of Municipal Solid Waste (MSW) has been solely done by AEPB. As at then, there was no any other recognized and approved refuse management agency or firm charged with the responsibility of evacuating solid waste from source points.

The use of refuse bins of various sizes was adopted in which the supply of the bins is based on demand by refuse generators. However, with the influx of people into Abuja and its environs, the magnitude of solid materials into waste stream increased. In addition, the drive towards private sector driven economy became widely accepted thereby bringing about private investment in refuse management which was initially government oriented and or dominated services. With the advent of private sectors into waste management, refuse is now being collected by private refuse management firms in Garki. Between 1995 to date, a total number of three private refuse management firms sprang up. Their mode of operation is not too different from the public refuse managers (AEPB), but their service charge and area differ.

An additional indicator towards the prospect of refuse management in Garki is the informal system of refuse collection done by peasant scavengers. These scavengers are on the increase in number and their areas of specialization usually include collection of household refuse such as bio-degradable wastes and recyclable materials on daily and weekly basis respectively.

The basis for the increase in number of scavengers in the study area include the non- taxation on the scavengers, their accessibility to service areas, punctuality, a stable source of income, increase in service area (source points).

The scavenger is the most familiar component in resource recovery. The under – listed category embraces the term scavengers:

- I. Refuse collections

- II So- called 'Rag and bone men'
- III Dump scavengers

All the three categories have a common idea of supporting themselves wholly or partially by obtaining waste materials from a variety of sources and selling them to secondary materials dealers. The scavenger is an independent entrepreneur, and very often devoting only part of his working time to this field.

An important habit widely noticeable with respect to management of refuse in Garki is the evacuation of waste from source point by waste generators themselves. This system entails a member of either a household, commercial outfit or industry to neatly package refuse in large or medium size polythene bags to be disposed off personally. This system of self disposal of refuse by waste generators became widespread due primarily to some observed shortcomings or lapses on the of refuse collection agents as observable during the research work.

2.6.1 PUBLIC ENLIGHTENMENT

The surest means of sensitizing the populace of any given geo-political entity on any local, national or even international issue is through public enlightenment. The populace of Abuja and its environs are sensitized on the issues of sanitation with particular reference to refuse using both the electronics and the print media. The electronic media include radio jingles, adverts, and warnings, refuse bins selling points, and the television of waste management with public or private refuse managers.

The print media on the other hand envelopes newspaper and magazines publications on refuse management and side-effect of non-collection of refuse, news bulletin by government agency, handbills and posters.

CHAPTER THREE

MATERIALS AND METHODS

3.1 DESIGN

This research is about an evaluation of refuse management systems in Garki (FCT). The study covers three functional aspects of management namely, waste collections, transportation and disposal. Among the other basic parameters that are perceived to be inherent in (the course of) evaluating the efficiency and effectiveness of refuse management in the study area include the following:-

- (a) Identification of major and minor streets.
- (b) Identification of waste type and categorization of wastes
- (c) Frequency of collection and collection points.
- (d) Types of waste collection and disposal methods
- (e) Collection agents
- (f) Operational control and equipments.

In an attempt not to depend absolutely on secondary sources of data, which are usually more or less mere projections arrived by extrapolations of figures and information by official and unofficial personnel with little or no requisite knowledge on waste management, some assumptions were made upon which the result of the findings, data analysis and recommendations are based.

The basic assumptions made were that:-

- (i) A rapid and complete change in refuse management strategy in this area a "sine qua non" For the sustenance of a clean and less polluted environment.
- (ii) The composition of the waste will be non- homogenous.
- (iii) The frequency of refuse collection will be twice weekly.
- (iv) All collection points will be accessible.
- (v) The underlying causes of the problem include population characteristics, inadequacy of technical personnel, equipments, fund and legislation.

3.2 PRE - FIELD SURVEY ACTIVITIES

Prior to household survey and interview, a reconnaissance survey was carried out in the study area for the purpose of familiarization with the area and the people therein, the reconnaissance survey paved away for a broader view and understanding of land use types, refuse deposit points, and related issues of solid waste management.

Pre-Field activities started from 4th April 2007 to 25th April 2007. In essence, a total of 3 weeks of week days and weekends was taken to cover the study area. Based on the reconnaissance survey carried out with field assistants, it was deduced that in general.

1. They lack public participation/ awareness on refuse management.
2. Many people are accustomed to disposing of bio-degradable and non-biodegradable substances in the same dust bin for those who have dustbins.
3. Roads/ culverts are in a terrible state of disrepair.
4. Infrastructures are built lopsidedly making accessibility difficult in some areas.
5. The presence of private refuse managers& scavengers are there.
6. The area 1 to 11 of Garki comprises residents with various socio-economic status.
7. Land filling is not carried out in any of the areas in Garki.
8. Residents pay for service charge.
9. Drainages are blocked with indiscriminately dumped refuse.
10. Speculated lands were used as dump sites.

3.3 DATA COLLECTION (SOURCE OF DATA)

The two basic conventional sources of data collection were employed. These sources are the primary and secondary sources of data.

3.3.1 PRIMARY DATA

The research was conducted using questionnaires field assistants different methods and schedules. However, to have a good coverage of the study area, the Garki Zones in FCT were taken one after the other. Here questionnaires were drafted and distributed. The distribution and questioning were carried on an irregular pattern comprising of weekdays and weekends in which timing of visit to households and dump sites were done in the morning, afternoon and evening. By this schedule, waste composition, category, treatment methods, waste, collection types and points and equipment used as a pragmatic approach to solid waste management within the study area was observed.

Prior to the interview (structured) and discussion, the principal aim and the objectives of the study were explained in details to the respondents (residents, scavengers, government agency and private firms). The interview was done tactically, and in order to boost the respondents morals and ego much respect and humility was always accorded to the respondents by addressing the respondents as Sir, Madam, Alhaji or Oga as the case may be. Base on these, the respondents answered questions freely.

The questionnaire had three parts to cover the three functional aspect of refuse management in Garki (FCT) namely waste collection, transportation and disposal. The questionnaire covers three functional refuse management sectors i.e Government Agency, private refuse firms and self employed peasant scavengers. By this arrangement, the respondents are in four categories namely, residents, governments refuse agency, private firms and scavengers.

In sampling, the whole of Garki, which was divided into area 1-11 with other sides of Garki to coincide with the existing and recognized Government area boundaries as designated by the Estate Department of Federal Housing Authority (FHA).

Each areas was further sub-divided into streets, Houses within each phase were originally numbered for identification purposes. The areas in Garki are not uniform in size and the distribution of built-up structures is also not homogenous, thus, the selection of samples and distribution of questionnaires were done randomly. Systematic random sample method was adopted for this survey so as to ensure that the samples selected were representative enough with minimum biases.

A total of eight field assistants were engaged in the field for data collection. The field assistants were drawn from recognized institutions such as water board, AEPB and PHCN. The water board and PHCN officials were drawn for the exercise simply because they have a good knowledge of the structural layout of each area due to the nature of their respective jobs especially in terms of issuance of water and PHCN bills. The study comprises a questionnaire survey of 481 households in Garki yielding 401 completed questionnaires. Prior to the distribution of questionnaires, one week induction exercise was organized so as to get the field assistants acquainted with the activities in the field.

Questionnaires distribution and retrieval schedule was drafted, taking into cognizance environmental factors (such as rain). Situational factors (for example, presence of civil servants at home) and time limit. (Duration of field activity). Each area in Garki was allotted two field assistants. A total of 3 weeks was earmarked for each area. In other words, duration of field data collection was 12 weeks.

3.3.2 SECONDARY DATA

For this research work, data on solid waste collection, cost of waste management, refuse collection points, frequency, type of collection, type of transportation (vehicles), and disposal strategies (methods) were gotten from

Abuja Environmental Protection Board (AEPB), private refuse management firms and self employed scavengers.

Useful materials were sourced from published sources such as journals, newspapers, and magazine. Also in view of the dynamism in data and information acquisition and to keep up pace with contemporary researches on refuse management, much emphasis were placed on internet browsing.

**CHAPTER FOUR
RESULTS**

Table 4.1: SUMMARY TABLE FOR REFUSE MANAGEMENT IN GARKI. (FCT)

S/No	Agent	Collection system	Outline description	Public participation	Frequency of collection	Mode of transportation	Materials and facilities	Disposal	Dump site
1	AEPB	a. Communal and b. House-to-House	(a) Central Bulk containers to rear endloaders and refuse communally deposited not into central containers being picked into tipper trucks or refuse vans (b) House-to-House visit and trolley transfer to rear end loading refuse collection vehicles	(a) Place or deposit refuse into neighbourhood bulk containers or open speculated plots of land (b) Place refuse bin into individual house hold or container at the entrance of each dwelling	Once weekly	Automated trucks and tipper trucks	Shovels rakes, diggers. Refuse polythene bags. Pay loaders and caterpillars	Land filling	Katampe hill & tipper garage main dump site
2	Private firm	House-to-House	Visits each household to pick refuse bins into refuse collection vehicles	Each household interested in refuse evacuation places refuse bins or polythene bags outside it's entrance for collection	Once weekly	Tipper trucks and pick-up vans	Polythene bags, hand rakes and shovels diggers	Land filling	Katampe hill & tipper garage main dump site
3	Scavenger	House-to-House	Visit each house to collect refuse usually based on subscription	Every household that has entered into refuse evacuation agreement with scavengers places its refuse bin or polythene bags outside its dwelling/house	Irregular	Wheel barrow and carts	Sacks bags paper cartons and iron rod		

Source: Field work, 2007

Basically, there are three conventional systems of refuse collection namely; communal, Cab side and house-to-house. Outs of the three conventional systems only two being employed generally in Garki District i.e the house-to-house and communal system respectively.



Plate 1: Illegal Refuse Dump along Area 1 Junction
Source: Field Work, 2008.



PLATE 2: Refuse Collectors at work in Area 11 Staff Quarters
Source: Field Work, 2008.



Plate 3: Indiscriminately Dumped Refuse inside Area II Garki Neighbourhood
Source: Field work, 2008.



Plate 4: An Overview of Dump Wastes on illegal Landfill
Source: Fieldwork, 2008.



Plate 5: Spill over Refuse Along Durumi, Garki Abuja
Source: Fieldwork, 2008.

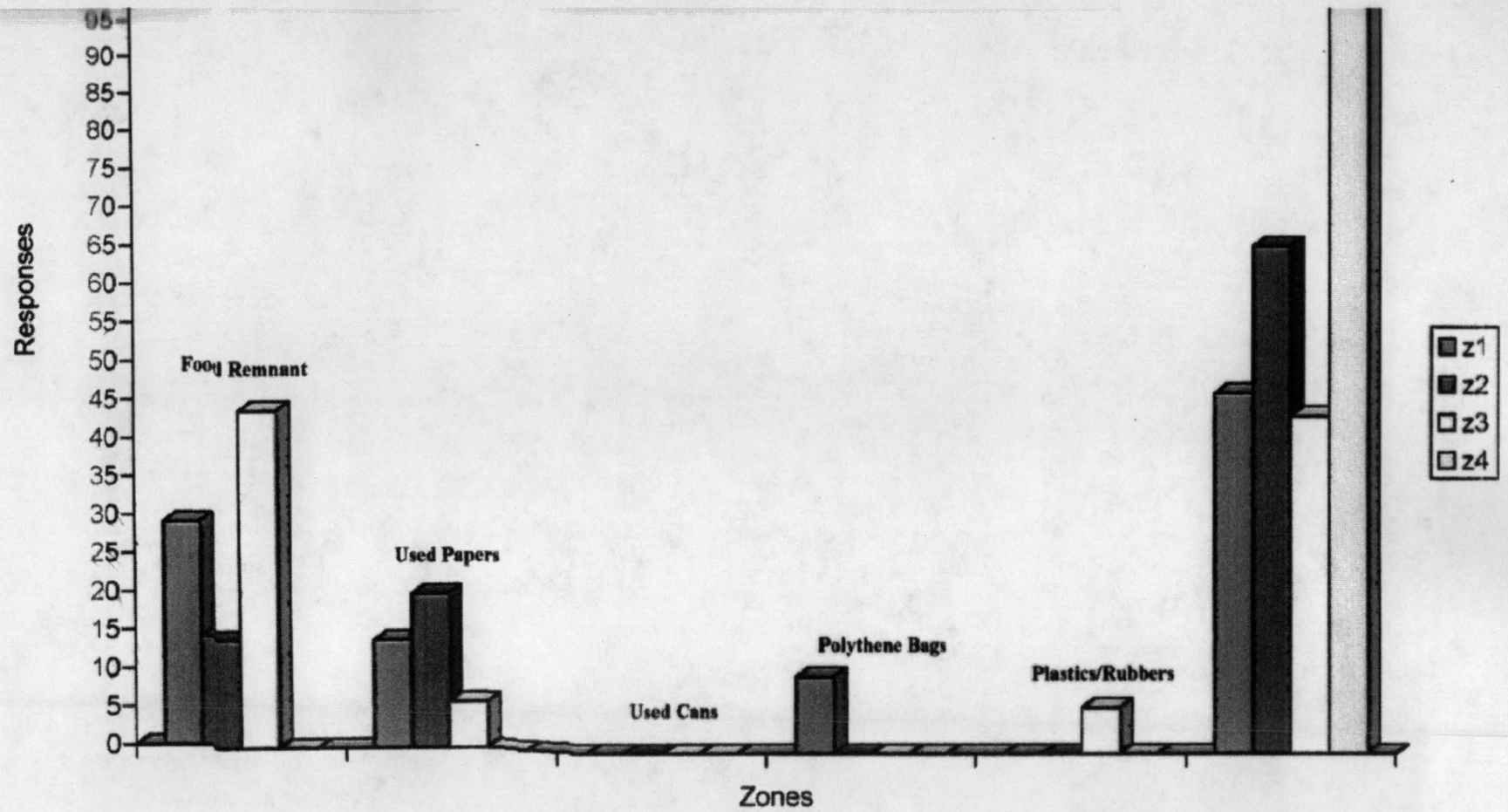


Plate 6: Refuse Collection by Scavengers
Source: Field work 2008.



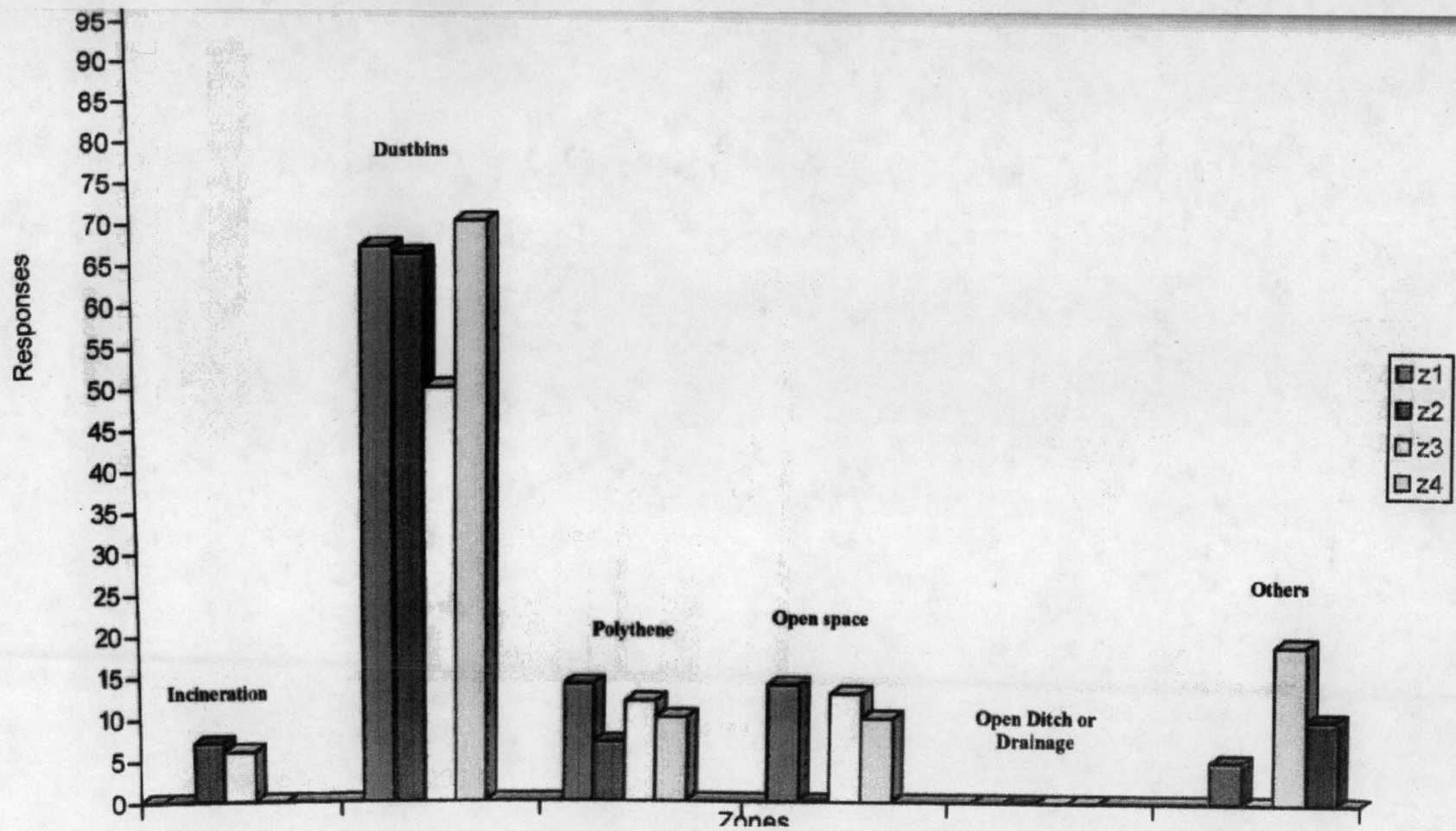
Plate 7: Refuse Bin Situated Near Eagle Square Abuja.
Source: Fieldwork, 2008.

The plates above indicated that, the evacuation of waste communally deposited tends to be much easier and more hygienic if there is a central place or point of waste deposition for central collection. See 5-3 for further explanation.



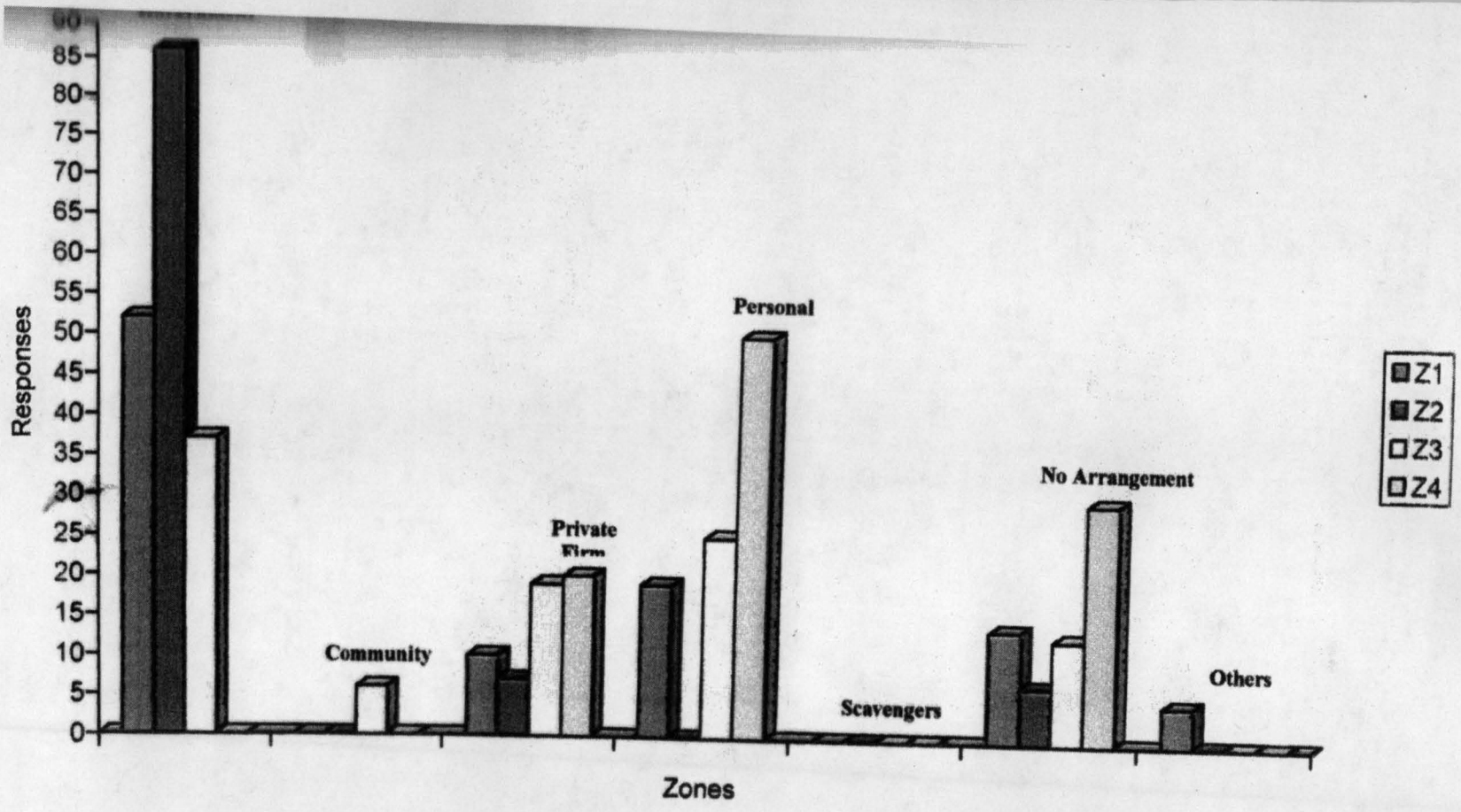
Source: Fieldwork, 2008

FIG 1: MAJOR SOURCES OF WASTE IN GARKI



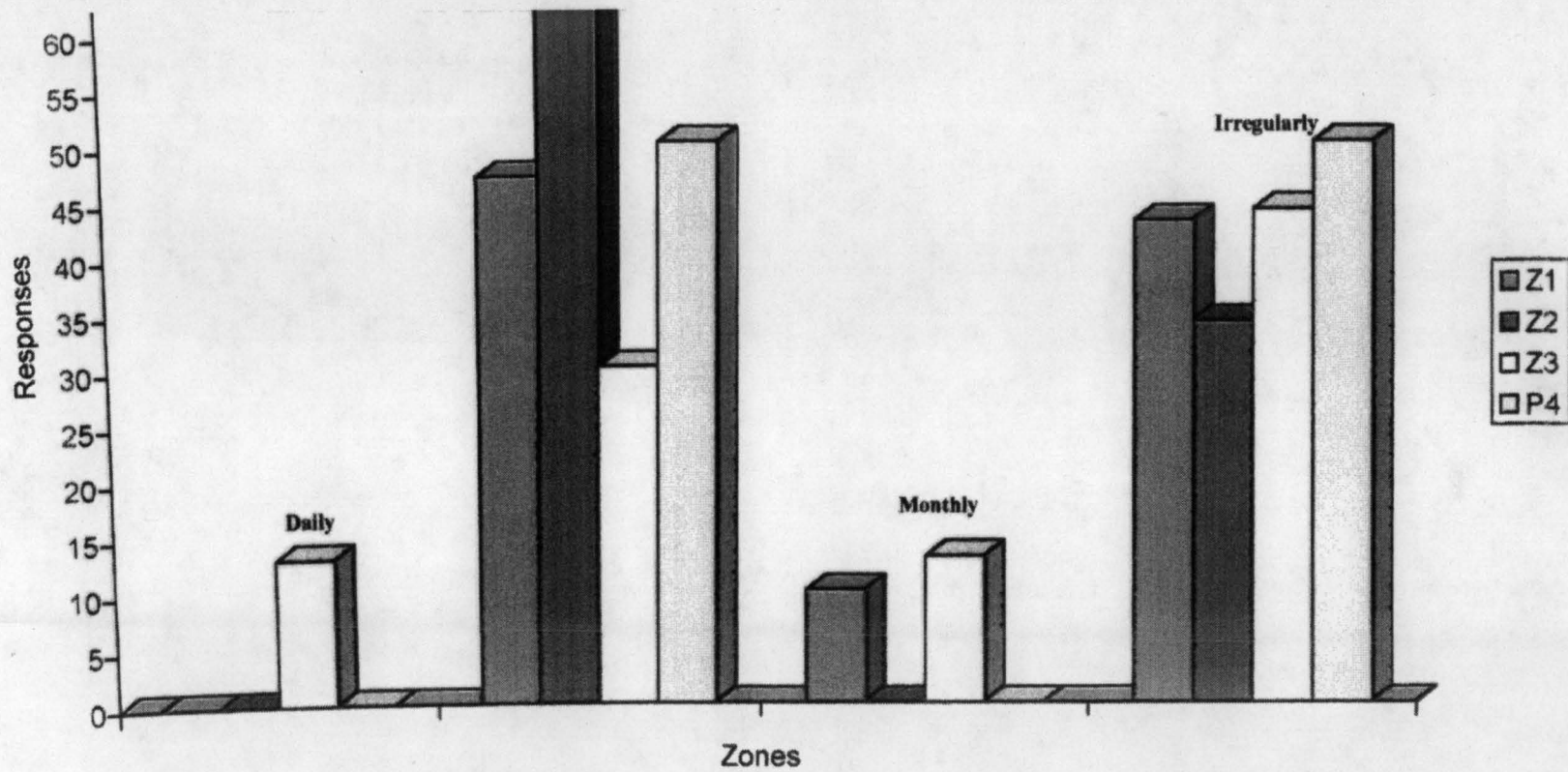
Source: Fieldwork, 2008

FIG 2: REFUSE DUMP IN GARKI



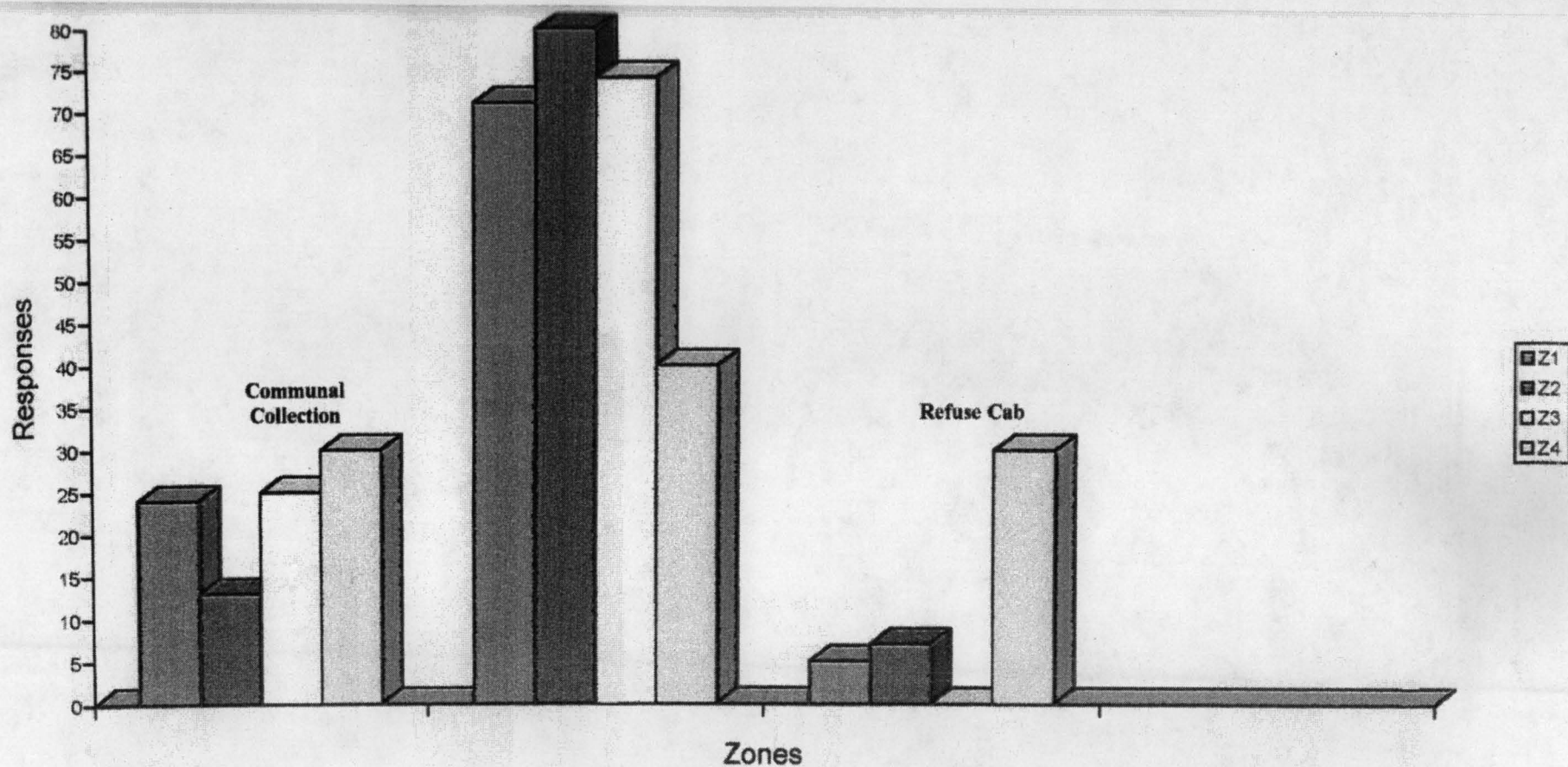
Source: Fieldwork, 2008

FIG 3: COLLECTION AGENTS IN GARKI



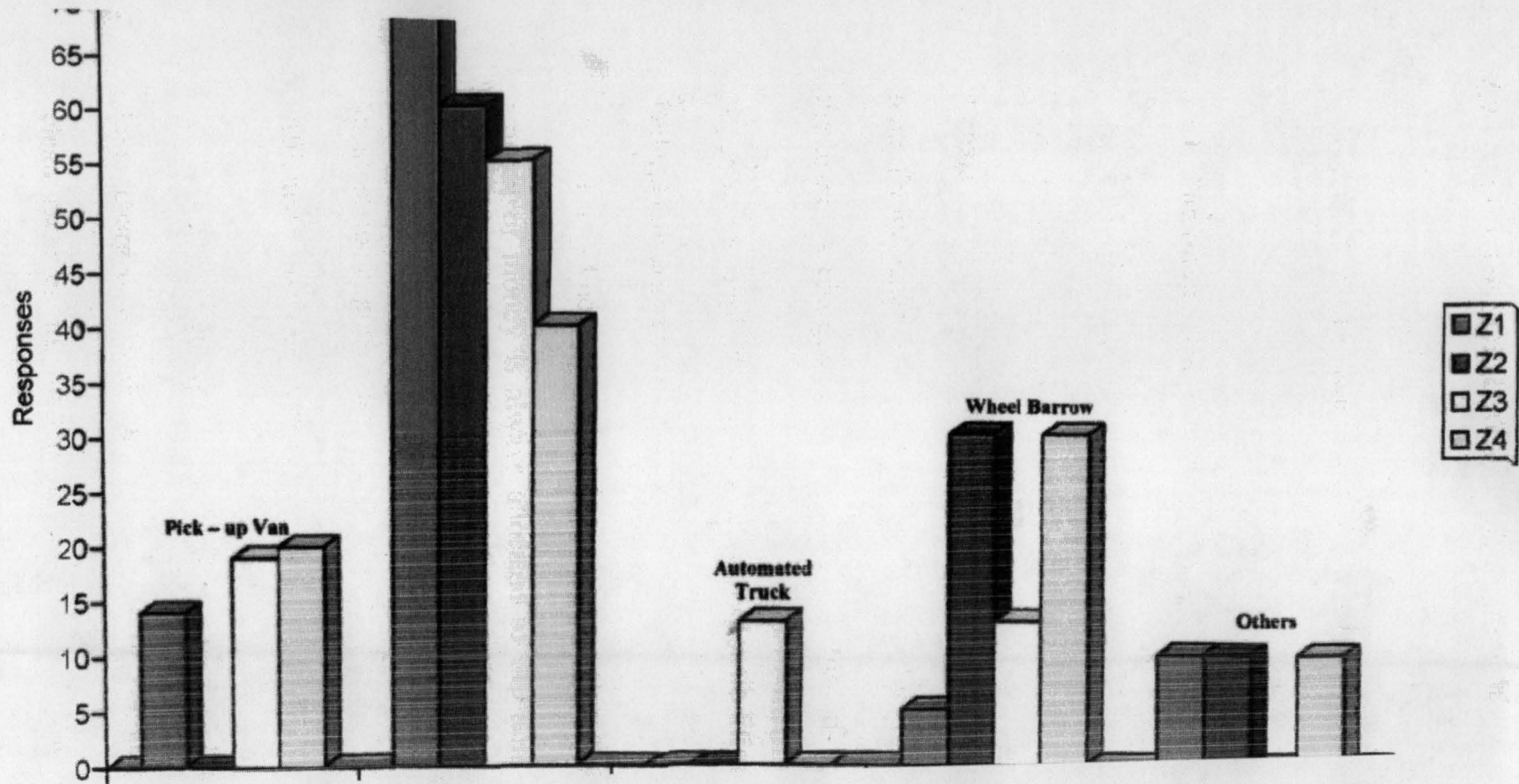
Source: Fieldwork, 2008

FIG 4: FREQUENCY OF REFUSE COLLECTION IN GARKI



Source: Fieldwork, 2008

FIG 5: MODE OF REFUSE COLLECTION IN GARKI



Source: Fieldwork, 2008

FIG 6: MODE OF REFUSE TRANSPORTATION IN GARKI

As I was earlier stated, the above figures solid waste is related myriad of human activities. Related studies have categorized solid wastes into biodegradable and non-biodegradable within which some are hazardous while some are non-hazardous.see 5.4 further explanations.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 DISCUSSION

Ideally, wastes from whatever source are supposed to be neatly dumped or packaged either in refuse polythene bags or large refuse bins for easy and hygienic collection. Abuja Environmental Protection Board (AEPB) is charged with the task of evacuating refuse from municipalities. In line with these, the issuance of hygienic refuse bins with sizes ranging from 120 liters, 240 liters to 1.1m³ has been the sole responsibility of Abuja Environmental Protection Board (AEPB).

An on-site assessment indicated that every household is deemed mandatory to obtain a plastic refuse bin as well as large and medium size refuse polythene bags (even though Optional) from AEPB. This is recommended so as to make refuse collection easy and hygienic and to avoid or minimize communal accumulation (indiscriminate dumping) of refuse. Still the accumulation of refuse in Garki has become so precarious that it is common to throw refuse anywhere without regard to the environment by the residence themselves.

In addition to AEPB's services, refuse is collected by private refuse collection agents/firms from households. Usually a requisition form is distributed to households to indicate the type of services required based on varying prices. Other households have arrangement with the local scavengers to clear /collect refuse either daily or weekly based on contact terms and financial capabilities of households. And on their own the scavengers, who are operating an informal refuse management system embark on house-to-house collection and recyclable refuse sorting (see plate v & i).

COLLECTION OF REFUSE BY AEPB

(a) Collection System AEPB carries out communal and house to house system of refuse collection. For communal collection, refuse dumped in metal containers in some streets is evacuated into waiting trucks to be transported into landfill sites. The evacuation entails AEPB's laborers using different materials such as shovels, rakes, diggers etc.

(b) House to House collection: This is a method of refuse collection in which AEPB staff visit households to collect refuse. This System normally involves the use of refuse bins and polythene bags of various sizes. Refuse neatly packed in polythene bags makes refuse collection easy and hygienic.

(c) Mode of Transportation: Two truck types are used for transporting collected waste to landfill sites. They are tipper and automated trucks.

(d) Materials and facilities: The under listed materials are used in refuse collection for communal and house-to- house.

(i) Shovels:-

Shovels are used for scooping and packing refuse communally deposited by residents. It is also used in clearing drainage blockage by scooping out dumped refuse. Spill over refuse from uncollected bins is cleared using shovels. In landfill shovels are used to off load refuse from open non-tipping trucks. Shovels are also used in picking refuse such as excreta (human and animal faeces) and smelly decomposed bio-degradable waste e.g. food scraps, carcass of domestic animals.

(ii) Rakes:-

Since the bulk of refuse communally deposited cannot sweep with a broom due to their weight and composition, rakes are used. They are also used for assembling scattered waste, spill over refuse on roads and sidewalks.

(iii) Hand Diggers:

It has been found that uncollected communally deposited refuse solidifies over time when rain and sun acts on the refuse .As such the use of digger in clearing such refuse involves digging so as to break up or loosen the compacted composition of the waste. Diggers are also very important in digging and enlarging trenches when land filling.

(iv) Refuse Polythene Bags:

Refuse polythene bags are used in collecting refuse from households using bins and other refuse collection containers. Refuse such as papers, yard trimmings, bottles and plastics are collected in polythene bags. Use of polythene bags are more hygienic system for collecting refuse.

(v) Pay loader and caterpillars:

They are large and heavy equipment used in refuse management. Pay loaders are used to carry caterpillars to sites with refuse heaps that shovels and diggers cannot be effectively used. Caterpillars are used to pack large volume of waste into waiting trucks. In landfill sites caterpillars are used to further push refuse into large holes and trenches.

5.1.1 PRIVATE FIRMS

(a) Refuse Collection:

They carry out only house to house system of refuse collection. This entails visiting each house holds to pick refuse collection vehicles. This system is only employed to households that have an arrangement with private firms charge every subscriber a levy that tallies with the member refuse collection frequency.

(b) Mode of Transportation:

In transporting collected refuse from source points, private firms use tippers trucks and pick-up vans. Virtually all the tipping trucks used by the private firms are hired.

(c) Materials and facilities:

Unlike the government owned refuse management agency that carry out communal and house to house collection of refuse, the private carryout house to house collection of refuse with simple materials such as:

(i) Shovels:

Shovels are used in packing spillover refuse from over filled refuse bins. In a situation where collected refuse from households to pour from punctured or torn polythene bags, on getting to dump or landfill sites, shovels are used to scoop out refuse from either tipper or pick-up vans .

(ii) Rakes:

The use of rakes here, is not too different from what AEPB use rakes for. However, the use of rakes are restricted to house to services since private firms do not partake in landfill preparations and maintenance. For assemblage of refuse in each household, rakes are used.

(iii) Polythene Bags:

Even though private firms do not indulge in sorting, they use polythene bags to pack refuse sorting, they use polythene bags to pack refuse and to transfer refuse from one bag to another due to defect such as tearing caused by over fill and sharp objects.

5.1.2 SCAVENGERS

(a) Collection System:

Scavengers engage in house to house collection of refuse based on request and agreement between households and scavengers. This scavenger visit houses to collect refuse. However, it does not necessarily follow in a regular pattern. In other words neighbors do not necessarily share scavengers simply because they are neighbors.

(b) Mode of Transportation:

Since the scavengers operate an informal system of refuse management, they use locally constructed pulling carts and wheelbarrows. Also, the scavengers deal only with sizeable volume of waste and are selective in the case of dump scavengers. With the type of transport they use, service areas are always accessible. Although, they only cover limited number of houses per day.

(c) Materials and Facilities:

The under listed working materials are used by the scavengers:

(i) Sacks/ Bags :

Virtually all scavengers use sacks or bags to collect sorted waste materials from source points. Due to their proximity to their service areas, sacks and bags are visible feature for housing, collected refuse which can always be kept aside while scavenging for more refuse.

(ii) Paper cartons:

For some scavengers that perfect in portable motor spare parts, they use paper cartons to collect sorted materials discarded by households or mechanics.

(iii) Iron Rod :

The use of iron rods or metallic object cannot be separated from scavenging simply because scavenging entails scattering waste composition and picking or selecting his desirable waste material. These rods are also used as weapon in case of reptile attack (snakes and scorpion). The rods keep the scavenger's bare hands from too much contact with waste such as decomposed food remnants and human faeces.

5.2 COST OF REFUSE MANAGEMENT

To evaluate the effectiveness and efficiency of refuse management in Garki are discussed in financial and cost context.

5.2.1 THE FINANCE CONTEXT

World Bank (1994) reported that in developing countries cities are hard pressed to obtain enough capital to finance their refuse management system and are burdened with political constraints limiting their ability to generate revenue. There is no gain in the fact that financing the agencies charged with the responsibilities of managing refuse in Nigeria as a whole has been the sole responsibilities of the local, state and federal government. It is also a known fact that in every national and state budgets, some amount of money has been allocated to the ministry of environment or urban development as the case may be at both state and federal level, while in most local government areas, issues of waste management are usually affiliated to local government health department.

It was observed during research work, that the government regulatory body charged with the responsibilities of keeping Abuja and its environ clean receives its funding through government subvention and service charge. It was also understood that the subvention from, government is to cover general administrative, technical and operational service within which these exist other auxiliary services such as debt service, personnel benefits, land acquisition

(where necessary for landfill) etc. However, the government agency would not state categorically the bulk (total) amount of money allocated to the agency for smooth running of the agency. Interview/discussions revealed that purchase of new and adequate number of refuse evacuation trucks, personnel and other important services have always been truncated by inadequate finance. In addition to finance by the government, other source of finance is the internally generated revenue through service charge. The situation of concealing information from researchers by government agency is not too different from what is obtained in the private sector.

5.2.2 THE COST CONTEXT

At first glance, a low cost for service delivery by the private sector would be one that is lower than the cost for government service with respect to refuse management. This argument certainly holds in countries where the competitive environment is well developed. However, what are the costs for government service?

World Bank (1994), reported that in most developing countries, accounting systems show cash flows rather than accruals, with no clear delineation between recurrent and capital expenditures. It went further to state that there is no attempt to aggregate municipal refuse management costs incurred by all the various agencies (government and private) that participate in the system. It was further pin-pointed that there is no attempt to keep track of depreciation, debt services, personnel benefit, Land acquisition and human settlement, costs within the refuse management accounting system. The end result is that most developing countries, estimate their costs for municipal refuse management service to be less than 50% of actual cost (World Bank, 1994).

With reference to the aforementioned, inadequacies observed and reported within the developing counties in terms of accounting system for refuse management, by and large, the above lapses are prevalent in Nigeria. Reliance

on secondary data in most organizations can be disappointing simply because data are not renewed (up- dated) and the system of storage is poor (Awoyelu, 1982).

The most astonishing aspect of data acquisition from government agencies and parastatals lies on the monetary spending and accruals. Government officials become very hostile by the mere mention of an intending research on cost analysis. The general fear is that any researcher has the potential of exposing hidden and unsubstantiated claims and costs.

To buttress these, during the research a visit to AEPB to assess the cost of managing refuse in Abuja and its environs, a clear proof of the much talked-about government bureaucracy was glaring. In the quest for the acquisition of data and information relating to accounting system, unnecessary and unnecessary and unethical civil service protocols were used to make deduction of data (quantitative) difficult.

Although, it was deducted during the reconnaissance survey and the field activity (data collection) using the questionnaires, that the government refuse management agency otherwise known as AEPB charges between N350 – N750 per month as service charge depending on the size of the houses. for a house hold to pay N350 consistently for a year would yield to N4,200 while for houses that pay N750 multiplied by 12 months would amount to N9,000.

Now, looking at this source of revenue from a broader perspective incorporating all the returned questionnaires from households, the sum of N350 multiplied by 410 would amount to one hundred and forty three thousand five hundred naira (143,500) per month for smaller flats while the bigger households could generate the sum of three hundred and seven thousand five hundred naira (307,500) per month. Based on this, an average estimated revenue for smaller flats per annum will amount to one million, seven hundred and twenty two thousand naira (N1,722,000.00) while for larger households

charged N750 monthly would yield three million, six hundred and ninety thousand (N3,690,000.00) naira per annum. Service charge for refuse collection and evacuation by private firms varies from private firm to another. For instance, top cleaners first came on board as far back as 1996 and a flat rate sum of N450 is charges, while Maikah Nig. Ltd. charge N500 monthly. Cost analysis can be made based on income generated from service charge monthly and annually. So, if four hundred and ten household interviewed are to pay the sum of N450 or N500 monthly, it would amount to one hundred and eighty four thousand five hundred naira (N184,500) and two hundred and five thousand (N205,000) naira in which an annual income would yield two million, two hundred and fourteen thousand (2,214,000.00) and two million four hundred and sixty thousand (N2,460,000.00) naira.

The scavengers play an integral part in refuse management in Garki, their mode of operation is not only hazardous but laborious, however, their services are a stable source of income to the practitioners. It was deduced that scavengers in some areas of Garki have an association which regulates and uphold their code of conducts such as honesty, service pricing, association dues and identity card, although, membership is optional and service area is restricted to non-members. Based on this type of arrangement, service charge ranges from N50, N150, N200 to N300 depending on the agreed frequency of collection and distance to communal dump sites along streets or speculated land used as dump sites.

An additional source of income to refuse collectors and dump scavengers is the profit they make on every item sold to garbage processors or garbage dealers. These scavengers pick selected substances from residential, commercial, agricultural, institutional and areas of mixed uses only to be sold to garbage processors.

In view of the aforementioned, proper planning has to effect so as to generate a substantial income from service charge for both government and private firms,

while the scavengers are scavenging the meagre part of the business, a well coordinated means of services needs to be addressed so as to stay on board.

Further more, cost attributable to operational cost, technical and administrative cost, encompassing equipment purchase, debt service, refuse collection cost, spare parts, equipment hiring and maintenance, advertisement etc. are data and information that were bureaucratically denied and subverted probably for fear of auditing and probing.

5.3 WASTE COLLECTION POINT

The evacuation of waste communally deposited tends to be much easier and more hygienic if there is a central place or point of waste deposition for central collection.

In societies where human activities of all sort are allowed to take place without giving regard to the safety of the environment, the people and their resources, then environmental degradation (Endogenic and Exogenic depletion) becomes eminent.

Field work by physical survey and interview in all the communal collection points within Garki, were initially open spaces with no specific function or land plots under speculation. In essence, there is no refuse collection points demarcated or prescribed by either AEPB or private firms, instead the society made the present refuse heaps a monumental feature which resulted to permanent dumping and collection centers/points (see plate iii, v &vii). Furthermore, the collection points were not all easily accessible for proper refuse evacuation.

5.3.1 REFUSE DISPOSAL, TYPE

Disposal, (the last resort ion management of solid waste) is one strategy towards management of solid waste. It is the release of material into the environment. In Garki, the only method of waste disposal observably practiced is land filling (see plate iv). Residual solid wastes evacuated from various source points in Garki are transported to government designated dump sites/landfills. It was also observed that considerable quantities of non-homogenous waste materials (ranging from biodegradable to non-biodegradable) are disposed into gully sites and depressions. Done by both government and private refuse management agencies. Land filling, as observed was done primarily as a means of reclaiming derelict land.

5.4 SOLID WASTE CATEGORY AND COMPOSITION

As I was earlier stated, the above figures solid waste is related myriad of human activities. Related studies have categorized solid wastes into biodegradable and non-biodegradable within which some are hazardous while some are non-hazardous.

The study of waste composition in Garki reveals heterogeneous composition since they come from various sources the waste comprises of both biodegradable and non-biodegradable, materials which are deposited without been sorted.

The bulk of the non-biodegradable wastes are recyclable materials (sorted occasionally by the scavengers only) while the bio-degradable materials consist of easily perishable and non-easily perishable (decomposable) items that can be further reprocessed into compost to serve as manure or fertilizer supplement see plate(v& vii).

5.4.1 FREQUENCY OF REFUSE COLLECTION

Frequency of waste collection simply refers to the number of visits made by refuse management bodies or firms to source points for collection of refuse. This is done in compliance with refuse operational chart and schedule towards effective and efficient management of solid waste.

Abuja Environmental Protection Board (AEPB) collects refuse within Garki once a week for both communal and house-to-house. The private firms engaged in refuse management on the other hand collects house-to-house refuse once a week usually based on subscription for such services by the households.

Collection of communally deposited refuse by AEPB is irregular while the private firms do not carryout evacuation on communally deposited refuse.

5.4.2 SOLID WASTE TRANSPORTATION, EQUIPMENTS AND FACILITIES.

In view of the fact that solid wastes comprises of both hazardous and non-hazardous substances or elements that emanate from various sources, transporting municipal wastes encompasses a wide range of skills (professional operation).

The classical tradition of indiscriminate dumping of refuse endangers the health of residents and also grossly affects the ecosystem and environment entirely. Thus, the use of the conventional waste transportation vehicles and refuse collection and disposal facilities should be an area of interest for all.

It was observed during the research work, that the major equipments/facilities used in transporting solid wastes of whatever form for source points in Garki include: tipper trucks, automated trucks, pick up vans and wheelbarrows. The basic implements used ranges from hand rakes, shovels, hand gloves, sacks/bags and sorting iron rods (used by scavengers).

The use of mode of transportation varies from one refuse management agency to the other as well as between and within service areas due primarily to population characteristics, refuse composition and volume, and physical parameters (such as roads, topography and soil).

5.5 SUMMARY

The serenity of an environment can be altered by agents of change in which man and his numerous activities play the major role. This research has evaluated the issue of effective and efficient waste management system in Garki (FCT). Systems of waste collection, waste collection point, frequency of refuse collection, Solid waste category and composition, system of transportation and equipments. The present disposal systems have been examine and proposals have been made towards improved waste management .It has been found that there is a gross deficiency in the refuse collection and transportation system operating in the area, resulting in a considerable hazard to public health.

The deficiencies stem essentially from adequate refuse collection schedule, public enlightenment, waste management equipments, and proper maintenance of equipments.

However, the situation is some what ameliorated by the involvement of private refuse management firms, the peasant scavengers and the relatively low number of households that evacuate refuse from their surroundings.

Frequency of refuse collection as per respondent's observation ranges from once a week for house-to-house collection or once in two weeks (irregular) to once a week in the case of communally deposited refuse.

However, some respondent were of the opinion that organized waste collection by the residents does not exist in all the areas of Garki district. Some respondents believe that odour from uncollected waste pose a potential health

hazard, littering the environment and causing road and drainage blockage and also obstructing free flow traffic.

It has been found that there are at least five means of transporting refuse collected from source points namely tipper truck, automated truck, prick -up van wheel barrow and cart and private/personals cars. The tipper truck is the most used. The automated trucks are mainly used within the Garki District, while the informal refuse collectors (scavengers) use locally constructed metal cart and wheelbarrows. The scavengers in Garki village do not transport collected waste to landfills /dump sites rather they dump refuse into drainage , under the bridges and most often along the roads and on heaps of already piled-up refuse. The same tradition applies to individuals that embark on personal form of refuse collection and disposal. This practice considerably add to the problems faced by AEPB, since they are the prominent public agencies expected to keep Abuja and its environs clean and free visible environmental inconveniences that constitute not only an eye sores, but a monumental health and sanitary problems.

5.6 CONCLUSION

The conclusion of this work is principally based on the major findings in above summary, and the following conclusions are made: that refuse management system in Garki is grossly under supervised by Abuja Environmental Protection Board (AEPB) due to these reasons:

The research has highlighted some of the factors responsible for this challenging environmental problem and has based on the research findings made, some recommendations and proposals to harness solid waste bearing in mind the conflict between development and environmental protection. They can be mutually supportive in that the examined refuse management system and the identified problems of refuse management in the studied area can be

harmonized so as to pave way for a much more efficient and effective refuse management, bearing in mind the cost benefit of such a task.

In conclusion, it is hoped that the issues raised in this study will stimulate discussions not only among fellow student's researchers and environmentalist, but also among policy makers and planners in Garki- FCT.

5.7 RECOMMENDATIONS

Based on the findings of the research on refuse management in the area (Garki), one would therefore wish to suggest the following recommendations as an attempt to strengthen efficiency and effectiveness towards waste management for the maintenance of Garki Districts Environment. In other to remove these problems, the following are recommended.

1. Government should properly control the use of unauthorized change of use of infrastructure. This can be done by enforcing the relevant clauses of the development guide – lines e.g. confiscating speculated lands, demolishing structures build on designated dump sites or refuse collection point. There should be constant monitoring by terms from the development control units to defaulters. Government should also rehabilitate deplorable roads and provide more tarred roads, culverts, drainages and bridges. Government should ensure that timely and periodic census of the area is taken (recorded) and up- dated due to the high influx of people so as to pave way for provision of sanitary facilities (dustbins, polythene bags, incinerators, refuse evacuation trucks, personnel etc.) as census helps in strategic planning towards ensuring a less polluted and populated environment. Government should also expedite the enforcement of its waste management laws and policies based on the principle of pay as you generate. Such policy will serve a dual function of achieving waste minimization and a source of revenue derivation. It has been observed that several households do not have refuse bins, thus, government should mandate waste generators to purchase both sanitary polythene bags and plastic

refuse bins to be kept in the entrance of each dwelling free from locks and keys. Waste generators should be compelled by law to regularly pay services rendered and be sensitized on the stiff penalty to be meted on defaulters.e.g imprisonment, an option of fine or publishing defaulters name, identity and nature of offence in a gazette.

2. Collection of refuse is usually the most expensive part of refuse management .To minimize cost therefore, an easy collection system is very important .Each household should be provided with the standard120 liters, 240 liters to 1.1m³ capacity refuse bin with lid to be place outside for easy refuse collection of refuse, centrally located collection points to be shared by a number of households within each of the designated areas in all the areas should be established. This will ensure a short walking distance from each of the houses to the area collection point/centers. Occupants of each of the houses should be made to empty their refuse bins (contents) in their houses to the area collection centers on daily basis or as soon as the bins are full to avoid spilling over. To further ease waste collection, more transfer stations should be constructed at designated point. This entails temporary storage structures made of brick or block wall enclosures with a raised platform from which the refuse van can load refuse to sanitary landfill site. However, to cut down operational expenses, frequency of collection in areas with transfer stations should be once in two weeks while for individual households with bins or drums and area collection point should be once a week. Also, all existing wastes dumped along the sides of some roads (tarred, feeder, access roads and foot paths), underneath bridges, culverts and speculated lands and drainage channels should be cleared as a matter of urgency.

3. Vehicles to be used for transportation of solid wastes from source point should be the type that will prevent the collected refuse from spilling over while moving. The refuse should not be made to deface the premises and side walks and roads after being collected. Refuse disposal vans and skillful

personnel should operate trucks equipped with tipping mechanism. Also the capacity of refuse collection and transportation machines should not be exceeded and regular maintenance should be carried out to avoid total break down. More equipment will have to be purchased to cope with the increasing waste generation due to increase in population and the attendant environmental problems.

4. Currently, Landfill is the predominant system of solid waste disposal practiced in Garki .As such landfill sites should be adequately fenced to avoid wind effects. The road to the site must also be accessible and the topography should be relatively flat and should be away from nearby water sources. To ensure sanitary land filling and safety, sorting out solid waste should be encouraged to be carried out by waste generators right from the source point laborers and dump scavenger. This is to ensure separation of hazardous waste like tyres, discarded dry cell batteries, chemical solvent and other inflammables. Recyclable metallic waste can be separated from other waste items by using large industrial magnet to attract metals.

5. Private investors should be encouraged to participate in refuse management (collection, transportation and disposal) using their vehicles or hired ones with personnel that have a requisite knowledge on waste management. To complement government and private refuse management agencies in the task of managing waste in Garki, community based participation should be encouraged. This can be done by forming the kind of vigilante/Volunteer group charged with responsibility of collecting refuse from source point to central points. In the case of membership, volunteers, can be drawn from serving civil servant, retirees, unemployed persons, student etc. However financing such laudable project can be done in such a way that every household should be charged a levy in which the total sum is to be used to purchased fuel, spare parts and general running costs including erecting sign post warning” Do Not Dump Refuse Here ”

6. Scavengers plays an integral role in refuse collection from source point, hence their services should be employed by residents. Local vigilante/volunteer groups should ensure that scavengers deposit collected households refuse at designated collection points.

7. Public enlightenment should be vigorously pursued consistently by government and private refuse management agencies; this can be effective using media (print and electronic), advert, organizing and sponsoring public lectures, Symposiums and sanitation competitions between communities. Therefore there should be campaign using all the organs of information and communication available so as to enlighten the people of Garki, district on the importance of good sanitation and sanitation system.

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APPENDIX 1

QUESTIONNAIRE ON REFUSE MANAGEMENT SYSTEM IN GARKI, DISTRICT.

Dear Respondents,

This questionnaire is designed for academic research only. The research is not sponsored by any government or organization. All your responses shall be treated as confidential. Your correct and sincere response will help a lot in this research .Please tick the appropriate answer/response.

Thanking you for your kind cooperation.

The Researcher.

SECTION A

1. Occupation:

2. Age:

3. Usage: (a)Residential (), (b)Commercial (), (c) Both, (d) Institutional (), (e)others ()

4. Tenure : (a) Rental (), (b) owner (), (c)Government ()
(d) Squatting () (e) Others ()

5. Duration in the location. You have been living in the area for past : (a) 1.5 Years () (b)6-10 years () (c) 11-15 years ()

6. What are your major sources of refuse? (a) food remnant and vegetable residues () (b) waste /used papers [] (b) used cans [] (d) Used polythene bags (e) Plastics and rubbers []
7. Where do you deposit your waste? (a) Incinerators [] (b) Polythene bags [] (c) dustbins []
- (d) Open space. [] (e) Open ditch or drainage [] (i) others (specify).....
8. Do you have any arrangement either with the government, communication or private for your
- Refuse collection: (a) Yes with government [] (b) Yes with the community [] (c) yes with
- Private firms. (d) Through personal arrangement [] (e) yes by scavenger [] (f) no
- Arrangement [] (g) others [specify].....
9. How frequent are your refuse collected /evacuated (a) Daily [] (b) weekly [] (c) Monthly [] (d) irregularly []
10. Are the number of times your wastes are collected adequate: (a) Yes [] (b) No []
11. If not how frequency do you think would be adequate
12. How are the waste collected (a) communal Bin/central collection [] (b) Individual house collection [] (c) Central Refuse Container (Refuse cab)
13. Do you pay for waste collection service: (a) Yes [] (b) No []
14. How much do you pay for the service.....

15. How are the wastes transported from your area to the destination: (a) using Pick-up van []

(b) Tipper Truck [] (c) Automated Truck [] (d) Wheel Barrow [] (e) Others []

16. What are the problems caused by these accumulations in the area?

(a)

(b).....

(c).....

(d).....

17. What are your suggestions towards proper refuse management in this area?

.....

.....

.....

.....

.....

APPENDIX 11

SECTION B
GOVERNMENT DISPOSAL, AGENCY

1. Name of organization :
2. Year of Establishment:
3. Is the organization responsible for refuse collection in Garki ?
 - (a) Yes [] (b) No []
4. What form of refuse collection is employed?
 - (a) Communal collection []
 - (b) House - to - house collection []
 - (c) Cabside collection []
5. What criteria do you use to monitor waste accumulation?
 - (a) Field visitations []
 - (b) Residents reports/notice []
 - (c) Others (specify)?.....
6. How often is refuse collected in Garki?
 - (a) Daily []
 - (b) Weekly []
 - (c) Monthly []
 - (d) Irregular time
7. What form of refuse transportation is used?
 - (a) Pick up van

- (b) Tipper truck (911) []
- (c) Automated trucks []
- (d) Wheel Barrows []
- (e) Others (specify) []

8. Are there stipulated refuse collection points in Garki?

- (a) Yes [] (b) No []

9. Is your Organsition responsible for refuse collection in this area:

- (a) Yes [] (b) No []

10. If yes who pay for the service rendered:

- (a) The Government [] (b) The community [] (C) The Individual []

11. Is your organization responsible for refuse bin distribution?

- (a) Yes [] (b) No []

12. If yes how are the refuse bin distributed?

- (a) One per every three houses
- (b) Base on refuse
- (c) One per house
- (d) One per two houses
- (e) At random location
- (f) Central bin

13. Are your bins for sale? (a) Yes [] (b) No []

14. If the bins are for sale how much are they sold
.....

15. Are there other sources (s) of income apart from government subvention?

(a) Yes [] (b) No []

16. If yes, what source (s)?.....

17. Does the Organization sub- contract refuse collection to private firms?

(a)Yes [] (b) No []

18. If yes why?

.....
.....
.....

19. Do residents pay for refuse clearing?

(a) Yes [] (b) No []

20. If yes how much / give the range
.....

21. if residents pay for refuse clearing, what do you base your amount of payments on?

- (a) Population of the houses
- (b) Size of the house
- (c) Location of the house
- (d) Distance to destinations

- (e) Size of your bin
- (f) Type of the house/economy status of owner
- (g) Flat rate

22. If flat rate is used, how much is paid per household?.....

23. What Form of waste disposal do you use for refuse?

- (a) Landfill []
- (b) Burning []
- (c) Chemical []
- (d) Any other (specify)

24. How many disposal sites do you haveand where.....

25. Are they government designated waste dump?

- (a) Yes [] (b) No []

26. Are the waste collected processed

- (a) Yes [] (b) No []

27. If they are processed how:

- (a) Recycled [] (b) burnt [] (c) Sorted by type and processed into fertilizer [] (d) chemically processed.

28. What problems do you encounter in refuse collection ?

- (a).....
- (b).....
- (c).....
- (d).....

(e).....

29. **What type of operational problems do you encounter?**

(a).....

(b).....

(c).....

(d).....

(e).....

30. **What type of technical problem do you encounter?**

(a).....

(b).....

(c).....

(d).....

(e).....

31. **If there any form of public enlighten on environmental sanitation?**

(a) Yes [] (b) No []

32. **If yes what form of public enlighten is predominant?**

(a) **Print media (specify) Magazine**

Newspapers [], Journals [], Handbills []

(b) **Electronic media (specify) TV []**

Radio []

APPENDIX 111

SECTION C

This is a Questionnaire designed for research and not sponsored by any Government or organization. The answer you give here shall be treated as confidential and only academic. Thanks for your kind response.

- 1. How old are you?.....**
- 2. What is your level of Education**
 - (a) Primary certificate [] (b) Secondary Certificate []**
 - (c) Others (Specify)**
- 3. How long have you been doing this business?.....**
 - (a) 1-2 Years (b) 3-5 years (c) 6-10 years (d) 11 years and above**
- 4. Are you self-employed? (a) Yes (b) No**
- 5. If No whom do you work for.....**
- 6. Where do you scavenge?**
 - (a) Incinerator (b) Open Spaces (c) Landfill Sites (d) Any other (specify)**
- 7. How frequencies do you scavenge?**
 - (a) Daily (b) Weekly (c) Monthly (d) Irregular times**
- 8. What type of waste do you scavenge?**
- 9. Are the wastes you scavenge seasonal?**
- 10. If yes, what season accounts for high waste generation?**

11. What do you do with the collected waste?

(a) Sell (b) Trade by Barter, (c) Process (d) Others
(Specify).....

12. Are the wastes processed? (a) Yes [] (b) No

13. If Yes, how?.....

14. Do you Purchase any particular waste? (a) Yes (b) No

15. If yes, (a) what type of waste? (b) How much

16. Is there any form of taxation on your business? (a) Yes (b) No

17. If yes, how much;.....

18. Is there any arrangement between you and the households in clearing specify waste?

19. If Yes, what sort of(a) Arrangement..... and (b) what sort of waste.....

20. What sort of problems do you face in your business?.....

21. What type of refuse clearing facilities do you use?.....