

WASTE GENERATION

AND

ENVIRONMENTAL DEGRADATION

(A CASE STUDY OF SULEJA LGA)

BY

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(PGD/GEO/2000/2001/131)

A PROJECT SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENT FOR THE AWARD OF A POST
GRADUATE DIPLOMA IN ENVIRONMENTAL
MANAGEMENT

DEPARTMENT OF GEOGRAPHY
FEDERAL UNIVERSITY OF TECHNOLOGY
MINNA.

MARCH, 2002

DECLARATION

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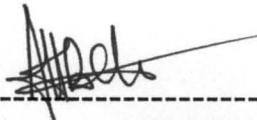
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ACKNOWLEDGEMENT

I acknowledge my indebtedness to all those that facilitated the production of this final dissertation.

I acknowledge with sincere gratitude the constructive advice and criticisms[&]_x untiring guidance of my Project Supervisor – **DR. HALILU AHMED SHABA**, to the successful completion of this work – A man of integrity, may he be rewarded accordingly.

I am most grateful to my wife and children – Grace, Lorraine and Naomi for their patience and understanding in the course of this study. They were denied the fatherly company they needed, yet they prayed for me always.

Worthy of mention are my mum MRS JUMMAI BARAU and all my Brothers; They were always there for me to lean on.

To God Almighty, I give glory and adoration for his banner over me is LOVE. I can do all things through HIM who strengthens me.

DEDICATION

To my late Sister of Blessed Memory "**MRS. NAOMI JAMES CHIDAWA**"; In fond remembrance of her wonderful love for me. "The good die young, but are oft interred with their bones". "Your candle burned out, but your Legend never will". You will remain alive in my heart, forever.

ABSTRACT

There have been phenomenal increase in the volume and range of waste produced in Nigeria today. The aim of this study is therefore to examine the impact of these waste on the environment so as to identify an appropriate management technique that will ensure a cleaner environment. Data for the study were collected through the use of questionnaire, oral interviews, personal observations; data so collected were analyzed. It was discovered that Suleja Local Government Area is under the threat of environmental pollution since the LGC has monopolized waste management in the area, to the detriment of the entire community, because the waste is being generated at a rate that is beyond the management capacity of the LG authority. To ensure a cleaner environment, therefore, the researcher has recommended among others, a more organized waste recycling and reuse (tagged waste-to-wealth option) so as to reduce its impact on the environment and also provide employment opportunity to the participants in the scheme; communities, NGOs and private sector participation; payment of clean-up tax', special allocation of fund for environmental clean-up in annual budget.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND:

The management of Solid Wastes generated within the Urban Centres has become one of the most intractable problems of development. In the last two decades, there has been a phenomenal increase in the volume and range of waste produced in many developing countries. This is due to increasing rate of population growth, Urbanization, Industrialization and general economic growth. It is not uncommon to find urban wastes blocking streets and roads and thereby contributing to the problem of flood disasters in cities like Lagos and Ibadan, Kano and Kaduna. Thus there is the need to keep discussing about waste and its management for sustainable development. Because humanity is responsible for its generation, waste management is also our responsibility; but managing waste successfully is complex.

There is a general concern that a lot of heterogeneous waste is generated and the volume and types have been on the increase in the country. Yet the problem has refused to abate. By 1989, an estimated 2.2. million tonnes of garbage per year was being

generated in Nigeria, equivalent to about 20kg of solid waste per capita. It was estimated that by the year 2000, Lagos metropolis alone may be generating about 998.081 tonnes of solid waste per year. The Task force on Environmental Sanitation of Kano State in 1993 reported that Kano city with a population of 1.5 million generated about 500 tonnes of waste per day, but less than 30% is evacuated, thus leading to a rapid build up.

This is a clear evidence that the volume of Solid Wastes is overwhelming Urban Administrator's Capacity to plan, evacuate and dispose them. Yet we are running out of space to put all the trash we generate. In view of the constant land area and increased Urbanisation which may be reducing vacant lands, there is the justified fear that if appropriate measures are not put in place for sustainable waste management, we may be overwhelmed if not consumed by waste.

1.2 **AIM OF STUDY:**

To examine the impact of waste generation on the environment.

1.3 **OBJECTIVES:**

1. To provide a comprehensive appraisal of policies, participation and technique of waste management so as to proffer suggestions that could assist the government in sustainable waste management.
2. To identify an appropriate management technique that will ensure a cleaner environment.
3. To introduce the utilitarian values of wastes i.e to change the common, conception of waste as "environmental nuisance to that of a "ASSET" (Waste – to – wealth options).

1.4 **STATEMENT OF PROBLEM:**

The proximity of Suleja Town to ABUJA (The Federal Capital Territory) and its status as the Largest and most important satellite Town to ABUJA, has given rise to population explosion there, in the last 20 years. This has led to the overstretching of social amenities and infrastructures and even complete breakdown of some, due to stress.

Inspite of the economic and social importance of Suleja Town to both Niger State and Abuja, it has remained the most neglected and the dirtiest, with refuse lying everywhere. The Town was not planned ab-initio, development in the town is still unplanned and uncontrolled, such that access to some interior

parts is virtually difficult if not impossible. This has thus made waste collection and disposal a herculean if not impossible task – No wonder then that unsightly heaps or mountains of wastes are found in all parts of the town, emitting foul smell and constituting nuisance to the unfortunate Local inhabitants and passers – by of the dumping sites (Plate 2).

To say that waste disposal system is grossly inadequate in Suleja Town is just stating the obvious. The waste is generated at a faster rate than what the authorities can properly manage or dispose of, given the capacity they possess. The Solid and liquid wastes constitutes health hazards and silage waste accumulation is providing a good breeding ground for mosquitoes. Unfortunately, the General Hospital in the town has become a place fit to be declared A DISASTER OR ENDEMIC ZONE. The researcher feels that there is great need to promote Local participatory approach to waste management.

1.5 JUSTIFICATION OF THE STUDY:

There is no doubt that a well articulated Solid Waste Management and technology will have positive effects on the various aspects of urban life, including economy, environment, technical and technological skills and social life in the country.

The problem of waste generation and disposal is having a disproportionate impact on the lives of Nigerian, and Environmental pollution is challenging sustainable development. Since reliance on known techniques of waste disposal have failed, there is the need to adopt a technique relevant to our stage of development, hence this study. This has become necessary since the very existence of man is threatened, and if his survival must be assured, the environment must be secured at an appropriate level of life sustaining quality.

In the past, waste disposal was seen as simply removing waste from human settlement, but lately, waste is seen as "misplaced resource" which should benefit the community generating it and the entire society. This study will achieve the following.

- (a) A cleaner and healthier environment in the LGA.
- (b) A more balance allocation of resources, by transferring what is not useful in one sector of the economy to other sector (s) where it is needed or required.
- (c) Adoption of a better waste management techniques which will positively alter the present level of urbanpoverty. A programme of

waste-to-wealth will improve environment and provide employment/income generation.

1.6 **SCOPE AND LIMITATION OF THE STUDY:**

The study is limited to Suleja LGA. and limited to solid wastes only.

It is not an attempt to originate new theories or hypothesis on waste management, rather, it is only an attempt to guide towards the choice of a most relevant management technology, firmly built on the framework of existing knowledge.

The scope of this research shall thus be restricted within the boundaries of existing knowledge, to examine the nature, source and Management of waste with a view to showing the way forward, towards sustainable waste management techniques.

1.7 **DEFINITION OF BASIC TERMS**

1.7.1. **SOLID WASTE:** This is defined as non-gaseous and non-liquid wastes, resulting from activities such as Agriculture, domestic, commerce and Industrial. They are often indiscriminately dumped along the Roadsides Adedibu (1983). The composition of Waste may be garbage or rubbish.

1.7.2 ENVIRONMENT: This is simply expressed as the natural condition which we live or a set of surrounding conditions especially those influencing development or growth.

1.7.3 POLLUTION: This is defined as the process of making the natural environment dirty, filthy or in a state that makes the natural environment un-natural (artificial)

1.7.4 DEGRADATION: Tending to make the environment lower in rank or quality (i.e dirty or Filthy).

1.8 STUDY AREA:

The study covers Suleja Local Government Area, but with emphasis on Suleja Township. Suleja LGA is one of the five most Urban centres in Niger State.

Location:

Suleja LGA is located in the South – western Part of the old Kingdom of Zazzau (Zaria). Suleja Town itself was established by Muhammadu Makau, a Habe Ruler of Zazzau, who was driven out of his Kingdom following the Jihad of Shehu Usman Danfodio in 1804.

The old Suleja Emirate (Before the carving of the new FCT) was initially inhabited by many tribes like Gbagyi, Koro, Gade,

Ebira, Gwandar and Bassa, who were governed by five different Chiefs, who in turn owed allegiance to the Kings of Zazzau.

The present Suleja LGA was created in August, 1976 with Headquarter at Suleja Town. It is made up of five districts. VIZ: Hashimi, Bagama, Magagiya, Madalla and Iku North. Each of these is headed by a district head who is responsible to the first class emir of Suleja.

Climatic Condition:

The LGA has an annual rainfall of 1640mm. The rain starts from October/November, and last till March/April. It is however, not unusual to have light showers in the month of December. The rains are heaviest in the months of August and September, temperatures are highest in the months of March and April and lowest in December and January. Wet season starts in March and end in October, while dry season starts from November and end in April.

Population:

The population of Suleja LGA was put at 115, 700 in 1997 (though this is doubtful to the researcher).

Linguistic Groups:

The oldest linguistic groups within the area are mainly Gbagyi and Koro. Nowadays, the Fulani, Hausa and other Nigerian tribes have been added to these indigeneous groups.

Occupation:

The main occupation of the people of Suleja LGA is farming. Root crops like yams and cassava, grains and millet etc. are widely grown. The influence of Abuja has boosted trade and Civil Service in the Area.

Religion:

The main religion practiced in the LGA are Christianity, Islam and Traditional Religions. The LGA is generally peaceful.

Landscape/Vegetation:

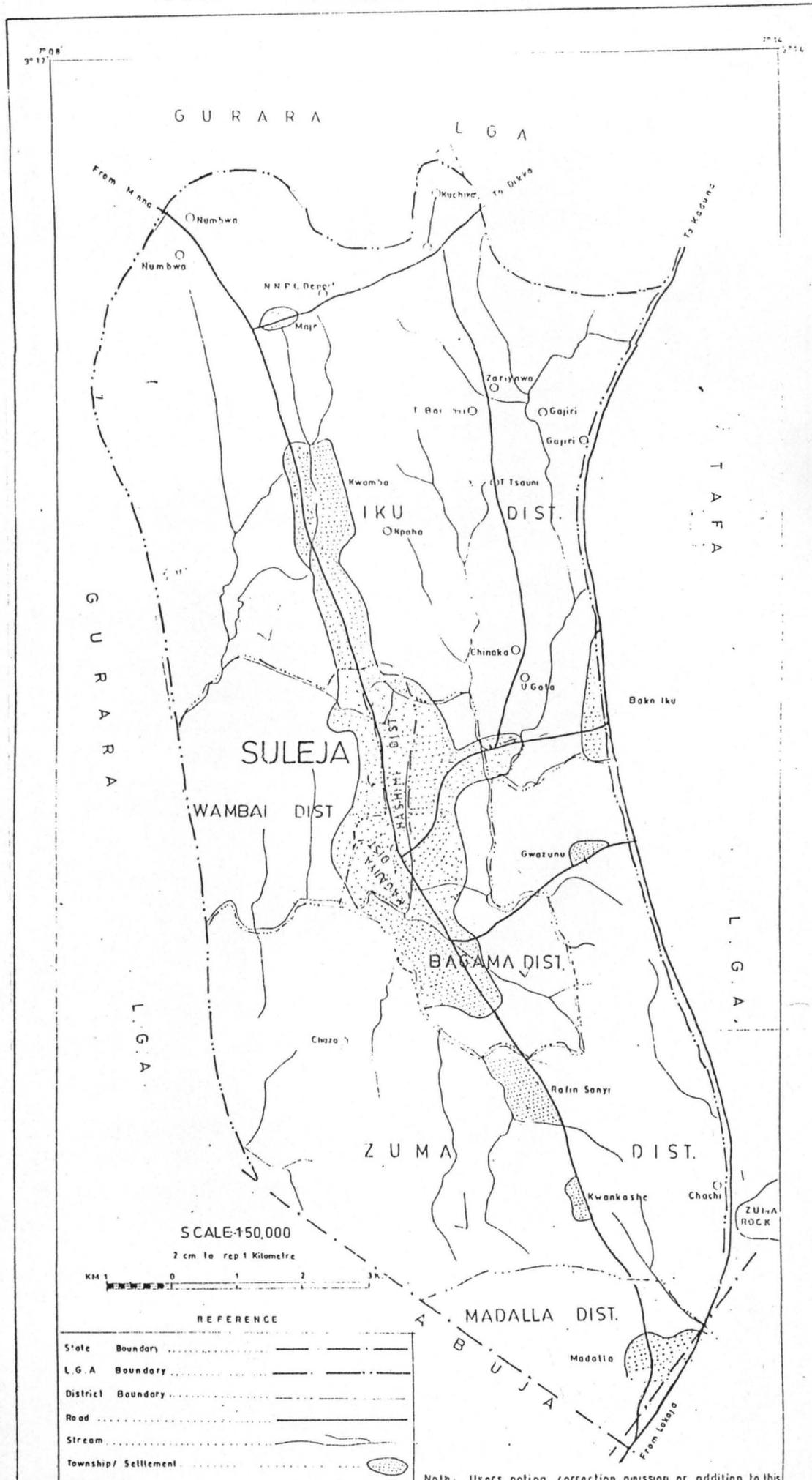
The LGA covers a plain land area of 46.031 sq.km and 92.063sq.km high lands and lies within the Savannah Belt. The settlements in the area is generally scattered on undulating to topography. The important places of attraction in the LGA are : ZUMA ROCK, MAYANKA FALLS, and LADI KWALI POTTERY CENTRE. The Principal River in the area is River Iku. It drains South West - Wards into River Gurara which is a tributary to River Niger.



Figure 7: Refuse blocking a concrete Bridge in Suleja.

SOURCE: The Author

SULEJA LOCAL GOVERNMENT AREA



SCALE: 150,000

2 cm to rep 1 Kilometre



REFERENCE

State Boundary	-----
L.G.A. Boundary	-----
District Boundary	-----
Road	-----
Stream	-----
Township/ Settlement	○
Other Town/Village	○

Note: Users noting correction omission or addition to this

CHAPTER TWO

LITERATURE REVIEW

2.1 **CONCEPT OF WASTE MANAGEMENT:**

Solid Waste generated in Urban areas may be derived from various sources such as household, commercial, institutional, street sweeping, construction and Industrial; depending on their source of origin, therefore, there are many types of solid wastes. All of them can generally be divided into two broad categories viz: Industrial solid wastes and commercial/domestic solid wastes.

2.1.1. Industrial Solid Wastes: are waste materials generated in the course of manufacturing processes. They are usually derived from processing and non-processing industries and utilities. Their characteristics are directly related to the number of Industries and their nature. They may include packaging materials, food wastes, discarded metal, plastic, and textiles, fuel-burning residuals, scraps, chips and grits from machine shops, sawdust, waste paper, pieces of glass, and spent processing chemicals. A large proportion of the wastes produced by this sector has the potential to be hazardous if not disposed correctly. Kankwenda (2000).

2.1.2 Household or Domestic Solid Wastes are the by-products of house keeping activities and consumption. They

include organic Kitchen Wastes, sweeping, paper and cardboard and small proportions of plastic, rubber, Leather, bone and metals as well as wrapping papers, leaves, and empty cans or containers. In poor neighbourhoods, traditional cooking can also produce ash, and where sanitation facilities are limited, the waste might also include faecal matter. This is the sector, which we can all make an individual contribution to reducing wastes. It is a challenging sector in which our own habits and behaviour need to be thought through.

2.1.3 **Commercial Wastes** may be derived from markets, modern stores, offices, restaurants, warehouses and hotels. They are organic in nature.

2.1.4 Paper is the predominant waste from most institutional sources Such as government offices, hospitals and religious buildings. By their nature hospital wastes are often handled separately.

2.1.5 **Streets Sweepings** Consist of sand, stones and litter. They may also include appreciate amount o household refuse, drain cleaning and human and faecal matter.

2.1.6 Construction and demolition activities generate a variety of residual building materials that can contribute significantly to quantities of waste Kankwenda (2000).

The phenomenon of waste generation is common to all human communities and often leads to urbanization process, especially when both the natural and the migratory nets are relatively large. When population explodes, consumption tends to be elastic, and people create refuse from all sorts of materials used for packaging. Thus, man's activities on domestic, commercial and industrial process produce some desirable effects, which are pollutants of all categories.

Rapid population growth is a significant factor that is causing poor environmental sanitation. Nevertheless, there are other factors such as inadequate knowledge of the composition of solid wastes, the rate at which population generates wastes, inadequate and uncoordinated infrastructural facilities for waste disposal, and Rural – Urban drifts Adedibu (1989). Adedibu (1986) described the phenomena of sources of waste generation as a result of changes in the wage earning by the workers. For instance higher income earning can lead to greater propensity of buying,

specifically the packed items which can also increase the wastes generated by the high income class.

The federal environmental protection agency (FEPA) has categorised wastes into three main types as follows:

- (a) The municipal wastes arising from Residential, Industrial, Commercial and Street left-over which include pieces of papers, food wastes, plastic and Rubber, pieces of metal, tins, Leaves and grasses among others.
- (b) The industrial waste, such as cartons, boxes, crates, scraps of building materials, wood and cellulosic materials, chemical wastes oil and plastics.

Adebibu (1987) noted that the source of these waste generations increases as income rises, but at a smaller unit than income. He opined that the amount of effluent discharged into the environment is related to the population composition, size and per capita income. A remarkable growth in population and income give rise to the production and consumption of goods and services and thus the discharge rate is increased. Lester (1987) said that without population there will be no pollution and that pollution is the price of progress.

The spatial variation of socio-economic and demographic characteristics as well as the Level of technological development of an environment has been found to have influenced waste generation efforts. Adedibu (1985) 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 instance, the common types of waste are usually in the form of leaves, food remnants, harvest wastes among others. But in industrial economy, tins, cans, plastic packages among others are common.

Mabogunje (1974) also argued that incidence of population explosion in an area enlarges the sizes of households and thus translating into heavy wastes generation. Generally, the source of waste generation is a function of many interacting variables.

2.2 **PROBLEMS OF SOLID WASTE DISPOSAL**

Historically, the problem of waste generation can be traced back to ancient times when man first started to congregate into tribes, hamlets, villages and communities. Such wastes emanated from the human consumption pattern. The situation was so terrible in the medieval towns as the wastes so generated led to the breeding of rats and the eventual outbreak of epidemics which

killed about 50% of the Europeans in the 14th Century. Later more epidemics emerged which equally resulted into more death tolls, Olokesusi (1994).

In developing countries where services are inadequate, waste disposal is a major problem in many urban areas. Rapid urban growth, increasing per capita production of solid waste and non-availability of land conveniently suitable for waste disposal are further aggravating the situation. In most cases, less than half the wastes generated in urban areas are collected by municipal authorities entrusted with their disposal.

In the absence of Solid Waste collection system, waste is dumped in open spaces on access roads, and along watercourses. An emerging trend in Nigeria is the invasion of dumps by scavengers and animals that scatter the wastes, and so serve as breeding grounds for disease vectors. Leachate from decomposing and putrefying garbage percolate into soil and nearby water sources. The resultant contamination of food, water and soil could be responsible for the transmission of many diseases. Uncollected wastes find their way into open drains, which become blocked, and thereby promote flooding and breeding of mosquitoes.

Many financial, institutional, technical, and socio-cultural factors are responsible for the low level of waste disposal being witnessed in many urban areas of developing countries. They include the following.

- i. poor municipal resources compounded by inadequate resource mobilization strategies.
- ii. Over-reliance on imported equipment
- iii. Inappropriate methods of finance in view of the fact that many waste collection equipment have short life that are not suitable for financing under very long-term soft loan
- iv. Use of inappropriate technology and
- v. Failure to involve the people in the management scheme, including paying for the services, Kakwenda (2000).

2.3 **MANAGEMENT OF WASTE:**

Waste Management is handling of waste from source to grave i.e from generation to its final disposal. It involves the collection, storage, transportation, processing, and disposal of generated waste. The final disposal method has been the worrisome aspect of the management. This when not adequately handled or executed may lead to the impairment of the environment.

Waste has been universally accepted as substances or objects discarded or intended to be discarded as worthless or unwanted, defective or of no further value from a manufacturing or production process of a particular System. However, it has been revealed that through affordable waste recycling Technologies, waste could be turned into wealth Olubori, (1999).

The current philosophy in both developed and developing countries is "WASTE -TO -WEALTH. Human scavengers can be seen turning around heaps of rubbish for survival. We can not entirely eliminate waste production ,but we can reduce its impact on our environment. To this end waste management has three key objectives

- To minimise the amount of wastes that we produce.
- To make best use of what is produced.
- Choose waste Management practices, which minimise the risk of immediate and future environmental pollution and harm to human health.

A hierarchy of waste Management options based on global policy of sustainable framework is defined to:

2.3.1 **Reduce-** By using Technology which require less material in production and produces less waste in Manufacture and by

producing longer lasting products with lower pollution potentials: This reduction provides less burden

- On the environment and economic costs of the raw material.
- On the environment and economic costs of collecting, transporting and processing both raw material and waste material.

2.3.2. **Reuse-** Intensify reuse of returnable and reusable material such as returnable bottle and reusable transit packaging (carrier bags) can save the environmental and economic costs of raw material, reduce the amount of waste that needs disposal and save the associated environmental and economic costs, exploit market opportunities for re-usable products, save money by buying re-usable and refillable products.

2.3.3. **Recovery:** - Finding beneficial uses for waste including:-

1. **Recycling:**

Solid wastes recycling refer to the process of using the solid waste as raw material again for same or different purpose. Example of Waste that have been recycled include tin cans, scrap metals, glass, plastics and paper. Flattened tins can be collected and transported to detinneries for the recovery of tin and ferrous

metal in the cans. Steel Industries convert scrap metals from junked automobile into steel. Metallic objects may be separated from the refuse by using powerful magnet.

2. **Composting:**

The end product of this is rich in nitrogen and phosphorus. Non biodegradable materials such as cans, stones and metals are removed from the waste before composting process begin. The remaining component is crushed into small pieces to allow for aeration and microbial growth. The composting is achieved by moistening the heap of refuse, and allowing it to ferment. The mixture is turned regularly for adequate aeration to remove any offensive odour from the heap (Fig. 1)

2.3.4 **Incineration:**

This is the process of burning the combustible component of solid waste at high temperatures. This can reduce the volume of solid waste by up to 90%.

Paper and plastics contained in Municipal Waste can be burned to generate heat or electricity. This can also be burned in special waterfall incinerators to produce steam or can be burned along with coal in the furnace of a steam-electric plant (Pate 3)

2.3.5. **Pyrolysis:**

This is a process by which organic wastes are decomposed under intense heat in the absence of oxygen. The products of this are gaseous and liquid fuel such as char, alcohol, light oils and combustible gases. All these are potential fuels.

2.3.6 **Biogas Production:**

This is another method of converting solid waste into beneficial product by subjecting them to anaerobic bacterial digestion to produce combustible biogas and fertilizer, Odeyemi (1979). Biogas provides energy for cooking, lighting, drying farm produce and electricity generation. The gas is a mixture of methane carbondioxide and traces of their elements (Plate 14).

2.3.7 **Deep well injection:**

This method of disposal is suitable for industrial wastes. These include acidic and caustic chemicals, oil field brine and radio active wastes from Uranium processing plants.

Deep well is dug into subsurface impermeable rock layer which can act as adequate reservoir for water. This method though may be associated with ground water contamination.

2.3.8 **Sanitary Landfills:**

This is also known as controlled tipping. Refuse is spread in thin layer, compacted by heavy bulldozer before another layer is spread. When the refuse is about 3m high, it is covered by a thin layer of clean soil and compacted again. The process is repeated until the pit is filled.

2.3.9 **Open dumping:**

In this method, waste is dumped in open space and subsequently burned. Because of the failure of incinerators and landfill facilities, what is effectively achieved or practiced is open dumping of the solid wastes which are left exposed or long period of time. This is the form of disposal that is of concern in identifying the impacts of solid waste disposal methods in municipalities (Plate 5).

2.4 **Stakeholders for sustainable solid waste management**

For sustainable management of municipal solid waste, it is important to recognize the diverse interests and roles of various actors and partners who are concerned about it as service users, service providers, intermediaries and /or regulators. They include households, community groups, NGOs, government, organized and informal private sector enterprises.

2.4.1. **Residential households** are mainly interested in receiving effective and dependable waste collection service at affordable prices. In general, disposal is not normally a priority demand of service users, unless their quality of life is threatened by dumpsites. It is, therefore not surprising to find that where waste management services are not satisfactory (e.g. Lagos), solid waste is commonly dumped onto nearby open sites, along main roads or railway tracks, or into drains and waterways (e.g. the lagoon in Lagos). Thus, it is imperative to note that pressure to improve waste collection and disposal will increase when poor people become more aware of the environmental and health implications of poor waste collection service.

Poorly served residents can also form community-based organizations that when sufficiently organized have considerable potential for managing and financing local collection services and operating waste recovery and composting activities.

2.4.2 **Commercial and industrial establishments** are interested in effective waste collection and, in many cases, waste minimization. Because of their usually keen interest in reducing waste generation, industrial enterprises, in particular, could play an active role in managing waste collection, treatment and disposal in

collaboration with governments and/or specialized private enterprises.

2.4.3. **Non-governmental organizations** (NGOs) may help to increase the capacity of communities for sustainable waste management problems and technical know-how of locally active CBOs. In addition, NGOs may provide important support to informal sector waste workers and enterprises, assisting them to organize themselves, to improve their working conditions and facilities, increase their earnings and extend their access to essential services.

2.4.4 **Organized private sector enterprises** are primarily interested in earning a return on their investment by selling waste collection, transfer treatment, recycling and/or disposal services. They are in position to provide capital, management and organizational capacity, labour and/or technical skills, and can, *under appropriate conditions* provide MSWM services more effectively and at lower costs than the public sectors. To decide whether to have private sector participation in municipal solid waste services, many factors need to be analyzed, such as cost recovery, efficiency, public accountability, management, finance, economies of scale, legislation, institutions and cost. Methods of private sector

community based organization



Plate 1: A communal solid wastes depot in Suleja with a disused Roll-on-Roll-off Refuse collection bin-Refuse is indiscriminately dumped on the site.

SOURCE: The Author



Plate 2: A communal solid wastes depot in Suleja. The heap of wastes is threatening to overflow the fence of the residential compound.

SOURCE: The Author



Plate 3: A typical waste burning incinerator in the new Abattoir at Suleja.

SOURCE: The Author



Plate 4: The Residue of Tyres burned in the process of preparing cow skin for consumption in old Abattoir. The process is polluting the environment with smoke.

SOURCE: The Author



Plate 5: A typical final waste disposal site in outskirts of Suleja town (Open dump).
SOURCE: The Author



Plate 6: A typical waste disposal site in outskirts of Suleja Town, with Vehicle and metal scraps.
SOURCE: The Author



Plate 7: Refuse blocking a concrete Bridge in Suleja.

SOURCE: The Author



Plate 8: A typical drainage in Suleja Town, threatened to be blocked by refuse in due course.

SOURCE: The Author

participation most common to solid waste management are contracting, concession, franchise, and open competition (see Cointreau-Levine, 1994 for details). This approach is in consonance with the recent decision of the Lagos State Waste Management Authority (LAWMA) to involve private sector participation in waste disposal.

The basic motivation of the *informal private sector actors* is self-organized revenue generation. This sector is made up of unregistered, unregulated activities carried out by individuals, families, groups or small enterprises. Informal sector workers are often driven by poverty to work as waste collectors.

2.4.5 Government, by their nature and constitutional disposition are generally responsible for the provision of solid waste collection and disposal services. This is due to the fact that they become legal owners of waste once it is collected or put out for collection. Responsibility for waste management is usually specified by laws and regulations that are often derived from environment policy goals. By the 1999 Nigeria constitution the authority to enforce bylaws and regulations, and to mobilize the resources required for solid waste management is in principle, conferred upon local governments. On the other hand, Federal and State governments

are responsible for the waste management institutional and legal framework. In this regard, problems can arise when local government's authority is not commensurate with its solid waste management responsibilities.

2.5 **Determinants for sustainable solid waste management** *

The effectiveness and sustainability of solid waste management system depend on a number of factors that need to be adopted to the prevailing context of the local conditions in which they operate. Some of these are outlined below, and they concern political, socio-cultural, economic and environmental aspects of waste management.

2.5.1. ***Political context***

Administrative decentralization affects the character of local governance and solid waste management systems. The existing relationship between governments at all levels (local, state and national), the form and extent of people's participation in the public process of policy making and the role of party politics in local government administration would all affect the character of waste management system which is feasible and appropriate.

2.5.2. *Socio-Cultural Context*

What have cultural values got to do with waste management? Values are integral to determining the criteria, options, objectives outcomes and technological solutions for waste management system. Values also determine and maintain the management structures and processes by which those decisions are made. Thus in general, it needs to be recognized that the people's attitude and patterns of waste handling influence the functioning of an effective waste management system. The functioning, effectiveness and sustainability of waste management will therefore depend on people's identification with the system. It is therefore imperative that people are involved from the outset in the planning of the segments of the intended system. Community involvement is particularly important regarding the siting of facilities for waste management. Programmes to disseminate knowledge and skills, or to improve behaviour patterns and attitudes regarding waste management, must be based on people's social and cultural values. This will enhance people's ownership of the system.

2.5.3 *Economic development*

The level of economic development is a determinant of waste generation and the demand for management system services. It determines the volume and composition of wastes generated by residential and other users.

2.5.4 *Environmental factor*

The design of a waste management system must be adopted to the environmental conditions of the local area. For example, the level of the built environment would have an important influence on the character and waste management needs, just as the suitability of waste disposal site depend upon many environmental conditions.

2.6 **INTRODUCING WASTE – TO – WEALTH OPTION**

Waste – to – wealth is an organised means of enhancing the utilitarian values of wastes from different sources. The bottom line of this is economic returns from re-use or recycling activities. Whether organised or unorganised the essential outcome of waste recycling is the benefit of reducing demand for national resources and the amount of waste requiring final disposal CASSAD (2000). As evident in Table I, a number of useful products are obtainable from what is often regarded as waste.

What exist in the country now in various formats, intensities and Levels of organisation is recycling business carried out by informal sector such as scavengers. These scavengers or pickers move useable items from the dumps which they sell to member of the public or to few industries which have sprung. However, what the above option will introduce is a more organised system.

Evidence from cities like Cairo in Egypt, manila in the Philippines, has revealed that Industrial recycling of waste could be a profitable venture which must be supported and promoted by all levels of government and the development agencies in Africa.

Apart from achieving cleaner environment through effective recycling of wastes, waste recycling is a viable strategy for employment creation, income generation and poverty alleviation. In this respect, government through its various economic development programmes should give priority to private initiatives and proposals targeted at Industrial recycling of waste.

The Federal Government has given public encouragement to activities of scavengers through the National Directorate of Employment (NDE). The Directorate advised the pickers to form cooperative society so that they can enjoy loan package from NDE and for easy recovery of any loan disbursed to the members. The pickers now have a union

known as Raw Material Waste collection Association. It will thus be quite in place if Niger State Government and its Local Governments councils adopt the same.

Waste to Wealth Recycling and Reuse activities may be grouped into 3, Viz:

- i. Physical Sorting
- ii. Reprocessing Manufacturing
- iii. Biotechnological Conversions.

2.6.1 **Physical Sorting:**

As the name implies, this process involves sorting using the physical characteristics of the wastes, grouped into plastics, metallic, glass, textile, wooden and paper products, among others. Such products lend themselves to reuse after thorough cleaning and disinfection / disinfestation. This is usually based on materials separation at source. According UDBN (1995) study, Separation is mainly based on unique physical and chemical properties such as colour, density and texture (Table 3)

2.6.2 **Reprocessing Manufacturing:**

This involves the reshaping, melting and mixing by physical actions or in sophisticated cases by chemical mixing and recompounding. This involves some measure of technological

inputs, but which are certainly not beyond that achievable through "cottage Industry technology". Examples of these are aluminium pots, spoons and spatula manufactured through the melting of aluminium Industry tail wastes.

2.6.3 **Biotechnological Conversions:**

This process involves natural biodegradation processes with highly organic materials as the starters. There are two major classes of such biodegradation processes, viz;

Composting and Biogassification

In composting, crop wastes and residues, municipal solid wastes, and certain aquatic weeds are converted into organic fertilizers through microbial action. (Figures 1 & 2) In the biogas production, excreta from animals, and in some cases human faeces, sewage sludges are anaerobically converted into biogas, mainly methane.

The former is universally adopted, while the latter is widely used as intermediate technology in some developing countries. These products of biological/biochemical conversions and inter conversions are environmentally friendly in that they make for waste minimisation and maximisation of Local energy needs (Table 2) The process do not encourage massive environmental

pollution as normally found in the manufacture of mineral fertilizers. They also prevent stench that emanates from putrefaction of animal dung piles and raw sewage discharge. See flow chart for the processing of wastes into organic fertilizer.

2.6.4 **PLASTICS:** Plastic Industries are probably the most active in organised. Level of recycling. There are hundreds of small and medium sized recyclers in Nigeria's urban centres. There are as many as 200 in Lagos and Ibadan put together. Examples are MAPO plastic Industry in Ibadan and SPAO Recyclers Nig. Ltd. Ibadan (plates 9, 10 & 11)

2.6.5 **METALS:** The most famous metal scrap Industries are the aluminium pot manufacturers at Shaki, Lagos. Here, after sorting they manufacture a wide variety of aluminium products like pots, fry pans, motorcycle parts etc.(Plates 12 & 13)

2.6.6 **Public Awareness Campaigns:**

This will reduce waste generation and promote recycling and reuse; some of the effective methods are, use of traditional and modern community communication channels; targeting the younger groups who are prone to changing life styles; mass media, and through the organization of workshops and meetings at neighbourhood levels. These campaigns should take place at

the beginning of a scheme and throughout the project period; the components should include education and information; local politicians and policy makers should also be involved in these programmes; government. NGOs, and educational institutions may be the facilitators. Clear roles must be given to National Ministries of Education and Information. The former is to ensure the introduction or reinvigoration of curriculum on the environment, with emphasis on waste management. Such curricula should be able to draw far-reaching inputs from the information generated by the proposed Workshop. The Ministries/Departments of Information have to utilize the facilities of Radio or Television to mount strong awareness campaigns, supported with pamphlets, posters and handbills. Such campaigns must be carried to the community level, including health/maternity centres.

2.6.7 Strategies for Community Participation:

Community participation will promote waste separation and effective collection. Participation can be achieved through workshops and neighbourhood communication sessions. Financial incentives may also encourage better participation. When community participation, is mentioned, many questions are always

raised: "who should participate" What is expected of them? To what extent should they contribute? All these questions are very pertinent and each should be answered within the socio-economic circumstances prevailing in the respective target community. In promoting community participation, the following should be borne in mind: support should be obtained from the formal waste management authority; people should be involved right from the beginning stage; one of the outcomes is establishment of "Neighbourhood Associations", general education level should be high to achieve separation of wastes; community participation can only be achieved through creation of understanding and appreciation; and community participation should be initiated at various neighbourhood levels, but always co-ordinated under the auspices of local authorities. In low-income areas, separation of waste on a household level is very profitable. Door-to-door collection of useable materials can be organized, or, alternatively, households can bring their collected paper, glass and plastic bottles to the transfer depots where dealers might have their shops or market stands.

Without any doubt, increased cooperation and participation by the citizenry at large will have the following impacts:

- Reduced capital and operational costs;
- Adoption of appropriate (small scale) technology;
- Reduction in the levels of unemployment in the communities;
- Reduction in the quality of waste to be transported and disposed of through thorough sorting and recycling;
- Protection of the environment through prevention of flooding and air pollution;
- Enhanced values for properties;
- Increased cleanliness and a generally improved level of sanitation and health in the cities.

To take maximum advantage of these benefits, the following are worthy of close attention:

- Need for enhanced education on sanitation and solid waste management among the people, through undertakings by the State and Local Governments.
- Need for increased level of consultation, to obtain the people's inputs into the various plans and projects concerned with environmental management; that is a definitive process of *consensus-building*, culminating in the inclusion of notable citizens and community leaders in the Boards of Waste management Authorities.
- Need for a renewed orientation of the judicial officers for the improvement in the legal and policy framework. Consequently, the

Judiciary and the Bar should be appropriately educated on the benefits of environmental management through the promotion of recycling, as well as anti-degradation philosophy in judicial pronouncements, including commensurate sanctions and penalties.

2.6.8 Training and promotion

Transfer of local know-how will be an important component of these programmes. Training should include recycling techniques, organization, marketing, communication and health aspects. There is a general lack of information for those who operate or initiate small-scale waste recycling industries. Therefore, there is a need to provide more information. The success of recycling depends on marketability of the products as people have bias for products from virgin materials. Change in behaviour is effective only when services are adequately provided and in this context the local authority should play a major role. Training and promotion should lead to action plans. The required inputs for these activities are facilities for pilot projects, long term assistance, short – term assistance and financial support.

All stakeholders in waste management must undergo training at all times both formal and informal training .

fortunately, there are a good number of NGOs that have acquired the capabilities of mounting capacity building projects.

2.6.9 **Health, Safety & Preventive Measures:**

Advantages of scavenging are:

- (i) it provides a decent livelihood for scavengers through money realized from the sale of the salvaged items.
- (ii) it reduces the volume of solid waste to be disposed.
- (iii) it reduces the cost of collection and disposal of solid wastes.
- (iv) it sustains some industries which use salvages items as raw materials.
- (v) it produces jobs to the unemployed youths.
- (vi) it gives room for the establishment of sophisticated recycling plants.

However, scavenging has some detrimental effects on the health of the people as they suffer from:

- (i) eye irritation,
- (ii) respiratory diseases such as coughing, sneezing, asthma etc.
- (iii) skin diseases especially scabies;
- (iv) headache (due to working in the sun) and backache (due to bending down most of the time).

Since scavengers help in the management of waste, government should come out to assist the group financially and otherwise.

- The scavengers should be trained on how to go about the business to maximize profit.
- They should be trained to use protective wear such as jungle boots, gloves, crash helmet and nose mask on site. This practice will prevent exposure to hazards. They may be asked to wear a uniform to distinguish them from lunatics and others so that their dignity can be enhanced.
- Basic health training (First Aid) should be given to them so as to take care of themselves in case of minor injury.

Solid wastes can come into direct or indirect contact with human beings at several stages of handling and processing. The groups at risk are: populations of unserved areas (especially school children), waste workers, workers in facilities that produce infectious and toxic material, people living close to disposal or recycle facilities, and people living in the dumping areas. Some of the common health hazard are:

- ❖ **Infections:** Skin and blood infections resulting from direct contact with waste from infected wounds, eye and respiratory infectious diseases resulting from exposure to infected dust, zoonoses resulting from bites by wild or stray animals feeding on wastes, and enteric infections transmitted by flies on wastes;

- ❖ **Chronic Disease:** Chronic respiratory disease, cancers resulting from exposures to dust and hazardous compounds; and
- ❖ **Accident:** Musculo-skeletal disorders, resulting from the handling of heavy containers; wounds infected from contact with sharp items; poisoning and chemical burns resulting from contact with small amount of hazardous chemical waste mixed with general wastes ; and burns and other injuries from occupational accidents at waste disposal sites, or from methane gas explosion at landfill sites.

2.7 **LOOKING AHEAD:** *Towards sustainable solid waste management in Suleja Local Government Area*

To achieve sustainable Waste Management in Suleja LGA, there must be a reliable and purposeful Master Plan as the policy driving tool with it associated "mechanistic gearing system". It is such a master plan that will define the philosophy, principles and practices of solid waste management to be adopted in the area. The master plan will cover, among others, the issues of:

- Background Goals and objectives
- Situation Analysis
- Intervention Strategies

- The BACKGROUND will encompass introduction; Environment setting and Existing Institutional Arrangements.
- THE SITUATION ANALYSIS will cover existing waste handling practices, Existing financing Arrangements, Waste Generation and Characterization.
- INTERVENTION STRATEGIES would contain strategic challenges, modalities for Waste Collection and transfer, waste transportation arrangements, waste disposal strategies, proposed institutional and legal arrangements, finance and Funding and Community Participation, and implementation guidelines.

2.7.1 Institutional Arrangement:

The Niger State government and Suleja LGA must be involved in the management of Waste in the Area. Conflicts in responsibilities of the two arms of government, and their political meddlesomeness must be stemmed for the management to succeed. The State government should:

- (1) Issue policy guidelines and establish environmental management standards to guide the local government
- (2) Establish standard Laboratory for monitoring environmental standards with a view to pollution abatement
- (3) Maintain Environmental data bank to aid broad environmental planning.

- (4) Offer technical assistance to Local Governments through training and manpower development programme for capacity building and institutional strengthening.
- (5) Provide environmental education to the public through public enlightenment campaigns.
- (6) Fund research in solid waste management.

While the Local Government will:

1. Establish and strengthen a waste management unit under the public Health Depart.
2. Enlist the services of the private sector in waste collection and disposal and provide an enabling environment and guarantee of security for their operation.
3. Prepare and implement a waste management plan suited to its specific needs, drawing experiences from the national and the state master plan.
4. Establish a consultation forum with members of the public where issues of public interest are to be discussed
5. Budget adequately for the solid waste management subsector of public health.
6. Provide environmental education and public enlightenment.

2.7.2 Funding And Financing Mechanism

The State and Local Governments must make new investments with due regards to institutional strengthening and capacity building towards sustainable waste management. Each of them must have to determine the management of new

investments with due regards to accurate projections of collection, cleaning, disposal and transfer processes in relation to projections of population and waste quantities.

2.7.3 Relevant Technology And Equipment Base:

For sustainable collection, transportation, disposal and recycle processing of Solid Waste, the LGA will need to address the issue of relevant (i.e Manageable) technology (in conjunction with the State Government). The need for local initiative in the manufacture of appropriate vehicles and equipment specific to Solid Waste management must be given due attention. The Designs should consider Labour rates, technical capacity, energy cost, various physical and socio-cultural factors typical of the L.G.A. Communities and settlements; and increasingly the market places. There are institutions, agencies and manufacturing companies in this country that are not only capable but have been producing different types of waste management equipment. What is now required is the political will and the financial commitment of the governments to encourage local production for the well known benefits as advocated by Adedipe (1997)

2.7.4 **Operation And Maintenance:**

Operation here relates to activities in the provision of transportation, while Maintenance refers to the set of activities and processes that ensure that the equipment base and associated inventory can be operated efficiently and cost effectively. The main objectives of operation and maintenance is to ensure that the vehicular and equipment stock provides long lasting benefits by minimising the total "out - of - service" during the useful life.

Equipment productivity must be maximised, supported by provision of regular replacement including expansion to cope with increased demand resulting from city growth. The use of obsolete and unserviceable equipment must be avoided to limit unbearable maintenance and repair costs. The process of standardization of equipment in the waste collection system must also be rationalize so as to reduce maintenance cost.

2.7.5 **Private Sector/Community Partnership:**

Since government alone can not, expectedly, bear the full burden of the financing of solid waste management, there must be alternative sources, particularly cost recovery from user charges, that is "Waste generator – pays – principle". This can only be successful if it is made a responsibility of the private sector. In

this principle, government will provide landfill site, equipment and infrastructure, while the private sector will manage through collection, disposal and recycling activities. The Nigerian study UDBN (1997) revealed that 58% of the respondents currently not paying user fees were willing to pay, thus buttressing the preparedness of viable private sector and community participation

2.7.6 **Mass Education And Public Enlightenment Drive:**

The importance of improving behaviour of the people for sustainable integrated waste management programme can not be overemphasized. The public should be sensitized and mobilized by way of well articulated publicity campaigns through the mass media (Radio, Television and print). This is aimed at enlightening the people about the dangers of polluted environment, efforts of government in securing a healthy environment and the duty of every responsible citizen in achieving a safe environment.

Posters, films, video clips and periodic educational pamphlets should be used extensively. Talks, lectures and film shows should be arranged for clubs, Youth organizations and schools

2.8 **Prospects For Intermediate Technology In Support Of Waste Management**

It has been revealed that there are competent public Sector design and production engineering agencies, which are able to engage in the fabrication of affordable equipment. See plates 15 – 33 for an array of products of some of these agencies.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 INTRODUCTION:

This chapter deals with the methods and procedures that were employed in this research work. The population and technique for data collection are also dealt with here.

The approaches resourceful to the research were used which include

- Thesis & Text review
- Questionnaires
- Personal observation
- Oral interviews.

2.3 THESIS & TEXTS REVIEW:

Existing literatures relevant to the research topic were reviewed. These formed the basis of the literature review on concept of waste generation, sources & types of wastes, problems of solid waste disposal and managing of solid waste disposal. The objective was to conduct an appraisal of policies participation and technique of waste management as a guide on the way forward, towards sustainable solid waste management.

3.2 QUESTIONNAIRES.

The research administered 210 questionnaires randomly to the LGA population in the three most affected district areas. (i.e. 70 per each district).

The population in this study comprises the residents of Hashimi, Magajiya and Bagama Districts Area. No restriction was made in the selection of the respondents, but care was taken to exclude the underage in the process. Those selected were literates and illiterates, Traders, housewives and civil servants, who provided the needed information.

The questionnaires were designed to elicit information from respondents to determine the public opinion with regards to the waste management in the LGA.

185 questionnaires were returned; out of these 15 were either not completed or were wrongly completed. The returned number represent 88% of the total administered questionnaires. The ones correctly returned (170) represent 81% of the total questionnaires. This is good enough for analysis. The returned questionnaires are presented and analysed in the next chapter.

3.3 ORAL INTERVIEW:

The researcher adopted this method to further elicit information from residents of refuse dump sites, passers by and those transacting business in close proximity to the dumping sites. 30 people were interviewed in all, and they supplied useful information which will be presented in the next chapter.

3.4 PERSONAL OBSERVATION

To complement the two approaches above, the researcher undertook visit to the sites of refuse storage and final disposal as identified by the LG officials charged with sanitation. Streams channels drainages, Bridges and culverts were inspected to determine the effect of refuse being dumped in them. Photographs of these sites were taken for documentation.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

4.0 INTRODUCTION:

This chapter deals with the presentation and analysis of Survey data. One of the measuring instruments used in this study is the questionnaire. Simple percentage

Table 4.1: Types of Waste Generated

RESPONSES	FREQUENCY	PERCENTAGE
Domestic	77	45.3%
Commercial	60	35.3%
Institutional	20	11.8%
Industrial	13	7.6%

Source: Computed from Survey data

The table above shows that the waste generated in the LGA is made up of 45.3% Domestic, 35.3% commercial, 11.8% institutional and 7.6% Industrial Waste.

The implication of the data collected is that with 45.3% and 35.3% responses respectively. Domestic wastes constitutes the bulk of the waste being generated in Suleja LGA, followed by commercial, while institutional and Industrial Wastes accounts for only 11.8% and 7.6% respectively. The data depicts Suleja as a low socio – economic area.

Table 4.2: Those responsible for refuse collection

RESPONSES	FREQUENCY	PERCENTAGE
Government agencies	95	55.9%
The Community	0	0%
Private organizations	0	0%
Have no idea	75	44.1%

Source: Computed from survey data

The table above shows that only 95 respondents representing 55.9% are aware that Government Agencies are responsible for collection of waste in the LGA. The remaining 75 respondents representing 44.1% have no idea of who collects and dispose waste in the LGA.

The 44.1% of respondents have no idea of those responsible for collection and disposal of waste in the LGA, is a clear indication of low level of Waste collection and disposal activities because government has monopolized the management of waste in the area.

Table 4.3: Frequency of refuse collection

RESPONSES	FREQUENCY	PERCENTAGE
Daily	0	0%
Once in a week	34	20%
Once in a month	51	30%
Twice in a month	25	14.7%
Never collected	60	35.3%

Source: Computed from survey data

The above table shows that all the respondents agreed that waste collection is not done on daily basis. 34 respondents representing 20% agreed that it is done once in a week, 51 respondents representing 30% agreed that it is done once in a month. 25 respondents representing 14.7% agreed that it is done twice in a month, while 60 respondents representing 35.3% are of the view that waste collection is non-existence in the LGA.

That 35.3% have agreed that waste collection and disposal has never been done, is a justification of the observation that the collection is grossly inadequate or inefficient. Waste is generated at a faster rate than what the authorities can properly managed or dispose of given the capacity they possess, this account for the amountains of refuse in the township as seen in Plate 2.

Table 4.4: The people are satisfied with present waste management

RESPONSES	FREQUENCY	PERCENTAGE
Yes	25	14.7%
No	145	85.3%
Undecided	0	0%

Source: Computed from survey data

The table above shows that 145 respondents representing 85.3% are of the view that Government is not doing enough in waste handling,

while the remaining 25 respondents, representing 14.7% hold contrary view: They believe that the LGC is doing its best to sanitize the LGA.

That 85.3% respondents shows dissatisfaction with the present waste collection and disposal system, and only 14.7% gave the government a pass make. This is a justification of the observation that government is not doing well in the collection storage and disposal of solid waste in Suleja LGA.

Table 4.5: The best way to improve waste management is through:

RESPONSES	FREQUENCY	PERCENTAGE
Community participation	53	31.2%
Private Sector participation	55	32.4%
Increase Government participation	62	36.4%

Source: Computed from survey data

The table above shows that 53 respondents representing 31.2% are in support of community participation in waste Management, 55 respondents, representing 32.4% are in support of private sector participation, while 62 respondents still favours governments continued handling of waste in the LGA.

Since 63.6% respondents have agreed that the private sector and the local communities should be involved in handling of waste in the LGA for better result. It shows lack of confidence in the present

government monopoly in waste management and need to break the monopoly for the good of the LGA.

Table 4.6: The people's preparedness to pay for refuse collection service.

RESPONSES	FREQUENCY	PERCENTAGE
Yes	110	64.7%
No	56	32.9%
Undecided	4	2.4%

Source: Computed from survey data

The table above shows that 110 respondents, representing 64.7% are willing to pay a token price for waste collection service; 56 respondents representing 32.9% are unwilling to pay anything for waste collection, while 4 respondents representing 2.4% are undecided.

That 64.7% respondents have agreed to pay small amount of money for waste collection service, indicates the people's general frustration. The known techniques of Waste Management have failed in the area, hence the need to grant license to interested private organisations that will be ready to render waste disposal services and that 32.9% objected the idea, shows lack of awareness on the implication of polluted environment on their lives

4.7 **ORAL INTERVIEWS:**

Thirty respondents were interviewed.

From personal interaction with correspondents, it was clear that most of the people in the LGA are ignorant of the effect of waste on their health and environment. Their major concern was the offensive odour the waste emits and blocking of Roads and Drainages.

All the respondents expressed dissatisfaction with the three strata of governments in the provision of basic social amenities and sanitizing the environment. 21 of the respondents recommended restoration of weekly sanitation exercise. 24 respondents were in support of government involving private sector in the handling of waste as is done in cities like Lagos and Kaduna etc. They believe that this will improve the sanitary condition of the LGA.

4.8 **PERSONAL OBSERVATION:**

The researcher undertook visit to the three most affected District Areas viz: Hashim, Magajiya and Bagama, for personal observation. The visit produced the photographs seen in the figures shown in this write up.

Heaps of refuse were seen in almost every part of the Suleja Town (Plate 2) left uncollected for a very long time, to the extent that they have almost overtaken some residential houses and if the trend is left

unchecked, the houses might be buried in the next two years. Polythene bags were the most offensive sight as they were seen littering every where in different colour, thus producing an ugly spectre of the Town.

Drainages were seen filled halfway with dumped refuse, (Plate 8) Some Bridges and Culverts were seen almost blocked by refuse (Plate 7) It is evident that if nothing is done fast, flood disaster is imminent in Suleja Town. It is a miracle that this has not occurred in the past.

Roll on Roll – off were seen left unused, in some places these have been taken over by lunatics as abode. (Plate 1).

The official waste dumping sites located in outskirts of the town were visited (Plate 5). The sites location are good but too close to the major Roads in Suleja.

From observation, it was evident that waste had not been dumped there since the beginning of this year. There weren't sign of fresh refuse in any of the sites visited. It was also clear, and this was collaborated by a LG official, that the waste disposed are not treated. They are just dumped in the open and left like that.

Other major contributors to the dirt in the LGA are the abandoned vehicles or scraps. They were seen constituting nuisance to the environment (Plate 6)

IMPLICATIONS OF THE STUDY

The study has identified the area as a Low socio-economic area. The Suleja LGC monopoly on waste handling has made the area vulnerable to pollution by Solid Wastes, since the wastes being generated is beyond the management capacity of the LG authority. There are sufficient evidences on the ground to prove that the LG authority alone can not effectively handle the waste management; the authority has practically failed in this regard. The implication here is that mountains of refuse will continue to rise unabated and if not properly managed, may constitute health hazard and also lead to impairment of the environment.

Untreated wastes may serve as breeding ground for disease vectors like flies. Leachate from decomposing and putrefying garbage could percolate into soil and nearby water sources. The resultant contamination of food, water and soil could be responsible for the transmission of many diseases like cholera.

Uncollected wastes will find their way into open drains which will become blocked, and thereby promote flooding and breeding of mosquitoes and hence malaria.

Uncollected wastes deposited beside highways will constitute obstacles to free traffic flow in the area.

The wastes if inappropriately disposed may cause smog and other form of air pollution when openly burned indiscriminately. This may cause or aggravate respiratory diseases like Asthma, bronchitis, sneezing, coughing etc.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

INTRODUCTION:

This chapter, which concluded this research work , summarizes the study and also deals with recommendations made to bring an improvement in waste management.

5.1 SUMMARY:

The waste management services in Suleja LGA can best be described as unreliable, ineffective and inefficient. This can be attributed to some inherent problems as outlined below;

There has been no coherent and comprehensive guideline for solid waste management at LG Level, although there are policies on environment and urban planning/development, these have not addressed the solid waste management issue in the kind of details and with the kind of specific policy instruments that will engender effectiveness and sustainability.

Low priority is accorded solid waste management in terms of budgetary and resource allocation. Government have not been providing adequate funds through annual budgets for service delivery.

There is no political will on the part of Government to charge fees for services rendered, yet it is obvious that the government agencies have been unable to put in place sustainable institution for solid waste management. The unwillingness of the people to pay for waste management in the past has been due to lack of satisfaction with, and confidence in, the services rendered by the public agencies.

There is lack of organised form of waste recycling to reduce waste load (except or plastics) and to create jobs opportunities for converting waste to useful products.

There is poor public sensitization about the deleterious effect of refuse accumulation and the inherent dangers of environmental pollution with grave public health implications.

5.2 **CONCLUSION:**

The evidence on the ground points to the fact that waste management authorities in Suleja LGA Lack the capacity to cope with the problem. They are generally incapable or unable to carry the burden of making the Area waste free. Waste management in the area has therefore remain an environmental problem that is becoming more complex on daily basis.

The current challenge therefore calls for all stakeholders (Government, private sector, civil society organizations and people) to

harmonize their activities to promote sustainable management of waste. A major reason for the current poor situation is the government inactiveness and insensitivity, poor method of waste management and Lack of adequate funding combined with breakdown of vehicles.

The issues raised in this research work are not exhaustive, but they identified a number of critical factors that need to be properly evaluated for meaningful progress in the area of waste management. The challenge before the L.G today is self-reliance and adaptation of existing technology to meet its needs. It need to develop and pursue strategies that it can sustain and use local resources to its advantage.

It is now obvious that government alone can not cope with the magnitude of waste being generated. All hands must be on deck, and the use of appropriate technology provides a good entry point. There is the need to tap the technological still of our engineers and technologists. There is also the need to use effectively the capability of the various technological institutions in our country.

5.3 **RECOMMENDATIONS**

The failure of government agencies to remedy the intractable problems of solid waste management calls for new innovative and pragmatic approaches that are realistic and sustainable. The strategic ways forward to sustainable waste management are:

A clear policy direction by way of developing solid waste 'Masterplan' should be drawn and policy makers must be well informed on environmental issues, so as to formulate appropriate policies that are relevant to the stage of development in the area.

Legal instruments at LG levels in consonance with provision of the constitution and ensuring by laws should be made to suit the circumstances in the LGA.

Enabling environment should be provided for private sector participation in waste management in the area.

Government should invest in the research for technical, social, political and economic aspects with a view to developing relevant equipment based on appropriate technology.

Provisions should be made for the involvement of NGOs, Community development Associations (CDA), traditional and Religious Leaders, in overall solid waste management, particularly in matters relating to Mass Education and public enlightenment.

The people must be well sensitized on the danger of polluted environment on their health, This will make them a useful partner in sustainable waste management.

Existing Industries discharging Waste should be identified and required to treat them before disposal or pay fine.

Government should make manufacturing Industries pay environmental clean-up tax.

Government should allocate special fund for environment clean ups in annual budget.

The Local Government should adopt waste-to-wealth option of waste management, to reduce the waste to be managed and enhance the utilitarian values of waste (i.e to generate some wealth out of waste) as part of overall poverty alleviation strategies of the state economy.

The Government must develop the political will to appreciate the grave consequences of its failure to implement the above recommendations, for the survival of mankind and his immediate environment.

REFERENCES

- Adedibu A. A. (1983)** Spatial pattern of Solid Waste generation in the third world countries. Environmental Monitoring Assessment Vol. 1. pp.239
- Adedibu A. A. (1985)** A Comparative Analysis Of Solid Waste Composition and generation in two cities of a Developing nations'. The Environmentalists Vol. 5 No. 2
- Adedibu A.A. (1987)** Measuring Waste Generation in Third World Cities; A case study of Ilorin, Nigeria. Environmental Monitoring and Assessment.
- Adedibu A. A. & Olekunle A. A. (1989)** Issues in the environmental Sanitation of Lagos State – Mainland. The Environmentalists Vol. 9 No. 2 pp 91 – 100.
- Mabogunje A. L. (1974)** 'Cities and Social order' An inaugural Lecture, University of Ibadan, Nigeria.
- Olokesusi F. (1994)** 'Impact of the ring road Solid Waste disposal facility in Ibadan NISER monograph series No. 3, in akinjide O. (1998) Current issues in Nigerian Environment. Davidson Press, University of Ibadan, Nigeria
- Cointreau – Levine S. (1994)** Private Sector Participation in Municipal Solid Waste Services in Developing Countries UNDP/UNCHS/world Bank.
- Mbaya Kankwendo (2000)** 'Sustainable Management of Solid Waste: Some critical issues. A keynote address in a Regional Workshop for waste management capacity building in Anglophone West Africa, Ibadan , 3 April 2000.
- CASSAD (2000)** Affordable Technology and Strategies for Waste Management in Africa: Lessons from Experience.

TABLE I RECYCLABLES AND THEIR USES FROM SOLID WASTES

WASTE	RECYCLABLE VALUE OR USE
Hair, Bristles, Wool, Feather	Brushes, Lanol, Fertilizer, Wigs, Blankets, Carpets, Fabrics and
Hoofs, Horns	Buttons, Combs, Hair pins, Novelties, Washers, Glue, Gelatin,
Bones	Buttons, Cutlery, Handles, Ornaments, Glue, Gelatin, Bone
Hides, Skins, Feet	Horse whips, Seats, Belts, Hand bags, Book binding, shoes
Intestines	Stockfeed, Surgical Ligature, Musical (Guitar) strings, Tennis
Blood	Firin foam, urified bovine albumin, Dried blood and blood
Ruminal contents, Excreta	Methane gas, Manure
Fats	Soap, Machine oil, Candles, Leather dressings
Glands and special organs	Pharmaceutical products (Inulin, Gall stones Corticosteroids) Corticosteroids
Aluminium	Soft Drink and beer cans, cutlery
Paper	Newspaper, Packaging materials, various types of recycled
Plastics (various types).	Bottles, milk jugs, pipes, thin film packing, battery cassings,
Glass	Various glass products, Decorative pieces
Ferrous metal	Tin cans, metal works
Non-ferrous metal	Aluminum, copper, lead, etc, various items
Yard wastes, organic wastes	Compost
Construction Wastes	Filling materials
Tires	Road paving, building, shoe soles
Batteris	Recycling for lead and reuse
Waste oil	Reuse after refining

Source: Sridhar and Onibokun, 1997

Biogas – Fact Sheet

- 1 Cattle head produces 10 Kg waste;
Biogas obtainable per animal/day: 3600 l or 13 ft³
- 1 Pig (50 Kg weighing) produces 2.25 Kg waste;
Biogas obtainable per animal is 180 litres or 6.3 ft³
- One chicken (app. 2Kg) produces 0.18 Kg waste;
Biogas obtainable per animal is 11.2 litres or 0.4ft³
- One human adult produces 0.4 Kg waste;
Biogas obtainable is 28 litres or 1.0 ft³

- 1 Kg of fresh animal wastes generate 0.05 m³ of gas
 - 1 m³ of biogas is equivalent to 2 Kg of fuel wood; 0.6 litres of kerosene; 0.5 litres of petrol; 0.4 litres of diesel
 - Cooking of 3 meals for 3 people
 - Running of 1 HP IC engine for 2 hrs
 - Running of 33 litre generator for 3 hrs;
 - 1.25 KW of electricity;
 - Lighting a gas lamp for 6 hrs or 6 lamps for 1 hr;
 - Illuminating 25 electric bulbs (40 W) for one hr, equivalent to a 60 W electric light burning for 6 to 7 hrs;
 - Driving a 3-tonne lorry for 2.8 hrs

- The weight of methane is roughly half of that of air;
- Approx. 1 m³ of digester space is occupied by 1000 Kg of animal manure and water;
- 1 m³ of waste materials yield 0.15 to 0.30 m³ of gas per day depending on climatic conditions and the type of the digester used;
- Digester volume should be at least 30 times the volume of daily feed rate; the feed may remain in the digester at least for 6 weeks;
- Gas consumption rates are for cooking: 0.25 – 0.42 m³ per person per day; lighting: 0.11 – 0.15 m³;
- The recommended detention time in days are: for countries like Nigeria 30 – 40 days; India 40 – 60 days; Europe etc. 60-90;
- Biogas has a calorific value of 4713 kcal/vol; effective heat available is 2828 Kcal/vol.

Culled from various sources: Professor M. K. C. Sridhar, University of Ibadan (1999)

Table 2: Adopted from CASSAD MONOGRAPH SERIES NO. 13.

METHOD	POTENTIAL MUNICIPAL SOLID WASTE APPLICATION
Magnetic Separation Inertial Separation Ballistic Secator Inclined Conveyor	Magnetic materials (iron) Difference in size, density, elastic properties (depending on type)
Eddy - Current Separation	Conductive non-magnetic materials (copper, aluminum, zinc)
Electrostatic Separation, Size Classification	Aluminum from glass; plastics, paper Preparation for further processing or rough cut
Air Classification Vertical Chute Horizontal Chute Vibrating Elutriator	Light material, such as paper, from heavier materials.
Gravity Separation	Glass from metals, paper from other materials, and other separations based on density difference.
Optical Sorting	Dirt from glass; separation of coloured glass.
Flotation	Air bubbles in liquid used to separate materials with differing affinities for air and fluids used.
Cryogenic Separation	Difference between materials in tendency to become brittle at low temperature (e.g. liquid nitrogen).

Source: UDBN, 1999
Table 3: Unit Process for Solid Waste Application.
Adopted from CASSAD MONOGRAPH SERIES NO. 13

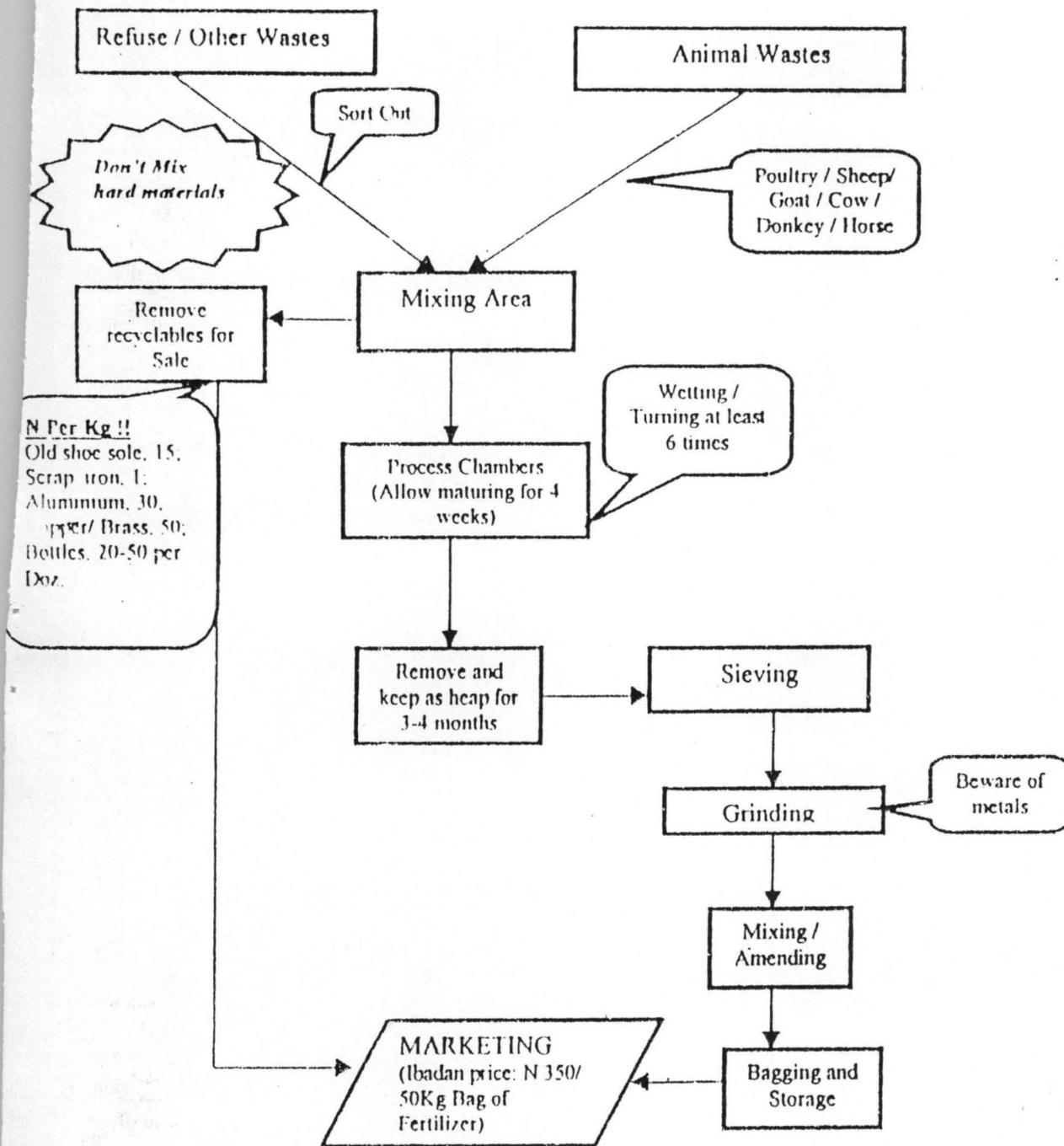


Figure 1: Flow sheet for the processing of wastes into organic fertilizer.
Adopted from CASSAN MONOGRAPH SERIES NO. 13.

RELATIVE BIOGAS PRODUCTION FROM DIFFERENT ORGANIC MATERIALS

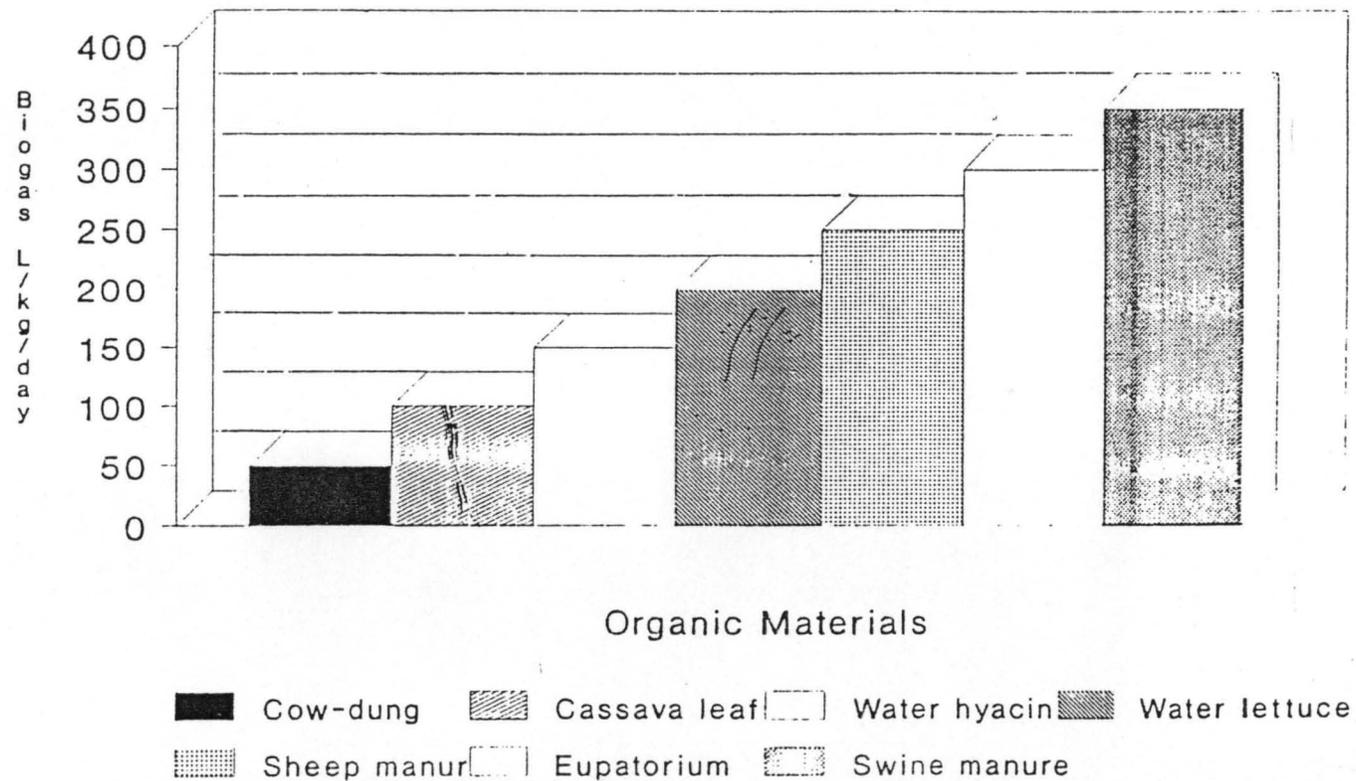
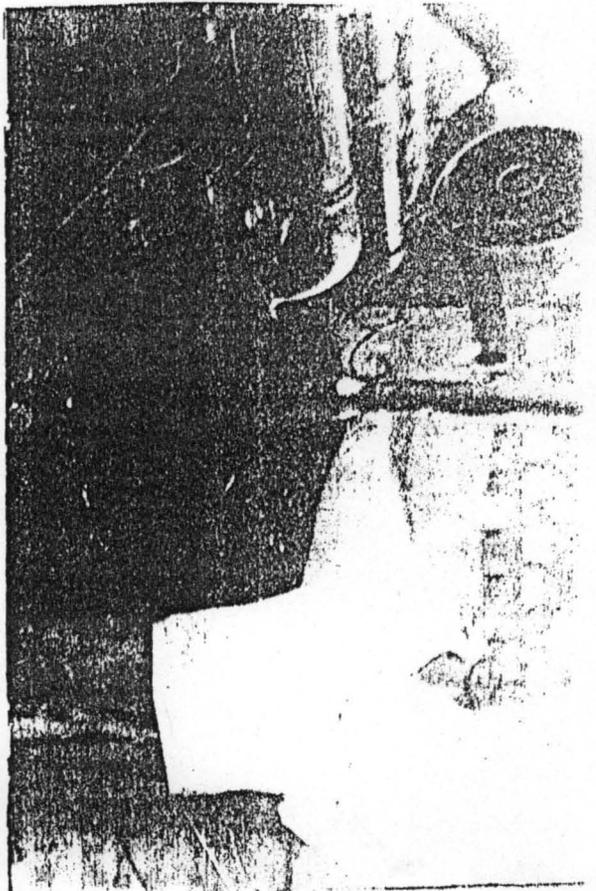
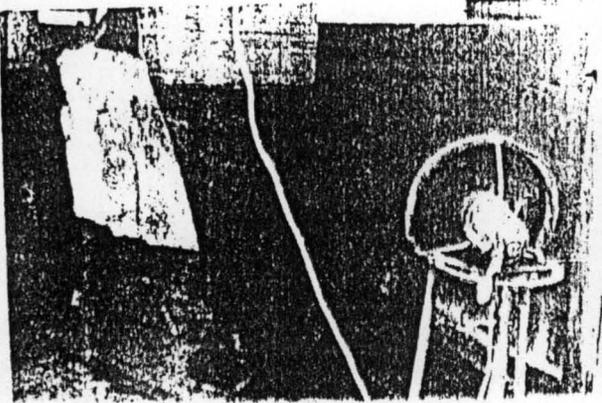
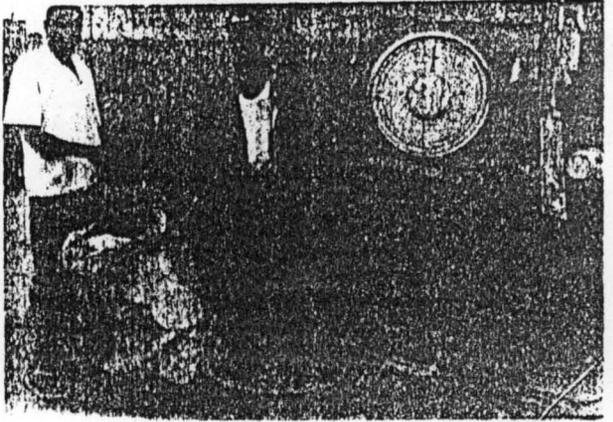
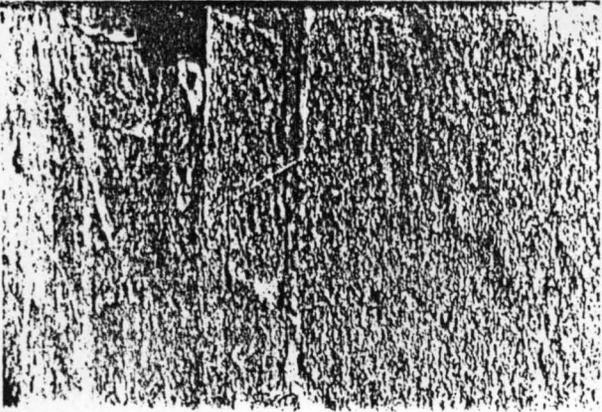
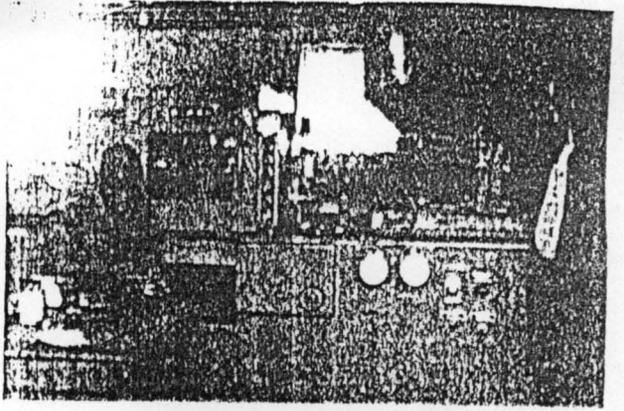


Figure 2: Adopted from CASSAD MONOGRAPH SERIES NO. 13



*Plate 10: A Plastic Scrap Industry with self fabricated machinery
(Proprietor in the background)*

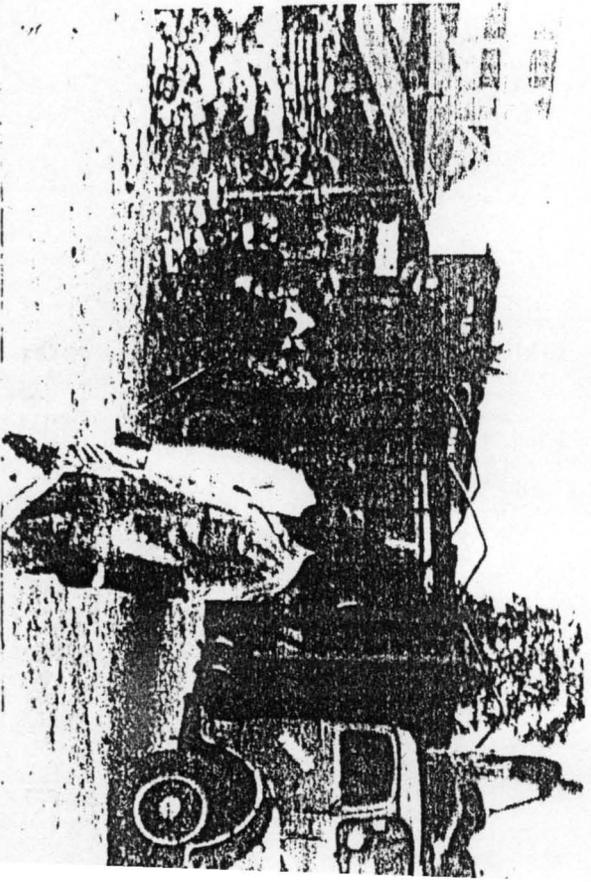


Plate 11: Scrap is being sorted and loaded into tippers

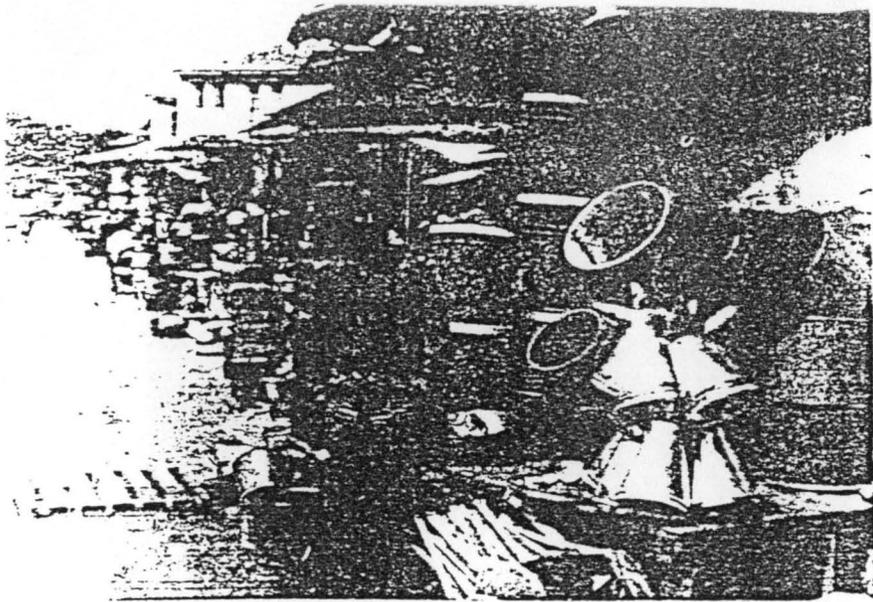


Plate 12



Plate 13: Some of the finished aluminum ware displayed in the market for sale



Plate 14: Biogas Plant at General Hospital, Osogbo, Nigeria

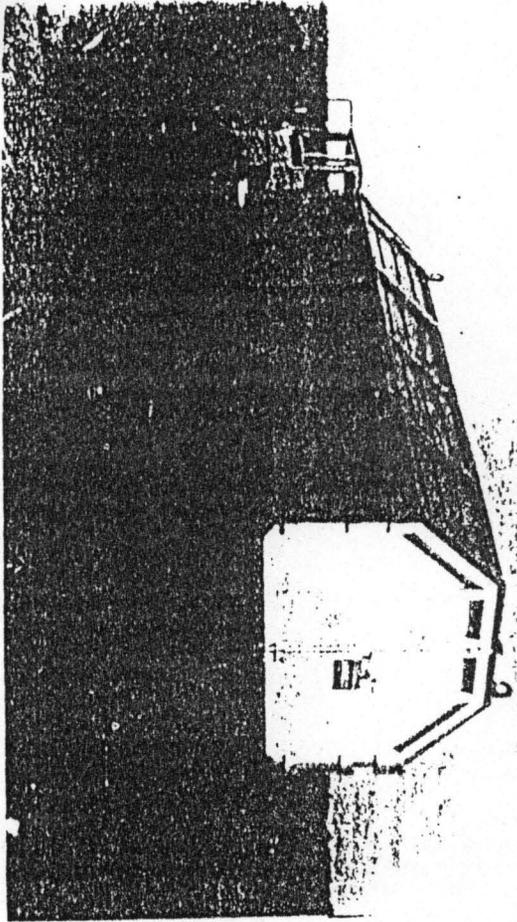


Plate 15: ARMECO Refuse Bin on Chassis

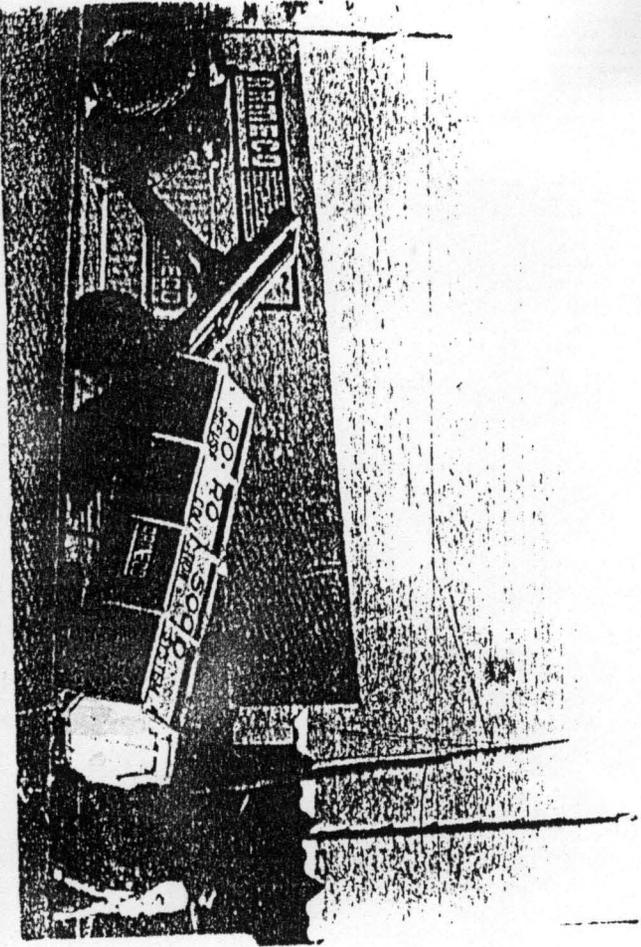
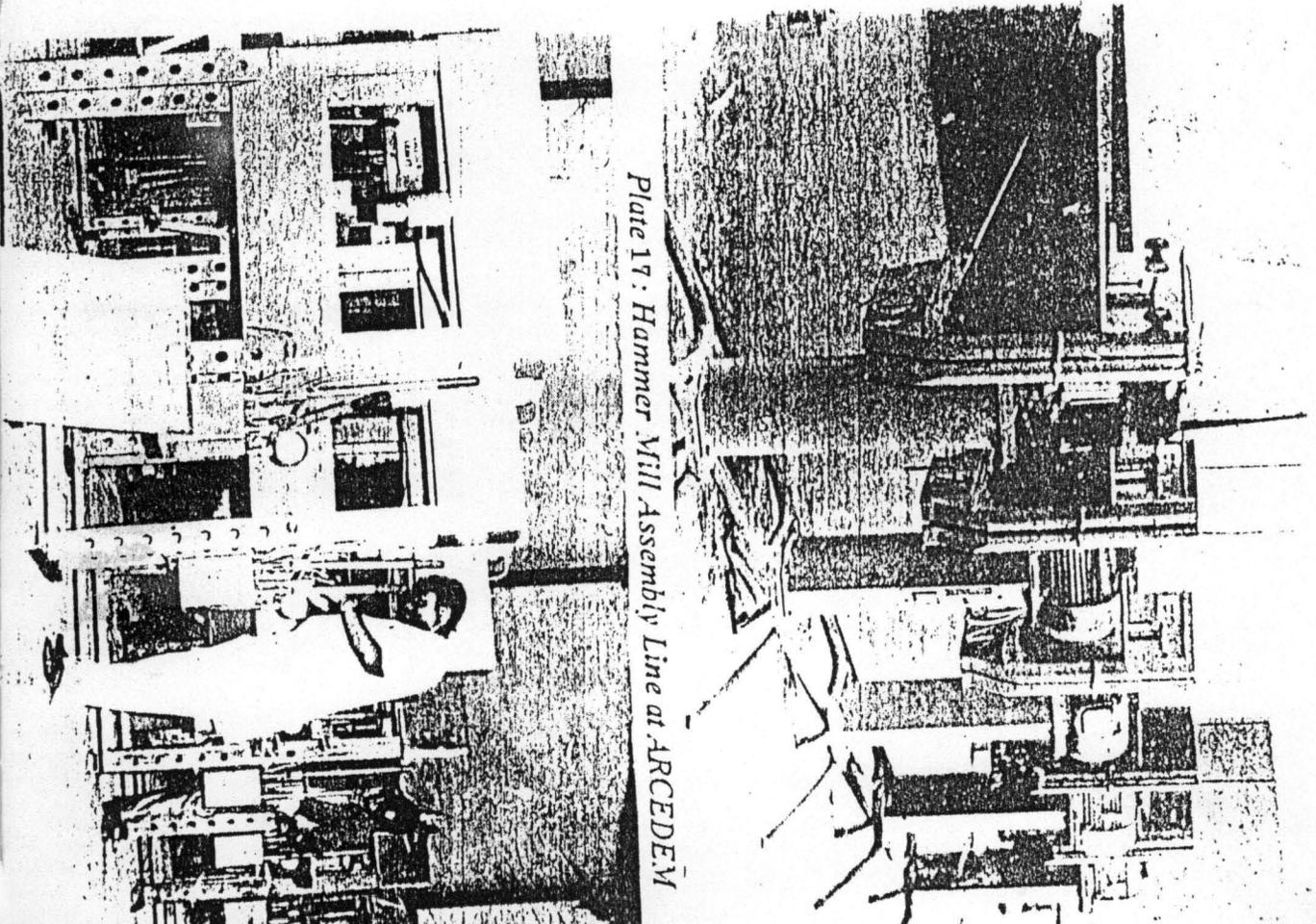


Plate 17: Hammer Mill Assembly Line at ARCEDEM



and for notching (both round and rectangular).

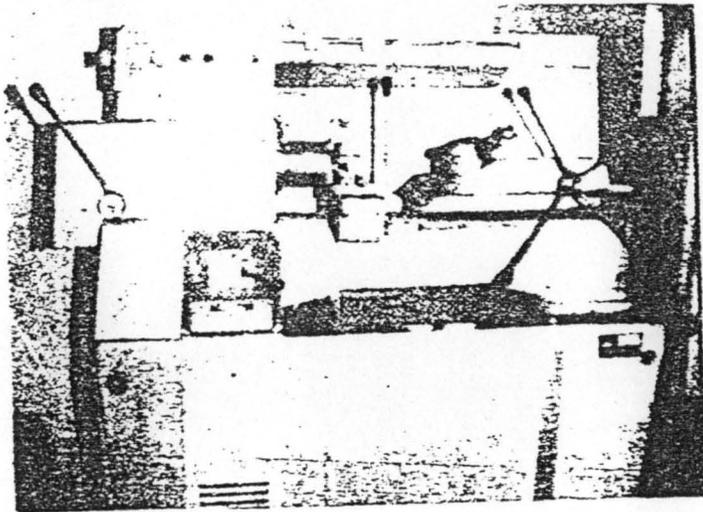


Plate 19 FIIRO Turret Lathe Machine

This is used for Turret Machining of Diameters specified above. It is a high-speed lathe machine.

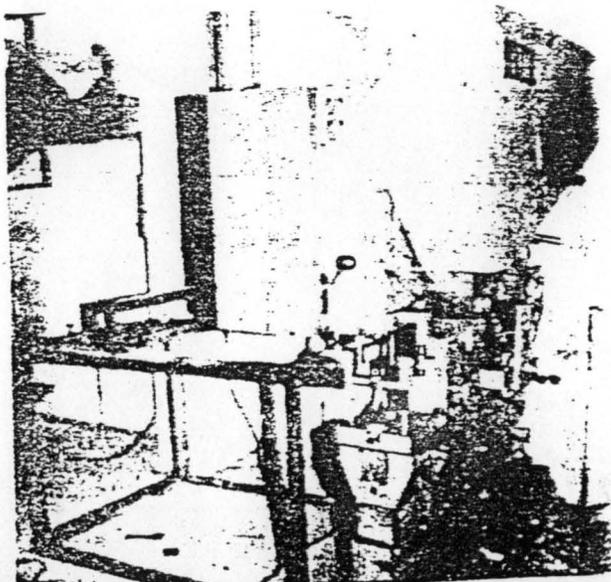


Plate 20: FIIRO Punching Cropping Shearing Machine

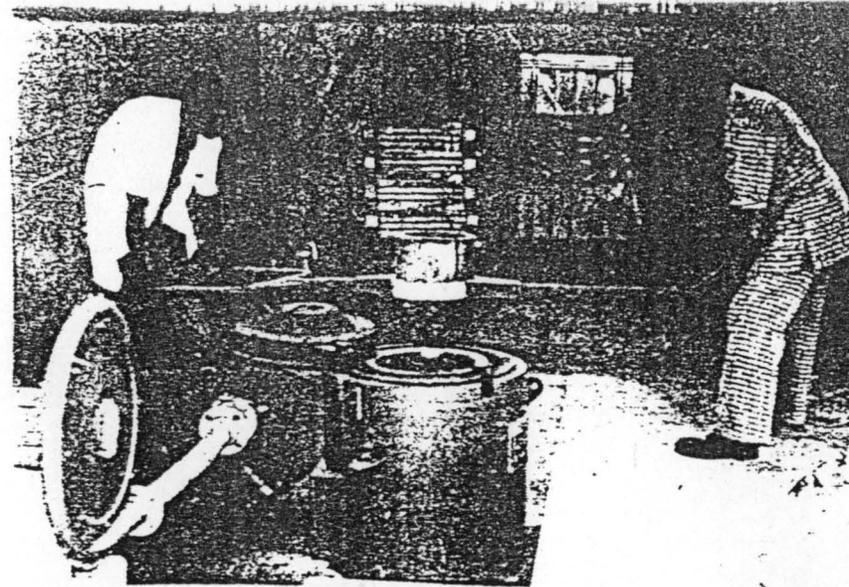


Plate 21 Nigerian Institute for Oil Palm Research (NIFOR) Benin. Furnace and Foundry Workshop

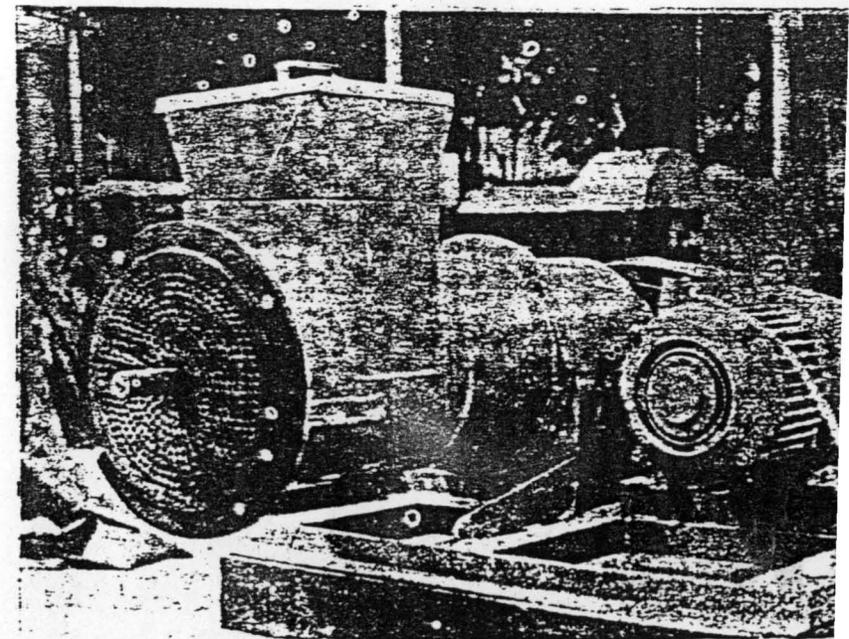


Plate 22 PRODA Palleting Machine

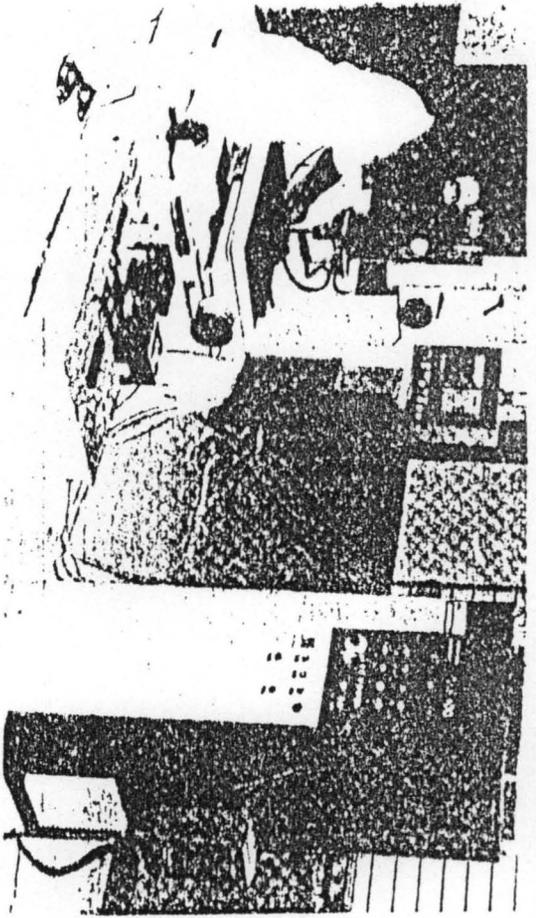


Plate 23: NC Electro-erosion

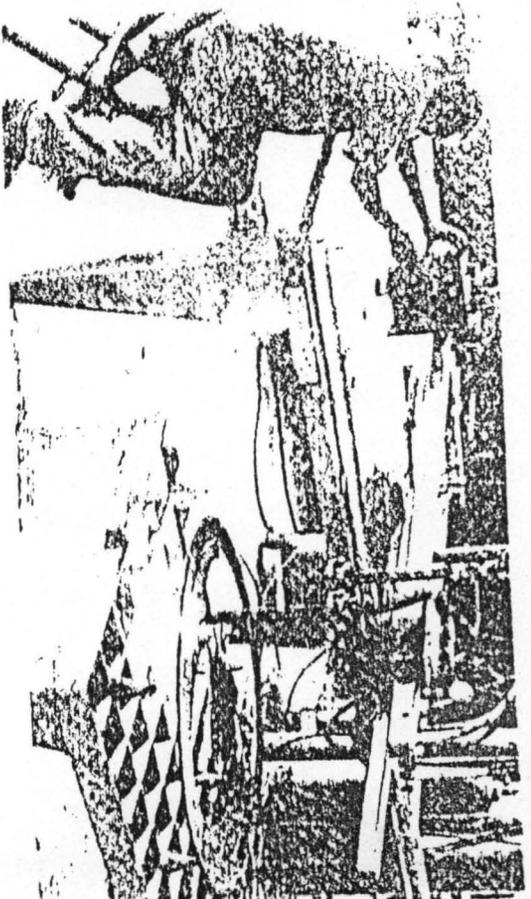


Plate 25: Automatic Plasma Cutting

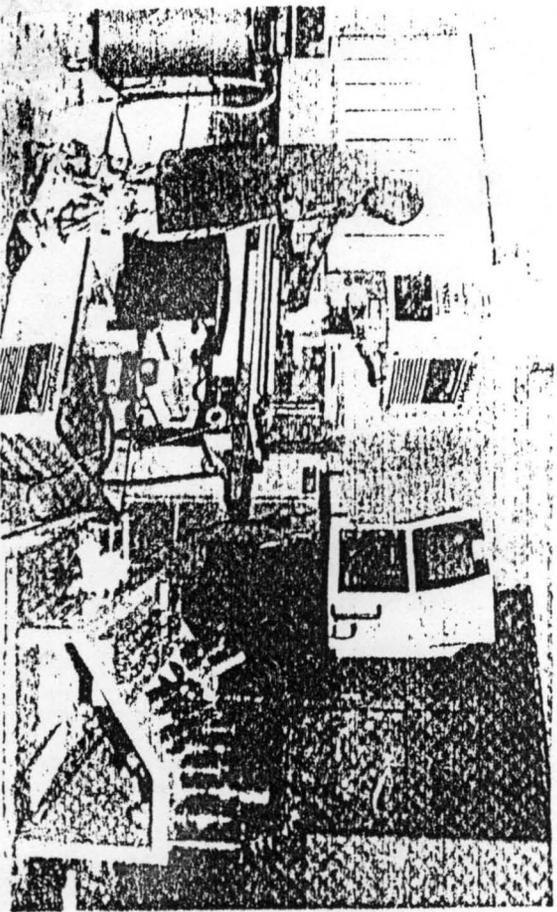


Plate 24: 3 Axis CNC Milling



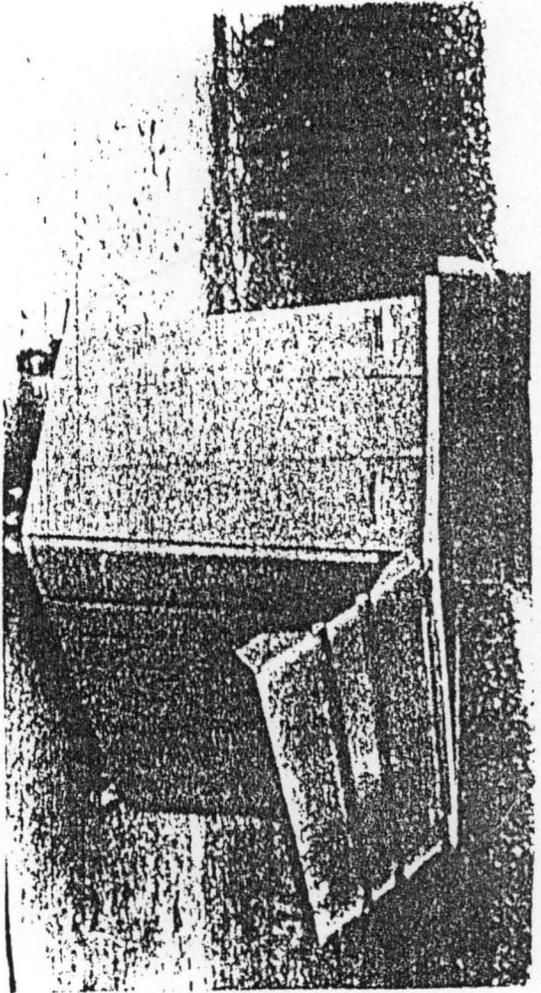


Plate 27: ARMECO Refuse Bin (Open)

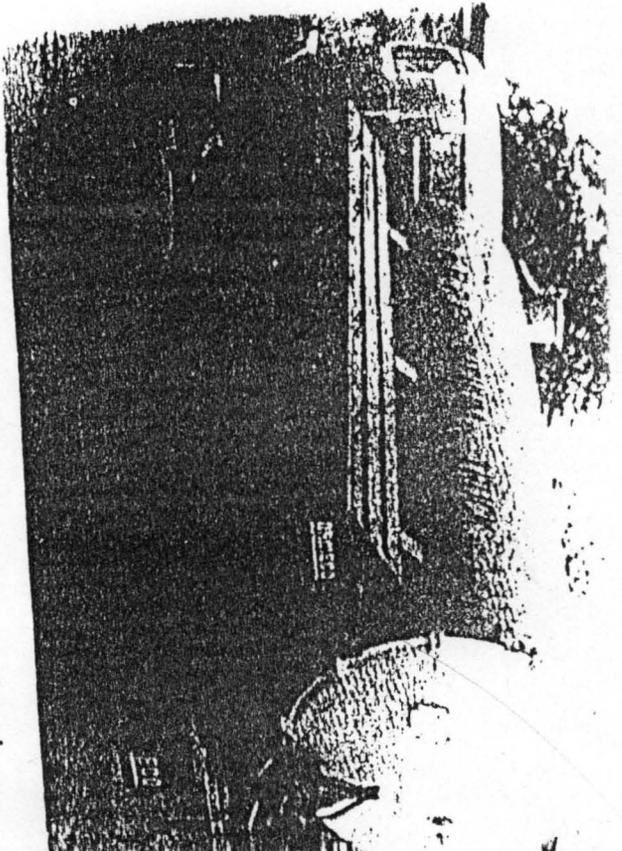
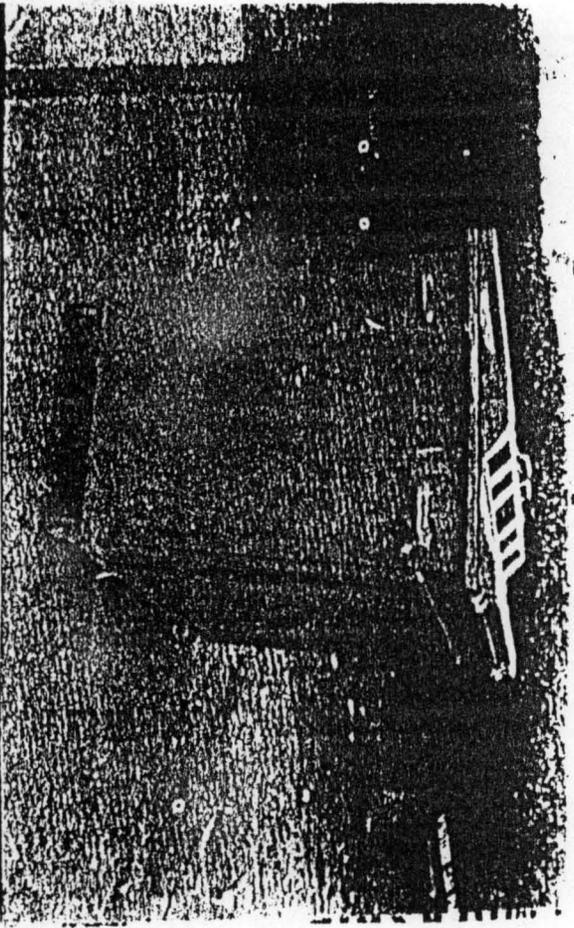
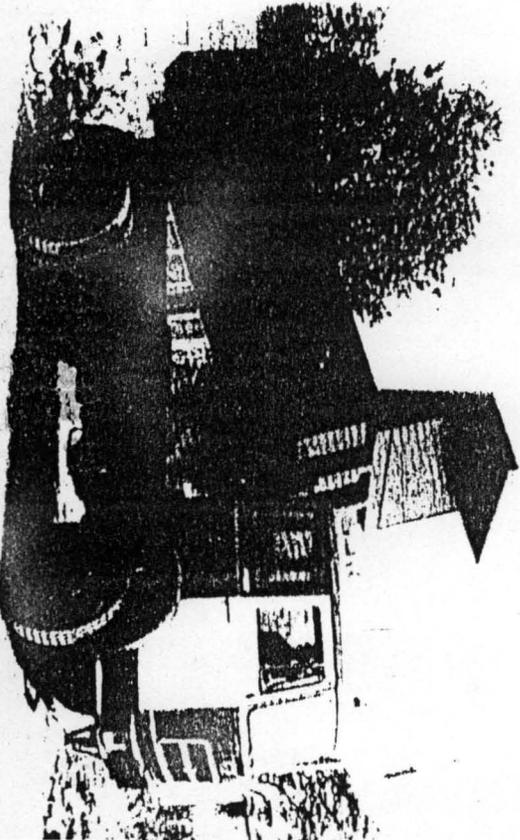


Plate 29: ARMECO Tanker Septic Emptier



ADDIS ENGINEERING, ISOLO, LAGOS

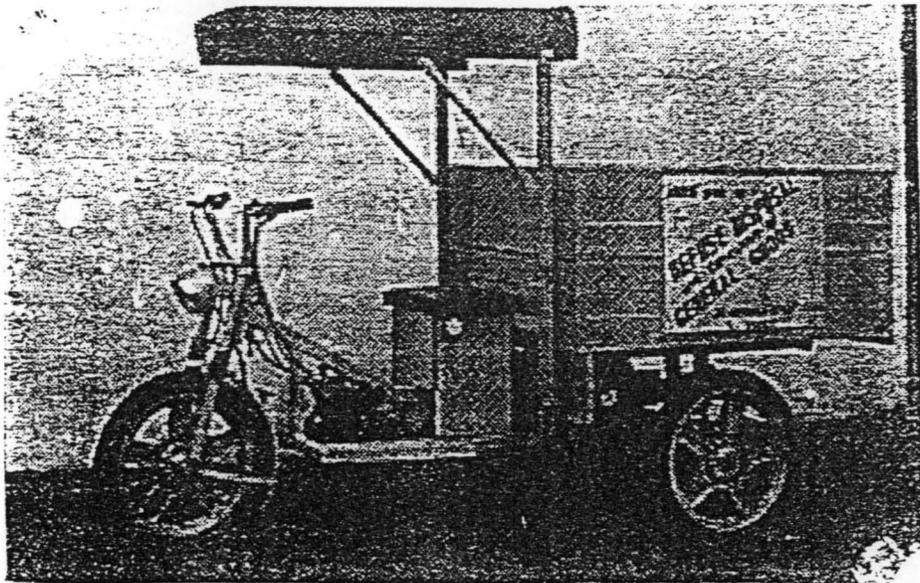


Plate 31: * Addis pick up

SOURCE: Adopted from CASSAD MONOGRAPH SERIES
NO. 13.

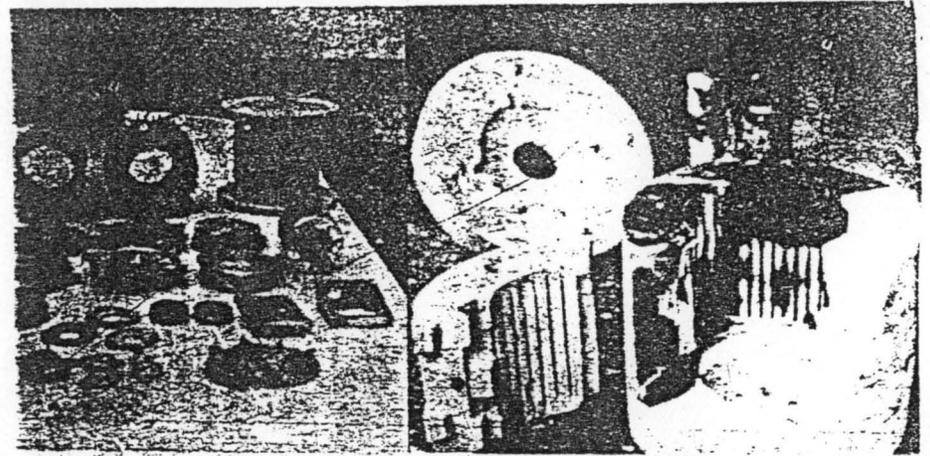


Plate 32: PRODA Lekon Electronic Motors

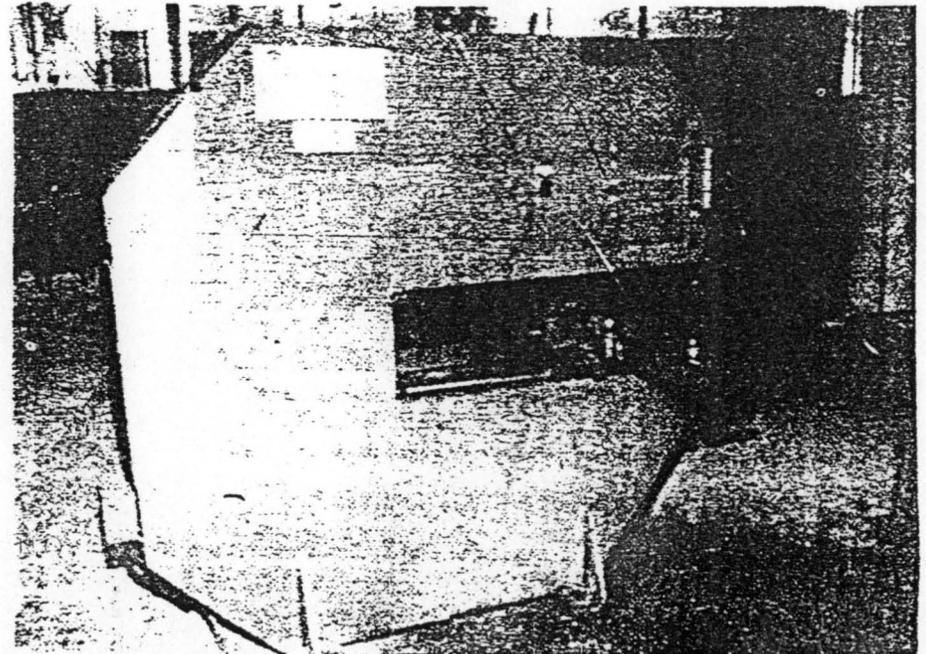


Plate 33: Oshodi (FIRO), Lagos - Universal Nibbling

1944
Plate

QUESTIONNAIRE

Federal University of Technology, School of Science and Science Education, Department of Geography, Minna, Niger State, Nigeria.

Note:

This questionnaire is designed to facilitate collection of information that will assist in ensuring a cleaner environment.

Any information given here shall be treated in strict confidence.

Thick the appropriate box to indicate your response.

1. Age (Years)
- | | | | |
|--------------|--------------------------|---------|--------------------------|
| 18 – 25 | <input type="checkbox"/> | 26 – 30 | <input type="checkbox"/> |
| 31 – 35 | <input type="checkbox"/> | 36 – 40 | <input type="checkbox"/> |
| 41 and above | <input type="checkbox"/> | | |

2. Sex:
- | | | | |
|------|--------------------------|--------|--------------------------|
| Male | <input type="checkbox"/> | Female | <input type="checkbox"/> |
|------|--------------------------|--------|--------------------------|

3. What is the most common type of waste (Refuse) being generated in your neighbourhood?

Domestic: (Kitchen waste, sweepings, leather, bones, ash, discarded furniture, garden waste, used appliances etc. }

Commercial: Markets wastes, packaging materials, waste from Restaurants, Ware houses, modern store and Hotels etc. }

- Industrial:** Wastes from manufacturing companies, Bakeries
- Institutional:** Waste from schools, government offices Hospitals, Religious buildings, etc.

4. Who is responsible for collection of waste from your neighbourhood?

Government Agencies The Community

Private Organizations No idea

5. How frequent is Wastes collected from your neighbourhood?

Daily Once in a week Once in a month

Twice in a month Never collected

6. Are you satisfied with the present manner of waste handling in Suleja L.G.A.?

Yes No Undecided

7. How best can the present Management be improved upon?

Community participation Private Sector participation

Increase government participation

8. Would you be willing to pay token price for waste collection service if the private sector is engaged for effective waste Management?

Yes No Undecided