Mendel University in Brno

Faculty of Regional Development and International Studies

THE EFFECTS OF IMPROPER SOLID WASTE MANAGEMENT IN GHANA.

Master Thesis

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Declaration

I hereby declare that I carried out this master thesis *"THE EFFECTS OF IMPROPER SOLID WASTE MANAGEMENT IN GHANA."* independently under the guidance of Ing. Alice Kozumplíková Ph.D., and only used sources and literature stated in the list of references. I agree that my work will be published in accordance with § 47b Act.No.111/1998 Coll. on Higher Education as amended thereafter and in accordance with valid *Directive of publishing university final thesis*.

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DEDICATION

To God Be the Glory

I dedicate this research work to my parents, siblings and all my loved ones especially Priscilla Osei for their support and prayer towards a successful completion of this work.

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ABSTRACT

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The study focuses on ensuring a hygienic environment in the Danko community in the Upper West Region of Ghana. It aims to look at the effect of improper management of solid waste. The study analysed the factors contributing to the effect of improper solid waste management in the community and also suggested measures that can possibly help to mitigate the problems. A combination of qualitative and quantitative methodological approaches was used in data collection and analysis. These methods include: questionnaire and interview. The findings revealed that, process of collecting waste was not on frequent base, transportation of solid waste was very challenging due to the bad nature to the road, waste management company collect waste only to landfill site, the environment is destroyed and investors are afraid to invest in the community.

The study concluded with recommendation that, there should be provision of adequate skips, regular collection of waste, adequate resourcing of the waste management institutions and sensitization campaigns to educate the people.

Key words:

Solid waste management, Danko community, health and environmental impact

ABSTRACT IN CZECH

Essuman, N. K. Efekty nesprávného nakládání s tuhým odpadem v Ghaně. Diplomová práce., Brno: MENDELU, 2015.

Diplomová práce se zabývá problematikou zajištění hygienicky bezpečného prostředí komunity Danko v Upper West regionu v Ghaně. Cílem práce je analyzovat způsob nakládání s tuhým odpadem. Jsou popsány faktory, které ovlivňují nakládání s pevným odpadem v regionu a jsou navržena opatření, která mohou pomoci ke zmírnění negativních dopadů nakládání s tuhým odpadem. K získání dat byly použity kvantitativní i kvalitativní metody - dotazník a rozhovory. Výsledky práce odhalily, že sběr tuhého odpadu na území regionu je nepravidelný, hromadný svoz odpadu je ztěžován špatnou kvalitou dopravní infrastruktury a odpady jsou ukládány pouze na skládky. Životní prostředí regionu je tak ohrožováno a místní komunita není dostatečně podporována. V závěru práce byla navržena doporučení, která by mohla přispět ke zlepšení stávajícího stavu a to zajistit regionu kvalitnější nakládání s tuhými odpady. Jedná se o zajištění pravidelného sběru a svozu odpadu, zajištění zdrojů ze strany příslušných institucí a zavádění vzdělávacích akcí pro obyvatele.

Key words: nakládání s tuhým odpadem, komunita Danko, zdravotní a environmentální dopady

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1. INTRODUCTION

Waste management has become a global issue which requires local and international intervention. In Africa, Ghana to be precise, government finds it very difficult to solve this problem alone which has called for the participation of the private sector and the contribution of individuals. Waste has many forms thus, solid and liquid which is generated by human activities and actions. Improper management of these wastes has the potential of causing health hazards. This turns to affect productivity and development of a country so therefore there is the need to invest in management of waste.

In Ghana, the problem of solid waste disposal is associated with indiscriminate dumping, increasingly difficulties with acquiring suitable disposal sites, difficulties with conveyance of solid waste by road due to worsening traffic problems and the lack of alternative transport options and the weak demand for composting as an option for waste treatment and disposal. The problem of waste management in Ghana is not only an engineering problem but rapid urbanization, poor financing capacity of local authority for planning and management of solid waste, weak enforcement of environmental regulations without any sanction have also contributed to this problem.

The disposal of solid waste has always been an intractable problem throughout Ghana. Landfills in Ghana are primarily open dumps without leachate. They are generally operated below the recommended standards of sanitary practice. It is estimated that throughout the country only about 10% of solid waste generated are properly disposed of. Based on an estimated population of 20 million and an average daily waste generation per capita of 0.45kg, Ghana generates annually about 3.0 million tons of solid waste daily. Almost all the collected quantities of waste in Ghana depend on “waste sink” function of the environment for assimilation. (Mensah, 2005)

1.1 Statement of the problem

Solid waste management is one of the essential services usually provided by metropolitan and municipal authorities in Ghana to keep the communities clean. However, the services rendered are mostly poor. Municipal laws governing the communities do not have adequate provisions to deal effectively with problem of solid waste management and its impact on the environment. The situation is getting more serious due to rapid urbanization.

Poor sanitation and municipal solid waste management has contributed to pollution and unsightly conditions in Ghana which is not affecting only the environment but the economic development as well. It is estimated that the average daily solid waste production is 0.45kg per capita per day. Accra for example, generates about 1500 tons of solid waste per day (Ghana landfill guidelines, July, 2002) of which only about 55% is collected and disposed. It is therefore common to find mountains of solid wastes uncollected for months especially in the urban areas which are causing harm to the environment.

The disposal of solid waste has become an alarming phenomenon in both rural and urban of Ghana but the problem is peculiar in densely populated areas with inadequate containers and trucks. This has increased the spread of infectious diseases such as cholera, malaria, diarrhea among others which goes a long way to affect nation.

This study will therefore look at the effect of improper solid waste management in Ghana focusing on Danko community in the Upper West Region.

1.2 Significance of the study

The study would provide an insight into the effect of improper solid waste management on health and environment. The study would help the waste management institutions to be conscious on the effect of improper solid waste management.

My findings would also serve as a baseline information on which policy makers can resort in designing course of action or inaction to improve solid waste management. The study would serve as a literature to any other future researcher, organizations and the government who might take up similar projects.

Finally, the study would be of help to me, as a researcher by means of broadening my scope of analyzing, understanding and evaluating the effect of improper solid waste management.

1.3 Scope and limitations of the study

Geographically, the research will cover Danko community in the Wa municipality in the Upper West Region of Ghana.

Scope

The study is focused on the effects of improper solid waste management on the environment and the health of people in Danko. This will include looking at the processes of collecting waste, how the waste are transported, the effect on the environment as well as the people and suggestions in addressing and improving of solid waste management related issues in the community.

Limitations

There were some limitations encountered during the research, literature on the topic was difficult to find especially within the local context. It was also difficult in meeting the target group for information since the research was conducted during the farming season. There was no fund to support me in this research.

Despite the above mentioned limitations, there were some measures that were used to overcome them. A lot of time and money were spent during the research. I managed to meet the respondents before they leave for farm.

1.4 Organization of the study

This research constitutes the following chapters; chapter one constitutes General introduction, problem statement, significant of the study, scope and limitations of the study, among others. Chapter two constitute main aim and motivation, Chapter three constitute Literature Review, Chapter four constitute Profile of the study area, Chapter five constitute Research methodology, chapter six constitute Result , Chapter six constitute Discussion, Chapter seven constitute findings, Recommendation and Conclusion and chapter eight which is the final chapter constitute references.

2. MAIN AIM AND MOTIVATION

Main aim

The aim of this study is to look at the effect of improper management of solid waste in Danko community in the Upper West Region of Ghana.

Partially aim

- To examine the process of collecting waste.
- To examine transportation of waste.
- To examine sorting and processing of waste.
- To assess the effect of solid waste on the environment.
- To assess the effect of solid waste on the society.
- To assess the effect of solid waste on the economy.

Motivation

The activities of human as well as animal generate different kinds of waste which affect our health and the environment. The type of waste which is mostly generated is solid waste, and is usually caused by population growth. It is one of the problems the world is facing today because our lands, water bodies and the air are polluted due to improper disposal of waste. When solid waste is allowed to accumulate, it creates unsanitary conditions that may lead to epidemic outbreaks such as cholera, diarrhea among others which usually causes loss of human lives. Also, when solid waste is improperly handled, it causes health hazards for the workers who come in direct contact with the waste.

If they are not properly treated, decomposition and putrefaction may take pace which will pollute the land and water bodies because the waste products will percolate down into the underground waters. During decomposition, the organic solid waste can generate obnoxious odors which have an impact on the environment. Looking at the effect of improper solid waste management, it has motivated me to analyse the collection, processes and disposal of solid waste.

3. LITERATURE REVIEW

This chapter provides review of literature on solid waste management. It looks at the key concepts, processes and problems of waste management. It also focuses on the impact of improper solid waste management on the environment as well as human health. This chapter will give a better understanding of solid waste management.

3.1 History of waste management

In ancient cities, wastes were thrown onto unpaved streets and roadways, where they were left to accumulate. It was not until 320 BCE in Athens that the first known law forbidding this practice was established. At that time a system for waste removal began to evolve in Greece and in the Greek-dominated cities of the eastern Mediterranean. In ancient Rome, property owners were responsible for cleaning the streets fronting their property. But organized waste collection was associated only with state-sponsored events such as parades. Disposal methods were very crude, involving open pits located just outside the city walls. As populations increased, efforts were made to transport waste farther out from the cities. (Nathanson, 2014)

After the fall of Rome, waste collection and municipal sanitation began a decline that lasted throughout the Middle Ages. Near the end of the 14th century, scavengers were given the task of carting waste to dumps outside city walls. But this was not the case in smaller towns, where most people still threw waste into the streets. It was not until 1714 that every city in England was required to have an official scavenger. Toward the end of the 18th century in America, municipal collection of garbage was begun in Boston, New York City, and Philadelphia. Waste disposal methods were still very crude, however. Garbage collected in Philadelphia, for example, was simply dumped into the Delaware River downstream from the city. (Nathanson, 2014)

A technological approach to solid-waste management began to develop in the latter part of the 19th century. Watertight garbage cans were first introduced in the United States, and sturdier vehicles were used to collect and transport wastes. A significant development in solid-waste treatment and disposal practices was marked by the construction of the first refuse incinerator in England in 1874. By the beginning of the 20th century, 15 percent of major American cities were

incinerating solid waste. Even then, however, most of the largest cities were still using primitive disposal methods such as open dumping on land or in water. (Nathanson, 2014)

Technological advances continued during the first half of the 20th century, including the development of garbage grinders, compaction trucks, and pneumatic collection systems. By mid-century, however, it had become evident that open dumping and improper incineration of solid waste were causing problems of pollution and jeopardizing public health. As a result, sanitary landfills were developed to replace the practice of open dumping and to reduce the reliance on waste incineration. In many countries waste was divided into two categories, hazardous and nonhazardous, and separate regulations were developed for their disposal. Landfills were designed and operated in a manner that minimized risks to public health and the environment. New refuse incinerators were designed to recover heat energy from the waste and were provided with extensive air pollution control devices to satisfy stringent standards of air quality. Modern solid-waste management plants in most developed countries now emphasize the practice of recycling and waste reduction at the source rather than incineration and land disposal. (Nathanson, 2014)

- Waste management in EU (http://ec.europa.eu/environment/waste/)

In Europe, we currently use 16 tonnes of material per person per year, of which 6 tonnes become waste. Although the management of that waste continues to improve in the EU, the European economy currently still loses a significant amount of potential 'secondary raw materials' such as metals, wood, glass, paper, plastics present waste streams. In 2010, total waste production in the EU amounted to 2.5 billion tons. From this total only a limited (albeit increasing) share (36%) was recycled, with the rest was landfilled or burned, of which some 600 million tons could be recycled or reused.

Just in terms of household waste alone, each person in Europe is currently producing, on average, half of tonne of such waste. Only 40 % of it is reused or recycled and in some countries more than 80% still goes to landfill (source: Environmental Data Centre on Waste, Eurostat).

Turning waste into a resource is one key to a circular economy. The objectives and targets set in European legislation have been key drivers to improve waste management, stimulate innovation

in recycling, limit the use of landfilling, and create incentives to change consumer behaviour. If we re-manufacture, reuse and recycle, and if one industry's waste becomes another's raw material, we can move to a more circular economy where waste is eliminated and resources are used in an efficient and sustainable way.

Improved waste management also helps to reduce health and environmental problems, reduce greenhouse gas emissions (directly by cutting emissions from landfills and indirectly by recycling materials which would otherwise be extracted and processed), and avoid negative impacts at local level such as landscape deterioration due to landfilling, local water and air pollution, as well as littering.

The European Union's approach to waste management is based on the "waste hierarchy" which sets the following priority order when shaping waste policy and managing waste at the operational level: prevention, (preparing for) reuse, recycling, recovery and, as the least preferred option, disposal (which includes landfilling and incineration without energy recovery).

In line with this the 7th Environment Action Programme sets the following priority objectives for waste policy in the EU:

- To reduce the amount of waste generated;
- To maximise recycling and re-use;
- To limit incineration to non-recyclable materials;
- To phase out landfilling to non-recyclable and non-recoverable waste;
- To ensure full implementation of the waste policy targets in all Member States.

3.2 Waste

Waste is more easily recognized than defined. Something can become waste when it is no longer useful to the owner or it is used and fails to fulfill its purpose (Gourlay, 1992 cited by Freduah, 2004). There are basically two types of waste namely liquid and solid waste. (Puopiel, 2010)

3.2.1 Solid waste

Solid waste is defined as any garbage, refuse, sludge from waste treatment plant, water supply treatment plant, or air pollution control facility and other materials, including solid, liquid, semisolid, contained gaseous resulting from industrials, commercials, mining and agricultural operations from community activities (Moeller, 2005). It is defined by the Ghana Innovation Market Place (2009) as neither wastewater discharges nor atmospheric emissions, arising from domestic, commercial, industrial, and institutional activities in an urban area. According to Tchobanoglous *et al* 1993, it is any material that arises from human and animal activities that are normally discarded as useless or unwanted. Furthermore, Zerbock (2003) also defined solid waste to include non-hazardous industrial, commercial and domestic waste including household organic trash, street sweepings, and institutional garbage and construction wastes.

Solid waste can therefore be said that, it is any products in solid state that is useless or unwanted which is generated from the activities of and discarded by society.

3.3 Sources and types of solid waste

According to Tchobanoglous *et al* (1993), solid waste is classified into types in terms of sources and generation facilities, activities or locations. The table below shows where wastes are generated, typical location and types of solid waste. Food waste was seen to be generated in all sources of waste.

Table 1 sources and types of solid waste.

SOURCE	TYPICAL LOCATION	TYPES OF SOLID WASTE
Residential	Single-family and multifamily dwellings, low-medium, and high-rise apartments.	Food wastes, rubbish, ashes, special wastes
Commercial/Municipal	Stores, restaurants, markets, office buildings, hotels, motels, print shops, auto repair shops, medical facilities and institutions	Food wastes, rubbish, ashes, demolition and construction
Industrial	Construction, fabrication, light and heavy manufacturing, refineries, chemical plants, lumbering, mining, demolition	Food wastes, rubbish, ashes, demolition and construction wastes, special wastes, occasionally hazardous wastes
Open areas	Streets, alleys, parks, vacant plots, playgrounds, beaches, highway and recreational areas.	Special wastes, rubbish
Treatment plant site	Water, wastes water, and industrial treatment processes.	Treatment plant wastes, principally composed of residual sludge
Agricultural	Field and row crops, orchards, vineyards, dairies, feedlots and farms	Spoiled food wastes, agricultural wastes, rubbish, hazardous wastes

Source: Tchobanoglous et al 1993 p.52-53.

Tchobanoglous et al (1993) has further explained the types of solid waste which include food waste, rubbish, ashes and residues and special waste. These are explained below. (Puopiel, 2010)

Food waste: Food wastes are all the animal, plant or vegetable residues resulting from the handling, preparation, cooking, and eating of foods (also called garbage). The most important characteristics of these waste is that they are highly putrescible and will decompose rapidly, especially in warm weather.

Often decomposition will lead to the development of offensive odours. In many locations, the putrescible nature of these waters will significantly influence the design and operations of solid waste collection.

Rubbish: Rubbish consists of combustible and non- combustible solid wastes of households, institutions and commercial activities. This excludes food wastes or other highly putrescible materials. Typically, combustible rubbish consists of materials such as paper, cardboard, plastics, textiles, rubber, leather, wood, furniture, and garden trimmings. Non-combustible rubbish consists of glass, tin cans, aluminium cans, ferrous and other non-ferrous metals, and dirt.

Ashes and Residues: These are materials remaining from the burning of wood, coal, coke and other combustible wastes in homes, stores, institutions, and industrial and municipal facilities for purposes of heating, cooking and disposing of combustible wastes. These are referred to as ashes and residues.

Special waste: Special waste includes street sweepings, roadside litter, litter from municipal containers, catch-basin debris, dead animals and abandoned vehicles.

The Centre for Environment and Development (2003) has classified types of solid waste based on origin (food waste, rubbish, ashes, residues, demolition and construction, agriculture waste) based on characteristics (biodegradable and non-biodegradable), based on the risk potential (hazardous waste).

The Centre also enumerated sources of solid waste as residential, waste from shops, commercials establishment, hotels/restaurants/eating stalls, slaughter houses and others. This has confirmed the sources and types of solid waste outlined by Tchobanoglous *et al* (1993). Based on the types of solid waste enumerated by Tchobanoglous *et al* (1993) and the Centre for Environment and Development (2003), it can be said that types of solid waste include the following; food waste, rubbish, ashes and residues, demolition and construction, and agriculture waste. The sources of solid waste also include domestic, commercial and industrial.

3.4 Solid waste management

Solid waste management systems in developing countries must deal with many difficulties, including low technical experience and low financial resources which often cover only collection and transfer costs, leaving no resources for safe final disposal (Collivignarelli et al., 2004). According to Tchobanoglous et al (1993: 7), solid waste management is

".....that discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best

principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations and that is also responsive to public attitudes". .

Kumah (2007: 2) also defines solid waste management as "the administration of activities that provide for the collection, source separation, storage, transportation, transfer, processing, treatment, and disposal of waste".

For a healthy environment, there is the need for solid waste management by systematically controlling generation, collection, storage, transport, source separation, processing, treatment, recovery, and disposal of solid waste. The figure below show simplified process for solid waste management.

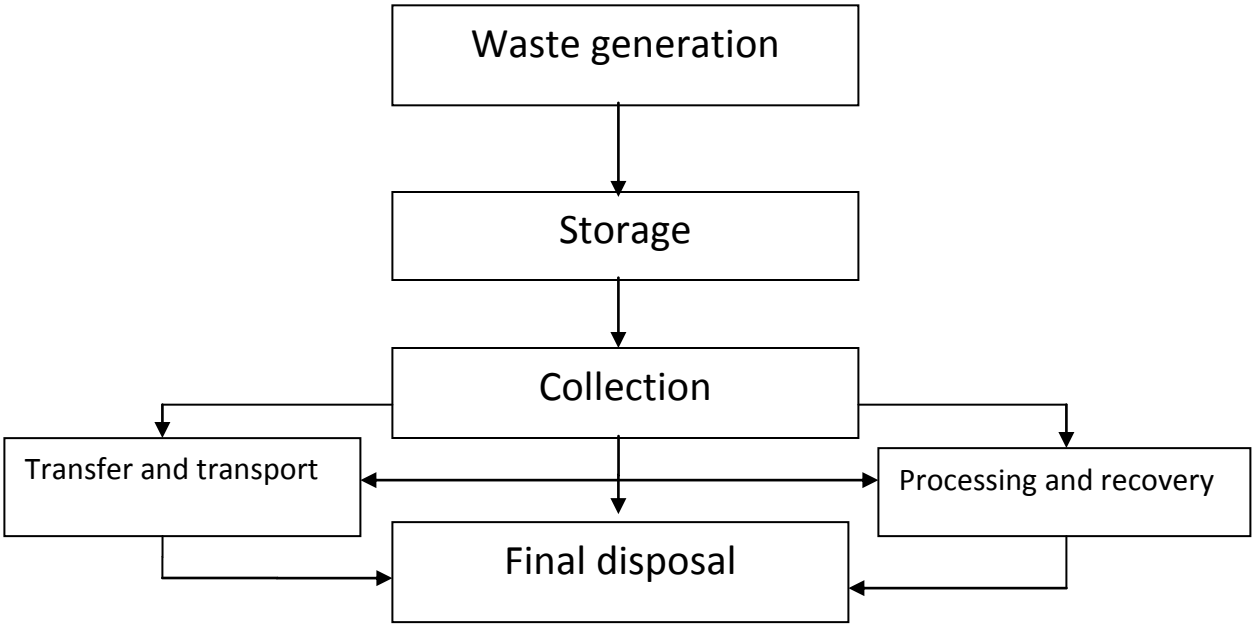

Figure 1 simplified process for solid waste management.

Source: Puopiel, 2010

3.5 Solid waste management process

For proper solid waste management system, there should be an effective control of the production of waste, its storage, collection, transportation, it's processing as well as proper disposal system. Waste should be disposed in a manner that will not have an effect on the environment and humans. According to Tchobanoglaus et al, 1993, managing solid waste must

be accomplished in an efficient and systematic manner hence the fundamental aspects and relationships accompanied with it need to be identified and tackled diligently.

3.5.1 Waste generation

According to United Nation Environment Programme (2009), in 2006 the total amount of municipal solid waste (MSW) generated globally reached 2.02 billion tones, representing a 7 per cent annual increase since 2003. They also indicated that solid waste generation is increasing at a faster rate globally. When comparing the less developed areas to the developed areas of higher income, the less developed area produce more waste.

3.5.2 Storage

According to Tchobanoglous *et al* (1977), storage means where solid waste is stored before it is collected. It could be stored in dustbins and not indiscriminately throwing it away. High income earners have proper containers for storing generated waste, the middle class can also be observed to have the same form of storage and the low income earners can be seen to observe the practice of storing solid waste in closed containers.

3.5.3 Collection

Collection of solid waste is a big problem for the waste management firms especially in Ghana. The process in collecting solid waste is not adequate and poses a higher risk of health impact to the society. According to the USPS (2000), in the city of Thimphu in Bhutan the collection of solid waste from households, commercial set-ups was done in concrete receptacles placed at strategic points and conveyed by trucks/tractors. In the populated area of Ghana, the containers usually full up early and when not collected by the waste management firms, the residents finds it very difficult to get a place to dump their waste which they turn to throw the waste on the ground near the container.

3.5.4 Transportation

According to Kreith (1994), transfer and transport involves two steps: (1) the transfer of wastes from the smaller collection vehicle to the larger transport equipment and (2) the subsequent transport of the wastes, usually over long distances to the final disposal site.

Sometime, transporting collected solid waste to a disposal site is a big problem in Ghana because of the poor nature of the roads. The vehicles for waste collection normally breaks down during the transfer of the collected solid waste and it take a longer time to be repaired and carried away. These waste cars pollute the environment since odour is being emitted from the collected waste even though they are helping solve sanitation problems.

3.5.5 Processing and recovery

The element of processing and recovery includes all the technology, equipment, and facilities used both to improve the efficiency of other functional elements and to recover usable materials, conversion products or energy from solid wastes (Tchobanoglous *et al*, 1977). The waste system in most developing countries are poorly managed which makes sorting of waste for further processing very difficult. Thus, wastes are not separated from the source.

3.5.6 Disposal

This is the final stage of generated waste. According to Tchobanoglous *et al* (1993: 17-18), the most commonly recognized methods for the final disposal of solid wastes were:

- dumping on land, canyons and mining pits
- dumping in water
- ploughing into the soil
- feeding to hogs
- reduction and incineration

In most towns and cities in developing countries, it is evident that waste are indiscriminately dumped opening on lands and in gutters. Those in the peri-urban and rural communities usually burn there waste. This practice causes air pollution and respiratory related diseases.

3.6 Solid-waste treatment and disposal

The following text in section 3.6 is reference to Nathanson, 2014.

Once collected, municipal solid waste may be treated in order to reduce the total volume and weight of material that requires final disposal. Treatment changes the form of the waste and makes it easier to handle. It can also serve to recover certain materials, as well as heat energy, for recycling or reuse.

Incineration

Burning is a very effective method of reducing the volume and weight of solid waste. In modern incinerators the waste is burned inside a properly designed furnace under very carefully controlled conditions. The combustible portion of the waste combines with oxygen, releasing mostly carbon dioxide, water vapour, and heat. Incineration can reduce the volume of uncompacted waste by more than 90 percent, leaving an inert residue of ash, glass, metal, and other solid materials called bottom ash. The gaseous by-products of incomplete combustion, along with finely divided particulate material called fly ash, are carried along in the incinerator airstream. Fly ash includes cinders, dust, and soot. In order to remove fly ash and gaseous by-products before they are exhausted into the atmosphere, modern incinerators must be equipped with extensive emission control devices. Such devices include fabric baghouse filters, acid gas scrubbers, and electrostatic precipitators. Bottom ash and fly ash are usually combined and disposed of in a landfill. If the ash is found to contain toxic metals, it must be managed as a hazardous waste.

Figure 2 incineration of waste

Source: www.chinaincinerator.net

Municipal solid-waste incinerators are designed to receive and burn a continuous supply of refuse. A deep refuse storage pit, or tipping area, provides enough space for about one day of waste storage. The refuse is lifted from the pit by a crane equipped with a bucket or grapple device. It is then deposited into a hopper and chute above the furnace and released onto a charging grate or stoker. The grate shakes and moves waste through the furnace, allowing air to circulate around the burning material. Modern incinerators are usually built with a rectangular furnace, although rotary kiln furnaces and vertical circular furnaces are available. Furnaces are constructed of refractory bricks that can withstand the high combustion temperatures.

Combustion in a furnace occurs in two stages: primary and secondary. In primary combustion, moisture is driven off, and the waste is ignited and volatilized. In secondary combustion, the remaining unburned gases and particulates are oxidized, eliminating odours and reducing the amount of fly ash in the exhaust. When the refuse is very moist, auxiliary gas or fuel oil is sometimes burned to start the primary combustion.

In order to provide enough oxygen for both primary and secondary combustion, air must be thoroughly mixed with the burning refuse. Air is supplied from openings beneath the grates or is admitted to the area above. The relative amounts of this underfire air and overfire air must be determined by the plant operator to achieve good combustion efficiency. A continuous flow of air can be maintained by a natural draft in a tall chimney or by mechanical forced-draft fans.

Composting

Another method of treating municipal solid waste is composting, a biological process in which the organic portion of refuse is allowed to decompose under carefully controlled conditions. Microbes metabolize the organic waste material and reduce its volume by as much as 50 percent. The stabilized product is called compost or humus. It resembles potting soil in texture and odour and may be used as a soil conditioner or mulch.

Figure 3 composting of waste

Source: www.edmonton.ca

Composting offers a method of processing and recycling both garbage and sewage sludge in one operation. As more stringent environmental rules and siting constraints limit the use of solid-waste incineration and landfill options, the application of composting is likely to increase. The steps involved in the process include sorting and separating, size reduction, and digestion of the refuse.

The decomposable materials in refuse are isolated from glass, metal, and other inorganic items through sorting and separating operations. These are carried out mechanically, using differences in such physical characteristics of the refuse as size, density, and magnetic properties. Shredding or pulverizing reduces the size of the waste articles, resulting in a uniform mass of material. It is accomplished with hammer mills and rotary shredders.

Pulverized waste is ready for composting either by the open windrow method or in an enclosed mechanical facility. Windrows are long, low mounds of refuse. They are turned or mixed every few days to provide air for the microbes digesting the organics. Depending on moisture conditions, it may take five to eight weeks for complete digestion of the waste. Because of the metabolic action of aerobic bacteria, temperatures in an active compost pile reach about 65 °C (150 °F), killing pathogenic organisms that may be in the waste material.

Open windrow composting requires relatively large land areas. Enclosed mechanical composting facilities can reduce land requirements by about 85 percent. Mechanical composting systems

employ one or more closed tanks or digesters equipped with rotating vanes that mix and aerate the shredded waste. Complete digestion of the waste takes about one week.

Digested compost must be processed before it can be used as a mulch or soil conditioner. Processing includes drying, screening, and granulating or pelletizing. These steps improve the market value of the compost, which is the most serious constraint to the success of composting as a waste management option. Agricultural demand for digested compost is usually low because of the high cost of transporting it and because of competition with inorganic chemical fertilizers.

Sanitary landfill

Land disposal is the most common management strategy for municipal solid waste. Refuse can be safely deposited in a sanitary landfill, a disposal site that is carefully selected, designed, constructed, and operated to protect the environment and public health.

Figure 4 sanitary landfill

Source: www.wasteline.wordpress.com

One of the most important factors relating to landfilling is that the buried waste never comes in contact with surface water or groundwater. Engineering design requirements include a minimum distance between the bottom of the landfill and the seasonally high groundwater table. Most new landfills are required to have an impermeable liner or barrier at the bottom, as well as a system of groundwater-monitoring wells. Completed landfill sections must be capped with an impermeable

cover to keep precipitation or surface runoff away from the buried waste. Bottom and cap liners may be made of flexible plastic membranes, layers of clay soil, or a combination of both.

Recycling

Separating, recovering, and reusing components of solid waste that may still have economic value is called recycling. One type of recycling is the recovery and reuse of heat energy, a practice discussed separately in Incineration. Composting can also be considered a recycling process, since it reclaims the organic parts of solid waste for reuse as mulch or soil conditioner. Still other waste materials have potential for reuse. These include paper, metal, glass, plastic, and rubber, and their recovery is discussed here.

Figure 5 recycling of waste

Source: www.dnr.mo.gov

Before any material can be recycled, it must be separated from the raw waste and sorted. Separation can be accomplished at the source of the waste or at a central processing facility. Source separation, also called curbside separation, is done by individual citizens who collect newspapers, bottles, cans, and garbage separately and place them at the curb for collection. Many communities allow "commingling" of nonpaper recyclables (glass, metal, and plastic). In either case, municipal collection of source-separated refuse is more expensive than ordinary refuse collection.

In lieu of source separation, recyclable materials can be separated from garbage at centralized mechanical processing plants. Experience has shown that the quality of recyclables recovered from such facilities is lowered by contamination with moist garbage and broken glass. The best practice, as now recognized, is to have citizens separate refuse into a limited number of categories, including newspaper; magazines and other wastepaper; commingled metals, glass, and plastics; and garbage and other nonrecyclables. The newspaper, other paper wastes, and commingled recyclables are collected separately from the other refuse and are processed at a centralized material recycling facility, or MRF (pronounced "murf" in waste-management jargon). A modern MRF can process about 300 tons of recyclable wastes per day.

At a typical MRF, commingled recyclables are loaded onto a conveyor. Steel cans ("tin" cans are actually steel with only a thin coating of tin) are removed by an electromagnetic separator, and the remaining material passes over a vibrating screen in order to remove broken glass. Next, the conveyor passes through an air classifier, which separates aluminum and plastic containers from heavier glass containers. Glass is manually sorted by colour, and aluminum cans are separated from plastics by an eddy-current separator, which repels the aluminum from the conveyor belt.

Recovered broken glass can be crushed and used in asphalt pavement. Colour-sorted glass is crushed and sold to glass manufacturers as cullet, an essential ingredient in glassmaking. Steel cans are baled and shipped to steel mills as scrap, and aluminum is baled or compacted for reuse by smelters. Aluminum is one of the smallest components of municipal solid waste, but it has the highest value as a recyclable material. Recycling of plastic is a challenge, mostly because of the many different polymeric materials used in its production. Mixed thermoplastics can be used only to make lower-quality products, such as "plastic lumber."

In the paper stream, old newspapers are sorted by hand on a conveyor belt in order to remove corrugated materials and mixed papers. They are then baled or loose-loaded into trailers for shipment to paper mills, where they are reused in the making of more newspaper. Mixed paper is separated from corrugated paper for sale to tissue mills. Although the processes of pulping, de-inking, and screening wastepaper are generally more expensive than making paper from virgin wood fibres, the market for recycled paper should improve as more processing plants are established.

Rubber is sometimes reclaimed from solid waste and shredded, reformed, and remolded in a process called revulcanization, but it is usually not as strong as the original material. Shredded rubber can be used as an additive in asphalt pavements, and discarded tires may be employed as swings and other recreational structures for use by children in "tire playgrounds." In general, the most difficult problem associated with the recycling of any solid-waste material is finding applications and suitable markets. Recycling by itself will not solve the growing problem of solid-waste management and disposal. There will always be some unusable and completely valueless solid residue requiring final disposal.

3.7 Problems of managing solid waste

According to Ogawa (2005), a typical solid waste management system in a developing country displays an array of problems, including low collection coverage and irregular collection services, crude open dumping and burning without air and water pollution control. He classified these challenges into technical, financial, institutional and social constraints.

3.7.1 Technical constraints

Technical knowledge on how to manage solid waste has been a problem in most developing countries. According to Ogawa (2005), there are inadequate human resources at the national and local level with technical expertise for the management of solid waste in most developing countries. The inadequacy of human resource with the technical expertise has made management of solid waste very difficult.

3.7.2 Financial constraints

According to Ogawa (2005), solid waste management in developing counties is given low, except the capital and large cities. Most government in developing countries provide limited funds to the solid waste management sector which makes the services required for protection of public health and the environment are not attained. They usually try to supplement the weak financial support from local government with user's service charge. The willingness to pay for the services by the users is also ineffective making solid waste management very challenging.

3.7.3 Institutional constraints

He points to the fact that, some agencies at the national level must involved at least partially in solid waste management but because there is no clear functions defining their relation in solid

waste management and also no committees designated to coordinate their projects as well as activities.

> *".....The lack of coordination among the relevant agencies often results in different agencies becoming the national counterpart to different external support agencies for different solid waste management collaborative projects without being aware of what other national agencies are doing. This leads to duplication of efforts, wasting of resources, and unsustainability of overall solid waste management programmes. The lack of effective legislation for solid waste management, which is a norm in most developing countries, is partially responsible for the roles/functions of the relevant national agencies not being clearly defined and the lack of co-ordination among them" (Ogawa, 2005: p-2)*

3.8 Impacts of solid waste on human health and environment (animals and aquatics life)

There are potential risks to environment and health from improper handling of solid wastes. Direct health risks concern mainly the workers in this field, who need to be protected, as far as possible, from contact with wastes. There are also specific risks in handling wastes from hospitals and clinics. For the general public, the main risks to health are indirect and arise from the breeding of disease vectors, primarily flies and rats. (Pervez & Kafeel, 2013)

Uncontrolled hazardous wastes from industries mixing up with municipal wastes create potential risks to human health. Traffic accidents can result from toxic spilled wastes. There is specific danger of concentration of heavy metals in the food chain, a problem that illustrates the relationship between municipal solid wastes and liquid industrial effluents containing heavy metals discharged to a drainage/sewerage system and /or open dumping sites of municipal solid wastes and the wastes discharged thereby maintains a vicious cycle including these some other types of problem are as follows. (Pervez & Kafeel, 2013)

- Chemical poisoning through chemical inhalation
- Uncollected waste can obstruct the storm water runoff resulting in flood
- Low birth weight
- Cancer
- Congenital malformations
- Neurological disease
- Nausea and vomiting
- Mercury toxicity from eating fish with high levels of mercury
- Plastic found in oceans ingested by birds
- Resulted in high algal population in rivers and sea
- Degrades water and soil quality

The decomposition of waste into constituent chemicals is a common source of local environmental pollution. This problem is especially acute in developing nations. Very few existing landfills in the world's poorest countries would meet environmental standards accepted in industrialized nations, and with limited budgets there are likely to be few sites rigorously evaluated prior to use in the future. The problem is again compounded by the issues associated with rapid urbanization. A major environmental concern is gas release by decomposing garbage. Methane is a by-product of the anaerobic respiration of bacteria, and these bacteria thrive in landfills with high amounts of moisture. Methane concentrations can reach up to 50% of the composition of landfill gas at maximum anaerobic decomposition (Cointreau-Levine, 1997 in pervez & kafeel, 2013). A second problem with these gasses is their contribution to the enhanced greenhouse gas effect and climate change. Liquid leachate management varies throughout the landfills of the developing world. Leachate poses a threat to local surface and ground water systems. The use of dense clay deposits at the bottom of waste pits, coupled with plastic sheeting-type liners to prevent infiltration into the surrounding soil, is generally regarded as the optimum strategy to contain excess liquid. In this way, waste is encouraged to evaporate rather than infiltrate. (pervez & kafeel, 2013)

3.9 Solid waste management in Ghana

Over the years, solid waste disposal in Ghana has become a major challenge to MMDAs. As a result of urbanisation and increasing densities, Metropolitan Assemblies find it difficult to deal with the large quantities of solid waste generated. This is due to the fact that, people resort to indiscriminate dumping as the only means to managing their domestic solid waste thus resulting in littering and heaping of waste. (Puopiel, 2010)

3.9.1 Solid waste generation

According to Anomanyo (2004) about 1800 tons of municipal solid wastes were generated per day in the Accra Metropolis and the average waste generated per capita per day was estimated at 0.5 tons. He attributed this to the rate of population growth in the Metropolis which stood at 3.5 percent. Waste from domestic sources include, food waste, garden waste, sweepings, ash, packaging materials, textiles and electric and electronic waste with organic waste being the major component. This constituted about 65 percent.

3.9.2 Solid waste collection

According to Tsiboe and Marbel (2004), there are basically three methods of household waste collection in Accra:

- Waste Management Department (WMD) curbside collection by trucks directly outside each house. According to them, this collection method was provided weekly in the high-income residential areas like Roman Ridge, Airport and Cantonment by compactor trucks.
- WMD collected from communal containers to which people must bring their own waste. These were restricted to low-income areas like Niima and amounted to some 200 communal containers. Households that could not afford the house to house collection service took their waste to any of these 200 communal containers and from which the WMD collected the waste and disposed of it at the landfill site (Stephens et al 1994: 25) cited in Tsiboe and Marbell (2004).
- Door-to-door collection services in middle-income areas like Labadi.

According to Anomanyo (2004), for the purpose of effective collection, the city was demarcated into waste in one district or two. Fifteen (15) waste collection companies were contracted. These include: Liberty Waste Service, Vicma Waste Construction, Ako Waste Management Limited, Gee Waste Limited and Daben Cleansing Construction Services Limited. The main types of vehicles used by AMA were compaction and skip trucks. The wastes were taken by road directly to the disposal sites. There were no waste transfer stations.

According to him solid waste collection in the city was carried out both on franchise bases, a house-to-house collection was done in high income areas and the contractors charged the households some fees with weekly collection frequency. These areas are well planned residential areas with access roads described as first and second class areas and include areas as Airport residential area and Cantoments. Each household had plastic containers with covers. These contractors then paid a tipping fee to the AMA for the use of its dump site. The user fees charged form about 20 percent of general service to the beneficiaries whose wastes are collected. On contract bases, waste contractors were paid by AMA to perform both block and communal container collection. Block collection occurred in the middle-income residential areas including Dansoman, Adabraka, Kaneshie and other parts of Accra. Central communal skip collection occurred in low income high population density and deprived residential areas such as James Town, Nima and other parts of Accra where houses were not well planned with poor or even no access roads. Market places were also covered with this arrangement. Residents deposited their waste in such communal containers and the frequency of collection was at least once daily. Waste generators here did not pay user charges. He added that despite the strategies put in place for the collection of waste in Accra, maximum waste collection was not achieved. Between 65 and 75 percent of waste was collected per day.

3.9.3 Solid waste disposal

According to Anomanyo (2004), waste disposal from households in AMA took different forms. These are represented in figure 6.

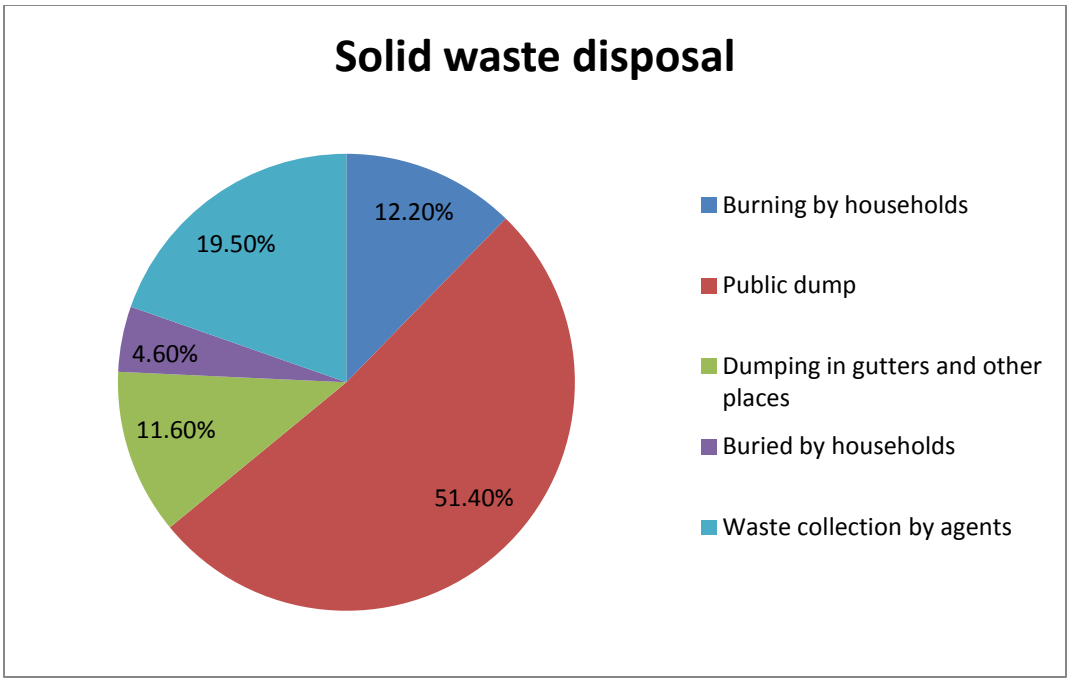

Figure 6 solid waste disposal from households

Source: AMA, 2004.

It can thus be ascertained that out of the about 1800 tons of waste generated, only 19.5 percent was collected. Anomanyo (2004), further added that between 1991 and late 2001, the AMA's Municipal solid waste in the Accra metropolis was deposited at Mallam, a suburb of Accra. This dumping at the Mallam site however was stopped in late 2001 as the dump capacity had been exceeded and objections from nearby residents. Waste dumping was henceforth shifted to Djanman which unfortunately could not last as it was filled to capacity in just three months. These abandoned Mallam and Djanman sites were mountains of dumps and since they were neither landfills nor were there controls to their spread and emissions, they are of great concern as a result of their threat to human health, leachate and landfill gas formation. According to him the dump site was an old stone quarry at Oblogo in the McCarthy Hills of Accra. Before it begun to be used in early 2002 there was an installation of clay lining. The site had no engineered containment of leachate. AMA was only able to compact the waste to guarantee some level of proper dumping and hence "this site was considered a controlled dump rather than a properly engineered landfill" (Anomanyo, 2004). He further added that since the formal systems of solid waste disposal could not cope with the ever-increasing volume of solid waste being generated in Accra, the public itself employs various means of waste disposal. Waste was thus disposed off

indiscriminately especially in watercourses and drainage channels and also through burning. (Puopiel, 2010)

3.9.4 Problems of waste management

In Ghana, Boadi and Kuitunen (2004) pointed out some of the problems affecting solid waste management. These include: weak institutional capacity and lack of resources; both human and capital. They also indicated that, home collection of waste is limited to high and, some middle income areas while the poor are left to contend with the problem on their own. This leads to indiscriminate disposal of waste in surface drains, canals and streams, creating unsanitary and unsightly environments in many parts of the city. According to Puopiel, 2010, the main challenges facing solid waste management in developing countries and for that matter Ghana include: inadequate funds to support waste management, inadequate equipment to support waste storage, collection and disposal, low collection coverage and irregular collection services, crude open dumping and burning without air and water pollution control.

4. PROFILE OF THE STUDY AREA

4.1 Geographical setting

4.1.1 Location

Danko is a community under Wa Municipality in the Upper West Region of Ghana. It can be found in the South-eastern part of Wa central. It shares boundaries with Jinkpang to the South-east, Konta to the North-west and Kampaha to the North-east. It is located on longitude 02°30'W and latitude 10°04'N approximately.

Figure 7 map of Ghana and location of Upper west region.

Source: ww.starofgodcc.webs.com

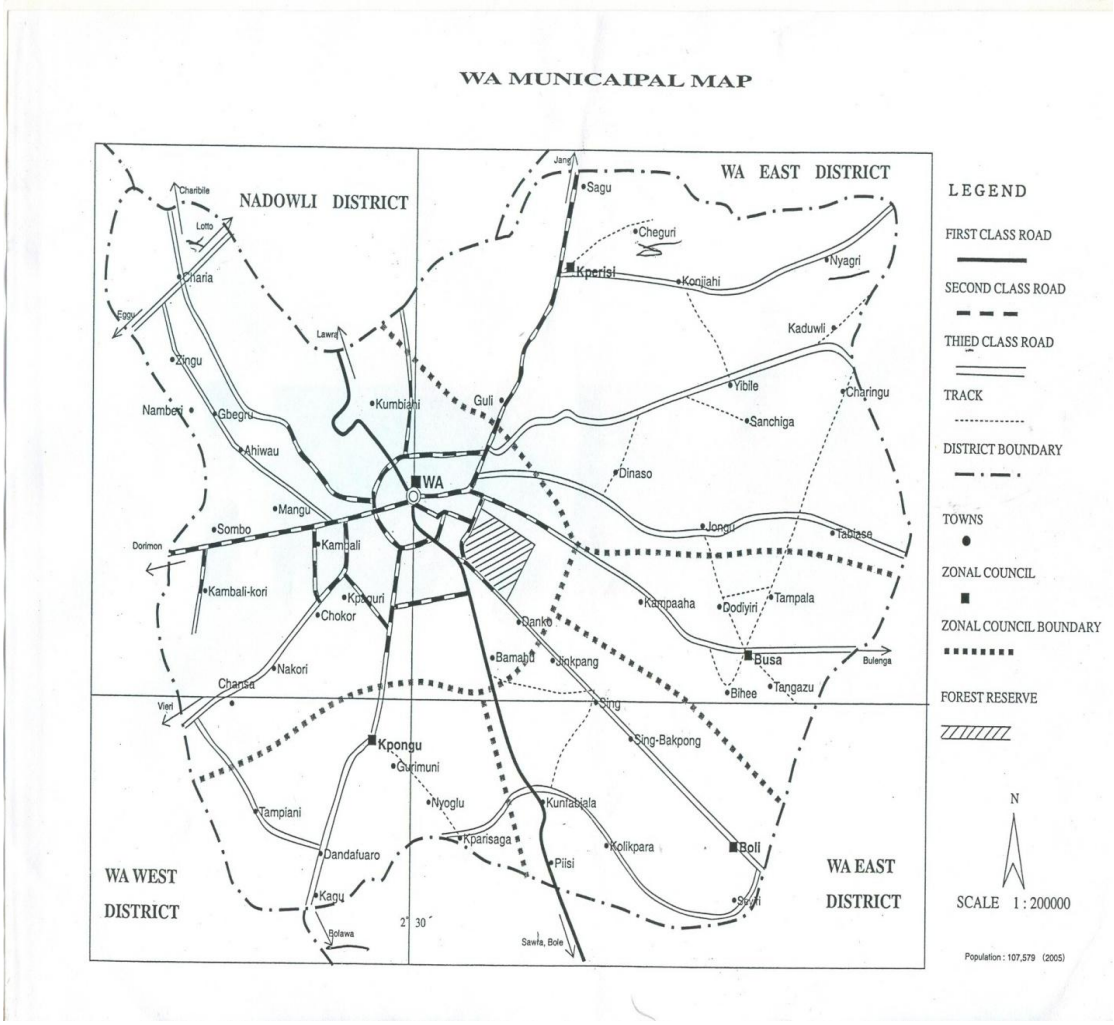

Figure 8 district map of Wa municipality

Sources: Wa Municipal Assembly

4.1.2 Geology and topography

The geology of Danko community is made of igneous, sedimentary and metamorphic rocks. Among the rocks found in the community, igneous rock is the dominant. The community has swampy areas where rice is normally cultivated with a deposit of clay and loam soil.

Land is relatively flat in Danko with gentle slopes from North-east towards the community. It has a seasonal river that helps the cultivation of rice which has created valleys within the study area.

4.1.3 Drainage and vegetation

The drainage of water in the community is moderate due to the sandy loam nature of the soil. When it rains, the rain water runs into the river in North-eastern part due to the sloppy nature.

There are two types of seasons in Danko community which is dry and rainy season. The community is characterized by a single rainy season which starts in late April with little rainfall, rises to its peak in July-August and declines sharply to a complete halt in October-November.

The community is located in the guinea savannah which sustains a large scale livestock and the cultivation of staples like rice, maize, groundnuts, beans, guinea corn and yam. The trees found in the area are drought resistance and hardly shed its leaves during the dry season. The trees have barks which prevent them from losing water. Most of the trees are of economic value and serves as an important means of livelihood especially for women. Notably among these trees are shea trees for sheabutter and dawadawa tree which provides seeds for several other purposes. The heterogeneous collection of trees provide domestic requirement for firewood and charcoal, construction of houses, cattle kraals and fencing of gardens. There is also vegetation consisting of grass and shorter shrubs which provides fodder for livestock.

4.1.4 Soil

The surface of the land is made of sandy loam and gravels in certain areas. Generally, these are not only suitable for the cultivation of cereals such as maize, rice as well as tubers like yam, cassava but also influences the types of vegetation in the area. In other words, deep rooted trees survive whiles shallow rooted trees shed off during the dry season.

4.2 Socio demographic issues

4.2.1 Population size and distribution

The total population of the community is about 995. Out of this total number, 424 are females and the remaining 571 being males. The community is also made up of 211 houses.

4.2.2 Occupational distribution

Most of the community's labour force is engaged in agriculture while the remaining engage in other occupations like petty trading. Animals like cattle, donkeys, sheep, goats, pigs and poultry are reared by almost each household in the community.

4.2.3 Ethnicity, kinship and values

The community is made up of people who are purely Gonjas. However, there are Mosis and Dagaaba in their midst.

The people trace their descent through the patrilineal and operate on the traditional extended family system. They also practice both endogamous and exogamous marriages. The community has the following as their values:

- greetings,
- respect,
- obedience,
- hospitality and
- hard work.

4.2.4 Property ownership

In Danko community, property ownership is classified into Communal, family and Individual property. The communal property is the property acquired and owned by the community while family and individual properties are owned and controlled by families and individuals respectively, irrespective of sex, age and religion.

4.3 Economic activities

4.3.1 Agriculture

Agriculture which is the engine of growth of the nation's economy cannot be left out in carrying out a research in a developing community like Danko. Danko is predominantly a farming community with majority of the population engaging in farming activities.

4.3.2 Methods and types of farming systems

Almost all the people of Danko are subsistence farmers and other few people practice commercial farming. The farming methods and systems predominantly used by farmers are mixed cropping, mono cropping and subsistence farming and extensive.

4.3.3 Financing

Farming activities in Danko community is usually self financed to the absence of credit facilities. Therefore financing is solely from the sale of farm produce, live stocks and assistance from relatives.

4.3.4 Labour

Labour employed by the people of Danko is personally employed. However, farmers in the community also depend on their families as a source of labour. Those who farm on commercial basis employ the services of hired labour which includes casual labour and tractors.

4.3.5 Marketing

Danko community mainly produce for consumption purposes. However, in times of financial difficulty people are compelled to transport their produce to nearby communities such as Wa central market.

4.4 Spatial organization

4.4.1 Community layout

The settlement pattern of Danko community is dispersed. The community is made up of 211 houses of which 157 are completed houses where as 54 are uncompleted. The road from Wa to Jinkpang divides the community into two sections. The buildings in the community are mainly of bricks and block houses.

4.4.2 Educational facilities

The community has a primary school with 8 classrooms and an office for the head of staff. The total number of pupils currently in the whole school is about 279 with 10 teaching staffs.

4.4.3 Health

The people of Danko rely on the Upper West Regional Hospital since there is neither a health centre nor a clinic in the community.

4.4.4 Transport and communication

The community lacks some modern communication and transport facilities such as post office, postal agents, radio stations, lorry parks and transport office. Therefore they travel to Wa the capital of Upper West Region in order to have access to some of these facilities. With respect to communication, few members of the community have personal mobile phones with three communication networks that are MTN, TIGO and VODAFONE networks. They are covered by several radio stations such as Radio Upper West and Radio Progress in the regional capital.

5. RESEARCH METHODOLOGY

The combinative method of research comprising both qualitative and quantitative methods was used.

Probability and non-probability sampling techniques was used. Purposive sampling technique was employed to enable meet the objective of interviewing the respondents connected to waste management industry. Simple random sampling was also used to select respondents in order to avoid bias which gave a fair chance to every respondent within the community to be interviewed.

Furthermore, the mathematical method was used to determine the sample size for the survey. A sample size of 91 of the total population was obtained. This figure was retrieved from the statistics below;

$X=n/(1+n(e)^2)$ (Taro, 1970)

X=Sample size, n=total population, e=level of error which is 10%

$=995/(1+995(0.1)^2)$

$=995/(1+995(0.01))$

$=995/(1+9.95)$

$=995/(10.95)$

$=90.9$

≈ 91

With regards to the information that was needed, I used both primary and secondary data.

Primary data; this involves a firsthand data collection from field using instruments like questionnaire and interviews.

- Interviews: I obtained in-depth information with the use of questions as shown in appendix 2 from the respondents through face to face interaction where by both verbal and non-verbal communication codes were been noted. This technique is more or less like a questionnaire just that the interview enables researchers to have more access to non-verbal communication hence goes beyond verbal expressions.

- Questionnaires: I obtained statistically useful information concerning the effect of improper solid waste management through the use of series of questions asked to the people in the community as shown in appendix 1. This technique does not go beyond verbal communication unlike interviews which goes beyond verbal communication.

Secondary data; this comprises of supplementary information obtained from journals, news papers, dissertation, articles and others which were relevant to the study.

Both qualitative and quantitative were used in analyzing the data collected. Quantitative or statistical data analysis tool was used in analyzing data on the personal information of the respondent, place of disposal of household waste, waste collection by waste management institutions among others. Qualitative or descriptive data analysis tool was also used in analyzing data on the effect of improper solid waste management on the health of the people as well as their environment.

6. RESULT

6.1 Introduction

This chapter shows the findings of the study. It is presented in three parts. The first part covers the socio-demographic data of respondents. The second part also covers waste management in the study area, while the third part looks at the effect of waste management. Tables and figures are used to present the findings. These are further discussed below.

6.2 Socio demographic characteristics of the respondents

This is the part showing the sex, ages, occupation and educational status of the respondents. Figure 9 shows the sex of the respondents.

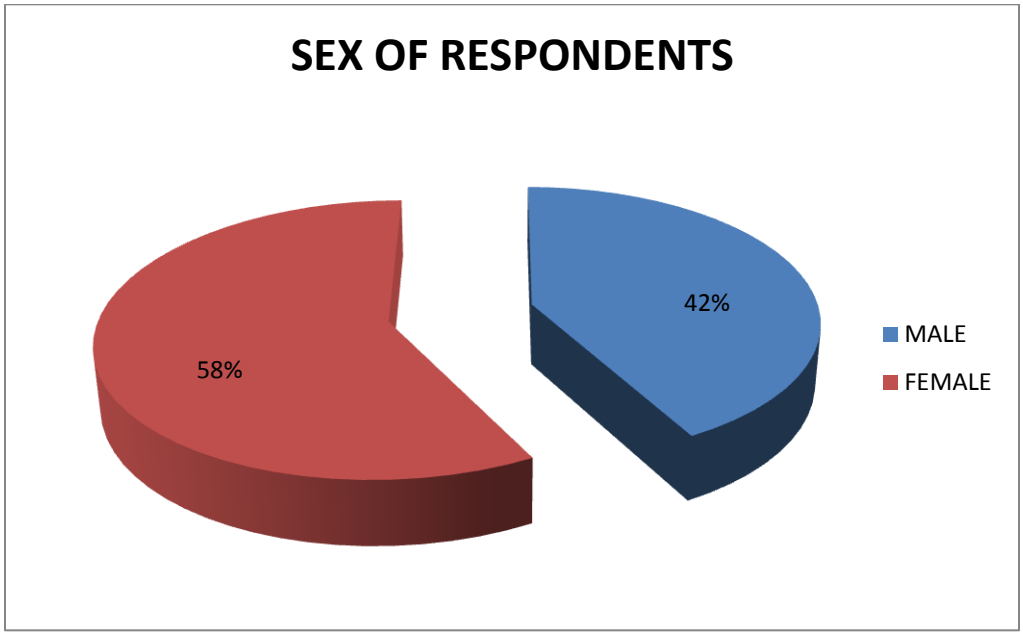

Figure 9 sex of the respondents.

Source: Field data

From the figure 9, females constituted 53 out of the 91 respondent while 38 out of the 91 respondents were males. This was due to the fact that, most women in the study area usually do the clean ups in their houses and the community as well. Also, during data collection, the women were mostly found at home since their husbands had gone to their various farms. This implies that females are responsible for improper disposing of waste than their male counterpart.

Below is a figure (fig. 10), showing the ages of the respondents.

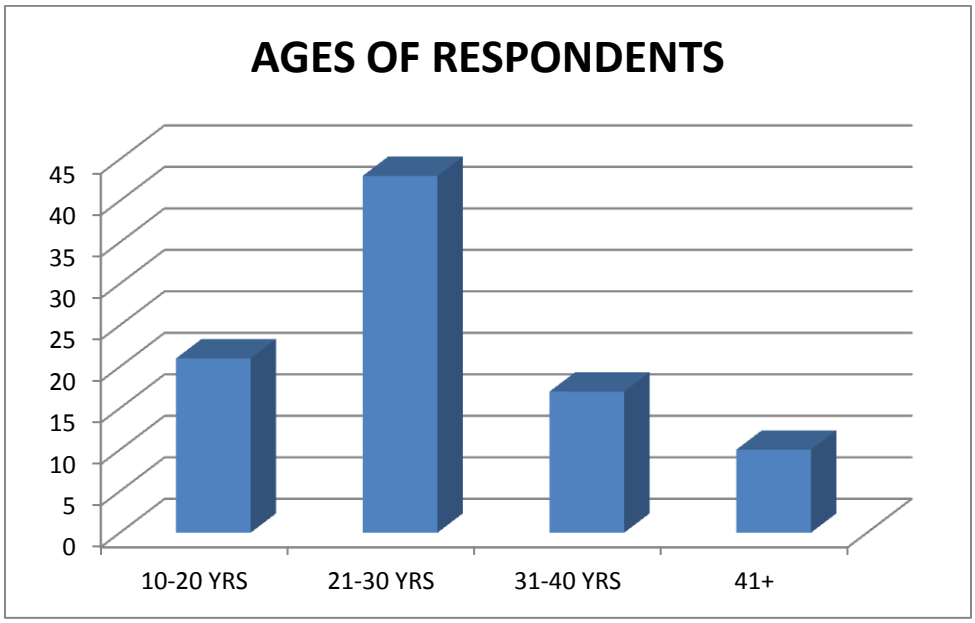

Figure 10 ages of the respondents.

Source: Field data

From the figure 10, the age group of the respondents shows that in the study area there are a lot of youth. 47% of the respondents were between the ages of 21 years and 30 years. The data shows that most youth in the community are responsible for improper dumping of waste since they usually do all clean ups in their homes and its surroundings.

Table 2 shows the educational status of the respondents.

Table 2 educational status of the respondents

EDUCATION	FREQUENCY	PERCENT (%)
PRIMARY	15	16
J.H.S	10	11
S.H.S	1	1
TERTIARY	0	0
NONE	66	72
TOTAL	91	100

Source: Field data

Table 2 shows that, most people have no education. 72% of the respondents had not been to school. 15 out of 91 respondents had their educational level to be primary, 10 of the respondents

had their educational level to be Junior High School and only one of the respondents had his educational level to be Senior High School. This implies that the community's illiteracy level is very high, thus one of the factors leading to improper dumping of waste.

Figure 11 shows the occupation of the respondents.

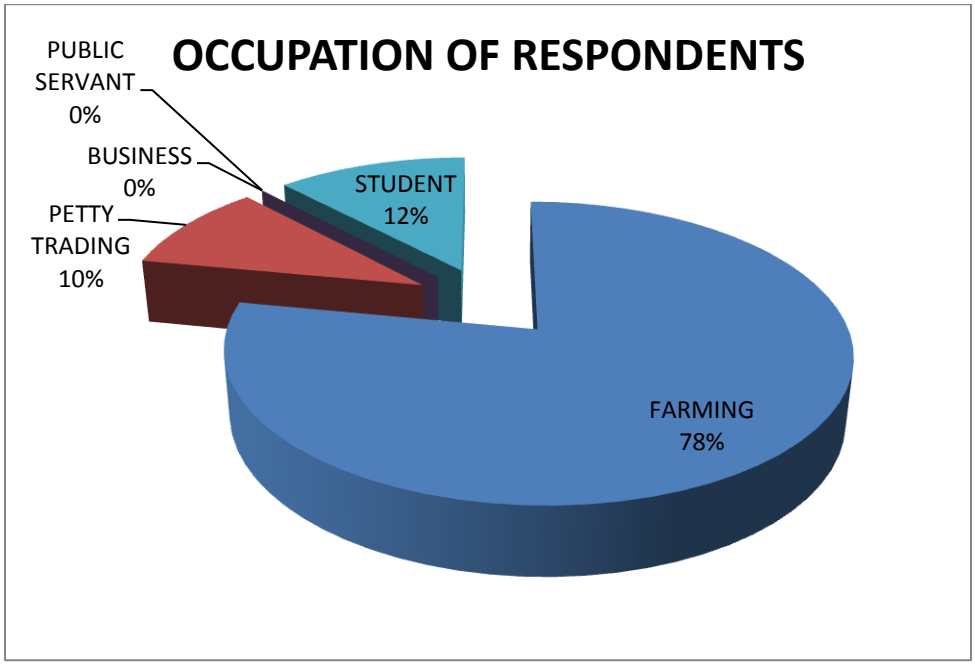

Figure 11 occupation of the respondents.

Source: Field data

Figure 11 indicates that, 71 out of 91 respondents were farmer, 9 out of 91 respondents were petty traders and 11 out 91 respondents were students. Almost all the farmers in the community practice subsistence farming. Due to this fact, they find it very difficult to generate income which makes them dispose waste improperly. This makes them unable to pay for services provided by the waste management institution.

6.3 Knowledge on waste management

According to the respondent, the commonest type of waste generated in the study area was food waste and rubbish. The figure (fig.12) below shows the types of waste generated.

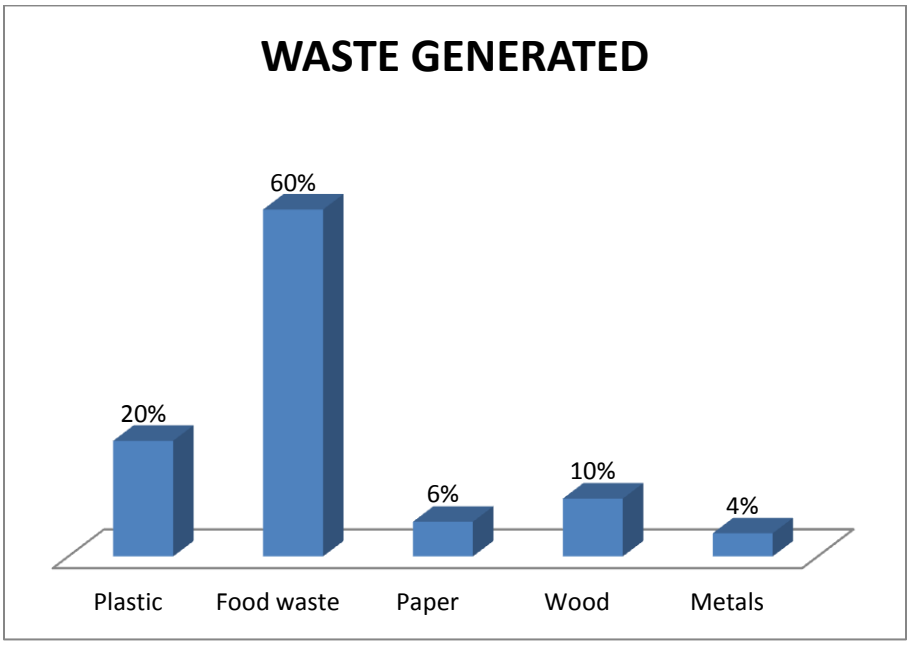

Figure 12 types of waste generated

Source: Field data

It's shown in the figure 12 that, food waste is the most generated in the community which constituted about 60 per cent of waste generated. The next is plastic waste because plastic (bag and bottle) is used mostly for shopping and keeping water safe. Due to their low level of education, they turn to litter the environment especially after using the plastic. Among all the component of waste generated in the community, the least is metals.

The below figure (fig.13) shows places of dumping waste.

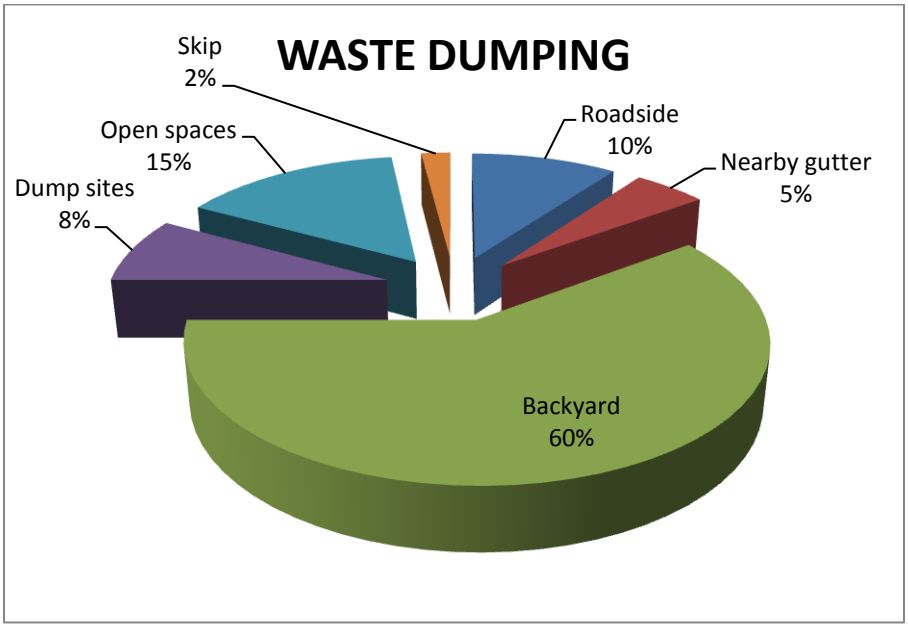

Figure 13 places of dumping waste

Source: Field data

From the figure 13, more than 90% of the respondents resorted to dumping waste in either the roadside, dump site, open spaces, nearby gutter or backyard. The response shows that almost everyone in the community disposes waste improperly. The reason was that, the waste management institution operating in the community does not frequently collect the waste for disposal which makes it very difficult for them to get a proper place of dumping waste. This has resulted in littering as well as heaping of waste in the community which is affecting their environment. The community is therefore vulnerable to environmental related diseases such as cholera and diarrhea.

The below figure (fig.14) shows dumping of waste in skip.

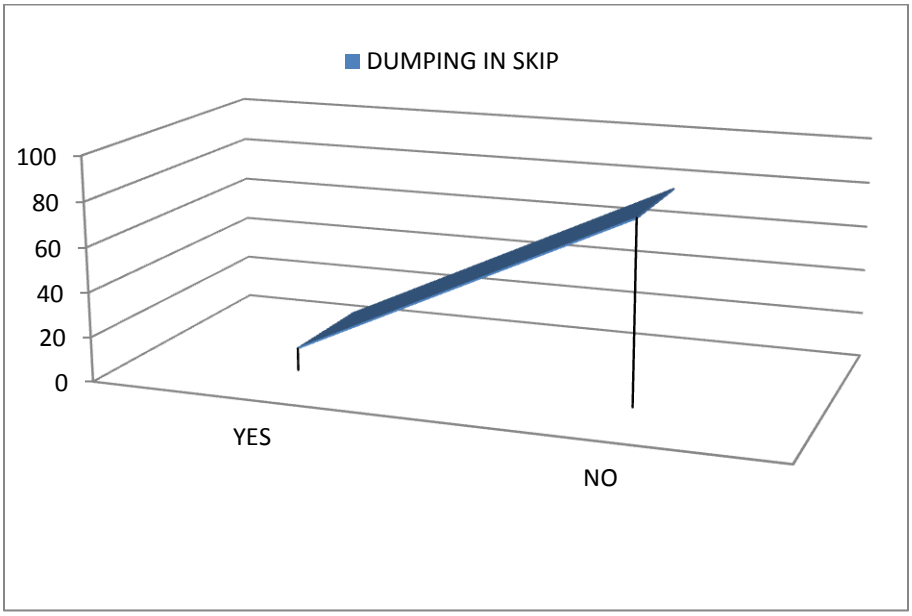

Figure 14 dumping of waste in skip

Source: Field data

Figure 14 shows that, 81out of 91 respondents answered "No". This was because they dump waste improperly. The reason was that, the skip in the community is only two which usually get full very early and it's collected once a week. This leaves them with no options than to dispose waste improperly. Also, since they farm for subsistence reason, they find it difficult to get money to pay for the waste when dumping in the skip. 10 out of 91 respondents said yes as their answer and they pay 20pesewas (0.05 Euros) averagely which some have to walk for long distance. The long distance sometimes makes them feel lazy to go and dump waste in the skip.

The below figure (fig.15) shows the minutes respondents walk to the skip.

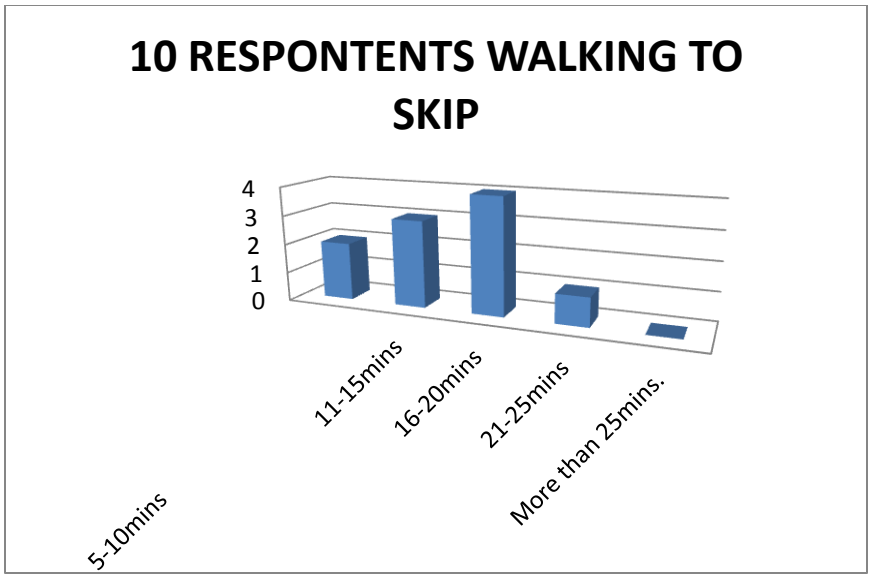

Figure 15 minutes respondents walk to the skip.

Source: Field data

The figure 15 shows, 2 out of the 10 respondents who dump waste in the skip walk for 5-10mins, 3 out of the 10 respondents walk for 11-15mins, 4 out of the 10 respondents walk for 16-20mins and 1 out of the 10 respondents walk for 21-25mins. From their response, almost all of them see the distance to be inconvenient which sometimes discourages them even though they pay for the service provided by the waste management company.

The waste management institution operating in the community is Zoom Lion Ghana Limited. They are private institution responsible for collection of waste for disposal in the community. They usually collect waste once a week which is not enough for the community members.

The table (tab.3) below shows how the respondents think disposal of solid waste should be managed.

Table 3 how the respondents think disposal of solid waste should be managed.

How do you think disposal of solid waste should be managed	Frequency	%
Contributing to buy waste containers	7	8
Paying for the disposal and collection of waste	11	12
More education on the effects of indiscriminate refuse disposal	48	53
Strict enforcement of existing sanitary laws	5	5
Enactment of stiffer sanitary laws	2	2
Provision of approved dumping sites close to all	18	20
Total	91	100

Source: Field data

Table 3 shows how they think they can manage improper disposal of solid waste. Due to their low level of education, 48 of the respondents which constitute the majority wanted to be educated on the effects of indiscriminate refuse disposal. 7 of the respondents preferred contributing to buy waste containers since the skip in the community is less. 11 of the respondents saw paying for the disposal and collection of waste as a way to manage improper waste disposal because the waste management institution operating in the community is a private company and they think that will encourage the company to improve on their services. 5 of the respondents thought strict enforcement of existing sanitary laws will help in waste management because that will make them very responsible for their actions. 2 of the respondents said that the enactment of sanitary laws should be stiffer to put people on track. 18 of the respondents preferred approved dumping sites closer to them since they walk far distance to dump their waste. From the responses, it was noted that, they wanted to reduce their waste. This showed that if proper waste management is done, they will definitely reduce waste to save their environment which will prevent them from environment related diseases.

The research conducted showed that 6% of the respondents said there are bye-laws in the community whiles 94% said there are no bye-laws governing solid waste management. This is represented in the figure (fig.16) below.

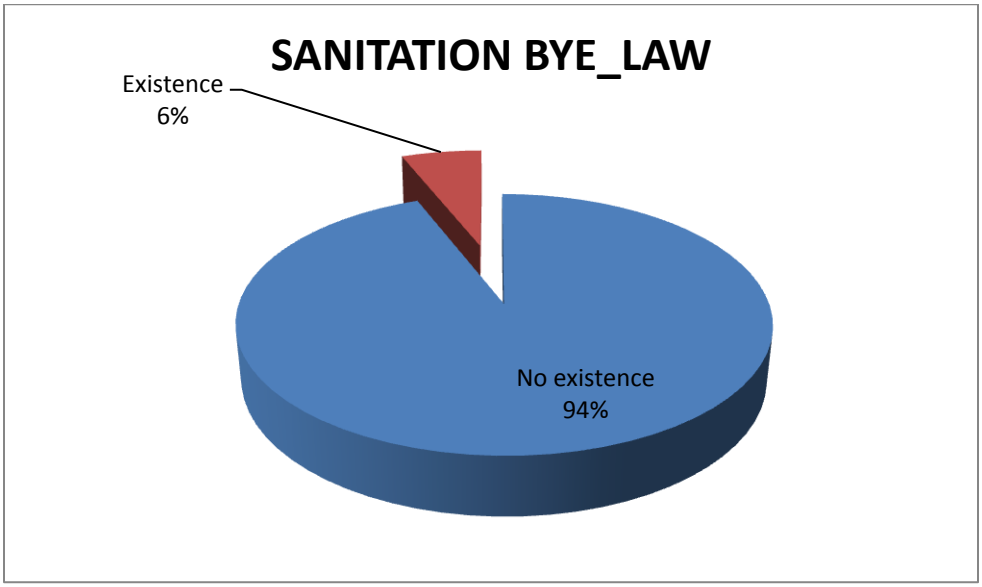

Figure 16 sanitation bye-law

Source: Field Survey

From the figure 16, 94% of the respondents said there is no sanitation bye-law in the community whereas 6 percent said there is existence of sanitation bye-law. According to the Ministry of Local Government and Rural Development (MLGRD) (2004), general waste management in Ghana is the responsibility of the MLGRD, which supervises the decentralized Metropolitan, Municipal and District Assemblies (MMDAs). However, the ministry indicates that, regulatory authority is vested in the Environmental Protection Agency (EPA) under the auspices of the Ministry of Environment and Science. The Metropolitan, Municipal and District Assemblies are responsible for the collection and final disposal of solid waste through their Waste Management Departments (WMDs) and their Environmental Health and Sanitation Departments (EHSD). The ministry further indicates that in an effort to address the problem of waste management, Government has over the years put in place adequate national policies, regulatory and institutional frameworks. Due to this the Environmental Sanitation Policy (ESP) was formulated in 1999. This policy has currently been amended and strategic action plans developed for

implementation according to the report. Various relevant legislations for the control of waste have also been enacted. These include the following.

- Local Government Act, 1990 (Act 462)
- Environmental Assessment Regulations, 1999 (LI 1652).
- Criminal Code, 1960 (Act 29).
- Water Resources Commission Act, 1996 (Act 522).
- Pesticides Control and Management Act, 1996 (Act 528).
- National Building Regulations, 1996 (LI 1630).

This shows that in every community there exist sanitation bye-laws of which residents of Danko are ignorant of them.

6.4 Effect of waste management

The figure (fig.17) below shows knowledge of respondents on link between poor waste disposal and health.

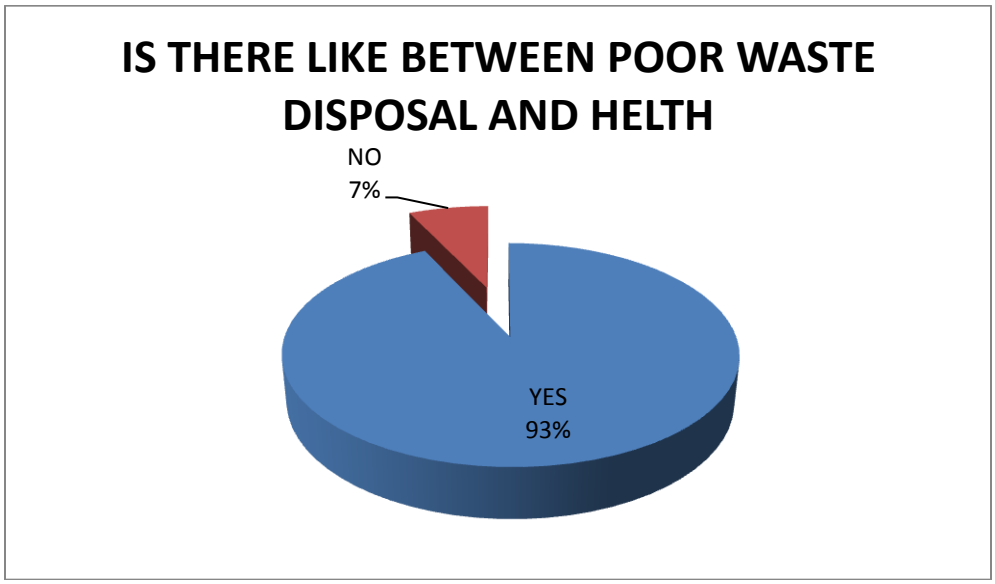

Figure 17 knowledge of respondents on link between poor waste disposal and health.

Source: Field data

Form the figure 17, 93% of the respondents gave yes as their answer because of the experience they are having in the environment due to their improper disposal of waste. They were very much aware about how poor waste disposal affects health. With the awareness of the poor waste disposal and health, they still indiscriminately dispose waste. The reason given was lack of

education in waste management and late collection by the waste management institution in the community. This has made them prone to diseases.

6.4.1 Diseases suffered by respondents

The diseases suffered by the people in Danko community are Malaria, cholera, diarrhea and other diseases. Below is a table (tab.4) showing the diseases in the community.

Table 4 diseases in the community.

Diseases	Frequency	Percentage
Malaria	55	60
Cholera	4	4
Diarrhea	6	7
Others	26	29
Total	91	100

Source: Field survey

From the table 4, it was shown that majority of people in Danko community suffer from malaria representing 60 percent. The next after malaria is other related diseases with 29 percent followed by diarrhoea with 7 percent and the least disease persistent in Danko community is cholera with 4 percent. With regards to illness associated with solid waste malaria stands tall.

The figure (fig. 18) below shows how poor waste disposal promote the spread of diseases.

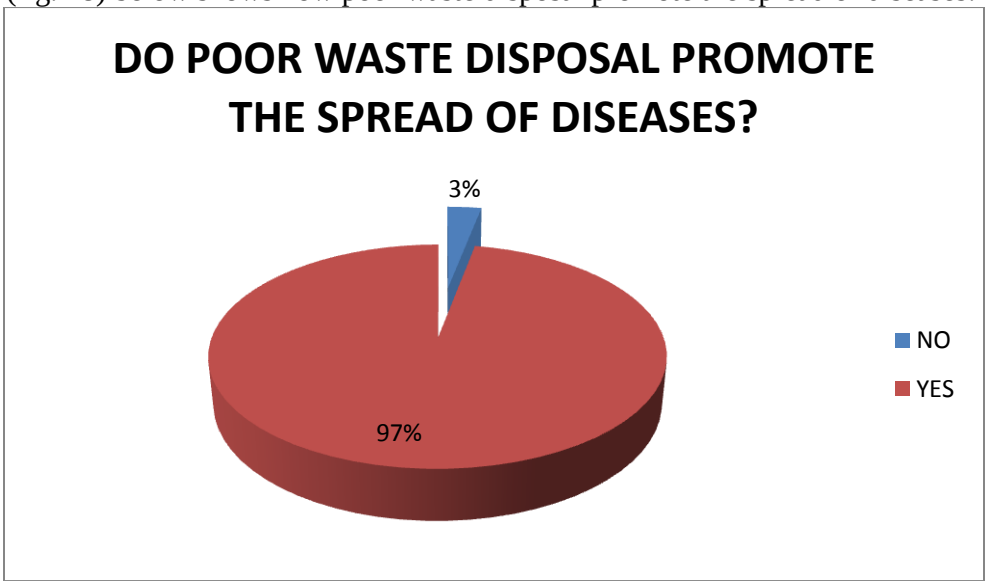

Figure 18 how poor waste disposal promote the spread of diseases.

Source: Field data

The figure 18 show that, 97% of the respondents answered yes to the fact that improper disposal of waste affects the environment. From their response, improper disposal of waste destroys the environment by spoiling the beauty, beings odour, pollution and spread of diseases. This makes them uncomfortable living in dirty environment since they lack education in waste management as well as unauthorized dumping site. This has left them with no choice but to dump refuse indiscriminately.

In order for the community to ensure clean environment, they suggested that, they want to be educated more on the effects of indiscriminate refuse disposal and waste management as well as wanted frequent collection of waste by Zoom Lion Ghana Limited.

7. MAJOR FINDINGS, RECOMMENDATIONS AND DISCUSSION

This section explores the summary of major findings with regards to the data that formed the basis of the research which brings about the recommendations of reducing the effects of improper solid waste management in Danko.

7.1 Major findings

- **Process of collecting waste.**

In data analysis, it was realized that solid waste is produce in all households in Danko community. The solid waste produced includes food waste, papers, plastics, and others. It was noted that food waste was the most produced among all the solid waste generated is the community. The study revealed that almost everyone in the community dispose waste improperly. Majority of the respondents dump waste in their backyard while the rest dump it in open spaces, roadside, nearby gutter, dump sites and skip. The waste is collected once a week from the skip by zoomlion Ghana limited. This shows that waste are not collected frequently due to the poor nature of the road and their poverty level.

- **Transportation of waste.**

The study showed that transportation of waste has been one of the factors that causes improper disposal of waste. The respondents who dump their waste in the skip work for minimum of 5 minutes and maximum of 25 minutes. They see the distance to be inconvenient which sometimes discourages them. The ZoomLion Ghana limited also finds it very different to transport the waste from the community due to the nature of the road because their vehicle usually gets stack on the road which makes operating in the community challenging.

- **Sorting and processing of waste.**

From the study, it was realized that sorting and processing of waste is not easy due to the wrong perception people have on waste. Since waste is seen as resource (generating money) in other countries, it is seen in Ghana which Danko community in no exception as to be sent to landfill site. The wrong perception has been a challenge for waste management company. Thus, instead of them to benefit from making useful resources or valuable products out of the solid waste through sorting and processing, they turn to be company collecting only waste to landfill site.

- **Effect of solid waste on the environment.**

The study revealed that improper solid waste disposal has adverse effect on the environment. Most of the respondents were aware of effect but yet still they dispose waste indiscriminately. The reason was lack of education in waste management and late collection by the waste management institution in the community. This has made them prone to diseases. From their response, improper disposal of waste has destroyed their environment by spoiling the beauty, being odour, pollution and spread of diseases which has made the community unattractive for visitors. The effect has made them uncomfortable living in their own environment.

- **Effect of solid waste on the society**

It was realized from the study that, improper dispose of solid waste has affected the health of people in the society. The data analysis showed that majority of people in Danko community suffers from health issues especially malaria due to effect of solid waste disposal. Since most of the people in the community are farmers and practice subsistence farming, they find it very challenging to feed their family when they are sick because they cannot go to the farm.

- **Effect of solid waste on the economy**

The data analysis showed that solid waste has affected the economy of the community. Since most of the people in Danko community are farmer and substance famers to be precise, they sometimes try to sell their food stuffs when it's in excess. They find it very difficult to sell the excess food stuff from the farm produce because the neighboring community as well as the municipality perceive them to be very dirty due to improper dumping of waste so therefore their food stuffs are seen to be unhygienic. Also, investors do not want to invest in the community due to poor waste management making the place unattractive which they think can affect their businesses. This has made job creation very difficult in the community.

7.1.1 Minor findings

Socio-demographic findings

In the analysis, it was realized that across a permanent sample size of 91, majority of the respondents are females. In addition to this, majority of the respondents fell between the age group of 21 to 30 years. This shows that more of the respondents fall within a youthful age group therefore depicting a vibrant labour force. The occupational background of respondents includes farming, trading and students. Also the study revealed that majority of respondents being 66% has not been to school at all which depicts high illiteracy level in Danko.

It was also realized from the survey that the indiscriminate dumping of solid waste has health implication on the people of Danko. The continuous gathering of solid waste can lead to spread of diseases.

From the field survey it was realized that indiscriminate dumping of solid waste leaves the environment in an unattractive condition.

7.2 Recommendations

The following have been the recommendations to reduce or combat the health and environmental effects of improper solid waste disposal in Danko.

- There should be provision of adequate skips and waste bins by the Zoomlion Ghana Limited and Wa Municipal Assembly in collaboration with other waste management organization.
- There should also be regular collection of waste by the Zoomlion Ghana Limited and other waste management organization.
- There should be the provision of adequate resources, logistics and financial support to waste management institutions in terms of fueling and servicing of vehicles which transport solid waste.
- Wa Municipal Assembly should embark on sensitization campaigns to educate the people of Danko on the existence of sanitation laws, how to manage their solid waste, the health and environmental effects of inappropriate disposal of solid waste and the relevance of appropriate disposal of solid waste.

- The community, Zoomlion Ghana Limited and Wa Municipal Assembly should come together to provide a site for the placement of communal containers and incinerators for crude dumping.
- Advocate for further research to identify favourable impacts of indigenous knowledge of solid waste disposal such as using food waste and animal dung for manure and compost by farmers which renders the soil fertile for crop cultivation.

If the above recommendations given are well taken and implemented, it will bring about effective solid waste management, ensure a clean environment and curb the health and environmental effects of inappropriate solid waste disposal.

There should be investment in prudent and environmentally friendly ways of managing waste such as recycling, incineration and composting.

7.3 Discusssion

The studies found out that, waste generated in the study area were food waste and rubbish. Waste containers (skip) were provided by the private waste company operating in the area. The skip in the community is not enough for the people. Waste containers placed in study area were not taking away for disposal when they are full because the waste company comes to collect once a week. Since it's taken once in a week, when the skips are full its left to litter around, flown to streets and sometimes flown to open drains. This clarified why most of the respondents resort to dumping waste at roadside, dump sites, open spaces, nearby gutter or backyard as a way of dealing with waste. It was observed that if more skips are provided and there is frequent collection of waste, indiscriminate dumping of waste will be reduced or stopped.

Plastic waste usually dumped is easily blown by wind into the environment which affects the nature of the environment. Dumping of waste in gutters can also cause flooding because when the stream is choked with waste the water ways will be blocked and cannot flow as it's suppose to. This will definitely affect nearby houses in the area.

Most private waste collection firms which Zoom Lion Ghana Limited is no exception have the habit of concentrating on collection of waste from areas where the settlements are developed. This is because they have good road network which is suitable for their vehicle and also they have money to pay for the services they render. It was observed that the community was facing

waste collecting problem because of their poverty level since the company will not get enough money for their service rendered. Moreover, the nature of their road network is very poor which makes it difficult for the waste company to operate there frequently. They did not want to go to the study area often because of the bad road and little fee paid for the service.

Figure 19 heap of solid waste in skip

Source: Modern Ghana

In Ghana, solid wastes are usually heaped in low income areas as well as the market places. This presents serious problem to the people in that area because it affects their human life as well as the environment. Since Danko community is a low income community, dealing with solid waste has always been their problem. Even tough, various researchers show that these problems are due to lack of resources and weak capacities of institutions, there are also some factors that are not regarded although they contribute to generation of solid waste. Some of these disregarded factors are the wrong perception people have about solid waste, poverty and ignorance of people as well as their actions or attitudes towards waste.

The situation Ghanaians find themselves now is the wrong perception people have about solid waste. All forms of solid waste are seen or intended to be sent to landfill site where as other countries such as the Singapore, Sweden among other are generating money out of these solid waste. The wrong perception has been a challenge for waste management companies. This is

because instead of them to benefit from making useful resources or valuable products out of the solid waste, they turn to be company's collecting only waste. They just collect generated solid waste and send them the landfill site. Moreover, management of solid waste goes beyond that.

With the right perception, income can be generated from solid waste by making useful items or valuable products from it which in the long run will protect the environment. This will enhance the work of the waste management companies in the country and the various communities since they deal with controlling of waste generation, storing, collecting, transporting, processing and disposing of solid waste in the right manner which has an impact on the environment.

The people living in Ghana which Danko community is no exception usually struggle for what they will eat so therefore do not think much about their health as well as the environment. They have to always struggle for everything they need to survive which makes the environment to be the least to think about making the street to be filed with heaps of waste as well as the gutters. The filthy environment is highly dependent on the widespread poverty among the general public. Solving or addressing the fundamental problem which is poverty can help serve the filthy environment.

Figure 20 waste in open space

Source: Field data

With the attitude of the public towards waste, it makes dealing with environmental sanitation to be difficult because people do not regard the environment so therefore turn to litter indiscriminately. In Ghana, some people intentionally litter the environment with the thoughts

that if they do not dump waste indiscriminately, how can the waste management companies have job to do.

Nevertheless, solid waste management can be improved if it's seen as a source of income. This can be done if avenues are created for some waste components to be returned for money. When solid waste such as plastic is returned for money, it could be a source of employment which can change their mindset and also think about the environment. This will make them to regard solid waste as a source of income not something to be sent to the landfill.

8. Conclusion

The aim of this study looked at the effect of improper management of solid waste in Danko community in the Upper West Region of Ghana. A combination of qualitative and quantitative methodological approaches was used in data collection and analysis. These methods include: questionnaire and interview. The study showed that, the process of collecting waste was not on frequent base. Transportation of solid waste was very challenging in Danko community since people have to walk for couple of minutes to dispose waste. The waste management company also had problems in transportation due to the bad nature to the road. It was found that, instead of the waste management company to benefit from making useful resources or valuable products out of the solid waste through sorting and processing, they turn to be company collecting only waste to landfill site. The improper disposal of waste has destroyed the environment by spoiling the beauty, being odour, pollution and spread of diseases which has made the community unattractive for visitors. It was realized that majority of people suffer from health issues especially malaria due to effect of solid waste disposal making it challenging to feed their family when they are sick and cannot go to the farm. It was seen that communities did not want to trade with them and also, investors do not want to invest in the community due to poor waste management making the place unattractive which they think can affect their businesses.

I therefore conclude that some factors that account for effect of solid waste management in Danko community includes: lack of education, bad road network, poor methods of waste management, ignorance about sanitation bye-laws and inefficiency and ineffective efforts by the waste management institutions.

9. Reference

Adelaide, A. (1995). Waste Management and Sanitation at James Town and Accra Central. A dissertation submitted to the Department of Sociology, University of Ghana, Legon.

Anku, Samuel Ernest Kwame (2000), Solid Waste Management in Ghana, Paper presented at a training workshop on Environmental Management for selected District Assemblies in Ghana

Anomanyo, D.E (2004). Integration of Municipal Solid Waste Management in Accra, Ghana: Biofactor treatment technology as an integral part of the management process. Presented to Lund University, Sweden.

Beukerung, P.V., Sehker, M., Gerlagh, R. and Kumar V. (1999). Analysing Urban Waste in Developing Countries: a perspective on Bangalore, India. Working Paper No.24

Boadi K.O and Kuitunen, M. (2004). Municipal Solid Waste Management in the Accra Metropolitan Area in the Environmentalist Journal. Volume 23, No.3

Centre for Environment and Development (2003). Study of the Attitude and Perception of Community towards Solid Waste Management. A case study of Thiruvananthapuram city-Phase II. Submitted to Kerala Research Programme on Local Level Development.

Collivignarelli, C., Sorlini, S., Vaccari, M., 2004. Solid Wastes Management in Developing Countries, CD-ROM of ISWA 2004 World Congress, October 17–21, Rome, Italy.

Environmental Protection Agency (2002). Ghana's State of the Environment Report EPA, MES, MLGRD, (2002) Ghana Landfill Guidelines: Best Practice Environmental Guidelines. Accra, Ghana.

Freduah, G.(2004). Problems of Solid Waste Management in Nima, Accra. University of Ghana, Legon

Ghana Innovation Marketplace (2009). Waste Management Conference and Exhibition. 11th-12th November, 2009. Great Hall, KNUST.

Kreith, F. (1994). Handbook of Solid Waste Management. McGraw Hill, USA.

Kumah, A.M.(2007). The Situation of Solid Waste in Ghana. Accra, Ghana.

Moeller, D. W. (2005). Environmental Health (3rd ed.). Cambridge, MA:Harvard University Press.

Momoh, J.J. and Oladebeye, D.H. (2010). Assessment of Awareness of Attitude and Willingness of People to Participate in Household Solid Waste Recycling Programme in Ado-Eketi, Nigeria, in the Journal of Applied Sciences in Environmenta Sanitation. Jakarta, Indonesia.

MLGRD (2004). SanitationCountryProfileGhana (2004). (http://www.un.org/esa/agenda21/natlinfo/countr/ghana/SanitationGHANA04F.pdf) Assessed on 12th April, 2015.

Nathanson, J. A. (2014), Solid-waste management. http://www.britannica.com/EBchecked/topic/553362/solid-waste-management Date Accessed: 18th January 2015

Ogawa,H.(2005). Sustainable Solid Waste Management in Developing Countries. (http://www.gdrc.org/uem/waste/swm-fogawa1.htm). Accessed on 30th January, 2015.

Tchobanoglous, G., Theisen, H. and Eliason, R. (1977). Solid Wastes: Engineering Principles and Management issues. McGraw-Hill Publishing Company, USA.

Pervez Alam & Kafeel Ahmade, 2013. Impact of solid waste on health and the environment.

Puopiel, F. (2010). Solid waste management in GHANA: The case of Tamale Metropolitan Area. KNUST, Ghana.

Tchobanoglous, G., Theisen, H. and Vigil, S. (1993). Integrated Solid Waste: Engineering principles and management issues. McGraw-Hill Publishing Company, USA.

Tsiboe, I.A. and Marbell, E.(2004). A Look at Urban Waste Disposal Problems in Accra. Roskilde University, Denmark.

Shafuil A.A and Mansoor .A. (2003). Partnerships for solid waste management in developing countries: Linking theories to realities in the Institute of Development Engineering, Water and Development Centre (WEDC). Loughborough University, U.K.

USPS (2000). Solid Waste Management Plan for Thimphu City, Bhutan, Draft version, April 2000. Bhutan: Urban Sector Programme Support Secretariat.

Zerbock, O. (2003). Urban Solid Waste Management: Waste Reduction in Developing Nations. (www.cee.mtu.ed). Accessed on 18th December, 2014.

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Appendix 1 Questionnaires for respondents

Appendix 2 Interview guide for key informants

Appendix 1

Questionnaires for respondents

Respondents are assured of confidentiality with regard to any information given.
Tick only one answer in the boxes provided

SECTION A: Socio-demographic data of respondents

1. Sex
   ☐ Male
   ☐ Female

2. Age ……

3. Religion
   ☐ Islam
   ☐ Christianity
   ☐ Traditional
   ☐ Other, specify ……

4. Level of education
   ☐ Primary
   ☐ J.H.S (Junior High School)
   ☐ S.H.S (Senior High School)
   ☐ Tertiary
   ☐ None

5. What is your major Occupation?
   ☐ Farming
   ☐ Petty Trading
   ☐ Business
   ☐ Public servant
   ☐ Other, specify.....

SECTION B: Waste Management

6. Do you generate solid waste in your household?
   ☐ Yes
   ☐ No

7. Which of the following types of waste do you generate in your home?
   - ☐ Food wastes
   - ☐ Rubbish
   - ☐ Other, specify: .....

8. Where do you dump your daily generated waste?
   - ☐ Roadside
   - ☐ Nearby gutter
   - ☐ Skip
   - ☐ Backyard
   - ☐ Dump sites
   - ☐ Open spaces
   - ☐ Other, specify: .....

9. Why do you dump it in the said place in Q7?

   ……
   ……

.

10. Do you pay for dumping waste in skip?
    - ☐ Yes
    - ☐ No

    If No, why…….

11. If yes, how much are you charged averagely?
    - ☐ 20pesewas (0.05 Euros)
    - ☐ 30pesewas (0.08 Euros)
    - ☐ 40pesewas (0.10 Euros)
    - ☐ 50pesewas (0.13 Euros)
    - ☐ Other, specify:.....

12. How many minutes does it take you to get to skip?
    - ☐ 5-10mins.
    - ☐ 11-15mins.
    - ☐ 16-20mins
    - ☐ 21-25mins.
    - ☐ More than 25mins.

13. Is it convenient for you if you travel more than 10mins to dispose off your waste?
    - ☐ Yes
    - ☐ No

    If No, why? .....

14. Which waste management institution is responsible for collecting waste for disposal?
    - ☐ Waste Management department (Municipal Assembly)
    - ☐ ZoomLion
    - ☐ None
    - ☐ Other, specify: .....

15. How many times is the waste collected?
    - ☐ Not at all
    - ☐ Once a week
    - ☐ Twice a week
    - ☐ Thrice a week
    - ☐ Four times a week
    - ☐ Five times a week
    - ☐ Throughout the week

16. How do you think disposal of solid waste should be managed?
    - ☐ Contributing to buy waste containers
    - ☐ Paying for the disposal and collection of waste
    - ☐ More education on the effects of indiscriminate refuse disposal
    - ☐ Strict enforcement of existing sanitary laws
    - ☐ Enactment of stiffer sanitary laws
    - ☐ Provision of approved dumping sites close to all
    - ☐ Other (specify): .....

SECTION C: Effect of Waste Management

17. Are you aware there is a link between Poor waste disposal and health?
    - ☐ Yes
    - ☐ No.

    If yes, why do you indiscriminately dispose waste?
    …….

.

18. Do you know poor waste disposal promotes the spread of diseases?
    - ☐ Yes
    - ☐ No

19. Do you normally fall sick?
    - ☐ Yes
    - ☐ No

20. What kind of sickness do you normally suffer from?
- ☐ Malaria
- ☐ Cholera
- ☐ Diarrhoea
- ☐ Other

21. Does improper disposal of waste affect the environment?
- ☐ Yes
- ☐ No

If yes, how?
……

22. Do you feel comfortable in dirty environment?
- ☐ Yes
- ☐ No

23. What do you think should be done to ensure clean environment?
……
……

Appendix 2

INTERVIEW GUIDE FOR KEY INFORMANTS

1. How will you assess waste disposal situation within the Wa Municipality?

   ……
   ……
   ……

2. Is waste disposal practices causing problem to the public health and the environment?

   ☐ Yes
   ☐ No

   If 'yes', what exactly is the problem?
   ……
   ……

3. Which waste management institution is responsible for the collection of waste for disposal?

   ……
   ……

4. How often do they come for collection?

   ……
   ……

5. What does the community face regarding solid waste disposal?

   ……
   ……

6. What are the causes to Q5?

   ……
   ……

7. Is there any measures put in place to ensure sanitary disposal of waste by the Municipal authorities?
   ……
   ……

8. What are some of the major difficulties you come across in an effort to ensure proper waste disposal practices?

   ……
   ……

9. What do you suggest should be done to solve the problem of improper solid waste disposal?

   ……
   ……

10. What suggestion do you have as a way of improving waste disposal practices within the Metropolis?

    ……
    ……