

**ASSESSING THE IMPACT OF SOLID WASTE ON HUMAN
HEALTH**

**A CASE STUDY OF PONDAMALI SLUM IN NAKURU
DISTRICT, KENYA**

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BEM/6024/51/DF

**A DISSERTATION SUBMITTED TO THE FACULTY OF
SOCIAL SCIENCES IN PARTIAL FULFILLMENT OF THE
AWARD OF DEGREE OF BACHELORS OF SCIENCE IN
ENVIRONMENTAL MANAGEMENT**

SEPTEMBER 2008

DECLARATION

Onyancha Caroline Kwamboka, declare that the work presented in this report is my own and has never been presented in any university or institution for the award of degree or its equivalent.

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APPROVAL FOR SUBMISSION

This work has been under my supervision as a university supervisor and submitted with my approval.

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DEDICATION

This research is dedicated to my parents Peter and Rhodahanne Onyancha. Brothers Davy, Bryan and sister Emmah. You are great inspirations to my life.

ACKNOWLEDGEMENT

wish to express my thanks to all those who assisted me materially and morally to be able to complete this research successfully. Special thanks goes to my supervisor Ms. Naomi Obbo whose guidance, advice and efforts made this research paper a success.

also wish to thank the entire department of Environment Kampala International University for the general assistance rendered to me during this research compilation.

would like to thank my course mates, the class of year 2008 for their contributions they made during the preparation of this research, especially Saoli, Lucy, Elizabeth, Maureen Kerubo and Muiruri.

am also highly indebted to the various persons of Ponda Mali slum who responded to my research questionnaires and interviews. Their valuable information helped me to accomplish the requirements for research objectives.

finally special thanks goes to my family for their financial support they offered me through out the three years that finally made this work a success.

special thanks and indescribable love to my parents Peter and Rhoda Anne Onyancha brothers Davy, Bryan and Sister Emma.

May God bless you abundantly.

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LIST OF ABBREVIATIONS

TC	Forest Industrial Training Center
AV	Hepatitis A Virus
IMS	Health Information Management Systems
EM	Immune Electron Microscopy
HW	Household hazardous waste
ICA	Japan International Cooperation Agency
km	Kilometers
m	Meters
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
OPD	Out patient department
SWM	Solid Waste Management
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environmental Programme
USAID	United States Agency for International Development
USEPA	United States Environment Protection Agency
WHO	World Health Organisation
WRI	World Research Institute

ABSTRACT

Solid waste management in the world over has proven to be a challenge, developing countries like the lead in poor solid waste management, this could be attributed to a number of factors which include lack of capacity either financially or infrastructure, and this has contributed largely to the deterioration of health standards of the poor who live in slum areas. A study on assessing the impacts of solid waste management on the human health was carried out in Pondamali Slum, Nakuru district Kenya. This research sought to answer questions on solid waste generated by the residents, health effect caused by the poor disposal of waste, the efforts of local residents to handle the problem of poor solid waste management and the measures that can be put in place to control the problem of poor solid waste management in the slum

To investigate the above variables a general survey research design was used. Data collection tools included interview, photography, observation, literature review and questionnaire. Interviews were carried out to the various groups in Pondamali slum and its nearest environs; photography was used to capture visual data of various parts of the slum and its environs, available literature was also reviewed on the effect of poor solid waste disposal on human health. Questionnaires to describe the effects of poor solid waste disposal on the human health were also distributed, to get greater depth of response.

This research reveals the effects of poor disposal of wastes on the general human health and further highlights the highest source of solid waste in Pondamali. The major impacts of poor disposal of wastes in the area as the study identified were diseases, bad odor and blockage of drainage systems. This research established what has been done to protect human health through community participation, setting up of policies and laws together with recycling of wastes.

The study came up with recommendations that must be put in place in order to manage wastes. They included raising awareness of the public and decision makers, developing self financing schemes, supporting strategic planning and follow up implementation, developing human resources, community participation and defining clear roles of relevant agencies in developing countries.

CHAPTER ONE: INTRODUCTION TO THE STUDY

1 Background to the Study

Waste is something which the owner no longer wants at a given place and time and which has no current value. Solid waste includes discarded material from municipal, industrial, agricultural activities according to World Health Organization (WHO 1971) solid waste refers to “useless” unwanted or discarded material that arise from man’s activities. Waste fall into two broad categories that is biodegradable and non-biodegradable. Biodegradable solid waste can be broken down by natural biological process into the environment and completely reduced to acceptable levels that have no harm to the environment. Non-biodegradable solid waste refers to waste that cannot be broken down easily by natural processes it takes a long time. Solid waste management has always been one of the major environmental problems in most cities in the developing world (Dwoll 1972).

The problem of solid waste is always associated with improper coordination of the concerned county councils as waste is collected irregularly, a negative attitude by the residents towards the management of the waste generated and the poor disposal facilities results in the scattering of wastes in the environment. Although solid waste is collected it is mainly done in the middle class areas and for those who can afford to pay (Co-vera 2005). This results into uncollected refuse in most areas. These areas act as breeding areas for disease carrying organism like mosquitoes and flies and also block the drainage system resulting into poor drainage in these areas. Corruption is another factor that has led to poor solid waste management. The city council in most countries has been found guilty of misusing funds for purchasing solid waste storage containers. This has led to disposal of these wastes in open places thus leading to environment hazards.

According to the United Nations report on Agenda 21 by the end of the 21st century over 2.0 billion people will be without access to basic sanitation, and an estimated half of the population in developing countries will be without adequate solid waste disposal services. As many as 5.2 million people, including 4 million children less than five years of age die each year from waste related diseases. The health impacts are particularly severe for the urban poor. The health and environmental impacts of inadequate waste management, however, go beyond the un served

tlements themselves and result in water, land, and air pollution over a wide area. Extending and improving waste collection and safe disposal services are crucial to gaining control over this form of pollution.

Many United Nations and bilateral programmes exist that seek to provide water supply and sanitation services to the unserved. The water and sanitation collaborative council, a global forum, currently acts to co-ordinate development and encourage co-operation. Even so, given the ever increasing number of unserved urban poor population and the need to address, in addition, the problem of solid waste disposal, additional mechanisms are essential to ensure accelerated coverage of urban waste disposal services. The international community in general and selected United Nations organization in particular is undertaking a systematic report on progress in providing waste service to those without such services. Also they are reviewing the effectiveness of techniques for and approach to increasing coverage and identifying innovative ways of accelerating the process.

Financing cost evaluation through the help of the United Nations and safe waste disposal programmes, are both relevant to both developed and developing countries. In developed countries the focus is on improving facilities to meet higher environmental quality criteria, while in developing countries considerable investment is required to build new treatment facilities.

The Conference Secretariat has estimated the average total annual cost of implementing to be about \$15 billion, including about \$3.4 billion from the international community on grant or concessional terms. (United Nations report on Agenda 21).

Scientific guidelines and research on various aspects of waste related pollution control is considered vital. Governments, Municipalities and local authorities, with appropriate and international co-operation are urged to prepare guidelines and technical reports on subjects such as the integration of land use planning in human settlement with waste disposal, environmental quality criteria and standards, waste treatment and safe disposal options, industrial waste treatment landfill operations.

United Nations and other relevant organizations anticipate by year 2025 to provide all urban population with adequate waste services together with full urban waste service and sanitation coverage that is maintained.

According to Payet et al (2004) one of the major impacts of urbanization in Africa is the increased generation of solid waste, which contributes to land conversion for landfills. For example in the African small island developing states of the Indian Ocean, at least 2.8 million tonnes of solid waste are generated annually of which only 30% are collected routinely. Beach deposit rubbish is estimated to be about 40,640 tonnes per year.

According to estimates from the World Research Institute and United States Environment Protection Agency, many local authorities in Africa spent over 30% of their budgets on refuse collection and disposal but can only collect at most 50-70% municipal solid waste most do not meet environmentally safe municipal solid waste disposal levels because of a lack of sanitary land filling.

Waste management is identified as one of Kenya's key environmental issues according to the United Nations Conference on Environment and Development (1999). In Kenya local authorities are charged with the responsibility of collecting and disposing of solid and liquid municipal wastes within their areas of jurisdiction. Most local authorities in Kenya use centralized Municipal Solid Waste management systems.

While poor management of solid waste is a general problem in Kenya it is probably worst in Nairobi. Due to lack of consistent data in other parts of the country, solid waste are a by product of a broad spectrum of industrial, service, and manufacturing processes. Industrial waste constitutes about 23% of the total solid waste generated in the city. Ikiara et al (2004) notes that the collection and disposal of industrial waste in Nairobi is done by the industries themselves. Only about 25% of the estimated 1,500 tonnes of solid waste generated daily in the city gets collected. It is now estimated that there are at least 60 private companies engaged in solid waste collection services in the city (Japan International Co-operation Agency 2005).

the study area which is Ponda Mali slum solid wastes are evident and they are mainly from households through domestic activities such as food left over, charcoal ash, little amounts of industrial wastes from home based industries like bakeries and also debris from houses that are constantly being constructed.

1.2 Statement of the Problem

The problems associated with the poor disposal of solid waste in Ponda Mali slum are numerous. Residents have exhibited an indifferent attitude when it comes to proper handling of waste material. This is clearly seen through careless disposal of fruit peelings, bottles, polythene bags, and poor disposal of personal effects which is done carelessly for example sanitary towels, poor drainage of used waters in households. Also the collection of wastes by the Nakuru Municipal Council is irregular resulting to much accumulation of wastes.

These waste materials usually have adverse effects on the particular and surrounding environments and also on human health. Residents in the slum often fall sick from communicable diseases like typhoid, dysentery, cholera among others, mostly affecting young children under the age of five years. Efforts have been made by some local organization such as Kinamama pamoja who strive to promote environmental awareness on better waste disposal by public lectures in schools and churches. The group also trains individuals on community small scale separation of wastes at the household level. The group further goes ahead collecting waste every Saturday starting from eight in the morning. However with the much effort put in place with the group there is still a big problem of wastes accumulation in the area. If more local organizations can come up it can be of benefit to the community since the Kinamama pamoja group cannot carry the load on their own without collaborating with other local groups in the area to achieve sustainable management of wastes in the area.

1.3 General Objective of the Study

The purpose of this study is to examine the impacts of solid waste on human health.

3.1 Specific objectives of the study

- i). To find out the types of waste generated in Ponda mali.
- i). To examine the effects of poor waste management on human health.
- i). To identify the local efforts to address poor waste management in Ponda mali.
- v). To advance possible solution to address the problem of poor waste management, in Ponda Mali slum.

.4 Significance of the Study

Generally the effects of poor waste management in different parts of the world are usually felt by the people around the affected area or people away as an externality. Most of these solid wastes do not easily decompose and most of them last forever in the earth's surface. Wastes for example plastics can be recycled to yield usable variables for example water storage containers. However ways of disposal and storage of solid waste in Ponda Mali slum have not been well defined and channeled. They are generated at a higher rate than disposed. There is an urgent for awareness on the need for proper disposal of solid waste to avoid them being harmful to human health.

This research study will be relevant especially to the government and policy makers because it will contribute to the already existing applicable policies and laws on dumping of wastes.

The research study will also create awareness amongst the people of the Ponda Mali slum community on the effects of poor solid waste disposal can have on their health and what they must do in order to remain healthy rather than spending much of their money in visiting the clinics.

It will also help the non governmental organization in that the research study will point out some crucial matters pertaining to the major reasons as to why there is poor disposal of wastes in Ponda Mali and thus the non governmental organizations who would want to extend a helping hand to the Ponda Mali community can have a base on where to start with their programmes.

.5 Research questions

- (i). What are the types of the waste generated by the residents?
- ii). What are the health effects caused by the poor disposal of wastes?
- ii). What efforts so far, have the local residents of Ponda Mali slum put in place to handle the problem of poor solid waste management?
- v). What are the measures that can be put in place to control the problem of poor solid waste management in Ponda Mali?

.3 CATEGORIES OF SOLID WASTE

They include the following;

Biodegradable waste which comprises of food and kitchen waste, green waste, paper. They can also be recycled. Recyclable material on the other hand comprises of paper, glass, bottles, cans, metals, certain plastics etc.

Inert waste comprises of construction and demolition waste, dirt, rocks, debris. Not forgetting Composite wastes which comprise of waste clothing, tetra packs, and waste plastics for example toys.

Domestic hazardous waste also called house hold domestic wastes or toxic wastes. They include medication, paints, chemicals, fluorescent tubes, spray cans, fertilizer and pesticides containers, batteries, shoe polish.

Biodegradable waste

The USEPA defines biodegradable waste as type of waste typically originating from plant or animal sources which may be broken down by other living organisms. Waste that cannot be broken down by other living organisms may be called non-biodegradable.

Biodegradable waste can be commonly found in municipal solid waste as green waste, food waste, paper waste, and biodegradable plastics. Other biodegradable wastes include human waste, manure sewage, slaughter house waste.

Recyclable material

Enger (2006) asserts that recyclable material may originate from home, business, or industry. They include glass, paper, metal, textile and plastics. Though analogous the composting of biodegradable waste such as food or garden waste is not typically considered recycling. These

materials are neither brought to a collection center nor picked up from the curb side sorted, cleaned and reprocessed into new products bound for manufacturing.

inert waste

It comprises of construction and demolition waste, dirt, rocks, debris. Cities characterized by continuous construction and demolition generate concrete, rocky materials example wood. Inert waste which is neither chemically or biologically reactive and will not decompose. Examples of this are sand, drywall and concrete. This has particularly relevance to landfills as inert waste typically requires lower disposal fees than biodegradable waste or hazardous waste.

The Waste Management Licensing Amendment (Scotland) Regulations 2003, as amended, include this definition for inert waste.

Waste is considered inert if:

It does not undergo any significant physical, chemical or biological transformation;

It does not dissolve, burn or adversely affect other matter with which it comes into account in a way likely to give rise to environmental pollution or harm to human health; and

Its total leach ability and pollutant content and the extent of its leachate are insignificant and in particular, do not endanger the quality of any surface water or ground water."

Domestic hazardous waste

Although the definition of hazardous waste varies from one country to another, one of the most widely used definitions is contained in the United States Resource Conservation and Recovery Act of 1976 which states that a hazardous waste is waste that poses substantial or potential threats to public health or the environment and generally exhibits one or more of these characteristics; Flammable, oxidizing, corrosibility, toxic, radio active, or exo-toxic explosive.

Household hazardous waste is waste that is generated from residential households. H.H.W. only applies to waste that are the result of the use of materials that are labeled for and sold for home use.

The following list includes categories often applied to H.H.W. It is important to note that many of these categories overlap and that many household wastes can fall into multiple categories, as mentioned below in box 1.

Box 1

- Paints and solvents.
- Pesticides,
- Mercury containing wastes like thermometer, fluorescent lighting.
- Electronics like televisions, computers
- Aerosols
- Caustics or cleaning agents
- Refrigerant containing appliances
- Batteries
- Ammunition

Source: Microsoft Encarta Encyclopedia Standard (2005)

Composite waste

Consists of waste clothing, tetrapaks waste, and plastics example toys.

2.4 Factors Influencing the Status of Solid Waste Worldwide

Reliable information about factors that may influence municipal waste arising and composition is relevant for a variety of reasons such as planning of waste analysis designs and forecasting future waste generation in a certain region.

Parameters often mentioned as affecting the arising and composition of municipal waste are social factors such as age, sex, income, educational level, size and status of family residential structure patterns such as one family houses versus multi storey houses, waste management and

organizational patterns such as source of waste example house hold waste or commercial. Waste bin size, collection system (door to door system, drop off system) separate collection, waste fees.

There are many factors that vary from place to place and that must be considered in the design of a solid waste management system (Zurbrugg 2000). These include waste amounts and composition, access to waste for collection, awareness and attitude.

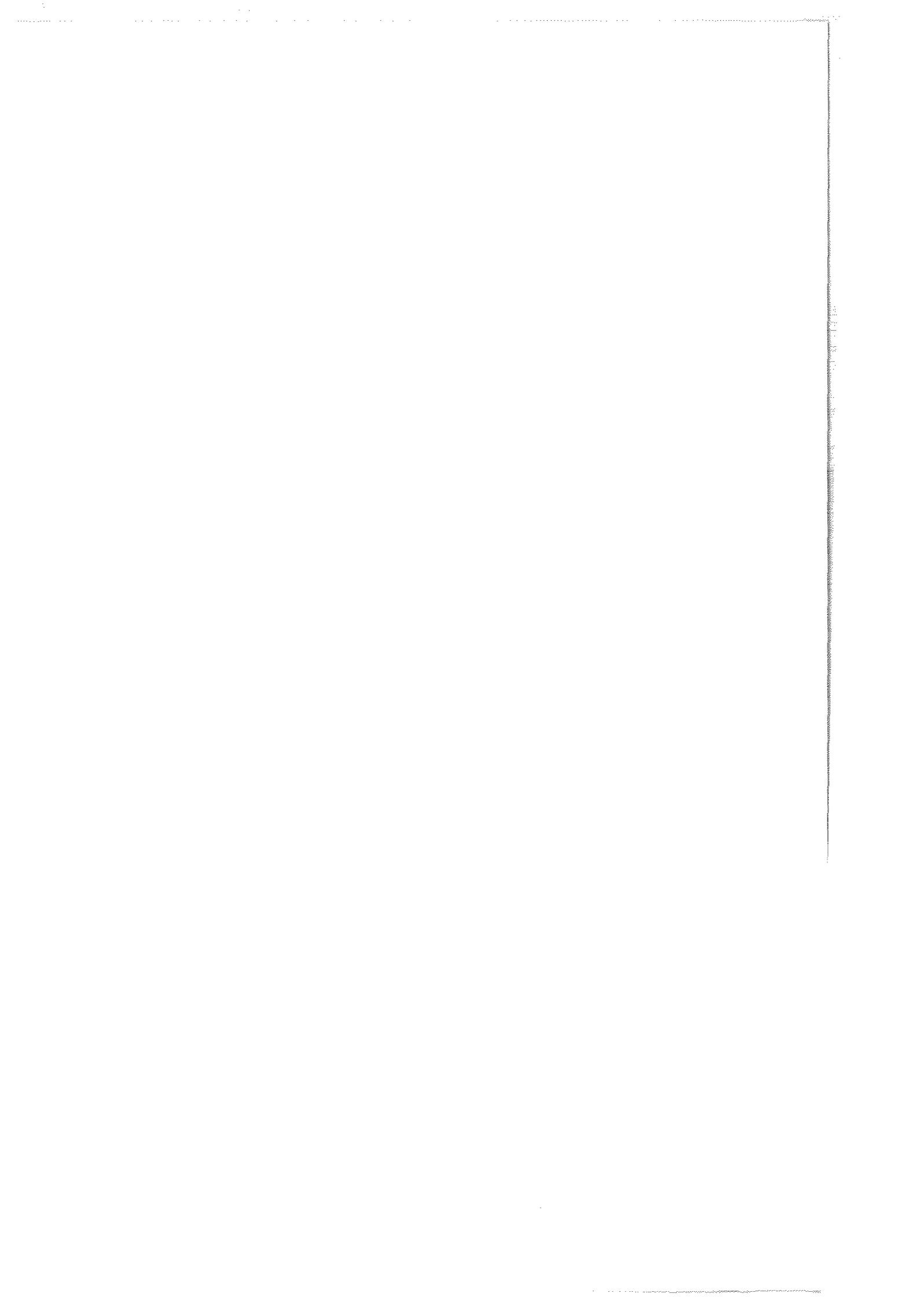
Wastes amount and composition: Domestic waste from industrialized countries has a high content of packaging made of paper, plastic, glass and metal, and so the waste has a low density. In many developing countries wastes contain large amounts of inert such as sand, ash, dust, and stones and high moisture levels because of high usage of fresh fruit and vegetables. These factors make the waste very dense (high weight per unit volume) (Glous and Kreith 2002).

According to Bertram (2000), the consequences of this high density are that vehicles and systems that operate well with low-density wastes in industrialized countries are not suitable or reliable when the wastes are heavy. The combination of extra weight, the abrasiveness of the sand and the corrosiveness caused by the water content, can use very rapid deterioration of equipment. If the waste contains a high proportion of moisture, or is mostly likely inert material, it is not suitable for incineration, and so is the treatment upon is ruled out.

Recycling or salvaging operations often reduce the proportion of combustible paper and plastic in waste before it reaches the treatment stage.

Access to waste for collection: Many sources of waste might only be reached by roads or alleys, which might be inaccessible to certain methods of transport because of their width, slope, congestion or surface. This is especially critical in unplanned settlements such as slums or low-income areas and thus largely affects the selection equipment (Ahsan and Habib 2000).

Awareness and attitudes: Schubeler and Peter et al (1999) puts that public awareness and attitudes to waste can affect the whole solid waste management system. All steps in solid waste management services, the opposition to the siting of waste treatment and disposal facilities, all



depend on public awareness and participation. Thus this is also a crucial issue, which determines the success or failure of a solid waste management system.

Institutional and legislation: As Cointreau et al (2000) stated institution issues include the current and intended legislation and the extent to which it is enforced; Standards and restrictions may limit the technology options that can be considered. The policy of governments regarding the role of the private sector (formal and informal) should also be taken into account. The strength and concerns of trade unions can also have an important influence on what can be done.

The waste management situation in the countries around the world is by no means uniform. This is because the category of countries that are now 'fine-tuning' their waste management system is a minority. Vast majority of countries are busy struggling with such basic issues as ensuring sufficient collection services and implementing a minimal degree of control at disposal sites at the same time as they are facing increasing waste amounts due to the trend of urbanization (Mwangi 2000).

Brook and Pugh (1999) also asserts that they also lack the technical and financial resources to safely manage solid wastes which includes adequate provisions for storing the waste at the point of generation as well as efficient and sufficient collection services. Final disposal in those countries is usually a matter of transporting the collected wastes to the nearest available open space and then discharging them.

Solid waste has a single problem- cost recovery. This is because; traditional, solid waste services are financed by general revenues from city taxes and levies. Consequently, many municipalities in developing countries spent a large proportion of their budgets on the collection, transportation, and disposal of solid waste. Their solid waste management is a costly service that consumes between 20 and 50 percent of available operational budgets for Municipal service, yet serves no more than 70% of the urban inhabitants (Barton and Bernstein 1993). Those who do not receive services are the low income populations concentrated in the peri-urban areas, which either do not prioritize the importance of clean environment or are caught in the abyss of poverty and have more pressing issues. Even those in decent housing areas are living next to mountain of heaps of

garbage lying uncollected. The Municipal authorities have not made sufficient efforts in educating them apart from asking for service changes.

In conclusion, there are various approaches to addressing the solid waste problem. Each country needs to study its situation and adapt approaches that are appropriate to its situation.

2.5 The impact of Poor Solid Waste Management on Human Health

Modernization and progress has had its share of disadvantages and one of the main aspects of concern is the pollution it is causing to the earth be it land, air, and water. With increase in the global population and the rising demand for food and other essentials there has been a rise in the amount of waste being generated daily by each house hold. This waste is ultimately thrown into municipal waste collection centers from where it is collected by the area municipalities to be further thrown into the landfills and dumps. However, either due to resource crunch or inefficient infrastructure, not all of this waste gets collected and transported to the final dump site. If at this stage the management and disposal is improperly done, it can cause serious impacts on health and problems to the surrounding environment (Elizabeth 2006).

Waste that is not properly managed, especially excreta and other liquid and solid waste from households and the community, are a serious health and lead to the spread of infectious diseases. Unattended waste lying around attracts rats, flies and other creature that spread disease. Normally it is the wet wastes that decompose and release a bad odor. This leads to unhygienic conditions and thereby to a rise in the health problems. The group at risk from the poor disposal of S.W. includes the population in areas where there is no proper waste disposal method, especially the pre school children, waste workers, and workers in facilities producing toxic and infectious material. Other high risk population includes those living close to a waste dump and those whose water supply has become contaminated either due to waste dumping or leakage from landfill sites (Hope 1998).

There are a number of diseases caused by poor waste disposal; these include the following.

Benenson (1990) asserts that Dengue fever (break bone fever) an acute febrile viral disease characterized by sudden onset, fever for 3-5 days (rarely more than 7, and often biphasic intense headaches, myalgia, arthralgia, retro-orbital pain, anorexia, GI, disturbance, and rash)

The incubation period is 3-14 days commonly 7-10 days. Period of communicability-not directly transmitted from person to person. Patients are usually infective for mosquitoes from the day before to the end of febrile period, an average of about 5 days. The mosquito becomes infective 3-12 days after the blood meals and remains so for life.

Susceptible and resistance-susceptibility is apparently universal, but children usually have milder disease than adults.

Measures of prevention include community survey to determine density of vector mosquitoes, to identify breeding places which for *Aedes aegypti* is usually in artificial or natural containers holding clear water close to or within human habitations e.g in old tires and to promote and implement plans for their elimination.

Davinder (1994) cites that Malaria, the most serious malarial infection *falciparum malaria* (malignant tertian) may present quite varied clinical picture, including fever, chills, sweats and headaches, and may progress to icterus coagulation defects, shock, renal and liver failure acute encephalopathy, pulmonary and cerebral edema, coma and death. It is a possible cause of coma and other central nervous system symptoms such as disorientation and delirium in any person recently returned from a tropical area.

The other human malarias, vivax (benign tertian) malariae (quartan) and ovales, generally are not life threatening except in the very young, the very old and in patients with concurrent disease or immunodeficiency. Illness may begin with indefinite malaise and a slowly rising fever of several days duration, followed by shaking chill and rapidly rising temperature, usually accompanied by headache and nausea, and ending with profuse fever and sweating is repeated, either daily, every other day or every third day.

infectious agent *Plasmodium vivax*, *P. malariae*, *P. falciparum* and *P. ovale*. Mixed infections are not frequent in endemic areas.

Man is the only important reservoir of human malaria. Non-human primates are naturally infected by many malarial species, including *P. knowlesi*, *P. cynomolgi*, *P. brasilianum*, *P. inui*, *P. schwezi* and *P. simium*, which can infect man, but natural transmission is extremely rare.

Incubation period- the time between the infective bite and the appearance of clinical symptoms is approximately 12 days for *P. falciparum*, 14 days for *P. vivax*, and 30 days for *P. malariae*.

Methods of control includes encouraging sanitary improvements (such as filling and draining areas of impounded water) that will result in permanent elimination or reduction of anopheline breeding habitats. Larvicides and biological control with larvivorous fish may be useful.

Hepatitis A Viral Hepatitis A onset is usually abrupt with fever, malaise, anorexia, nausea and abdominal discomforts followed within a few days by jaundice. The disease varies in clinical severity from a mild illness lasting 1-2 weeks, to a severe disabling disease lasting several months (rare). Convalescence often is prolonged. In general severity increases with age, but complete recovery without recurrences is the rule. Many infections are asymptomatic, many are mild and without jaundice, especially in children and recognizable only by liver function tests. The case fatality rate is low (about 0.6%) the rare death usually occurs in the older patient in whom the disease has a fulminant course. (Hobson 1969).

Infectious agent is Hepatitis A virus (HAV). The disease affects man and rarely captive chimpanzee; less frequently, certain other non-human primates. An enzootic focus has been identified in Malaysia, but there is no suggestion of transmission to man.

The mode of transmission is from person to person by fecal-oral route. The infectious agent is found in feces, reaching peak levels the week or two before onset of symptoms and diminishing rapidly after liver dysfunction or symptoms appear, which is concurrent with the appearance of circulating antibodies to HAV. Common source outbreaks have been related to contaminated

water, food contaminated by infected handlers, including sandwiches and salads which are not cooked or handled after cooking and raw or undercooked molluscs harvested from contaminated waters. Incubation period is 15-50 days depending on dose; average 28-30days.

Measures of prevention includes the following, educating the public about good sanitation, personal hygiene with special emphasis on careful hand washing, sanitary disposal of feces, providing proper water treatment, dust systems and sewage disposal.

Viral hepatitis E the epidemiology and clinical course are similar to that of hepatitis A. There is no evidence of chronic form. The case fatality rate is similar to that of hepatitis, except in pregnant women where the rate may reach 20% during the third trimester of pregnancy, epidemic and sporadic cases have been described.

Diagnosis depends on exclusion of other etiologies of hepatitis, especially hepatitis A, by serologic means. At present, a serologic test is being developed for characterized agent of hepatitis E.

Infectious agent: there is evidence that one virus family is responsible for hepatitis E. 32-nm virus-like particle has been found in stools during the early acute phase of infection with a sedimentation coefficient of 1835 (compared to 1575 for HAV) which reacts by IEM with acute phase sera from several areas around the world. It is transmitted through contaminated water and probably from person to person by fecal-oral route. The incubation period is often fifteen to 64days; mean incubation period has varied from 26 to 42 in different epidemics.

Preventive measure includes provision of educational programs to stress sanitary disposal and careful hand washing after defecation and before handling food.

According to United Nations (1990) cholera is an acute bacterial enteric disease with sudden onset profuse painless watery stools, occasional vomiting, rapid dehydration, acidosis and circulatory collapse. A symptomatic infection is much more frequent than clinical illness, especially with organisms of the eltor biotype; mild cases with only diarrhea are common

particularly among children. In severe untreated cases, death may occur within a few hours and the case fatality rate may exceed 50% with proper treatment the rate is below 1%.

It affects people and the mode of transmission is primarily ingestion of water contaminated with feces and vomits of patients, or a lesser extent, feces carriers or ingestion of unrefrigerated food which has been contaminated by dirty water, feces, soiled hands or perhaps flies. Incubation period is from a few hours to 5 days usually 2-3 days.

Methods of control: Dispose of human feces in a sanitary manner and maintain fly-proof latrines. Stress the use of sufficient latrine paper to minimize finger contamination. Under field conditions, dispose of feces by burial at a site distant and downstream from the source of drinking water.

Benenson (1990) also states that; Typhoid fever is a systemic bacterial disease characterized by insidious onset of sustained fever, headache, malaise, anorexia, a relative bradycardia, splenomegaly, rose spots on the trunk, non-productive cough, constipation more commonly than diarrhea (in adults) and involvement of the lymphoid tissues. Many mild and atypical infections occur.

Infectious agents for typhoid fever, *Salmonella typhi*, the typhoid bacillus. Presently 106 types can be distinguished by phage typing, which is the value in epidemiologic studies.

For paratyphoid fever, three serotypes are recognized *Salmonella paratyphi A*; *S. paratyphi B* (*S. scholtmulleri*) and *S. paratyphi C* (*S. hirschfeldii*). A number of phage types can be distinguished.

Mode of transmission is by food and water contaminated by feces and urine of patients carriers. Flies may infect foods which the organisms then multiply to achieve an infective dose.

Methods of control include disposal of human feces in a sanitary manner and maintain fly-proof latrines stress the use of sufficient latrine paper to minimize finger contamination. Under field

conditions, dispose of faeces by burial at a site distant and downstream from the source of draining water

Ascariasis is a helminthic infection of small intestine generally associated with few or no symptoms: - leved worms passed in stools occasionally from the mouth or nose are the first recognized sign of infection. The infectious agent is *Ascaris lumbricoides*, the large intestinal roundworm of man. A *suum* a similar parasite of pigs, rarely, if ever, develops to maturity in man, although it may be caused by larval migration. The prevalence and intensity of infection are usually highest in children between 3-8 years.

Thompson (1988) further states that the mode of transmission of ascariasis is by ingestion of infective eggs from soil contaminated with human feces. Transmission mainly takes place in the vicinity of the home, where children, in the absence of sanitary facilities, fecally pollute the area. Heavy infections in children are frequently as the result of ingesting soil. Contaminated soil may be carried long distance on feet or foot wear into the house and conveyance. Transmission of infection by dust is also possible incubation period-the life cycle requires 4-8 weeks to be completed .Feces contain fertile eggs about 60 days after ingestion of embryonated eggs.

Methods of control include provision of adequate facilities for proper disposal of feces and prevent soil contaminated in areas immediately adjacent to houses, particularly in children play areas.

2.6 Strategies to Address the Problem of Poor Solid Waste Management.

According to Srinivas (2003), strong laws and policies should be introduced and put into practice. Governments through the cleaning departments should pass a law on illegal dumping and individuals found guilty should be charged heavily. To guard against poor disposal of wastes it is vital for waste picking to be considered as a profession since individuals involved in the collection of waste help so much in keeping the environment clean. Employees working directly with the management of wastes should be put in the heavy and hazardous working category hence wage policies and hazardous allowance; labor protection must be given proper

consideration. There should also be provision of incentive scheme to encourage good habits in citizens.

The existing disposal facilities for open dumping of solid wastes which is so much dominant in the developing countries should be improved to become sanitary landfills with large capacities that can serve for adequate years. These landfills should be designed in a manner to handle both toxic and hazardous wastes (Savage et al 1998).

Community participation, co-operation and participation of the community in solid waste management are essential in implementing any solid waste strategy. Reduction, re-use, and recycling of waste cannot be successful without such an active participation as (Zurbrugg and Ahmed 2002) asserts. It is so vital for community involvement in the decision making process pertaining to solid waste management as this would lead to the success of the programme. Sorting of wastes at the source makes the process of solid waste management easy thus with the involvement of the community local industries like that of recycling may be promoted by the support of the donors, municipalities among others.

Furedy (1992) asserts that one alternative of waste management technique is the urban Poor re-use of refuse. Waste recycling is often undertaken as a survival strategy when the urban poor are unable to obtain formal employment and when non waste resources are scarce or unaffordable. By reducing the total amount of solid waste headed for the landfill or left lying to rot in the streets, recycling and composting are land saving and pollution reducing strategies. This is done appropriately when one controls his or her own solid waste either by separating the degradable from the non degradable.

Local authorities should undertake management reforms to bring to an end to unsightly areas of uncollected or illegally dumped solid waste. This would involve minimization of waste reaching the drop of points the 3Rs approach that is reduce, reuse, and recycle of wastes is gaining acceptance. Source reduction of M.S.W. involves measures such as use of existing packaging materials as opposed to producing new ones. Lengthening the usage life of products to minimize the frequency of replacement, developing alternatives for disposal of such as composting of grass

and food wastes and other compostable solid wastes from farms or markets is also a strategy. This strategy however may need changes in industrial technology and in consumer choice and preferences as well as taste (Mwangi 2000).

The Ministry of Local Government should consider offering a tax concession to industries involved in developing re usable products that will reduce solid wastes intended for disposal (Mungai 2000). The Jua Kali private an artisan group in Kenya, should be supported by the local Government since they provide an avenue for re use of old and disposal items like metals, scraps, Thus by recycling less solid wastes will be reaching the dumpsite.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This Chapter gives Ponda Mali as the selected area for the pilot study found in Nakuru District. Considered also is the research design, sample size and data collection, instruments, techniques and presentation of data.

3.2 Research Design

The problem of poor disposal of wastes in Ponda Mali slum will be looked at using variables such as, categories of solid wastes, types of wastes generated in the Slum, effects that poor solid waste management has on the human health and the local efforts to address poor waste management in Ponda Mali.

3.3 Area and Study Population

Kenya is located in the Eastern Part of Africa. It lies between latitudes 4 North and 4 South and longitude 34° East and 41° East. The country is bordered by the Indian Ocean, Somali, Ethiopia, Uganda and Tanzania. The climate is tropical along the Coast, temperate in the interior and semi-arid to arid in the eastern and northern parts of the country. The topography is characterized by a plateau which gradually rises from the sea level at the coast and peaks at Mount Kenya 5199 m in the central part of the country. The Rift Valley splits the country into two parts, the western area which is more agriculturally fertile and the eastern part which receives low rainfall. Kenya is a developing country with an area of about 569,137 km square. The urban population constitutes about 34% of the total population and is mainly concentrated in five major towns namely; Nairobi, Mombassa, Kisumu, Eldoret, Nakuru. (*Refer to Appendix IV*).

Nakuru town the provincial capital of Rift valley province with roughly 300,000 inhabitants and currently the 4th largest conurbation in the country lies about 2100 m above sea level. (*Refer to Appendix III*).

Ponda Mali is located 5 kilometers, Southeast of Nakuru town center. Ponda Mali is situated near the immediate outskirts of Githima location. It is a relatively flat area. Ndarugu stream passes through the slum and is regarded as an important resource since it provides with water especially during the rainy seasons. Ponda Mali has about 15,000 inhabitants. The border areas to the slum are Githima, Shaburb, and Ronda. The ethnic diversity of Ponda Mali is heterogeneous it comprises of different tribes in Kenya with the dominating tribes being dholuo and kikuyu. Residents in the area comprises of the self-employed who own grocery shops, hardware shops, saloons, There exists also quacks who operate clinics within the slum. Some residents are employed by the government and this forms the least number.

3.4 Sample selection and size

A number of respondents will be selected where by a sample will be of at least of 10 people per different group of respondents which will include of the residents of Ponda Mali, Health workers in the clinic, staff of the Nakuru Municipal Council, the local leaders, and the waste collectors. The total sample targeted will be 50.

3.5 Data Collection, Methods and Research Instruments

During the field research various methods will be used by the researcher to collect data. They include primary and secondary data.

3.5.1 Interview / Oral interview

The researcher will use random method in interviewing various groups of individuals in Ponda Mali slum and its nearest environs. Interviewing will ensure those that cannot fill the questionnaires by being illiterate or biased to fill in the questionnaires will be able to view in their contributions. 10 health workers will be interviewed including 10 of those involved in the waste collection, 10 individuals working for the Nakuru Municipal council will be interviewed. 10 local leaders will also be interviewed to air out their views not forgetting the local residents

who will be 10 in number. The questions will be open ended and closed ended questions. A total of 50 respondents are expected to be interviewed.

3.5.2 Observation and Photography

The researcher will use direct observation in observing various parts of Ponda Mali and its nearest environs on how the solid wastes are disposed. Various areas of interest will be observed by the researcher to see what is present and what lacks for instance type and source of waste, latrines. Further more it will help the researcher to see what is happening in the field and then compare it with the literature reviewed. Photographs for the various sites will be taken to support and give more evidence on the information obtained during the study.

3.5.3 Focus group discussion

The researcher will gather a panel of people to meet for a short duration to exchange ideas, feelings, and experiences on the research topic. This will enable the researcher to gain much information in a relatively short period of time.

3.5.4 Questionnaire

The researcher will use several questionnaire formats to gather information and data from Ponda Mali residents. Open ended questions will be used to allow for free response from the respondents. It will also be used to allow for greater depth of response. Close-ended questions will also be used where the respondents will be required to give a yes or no answer.

3.6 Procedures of collecting data

Permission to carry out the research will be obtained from Kampala international university. Also permission will be obtained from the Local Chief Officer. Questionnaire shall be administered to employees of the Nakuru Municipality, local residents of Ponda Mali, local official leaders, health workers in the Forest Industrial Training Center Clinic, and the waste collectors from the Nakuru Municipality.

3.7 Data processing and presentation analysis

Data analysis will be done using both qualitative and quantitative methods. The qualitative data will be obtained from an interview guide on focus group discussions and data from questionnaires to describe the effects of poor solid waste disposal on the human health. After collecting questionnaires and conducting of the interviews, data will be analyzed using various ways of representing statistical information this will include frequency tables, percentages, pie chart and bar graph.

CHAPTER FOUR: PRESENTATION AND INTERPRETATION OF RESEARCH FINDINGS

This Chapter presents the research findings on the impacts of solid waste on human health, the types of wastes generated in Ponda Mali, and the measures which have been taken to address the problem of poor solid waste management.

4.1 Introduction

Municipal solid waste management consist of all the material that people in a region no longer want because they are broken spoiled or have no further use. It includes wastes form households, commercial establishments' institutions and some industrial sources. Municipal Solid Waste Management (MSWM) encompasses the function of collection, transfer, resource, recovery, recycling and treatment. The primary target MSWM is to protect the health of the productions, promote environmental qualities develop sustainability and provide support to economic productivity of Ponda Mali slum.

To meet these goals sustainable solid waste management system must be embraced fully by the local authorities in collaboration with both the public and private sectors. This Chapter is going to look at following variables in detail and see how they can help in reaching the above targets. The variables includes the major types of solid waste in Ponda Mali slum, the effect of this solid waste on the human health the local efforts to address poor waste management in Ponda Mali slum.

4.2 Major types of solid waste in Ponda Mali slum.

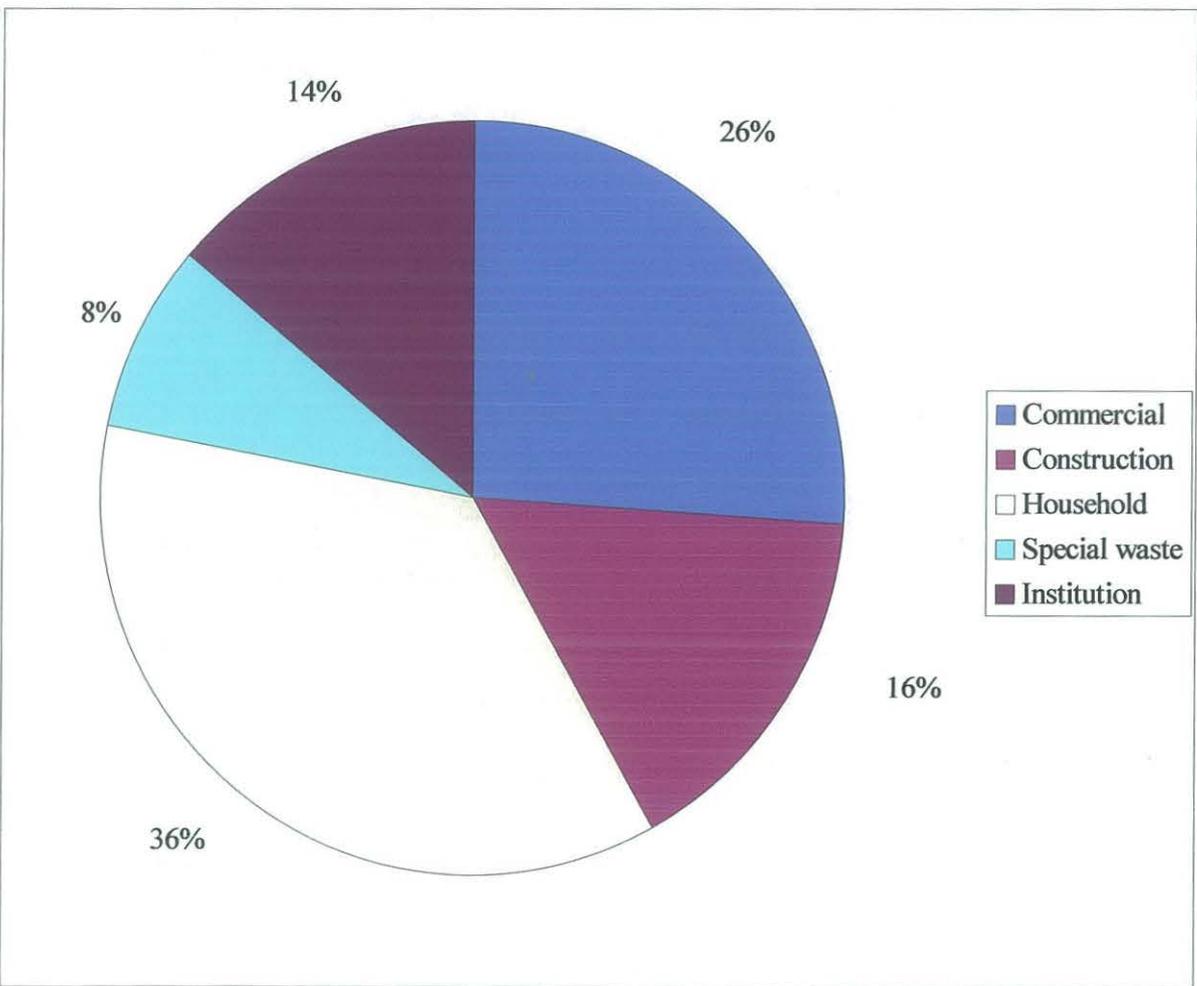
In Ponda Mali slum there are various types of solid waste generated ranging from construction waste, commercial waste, household waste, institution and special waste. All these types of waste require proper management so as to enhance health.

Table1: Types of solid waste in Ponda Mali slum

Types of solid waste	Number of respondents	Percentage %	Rank
Commercial	13	26	2
Construction	08	16	3
Household	18	36	1
Special waste	04	8	5
Institution	07	14	4
Total	50	100	

By_researcher in the field

Fig 1. Pie chart showing types of solid waste



Household or domestic waste

The highest source of solid waste in Ponda Mali slum is domestic households, it accounts for 36% and ranked number one (*Refer to Table 1*). Food left over is the highest in percentage, since there are no particular points of dumping. The residents tend to throw food remains, polythene wrappers any where. People of the area also lack proper latrine facilities such as improved latrines and instead the residents opt for flying latrines and this is major problem in the slum.

Plate 1: Picture showing how solid waste in the slum mainly compose of household Waste



By researcher in the field

Special waste

Around the Ponda Mali slum there are numerous unqualified doctors that operate clinics. They lack where to dispose off their special waste. This solid waste accounts for 8% and ranked number five.

The waste contains used syringes, plastic bottles, medicine, and bandages among others which eventually end up in the slum.

Commercial waste

Another source of solid waste is usually from the commercial places in Ponda Mali this is usually from the market center known as Soko Mjinga and from shops. Commercial waste accounts for 26% and ranked number two (*Refer to Table 1*). This is more evident in the Ponda Mali shopping centre where the dumping containers usually overflow with waste from the adjacent shops. Due to the inadequacy in collection by the municipal council, the waste in the commercial places usually accumulates at high rates.

Construction waste

This type of waste accounts for 16% and is ranked number three (*Refer to Table 1*). New structures are always being erected either the residents replacing the former temporary structures with permanent ones.

Institutional waste

This type of waste is usually generated from schools around the slum area. It accounts for 14% and is ranked number four (*Refer to Table 1*). There are usually a number of schools in the area ranging from nursery to primary schools. The waste found in these schools mainly comprises of paper sanitary towels and many more. This waste gets its way to the slum environment mainly because the schools are not fenced and have poor management skills on the waste.

4.3. Effects of Poor Solid Waste Management on Human Health

Poor health safety issues have arose in Ponda Mali slum due to improper solid waste management. Human fecal matter is commonly found in the slum area either in busted sewer or

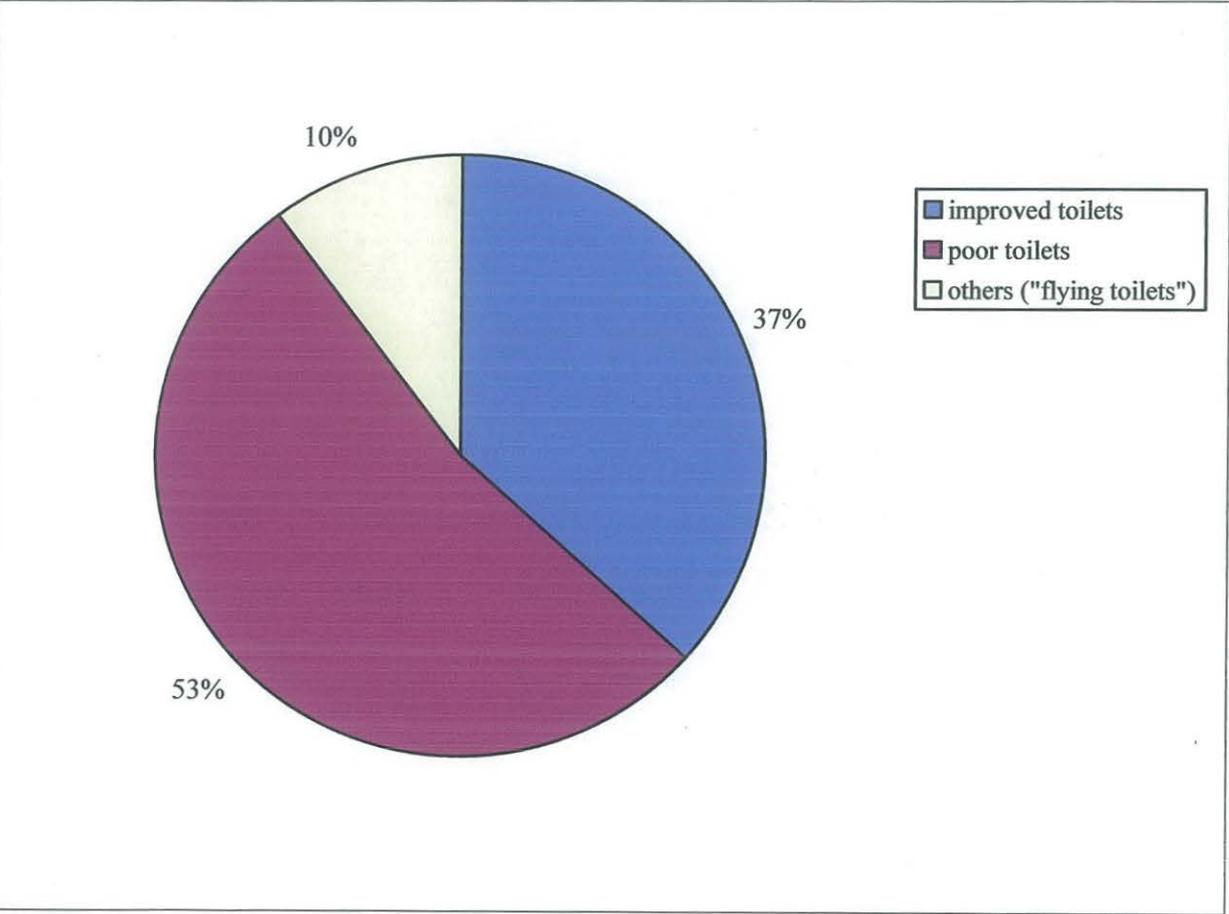
overflowing latrines. Because of this insect and rodent vectors are attracted to the waste and spread diseases.

Table 2: Latrine facilities in Ponda Mali slum

Types of latrines	Number of respondent	Percentage
Improved latrines (hygienic)	18	36
Poor latrines (unhygienic)	27	54
Others (flying latrines)	5	10
Total	50	100

By researcher in the field

Fig 2: Latrine facilities in Ponda Mali slum



In Ponda Mali slum improved latrines accounts for 36 % (*Refer to Table 2*). Poor latrines accounts for 54 % (*Refer to Table 2*) and others accounts for 10% (*Refer to Table 2*). Improved latrines are those with cemented floors, walls and roofs which are either cemented or of corrugated iron sheets while poor latrines are those roughly built using mud, sacks, banana fibers or cardboard boxes (cartons). Others include flying toilets whereby individuals defecate in containers or polythene bags and hurl it anyhow. This is a common behavior in Kenyan slums due to lack of places where people can ease themselves. Residents in the slum despite others accessing improved latrines the way of managing the latrines is still poor resulting to unhygienic latrines that is a threat to human health.

Plate 2: showing flowing sewage sludge in contact with water pipe



By researcher in the field

The residents in the slum have exhibited an indifferent attitude when it comes to proper handling of waste materials. This is seen through the careless disposal of household wastes behind houses and even along the roads and the situation becomes worst when it rains since it is the wet wastes that produce foul smell attracting houseflies and resulting to unhygienic conditions.

Plate 3: showing household waste dumped behind a house.



By researcher in the field

On visiting one of the government dispensaries near the slum area the most reported diseases are diarrhea, cholera, dysentery, helminthiasis and typhoid with children under the age of five years being most infected. This is because children are mostly found outside homes playing while consuming anything they come across.

Table 3: The flow of out patients in FITC dispensary

DISEASE	UNDER FIVE	% OF OPD CASES	ABOVE FIVE	% OF OPD CASES	TOTAL CASES
Diarrhea	876	73.7	312	26.3	1,188
Helminthiasis	779	79.2	204	20.8	983
Typhoid	251	48.4	268	51.6	519
Dysentery	113	62.8	67	37.2	180
Cholera	04	17.4	19	82.6	23

Source: HIMS report of July 2007-Dec 2007

From (Table 3), the results depicts that Dysentery mostly affects children under the age of five years followed by Helminthiasis then Typhoid, Dysentery, and finally Cholera. From the (Table 3) children under the age of five years are infected much by the above mentioned diseases than those over the age of five apart from cholera because they are fond of playing outside not minding of what they come across as they play. This implies that effort needs to be put in place by the local residents of Ponda Mali slum in ensuring proper sanitation in the slum. Most of these diseases can be minimized from occurring if only the local residents of Ponda Mali can embrace proper management of solid wastes especially through community participation.

It was observed women fetch water for domestic use from Ndarugu stream that passes through the slum and the stream is polluted by wastes from the slum. In asking the women whether they boiled the water for drinking a majority of the women rarely boil water and the reason was that of financial constrain. The women asserted that the cost of cooking fuel is expensive for them and thus cannot afford to boil water every day.

Plate 4: The pollution upstream in Ndarugu stream



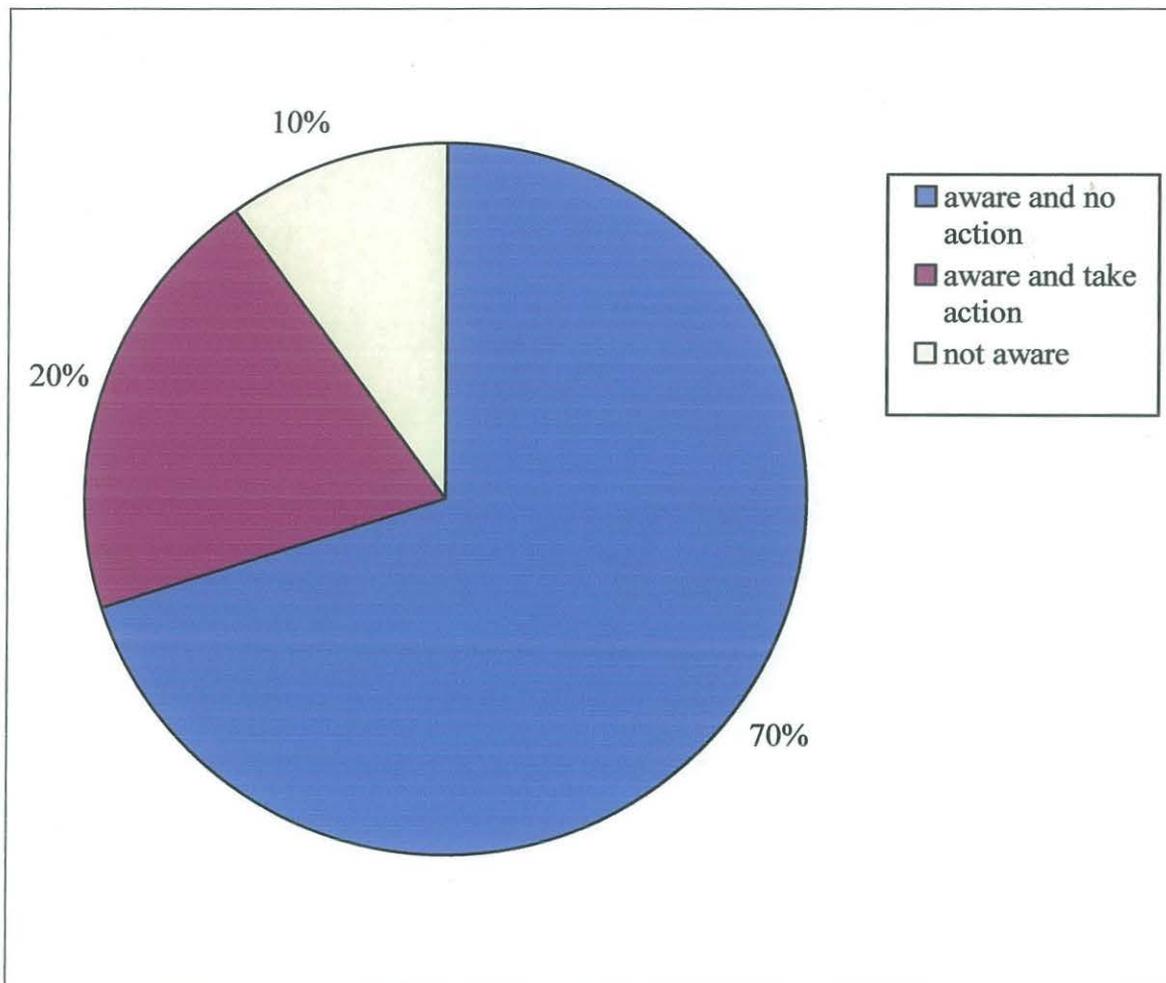
By researcher in the field

Table 4: Awareness and action on poor solid waste management in Ponda Mali slum

Awareness and action on poor solid waste management (P.S.W.M)	Number of respondents	Percentage
Aware and take action	10	20
Aware and no action	35	70
Not aware	5	10
Total	50	100

By researcher in the field

Fig 3: Awareness and action on poor solid waste management in Ponda Mali slum



In Ponda Mali slum there exists a big problem when it comes to taking action on the management of solid waste. Residents in the slum, who are aware of the effects of poor disposal of wastes and take no action accounts for 70% (*Refer to Table 4*). Residents who are aware and take action accounts to 20% (*Refer to Table 4*). Those not aware at all of the effects of poor disposal of wastes accounts for 10% (*Refer to Table 4*). The category of residents who are aware of the effects of poor waste disposal and take no action refers to those who are not concerned with management of wastes and thus do not mind about waste management hence do not bother. those who are aware and take action are involved in the management of wastes and have joined the local waste management groups, for example, Kinamama Pamoja and Undugu groups. Those not aware are the ones without any idea on proper waste management and therefore have to be educated on this. This then calls for serious sensitization to the residents of Ponda Mali to manage their wastes.

Plate 5: Showing women fetching water from Ndarugu stream that is heavily polluted upstream



By researcher in the field

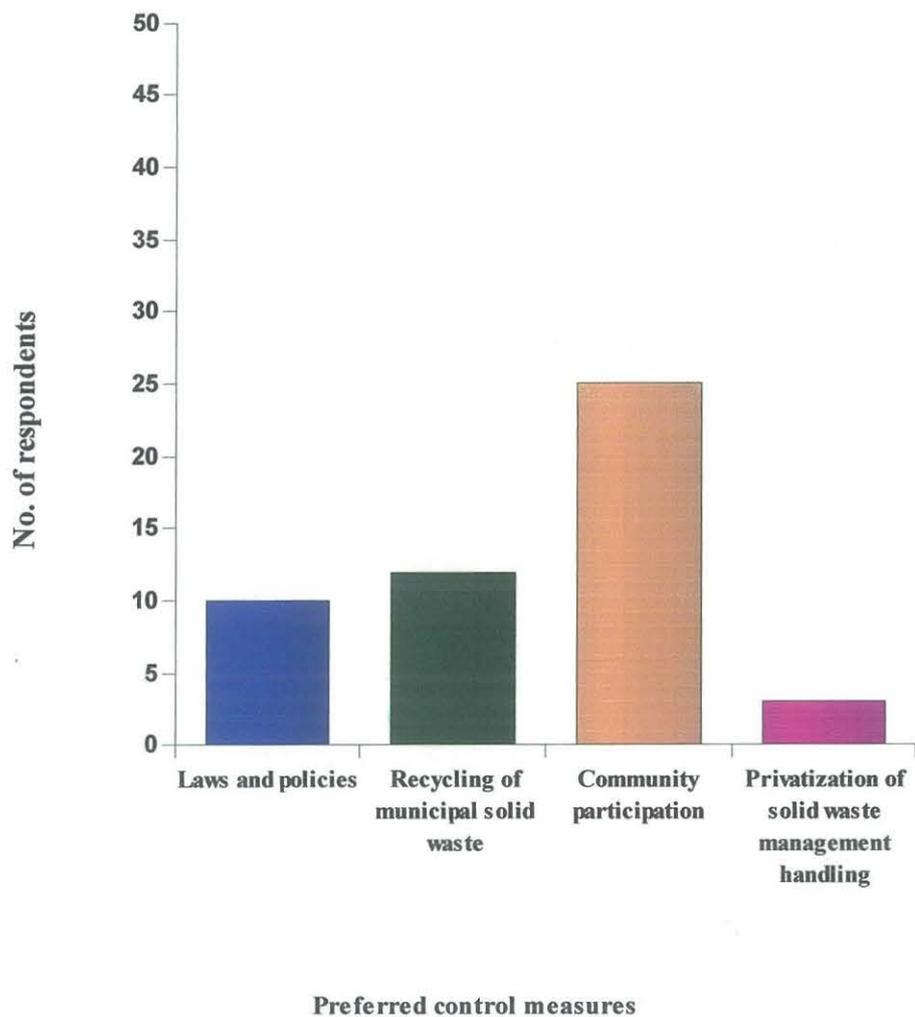
4.4 Control Measures for Solid Waste

Table 5: showing type of preferred control measures of solid waste as per the respondents

Type of control measures	Number of respondents	Percentage
Laws and policies	10	20
Recycling of municipal solid waste	12	24
Community participation	25	50
Privatization of solid waste management handling	3	6
Total	50	100

By researcher in the field

Fig 4: Bar graph showing type of preferred control measure of solid waste in Ponda Mali slum



The problems faced in handling of municipal solid and liquid wastes can be solved only if there is concerted effort from all sectors of the society. Waste is everybody's business, we all produce unwanted by products and residues in merely everything we do thus it is the responsibility of every resident to act positively towards handling of wastes. An important approach should be adopted in order to achieve any meaningful and lasting solution. Discussed below are important approaches that might bring about solution in the slum concerning the disposal of wastes in the slum as per the respondents.

4.4.1 Community participation

This type of control measure accounted for 25% of the respondents which was the highest (*Refer to Table 5*).

A majority of the residents urged that Co-operation and participation of the community in solid waste management is essential in implementing any solid waste management strategy. In fact, the residents urged that community involvement in the decision making process in developing solid waste management strategies should be encouraged at its inception in the slum to make the implementation of any solid waste management programme a success.

The best example of community participation has been done by the Kinamama Pamoja group in Ponda Mali slum. Homes in Ponda Mali slum are often surrounded by garbage and waste which cause diseases that cripple or kill many of the slum dwellers. It was started in the years 2000 as a small self help project consisting of only local women to organize for slum clean up activities. The kinamama Pamoja group did not have few members for long. In 2002 it expanded and consisted of other well wishers like men, business individuals in Nakuru town who saw the need to join and help. The group now is registered under the society's act of Kenya as a government non profit and non-political organization.

The Nakuru Municipal Council does not have an office policy on community involvement in waste management but does participate actively in several communities clean up programs. Community responsibility is promoted by the Kinamama pamoja group through clean up carried out once a week on Saturdays in the various sections in the slum. Garbage is collected and removed and drainage ditches are cleared with the aid of the groups cleaning equipments. The idea behind the clean up stemmed from the concern that residents especially the young children often fall sick now and then from communicable disease like cholera dysentery because of poor disposal of wastes.

The Kinamama pamoja group has strived to promote conservation as a source of livelihood for the poor. The group is involved in the composting of community organic waste. The group in Ponda Mali also operates a demonstration garden plot where the benefits of compositing are

demonstrated. Although the composting activity of the composting group is self financing the group has financial problems because the sale of compost is not a sufficient source of income for long term capital investments. They also derive their incomes from membership fees and donations from non governmental organizations or individuals that visit that sites however these sources are unreliable and unpredictable. Seasonal variation in the demand for compost cause financial problems. The group needs assistance in the wider marketing of their compost and promotion of the virtues of composting to urban residents. The compost group has not had access to credit facilities such as bank loans because they lack securities. Development research also indicates that women groups are often discriminated by financial institutions (UNEP 1985).

In Ponda Mali slum area comprises a higher percentage of readily biodegradable matter with the non biodegradable waste being of a low percentage this composition makes the wastes suitable for composting after sorting. The main aim of composting is to convert a major proportion of solid waste into manure.

The Kinamama pamoja group have really tried in the composting activity as this activity have indeed reduced on the quantity of solid wastes that could be accumulating leading to the rapid spread of communicable diseases. This is because composting reduces open occurrence of garbage in narrow streets resulting in reduced population of rats, mice, snakes, cockroach, mosquitoes and flees and also prevents blockage of drainage. Above all the group has made use of the available resource that is the biodegradable waste that is converted to manure and sold to farmers earning them money for survival.

4.4.2 Laws and policies

It accounted for 10% of the respondents (*Refer to Table 5*). Some respondents urged that strong laws and policies should be introduced and put into practice government through the cleaning departments should pass a law on illegal dumping and individual's found guilty should be charged heavily.

According to some respondents they proposed that to orientate and guard against poor solid waste management major orientations for S.W.M policies in particular and for environmental protection in general should include the following:-

According to the waste collectors and the general workers in the Municipal council and the local leaders, waste collection should be considered as a profession since individuals involved in the collection waste help so much in keeping the environment clean. Employees working directly with the management of wastes should be put in heavy and hazardous allowances; labor protection must be given proper consideration. There should also be provision of incentive schemes to encourage individuals dispose their wastes properly this will make the waste collectors appreciate their work and thus work to perfection ensuring clean environment.

4.4.3 Recycling of municipal solid waste

It accounted for 12% (*Refer to Table 5*). Some respondents urged that, with the increasing cost of raw materials, recycling provides a cheaper source of raw materials for manufacturing industries. Sorting and separation of municipal solid waste is gaining importance in various sectors. A visit to the MSW dumpsite reveals intense scavenging for recyclables in the disposed waste. Scavenging initially was driven by poverty and a desire to earn a living, but the emergence of recycling industries has given a boost to search for recyclable in the dump sites.

In Nakuru, a number of non governmental organization and community based organization such as the Undugu group in the slum area of Ponda Mali have got involved in projects aimed at improving the livelihood of unemployed individuals through mobilization towards self employment groups. The Undugu group is engaged in collecting recyclable materials such as paper, metal scraps and plastics which are sold to generate some income.

According to the residents, community participation co operation and participation in S.W.M is essential in implementing any solid waste strategy. Reduction, reuse and recycling of waste cannot be successful without such an active participation, it is so vital for community involvement in the decision making process pertaining to solid waste management as this would

lead to the success of the programme. Sorting of waste at the source makes the process of S.W.M easy thus with the involvement of the community local industries like that of recycling may be promoted by the support of the donors, municipalities among others.

4.4.4 Privatization of solid waste management handling

It accounted for 3% of the total respondents (*Refer to Table 5*). To improve management of municipal solid waste collection and disposal in the slum area some respondents were suggesting privatization of solid waste handling in that the Nakuru municipality should enter in a contract with a suitable firm that will provide and operate a solid waste collection service covering refuse collection, storage, and transportation. The firm should implement a cost recovery mechanism through charging collection fees to make the service sustainable. Private municipal solid waste may be expensive as it can only be sustained by highly monthly charges. With privatization of M.S.W. services in the upper to middle income areas, local authorities can then divert some of the services to the poor urban areas communities where private services may not be affordable. This would work very efficiently in Ponda Mali slum as per some respondents.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

From the research findings the major sources of solid waste in Ponda Mali slum can be classified into five categories. Households' wastes which form the highest percentage of wastes generated in the slum and accounts for 36% (*Refer to Table 1*). It contains food remaining wrappers, and even containing fecal matter. Commercial waste which accounts for 26% (*refer to table 1*) include wastes from market areas for example polythene bags and fruit peelings. Special wastes which accounts for 8% (*Refer to Table 1*) include syringes, medicine bottles from clinics and dispensary. There is also waste from construction sites in form of debris accounting for 16% (*Refer to Table 1*) resulting from the constant construction of semi permanent houses in the area. There is institutional waste which accounts for 14% (*Refer to Table 1*) and is from the schools in the area, such as Githima primary school, Mwariki primary school.

A majority of the respondents that accounted for 70% (*Refer to Table 4*) knew that poor solid waste management could lead to some dangers namely diseases, breeding disease vector, flooding and foul odors and took no action of managing their wastes. 47% of the residents knew that diseases like diarrhea, dysentery, helminthes, cholera and typhoid are associated with poor solid waste management. More than 33% of the respondents reported that at least one member had suffered from diarrhea, helminthiasis, typhoid, and dysentery with the biggest proportion of the cases being children at the age of 5 years and below. This is because children are fond of playing outside not minding of what they handle as they play. Latrines in the slum are still poorly managed and this calls for community sensitization on proper management of latrines. Poor latrines accounted for 56% (*Refer to Table 2*).

The Kinamama Pamoja group has so much tried in handling of the waste in the slum but still the problem of poor disposal of waste still exists. This is because the group still needs assistance in

terms of finances to keep it going. The group needs assistance in the wider marketing of their compost manure to the urban farmers.

The Undugu group recycling or recovering activities have proved promising to the under reemployed population in the slum. However, the major constraints are lack of adequate financial resources and technical capability.

The research also looked at the possible control measures for solid waste in the slum area. Some residents had certain suggestions that included privatization of solid waste management handling which accounted for 3% (*Refer to Table 5*). Community participation accounted for 25% (*Refer to table 5*). Laws and policies accounted for 10% (*Refer to Table 5*). While recycling of wastes accounted for 12% (*Refer to Table 5*).

Community participation and recycling of wastes have been much embraced and shows promising outcomes to the management of solid waste in Ponda Mali slum and needs support financially to keep them going.

5.2 Recommendations

Solid waste management is still poor in Ponda Mali slum, and measures must be put in place. 70% (*Refer to Table 4*) of the residents in the slum are aware about the dangers of poor solid waste management and fail to take action with concerted efforts of the public and private sectors together with the commercial and effective and sustainable solid waste management system can be established. This can be done through the following means.

5.2.1 Community participation

It ensures promotion of better living strategies for individual's family and the community. Community participation is necessary because there are different beliefs, customs and practices which may affect the acceptability if they are not involved in planning in order to stimulate the participation of community it is important that the health worker knows who are involved in

decision making, the political set up, influential leaders, the organizations and groups in that community.

The people in Ponda Mali and its environs should be made aware that proper management of wastes is to control the spread of communicable diseases so that they become involved right from the start. The information about disease transmission and how to control it should be passed to the community through meetings called by the chief assistant chief or head man. The leaders of the community of Ponda Mali slum should be given the respect which they are entitled to. This is the best way to ensure that active understanding is there from the start. When a sanitation program is to be introduced the health worker should use the community leaders when it comes to decision making. These leaders are the key personalities who will involve the community in prioritizing the health problems affecting them. This is important because the community and their leaders will then be involved in planning and implementing the program. The community should be involved from the beginning to the end of the program. This will enable them to see how the program is going to assist them in solving their health problem. After first giving the reason for controlling disease transmission the health worker should continue to make the community understand the operation and maintenance of the whole program so that it can be accepted and will continue to be used.

5.2.2 Defining clear roles of relevant agencies in the management of solid waste

Better coordination for effective implementation of a solid waste management collaborative project is also required by the various agencies involved in solid waste management in Ponda Mali slum. However, many solid waste management projects within the Nakuru Municipal Council and Ponda Mali itself suffer from the lack of coordination among the relevant agencies, which often results from the lack of clear roles defined for these agencies in solid waste management. To ensure effective institutional support for a collaborative project for solid waste management, the roles and responsibilities of the various agencies involved should be defined clearly and a coordination mechanism be established. A working group involving officials from the various agencies can be set up to discuss initially the roles and responsibilities of their respective agencies, and the working group can be later upgraded to an administrative committee or task force.

5.2.3 Supporting strategic planning and follow-up implementation

Overall solid waste management plans in Ponda Mali slum are essential for utilizing limited resources most effectively, and providing a frame of reference for potential external support like the well wishers who would want to extend a helping hand in the management of wastes in the slum. Therefore, the formulation of strategic plans in Ponda Mali slum for solid waste management should be considered at the initial stage for the sustainability of a solid waste collaborative project.

5.2.4 Developing self-financing schemes

The Municipal Council of Nakuru has limited funds for solid waste management and must develop measures to reduce and recover the expenditure and increase revenues where possible. They need to turn their solid waste management systems to more self-financing programmes. External support can be effectively used to develop different alternative cost-recovering and revenue-raising schemes (example waste minimization, deposit-refund system for recyclable materials, collection of user service charges, etc.) and implement pilot studies on these economic incentive measures so as to ensure a sustainable solid waste management scheme.

Private sector participation in solid waste management collection and disposal services is also a way to reduce the financial burden of the Municipal Council of Nakuru. It can draw not only investment finance from private companies for solid waste management equipment and facilities, but also managerial expertise and technical skills.

5.2.5 Raising awareness of the public and decision makers

Effective management of solid waste requires the cooperation of the general public. Lifting the priority of, and allocating more resources the solid waste management sector needs the support from decision makers in Ponda Mali slum. It is therefore important to ensure that public and decision makers' awareness activities are incorporated in Ponda Mali slum. The aim of these activities is normally long term and it takes some momentum to build up before the effects are

realized. However, once the interests of the public and decision makers in improving solid waste management are created, the sustainability of solid waste management projects will be significantly improved.

APPENDIX I:
LETTER OF INTRODUCTION FROM FACULTY



**KAMPALA
INTERNATIONAL
UNIVERSITY**

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E-mail: admin@kiu.ac.ug * Website: <http://www.kiu.ac.ug>

FACULTY OF SOCIAL SCIENCES

To.....
.....
.....

This is to introduce to you Mr/Miss
who is a bonafide student of Kampala International University. He/She is
working on a research project for a dissertation, which is a partial requirement
for the award of a degree. I here by request you, in the name of the University,
to accord him/her all the necessary assistance he/she may require for this
work.

I have the pleasure of thanking you in advance for your cooperation!

Yours sincerely,



**APPENDIX II:
QUESTIONNAIRES**

QUESTIONNAIRE A

Section A: Personal Information

Age.

- a) 18 – 25
- b) 26 – 33
- c) 34 – 41
- d) 42 – 49
- e) 50 and above

Sex (please tick the appropriate)

- a) Male
- b) Female

Number of household members.....

Occupation.....

Educational Level

- a) None
- b) Primary 1-Primary 8
- c) Secondary
- d) Advanced
- e) University

Section B: Types of wastes generated in Ponda Mali slum

Residents of Ponda Mali Slum

1. Is solid waste a problem in your area? (please tick appropriate)

- a) Yes
- b) No

2. What type of solid waste do you generate the most?

- a) Organic example food remains
- b) Inorganic example papers, polythene bags, syringes, metals

c) Others.....

3. Which categories and materials make up the largest amount of your waste?

- (a) Commercial
- (b) Construction
- (c) Household
- (d) Special waste
- (e) Institution

4. How much of what you discard could be reused or recycled

- (a) 25%
- (b) 50 %
- (c) 75 %
- (d) 100 %

5. Are there ways that you could reduce your trash generation?

- a) Yes
- b) No

If yes please specify

6. How many times in a week is the collection service done by the Municipal Council?

- (a) Once
- (b) Twice
- (c) None

Section C. Effects of poor disposal of waste on human health

Residents of Ponda Mali slum

7. Which diseases do you think are caused by poor disposal of solid waste in this area? (Please state)

.....
8. Have you ever suffered from any disease due to the poor disposal of wastes?

- (a) Yes
- (b) No

If yes please state the disease(s).....
.....

9. Is there any person you know who has died from any disease caused by poor solid waste disposal?

- (a) Yes
- (b) No

10. Do you experience any bad smell in your area?

- (a) Yes
- (b) No

Section D. Local efforts to address poor waste management in Pondamali Slum
Residents of Ponda Mali / Local Leaders

11. Do you have any other method of disposing or managing solid waste?

- (a) Yes
- (b) No

If yes: (please state)
.....
.....

12. Is this method effective in terms of environment friendly?

(a) Yes

(b) No

13. Are you enrolled in any Environmental Organization?

(a) Yes

(b) No

If yes: (please state the organization).....

14. Have you seen any improvement in terms of solid waste management in the area that is advocated by the organization?

(a) Yes

(b) No

If yes: (please state the progress)

15. What other measures do you think can be undertaken to solve the problem of poor solid waste management in this area? Please specify.....

SECTION E: Advancing other possible solutions to address the problem of waste in

Pondamali slum

Residents of Ponda Mali slum/ Local Leaders

16. What can be done to control the problem of poor solid waste management?

17. Despite the named solutions, the problem of poor solid waste management is persisting in the slum.

Do you think it can be solved?

If yes please explain how it can be solved.....

.....

.....

If no why

.....

.....

QUESTIONNAIRE B:

Health Workers

1. How many patients suffering from communicable disease in average visit the clinic in a day?

.....

.....

2. Amongst the patients who visit the clinic what age range bears the majority?.....

.....

3. What measures do you think can be put in place in order to reduce on the number of patients who visit the clinic?

.....

.....

.....

Waste Collectors

4. How many times in a week is waste collection service done in Pondamali slum?

(a) Once

(b) Twice

(c) None

5. Do you appreciate your work as a waste collector?

(a) Yes

(b) No

If (No please specify why).....

6. Are there measures that should be put in place in order to make your working conducive?

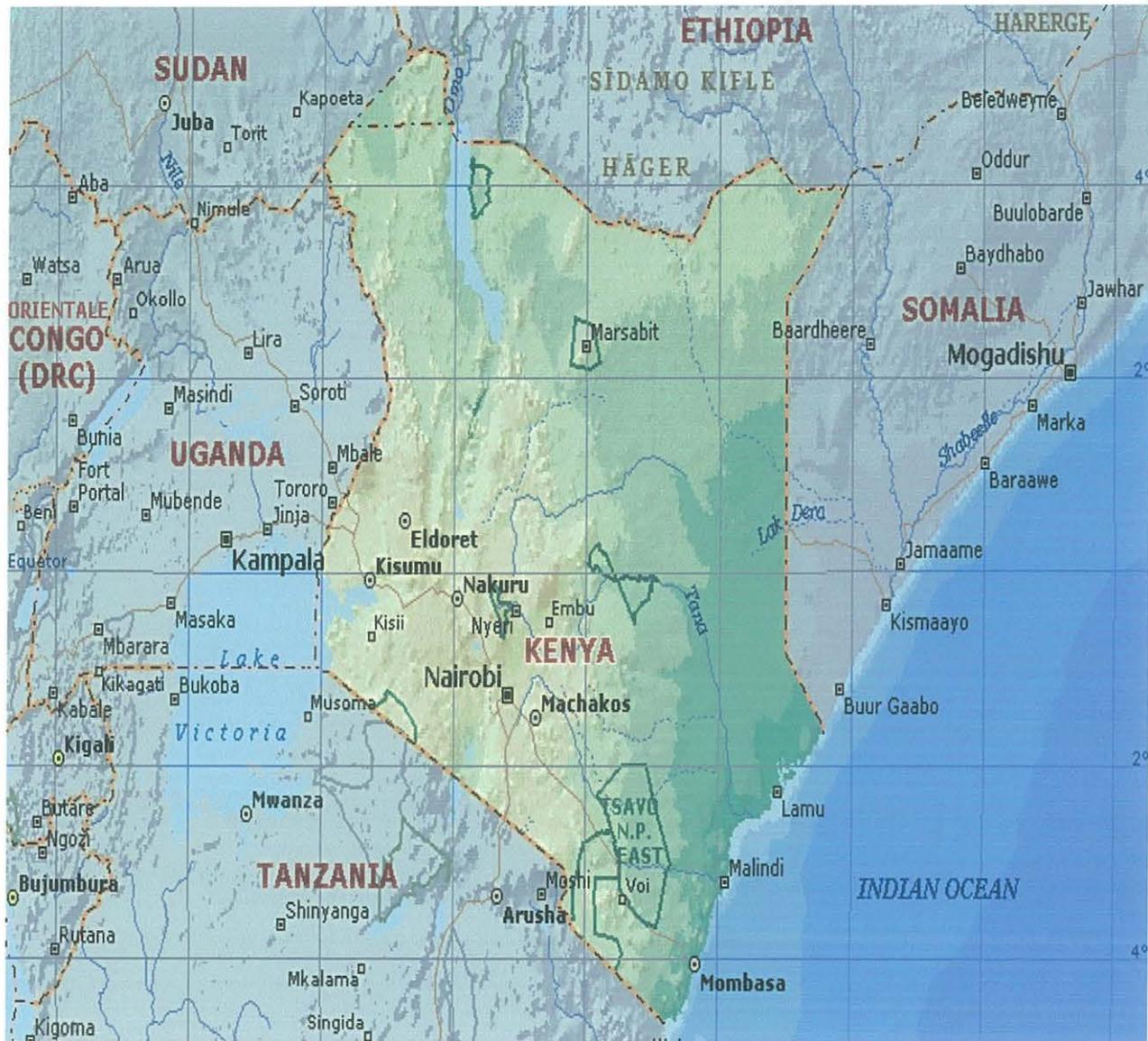
(a) Yes

(b) No

If yes (please specify).....

.....

APPENDIX III
MAP OF KENYA SHOWING NAKURU DISTRICT



Source: Microsoft Encarta Encyclopedia Standard (2005)

APPENDIX IV

MAP OF KENYA SHOWING PROVINCES WITH THEIR HEADQUARTERS



Source: Microsoft Encarta Encyclopedia Standard (2005)

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