

Assessment of Solid Waste Management among Households in Kaptembwa Location in Nakuru West Sub-County, Nakuru County, Kenya

¹Bett, J.K., ²Esilaba, M.O., ³Makindi, S.M.

¹Department of Environmental Health Sciences, Mount Kenya University, Kenya

^{2,3}Department of Environmental Science, Egerton University, Kenya

Abstract: Solid waste disposal remains one of the major challenges of urbanization in developed and developing countries. The sanitary state of an area, particularly the sub-urban areas is influenced by waste handling practices by the residents and the measures put in place for safe waste collection and disposal. The objective of this study was to assess disposal mechanisms of solid waste among households in Kaptembwa location in Nakuru West Sub-County. The research adopted social inquiry design where a structured questionnaire was administered to household heads, oral interviews and focus group discussions were also conducted. The unit of analysis was the household selected in four estates. The study population was 400 households and a sample size of 200 households. The selection of the household units for data collection was based on simple random sampling. The data was analyzed using the Statistical Package for the Social Sciences (SPSS) computer software (version 17) and results presented by descriptive statistics (graphs and tables). Inferential statistics was also used to show the relationships between independent and dependent variables. The findings and recommendations of this study provide information not only to the Kaptembwa residents but also residents living in low income of urban and peri-urban areas to adopt best practices in solid waste management to improve environmental quality and enhance the health status by reducing the incidence of disease outbreaks. This can be achieved by the implementation of some key research recommendations which includes use of smart shopping to avoid the excess use of polythene bags, proper sorting and storage of waste, using improvised storage receptacles such as disposable cartons and dust bins as well as engaging the Community Based Organization (CBO) dealing with waste collection, transportation and disposal.

Keywords: Solid Waste Management, Community Based Organization (CBO), Statistical Package for the Social Sciences (SPSS).

1. INTRODUCTION

Solid waste is defined as unwanted remains, residues discarded, and material or by products which are no longer required by the initial user. These materials are by-products of human activities such as process of preparation, manufacture, packing, repacking, unpacking, construction, renovation of structures and mining operations (Flintoff, 1984). Waste is considered to be something which is no longer wanted in a given place and time, which has no current market value and since solid waste is perceived as having little or no value, there is little incentives to handle it carefully and there is a temptation to relinquish responsibility from it at the earliest opportunity, (Rukunga,2001). Solid wastes include trade waste, agricultural waste, institutional waste, domestic waste, construction debris and waste from mining operations (Tekele, 2004).

Waste management is the collection, transport, processing, recycling or disposal or monitoring of waste materials (Teka, 1997). Most authorities give attention to liquid waste giving little attention to solid waste management. Household waste is one of the most difficult sources of solid waste to manage because of its diverse range of composite materials. A substantial portion of waste is made up of garbage, which arises from the preparation and consumption of food and

consists of waste food, vegetable peelings and other organic matter. Other components of household solid waste include plastics, paper, glass, textiles, metals and some hazardous waste from household products such as paint, garden pesticides, pharmaceuticals, fluorescent tubes, personal care products, batteries containing heavy metals and discarded wood treated with dangerous substances such as anti-fungal and anti-termite chemicals(UNCHS,1998).

It is estimated that in 2006 the total amount of Municipal solid waste (MSW) generated globally reached 2.02 billion tonnes, representing a 7% annual increase since 2003 (Sharloy,2006).It is further estimated that between 2007and 2011, global generation of municipal waste rose by 37.3%, equivalent to roughly 8% increase per year. The Basel convention estimated that about 318 and 338 million tons of hazardous and other waste were generated in 200 and 2001 respectively (UN, 1992). As per the WHO estimations, the total health care waste per person per year in most low –income countries, ranges between 5kg to 3kg (WHO,1999).

Waste is considered to be something which is of no value in a place and time and should be discarded or disposed off. Because waste is perceived as having little or no value, there is little effort and input in its management. In developed countries, forward planning, technical resources, sound financial resources and fairly static population growth have meant that the provision of adequate facilities is possible. However in developing countries like Kenya, most urban authorities have to function under pressure as a result of rural-urban migration that results in increase in generation of solid waste. This rapid accumulation of solid wastes poses major constraints to the collection, handling, transportation and disposal methods available. Most disposal methods are simply crude dumping in open grounds that is a health hazard. Kaptembwa the study area is one of densely populated estate in Nakuru West Sub-County, with high number of semi-permanent buildings and improper solid waste management. The waste is blown about by wind and most of the waste scatters everywhere, resulting in blockage of drains. The situation is made worse during the wet season and since the study area is situated on a valley, it receives most of the surface run-off loaded with wastes. All these wastes are considered to be the cause of land depreciation, unaesthetic appearance of the area and outbreak of diseases such as cholera, malaria and dysentery. Rodents such as rats breed in accumulated refuse and incidence of diseases such as dengue, leptospirosis and typhus. Equally leachate from refuse may bring about surface ground water pollution.

Broad objective of the study:

To assess solid waste management practices applied by household heads in Kaptembwa location in Nakuru County.

Specific objectives:

- i. To identify the types and sources of solid wastes in Kaptembwa Location
- ii. To examine the handling procedures used by households
- iii. To examine the methods of solid waste disposal.
- iv. To determine the effects of poor solid waste management on the environment and the people.

Research Questions:

- i. What types of solid waste are generated in Kaptembwa Location?
- ii. How do people handle their solid waste after generation?
- iii. What methods are used for solid waste disposal?
- iv. What are the effects of poor solid waste management on the environment and the people?

2. MATERIALS AND METHODS

Sampling method:

Simple random sampling was used to select the household heads. The four estates were assigned sub-groups as East, West, South and North and households in each estates were counted and assigned numbers and the numbers written on pieces of paper were placed into a container and then picking the numbers at random. This method was chosen because of the even nature of the arrangement of the houses in the estates. The number of households selected in each estate was proportionate to the total households.

Data Collection Instruments:

Information was collected by the administration of the questionnaire to the respondents. Structured or closed ended questions accompanied by a list of possible alternatives from which respondents selected the answers to describe the situation. Interviews focus group discussions and observations checklist were also used to collect more information that were not captured in the questionnaire.

Description of Study Area:

The study was conducted in Kaptembwa location of Nakuru Municipality within Nakuru sub-county (Fig. 1). It lies within the great rift valley and borders four other sub-counties namely, Naivasha to south east, Nakuru north to the north, Molo to the west.

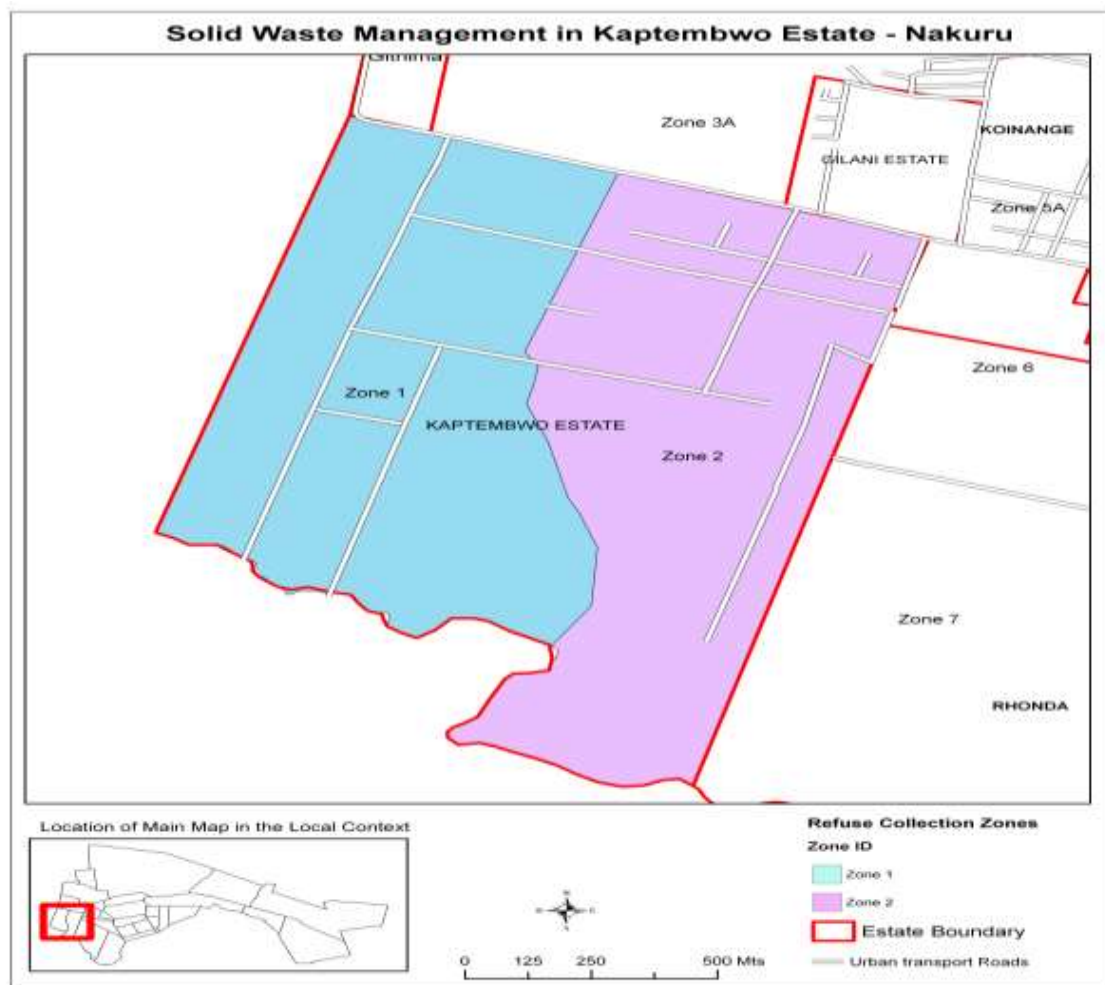


Figure 1: The Map of the study area

Research Design:

The study applied a social survey and the unit of analysis was households selected in four estates (Checkpoint, Soko Mjinga, Nakuru west and Mother Kevin). This design intended to collect information on the nature and the status of waste management. Both qualitative and quantitative data was obtained through the questionnaire, interviews and focus group discussions. The study population was 400 households as per the 1999 census and the sample size was 200 households (50% of the total households). The questionnaire was administered on the 200 household heads, since the minimum threshold for social survey is 100. Information was obtained from household heads or any member of the household above 18 years.

Sampling procedure:

Simple random sampling was used to select the household heads in the four estates: East, West, South and North Kaptembwa and households in each estate were counted and assigned numbers and the numbers written on pieces of paper were placed into a container and then picked at random. This sampling procedure was used due to the even distribution of the houses in the estates. Information was collected by the administration of a structured questionnaire (with open and closed questions) to the respondents (household heads). Oral interviews, focus group discussions were also conducted. Personal observations were made to complement information collected by the other instruments.

Data analysis:

The data collected was analyzed using SPSS computer software (version17). The data was presented in descriptive statistics (mean, standard deviation, and standard error) and inferential statistics that show the relationships among the variables.

3. RESULTS**Social Demographic Data:**

The results (Table1) shows that the majority of the respondents (51%) were between 18-30 years, 25.5% were between 31-40 years whereas 19.5% were between 41-50 years and 4% were above 50 years. This indicates that most of the residents of Kaptembwa estate were youths and small population of adults.

Table 1: Age of the respondents

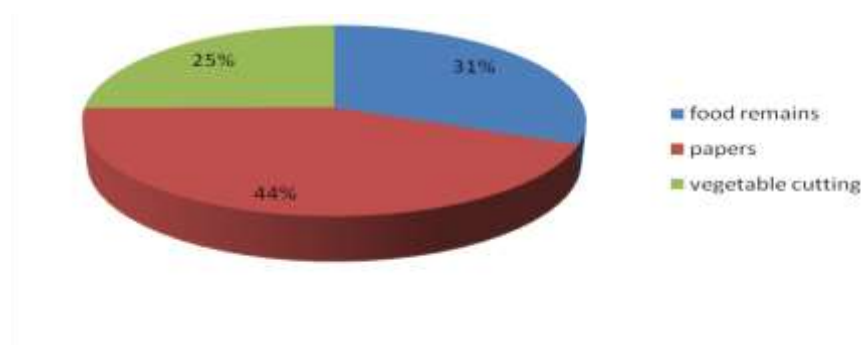
Age	Frequency	Percentage
18-30	102	51%
31-40	51	25.5%
41-50	39	19.5%
> 50	8	4%
Total	200	100

The results (Table 2) show that 34% of the respondents were involved in their own businesses, 21% were employed, 12% casual workers and 32.5% not employed.

Table 2: Occupation of the respondents

Occupation	Frequency	Percentage
Self Employed	68	34%
Casual Worker	25	12.5%
Employed	42	21%
Not Employed	65	32.5%
Total	200	100

The results (Figure 1) show that most (44%) of the waste is paper, 31% food remains whereas 25% was of vegetable cuttings. The results indicate that paper was the major source of waste in the estate, particularly the plastic bags used for packaging materials and carrying household items.

**Figure 1: Sources and types of solid waste**

The results (Figure 2) indicate that most (54%) of the respondents put the waste in containers and placed at the door steps for collection, 25% indicated that waste from households was taken to transfer station, 11% took their waste to kerbside, 9% composted their waste while 1% did not have any disposal mechanism.

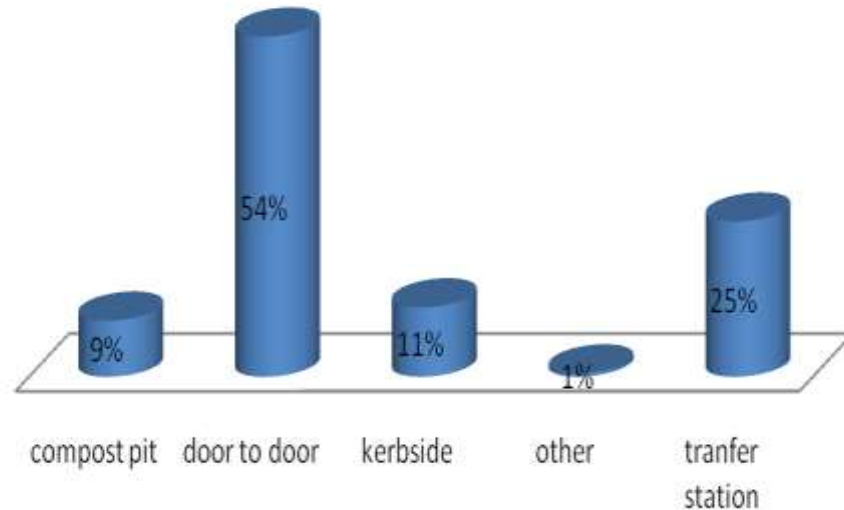


Figure 2: Collection and Handling of Solid waste

The results (Figure 3) show that 55% of respondents indicate that burning is the most appropriate method of solid waste disposal, 23% disposed the waste through composting in pits, 12% disposed off to the transfer station (common place where the community dispose their waste which forms heaps if not collected), 9% threw away the waste as they generate. Burning was the most preferred method in the area due to less effort needed and hence most convenient in the disposal of waste.

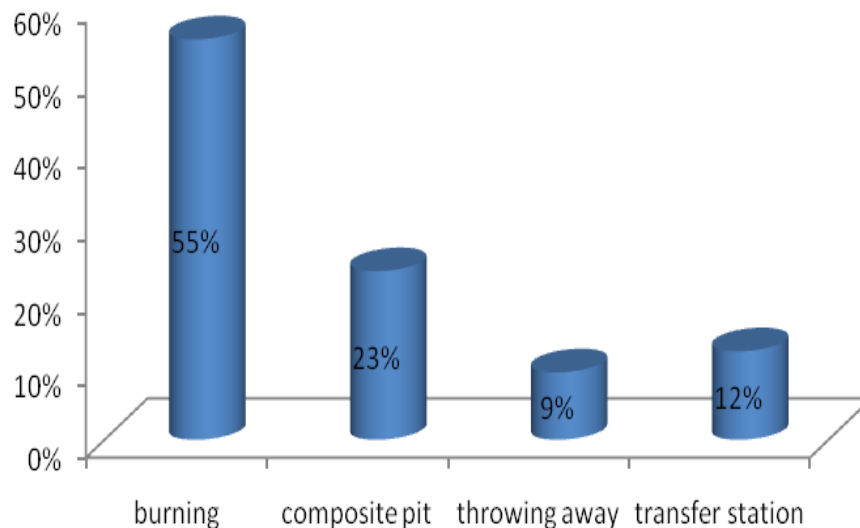


Figure 3: Methods of Solid waste disposal

The results (Figure 4) show that majority (57%) of the respondents indicated that spread of diseases is the most likely effect of poor solid waste disposal on environment, 25% indicated bad odour as another effect of poor solid waste disposal on the environment, 17% indicated that poor waste disposal may cause injury to the people, especially glass wares, whereas 1% of the respondents had no idea of the effects of poor solid waste disposal on the environment.

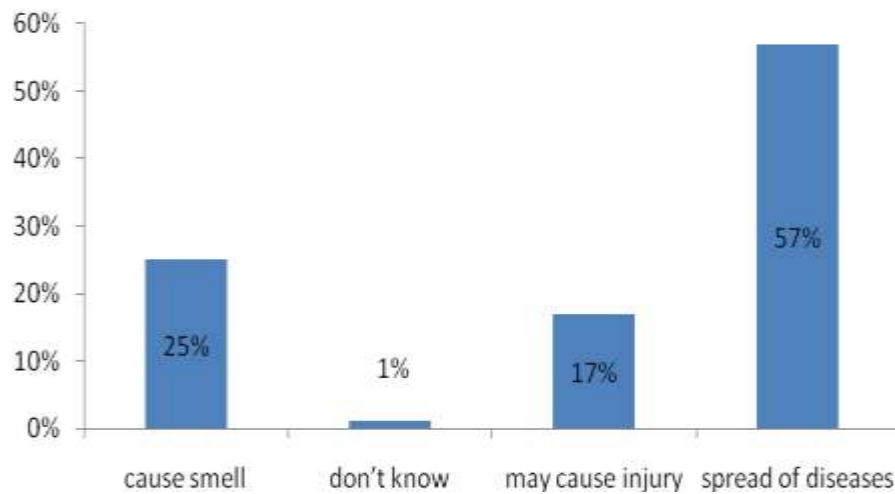


Figure 4. Effects of poor solid waste disposal on people

The results (Figure 5) show that 35% of the respondents indicated that malaria was the most prevalent of the communicable diseases in the study area as a result of poor solid waste disposal, 34% indicated diarrhoea, 28% indicated cholera whereas 4% did not know any disease that may result from poor solid waste disposal.

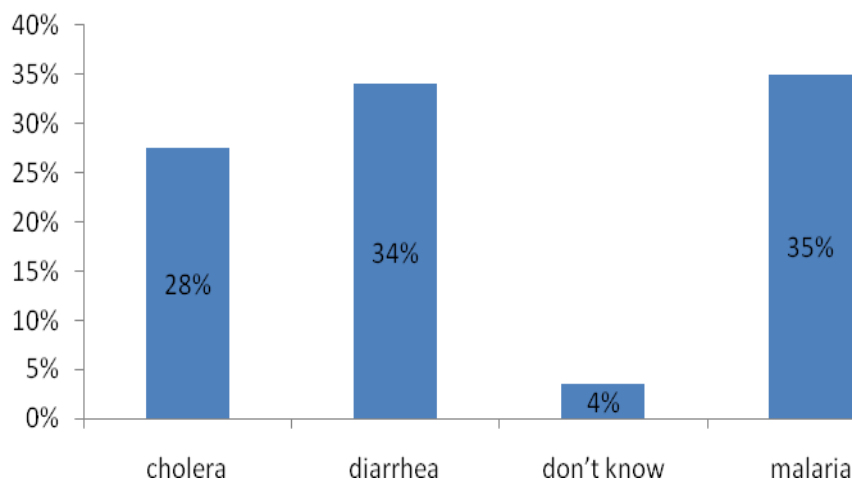


Figure 5: Effects of poor solid waste disposal on people.

The results (Table 3) show that there exist a strong positive correlation of 0.752 between the source and effects of solid waste ($p=0.01$) implying that solid waste source has significant effect on the environment and people. The results also indicate that handling of solid waste recorded a strong positive correlation with ($p=0.004$). This implies that solid waste handling has significant effects on environment and health of the people. There was of a strong positive correlation between waste disposal and effects on environment and people ($p= 0.005$) which is less than 0.05. This implies that solid waste disposal has significant effects on waste's effects on environment and people.

Table 3: Karl Pearson Correlation Coefficients for the Study Variables

Variables	Effects	Sources	Handling	Disposal	
Pearson Correlation	Effects	1	0.752	0.819	0.645
	Sources	0.752	1	0.557	0.423
	Handling	0.819	0.557	1	0.791
	Disposal	0.645	0.423	0.791	1

Confirmatory statistical tests were performed using regression analysis and yielded the results (Table 4). The regression analysis indicated that there was a significantly ($p=0.000$, $p=0.016$ and $p=0.034$) relationship between sources, handling and disposal of waste on environment and human health, implying that the source, handling and disposal have a great influence on the environment and residents of Nakuru West Sub-County.

Table 4: The Regression Analysis of the Study Variables on their Effects on Environment and People

	Unstandardized Coefficients	Std Error	Standardized Coefficients (β)	T	p-value
(Constant)	1.645	1.92		8.581	5.115
Sources	0.271	0.041	0.327	-0.652	0
Handling	0.091	0.068	0.096	1.331	0.016
Disposal	0.189	0.043	0.145	-0.189	0.034

4. DISCUSSION

The findings of this study indicate that majority of the respondents were youth, which is the most productive age group, a reflection of the group seeking employment, thus living in low income areas; and hence spend most of their time at home. It is also clear that majority of the males were at home. This does not imply that they are idle, but they are involved in business of selling food in canteens, others welding next to their homesteads and others selling charcoal. Due to high illiteracy levels, waste is improperly disposed, thus poor waste management practices.

Hazardous wastes are being recognized as a priority problem in many urban areas in developing countries, but most countries are at a relatively early stage of implementing action programmes on waste management. It is also important to appreciate the successes and failures of past programmes in African countries. For example, solid waste management has been an issue in both urban and rural areas of Rwanda. Though there is a system of collection and transportation of solid wastes across the country, solid waste management in Rwanda faces many challenges including lack of waste sorting or separation at source, poor waste disposal and management of dumping sites, poor treatment and exploitation of the generated solid waste, among others. Rwanda Environment Management Authority (REMA) has devised strategies to ensure proper solid waste management in Rwanda, including dissemination of practical tools on solid waste handling, promotion of wastes recycling companies, among other strategies. (Datta, 1997).

In Kenya there is no much literature on the solid waste management (SWM) sector with the exception of Nairobi. Even for Nairobi, the available literature dwells largely on performance description and its causes, household waste generation behaviour, and waste characteristics. There is widespread indiscriminate dumping in illegal dumpsites and waste pickers litter the city with unusable waste materials without control (Ikiara *et al.* 2004).

The findings of this study show that 44% of the domestic solid waste comprised of paper an indication of the importance of paper materials in the homestead as paper is used for writing by school children, plastic paper for packaging and carrying consumable goods and 31% of the waste comprised organic wastes, thus an indication of high generation of food remains from households that without proper disposal can cause health risks in a society. Based on these findings, it was clear that although there were other wastes that emanated from households' regular activities, they could not be able to explain the origin because of high illiteracy levels. Similarly waste emanating from house cleaning was not considered waste and hence was thrown outside on the road reserves which kept piling with time forming illegal dumps. These wastes included polythene bags, metals craps, rags, and plastics. Other waste also included dead animals such as dogs and donkeys. These observations are agreement with similar findings of Osman (2011) which indicated that both developed and developing countries face similar situations in the process of waste management.

Most of the wastes generated were collected from door to door, while others put waste to kerbside later collection, others threw waste on roadsides. This implied that despite waste being collected from door to door which is part of the best practice, waste was still seen littered all over in the estate. The dumping of waste along roadsides results into blocking of the open drains and contributed to the incidence of epidemics such as cholera. Findings of studies in other countries have also indicated similarities to the study area. In cities such as Bangkok and Manila, estimates of uncollected solid waste are around 20 - 30 % (Wood, 2008). Uncollected refuse provides breeding ground for disease vectors, both directly and indirectly through blocking surface drains. The lowest level of service is inevitably in the slum and shanty areas. Minghua *et al.* (2009) reported that in California in United States showed that increasing population levels, booming economy,

rapid urbanization and the rise in community living standards have greatly accelerated the municipal solid waste generation rate in developing countries. Municipalities, usually responsible for waste management in the cities, have the challenge to provide an effective and efficient system to the inhabitants. However, they often face problems beyond the ability of the municipal authority to tackle mainly due to lack of organization, financial resources, complexity and system multi dimensionality. Hazra and Goel,(2009) reported that in India, collection, transfer and transport practices were affected by improper bin collection systems, poor route planning, lack of information about collection schedule ,insufficient infrastructure , poor roads and number of vehicles for waste collection. Organizing the informal sector and promoting micro-enterprises were mentioned by Hazra (2009) as effective ways of extending affordable waste collection services. Tadesse *et al.* (2004) analyzed the factors that influence household waste disposal decision making in Ethiopia and the results showed that the supply of waste facilities significantly affects waste disposal choice. Inadequate supply of waste containers and longer distance to these containers increase the probability of waste dumping in open areas and roadsides relative to the use of communal containers.

Most of the respondents indicated burning as their most appropriate method of solid waste disposal, while others took their waste to transfer station and few residents threw away the waste as they generate. This reveals that although there are various methods of solid waste disposal, such as incineration and sanitary landfill among the practice has not been applied in this area of study except crude dumping. This has therefore contributed greatly in indiscriminate disposal of solid waste in the study area. Disposal being the last stage in solid waste management, it should therefore reflect the good housekeeping to avoid environment and health risks associated with poor solid waste disposal. In India, the two leading innovative mechanisms of waste disposal being adopted include composting (aerobic composting and vermi-composting) and waste-to-energy (WTE) (incineration, pelletisation, biomethanation).As stated by Siddiqui, (2006) WTE projects for disposal of MSW are a relatively new concept in India. Although these have been tried and tested in developed countries with positive results, these are yet to get off the ground in India largely because of the fact that financial viability and sustainability is still being tested (Lal, 1996; Khan, 1994).

In many metropolitan cities in Kenya, open, uncontrolled and poorly managed dumping is commonly practiced, giving rise to serious environmental degradation. More than 90% of solid waste in cities and towns is directly disposed of on land in an unsatisfactory manner. Such dumping activity in many coastal towns has led to heavy metals rapidly leaching into the coastal waters.

The findings indicated that spread of diseases was the most likely effect of poor solid waste disposal on environment. The results also indicated that malaria, cholera and diarrhea incidences were high due to poor solid waste disposal in the area. This was an indication that residents had knowledge of the health implications posed by poor solid waste disposal. Waste that ends up in water bodies can change the chemical composition of the water. Technically, this is called water pollution. This will affect all ecosystems existing in the water. It can also cause harm to animals that drink from such polluted water.

The effects of hazardous chemicals that infiltrate into the soil (contaminants) can also be transmitted to humans through food chains. Bad waste management practices can result in land and air pollution and can cause adverse health effects Upgrading open dumps into properly managed, environmentally acceptable landfill had been a challenge. In many towns and municipalities, people, particularly the street children are used as scavengers on the dump sites to collect recyclable wastes due to high unemployment.

5. CONCLUSION

The findings of the study provide an insight into the current situation of solid waste management in low income suburbs in urban centres. There is need therefore, to provide information to the residents of such areas on proper waste collection, handling and disposal of solid waste to enhance human and environmental health

ACKNOWLEDGEMENT

I wish to express my gratitude to the following Lecturers who also contributed to gather information towards this article, particularly to Professor Njure, Dr. Joyce Bett and Dr.Grace Kibue. My wife Lillian Bett and our son and daughter Roy and Eve respectively, deserve special thanks for their love, encouragement, support and prayers and the burden they shared during my studies.

REFERENCES

- [1] Datta, M. (1997). *Waste Disposal in Engineered Landfills*. New Delhi: Narosa Publishing house
- [2] Flintoff. (1984): Developing countries, WHO Regional Publications, Management of solid wastes, South East Asia, Series No.1
- [3] Hazra and Goel, (2009): "Country Report-Solid waste management in Kolkata, India: Practices and challenges "waste management 29(2009) 470-478"
- [4] Ikiara et al. (2004): "Collection, Transportation and Disposal of Urban Solid Waste in Nairobi", JICA.
- [5] Khan, R.R., 1994: Environmental management of municipal solid wastes. *Indian Journal of Environmental Protection* 14 (1), 26–30.
- [6] La, 1996: Community solid waste management and water supply Minghua et al (2009): Municipal Solid Waste Management in Pudong New Area, China. *Journal of Waste Management*, 29, 1227-1233
- [7] Osman, (2011): Osman, 2011. Solid waste management and its Environmental impacts on human health in Juba town-South Sudan.
- [8] Rukunga, G.K. (2001). *Environmental Health for East Africa AMREF Rural Health Series No.16*, Nairobi Kenya.
- [9] Sharloy, 2006: Final comprehensive solid waste management planning, New York City.
- [10] Siddiqui et al (2006): Sustainable development through integrated municipal solid waste management (MSWM) approach, a case study of Aligarh District. In: Proceedings of National Conference of Advanced in Mechanical Engineering (AIME- 2006), Jamia Millia Islamia, New Delhi, India: 1168–1175.
- [11] Tadesse, T. (2004): Solid and Hazardous Waste Management, Ethiopia Public Health Training Initiative, Addis Ababa.
- [12] UNCHS (1998): Solid waste management in low – income housing projects.
- [13] WHO (1999): Safe Management of wastes from health care activities.
- [14] Wood, (2008): Solid waste management in Metro Manila; "The Garbage Book"