

**MASENO UNIVERSITY
S.G. S. LIBRARY**

**THE IMPACT OF GARBAGE SKIPS ON SOLID WASTE
MANAGEMENT IN KISUMU CITY, KENYA**

BY

MARY KAMENE NGUNDO

**A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILMENT FOR THE
REQUIREMENTS OF THE DEGREE OF MASTER OF ARTS IN PROJECT
PLANNING AND MANAGEMENT**

SCHOOL OF PLANNING AND ARCHITECTURE

MASENO UNIVERSITY

©2013

ABSTRACT

A discrepancy exists between urban growing population, increasing demand for solid waste collection services and capacity of the local government to provide these services. In many developing countries solid waste collection is inadequate and poor, leaving waste uncollected. In Kisumu indiscriminate dumping, irregular collections of waste and inadequate resources are the key problems facing solid waste management. It is estimated that 400 tonnes of waste is generated daily and only 80 tonnes are hauled to disposal site which translate to a collection efficiency of 20%. The objectives of the study are to: assess the capacity of skips in managing solid waste, assess the attitude of urban residents towards use of skips for solid waste management and; examine whether the skips are durable for solid waste management. Quasi Experimental design was used for the study. Using the Krejcie Robert and Morgan Daryle table for determining sample size and the target household population being 56,020, the sample size for the study is 382 households. The households around where the skips were located were chosen through simple random sampling. The data collection techniques included; observations, in-depth interviews through use of questionnaires, check list and key informants' discussions. In data analysis, Quantitative analysis was done through mean, median, mode and range while qualitative analysis was through interviews and observations. Different analysis techniques were used to measure each objective; for objective one, correlation analysis was used, Likert scale by Rensis Likert in 1932 was used to measure objective two, while the material for making the skips combined with the level of maintenance (by G.Waller & D.J Cochrane) were used to measure objective three. Presentation of findings by means of report, maps, charts and tables was done. The key findings established to be impacting on the use of skips for solid waste management were; inadequate supply, irregular collection of garbage, vandalism of the skips, improved positive attitude towards the use of skips because of their cost effectiveness and that the skips are prone to rusting and rotting thus reducing their life span. In conclusion the skips were effective though inadequate and prone to vandalism. The research recommended provision of adequate skips; regular collection of the garbage, awareness campaign, polluter pays principle for skips vandalization and use of a more durable material for making skips like stainless steel combined with proper maintenance to extend their life span.

MASENO UNIVERSITY
S.G. S. LIBRARY

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Rapid population growth and uncontrolled development are seriously degrading the urban environment in many developing countries. One of the most serious environmental consequences of the process of urbanization is the ever growing amount of solid waste generated by cities. Often a discrepancy exists between the growing population and the increasing demand for solid waste collection services on one hand and on the other capacity of the local government to provide these services (UNCHS, 1994).

It is the ultimate fate of all solid wastes whether they are residential wastes collected and transported directly to a final disposal site. According to Tchobanoglous *et al* (1993) the most commonly recognized early methods for disposal of solid wastes were: dumping on land, mining pits, dumping in water, ploughing into the soil, feeding to hogs, reduction and incineration.

Burning of garbage is also common in peri-urban and rural communities in Ghana and in many other less developed countries. A study carried out in Ado-Akiti in Nigeria by Momoh and Oladebeye (2010) showed that, the methods of solid waste disposal include dumping of waste in gutters, drains, by roadside, unauthorized dumping sites and stream channels during raining season and burning of wastes on unapproved dumping sites during the dry season. This has gone to confirm that the practices of solid waste disposal in the 1950s still exist today and study area is not an exception. On the other hand, Momoh and Oladebeye's (2010), assessment of waste situation in Ado-Akiti in Nigeria is questionable as they did not further explain what brought about the indiscriminate dumping. It could be that people dumped the waste any how because they were no transfer stations like skips for the people to store their waste for collection.

Dar Es Salaam in Tanzania is among the first African countries which introduced Integrated Solid Waste Management by use of skips following major challenges in solid waste management in 1998. This was exacerbated by the citizens' misconception/negative attitude towards waste management. Inadequate waste facilities (skips), infrastructures and legal and institutional framework are some of the major drawbacks encountered during proper waste management (Tanzania Sanitation Project 2009).

Arusha, Tanzania has led to the engagement of the local private investment companies through the approach of Integrated Sustainable Waste Management Project (ISWAMP). Integrated Solid Waste Management (ISWM) is a comprehensive waste prevention, recycling, composting, and disposal program (Solid Waste and Emergency Response 2002). The garbage collections started with private companies collecting from the household then dispose the garbage in to the skips. The Municipal Trailer then emptied the skips and transported the waste to the designated dump site. This led to improved efficiency in waste collection and widened coverage in service provision. The service provision extended from CBD and high-income areas like Njiro, Corridor area to inner-city and shanty compounds of Unga Limited and Kijenge even though not all households have been covered. Private companies in solid waste activities are taking Arusha's cleanliness to the next level through importation of more collection vehicles (2 compactors with carrying capacity of 18 tonnes of solid waste per trip) though people's misconception about solid waste and inadequacy of skips are hindering factors (Tanzania Sanitation Project 2009).

Although not much research has been done on garbage skips in Kisumu, related methods of solid waste management have been done, for example, the use of litter bins as transfer points. In collaboration with the authorized bottlers of the Coca Cola Company in Kisumu-Equator Bottling limited, who donated litter bins, the council embarked on sensitizing the public on street cleanliness and also placed the bins, at vantage points in the Central Business District where the public could put litter. Though this project was faced with the challenge of vandalism where some streets were left without a single waste bin the impact of these bins proved worthwhile to have the transfer station (skips) for solid waste disposal (USEPA, 2001). Some people just litter the area around the bins with a conception that the MCK cleaners will have to perform their duties. The council is undertaking a bigger project on Integrate Solid Waste Management (ISWMP) with the support of Swedish International Development Agency (SIDA), which include the use of skips instead of bins and also relocation of the undesignated dumping site (MCK, 2010-2020).

Waste management and sustainable development has also been widely recognized as a major concern for the City of Kisumu. Most of the solid waste remains uncollected with a collection efficiency estimated at 20% of the 400 tonnes generated per day (Physical Planning Department, 2010).

The Kisumu Integrated Sustainable Waste Management Project (KISWAMP) is an initiative under support from SIDA together with UN-Habitat, the ILO and Municipal Council of Kisumu. The project aim at promoting ISWAMP through involvement of community based groups, SMEs and Civil Society Organization in providing urban services for improved urban environment and poverty reduction. These interventions are directed to contribute to improved living conditions for the urban poor, providing a cleaner environment through waste collection and disposal (Municipal Council of Kisumu, 2010-2020). The use of garbage skips for solid waste management is part of the KISWAMP. Through UN-Habitat, 1 skip loader and 24 refuse skips were acquired and placed in strategic areas especially in the urban built up zones. The Council through Local Authority Service Delivery Action Plan (LASDAP) was able to add 7 more skips thus bringing the number of skips in the municipality to 31.

1.2 Statement of problem

Many countries lack adequate resources that are needed in order to achieve mismanaged solid waste free environment. One of the most crucial consequences of the lack of resources involves the unsafe and inappropriate disposal of solid waste, which has created considerable problems and very unpleasant living conditions in different countries. These problems involve the uncontrolled dumping of rubbish in public places, ineffective planning and poor implementation of existing waste management plans, ineffective legislations, inadequate and inconsistent sustainable funding.

Over the years, solid waste disposal has become a major problem in Kisumu. Therefore, indiscriminate dumping, irregular collection of waste generated and inadequate resources are the key problems facing solid waste management in Kisumu. It is estimated that 400 tonnes of waste is generated a day and out of this, 80 tonnes are hauled daily. This leaves a backlog of 320 tonnes uncollected a day. This translates to a collection efficiency of 20% (CarlBro, 2001) which has resulted in littering, heaping of waste in Kisumu most especially in the low class residential and peri-urban areas. The recent proliferation of polythene bags for packaging has seriously aggravated the situation in the study area. This makes the above mentioned residential areas filthy and unattractive for living. Therefore, if the situation is left unchecked it can result in the out break of communicable diseases such as cholera, typhoid and this will affect people exposed to this unsanitary conditions.

Inadequate and inaccessible transfer stations for collection of garbage aggravates the situation as people don't like travelling long distances for garbage disposal. Garbage skips acts as transfer station for the temporary disposal. They are cost effective because most urban residents of Kisumu prefer to dump their waste directly into the skips without paying as compared to the payment of Ksh. 200 for private garbage collectors. Unfortunately, Kisumu Municipal has no designated dumping site for proper solid waste disposal. Currently the council is in the process of selecting a site land for a landfill which could be a better idea than having an open dumping site. This is because a landfill is a means of safe and sanitary solid waste disposal (PPD, 2010).

An assessment of the impact of the skips on solid waste disposal would determine whether there are any achievements made so far. The skips act as transfer points for solid waste which makes it easier for the council skip loader to transport the waste to the final destination. A transfer station is a facility with a designated receiving area where waste collection vehicles or people discharge their loads. The need for the installation of the skips was that, the Council's capacity to collect waste from each household had become difficult due to population demand for waste collection thus the unsightly scenes of garbage in the city.

1.3 Objectives of the study

The main objective of this study is to assess the role played by garbage skips in Solid Waste Management.

The specific objectives include:

- i. To assess capacity of garbage skips as transfer stations in solid waste management.
- ii. To assess the attitude of urban residents towards use of skips for solid waste management.
- iii. To examine whether the skips are durable for solid waste management.

1.4 Research Questions

1. What is the capacity of garbage skips in managing solid waste?
2. What are the residents' perceptions to the use garbage skips in solid waste management?
3. What is the durability of skips as a method for solid waste management?

1.5 Significance of the study

The generation and disposal of waste has direct and indirect linkages to social and economic development and most adversely to the environment. Solid waste is generated by social and economic activities, and solid waste in turn also affects these activities that originally give rise to it (Ministry of Environment, Conservation and Meteorology, Honiara, Solomon Islands, 2009).

Solid waste management has become a major development challenge in Kisumu recent times. This deserves not only the attention of the MCK and the waste management institutions but also concerns of corporate organizations and individuals to find a lasting solution to the problem. The study therefore intends to explore the impact of garbage skips in managing this solid waste.

Despite the immensity of the problem, very little research on use of garbage skips for solid waste management has been carried out in Kisumu though research on the use of dustbins as transfer points proved worthwhile. The study will serve as a reference point to MCK and waste management institutions as far as solid waste management is concerned. It will give them an in-depth understanding on the use of garbage skips in solid waste management. Additionally, the study will contribute to existing body of knowledge on solid waste management and also stimulates further research on the subject in other Municipalities.

Currently, the waste management service in Kisumu Municipality covers about 80 tonnes of the total 400 tonnes waste generation. The rest is left piled up around the corners of the town settlements and open spaces without regard to the environment now affecting our inshore fisheries, beaches and land. The waste is piled without proper receptacles, and existing receptacles are usually overflowing with waste due to lack of waste minimization activities and irregular collection schedule. Percentage of un-served areas is increasingly high. The households which have access to road throw garbage into the road and who do not have access to road throw in any open space, causing hindrances to movement of pedestrians, vehicles, water pollution and chances of disease spread (PDP, 2010). It is foreseen that with the introduction of the skips, the collection efficiency will improve and more solid waste is likely to find its way to the dumping site, leaving the environment cleaner.

1.6 Scope and Limitation

The study was confined to the urban built up areas within the Central Business District (CBD) and some estates located 2 km from the CBD of Kisumu Municipality, Kenya where the skips were located. It encompassed, determining the amount of solid waste which garbage skips can carry, urban residents' perception towards the use of skips for solid waste management and the economic life of the skips, if no vandalism or rusting occurred.

The following hindered the smooth completion of the study. These are enumerated below.

- The prevailing vandalism of the garbage skips where some skips had to be rotated from one location to the other.
- Though the life span of the garbage skips could be determined through durability index, measuring vandalism proved a challenge.
- Some potential respondents wanted to be compensated for the time spent in responding to the questionnaire. This made the administration of questionnaire quite difficult.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter explores literature on the use of garbage skips for solid waste management giving emphasis to the three objectives of the study and a conceptual framework that guides the study.

2.2 Capacity of garbage skips in managing solid waste

The term solid waste management has been viewed differently by various authors. Tchobanoglous *et al* (1993) provide a comprehensive definition of solid waste management. According to them, solid waste management is:

“.....that discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations and that is also responsive to public attitudes”.

Tchobanoglous *et al* (1977) explain storage to mean where solid waste is stored before it is collected. It could be stored in a skip or dustbins and not thrown away indiscriminately.

According to Kreith (1994), the most common type of residential collection services in the United States include “skip”, “setout-setback” and “curb”. According to the USPS (2000), in the city of Thimphu in Bhutan the collection of solid waste from households, commercial set-ups was done in concrete receptacles placed at strategic points and conveyed by trucks/tractors. Individual bins/containers were placed alongside the shops in certain areas, which were emptied directly into the trucks/tippers. This prevented people from dumping waste indiscriminately. On the other hand, the building of these concrete bins and containers may be expensive to do in Kenya and for that matter Kisumu.

Transfer station is one of the elements in solid waste management system. It plays an important role in a community's total waste management system, serving as the link between a community's solid waste collection program and a final waste disposal facility (Tzipi *et al*, 2007). While facility ownership, sizes and services offered vary significantly among transfer stations, they all serve the same basic purpose which is consolidating waste from multiple collection vehicles into larger, high-volume transfer vehicles (skip loaders) for more economical shipment to distant disposal sites (USEPA, 2001).

According to Gil & Kellerman (1989), there are three reasons why transfer stations are useful. First, because small or medium sized communities may not generate sufficient waste to support a disposal facility. Second, if the distance to the disposal plant is long the use of small collection trucks may be unnecessarily high in terms of cost. Third, the location of a single disposal plant in a remote location to serve several communities will remove negative environmental impacts from residential areas.

According to Ogawa (2005), a typical solid waste management system in a developing country displays an array of challenges categorised into technical, financial, institutional and social constraints. He further discussed these constraints in relation to the sustainability of skips in developing countries. In most developing countries, there are inadequate human resources at both the national and local levels with technical expertise necessary for solid waste management planning and operation. Many officers in charge of solid waste management, particularly at the local level, have little or no technical background or training in engineering or management.

Agawa (2005) indicated that Legislation (Public Health Act, Local Government Act, Environmental Protection Act) related to solid waste management in developing countries is usually fragmented. Zurbrugg (2009) further added that, solid waste collection schemes of cities in the developing world generally serve only a limited part of the urban population. The people remaining without waste collection services are usually the low-income population living in peri-urban areas.

In Kenya, municipal corporations are primarily responsible for solid waste management, but with the growing population and urbanization municipal bodies are facing financial crunch and can no longer cope with the demands. The limited revenues earmarked for the Council's make them ill equipped to provide for high cost involved in the collection, storage, treatment and proper disposal of waste. Municipalities are only able to provide secondary collection of waste, meaning they only collect waste from municipal bins or depots. A substantial part of the municipal solid waste generated remains unattended and grows in the heaps at poorly maintained collection centres. Open dumping of garbage facilitates breeding of disease vectors such as flies, mosquitoes, cockroaches, rats and other pests. Efficient waste collection method will help most of the Councils in dealing with the issue of solid waste management.

This suggests that the percentage of waste collected will improve thus causing slightly scenes in the cities.

In Kisumu Municipality, as earlier mentioned most solid waste generated remains uncollected with a collection efficiency estimated at 20%. The total amount of solid waste produced is estimated at 400 tons per day and quantity delivered to the dump site is estimated to be 80 tons per day which concentrated in high income areas, leaving the poor neighbourhood largely unattended (CarlBro, 2001). This means about 320 tonnes of solid waste is left unaccounted for. This study focused on whether there was any change in the amount produced versus the amount collected with the introduction of the garbage skips in the Municipality. The result was used to assess the capacity of the skips in solid waste management.

2.3 Attitudes of urban residents towards skips

Events of the 20th and early into the 21st century indicate that waste has become a major consequence of modernization and economic development (Tsiboe and Marbell, 2004). In the quest for 'Western-styled' development, humanity did not budget for the problems related to the management of waste. Solid waste generation is one of the major environmental problems faced by municipalities in the world. Generally, it is positively related to the level of income and urbanization, with higher income and more urbanized economies generating higher levels of solid wastes per capita. Yet, despite significant efforts, solid waste management has not become a universal way of life in Malaysia. Over 100 million tones annually of solid waste could be collected and recycled, but instead is discarded and land-filled (Omran A,2008).

Solid waste management is given a very low priority in developing countries, except perhaps in capital and large cities. As a result, very limited funds are provided to the solid waste management sector by the governments, and the levels of services required for protection of public health and the environment are not attained. The problem is acute at the local government level where the local taxation system is inadequately developed and, therefore, the financial basis for public services, including solid waste management, is weak. This weak financial basis of local governments can be supplemented by the collection of user service charges. However, users' ability to pay for the services is very limited in poorer developing countries, and their willingness to pay for the services which are irregular and ineffective (Ogawa 2005).

The government of Malaysia decided to launch the collection campaign in 2001. Money was used for publicity and for educating the public on solid waste management. However, seven years after the launch, the result is comparatively still the same (Abdelnaser et al., 2006). Despite the high potential, only 5% of the total waste is being collected and recycled (Department of Environment, 2005). In interview the head of the department of the collection and recycling program in the Municipal Council of Alor Setar (MCAS) in the town of Alor Setar asserted that *'the majority of households do not understand and respect the waste collection schedule of both municipal and private waste collection company and there is a lack of co-operation from the households to make the town clean'*.

Various activities have been implemented by the government of Malaysia (through the Department of Local Government, Ministry of Housing and Local Government) to increase awareness of the importance of household participation in use of skips in solid waste management. Several advertisements and radio 'jingles' have been aired on television and radio channels as an effort to increase awareness of this issue. In addition, various NGO's have also been involved in these campaigns. For example, many 'campaigning days' were organized at various levels involving the end users/general public. Programs were organized in housing estates, schools and shopping complexes. However, despite the effort and money spent, the campaigns failed to inspire the public due to lack of support from householders and the need for longer term education and awareness campaigns that will change public attitudes (Ong, 2003).

Along roadways, motorists (52%) and pedestrians (23%) are the biggest contributors to litter. Research also shows that individuals under 30 are more likely to litter than those who are older (KAB, 2009) In fact, age, and not gender, is a significant predictor of littering behavior. KAB's 2009 Littering Behavior in America research found out that;

- Nearly 81% of all disposals observed in public spaces were intentional. On the other hand, individuals who hold the belief that littering is wrong, and consequently feel a personal obligation not to litter, are less likely to do so,
- Individuals are much more likely to litter into a littered environment. And once there, it attracts more litter. Availability and proximity to trash and recycling receptacles also impact whether someone chooses to litter.

- Some people feel no sense of ownership for parks, walkways, beaches, and other public spaces. They believe someone else will pick up after them; that it's not their responsibility.

For over 30 years, KAB has successfully pursued a behavioral approach to reduce littering and increase beautification and waste reduction. To eliminate litter, KAB research identified the need to change behavior as the only effective way to achieve lasting, sustainable improvement in solid waste. These five-step attitude change process include: Get the Facts , Involve the People, Develop a Plan, Focus on Results and Provide Positive Reinforcement. A sustainable method of solid waste management must have low operating costs.

Traditional approaches to litter, most particularly clean-up projects, work only to remove the litter. KAB attempts to deal with the root cause of the problem. Changing attitudes and influencing behavior are brought about most effectively using a combination of methods: Education, Ordinances, Tools and Resources.

2.4 Durability of Skips

Solid waste is the unwanted or useless solid materials generated from combined residential, industrial and commercial activities in a given area. Management of solid waste reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life.

Integrated Solid Waste Management (ISWM) takes an overall approach to creating sustainable systems that are economically affordable, socially acceptable and environmentally effective. It is important to note that although no one single method can manage all the waste materials in an environmentally effective way the best option must be evaluated suited to the particular community chosen. Effective management method therefore need to operate in ways which best meet current social, economic, and environmental conditions of the municipality.

Although motor vehicle transport is most common, transport by rail and barges is also available. For example in San Francisco, the collection vehicles which are relatively small because of the need to manoeuvre in the narrow city streets, haul their loads to a transfer station at the southern boundary of the city. At the transfer station, the wastes are unloaded from the collection vehicles into larger tractor-trailer trucks. A similar system of transfer is

found in Ghana where tricycles are used to transfer the solid wastes to storage containers, where they are subsequently transported to the disposal sites (Zoomlion Ghana Ltd, 2006).

It should also be noted that if skips/containers are not maintained they quickly corrode or are damaged. According to Zoomlion Ghana Ltd, 2006, if skips/containers are not maintained they quickly corrode or are damaged. Garbage skips receptacle constructed of stainless steel with durable powder coated finish are likely to be durable, a life span of 10-12 years thus minimising replacement costs.

Fire tests and study of the life cycle costs together demonstrate that stainless steels are cost effective materials. The wider deployment of stainless steel will therefore yield significant economic benefits as well as providing levels of fire safety unequalled by alternative materials (G. Waller & D.J Cochrane)

Sensitization on the importance of skips in solid waste management is of important. The urban residents will own up the project and there will be no likelihood of vandalising these receptacles.

In summary, there has been a knowledge gap in terms of using trash receptacles (skips) as transfer points. These gaps are noted as; first it's cheaper to transport great amounts of waste over long distances in large loads than in small one thus the preference of skips as transfer station. Long distance hauling of solid waste has been the norm. Secondly, skips provided at various locations prevent people from dumping indiscriminately. Thirdly, Little or no technical background or training in solid waste management affects the effectiveness of skips. Fourth, solid waste collection schemes of cities in the developing world generally serve only a limited part of the urban population especially the high income population. Fifthly, very low priority is given to use of skips in solid waste management in developing countries and as a result, very limited funds are provided to the solid waste management sector by the governments. And lastly availability and proximity to skips as receptacles also impact whether someone chooses to litter. There is also need for proper maintenance of skips/containers because if not maintained they quickly corrode or are damaged. Garbage skips receptacle constructed of steel with durable powder coated finish are likely to be durable thus minimising replacement costs.

There has been door to door garbage collection in Kisumu city, with the ultimate disposal point being the dumping site. This has proved expensive and ineffective with rise in indiscriminate dumping. The use of garbage skips as transfer points for solid waste management has been the entry point to this study. There is need for availability and proximity interms of skips location to avoid long distances for solid waste disposal. There is also need for sensitization and training of experts in the field of solid waste management planning and operation. Increasing awareness on the importance of household participation in the use of skips in solid waste management is also a key factor in this study.

2.5 Conceptual Framework

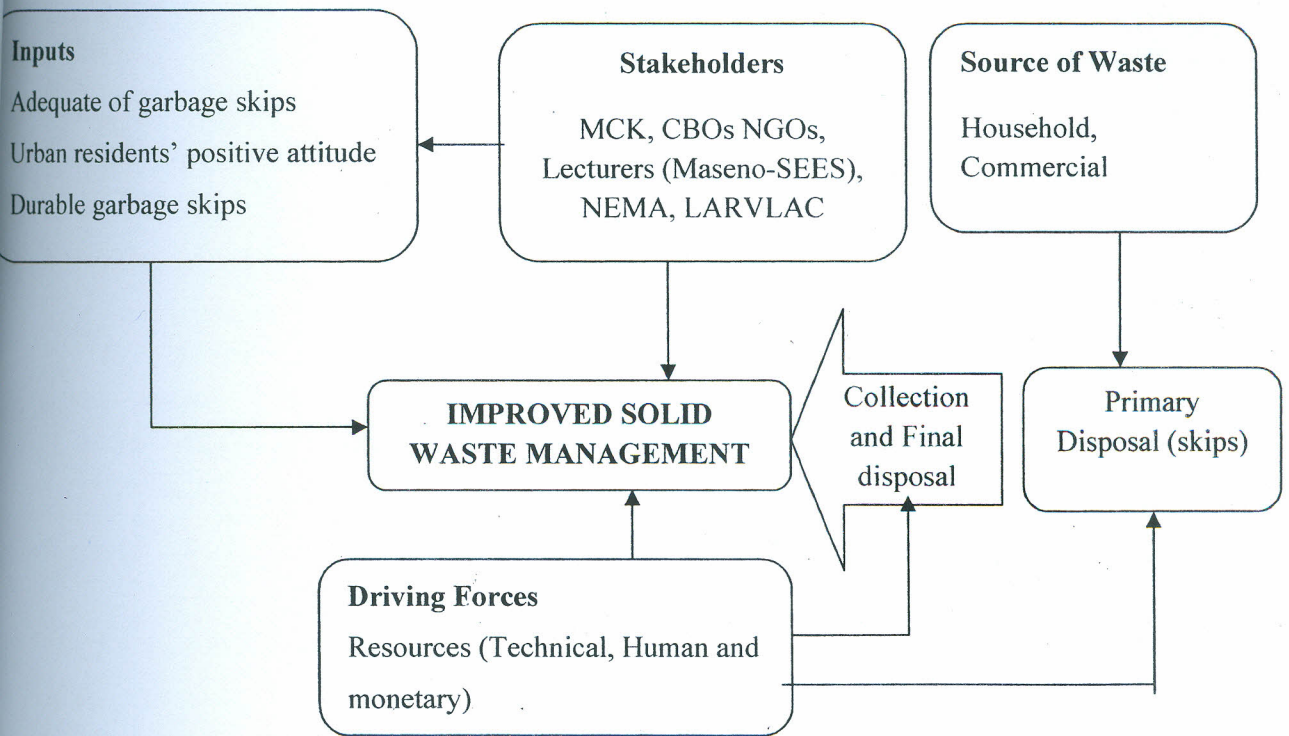


Figure 2.1: Conceptual Framework

Source: Modified from Kerlinger, F.N (1979)

From figure 2.1 above, improved solid waste management is the focus of the framework. Therefore, in the solid waste management stream, three main issues have been considered. These are: Inputs (objectives), driving forces of managing solid waste (resources), Primary Disposal and the role stakeholders play (waste management institutions and waste generators-households and individuals) in managing solid waste. It is important to recognize that, the major portion of solid waste comes from domestic sources. However its proper disposal depends heavily on adequacy and availability of skips, attitudes of the people, durability and

resources. Where garbage skips are appropriately placed and properly used and there is community participation/ involvement improved solid waste management is bound to be achieved. Community participation should be fostered not only in regard to waste handling and waste disposal but also in reduction at source. The waste that is disposed of from the households has to be collected and transported for final disposal. The collection and transportation depends heavily on the resources available.

Having been guided by lessons learnt from the literature; an appropriate research methodology has been developed to collect data to fill the gaps identified in relation to the key issues outlined in the framework. This forms the basis of the chapter on methodology.



Figure 3.1: Map of the study area. Source: Department of Environment and Planning, 2010.

Figure 3.1 above shows the study area which is bounded by the ... other adjacent cities.

CHAPTER THREE: METHODOLOGY

3.1 Study Area

Kisumu, located in the western part of Kenya, is the third largest city in Kenya and the headquarters of Kisumu County, as well as Nyanza Province respectively. It lies along the shores of the Lake Victoria (One of the largest fresh water lakes in the world) and covers an area of approximately 417 Km² of which 157 Km² is under water. It is located between latitudes 34° 35₀ E and 34° 55₀ E and longitudes 0° 00₀ S and 12° 0₀ S and lies within the equator. The study area comprises of the following estates within Kisumu Municipality; Kaloleni, Shauri Moyo, Ring Road Migosi, Anderson, Manyatta, Makasembo, Celtel, Arina, Nubian and commercial nodes namely; Kibuye, Kondele, Nyaori, Oboch, Kowino and Nyamasaria (MCK).



LEGEND

- Major Cities & Towns

Figure 3.1: Map on study area in the regional context

Source: Department of Physical Planning, 2010

Figure 3.1 above shows Kisumu City in the regional context, that is, how it is related to the other adjacent cities and urban areas.

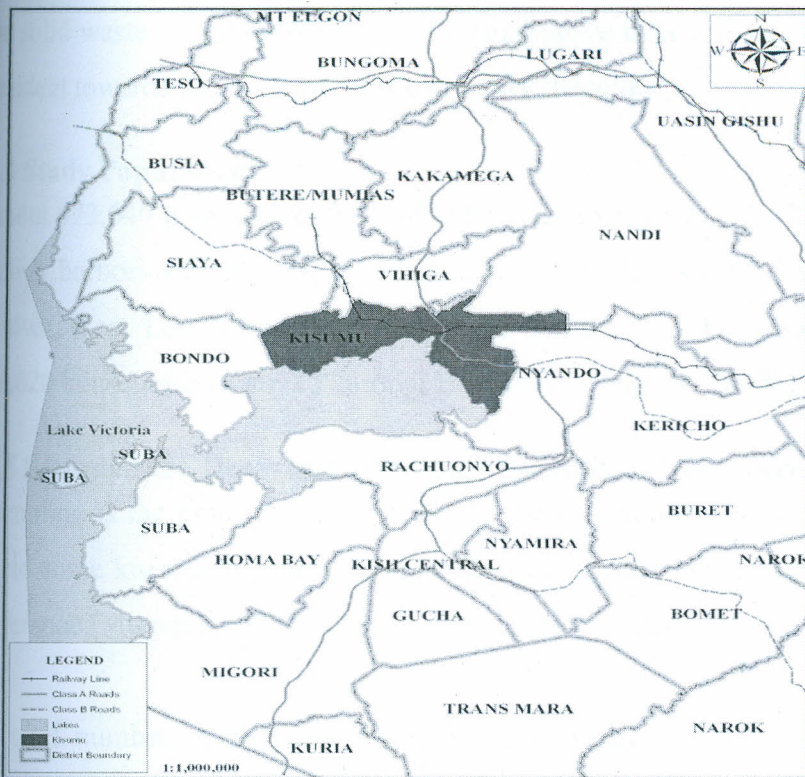


Figure 3.2: Map on study area in the local context

Source: Department of Physical Planning, 2010

3.2 Climatic conditions

The Municipality experiences an equatorial type of climate with $20^{\circ}\text{c} - 30^{\circ}\text{c}$ mean annual temperature and 1280mm mean annual rainfall. It receives bimodal rainfall with the long rainy season from March to May and short rainy season from August to October.

Peak rainfalls are between March and May with the second peak in September and October. The heavy rains cause floods in poorly drained areas and rising lake levels. The heavy rains also interfere with sanitation facilities, contamination of water and large masses of stagnant water contributing to spread of malaria and other borne diseases.

3.3 Research Design

Research design is the conceptual structure within which research is conducted providing a blueprint for collection, measurement and analysis of data. It provides the arrangement of conditions for collection and analysis of data in a manner that aims at combining relevance to the research. The study aimed at highlighting the impact of garbage skips on solid waste management.

Quasi-experimental Design was used for the study. This is because there were two groups of population under study i.e. the Group not served by skips and those where the skips are strategically placed. Quantitative data was used to examine the impact of the garbage skips

on solid waste management while the Qualitative data was used to assess the attitudes of the resident towards the skips and the durability the skips.

3.4 Study Population

About 473,649 people live in Kisumu East District, with 412,323 residing in Winam Division which harbors the locations of the study area. The study covers Township, Kondele and Kolwa West Locations where the skips are located. These locations have approximately 56,020 households (Kenya National Bureau of Statistics, 2009).

3.5 Sample Size Determination and Sampling Procedure

Sampling is the practice concerned with the selection of individual observations intended to yield some knowledge about a population of concern especially for the purpose of statistical inference (Mugenda 1999). The sample size is a representative of the target population.

A total number of fifty six thousand and twenty (56,020) household was obtained from KNBS, 2009 for Township, Kondele and Kolwa West Locations. These locations make up the study area. This represented the sample frame of the questionnaire survey.

A table by Krejcie, Robert and Morgan Daryle for determining sample size was used. According to them a population of 56,020 would be represented by a sample size of 382 with a 0.05 margin of error at a 95% level of confidence (refer to the attached table). To arrive at the sample size of 382 households, 69, 146 and 167 households were randomly chosen around the areas where the skips are located in Township, Kondele and Kolwa west locations respectively. Refer to table 3.1 below.

Table 3.1 Sample frame

Locations	Population	Sample	%
Township	10,162	69	18
Kondele	21,419	146	38
Kolwa West	24,439	167	44
Total	56,020	382	100

Source: Author, 2013

Quota sampling at 95% degree of accuracy was used because the population lists for the municipality were not available thus this type of sampling was ideal for the research. The sampling type is always cheaper, faster and quite adequate for population where only a few variables are examined.

3.6 Data collection

Data Collection is an important aspect of any type of research study. Inaccurate data collection can impact the results of a study and ultimately lead to invalid results. The data collection was categorized into two: secondary and primary data collection.

3.6.1 Secondary Data Collection

This was firmly backed by extensive literature review to identify research gaps and put the study into context with existing body of knowledge. It was collected from published books, book chapters, journal papers and web pages.

3.6.2 Primary Data Collection

Primary data was sought by way of direct observation which included developing a guide or check list on what would expect to see, like who disposes the waste into the skips. This was done through continuous observation. The data gathered was interpreted using the following mechanisms: Descriptive observations: writing down what was simply observed, Inferential observations: writing down an observation that was inferred by the subject's body language and behavior and Evaluative observation: making an inference and therefore a judgment from the behavior.

Household interviews through use of scheduled, structured questionnaires were carried out. This involved door to door interviews.

Key informants interview with policy makers in Kisumu Municipal Council will be conducted with the aim of obtaining in-depth information on concepts, perceptions and ideas on solid waste management. Experts and knowledgeable persons in the field of integrated solid waste management who will be identified as key informants will also be interviewed. The Key Informants will be;

- Lecturers from Maseno University in the schools of Planning and Architecture and Environmental Sciences.
- NGOs involved in solid waste management like SECODE, Umande Trust
- Government Departments e.g National Environment Management Authority (NEMA)
- Lake Victoria Regional Local Authorities (LAVRLAC)

Interviews involved two formats: Open-ended questions which were designed to generate longer reflections and responses from the interview respondents, and explore the research literature which there was limited understanding and highly structured questions designed to elicit shorter and more focused answers.

3.7 Data Analysis and Presentation

3.7.1 Data Analysis

The collected data was analyzed by statistical package for social sciences (SPSS). Data from the questionnaire was be coded and in fed into the computer for analysis. The results were presented in analytical tools such graphs, pie charts. Secondary data was input for trend analysis.

3.7.1.1 Quantitative analysis

For quantitative data simple spreadsheets (Microsoft Excel) and correlation analysis were employed. Correlation analysis is used to measure the relationship between two items. In this study, it was used to measure whether there was a correlation between the garbage skips and solid waste management.

The quantitative data collected was analyzed by use of descriptive statistics including frequencies and percentages and presented by means of pie charts and bar graphs. Descriptive statistics helped in describing a set of data through descriptive measures, such as means and standard deviations Frequency distributions tell how many people answered a survey question a certain way. For example, if a survey question asked respondents whether they approve the use of skips for solid waste management, a frequency distribution gave the number /percentage of respondents who approved and disapproved use of skips. The following steps were followed when analyzing quantitative data;

- Developing codes that helped one organize and analyze the collected data;
- Checking, cleaning, and organizing collected data;
- Revising the codes based on an initial review of the data and emerging patterns;
- Connecting patterns together in the form of key relationships; and
- Searching for alternative explanations.

3.7.1.2 Qualitative analysis

In qualitative data, inferential statistics enabled one to look at two or more variables in relation to each other, and, with some degree of confidence, statements were made about whether the relationship could have occurred by chance or whether the observed relationship appeared to be 'real'. Qualitative data from the interviews and observation was harmonized, coded and analyzed.

Likert Scale developed by Rensis Likert in 1932 was used to measure the urban resident's attitude towards the use of garbage skips for solid waste management. The Likert scale requires the individuals to make a decision on their level of agreement, generally on a five-point scale (ie. Strongly Agree, Agree, Disagree, Strongly Disagree) with a statement. The number beside each response becomes the value for that response and the total score is obtained by adding the values for each response, hence the reason why they are also called 'summated scales' (the respondents score is found by summing the number of responses). Dumas (1999) suggest, ' this is the most commonly used question format for assessing participants' opinions of usability'.

The scale is simple to construct, likely to produce a highly reliable scale and also easy to read and complete.

The kind of material used to make the garbage skips combined with the level of maintenance were used to measure the durability of the skips.

3.7.2. Data Presentation

Here, data presentation was done through printing the report, visualization by means of maps, graphs and tables. At this end, the final results were presented, and then conclusions and recommendations for further research made in this final report. The final findings are to be disseminated through report and during conferences which focus on solid waste management as the theme.

CHAPTER FOUR: FINDINGS AND DISCUSSIONS

After data collection and interpretation, the research findings followed being categorised according to the objectives outlined earlier.

4.1 Capacity of skips as a transfer station in solid waste management

For effective and sustainable management of solid waste within the city, the Department of Environment in the Municipal Council of Kisumu has been involved in a routine monitoring of environmental condition to help in up grading and planning for environmental status of the city in order to achieve the recommended standards. As a result, the department did a spot check on waste collection by assessing the availability and working conditions of the skips.

Based on skips, the survey revealed that the whole of KISUMU municipality had 31 skips. They were located in various areas with significant waste generation which called for availability of skip. Out of the 31 skips only 12 are currently in good working condition.

Through UN-Habitat, 1 skip loader and 24 refuse skips were acquired and placed in strategic areas especially in the urban built up zones. The Council through Local Authority Service Delivery Action Plan (LASDAP) was able to add 7 more skips thus bringing the number of skips in the municipality to 31. (See table below)

Table 4.1: Skips Distribution in Kisumu

Area	No. of skips	Area	No. of Skips	Area	No. of Skips
Fish Market	1	Goan Institute	1	Shauri Moyo	1
Taifa Park	1	Kaloleni	1	Kibuye Market	2
Jua Kali	1	Anderson Estate	1	Kondele Market	1
Mamba Hotel	1	Kilimani	1	Ring Road Migosi	1
Wayside	1	Makasembo Estate	1	Manyatta Market	1
Dunga	1	Celtel Estate	1	Nyaori (Javaisha)	1
Roving Skip	1	Anderson Estate	1	Oboch Market	1
Nyamlori	1	Arina Estate	1	Kowino Market	1
Social Centre	1	Nubian Estate	1	Nyamasaria Market	1
Oile Market	1	Lumumba health centre	1	Pandpieri primary	1

Source: (Municipal Council of Kisumu)

This number of skips compared to the current population (56,020) of households and the geographical size of Kisumu Municipality which leads to generation of large volume of waste, is still inadequate (MCK, 2012). According to Zoomlion Ghana Limited, a giant in the waste management as well as environmental sanitation in Ghana, the acceptable world standard by

United States Environmental Protection Agency (USEPA, 2001) skip ratio to the Household population is 1: 700. Going per this standard, then it can be concluded that the available skips are inadequate. In the Township location which has a household population of 10,162 requires 15 skips, Kondele location with 21,419 households requires 31 skips and Kolwa West with 24,439 Households requires 35 skips. The total number of skips provided for the study area was 31 instead of the required 81.

Most of the informal settlements were not served with the skips. Also the rural areas of the Municipality were not served with the skips due to the factor of the waste evacuation. The concept of the skip loader was to have private companies and CBOs dealing with solid waste register with council and be awarded the tender of garbage collection at the household level. They would in turn carry the waste to the nearest skips which they have the mandate to manage and also ensure that they are used efficiently and effectively. The private companies' staff would then have the mandate of collecting and putting garbage in the skips placed in the CBD. The garbage is kept in the skips awaiting onward transportation by the skip loader to the Municipal Dumping site in Kachok. Once in the dumping site the waste is then compacted by a garbage compactor.

Table 4.2a: Garbage produced and Transferred to the dumping site from Jan-July, 2012 via different modes of transport in Tonnes: The current waste production per day is still estimated at 400 tonnes which translates to 12,000 tonnes in a Month (MCK, 2012).

Mode of collection & Transfer (tonnes)	Skips	Canter	tractor	Pick Up	Compactor	Private Collectors	Grand Totals (With Skips)	Grand Totals (Without Skips)
Jan	1782	538	474	263	620	2506	6183	4401
Feb	1890	601	500	278	665	3934	6829	5978
March	1798	861	415	288	637	3094	7093	5295
April	2016	730	465	287	650	2981	7129	5113
May	1878	900	-	305	675	2216	5974	4096
June	1934	892	-	350	720	2874	6770	4836
July	2115	903	-	345	726	3011	7100	4985
Totals	13413	5425	1854	2116	4693	20616	47,493	34,080

NB/ In the month of May, June and July the tractor had broken down thus the missing figures.

Source: MCK 2012

The collection efficiency which was estimated at 20% drastically improved since the introduction of the skips as a method of solid waste management. From table 4.2a above, the collection efficiency rose to 51.5% in January through 59.2% in July 2012. In April, 2013 as depicted in table 4.2b below the figure rose to 60.2%. This has been the rising trend of the amount of solid waste collected from January 2012 to April, 2013.

Table 4.2b: Garbage produced and transferred to the dumping site from Oct, 2012 - April, 2013 via different modes of transport in Tonnes

Mode of collection & Transfer (tonnes)	Skips	Canter	tractor	Pick Up	Compactor	Private Collectors	Grand Totals (With Skips)	Grand Totals (Without Skips)
October	1870	543	-	316	725	2682	6136	4266
November	1503	1118	-	315	837	2965	6738	5235
December	1976	911	-	295	557	2766	6505	4536
January	1788	1023	-	297	690	2325	6123	4335
February	1817	955	-	380	697	3101	6950	5133
March	1634	910	-	556	870	3126	7096	5462
April	1598	949	510	1112	745	34217	8331	6733
Totals	12186	6409	510	3271	5121	20382	52,312	38,524

NB/ The tractor had broken down from October to March thus the missing figures.

Source: MCK 2013

Before the introduction of the garbage skips for solid waste management the Municipal Council of Kisumu had been using a Canter, Pick up, Tractor and the Private collectors as the means for garbage collection and transportation to the dumping site in Kachok near Nakumatt Mega City along Kisumu-Nairobi Road. Table 4.2a&b above show these different modes of solid waste collection and transportation. Private collectors have been reliable and efficient especially when the council was unable due to breaking down of their garbage vehicle or there is inadequate manpower for garbage management.

The Table 4.2a & b above also illustrates that within the months of Jan to July, 2012 the amount transported to the dumping site with inclusion of the skips was 47,493 tonnes and 52,312 tonnes from Oct, 2012 to April, 2013. Comparing the waste collected with the estimated amount of waste (14,400 tonnes) to have been collected and transported to the dumping site in 6 months, it can be concluded that with the introduction of garbage skips there is a significant difference between amount produced and amount transported to the dumping site.

Figure 4.1 below depicts the contribution of the garbage skips as a percentage of the total amount of garbage collected and disposed in relation to the other methods of solid waste disposal. The garbage skip comes second after private collectors at 27%. All the other methods of solid waste disposal have been in existence but since the introduction of the garbage skips there has been an improved collection efficiency of 51.5% in January 2012, and 60.2 % in April, 2013 way above the 20% before introduction of the skips.

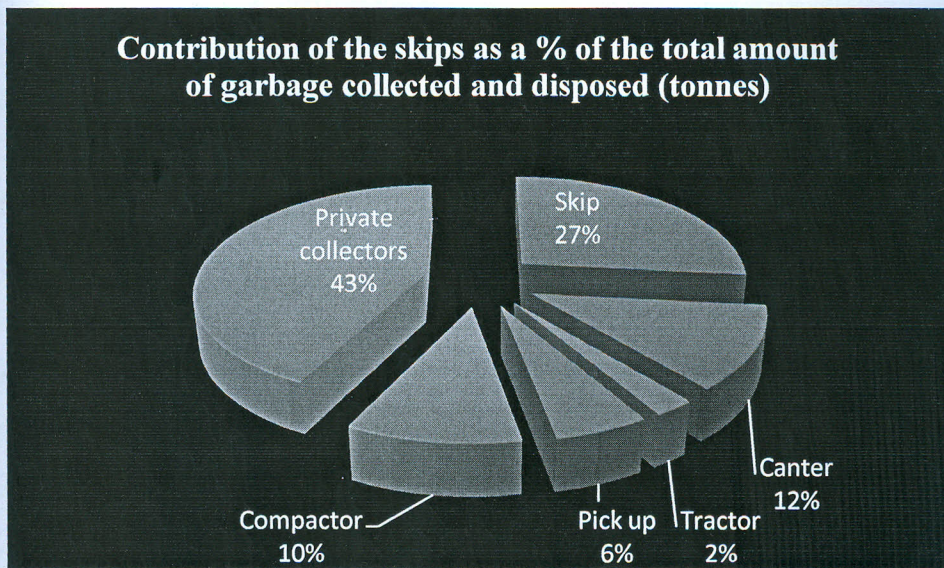


Figure 4.1: contribution of the skips as a % of the total amount of garbage collected and disposed (tonnes) *Source: Author, 2013*

Garbage skips have been used in Tamale Metropolis (TAMA) in Ghana. The skip ratio to the population was 1:9378 as opposed to the acceptable standard of 1:700 (ZoomLion Ltd, 2000). This means that the average population a skip served was 13 times greater than the standard maximum population a skip was supposed to have served.

Table 4.3 below translates the figures in the above graphs into percentage of the different modes of solid waste transfer. The use of garbage skips has proved to be an effective method of managing solid waste within the Municipality with 28% being second after private collectors. Private collectors have continued to lead.

Table 4.3: Different modes of solid waste transfer for 6months at different times of year

No.	Mode of Transfer	From Jan-July, 2012 (in %)	From Oct, 2012-April, 2013 (in %)
1.	Private Collectors	43	43
2.	Skips	28	25
3.	Compactor	10	11
4.	Canter	11	13
5.	Pickup	4	7
6.	Tractor	4	1

Source: MCK, 2012-2013

The percentage of skips dropped from 28% in July, 2012 to 25% in April, 2013 due to the factor of vandalism. By April, 2013 the number of skips available had dropped from 31 to 12 thus the depicted results in table 4.3 above.

Figures 4.2 a & b below depicts the fact that with the introduction of the garbage skips the amount of solid waste collected and transported to the dumping drastically went high from 34,080 tonnes to 47,493 tonnes in Jan-July, 2012 and from 38,524 to 52,312 tonnes in Oct, 2012 - April, 2013. There has been a noticeable positive change since the introduction of the skips in every month with a range between 1,782 tonnes in the Month of January and 2,115 tonnes in the Month of July, however this upward trend started going down in the Month of October, 2012. By April, 2013 the range was 1,598 tonnes way down compared to 1,782 tonnes in the Month of January 2012. Several factors brought about this. Some of the garbage skips located in middle income residential areas had been vandalized for scrap metals. The result was fewer skip thus a situation where the remaining skip were to be shifted from place to place. This was done to at least avail skips in areas where the original skips had been spoilt to avoid chances of emergency of unwanted open dumping. The skip loader and compactor were been faced with the challenge of mechanical breakdown which took time for the MCK to repair them.

This shows that there has been a positive correlation between the two variables that is garbage skips and solid waste management. There was improved solid waste collection and disposal when the number of skips was 31. As the number of skips reduced to 12, a declining fluctuation on the amount of waste collected and transported is evident.

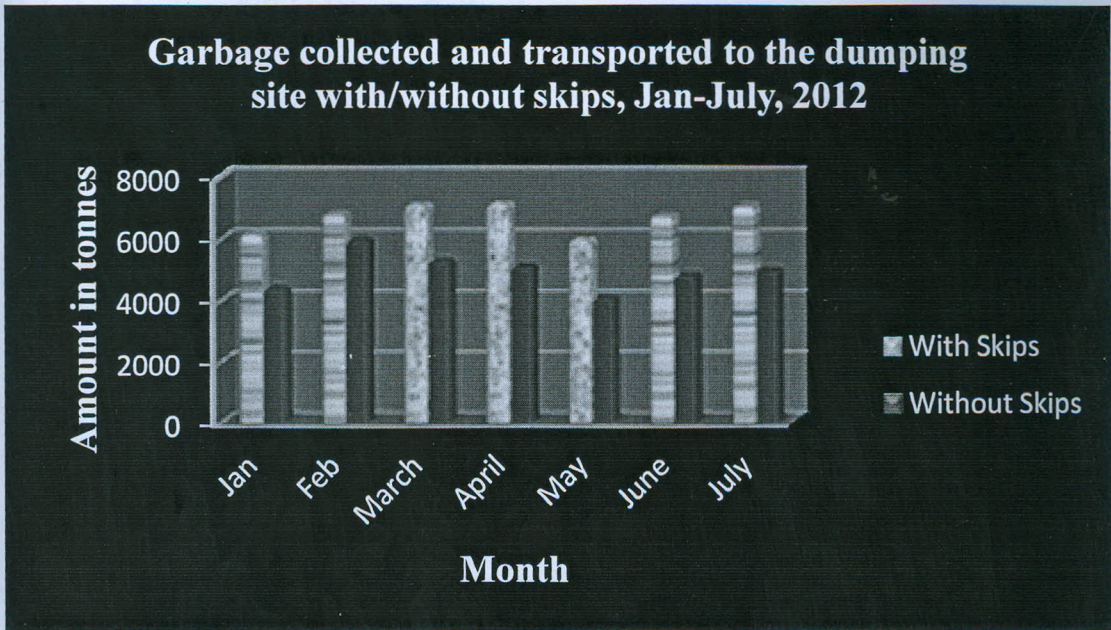


Figure 4.2a: Garbage collected and transported to the dumping site with/without skips Jan-July, 2012 *Source: MCK 2012*

Since the introduction of the garbage skips there has been an improvement in the amount of solid waste collected and transported. In the month of Oct, 2012 to April 2013, the amount of the garbage collected and transported to the dumping site with the inclusion of the skips was estimated at 52, 312 tonnes way above the estimated 47, 493 tonnes in Jan to July, 2012. Without the skips the tonnage stood at 34,080 and 38,524 tonnes in Jan-July, 2012 and Oct, 2012-April 2013 respectively. This is depicted in figure 4.2 a& b above and below.

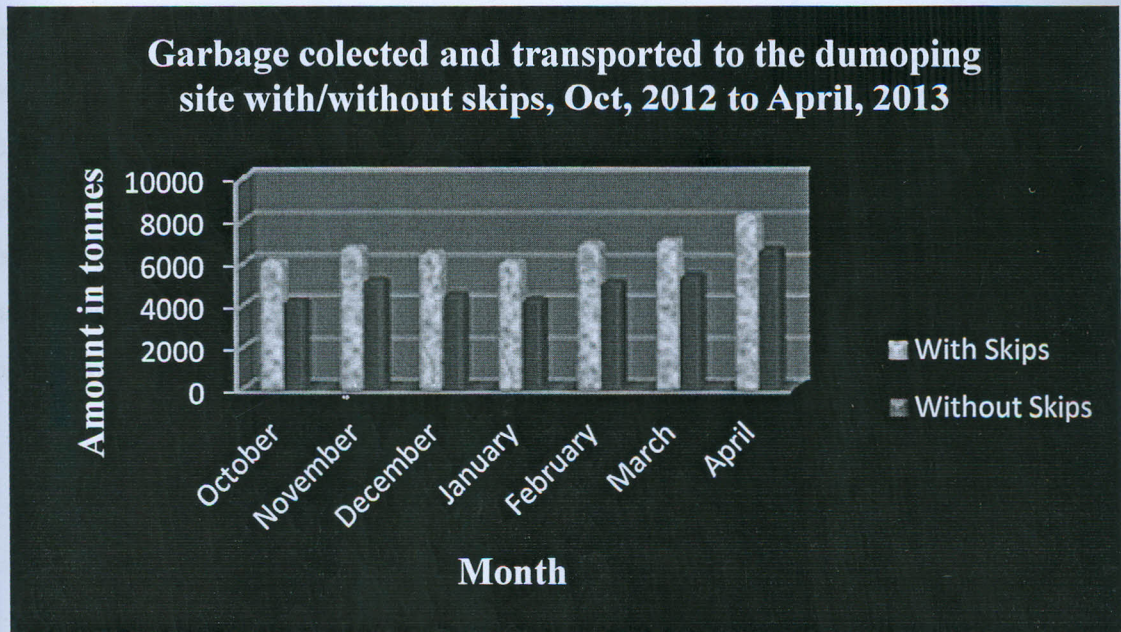


Figure 4.2b: Garbage collected and transported to the dumping site with/without skips, Oct, 2012-April, 2013 *Source: MCK, 2013*

4.1.1 Regularity of Skip Waste Collection

Regular collection is an important exercise in solid waste management. Figure 4.3 below illustrates generally, the number of times waste dumped in skips was collected per week in Kisumu.

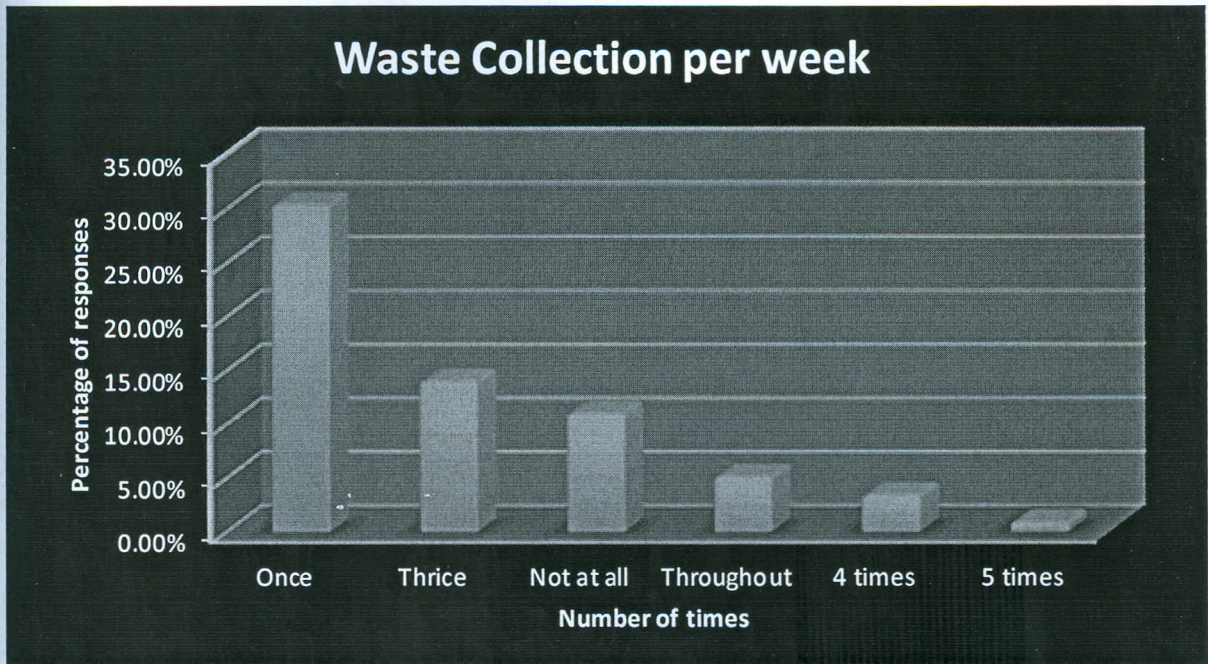


Figure 4.3: Waste Collection per week

Source: Author

From figure 4.3 above, 35.2 per cent of respondents indicated that waste was collected twice a week and in some instances once a week as indicated by 30.4 per cent of the respondents. In some areas like Migosi collection did not take place at all. Four times a week which should have been the required number of times waste was collected was rather the least particularly in the low class residential areas. This brought about heaping of waste in skips which were overflowing with waste particularly in the low class residential areas. Table 4.4 below further summarises number of times waste was collected in a week in the areas where skips were remaining in Kisumu as per the residents responses.

Table 4.4: Number of Times of Waste Collection per Week

Residential area/Section	Mode of collection	Number of times in a week
Low Class Residential Areas		
Nyaori	Skips	2
Nyamlori	Skips	2
Middle Class Residential Areas		
Celtel Estate	Skips	1
Arina Estate	Skips	1
Kondele	Skips	1
Mamba Hotel	Skips	1
Makasembo	Skips	1
High Class Residential Areas		
Kilimani	Skips	1
Dunga	Skips	1
Markets		
Fish market/Buspark	Skips	5
Kibuye Market	Skips	6
Oile Market	Skips	5

Source: Author

Table 4.4 above, suggests that, the average number of times that waste was collected in low class residential areas was twice a week as opposed to the minimum of four times a week. This is because in low class residential areas, the population is high as compared to the middle and high class residential areas. It is also important to add that waste was collected six (5/6) times a week in Buspark, Kibuye and oile because there was a market located there, because a lot of waste was generated in this area.

In the high and middle class residential areas, waste was collected once a week in stead of three times a week. This is because the MCK felt the people in this classes were capable of paying for the door-to-door collection. But respondents also gave a contrary view. According to them, door-to-door services (private companies) were expensive. During the field investigation it was observed that a lot of skips were overflowing with waste uncollected for days especially in the low class residential areas.

In Tama, Ghana (Tamale Metropolis), Africa the situation is no different. Table 4.5 below, suggests that, the average number of times that waste was collected in low class residential areas was thrice a week. In an area like Abaobo because there was a market located in the heart of the settlement, waste was collected seven (7) times. In the middle class residential areas, waste was collected once a week. This is because these areas were supposed to demand door-to-door collection in the Metropolis which they did not do.

Table 4.5 Modes and Number of Times of Waste Collection per week in TAMA, GHANA

Residential Area/ Section	Mode of Collection	Number of Times in a week
Low Class Residential Areas		
Aboabo	Communal	7
Choggu	Communal	3
Lamashegu	Communal	4
Moshi Zongo	Communal	4
Nyohini	Communal	3
Sakasaka	Communal	3
Middle Class Residential Areas		
Education Ridge	Communal	1
Ghanasco	Communal	1
Russian Bungalows	Communal/Door to door	1
High Class Residential Areas		
Kalpohin Estates	Door to door	2
SSNIT Flats	Door to door	2
Vitting Estates	Door to door	2

Source: ZoomLion, TAMA, April, 2010

An interview with ZoomLion showed that 216 tonnes were hauled every day out of the 810 tonnes generated daily. This meant that a backlog of 594 tonnes was left uncollected in the entire Metropolis. During the field investigation it was observed that a lot of skips were overflowing with waste uncollected for days in the low class residential areas. This has the tendency of breeding diseases such as typhoid, cholera, chicken pox which are sanitation related disease (F. puopiel,2010). Figure 4.4 below illustrates the situation in Choggu.



Figure 4.4: Solid waste container overflowing with waste at Choggu

Source: Felix puopiel,2010

The skip ratio to the population in the low class residential areas , Tama was 1:9378 as opposed to the acceptable standard of 1:700 (ZoomLion Ltd). This meant that the average population a skip served was 13 times greater than the standard maximum population a skip was supposed to have served. This explained why 40.5 per cent of the respondents resort to dumping waste at roadside, dump sites, open spaces, nearby gutter, backyard or burning as means to deal with their domestic waste in the Metropolis. To avoid indiscriminate dumping, a lot of skips had to be provided. However, this was still not adequate as 14 more skips were required. In effect skips were seen overflowing with waste (F. puopiel,2010).

In the middle class residential areas, no skip container existed and door to door services were not rendered. This also explains why the respondents resorted to dumping waste at unapproved sites. It is also important to add that very few households used dustbins in these areas (Middle class). The rest resorted to dumping their waste in front of their houses and burning them (F. puopiel,2010).

In the high class residential areas, dustbins were strictly used by households. Therefore, the dustbin ratio to the household was 1: 3 as compared to acceptable standard of 1:1. This means that very few households did not use dustbins for storing their waste. Therefore, in these areas where dustbins were used the environment looked very clean and serene. Waste was not dumped indiscriminately compared to the situation in the low class residential areas.

4.2 Attitudes of urban residents towards the use of skips for solid waste management

The manner in which solid waste was previously managed in Kisumu Municipality has slightly changed. Increasingly, peoples' attitudes on solid waste are gradually changing though at a snail's pace so that they no longer regard solid waste as a menace but rather as a commercial good that can be used to generate income and alleviate poverty. This gives an opportunity to the Municipal council to carry out intensive public sensitization on solid waste management which may have positive impact on urban residents' attitudes towards the use of skips (MCK, 2012). From the interviews, it came out that the MCK has failed in terms of carrying out promotion/ sensitization campaigns on the use of skips as a method of solid waste management. Not a single campaign had been carried out by the time this research was being done.

Likert Scale developed by Rensis Likert in 1932 was used to measure the urban resident's attitude towards the use of garbage skips for solid waste management. The Likert scale required the urban residents to make a decision on which method of solid waste disposal they approve to use on a five-point scale (Strongly Approve = 1, Approve = 2, Neutral = 3, Disapprove = 4, Strongly Disapprove =5). The measure used was the mode, or the most frequent response. This is because the mode makes the survey results much easier for the analyst and the audience to interpret (see attached appendix III, the Likert scale used).

Using the most frequent response which was strongly approved having 250 responses then approximately 65% of all the residents interviewed preferred the garbage skips for solid waste than the other disposal methods (refer to figure below). This was because the skips were free in terms of cost as compared to payment of Ksh. 200 to door to door private collectors. People also felt that with the skips, one didn't have to wait for a specific day in a week to have his/her garbage collected. The skips are open anytime any day for waste disposal.

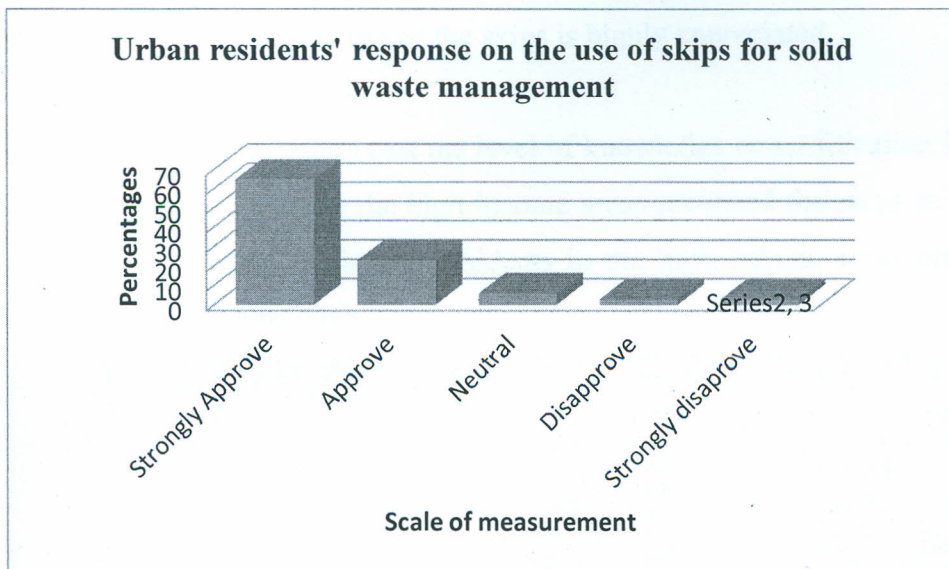


Figure 4.5 Urban Residents' response on the use of skips for solid waste management

Strongly Approve 65%, Approve 21%, Neutral 8%, Disapprove 4%, Strongly Disapprove 2%

Source: Author 2013

Of the 382 households interviewed 90% which translates to 344 household had an access to a skip located in less than a 1km distance. The High income, Medium Residential areas and the CBD were all well served with the skips at a walking distance (500m or less). The 10% left was in the Informal Settlements/ Slums areas where accessibility in terms of road was difficult. Most roads in these areas are very narrow and impassable especially during the rainy

season thus making it difficult for the garbage vehicles to collect and transfer the solid waste. Due to this factor the garbage skips were normally placed along the main road or in the accessible areas within the informal settlements. In this case only 22% of the household within the Informal Settlement had access to skips within a radius of 1km, with the remaining 78% having to walk quite a distance to access the skips while others opt for other methods of solid waste disposal.

The private collectors who have been a key component in collecting solid waste in the past didn't appreciate the introduction of the garbage skips. They felt that the introduction of skips was an impediment to their work as most residents preferred the skips because they are cheaper compared to door to door services. Figure 4.6 a,b & c below depict that people attitude towards the use of skips for solid waste management was related to the areas they reside. 51% of the population living in High Income areas preferred to use the skips as compared to 49% in Middle income areas and 22% in Low income areas. The level of knowledge is also related to the use of the skips. Most people who are enlightened live in High or Middle where the use of the skips is highly appreciated.

Figure 4.6a below supports that the level of knowledge or sensitization is related to the use of skips. 51% of residents in the high income areas preferred the skips as compared to 4% who prefer the road side. In fact no residents in the high income areas preferred an open drain which was very impressive.

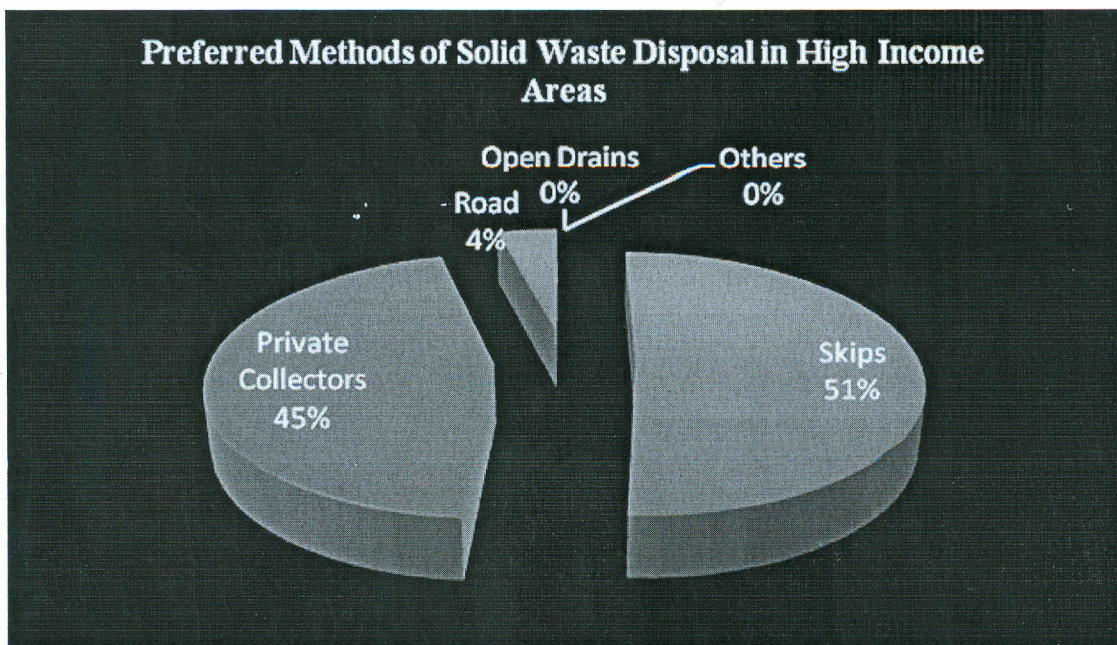


Figure 4.6a: Preferred methods of Solid Waste Disposal in High Income

Source: Author

In figure 4.6b below depicts the same trend though 8%, 4% and 2% of the residents in the middle income areas resulted to the use of road side, open drains and other methods for solid waste disposal respectively. Use of garbage skips though at a lower percentage of 49% compared to the high income areas still is the most preferred method of solid waste disposal in the medium income areas followed by private collectors at 37%.

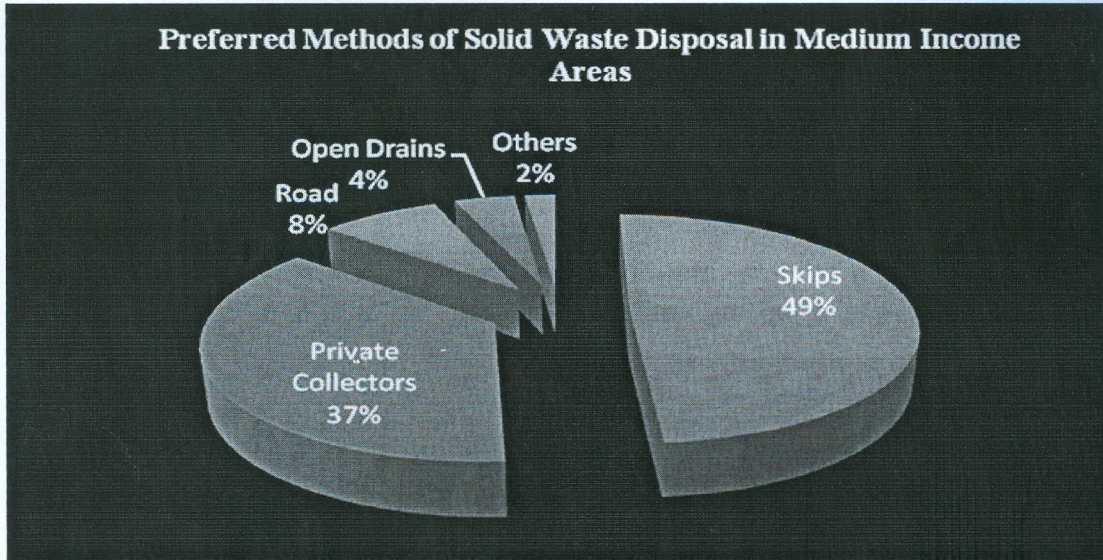


Figure 4.6b: Preferred Methods of Solid Waste Disposal in Medium Income Areas

Source: Author

The figure below also show that at 22% the use of garbage skips is still the most preferred method of solid waste disposal. What is disappointing is the higher percentage of the residents preferring to use the roadside which stands at 35%. Open drains and others stand at 6% and 26% respectively.

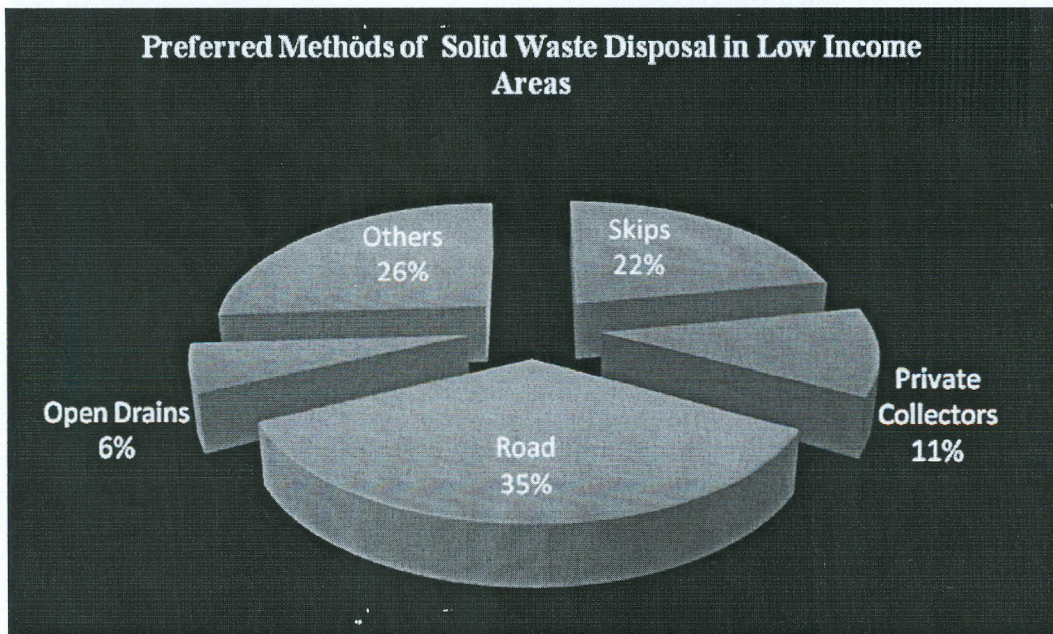


Figure 4.6c: Preferred Methods of Solid Waste Disposal in Low Income Areas

Source: Author

The concept of the skips was to have the private companies and CBOs dealing with solid waste register with council and be awarded the tender of garbage collection at the household level. They would in turn carry the waste to the nearest skips which they have the mandate to manage and also ensure that they are used efficiently and effectively. The private companies' staff would then have the mandate of collecting and putting garbage in the skips placed in the CBD. The garbage would be kept in the skips awaiting onward transportation by the skip loader to the Municipal Dumping site in Kachok. This concept was never implemented thus the insecurity felt by the private garbage collectors. Most of the garbage skips have been left unattended, garbage spilling over, leading to unsightly scene (see skip below). This is so especially when most of the people using the skips for solid waste disposal throw their garbage around the skips instead of putting it inside.



Figure 4.7 a) A well maintained skip located in one of the Middle Income areas (Celtel Estate) Source: Author, 2012



Figure 4.7b) A over filled and unattended to garbage skips

Source: Author, 2013

Metal dealers and street children vandalized most of the skips to obtain scrap metals for their own use. Sensitization on how important the skips are as compared to the scrap metals could change their attitude towards the skips.

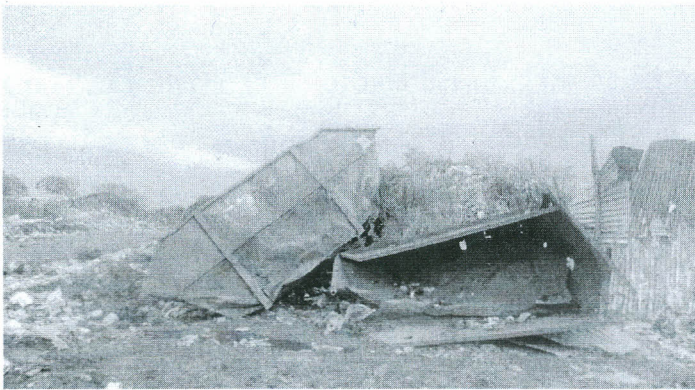


Figure 4.8 Vandalized garbage skips

Source: Author, 2013

Badilisha youth group have been in the forefront in helping garbage collection in Kisumu. They have been of help in maintenance of the garbage skips. MCK should partner with more Community Based Organisation to help fight vandalism.

Some of the skip loader drivers also avoided collecting some of the skips since they were located far away from the dumping site. This led to garbage accumulating in the skips, thus the overfilled skips.

During loading and off-loading of the skips, some of the skip loader operators mishandled the skips. Most often the skips were released without care thus crushing on the ground.

4.3 Durability of Skips (Sustainability)

Durability is an assurance or probability that an equipment, machine, or material will have a relatively long continuous useful life, without requiring an inordinate degree of maintenance. Also it is the ability to exist for long without significant deterioration by resisting the effects of heavy use, drying, wetting, heating, freezing, thawing, corrosion, oxidation, volatilization, etc (G. Waller & D.J Cochrane).

Coupled with the issue of number of skips being much less, about 19 of them were spoiled and of no use by April, 2013. The remaining 12 skips were located in the high income areas and around the CBD. This led to a situation where the remaining skips were to be shifted from place to place in order to at least avail skips in areas where the original skips had been spoiled to avoid chances of emerging of open dumping around such places. This proved a major challenge in solid waste management and the emergency of the open dumping around the areas where the spoilt skips were located become the norm. Most of skips were not been well maintained thus they quickly corroded or got damaged.

Other skips have been vandalized by street children through burning of solid waste inside and metal dealers in need of scrap metals for their own benefit. During the rainy season, the skips were rained on, thus rotting and rusting. After sometime the bottom of the skips opened up which rendered them unusable.

During the implementation of the skips, the Municipal expected the skips to have a lifespan of 5 years (MCK, 2011) depending on the material they were made of. However this was never

the case as most of the skips were either vandalised or rotten reducing the number to 12 from the initial 31 skips.

Garbage skips made of stainless steel though expensive at the time of purchase is worthwhile investing in, primarily because of the fact that they have many more advantages over a regular plastic trash can (ww.chenbros.com). One of the main benefits is the fact that they do not absorb odors like the plastic trash cans do. While a plastic trash can is relatively durable, in some cases, they are susceptible to cracking and breaking if they are dropped or bumped too hard. A stainless steel garbage skip is a lot more durable because of the fact that it is made of metal instead of plastic. Stainless steel garbage skip is not also prone to rusting thus making it more durable. They can last up to 12 years if well maintained. Stainless steel is 100% recyclable. An average stainless steel object is composed of about 60% recycled material of which approximately 40% originates from end of life products and about 60% comes from manufacturing processes (G.Waller & D. J. Cochrane, 1990).

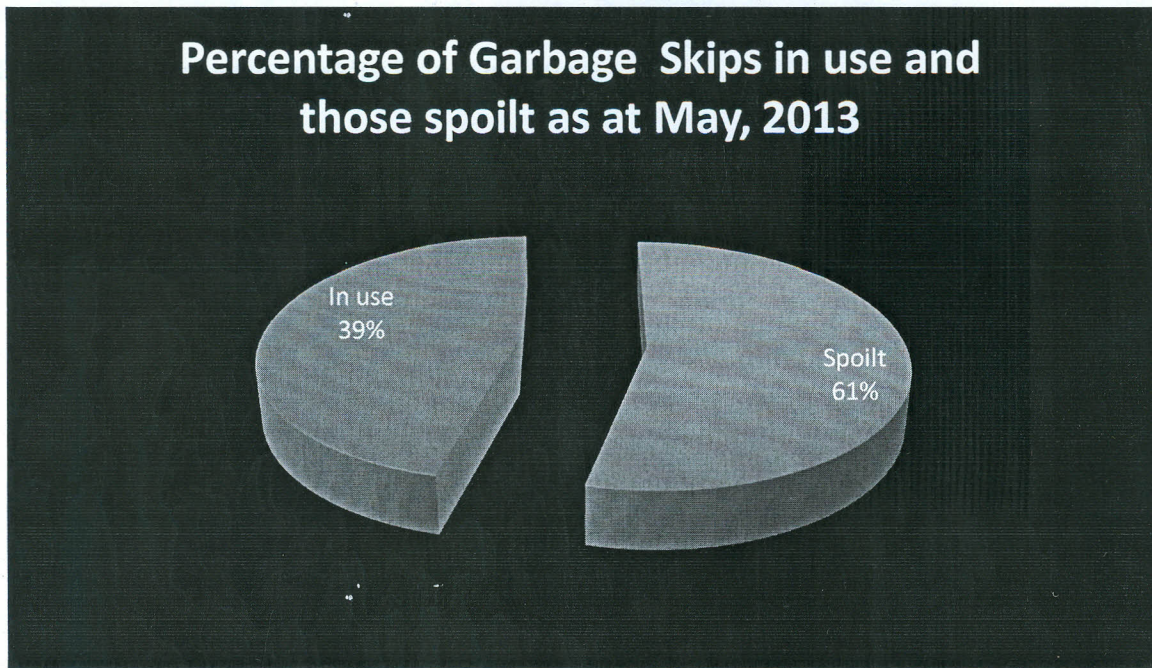


Figure 4.9: Percentage of garbage skips in use and those spoilt as at May, 2013

Source: MCK, 2013

A part from less number of skips and the spoiled ones, the truck used for collection of the skips was also faced with challenges such as mechanical breakdown and avoidance of some skips since they were located far away. This condition requires addition of another skip loader for continuous collection in case of any breakdown.

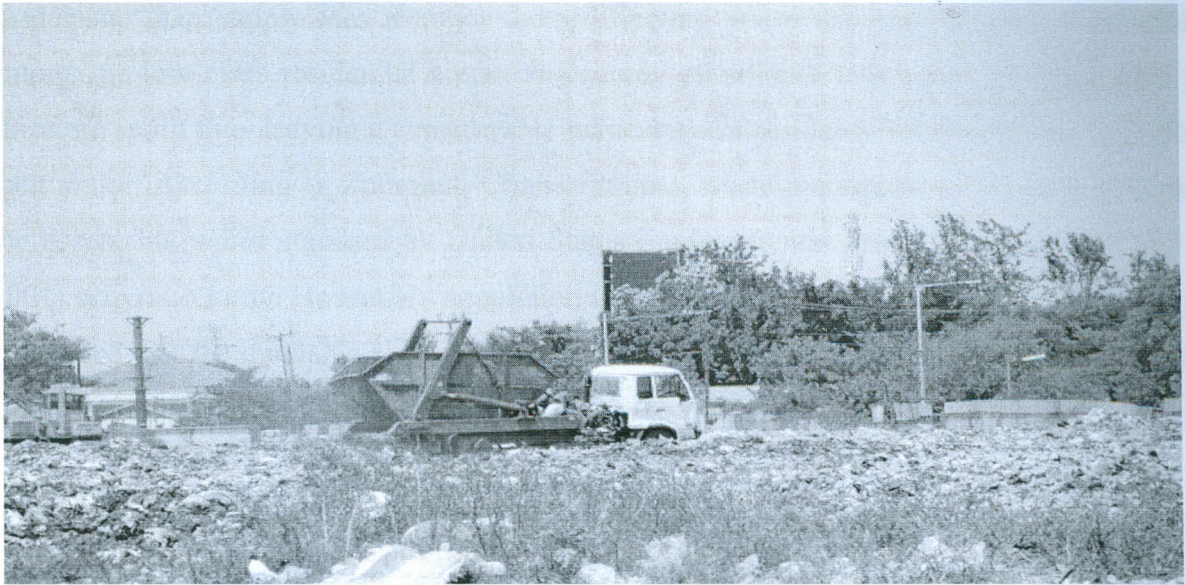


Figure 4.10: The garbage skips loader in action

Source: Author 2013

CHAPTER FIVE: SUMMARY OF KEY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Key Findings

Through the analyses, the following are the key findings of the study.

Inadequate skip supply was a major factor affecting waste disposal in Kisumu especially among the low class residential areas. The survey established that about 19 of the total 31 skips are spoilt thus leaving a considerable percentage of residents without a place to dispose their waste. According to Zoomlion Ghana Limited, waste management company in Ghana, the acceptable world standard by United States Environmental Protection Agency (USEPA, 2001) skip ratio to the Household population is 1: 700. Going per this standard, then it can be concluded that the available skips are inadequate. The total number of skips provided for the study area was 31 instead of the required 81.

Indeed there was irregular or lack of routine collection of waste by MCK especially in the low class residential areas. Waste collection was mostly carried out twice a week and in some areas like middle class residential areas once a week. Even in the high class residential areas collection was done once a week. According to (USEPA, 2000) the recommended collection routine is 4 times in Low Income Residential areas, 2 times for Medium, High income areas and CBD and 7 times in market areas.

Equipment for waste transportation were also inadequate; there was only 1 skip loader and 1 compactor. According to Zoomlion Limited, Ghana and USEPA, 2000, 1 skip is required for 30 skips thus the need for 2 more skips. This was because the number of skips needed to serve the study population of 56,020 should be 81.

The private companies felt threatened by the introduction of the garbage skips and so they weren't willing to cooperate with the MCK on the same issue. In figure 4.1 on the contribution of the skips as a % of the total amount of garbage collected and disposed in tonnes, the skips came second after private collectors at 27% and 43% respectively. The concept of skips on solid waste management was for the idea that the MCK will collaborate with the private collectors who were to manage the skips. However this was never implemented thus the insecurity.

Vandalism of the garbage skips and burning of the garbage inside the skips was a major challenge to the sustainability of the skips. This reduced their life span. Out of the 31 skips available at the start of the project in 2010, in April, 2013 only 12 were remaining.

Metallic materials used to make the skips is prone to rotting and rusting especially during the rainy season. There was a need to look for a more durable material for making the skips. According to Zoomlion Ghana Ltd, 2006, if skips/containers are not maintained they quickly corrode or are damaged. Garbage skips receptacle constructed of stainless steel with durable powder coated finish are likely to be durable, a life span of 10-12 years thus minimising replacement costs. Fire tests and study of the life cycle costs together demonstrate that stainless steels are cost effective materials. The wider deployment of stainless steel will therefore yield significant economic benefits as well as providing levels of fire safety unequalled by alternative materials (G. Waller & D.J Cochrane)

5.2 Conclusion

In the study, the following objectives were set to be achieved. The first objective was to assess the capacity of skips in solid waste management (effectiveness). Therefore, the survey established that the skips were effective though they were woefully inadequate and prone to vandalism. It also emerged that irregular collection of garbage from the skips to the dumping site affected the effectiveness of the skips. The second objective was to assess the attitude of urban residents towards the use of skips for solid waste management. The survey revealed that use of skips was the second most preferred method of garbage disposal. People attitude had changed to the better in terms of using the skips was concerned. They felt that it was a fairly cheap method of disposing waste. Thirdly, the research seeks to examine whether the skips are durable for solid waste management. If made from a more durable material like stainless steel which though expensive on purchase is more durable and doesn't rust and are also well taken care of the skips could last for a span of 10-12 years. But unfortunately, they were prone to vandalism and some individuals burnt garbage inside the skips thus causing environment pollution. When rained on the skips also got rotten and rusted.

Therefore, all the objectives set were achieved and with regard to the main objective of the study it can be concluded that the following are indeed the key factors affecting capacity of the skips in solid waste management in Kisumu. These include inadequate skip supply for storing waste; lack of routine collection of waste, vandalism, skips rotting and rusting and

inadequate resources for solid waste management institutions to effectively manage the waste generated. To effectively tackle the problems enumerated, the following measures are recommended: Provision of adequate skips, Regular collection of Waste, Use of Integrated Solid Waste Management Model, Proper Management of Skips and Adequate resourcing of Solid Waste Management Institutions.

If the above recommendations given are well taken and implemented, they will bring about a positive impact of skips in solid waste management; positive residents attitude towards solid waste and ensure durability of the skips.

5.3 Recommendations

Adequate skips (81 instead of the 31 provided) should be provided by MCK in collaboration with UN Habitat and Sida. This should be provided particularly for the low class residential and middle class residential areas to avoid dumping of waste in open spaces, open drains and roadside. The required skip to household population ratio should be 1:700 thus the need for 81 skips for a household population of 56,020 (USEPA, 2000).

There should be regularity of waste collection by MCK, particularly in highly populated areas like Nyalenda, Manyatta and Pandpieri among others to avoid heaping of waste and overflowing of skips with solid waste. At least, waste should be collected four times a week in these areas, twice in the Middle and high class residential areas, CBD and 7 in market areas (USEPA, 2000).

Currently the equipment used for transport and disposal of waste are not sufficient to cater for the increasing amount of wastes generated. MCK has only 1 compact refuse vehicle and 1 skip loader. This is not adequate to meet the demands of today's waste thus 2 more appropriate vehicles need to be sourced for effective solid waste management. According to USEPA, 2000, 1 skiploader should serve 30 skips.

The Waste Hierarchy principle includes the 3 R's principles which are; Reduce; Re-use and Recycle. Waste minimization through reduce, separation at source, reuse and recycling prevents the creation of wastes and reduces the quantity and the impacts of waste that is generated. This will mean that the waste which finds its way to the skips is minimal thus increasing their effectiveness in solid waste management.

The involvement of the private sector in partnership with local communities in solid waste management activities can create employment and job opportunities to a substantial number of residents. This may make the urban residents have a slightly positive attitude towards the use of skips.

By making it fun to do certain activities, it is easy to change people's behavior for the better. People do good things without even noticing just because it is funnier than doing the bad alternatives. The need to place attractive skips at strategic areas was rather high among the people interviewed. Artistic trash skips with sounds like "thanks for using me" or "welcoming music" which could encourage more people to use the bins can be designed. A simple sound effect can completely change the experience of properly disposing of waste.

Polluter pay principle should be applied for those caught burning the garbage in the skips or vandalising. They should pay for the cost and bear full responsibility of replacing the skips and also cleaning up the environment.

The metallic material used to make the skips has proved unsustainable because of vandalism, rusting and rotting. Stainless steel metal though expensive at purchase should be preferred as it is durable and rust free. They can last upto a life span of 10-12 years.

**MASENO UNIVERSITY
S.G. S. LIBRARY**

REFERENCE

- Agamuthu, P., 2001. *Solid Waste: Principles and Management*. Institute of Biological Sciences, University of Malaya Kuala Lumpur, Malaysia
- Anschutz, J., Gosse, J., and Scheinberg, A., 2003. *Putting Integrated Sustainable Waste Management into Practice; Using the ISWM Assessment Methodology*, Guodo, Netherlands.
- Arvind, K. 1997. *Sustainable Municipal Solid Waste Management in low income group of cities*, Tropical Ecology, ISSN 0564-3295
- Bartone, C.R., 1995. "The role of the private sector in developing countries: Keys to success. Paper presented at ISWA Conference on Waste Management - Role of the Private Sector, Singapore.
- Carl, B., 2001. *Study and Environmental situation in three urban centres*
- Casley, D. and Lury, D., 1981. *Data collection in Developing Countries*, Oxford; Clarendon Press/Oxford University Press.
- Vivek, S.A., 1998. *Sustainable Waste management; case study of Nagpur India*, Envis Centre, Ministry of Environment and Forest, India
- Kibwage, J.K. and Onyango G.M., 2008. *Kisumu Integrated Solid Waste Management Baseline Survey*, Nairobi, Kenya: UN-HABITAT.
- Felix, P., 2010. *Solid Waste Management In Ghana: The Case Of Tamale Metropolitan Area*, Ghana, Africa
- Gil, Y. and Kellerman, A., 1989. *A multicriteria model for the location of solid waste transfer stations: the case of Ashdod, Israel*, Mimeo, Department of Geography, University of Haifa.
- Government of Kenya, 2010. *Kenya National Bureau of Statistics*, Government Printers
- Kerlinger, F.N., 1979. *Behavioral research: A conceptual approach*. New York: Holt, Rinehart & Winston
- Klundert A.V. and Anshitz, J., 2000. *The Sustainability of Alliances between stakeholders in Waste Management, Ittingen, Switzerland*.
- Government of Kenya, Department of Physical Planning, 2008. *Physical Planning Handbook*, Physical Planning Department, Government Printers
- Government of Kenya, Department of Physical Planning, 2010. *Kisumu Structure Plan*, Physical Planning Department, Government Printers
- UN HABITAT/SIDA, 2004. *Kisumu City Development Strategies(2004-2009)*, UNoN, Nairobi
- Omran, A., Mahmood, A. Abdul, A. H and Robinson, G.M., 2008. *Investigating Household attitude Toward Recycling of solid waste in Malaysia*: International Journal of Environmental Research, University of Tehrar

Tchobanoglous, G. Theisen, H. and Vigi, S., 1993. *Integrated Solid Waste Management*. McGraw-Hill, New York.

Tzipi, E., Mira G.B., Mordechai, S. and Ofira, A., 2007. *Measuring externalities of waste transfer stations in Israel using hedonic pricing*. *Waste Management* 27 (5): 614-625.

UNHABITAT, PRACTICAL ACTION., 2010-2020. *Ten Year Integrated Solid Waste Management Strategy for Municipal Council of Kisumu, Kenya*, UN Habitat

USEPA, 2000. *Waste Transfer Station: Involved Citizens Make the Difference*. EPA530-K-01-003. Office of Solid Waste and Emergency Response, Washington.

USEPA, 2001. *Waste Transfer Stations: A Manual for Decision Making*. EPA A530-K-01-005. Office of Solid Waste and Emergency Response, Washington.

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

Waller, G. and Cochrane, D.J., *Stainless steel for durability, fire-resistance and safety*, Nickel Development Institute, technical series 10042, Toronto, Ontario, Canada