

**ROLE OF INFORMAL PLASTIC WASTE RECOVERY IN SOLID WASTE
MANAGEMENT AND PLANNING IN KISUMU TOWN, KENYA**

BY

EVANS MAGETO GICHANA

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF SCIENCE IN URBAN ENVIRONMENTAL PLANNING
AND MANAGEMENT

SCHOOL OF ENVIRONMENT AND EARTH SCIENCES
ENVIRONMENTAL SCIENCE PROGRAMME

MASENO UNIVERSITY

©2010

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

ABSTRACT

The rapid rate of urbanization throughout the world has contributed to increased amounts of waste thus posing difficulties for disposal. The problem is more acute in developing countries including Kenya, where economic growth as well as urbanization is faster. Plastics have become a major threat due to their non-biodegradability and high visibility in the waste stream. Their presence in the waste stream causes a serious problem when there is lack of efficient end of life management of plastic waste. Inadequate management of plastic waste in Kisumu is as a result of lack of integration of the informal recovery sector into the formal solid waste management within the municipality. The main objective of this study was to examine the role of informal plastic waste recovery in solid waste management and planning in Kisumu Town, Kenya. The study explored the existing approaches, practices and impacts of plastic waste recycling and reuse by the informal sector. A sample size of 80 WPs out of 200 identified during the reconnaissance was selected for the study. The sample size was determined using a table developed by Bartlett, Kotrlik and Higgins for determining minimum sample size from a given population size for continuous and categorical data. Systematic random sampling technique was used to select the 80 respondents from ten identified sites. The study applied qualitative and quantitative techniques in collecting primary and secondary data. The data was analyzed, interpreted and presented using measure of central tendency, statistical tables and graphs. The result of the study indicated that 47% of the respondents are found within the age bracket of 10-18 years who are within the school going age. This raises the concern about care and parental responsibility in which the respondents gave varied views as to why they engaged in waste picking. Majority of WPs (70%) of them engaged in waste picking in order to get income against 5% who said they were keen on cleaning the environment. The results also indicated that a well established network exists in the informal recovery sector involving waste pickers, waste dealers and factories. About eight hundred households in Kisumu depend on the recovery of plastic waste materials in order to make a living. The activities have proved profitable and play an important role in waste management. Furthermore, lack of a formal recycling system has made it possible for the informal sector to flourish with minimal government interference. The government's neglect of the work of informal plastic recovery sector as

well as civil society's lack of trust has proved to be one of the main difficulties confronting the sector. This research recommended that it is essential that the government starts to recognize the role of the informal sector by putting in place a policy framework that can guide plastic waste recovery systems by incorporating informal recycling activities into sustainable plastic waste management systems.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

The fast growth of urbanization has led to a rapid increase in the global urban population. In the past 50 years, the urban population in the world has grown from under 300 million to 1.3 billion at a rate of 4 % (World Bank, 1991). Further population projections estimate that the world urban population will be 4.96 billion by 2030 (Demographia, 2008). Current studies show that the world population living in urban centres is 47% and studies further indicate that contemporary urban growth and rural-urban shifts in the South are occurring in a context of a much higher absolute population growth but contemporary at lower income levels, with much less institutional and financial capacity and considerably fewer opportunities to expand into new frontiers be they foreign or domestic (UNCHS, 2001). In Sub-Saharan Africa the urban population is about 36% of the total population and is projected to rise to 50% by the year 2025 (Intermediate Technology Development Group (ITDG, 2004). Out of the 50%, 30% of city dwellers will still be living in slums and the general waste generation standing at 0.8 kg per capita per day (Contreau, 2007). This means that there will be more waste generated in urban areas which will require forecast planning to avoid haphazard solid waste disposal.

The increase in population coupled with uncontrolled industrial development has put pressure on the already limited natural resources, facilities and services. Therefore solid waste management (SWM) is perceived to be a growing cause of environmental and financial concern in developing countries (Klundert, 1995a). Significant efforts towards proper SWM have been made in the last decades. However, majority of municipalities in developing countries still cannot manage the growing volume of waste produced in their cities (ITDG, 2004). Population growth is intensifying pressure on urban infrastructure in many cities already overburdened with the provision of urban services. One of the aspects that constitute a serious problem in many third world cities is municipal solid waste management. Most cities do not collect the totality of waste generated and of this, only a fraction receives proper disposal. The insufficient collection and inappropriate

disposal of solid waste causes land, water, and air pollution and poses risks to human health and the environment. Despite these risks, SWM in developing countries receives less attention from policy makers and academics than other environmental problems like air pollution and waste water treatment (Medina, 2000).

The current status of urban areas indicates that most of them are faced by solid waste disposal problems. The National Environment Management Authority (NEMA) in Kenya admits that most towns have inadequate capacity to handle waste and a significant portion of the population does not have access to waste collection (NEMA, 2004). Only 40% of waste generated in urban centres in the country is collected. For example in Nairobi which is the capital city of Kenya with a population of about 3 million people generates about 2000 tonnes per day of solid waste of which 68% is domestic waste. However, the city council collects only 400 tonnes per day of the solid waste. Mombasa which is the second largest city generates about 750 tonnes per day while Kisumu municipality being the third largest town generates about 400 tonnes day. According to a research by (KIPPRA, 2003), most of Kenya's urban households have no access to waste management services other than those they provide themselves as illustrated in figure 1.

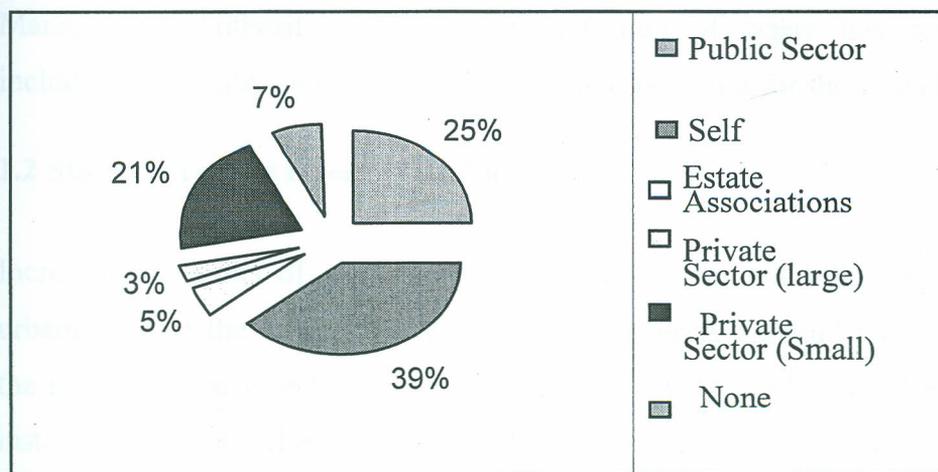


Figure 1: Solid Waste Management in Urban Kenya, KIPPRA (2003)

Plastic products and packaging materials make up a growing portion of the waste stream and often block sewers and cause livestock deaths because they resist degradation.

Plastics account for 28% of the Cadmium and some 32% of the lead found in MSW. Both are toxic.

Kenya's urban population rose from 15% in 1979 to 27% in 1999 whereby Nairobi city hosts approximately between 2.1 to 3 million residents (Intermediate Technology Development Group, 2004). Population trends from national censuses indicate that the population of Kisumu Municipality also has grown steadily from 85,361 in 1969 to 152,643 in 1979 to 214,699 in 1989 and 322,734 in 1999 (GoK, 1970; GoK, 1981; GoK, 1994; GoK, 2001). The annual population growth rate which is estimated at 2.8% is expected to project the population of the town at about 565,000 by 2010. According to (Rakodi, 1997) there is a positive correlation between city population size and both the percentage of waste moved and rate of households enjoying regular waste collection. This suggests that increasing city size poses a greater problem to the solid waste management in Africa. In Kisumu town, the increase has presented unusual problems to planners as they exert pressure on the existing infrastructure such as supply, sewerage disposal, housing and solid waste. According to National Environmental Management Authority (NEMA), only 20% of solid waste in Kisumu is collected, transported and disposed while more than 80% remains uncollected (National Environmental Management Authority, 2005). Poor collection of waste has several implications including soil, water and air pollution as well as potential for the spread of diseases.

1.2 Statement of the research problem

Increasing amounts of plastic waste are being generated following the rapid rate of urbanisation in the world. Today, there is a staggering demand for plastic products with the rising affluence and public embracement of western consumerism. Nairobi city for instance has attracted a number of industries which produce plastics to a tune of about 193,000 tonnes annually (KNCP, 2006). However, this expansion of plastic production and consumption is having a significant impact both visibly and invisibly on the environment and society in Africa. Despite the role played by the informal plastic waste recovery to reduce waste from the waste stream and creates employment, little has been done to involve and incorporate the sector into the municipal solid waste management

services of Kisumu town. This makes the sector to operate in isolation without the regulations and policies essential for the growth of recycling activities. The collective support required through participatory planning and management of waste in the town is lacking due to traditional policies by the MCK of assuming the control of SWM yet the problem of waste management persists. Informal plastic waste activities are uncoordinated and the waste pickers are harassed during their practices of waste collection. Furthermore the waste pickers face occupational and environmental challenges which can be resolved through collaboration and networking with all stakeholders in waste management including MCK. Studies on formal MSW collection and benefits of recycling have been extensively done but little information is available on incorporating plastic waste management into formal solid waste management.

1.3 Objective of the study

The main objective of this study was to examine the role of informal plastic waste recovery in solid waste management and planning in Kisumu Town, Kenya.

The specific objectives of the study were:-

1. To determine the sources, quantities and types of plastic waste materials salvaged by waste pickers in Kisumu town
2. To establish formal and informal linkages that exists in the plastic waste recovery sector.
3. To evaluate the socio-economic aspects, occupational health and environmental implications of informal plastic recovery activities in Kisumu town.
4. To examine the developments in Kenya's plastic waste management policies between 2002 and 2007.

1.4 Research questions

The study was guided by the following research questions:

1. What are the main sources, quantities and types of plastic waste materials salvaged by waste pickers in Kisumu town?

2. How are the formal and informal linkages and networks organized in the plastic waste recovery sector in Kisumu town? What are the planning challenges experienced in the sector?
3. What relations exist between waste picking and occupational health and environmental implications in plastic waste recovery?
4. What have been the positive and negative developments of plastic waste management policies in Kenya between (2002-2007) years?

1.5 Scope and limitations of the study

There are different levels of networks involved in the collection, sorting, cleaning and transporting plastics. However, the study was limited to the major actors directly involved in plastic waste recovery activities i.e. recycling dealers, waste pickers, plastic industries and their agents. Other actors targeted by the study included MCK, Community based development groups, private collectors of solid waste and environmental groups. The study also confined itself to the four main recycling factories that deal in plastic waste within Kisumu town. This was due to the limitation of time and financial costs.

1.6 Justification of the study

The results of this study are expected to be significant to the policy makers, environmental managers, urban planners, city engineers, consultants in the field of SWM and other professionals who find it relevant. Plastic products and packaging materials which resist degradation for example in Nairobi account for 28% of cadmium and some 32% of the lead found in MSW yet both are toxic (Ikiara M and C. Koech, 2002). Most probably increasingly more consumer products made of plastic will enter the market due to the strong substitution effects plastic materials have as compared to other materials such as less energy consumption and low cost linked. In view of the aforementioned, some empirical data provided in the study can be useful as a guide to future implementation of plastic waste programs at networks operations. The MCK can utilize the findings to locate a formal plastic recycling plant. Finally, the study findings underscore the importance of the existence of a plastic waste policy in towns which can guide in decision making processes pertaining to plastic waste management (PWM).

2.1 Introduction

This chapter reviews the literature written by various scholars in the field of solid waste management and related aspects. The sub-topics include: overview of world plastic production, background of plastic industry in Kenya, sources and types of plastic waste, environmental implications and occupational health, organizational networks in plastic waste recycling sector, plastic waste recycling policies and conceptual framework.

2.2 Overview of World plastic production

The world's first plastics were produced at the turn of the 20th century and were mainly based on natural raw materials. Only in 1930 were thermoplastic made from basic materials styrene, vinyl chlorine and ethylene, introduced into the market. But the main growth of the plastic industry did not take place before the 1960s. It reached its peak in 1973 when production exceeded 40 million tons per year (Saechtling, 1987). Following a temporary drop in production during the oil crises and the economic recession in the beginning of the 1980s, the world production of plastics continued to increase to approximately 77 million tons in 1986 and 86 million in 1990 (Sechouten and Van der Vegt, 1991). Figure 2 shows the rapid development of plastics production worldwide which far exceeds the combined production of non-ferrous metals such as aluminium, Zinc, lead and copper.

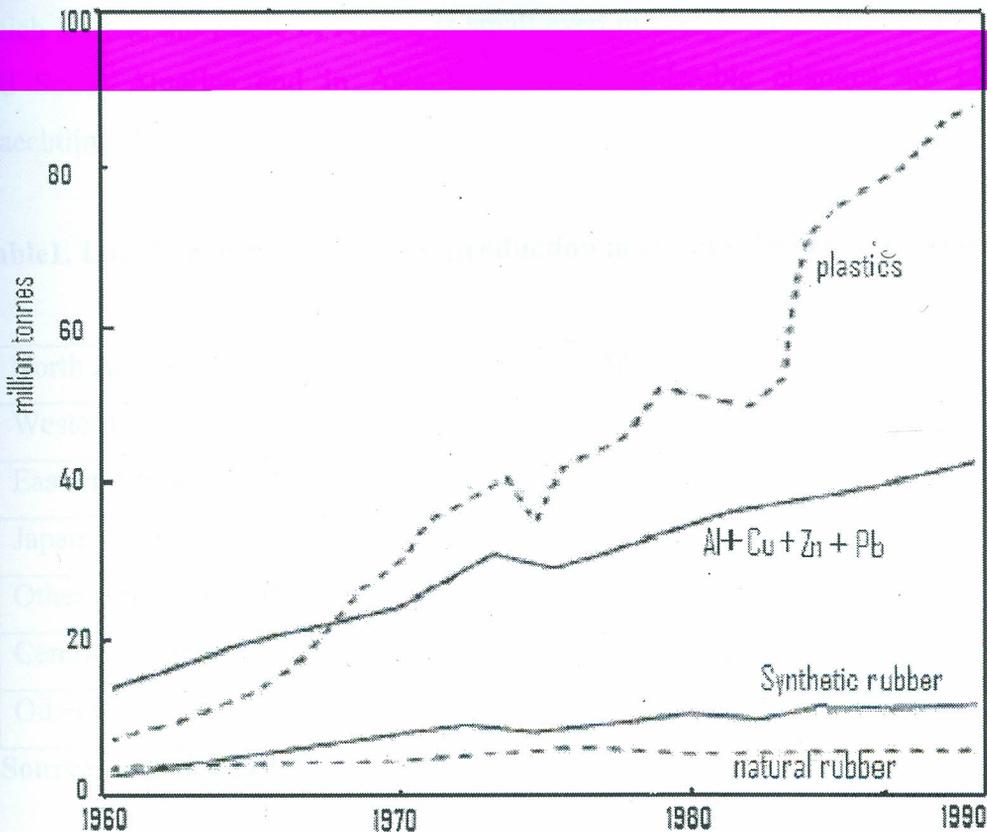


Figure 2 Development of plastics production Worldwide
Source: Schouten (1991)

The major producers and consumers of plastic materials are found in North America, Western Europe and Japan. Currently, about three quarters of the worlds plastic are produced in these regions (Johnson, 1990). In 1989, the United States used over twelve billion pounds of plastic for packaging designed to be thrown away as soon as the package is opened. In the 1990s, this figure was expected to be almost double. Unlike in developed countries, more and more people were becoming aware of the damage plastics do to the environment. They spoke against it, protesting irresponsible industries and getting laws passed banning polystyrene and other plastics (Greenpeace, 2006). In 1989, Italy introduced a tax on plastic bags that reflected the cost the bags imposed on society and the environment while in 2003 South Africa introduced a new legislation on plastics that sought to prevent plastic pollution, promote the repeated use of bags, and encourage the bags' recycling (UNEP, 2005).

Table I below gives an indication of the shares of plastics production in the main world regions in the late 80s. It can be observed from Table 1 that the share of other countries,

which include the whole of Africa, is small even in comparison with countries in central and South America and in Asia. However considerable changes are taking place. (Saechtling, 1987)

Table1. Location of world plastics production in the late 1980's in percentage

North America	32%
Western Europe	31.2 %
Eastern Europe and Soviet Union	12.3 %
Japan	11.7%
Other Asian countries	6.9%
Central and south America	4.3%
Others	1.6 %

Source: Klundert (1995a)

In contrast with most African countries which import plastics, Egypt has rapidly increased its output of plastics, largely as a result of the governments' policy to encourage domestic production. The total value of the plastics produced in Egypt increased from \$18.5 million in 1979 to more than \$200 million in 1991. A part of this output is exported, and total earnings rose from about \$0.5 million in the early 1980s to more than \$60 million in 1990. (EQI, 1991)

During the last few decades, there has been a steady increase in the use of plastic products resulting in a proportionate rise in plastic wastes in the MSW streams in large cities in Sub-Saharan-Africa (World Bank, 1996; Yankson, 1999). The adoption of a more hygienic mode of packaging food, beverages, "iced water" and other products brought plastic packaging to replace the existing cultural packaging methods such as leaf wrappers, brown paper and metal cup uses in cities and towns (World Bank, 1995). This widespread replacement of the modes of packaging with plastics is an indication of the uniqueness of plastic properties such as versatility, inertness and flexibility, especially in its application to packaging. As a result of their unique properties, plastics have become

the most favoured packaging materials in commerce with firms making windfall profits and transferring the environmental cost associated with cleaning plastic waste to the general public.

Kreith (1994) suggested that the factors that tend to increase the per-capita and total amount of wastes as well as their constituents in waste stream include increased population, increased levels of affluence, changes in lifestyle, changes in work patterns, new products, redesign of products, material substitution and changes in food processing and packaging methods. Urbanization in Kenya has had implications like the expansion of slum areas and the creation of new ones. Population growth has also intensified the pressure on urban infrastructure in many towns already overburdened by the provision of urban services. For instance, Nairobi's population is about 2.1 million and generates about 1740 tonnes of waste a day. However, only 40% of this is collected and disposed at Dandora dumpsite (ITDG, 2004). Kisumu town has seen gradual increase in the population from about 365,000 people in 1999 to around 565,000 people today. Subsequently, this has led to an increase in the daily solid waste generation from about 180 tonnes per day in 1999 to about 300 tons per day today (NEMA, 2005).

Plastic waste generation rates are often affected by socio-economic development, degree of industrialization and climatic conditions. Generally, the greater the economic prosperity and the higher the percentage of urban population, the greater the amount of solid waste produced. Urbanization and rising incomes, which lead to more use of resources in Kenya therefore bring about more waste. A case in point is Nairobi city where increased levels of affluence has lead to the increased use of plastic packaged products from supermarkets including bottled water packaged in polyethylene terephthalate (PET) bottles. Waste quantities are inextricably linked to economic activity and resource consumption. The consumption of plastic bags in Nairobi, Kenya, is very high in comparison to other urban centres in the country. Supermarket chain stores issue an estimated number of 8 million plastic shopping bags per month in Nairobi alone.

As towns become richer and more urbanized their waste composition changes. The substantial increase in use of paper and paper packaging is probably the most obvious

change. The next most significant change is a much higher proportion of plastics, multi-material items and “consumer products” and their related packaging materials. More newspapers and magazines (along with corresponding increases in advertising), fast-service restaurants, single-serving beverages, disposable diapers, more packaged foods, and more mass produced products are all by-products of widespread rise in local “disposable incomes.” A negative side of greater affluence is that it brings with it more waste of higher volume. In turn, this makes waste more expensive to collect. Often, increased use of plastic waste and food packaging results in a related rise in the amount of litter.

Kenya lacks environmental labelling programs, businesses voluntarily label their products to inform consumers and promote products determined to be more environmentally friendly than other functionally and competitively similar products. Environmental labelling can help achieve a number of goals, including improving the sales or image of a labelled product raising consumers’ environmental awareness, providing accurate, complete information regarding product ingredients; and making manufacturers more accountable for the environmental impact of their products. Although labelling is done for Kenyan industrial products, there is minimal information on environmental awareness.

2.3 Plastics in Kenya

The first plastics factory in Kenya was inaugurated on November 16th 1968. During the launch, the then Minister for Commerce and Industry, Mr. Mwai Kibaki, was reported to have hailed the use of plastics as “a new boon to young Developing Nations”. Since then, the plastic manufacturing industry has grown rapidly due to the increasing demand of plastic products. During the last five years, the plastic manufacturing sub-sector grew by 7.1% in 2001, 7.1% in 2002, 8.2% in 2003 and 2.9% in the year 2004. The manufacture of plastic crates, bottles and plates in the same period increased by about 20%, 6.8% and 12.7% respectively (GoK, 2006: 176-182). Examples of this include the edible oil manufacturers i.e. KAPA oil refineries and East African Industries who have plastic production lines for packaging their oil products. Others include health and beauty

products both from local and international companies, for instance, Consumer beauty and professional products (Barcelona, Spain) and Uniliver, Kenya Limited.

2.4 Plastic production trends

In Kenya, plastic virgin materials are imported and the recycled material production is low as compared to Egypt. Figure 3 shows the trend of plastic manufacturing industry in Kenya which went up by 25.9% in the year 2005 (GOK, 2006).

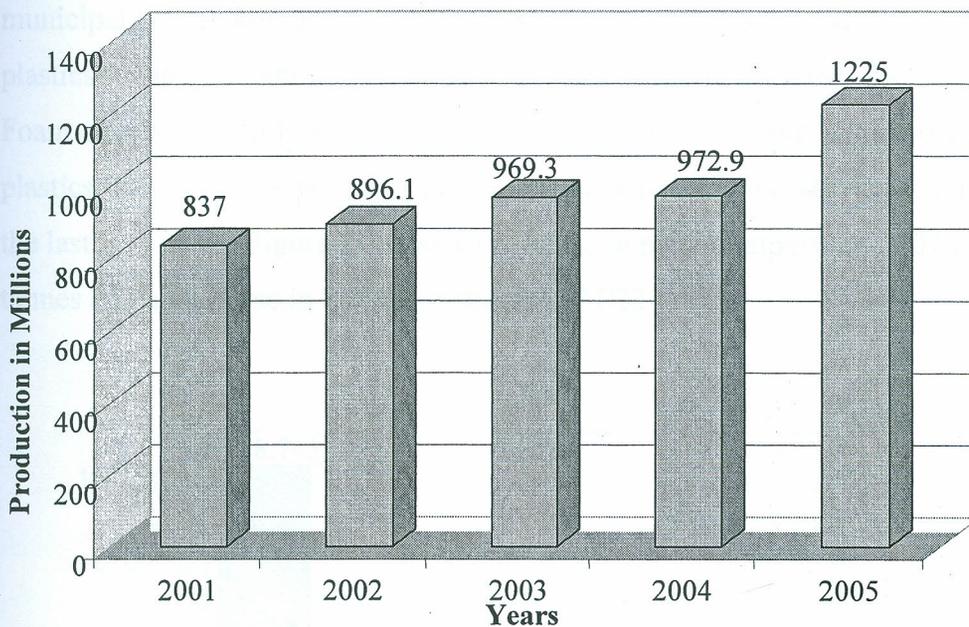


Figure 3 Plastic manufacturing productions in Kenya since 2001-2005
Source: GOK (2006)

This was indication of steady upward growth in the industry which has been clearly evident since the year 2001 as illustrated in figure 7. The industry gave the industrial sector earnings totalling to 631.5 million in 2003 and 728.6 million in 2004 hence showing an increase of 91.1 million. However, this has been compromised with the impact of plastics which include littering and blockages of sewage and storm water systems in Kisumu and other cities in Kenya leading to flooding.

Production of plastic bottles increased by 19.2 percent in 2005 (GoK, 2005). An increase was also recorded in the production of plastic shoes, PVC pipes, plastic crates and plastic plates which registered growths of 45%, 17.3%, 18.4% and 12% respectively over the same period. Production of polythene bags (films) went down by 9.2% due to the launching of campaigns on plastic waste management strategies in the country in 2003.

Statistics also indicate that the manufacturing sector for plastic products has a total of 107 industries whereby Nairobi city leads with approximately 50 industries while the total employed workers are 6,883 nationally (GoK, 2004). As mentioned earlier, Kisumu municipality has four industries dealing in virgin material production and recycling of plastics namely, Vyatu industries Ltd, Victoria enterprise, SONI Technical Ltd and Tuff Foam mattresses Ltd who have employed a total of about 400 workers. Imports of plastics in Kenya, for primary and non-primary forms have also been on the increase in the last five years. Figure 4 shows an increase in plastic imports in 2001 of up to 188,745 tonnes and a decrease in 2002 registering 177,022 tonnes.

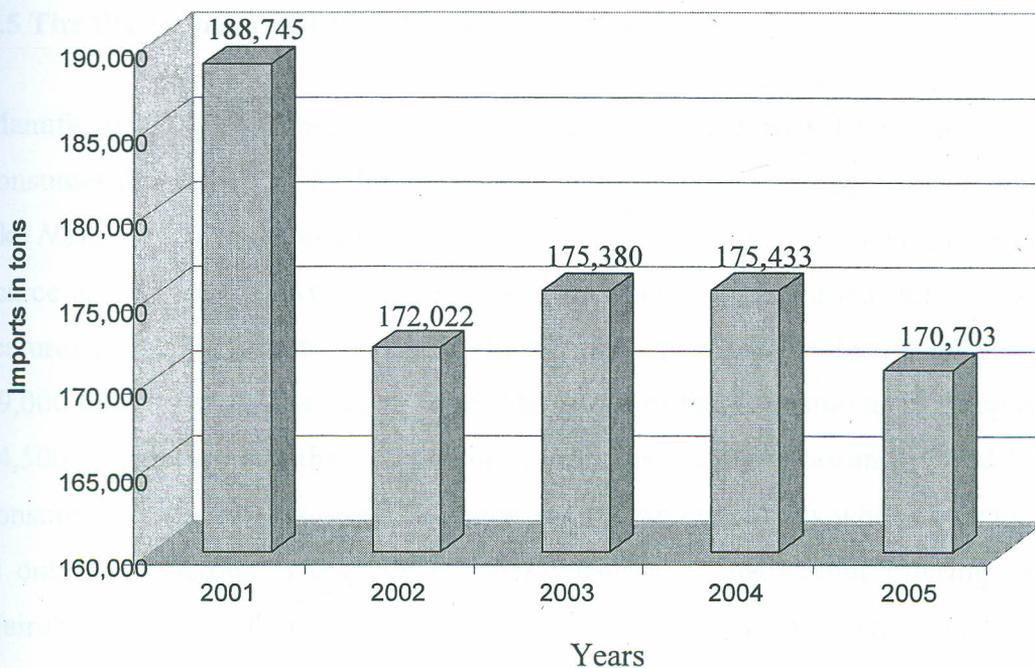


Figure 4 Imports of primary plastic products in Kenya (2001-2005)
Source: GOK (2006)

This may have been caused by the oil crisis of 2002 according to the trend observed. However, according to GoK (2006), the importation of plastics started to increase again in 2003 and 2004 when they registered 175,380 and 174,433 respectively. The decrease of imports in 2005 is attributed to anti-plastic bags campaign on usage of less than 30 microns launched in 2003 by UNDP, GoK and NEMA.

The growth of plastic imports and manufacturing production has also brought about an increase in waste production which is recovered after use. The very qualities that made plastics so attractive all over the world are now also regarded as disadvantages, especially in the industrialized countries (Klundert, 1995a). There are very few environmentally sound methods of disposing plastics. Most of them resist decay so well that it will take centuries for them to break down naturally (Klundert, 1995a). Because of their light weight transportation costs of plastics are relatively high. In addition, the large amount of different plastic types has made sorting a difficult process. For these reasons, the recycling of used plastics into new products has been slower in becoming established than some other waste materials such as paper or glass.

2.5 The Plastic bags and PET bottles generation

Manufacture of plastic bags in Kenya boomed around the early 1990s strongly driven by consumer demand (ELCI, 2005: 26). To this end, major growing Kenyan supermarkets like *NAKUMATT* and *Uchumi* resorted to using them because as paper bags were proving scarce and expensive. Another reason was that plastic bags turned out to possess better features in many respects. Of the 193,000 tonnes per year of plastics output, a sizeable 49,000 tonnes per year is plastic bags. About half of this (an equivalent of approximately 24,500 tonnes) are less than 15 microns in thickness and are primarily used for carrying consumer products. This category comprises plastic bread bags whose average thickness is only 6-7 microns. These are the major causes of inadvertent littering observed in Nairobi and many other urban and rural environments in Kenya. The Kenya Association of Manufacturers (KAM) and (UNEP, 2005: xii) gives a slightly lower figure of 48,000 tonnes per year of production of plastic bags. According to KNCPC (2006), there are 45 plastic bag manufacturers registered with the Kenya Association of Manufacturers.

Polymer industry in Kenya has moved a long way and has diversified to serve key sectors like agriculture, Telecom, transport and packaging. With the liberalization of the economy, it is likely that there will be an increase in plastic production and consumption in future given the growing economy (GoK, 2007). This calls upon policy makers and stakeholders to put in place strategies of plastic waste management in order to protect the environment sustainably.

The Kenya National Cleaner Production Centre conducted interviews in the year 2006 with plastic manufacturers on plastic consumption levels and comparisons with the production levels gauged from demand and supply levels. It was estimated that the total plastic products consumption in Nairobi is about 212, 000 tonnes per year (KNCPC, 2006). According to the Central Bureau of Statistics, Kenya imported a total of 139, 000 tonnes of finished products between the years 2000 and 2004. By calculating the average imports for the 5 years (GoK, 2005) this translates to about 28, 000 tons per year. Currently, Nairobi city has about three million inhabitants as compared to Kisumu which has approximately 500,000. Nairobi City generates solid waste to the tune of 2,400 tons per day while Kisumu generates 400 tonnes per day. The amount of solid waste generation is getting worse by the day as a result of increasing populations which is fuelled by large scale migration to the two cities.

As it emerges from figure 3 mentioned earlier, the percentage of plastics production and consumption is growing annually. A separate solid waste management survey carried out by the ITDG on waste management in the informal settlements of Nairobi, revealed that about 90% of the organic fraction of solid waste originates from food materials while 70% of the inorganic waste is from plastics. The majority of the households were also found to store their waste in plastic bags (75%). Figure 5 on the next page highlights a summary of plastic material balance according to KNCPC. According to them, 38,516 tonnes of plastic materials are retained and reused annually while 172,800 tonnes per year is disposed as waste. Only 1,728 tonnes per year is recycled. Consequently, the potential for recycling in most urban and rural centres exist but has not been fully exploited.

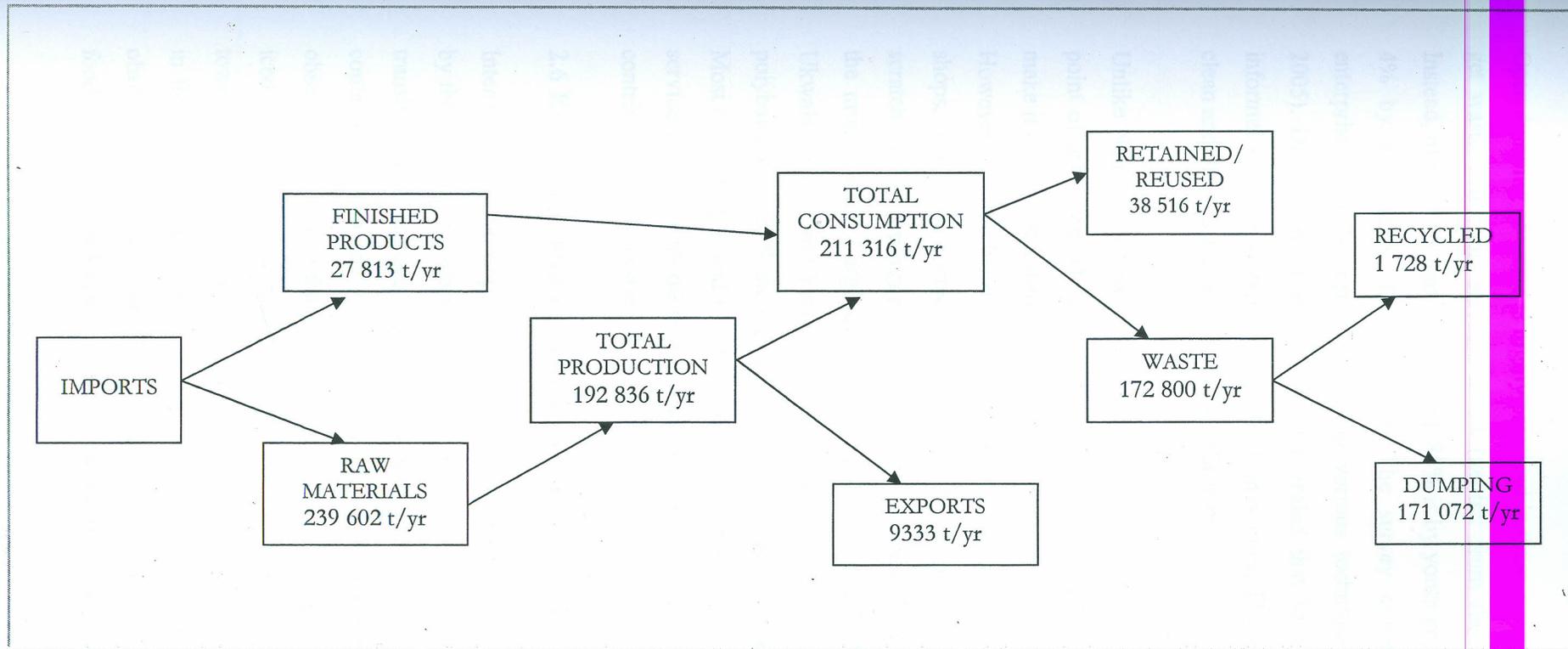


Figure 5 Summary of the plastics material balance

Source: KNCPC, 2006

Open dumping of waste is highly practiced in these areas since 70% of the households do not get waste collection services at all (neither from the NCC nor from private operators). Instead, of the 30% that are serviced, 85% is by youth groups, 11% by private companies and 4% by scavengers (ITDG, 2005). The survey covered 340 households, 54 business enterprises and 24 institutions using various techniques including GIS mapping (ITDG, 2005). Discussions from this report revealed that hard plastics are well collected by the informal sector in comparison to the flimsy ones. The hard plastics are easy to collect and clean and there is also a ready market for them.

Unlike Nairobi, no research survey on plastics has been conducted in Kisumu that can be a point of reference. Most studies have been done in Nairobi or Mombasa and therefore this make it difficult to estimate the waste composition, and plastic waste levels in smaller towns. However, like the Nairobi situation, most of the plastic waste originates from supermarkets, shops, residential zones, and industries. According to (NEMA, 2005), littering of plastics, scratch card wrappings and sweet wrappings cause clogging of drains and sewer lines within the municipality. Large quantities of polybags and PET bottles originate from Nakumatt, Ukwala, Tusker, and Yatin supermarkets which are situated within the town. Other sources of polybags and PETS include, the Bus Park, Jubilee market, Oile Park and Kibuye markets. Most of the HDPE and LDPE plastics are commonly traced at *Jua kali* where the mechanics service vehicles with oil from plastic containers. Furthermore, households or residential areas contribute broken plastic wares, e.g basins, plates, toys, Jerri cans and rubber materials.

2.6 Knowledge, attitude and behaviour in plastic waste disposal

Intense heat in the tropical and equatorial latitudes has necessitated constant intake of water by the trekking populations during work hours and in market places. Those travelling or on transit during stopover also take packaged food, water and other soft drinks in plastic containers which are disposed of carelessly by the roadsides. Therefore it is a common observation in Sub-Saharan Countries to find young people trekking, or at bus stages selling iced water in trays or basins on their heads in public places while in the streets of cities and towns. Cooked food is also sold on the way side and in canteens or restaurants usually sited in the open spaces near work places, offices, churches, markets and schools. It has been observed that for the past two decades, plastics have become the most favoured materials in food and water packaging industry and contributing to the large rise in their proportions in

the waste streams. In this regard, the knowledge, attitude and behaviour in waste disposal for the public in developing countries is low compared to developed countries. According to Fobil (2000), most countries in Africa do not have data on waste stream composition, but individual management authorities recognize and acknowledge the growing magnitude and prominence of plastic waste problems in the region. It has been realized that the quantity and composition of solid waste generated by a society provide a mirror that reflects among others the cultural habits of the population. The amount of solid waste generated is closely related to the overall economic level of the population from which it originates. High income countries generate more plastic waste than low income countries. According to Cointreau, the amount of plastic waste, as percentages of total amounts of municipal refuse (wet weight) for low, middle and high income countries are 1-5%, 2-6%, and 2-10%, respectively (Cointreau, 1984).

It is estimated that an average European family of four throws away around 40% of plastic each year, which amounts to approximately 7% of the total weight of household waste. (Klundert, 1995b). Although plastics occupy an estimated 20-30% of the total volume of a dustbin, the volume occupied by plastics in a land fill site is only about 10% due to compaction among other reasons. These percentages have remained more or less constant for a number of years. In Germany for example, plastics account for 5% of the 30 million tonnes of domestic waste collected each year, but make up 20% of the volume. About 75% of this waste consists of packaging materials. The above example demonstrates that in quantifying plastic waste, it is important to distinguish between weight and volume. Plastics are voluminous but relatively light so that in terms of weight the proportion of plastics in municipal solid waste is relatively modest. According to a study conducted in Accra, Ghana by GOPA consultants in 1983, plastics account for 1-5% (of wet weight) of the total amount of waste generated (Klundert, 1995b). In Ghana, per capita generation of plastic wastes stands at 0.016-0.035kg per person per day, and plastics make up between 8-9% of the component materials in the waste stream (Fobil, 2000). In a recent study by JICA in 2005 aimed at identifying and structuring all issues facing developing countries with reference to recent trends in this sector as well as exploring the future directions and approaches for Japan's development assistance in the SWM, the report indicates that there is a clear correlation between income levels and waste quantities and composition on the other. It further observes that the higher the income levels grow, the more the per capita waste generation becomes and so does the proportions of paper, plastic, glass and metal. A World

Bank report (1999), describes the quantities and composition of urban solid waste per capita in the world as indicated in Table 2. The table indicates that Middle-income countries and High income countries have high composition of plastics compared to low-income countries. This is also an indication that economic levels in cities are directly linked to waste generation. It is important to note that as a global trend, waste quantities generated in cities are on a steady rise due to rural-to-urban migration, quantitative expansion of consumption oriented lifestyle, and qualitative change of consumer goods (e.g. a wider use of plastic and packaging such as PET bottles, glass bottles and cans), (JICA,2005). In addition, lifestyles that take mass production and mass consumption for granted are associated with increased quantities of packaging wastes such as paper, plastic and PET among others.

Table 2 Generation and composition of urban MSW in various countries

		Low income	Middle-income	High-income
Quantity(Unit:Kg/person/day)		0.64	0.73	1.64
Composition %	Organic	41	58	28
	Paper	5	15	36
	Plastic	4	11	9
	Glass	2	2	7
	Metal	1	3	8
	Others	47	11	12

Source: World Bank, 1999

The aforementioned studies indicate that the demand and use of plastics in the world has been increasing within the last few decades. Moreover, the amount of waste generated shows that economies particularly in developed countries have been improving. An increase in wealth not only creates an increase in the volume of waste but also in the value of the waste. The higher income groups produce higher amounts of easily retrievable and vulnerable items such as plastics, paper and metals (Klundert, 1995a)

A JICA study of Nairobi city, Kenya estimated that about 1,450 tonnes of Municipal Solid Waste (MSW) was generated daily in Nairobi in the late 1990s (JICA, 1998). The study put the MSW per capita generation at the time at 0.67 kg per day, which translates to about 245 kg per person per year. A recent study (ITDG, 2004) puts the daily MSW generation at a

relatively higher value of 2,400 tonnes. The study estimates a per capita solid waste generation of about 253 kg per person per year. This figure falls within the range specified by IETC for African urban centres. The NCC estimates for daily waste generation is between 1,600 to 2,400 tonnes which appears to be a projection based on the JICA study. The corresponding estimate of per capita generation is 0.65 kg per person day and is again based on the JICA study. On MSW composition in the city, the JICA study (1998) documented the following results: organics (51%), paper (18%), plastics (15%), glass & metal (7%), textile (3%) and others (6%). ITDG, (2004) gives slightly different figures - organics (61%), plastics (21%), paper (12%). All these studies indicate that the amount of plastic waste in urban centres is increasing as towns' populations also grow causing waste challenges.

The Environment Department of the MCK takes charge of all SWM activities of the council. The council's capacity for waste collection and disposal is inadequate to cope with the current situation. These results in large amounts of uncollected solid waste, much of which (80%) is organic in nature with plastic waste comprising a substantial amount of total solid waste generated. The amount disposed at Kachok dumpsite in Kisumu town can only be accurately confirmed once a weighbridge is installed at the site. Current estimates indicate that more than 70% of generated waste is uncollected (NEMA, 2005). As mentioned in chapter one, the situation within the municipality is currently unmanageable due to minimal financial resources, lack of standard vehicles, mismanagement and inadequate trained personnel.

2.7 Identification of sources and types of plastic waste materials

In an attempt to develop an environmental policy package to address a specific solid waste management problem of plastic bags in Nairobi city, UNEP involved an effective multi-stakeholder process from the public sector institutions, the private sector, universities and civil society in 2005 to get broader consensus and support for implementation of the final package of policy proposals. The broad objective of the report was to equip policymakers, planners and other stakeholders with the techniques and methodologies required to develop and apply appropriate economic instruments for SWM. The study approach used was broadly that of integrating international and local experiences through observations, views, suggestions and advice. The methodology involved desk reviews of national and international publications, discussions on economic instruments, group discussions in national workshops,

round table panels and review meetings, use of structured questionnaires and informal interviews and inputs of consultants at different stages of the project. The report findings on recycling indicate that the percentage of solid waste that is recovered by the city council is about 8% of the recyclables and 5% of the compostable. The private sector participation was found to be un-regulated, with private companies operating in open competition with each other purely on a "willing –buyer-willing seller" basis. There is also widespread indiscriminate dumping in illegal dumpsite. On plastic bags, the findings show that the flexible industry is growing at the rate of 8 to 10 per cent per year and the level of recycling and reuse of post-consumption flexible is very low. Recycling has not been widely practised as a result of various factors. The report concludes that there is need to implement the policy package of economic instruments. The report recommends that the key economic instrument proposed in the plastic bag levy from which the funds raised would be earmarked to support development of environmentally-friendly alternative bags, effective plastic bags recycling system and a well-managed disposal system. The UNEP study however, neglected other types of plastics and concentrated mainly on plastic bags when the plastic waste problem cuts across from PETs, PVCs and other forms of imported and local wrappings that affect the tourism industry as well as the aesthetic of the towns in Kenya. Furthermore, the methods used were not all inclusive since comments were drawn from Nairobi city only yet the economic instruments are expected to be rolled out to other towns in Kenya when approved by the government. Participation of the consumers of plastics also was not clearly considered yet there is need for knowledge, attitude and perception change among the consumers towards plastic waste disposal.

Klundert (1995a) and WASTE Consultants in a research study with the objective of setting up a Waste Recovery System in Nairobi identified various sources and types of waste in Nairobi. WASTE Consultants adopted a methodology of following general terms of reference drafted to guide the research in some cities namely Cairo, Bamako, Accra, Manila and Calcutta which they adopted to suit local conditions. In Nairobi, similar research was conducted to inventorise the state of recycling at that time (1995) and to identify new implementation opportunities. The results indicated that there were ten major waste materials namely rubber, plastics, motor oil, cooking oil, tin can, photochemical, broken glass, bone and horn, household batteries and organic waste in Nairobi. This research was only limited to a capital city leaving out the upcoming cities and towns that are also vulnerable to major solid waste management problems. Furthermore Klundert, describes only four sources of plastic

waste including industrial, commercial, agricultural and municipal waste neglecting institutions such as hospitals and colleges which generate a lot of plastic waste.

Another research based in Nairobi city was conducted by Kibwage, (2002) with the aim of understanding the existing approaches, practices and impacts of recycling and re-use of solid waste by informal recycling sector. Using standard questionnaires and schedules, key informant interviews, participant observation and photography, he sampled 120 waste street and dumpsite pickers, 20 waste dealers and five Waste Recycling institutions for the study. According to this research, the results described the sources of waste by zoning. These included residential zone, commercial zone, and industrial zone. The results indicated gaps in SWM due to lack of policy formulation. The research also extensively discussed Nairobi city as a study case with minimal reference to smaller towns in Kenya where upcoming SWM problems cause environmental hazards. Baud, (1994) in a study on Solid Waste Recovery, Re-use and Recycling based on Indian cities identified four sources from which solid waste emanates. These include; household waste, commercial waste, institutional waste and industrial waste. Baud's study left out agricultural waste sources which are also becoming a large contributor to the plastic waste recovery stream. These studies, although from different backgrounds and contexts, supplement each other in terms of identifying critical sources of waste in cities. According to Afullo (2003), to manage waste properly, it is important to know how much waste is being produced the composition of waste from each of the different sources and how the quantity and composition might change in the future. Afullo further identifies categories of waste as; domestic, commercial, institutional, street sweepings, construction and demolition waste and sanitary wastes. The study however does not describe how these categories of waste can be properly organised to promote sustainable SWM in cities.

2.8 The role of formal and informal networks in plastic waste recovery

Formal waste recovery includes waste collection and recycling activities which are within the mandate of the local authorities vested upon them by the government. Local municipal government has a role in the setup and operation of waste management systems. Most urban authorities in both industrialized and developing countries derive their powers and obligations from a central government authority, with allocation of powers and responsibilities to protect the rights of the citizens, to provide services, and to serve the

common good (Gidman, 1995). In essence, they are charged with controlling living conditions and public health. Informal sector on the other hand refers to unregistered, unregulated, or casual activities and community enterprises that engage in various value-adding activities on a small-scale with minimal capital input, using local materials and labour-intensive techniques (Furedy, 1989). Informal activities, in contrast with the formal sector in waste collecting and recycling, are often driven by poverty, and are initiated personally and spontaneously sometimes haphazardly in the struggle by survival although some enterprises, especially the ones engaged in recycling activities, manage to make considerable profits.

In general, SWM sector is described as a complex system of different interrelated activities both primary and secondary collection, transport to processing plants and disposal sites, and recovery and recycling. The sector as a whole consists of a 'formal' and an 'informal' sector. Formally, the municipalities in cities of most developing countries are responsible for processing household, commercial and institutional waste. It is supposed to provide containers, keep the streets clean, collect and transport solid waste process it in some manner. However in cities of developing countries this is not the case. Before plastic waste reach large enterprises, they go through many wings of the informal sectors i.e those individuals and groups of waste pickers, dealers and wholesalers selling solid waste as raw materials to recycling enterprises. Various studies have perceived formal and informal activities in different ways. Baud and Schenk, (1994), Kibwage (2002) and Konings (1989) all describe a detailed view of the existing formal and informal networks in various cities. Konings describes how waste is received from the three main networks i.e. waste pickers, waste dealers and the factories.

Some informal networks form part and parcel of the only source of livelihood for dumpsite dwellers. For instance, in a survey by Practical action at Gioto dumpsite, (in 2005), at Nakuru town, Kenya, aimed at clearly understanding the salvagers' way of life, their livelihoods, challenges and available opportunities for intervention 130 salvagers were sampled. Methods including personal interviews and questionnaires, focus group discussions and observation were used. The waste collected included plastics, bones, organic waste, scrap metals and glass. The findings revealed that 21% of the salvagers are single parents, 55.2% were living without their spouses but do not live with their children due to divorce or death of their partners. Only 23% are married and living with their spouses. The survey also identified

gender discrimination and drug abuse among the salvagers as key challenges at the Gioto dumpsite. The findings implied a poor community relying on waste recovery for livelihood. The study however was not able to articulate and bring out coping mechanisms used by waste pickers to survive in their environment. The role of the municipality in managing the Gioto dumpsite was also not discussed in the study to provide the overall response in SWM.

Baud, (1994) describes an in depth view of the existing formal and informal networks in Bangalore city, India. The research describes a factory like atmosphere in the waste recycling sector, where a larger force of workers is controlled by a few males' leaders. Using Konings' (1989) structure, (fig.13) various actors in the waste recycling stream are identified. The first, group of actors consist of the street and dumpsite pickers, the itinerant buyers who collect waste and make first selection of materials and sell it to the buyers and dealers. These studies reveal that, in this organization, the street and dumpsite pickers are the group with the lowest bargaining power. Among these groups, there also exist the itinerant waste pickers. Because they collect waste matter directly from the sources without it being broken, contaminated or mixed with other materials, their collections have higher sales value than those obtained from the dustbins on the street or at the dumpsite by other waste pickers. The study reveals that the informal waste recycling sector is commonly based on a network of buyers and their appointed agents, typically specializing in only one or just a few categories of materials. Hence the recycling enterprises do not directly buy from them but through wholesalers. The above situation leads to the second group within the hierarchy who are the small dealers and who often live and work near a slum with many waste pickers. They buy all waste directly from the waste pickers. Waste dealers normally act as middlemen and exploit the waste pickers' by paying them the very minimal amount per kilogram of plastic waste weighed every day. Kibwage, (2002) reveals that waste dealers often control the prices offered to the salvagers and also act as controls at the dumpsite. It is also estimated that about 90% of these scavengers in Asian cities sell their recyclables and other materials to waste dealers (UNCHS, 1994).

The wholesalers, on the other hand, are larger buyers specialized in certain materials, and link the waste dealers to the recycling industries. Literature from Less Developed countries show that both formal and informal manufacturing enterprises do receive waste materials in larger quantities from the informal sector and use them as raw materials in the production process.

Baud, (1994), further explains the linkages between the municipal (formal) and informal sector in SWM in Southern Indian cities.

This study concludes that informal trade and recycling activities play a big role in urban SWM that cannot be ignored. Baud indicates that the missing link is that between the municipality and the informal recycling enterprises and solid waste dealers and waste pickers. It is observed that this possible linkage is usually ignored by private (formal and informal) enterprises, because they are also hesitant to be involved with government agencies. Waste picking groups also have little faith in such possible linkages.

Plastics recycling or reprocessing is usually referred to as the process by which plastic waste material that would otherwise become solid waste are collected, separated, processed and returned to use (Klundert, 1995b). Recycling is the third option in the Integrated Waste Management hierarchy. It is technically feasible to recycle a large amount of materials such as plastics, wood, metals, glass, textiles, paper, cardboard, rubber, ceramics and leather. Besides technical feasibility and know-how, demand determines the types and amounts of materials that are recyclable in the region. Medina (1999) asserts that areas with diversified economy and industrial base usually demand more different types of raw materials that can be recycled. In some African countries, artisans and micro-entrepreneurs manufacture consumer products from waste materials, such as sandals, lamps, pots and pans.

Apparently, many thousands of people in developing country cities depend on recycling materials from waste for their livelihoods. With the focus of the Millennium Development Goals on poverty reduction and of waste strategies on improving recycling rates, one of the major challenges in solid waste management in developing countries is how best to work with this informal sector to improve their livelihoods, working conditions and efficiency in recycling. Wilson, (2001) claims that despite the health and social problems associated with informal recycling; it provides significant economic benefits that need to be retained. Experience shows that it can be highly counterproductive to establish new formal waste recycling systems without taking into account informal systems that already exist. The preferred option is to integrate the informal sector into waste management planning, building on their practices and experience, while working to improve efficiency and the living and working conditions of those involved.

Recycling has economic, social and environmental benefits according to Medina (2000) and Kibwage (2002) because it provides an income to the scavengers (waste pickers) who recover recyclable materials. Factories that consume recyclable materials can be built for a fraction of the cost of building plants that consume virgin materials. Recycling saves energy and water and generates less pollution than obtaining virgin raw materials. This translates into lower operating costs. Recycling also reduces the amount of waste that need to be collected, transported and disposed of, and extends the life of disposal facilities, which saves money to the municipalities. Recycling can result in a more competitive economy and a cleaner environment and can contribute to a more sustainable development.

The Local Authorities Act (cap. 265) of the laws of Kenya mandates the local authorities with the primary responsibility of managing of MSW. Their delivery of this service however, is extremely poor. Coverage is low and scheduling non-existent. The human and institutional capacities are weak and the technology inadequate. Underlying these shortcomings are financial mismanagement, poor governance, poor technology, political squabbling, weak revenue collection, low and rigid service charges that barely cover marginal costs which were inflated by the padding of stuffs, insufficient autonomy granted by the central government, poor management of dumps and lack of waste transfer facilities (Ikiara, 2002). The problem is exacerbated by inadequate planning, inefficiency, and inadequate capacity, poor technology and weak enforcement of existing legislation by authorities (NEMA, 2004).

There are several benefits that are obtained from waste recycling in any country and this can be as follows: First from the environmental economics point of view, waste recovery leads to saving on foreign exchange earnings by reducing the imports of raw materials for production. For example in Dar es Salaam, Tanzania, one study found out that small-scale industries receive 50% to 65% of their raw materials from waste pickers working in landfill sites (Yhdego, 1991). Secondly, are deduction in expenditure on primary health care required to control waste related diseases as a result of improved environmental and health conditions in the cities is also one of the obvious advantages of waste recycling. Thirdly, waste recycling is associated with the conservation of natural resources and energy saving from the use of virgin materials for the production of the same product from extraction to manufacturing. For example, Powell (1983) indicates in detail that producing aluminium from scrap instead of bauxite cuts energy use and air pollution by 95%, plastic polyethylene 97%, plastic (polymer) 92%, rubber – 72%, glass (cullet) 22% and paper by 60%. Waste reduction also contributes to

a reduction in waste disposal costs by reducing collection requirements and need for new land sites. In conclusion, waste recycling has high potential for employment and income generation. Medina (2000), Gunnerson (1985), Klundert (1995b) and Bjerkli (2005) reveal from their studies that informal sector employs thousands of low income people who could otherwise be jobless.

2.9 Socio-economic and environmental health implications of plastic waste recovery

In her research study for a Masters degree, Bjerkli (2005), explored the organization and the actors involved in the informal plastic recovery system in Addis Ababa. The study evaluated primary and secondary data using standard surveys, structured and unstructured interviews, observation and literature review. The findings concluded that thousands of individuals in Addis Ababa depended on the recovery of plastic materials in order to make a living. The government's ignorance of the informal plastic recovery system as well as civil society's lack of trust and credibility in the government has proved to be one of the main difficulties confronting the plastic recovery. The research study however did not show a sampling procedure that indicates the number, categories or groups studied. This creates a gap in the methodology used in the research.

Waste picking as a lowly rated activity in the community particularly in developing countries is regarded as dirty work. Despite the society's attitude, Medina (1998), Kibwage (2002) and Bjerkli (2005) identify recycling of plastics as a sector which has a number of economic and environmental benefits despite its positive and negative environmental implications. Benefits include employment creation for street pickers, small scale recyclers and factory workers. According to Kibwage (2002), recycling also reduces the problems of littering especially at the collection points and at the dumping site. Since the plastics produced in Kenya are not biodegradable, recycling protects agricultural fields, leisure parks and the city flower beds because plastics inhibit the growth of plants. The researcher also concludes that a number of undamaged plastic bags recovered by the waste pickers are sold to street hawkers for carrying home foodstuffs sold in the streets or open market in Nairobi city. This makes the re-use risky since there is a possibility of contamination of food and spread of diseases. These conclusions, however, did not provide statistical evidence of the number of people affected due to contamination.

From Asian countries, Baud (1994) initiated a study to find out to what extent gender aspects affect the circumstances and the consequences of waste pickers' work, given the starting point that women are more vulnerable in the labour market than men. The study was conducted in Bangalore. Baud sampled 157 women waste pickers and interviewed them. The results indicated that child mortality within these households occurs frequently. 30% of the women had lost one child, 10% had lost three or more children. Babies died of diarrhoea, tetanus, smallpox, bronchitis and virus infections. These results are evidence of the levels of poverty in slum settlement in developing countries. Contrary to the research done in Nairobi by Kibwage (2002) which revealed that majority of waste pickers were men, Baud's research was biased towards the female gender leaving little room for comparison with men vulnerability in developing countries.

In a paper which examines the conventional approaches to Municipal Solid Waste Management, used by development agencies in general Medina (2000) suggests that waste picking renders economic and environmental benefits, such as providing income to unemployed individuals, supplies inexpensive raw materials to industry, reduces the demand for collection, transport and disposal equipment and facilities. Further, materials' recycling has a lower environmental impact compared to the use of virgin resources. Despite the lack of reliable data at the national level, various studies have highlighted the economic importance of waste picking activities. Medina further says that in Bangkok, Jakarta, Kanpur, Karachi and Manila, waste picking saves each city at least U.S \$23 million a year in the lower imports of raw materials and reduced need for collection, transport and disposal equipment, personnel and facilities.

Zerbock (2003) in his study identifies some health risks that affect waste pickers in developing nations to be associated with solid waste handling and disposal in all countries to some degree, but certain problems are more acute and widespread in underdeveloped nations. The major ones are classified into four main categories: 1) presence of human faecal matter, 2) presence of potentially hazardous industrial waste, 3) the decomposition of solids into constituent chemicals which contaminate air and water systems, and 4) the air pollution caused by consistently burning dumps and methane release. Narayan (2001) identifies washing and cleaning process of plastic waste as the major source of effluent particularly wastewater generated during recycling process that has high pollution load of biochemical oxygen demand (BOD), chemical oxygen demand (COD) and total solvent solids (TSS)

depending on material which was packed. When untreated, such wastewater draining downstream to water bodies if untreated, affect lake marine life even causing death. Narayan's study however does not provide empirical evidence of the cumulative impact of such pollution in developing countries. In summary, the above studies observe that the informal sector faces numerous socio-economic and occupational health challenges particularly at waste picking level, dealers' level while sorting and washing and recycling stage particularly affect the factory staff.

JICA (2005) identifies waste as a menace and nuisance which not only produces odours that attract insects and rats but are also a source of ammonia, hydrogen sulphide, or other chemicals that may cause poisoning, irritation of respiratory mucous membranes or otherwise damage human health. The report continues to assert that more people suffer because of inadequate waste collection systems and improper landfill operations partly due to insufficient capacity of the facilities and equipment.

2.10 Public policies towards informal waste recovery and management

Policy is complex and dynamic. The term embraces a range of different aspects. Policy statements such as white papers are what one might think of firstly as policy. But what led to their formulation, and are they always put into practice? The processes by which policy is informed and formulated are also highly significant. Measures for policy implementation for instance laws, regulations, or programmes are necessary to ensure that policy can be put into practice. Furthermore, policy and policy making is conditioned and shaped by the political, social and economic environment, as well as historical factors. Various scholars have attributed SWM problems to lack of adequate policies in developing countries to address issues as they emerge.

The study referred to two theoretical frameworks employed to examine the developments of solid waste management policies in Kenya for the last five years. The first was adopted from Tavares (2001). In his approach known as political economy approach, he explains that in areas that are traditionally under the responsibility of local governments, state policy can be justified as a way of reducing economic and political transaction costs in search of both economic and political efficiency. Under the economic transaction costs, the decision faced by the state government is one along a continuum between vertical integration and complete

delegation of solid waste policy. The first solution is one of total centralization, with the state government responsible for writing and implementing solid waste policy without any input or discretion left to the localities. This alternative implies the existence of a single hierarchical structure at the state level but it is not reasonable since it becomes too centralized, costly and inflexible to handle the thousands of decisions to be made. The second solution is complete delegation or non-intervention emphasizing policy adoption at the local level where the local governments are free to select the governance structure for each policy area that minimizes local transaction costs. Ultimately, the relationship between state and local governments fits within these two ideal types. On the political transaction costs, it would be naive to believe that state legislatures are unequally concerned with economic efficiency. Consequently, state officials' goals support faster efficiency and encompass, among others, re-election and subjective equity goals. Hence, when contracting with local governments, state legislators will write a contract that maximises their re-election chances motivated by the logic of political efficiency and minimization of political transaction costs. Why would states be interested in entrusting local governments with policy activity? O'Halloran and Epstein, (1999) argue that delegation helps states to reduce their workload, to take advantage of local agency expertise and proximity to the problems, and to avoid inefficiencies arising from over centralization usually known as influence costs such as delays, log rolling and information inefficiencies.

The second simple policy framework was adopted from Narayan (2001) in which various components that are essential were considered. The reason for maintaining simplicity was to remain focused and cope with the time allocated for the study. Since plastic waste policies are relatively new in the country, SWM policies within the country were referred to provide the background through government documents such as acts of parliament on the same. The EMCA Act in Kenya of 1999, Public Health Act, Cap. 242 and Local Authority Act, Cap. 265 and the MCK environmental by-laws were examined with a view to understand their efficiency, effectiveness and inclusiveness.

It is important to note at this juncture that many developing countries lack SWM policies to drive the local authorities in the right direction. Contreau (2007) in a paper presented at a workshop for World Bank says that this problem is caused by poor governance, social exclusion and lack of accountability. One of the key issues that affect the sub-sector is policy formulation and legislation for plastic waste recovery. JICA (2005) says that developing

countries often have difficulty in streamlining the institutional systems, administrative bodies, management capabilities and human resources that are needed to take the lead in solving solid waste problems. Indeed, SWM policy gaps exist in Kenya like other developing countries. For instance, the recovery of plastic materials is not governed by any policy and this leads to over exploitation of the collectors by the factories.

In Kenya, various policy and legislative frameworks that indirectly or directly address plastic waste recycling issues have been developed in the past few years. These include; National Environment Action Plan (NEAP) 1994, Policy paper on Industrialization to the year 2020 (1996), JICA Study Report (1998), Sessional Paper No. 6 of 1999 on Environment and Development, Environment and Management Coordination Act (1999). The UNEP (2005) report which was a product of a long struggle for laying down procedures in the development of regulations that can reduce plastic waste menace in not only Nairobi but other big towns like Mombasa, Nakuru and Kisumu paved a step towards plastic policy formulation. Unfortunately, this report centered their views and discussions on Nairobi city leaving out major SWM concerns of other upcoming towns. Another document that was done in draft was the KNCPC (2006). If ratified for implementation by the Government, it will be the first strategy document on plastic waste management in Kenya but biased towards Nairobi city.

The Sessional paper no. 6 of 1999 on Environment and Development is a policy document which was developed out of the Government position as articulated in the Earth Summit in Rio de Janeiro in 1992 where the then President Daniel Toroitich arap Moi participated . It highlights the Government commitment to proper environmental management demonstrated by the adoption of the National Environmental Action Plan and the establishment of public environmental institutions. The document identifies key challenges of waste management including solid and liquid waste management and toxic wastes to be addressed by relevant statutes. It is upon this Sessional paper that EMCA, 1999 and finally NEMA were founded. However, the paper still remains a draft since it was never discussed and passed into law in parliament. EMCA 1999 is an Act of parliament provided for the establishment of an appropriate legal and institutional framework for the management of the environment and for matters connected with it. The act provides for environmental quality standards to be enforced in issues such as pollution of industries or agencies. In the year 2003, NEMA with support from UNEP conducted a study on appropriate economic instruments for waste management. The EMCA also included provisions on the polluter-pays principle and the

precautionary principle. Taking these into consideration, NEMA responded to public concern in the year 2003 over plastic waste and prepared an action plan to deal with such material over time. Efforts to come up with a plastic waste management policy began in 2003 although there were other documents developed before addressing environmental issues. Despite the weight that has been given on the issues in the act, NEMA has failed to implement the EMCA standards required in various environmental concerns, hence compromising with compliance. The implication of this is seen in the dilapidated state of environment in urban centres. The act also did not provide the minimum gauge for plastic waste papers when manufactured thus giving leeway for industries to manufacture and sell at will.

In 2005, UNEP and the Government of Kenya produced a report out of a study of the situation on plastic bags in Nairobi city. The objectives of the report was to equip policy makers, planners and other stakeholders with techniques and methodologies required to develop and apply appropriate economic instruments for solid waste management. The reports' overemphasis on Nairobi makes it appear as a Nairobi issue yet the strategy was meant to apply to all urban centers nationwide. The implementation of the proposed instruments has also taken long due to lack of staff, logistics and effective support from the stakeholders. The Comprehensive Strategy on Plastic Waste Management for Nairobi City (2006) spearheaded by Kenya National Cleaner Production Centre, is another strategy that was conceptualized in 2006. The centre brought together various stakeholders with the objective to reduce the generation of plastic waste and its environmental impact thereby ensuring that the socio-economic development of Nairobi City, the health of the people and the quality of its environment is no longer adversely affected by uncontrolled and uncoordinated plastic waste management. That strategy has not been implemented although it was proposed in the year 2005. Unlike the South African participatory process on waste policy management (South African Journal of education Vol. 20, 2003) which was comprehensive and participatory, the Kenyan SWM policy processes were done in piece meal and uncoordinated manner. Furthermore, they have not been fully implemented the way the plastic bag policy has been enforced in South Africa.

An analysis of development policy papers and reports in Kenya including; the Economic Recovery Strategy Paper (2003-2004), Annual Monitoring and Evaluation report (2004-2005), Achieving Millennium Development Goals in Kenya: A needs Assessment and

Costing Report, 2005 and Mid-Term Review (2003-2006) and Monitoring report identify; a) absence of a policy on recycling of waste materials and dysfunctional local authorities, b) inadequate information on technologies for the profitable recycling of waste and failure to include the informal sector, particularly slum dwellers, into viable recycling processes, c) the need to upgrade urban slums through improved sanitation, garbage collection and treatment systems d) increased pollution from solid waste such as polythene and plastic generated waste due to lack of a national policy on recycling of waste materials respectively as key challenges facing Solid Waste Management sub-sector (GoK, 2003; GoK, 2006a; GoK, 2005; GoK, 2006b). The National Environmental Sanitation and Hygiene policy (2007) is the latest policy document that provides measures to be undertaken to effect behavior change and improvement of environmental sanitation which includes SWM. The policy generalizes sanitation and environmental issues without specifying what should be done with specific issues of concern including plastic waste disposal.

2.11 Conceptual framework of the study

In response to the municipal solid waste management challenges, most local governments in developing countries are being encouraged to promote the use of a mix of solutions to handle waste, since there is no single management approach that will serve as a panacea for their waste problems. An integrated SWM approach has been recommended by various authors and EPA, (1989) and Kibwage, (2002)). According to EPA, (1989), integrated systems involve the use of a combination of techniques and programme to manage the municipal waste stream. Within the range of management options, a hierarchy for SWM planners to consider when planning and implementing programmes has been proposed (Figure 6) In this approach, the first level is source reduction which advocates for the reduction of the amount and or the toxicity of waste generated at source. Reuse of the plastics at source is also encouraged. The second is recycling, which is the collection, reprocessing, marketing and using materials that were once considered waste. Waste combustion should be considered next because this method reduces the bulk of municipal waste and can provide the added benefit of energy production. A final level is land filling which is at the bottom of the hierarchy. This level is necessary to manage non-recyclable and non-combustible wastes. To emphasise on the above approach, Furedy (1992), recognises waste as a 'greater resource' which is unused. He further suggests that producers require reduction at production level and thus improves re-use and recycling. An essential aspect of the approach is the emphasis of

community participation in the promotion of separation of wastes to facilitate more efficient and decentralised recycling.

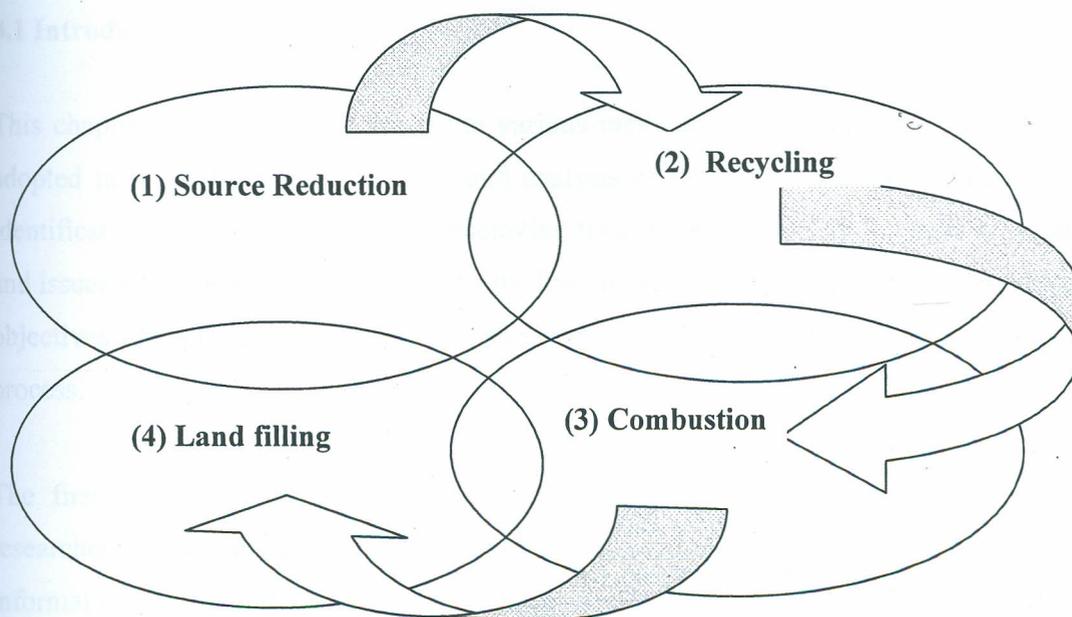


Figure 6 An integrated solid waste management approach

Source: EPA (1989)

The study considers informal plastic waste recycling in Kisumu, Kenya as a significant sector to be considered in SWM planning. The reason is that plastic waste recovery reduces the quantity of waste from the waste stream, provides jobs to scavengers, and conserves natural resources, particularly raw materials such as oil and energy. As Pollock (1987) states, recycling programs are most effective when integrated within a city's overall SWM Plan. JICA (2005) also asserts that waste recycling and reduction is an important element of SWM in developing countries as well as developed countries in terms of reducing SWM costs, effective use of resources, and lessening the burden on the environment. The main reason for adopting this conceptual framework is that the perception of the worldview on SWM is changing from techno-managerial approaches to integrated plans that recognize the socio-economic and cultural factors in solid waste management. Solid Waste Management researchers argue that developing countries should first consider enhancing the existing systems of separation, waste trading and recycling and promoting employment in this sector for poverty alleviation, before considering elaborate European models (Klundert, 1995b; Medina, 2000). In this study on Kisumu town, the researcher raises issues generated from the results of the study.

3.1 Introduction

This chapter contains details about the various methodological procedures and techniques adopted in the collection, processing and analysis of the data. The initial stages involving identification of sites, mapping and scheduling took place in May 2007, when the objectives and issues were identified and agreed by the researcher and supervisors. Following the agreed objectives and procedures, there were steps which were adapted to facilitate the research process.

The first step involved a reconnaissance survey. The main reason was to enable the researcher to familiarize himself with the current situation of the networks of both formal and informal actors in solid waste handling and management, so as to identify the respondents to be included in the study. During this period, a clearance letter for the research from the District Commissioner, Kisumu District and the MCK Director of Environment were issued. Other activities conducted during this step involved preparation of schedules and questionnaires used in the survey and testing them, training of two research assistants and taking of photographs relevant to the study.

The second step involved the main tasks of the research. These included: - administering questionnaires and interview schedules in appendix I involving the waste pickers and appendix II, concentrating on the waste dealers. The two were done concurrently. Observation of the collection, transportation and disposal of solid waste in the town featured also during this period. The exercise took one month (30th June- 30th, July). The third and fourth steps were combined. The third step involved approaching key informants at the MCK environment department and the District Environment Officer (see appendices IV and V). The fourth step involved administration of the interview schedules in appendix III, involving the factory recycling personnel and managers in Kisumu town.

3.2 Study Area

Kisumu town is located on the eastern shores of Lake Victoria in Nyanza province (Fig.7). It is the third largest town in Kenya after Nairobi and Mombasa. It is the capital of Nyanza

province and the administrative centre of Kisumu East district. Kisumu town is situated approximately 00006' South of the equator and 34045' East of Greenwich.

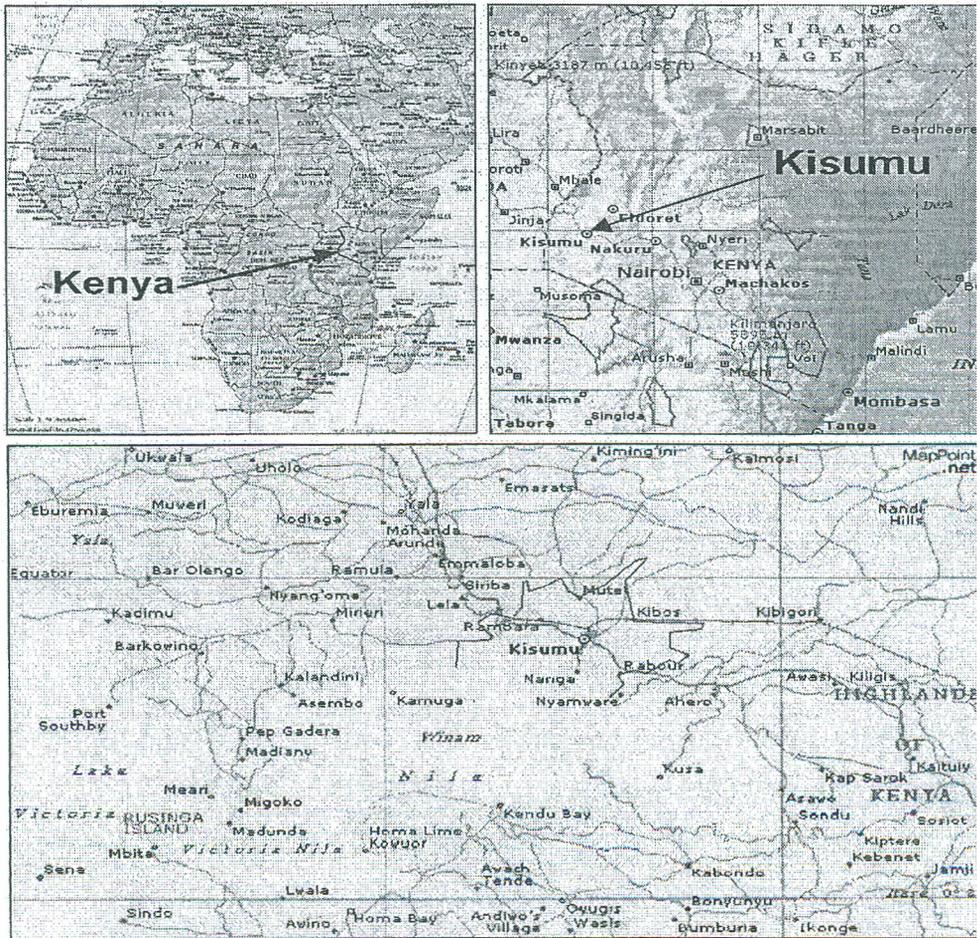


Figure 7 Global position of Kisumu Town, Kenya

Source: Halcrow, 2003

Kisumu town owes its origin to a site at which the local communities bartered their surplus produced at the head of Winam Gulf long before the colonial period, an activity from which it derived its original name, “Kisuma” which means a meeting point for exchange of goods or barter trade in Dholuo. The population of Kisumu is projected to be around 565,000 in 2007 with perhaps two thirds of that i.e.375, 000 being the city population. The climate is warm and humid, moderated somewhat by the elevation of over 1,100 meters. The annual rainfall during the long and short rains in March-June and October-December respectively, is 1245mm (Columbia University, 2007). The city covers an area of approximately 417 km² of

which 297 km² is dry land and approximately 120 km² is under water (UN-Habitat, 2005). The study covered six sub-locations which were identified namely; Southern, Northern, Nyalenda A, Kaloleni, Migosi and Manyatta B which are within Winam division of Kisumu East District.

3.3 Research design

The research used a cross sectional and descriptive method where waste pickers and waste dealers in Kisumu town were targeted and surveyed at the same time. The study aimed at collecting information from respondents on their attitudes and opinions in relation to plastic waste collection, processing, recycling and management by stakeholders. Schedules and questionnaires combined both qualitative and quantitative techniques so as to be exhaustive enough.

3.4 Sampling procedure

Eighty (80) respondents were randomly selected from a sample population of 200 waste pickers obtained during reconnaissance survey. The sample size was determined using a table developed by Bartlett, Kotrlík and Higgins for determining minimum returned sample size for continuous data assuming alpha level of 0.05 and margin error of 0.03. Thus a population size of 200 will require a sample size of 75 (Bartlett, 2001). The size of 80 was distributed to the sites representatively and it took care of non-responses and errors anticipated from the respondents. In order to select the 80 respondents, the researcher used systematic random sampling technique as indicated in the following steps;

Step 1. Ten sites where waste dealers operate were identified.

Step 2. Research assistants were stationed at each site from 8.00 am to 4.00pm.

Step 3. Using systematic random sampling, the 1st item was selected randomly and then every 3rd item was automatically included. In total 80 respondents were interviewed.

The following sites (Figure 8) were surveyed; 1) Jomo Kenyatta Sports ground; 2) Rachael Scrap dealers (Kibuye Market); 3) Jubilee municipal Market; 4) Nyalenda Mkorino plastic dealer; 5) Manyatta Solid waste centre (Situated at Manyatta primary school); 6) Bamato (CBO) plastic centre -Nyalenda 7) Swan Centre paper dealers; 8) Nyalenda Standard

Quarters scrap dealers, 9) Sophie scrap dealers (next to Aga Khan primary), and 10) Kachok, MCK main dumpsite.

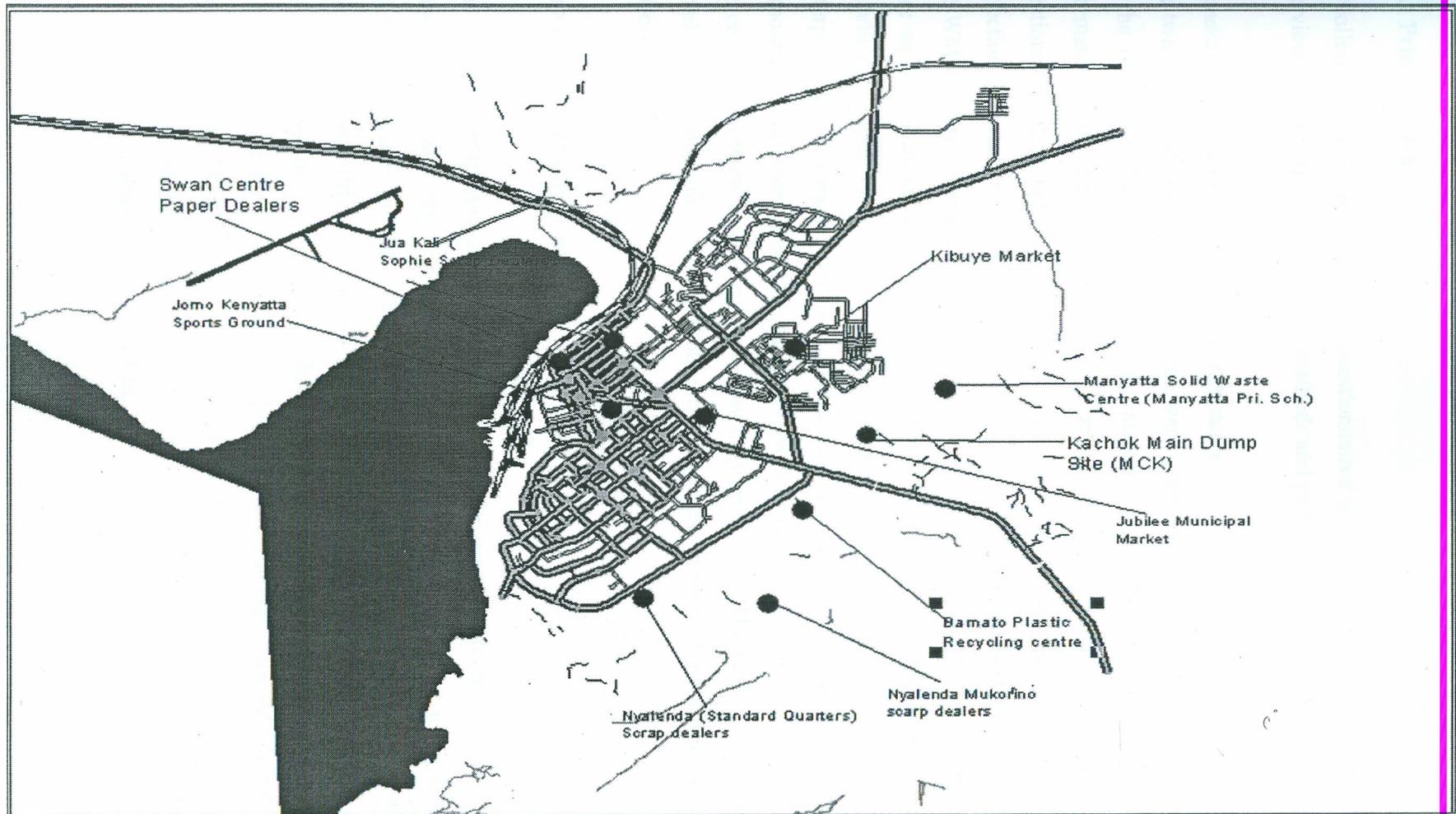


Figure 8 Plastic waste collection and buying sites in Kisumu municipality

Source: GIS department, Kisumu Municipality, 2009

3.5 Data collection Instruments

3.5.1 Primary data

To collect the data, the study used questionnaires and interview schedules, Key informant interviews, observation, photography methods and participation in SWM events.

Standard questionnaire and interview schedules

The two main instruments in the research were questionnaires and interview schedules based on the objectives. In the questionnaires questions were standard and designed to gather information from the waste pickers and dealers within Kisumu town. The items in the questionnaires were both closed and open ended in order to give a dynamic approach to data collection. The data required included the activities, organization, behaviour, and transactions in SWM and the recycling sector. The schedules and questionnaires (see Appendices I-III) were administered to waste pickers, small scale waste buyers and sellers and 4 plastic recycling factories in Kisumu. The plastic recycling factories sampled included Victoria Enterprise, Vyatu Limited, Tuffoam mattresses Limited and Soni Technical services. The purpose of using questionnaires and interview schedules was to maintain the focus of the subject and to ensure consistency and flow of primary data. The researcher ensured that all scheduled questionnaires were self-administered to avoid misunderstanding of questions by respondents.

Key informant Interview schedule

The schedules employed a combination of quantitative and qualitative methodology. The reason for choosing interviews schedule was to allow the possibility to be flexible and to adjust the questions to each of the informants. In addition, the researcher also wanted to be open to the possibility of obtaining other information from the informants that could be of interest to the study. An interview schedule with open ended questions (see Appendices IV and V) was used for interviewing Key Informants including: - the Municipal Director of Environment and District Environment Officer in order to understand their role in SWM. The key informant interviews played an important role towards understanding the role and mandate of each stakeholder in the SWM.

Observation of the activities and procedures in plastic waste collection, sorting, cleaning and weighing were recorded and some activities captured in photographs. At the recycling centres and factory, the processing and pelletizing was observed.

3.5.2 Secondary data

Existing literature on solid waste in Kenya and informal recovery systems in other developing countries was reviewed. Documents referred included Local Authority Act, Physical Planning Act, Sessional papers and statistical abstracts, State of Environmental reports by National Environmental Management Authority (NEMA), Periodicals on Environment published by various organizations (e.g Practical Action and NEMA), Research thesis reports from School of Graduate Studies at Maseno University, university of Nairobi library, seminar reports, Central Bureau of Statistics and Kenya National Cleaner Production Centre (KNCPC).

Use of internet

Electronic media was used to obtain secondary data from the internet which was used to complement primary data.

3.6 Data Collected

Quantitative and qualitative data was collected and analysed accordingly. Sources of plastic waste, background information of the waste pickers, characteristics and types of plastic waste papers, quantities collected and weighed collection methods, efficiency and effectiveness of the MCK in terms of collection and disposal.

3.7 Levels of Data Collection and Sampling Procedures

In order to meet the research objectives, three levels adopted from Kibwage (2002) were used in the study.

These included:

- i) **Primary Level** – At this level, 80 WPs in plastic waste out of 200 (WPs) as per the reconnaissance prior to the study were selected using purposive sampling (3.4)

ii) **Secondary level** – Data collection targeted all the dealers, wholesalers/plastic waste tradesmen and market brokers based at various zones. During the reconnaissance, 20 dealers were randomly identified as participants involved in purchase of plastic waste from waste pickers and selling the same to industries within Kisumu town. However, when the pre-test of the questionnaire was conducted, it was realized that 10 dealers were actively operating in Kisumu. The researcher, therefore, purposively selected 10 dealers i.e. one dealer from each site. The researcher opted to use purposive sampling because of the sample size and to maintain consistency during the study period. This level was done concurrently with the primary level so as to obtain data for quick comparison.

ii) **Tertiary level** – At this level, the researcher found out the types of plastics at each factory and its specialization in moulding into various products, quantities of waste received per day (in kilograms), amount paid to dealers and challenges faced. Structured schedules were used to get the outlined data from the 4 factories in Kisumu namely:- Vyatu Ltd, SONI Technical Ltd, Tuff foam Ltd and Victoria Enterprises. (Appendix III).

3.8 Data analysis, interpretation and presentation

The questionnaires and interview schedules and the field notes were edited and completed for substantial quality of data. Data processing using Statistical Package for social sciences (SPSS) version 12 was used to enter and analyse data as soon as it was received from the field. The results were analyzed using text, the measure of central tendency, frequency tables, charts, simple statistical ratios, percentages and graphs to show interrelations of various variables. Both qualitative and quantitative data analysis methods were applied to avoid gaps that could arise by using one method. The interpretation gave logical explanations of relations found and the lines of relationships in terms of the underlying processes. Guidance was sought from experts in research who included my supervisors in order to make useful interpretations.

3.8.1 Policy analysis

The key methodologies used included; 1) Review of existing literature to develop suitable criteria for analysing existing policy framework. These included documents, posters and write ups; 2) Personal interviews were conducted with the government officers and other

stakeholders within the municipality; 3) Understanding of the existing situation to obtain viewpoints on the problems and plausible solutions as perceived by various stakeholders in the plastic chain, through interviews and face-to-face dialogue. The framework adopted is shown below (Figure 9):

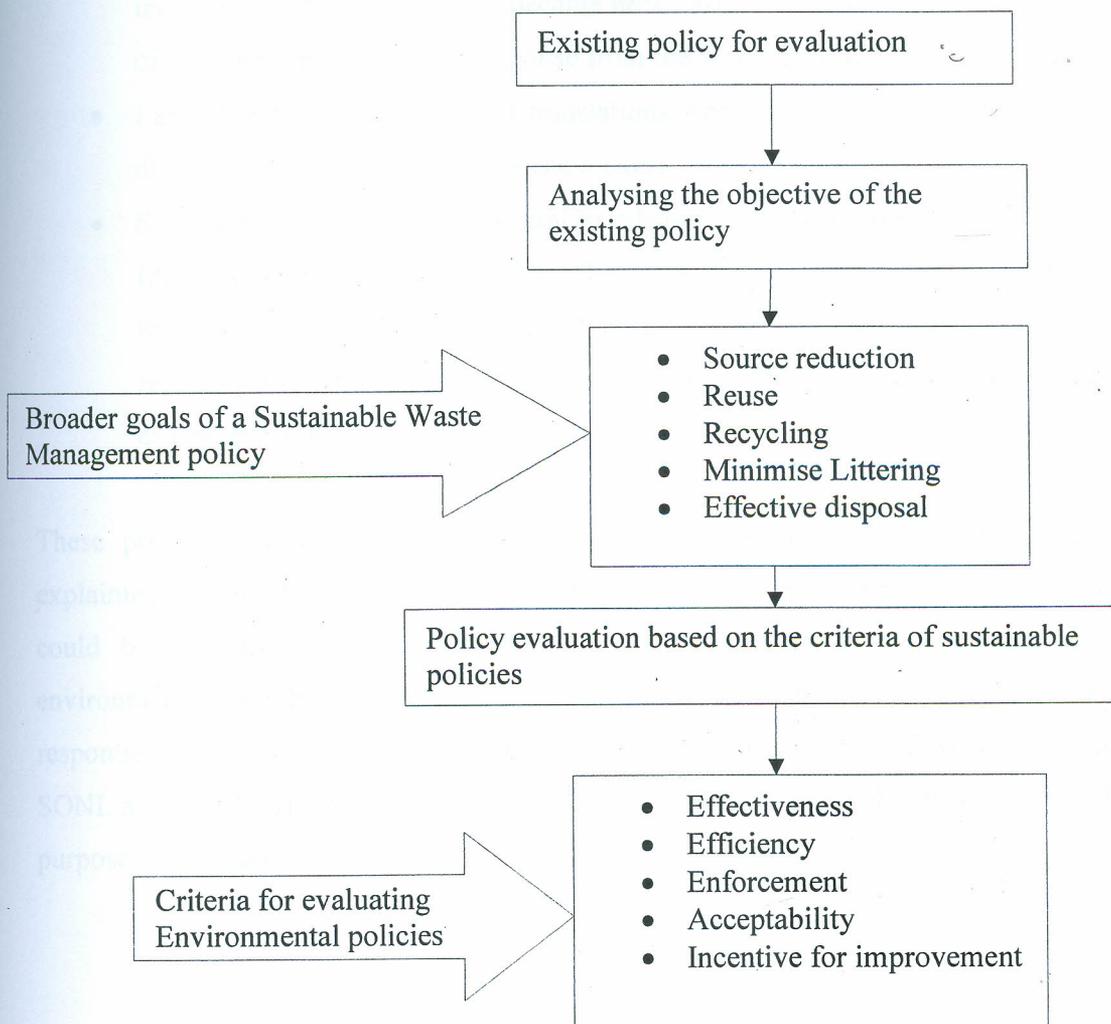


Figure 9: Framework for policy evaluation (adopted from Narayan, 2001)

3.9 Constraints Experienced from methodologies used

During the research there were some problems experienced as follows:-

- Insecurity at the dumpsite where control is left to the scavengers who do not accept any stranger. The scavengers looked fierce and challenged any move to take a photograph while others demanded for money before anything was done. Observation was interfered with as the dumpsite dwellers were unwelcoming. It became necessary to use the municipal personnel in order to get their understanding.

- Another constraint was demand for “*gi moro*” in Dholuo language meaning ‘something’ to be given including food before a respondent answers questions particularly for waste pickers. The research professional ethics demand that the respondent understands the purpose of the study to avoid any use of influence including money. It therefore became necessary to explain several times the purpose of the study in order to get response from the waste pickers.
- Language barrier necessitated translations from English into Dholuo or Kiswahili due to high illiteracy level of waste pickers.
- Some organizations were reluctant to release their information records especially on finances or expenditure for fear of confidentiality. One of the factory managers refused even to give an estimate of their expenditure on electricity but complained of regular power fluctuations. The researcher assured the respondent of confidentiality as per research ethics.

These problems, however, were reduced during the process of field work by clearly explaining the objectives of the study as aiming at how the informal and formal activities could be incorporated into the SWM in order to improve their welfare and urban environmental and health conditions in general. Despite these challenges, some of the respondents were very helpful. For instance, the operations managers of Vyatu industries, SONI, and the District Industrial Officer provided information freely after understanding the purpose of the study.

4.1 Introduction

The results and discussions of the study are intertwined and presented in this chapter according to the objectives of the study.

4.2 Waste producers, sources and types of recycled plastic materials in Kisumu town

This section describes the sources, types and characteristics of recyclable materials.

4.2.1 Producers and sources of waste materials

Table 3 below shows sources of plastic waste and quantities received from each source in percentage within Kisumu.

Table 3 Sources of plastic waste

	Source	Percentage
1	Residential areas	52
2	Dump site	32
3	Institutions	7
4	Commercial areas	6
5	Non response	3
	Total	100

The findings revealed that most of the plastic waste emanate from residential or households' areas accounting for 52 %. These include densely populated slums of Manyatta, Nyalenda, Obunga, Bandari and Kaloleni. The middle income estates including Okore, Moscow, High rise, Tom Mboya, Railways quarters also contribute to this. The high income estates such as Milimani, Kenya Re and Mountain View are a source of fairly sorted plastic waste. The high quantities in low income estates were attributed to regular disposal of plastic containers of cooking oil and fat, basins, spoons, plates and other recyclables. The common practice in low income estates is that residents afford commodities in small quantities packed in polyethylene or other form of plastic which they dispose off almost on a daily basis. The second largest source of plastic waste was the dumpsite with 32%. Institutions contribute 7% and these include schools, colleges and hospitals situated within town.

Commercial areas which include, restaurants, shops, supermarkets and other related business premises generate only 6%. The recovered materials include polythene wrappings, glass, car batteries and scrap-metal. Three per cent of the respondents did not respond to this question probably because they kept the source a secret for fear of competition or they simply did not want.

Residential type of waste is derived from households which discard waste in open dumps within the estates. It consists of a large number of different elements difficult to separate such as food and garden waste, paper, plastic, cardboard, glass, leather, and old clothes and furniture, newspaper and magazines. Residential areas within Kisumu Municipality generate about 60% of the plastic waste (NEMA, 2005).

The residential zones can be divided into:-

- (a) Low density settlements
- (b) Medium density settlements.
- (c) High density settlements

Low density settlements are further divided into high, medium and low cost housing. The high cost residential areas include Milimani estate, Kenya – Re estate and Miligan estate. Medium density settlements are characterised by planned Municipal housing and National housing Corporation estates which include; Ondiek estate, Makasembo estate, Moscow estate, Arina Municipal estate, Tom Mboya estate, Lumumba estate, Shaurimoyo estate, Nubian Estate, USAID estate, Okore estate and Robert Ouko estate. These are characterized by planned sewerage systems, fairly good road network, irregular water supply and electricity. High density settlements included informal settlement or slums. These settlements are characterized by high population, poor sanitation, and lack of basic infrastructure such as water, roads, electricity and even lack of health care facilities. Generation of waste is relatively high with organic waste leading in categorization. Some of the dwellings are constructed in units of 10x10 square feet but accommodated as much as 5 occupants per household. Many of such houses were common in unplanned residential areas or slums which included:- Manyatta, Obunga, Bandani, Nyalenda and Kaloleni. The findings above indicate that SWM is a serious challenge from all residential sites of Kisumu town regardless of whether it is in high, middle or low income housing.

4.2.2 Types of waste obtained from residential areas

The types of waste generated from residential areas are a characteristic of the lifestyles of the people in these areas. Low density settlements such as Kenya Re estate, Milimani and Miligan estates generate assorted wastes such as organic, plastic and metal scrap materials of high value compared with high density settlements including slums. Inadequate collection schemes in high density settlements and a weak municipal disposal policy for high density settlements are a challenge. Common types of wastes are shown in table 4 below.

Table 4 Types of waste and waste sources

	Type of waste	Source and characteristics
1	Organic waste	Comprise of 70% of waste generated in Kisumu (NEMA, 2005), mostly from residential areas, hotels and cafes, bus park. Include remains of food item, bones and fruits.
2	Plastic waste	High, low and medium density residential areas, hotels, garages. Include plastic mugs, basins, oil plastic containers, battery casing, water bottles
3	Metal waste	Commercial, garages, and construction sites and rural homes. Types include pieces of metal bars, metal containers, pieces of iron sheets, metal pipes and scrap from vehicles.
4	Glass	Broken glasses at construction sites, glass repair shops, and equator bottlers, dumpsite. Include broken bottles, glass containers, plates and windscreen.

b) Commercial zone

The existence of various commercial businesses such as shops, government and private offices, business enterprises, markets, supermarkets, hotels and restaurants in Kisumu have contributed substantial amounts of assorted solid waste. The solid waste types are varied and can be divided into biodegradable and non-biodegradable. They include papers, paper wrappings, plastics, clothing remains, sweepings and garbage. The plastic dealers in this category have networks with support staff working in offices which are large users of plastic materials and schedule to collect them weekly. Sometimes watchmen are involved in giving the waste pickers access to where the polythene bags or PET bottles are discarded. The rise in

PET is mainly associated with inadequate sources of clean water in town. Four giant supermarkets which are a source of plastic waste include Ukwala Supermarkets Ltd, Nakumatt Ltd, Tusker mattresses Ltd, and Yatin Supermarkets Ltd. The offices, private enterprises and shops generate plastic bags and polythene wrappings. Restaurants and hotels within the town centre are a source of mainly organic waste from food remains and water bottles (PETs) as well as LDPE Jerry cans containers of cooking oils.

c) Institutional zone

Institutional wastes originate from government and private institutions, religious organizations, universities, schools and hospitals. Kisumu Municipality hosts several types of institutions. First there are three government hospitals, 5 private hospitals and ten private clinics. All health institutions generate hazardous wastes which require careful handling before they are selected or disposed of. Hospital waste also forms a threat to the health of waste pickers and neighbouring residents when mixed with other types of waste. The research observed that the composition of hospital waste included swabs, soiled waste, disposables, anatomical wastes, cultures, discarded medicines, chemical wastes among others. These were in the form of disposable syringes, used bandages, body fluids and human excreta. Two government hospitals and one private hospital were found to have incinerators. However, most of these facilities are not upgraded to handle large volumes of plastic type of waste and disposable syringes. Waste pickers were not permitted to select plastics from hospital institutions due to their nature of toxicity except for containers of HDPE plastics and PETS.

University campuses, tertiary colleges and business enterprises also generate paper and plastic waste in form of water bottles, plastic bags and organic waste. The result from the above reveals that there is lack of organized disposal strategy of plastics in institutions. NEMA (2005) discloses that air pollution from burning of plastics from such institutions without proper incinerators is dangerous to human health.

d) Industrial and *Jua kali* wastes

Industrial waste is obtained from large processing manufacturing and packaging industries. Kisumu Municipality accommodates heavy and light industries which are a source of various forms of wastes. Plastic wastes from these industries compose of plastic wrappings, containers and other forms of packages. Waste pickers, however, are not permitted to pick waste from industries unlike other open places since some industries have their own planned

form of disposal system or organized services from the municipality. The *jua kali* garages, although not categorized under industries, are a wide source of plastic containers for fuels and oil lubricants. The plastic containers are carelessly disposed of at the garage yards and the scavengers take advantage to collect them daily. Other plastic materials common at *jua kali* include plastic bags which are used in wrapping food, water or milk particularly disposed of by those who paint vehicles at *jua kali* garages. Small scale machines for plastic granulations do exist at *Jua Kali*. The proprietors of these workshops obtain their waste materials from; (i) waste dealers, (ii) hardware shops, and (iii) in some limited incidents they buy directly from waste pickers and manufacturing industries.

e) Construction and demolition zones

This form of waste was common on construction sites and it includes wastes such as cement bags, pieces of timber, assorted metals, and mixture of rubble, poly bags and paint containers including plastic containers for water and other purposes. The research observed that there were many construction activities due to the expansion of the town but lack of environmental planning strategies contributes to disorderliness in waste disposal in the construction sector. Debris and soils were also common on sites of construction.

4.2.3 Source reduction and reuse

Since waste management starts from individual household, solid waste disposal have been of great concern. Currently, there is no source separation practiced within all residential estates. Most residents particularly the slum dwellers dump waste in unauthorized places resulting to heaps of garbage at various points in town. Littering of rubbish haphazardly such as sweet wrappings, cigarettes bouts, plastic wrappings, scratch cards and other unwanted rubbish makes the environment untidy especially within the city centre. However at the household level sorting involves selection of reusable plastics such as PET bottles for liquid storage such as paraffin or water, 5-10 litre LDPE containers from used cooking oil is also kept for water storage and polythene bags (nicknamed *juala* in the local language) are kept for reuse in local market shopping. Rather than taking a bag from the store after each trip, a reusable bag could be used several times. Using reusable products instead of their disposable equivalents reduces the amount of materials that must be managed as waste (EPA, 1989). Developed countries emphasize waste reduction, reuse, recycling and proper waste disposal in this order of priority and the developing countries have realised the value of the “4Rs i.e. Reduction, reuse, recover and recycle” (JICA, 2005).

4.2.4 Types of plastics salvaged

During the research, there were four types of plastics that were observed in the field. However not all types were salvaged for recycling. The following were recovered in Kisumu included; polyethylene (PE), Polypropylene (PP), Polystyrene (PS) and polyvinyl chloride (PVC). Each of these can be sub-divided according to their density, the type of process involved in their manufacture, and the additives they contain.

4.2.5 Collection centres for recyclables

These points of collection can be categorized as recovery at source, recovery from waste bins and open space dumping, waste collection vehicles and dumpsite. The study established that Kisumu has 20 plastic collection points including the dumpsite which is under the management of MCK despite the illegal control by the dumpsite scavengers. However only 10 of these collection points have defined structures and are regular in collection and selling of recycled material. Some of the waste sources are described in more details as follows;

a) Recovery at source

Recovery at source includes waste from the domestic use through housewives, servants and watchmen who allow the waste pickers to collect from residential dumping sites. Waste separated at source from the household level, have negotiable prices depending on the type and nature of plastics. Besides, there are reuse habits particularly by households that are attributed to prevailing levels of poverty. No effective source separation practised by residents in Kisumu town. The reasons given by the respondents included lack of receptacles clearly labelled to accommodate various categories of waste, inadequate sensitization and monitoring of SWM by the MCK and the availability of cheap option of open dumping which saves time.

b) Wastes from rural centres

During this study, some dealers revealed that recycling industries had agents from other urban centres such as Siaya, Yala, Bondo, Kericho, Kisii and Muhoroni who brought plastics to their industries. The plastics were assorted in nature but mainly composed of HDPE and LDPE. These include; basins, brushes, plastic plates, spoons, buckets and oil containers. This revelation was an indication that SWM message was extending to rural towns where recycling was neglected. However, it was realised that

the middlemen exploit the waste collectors from rural towns by paying them only Kshs.7 per kg as compared to Kshs.17 paid to them by the recycling industries.

c) Recovery from Trucks and private vehicles

Municipal trucks and private collectors' trucks allow scavengers to accompany the crew in loading and offloading. By taking active part in this task, they get the opportunity to sort waste within the vehicles or trucks and keep the recyclables in their bags before they arrive at the dumpsite.

d) Dumpsite recovery

Selection and recovery of waste materials is done intensively at Kachok dumpsite despite the fact that most of the valuable items are recovered upstream by the street waste pickers, itinerant waste buyers and waste dealers. The quantities and income depends on the availability of materials, time of collection and luck. The conditions at the dumpsite are pathetic with stinking smell and contamination from toxic waste and fumes from the burnt PVC plastics. Most of the items which are deposited are of assorted nature. Even toxic chemicals are littered everywhere. There is no soil filling done, no litter and dust control, there is lack of essential amenities like water, lighting and health services. During the rainy spell, the interior part is impassable. The dumpsite lacks a fence and hence endangers the health and life of straying urban livestock (Plate 1). A number of waste pickers depend on food waste hence competing with animals and birds at the dumpsite.



Plate 1: Livestock feeding on plastics and other wastes, Kachok dumpsite, Kisumu town.

4.2.6 Quantity of Plastic waste Collected by a Waste Picker per Day

The survey established that LDPE and HDPE were the most preferred type of plastics by dealers. The waste dealers purchased and weighed on average 815kg of (LDPE) and 775 Kg of (HDPE) per day from various sites as shown in figure10. Each waste picker on average therefore collected and weighed a total of 35.4kgs per day in Kisumu compared to Nairobi where the street waste pickers collect up to 96 kgs per day (Kibwage, 2002).

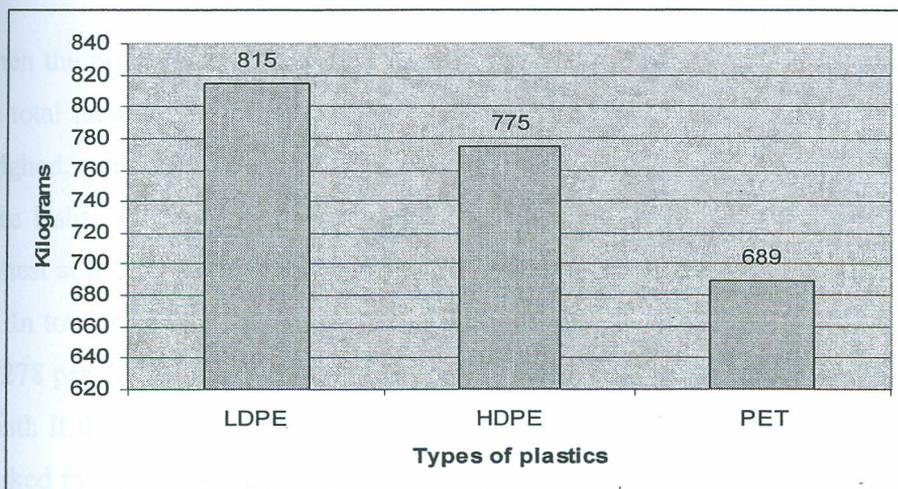


Figure 10 Quantity and type of plastic waste weighed by waste pickers per day

As already observed in section 4.6, the amount collected in any given day depended on one's luck, availability of materials, body health, family commitments (men collect more than women), age, and one's daily planned operations. The PET type weighed 689 kg per day from the buying centres studied. PETs did not attract many waste pickers since there were few dealers in it and the prices were not attractive. PETs also required large bags consuming a lot of volume but weighing very little.

When the waste pickers were interviewed on any positive environmental changes they have observed since they started their occupations, the majority indicated that no positive changes have taken place. Instead, they noted that conditions are becoming worse from time to time. The introduction of economically unrecoverable materials, especially plastic bags, was also cited as the major cause of littering in the city. Most of the polythene bags were not being collected regularly during the study period because of lack of a local market for this material. The other unforeseen, but one of the most important implications of informal waste recovery activities is the reduction in waste collection cost and space requirements in the landfill. For

example, the Nairobi Dandora landfill, which became operational in 1984, was projected to be filled and closed by 1990, but still there is more space for filling after another decade. The extension of the life span of the Dandora dumping site can only be attributed to the intensive waste picking that takes place at the moment in the City. Similarly, Kachok dumpsite of Kisumu has served as a dumpsite for over 20 years. Waste recovery from that site has saved the council the cost and space requirement in the landfill.

4.2.7 Quantity compared to income

When the prices for PET plastics remain constant at Kshs. 2 per kilo paid to waste pickers, the total income per day earned by all waste pickers is Kshs. 1378 from the 689 kilograms weighed, per day while in HDPE plastics purchased at Kshs.10 per kilogram the earnings were Kshs. 7750 per day from the 775kg obtained daily. The LDPE plastics weighed the highest at 815 kg per day and earned the waste pickers Kshs. 8150 per day as shown in figure 11. In total, from all the transactions, (PETS, HDPE, LDPE) the waste pickers earned Kshs. 18,278 per day which translates to a total of Kshs 127,946 per week and Kshs. 3,838,380 per month if they (waste pickers) worked daily. However, from table 5, 18% of the respondents worked for 5 days while 21% worked for 7 days.

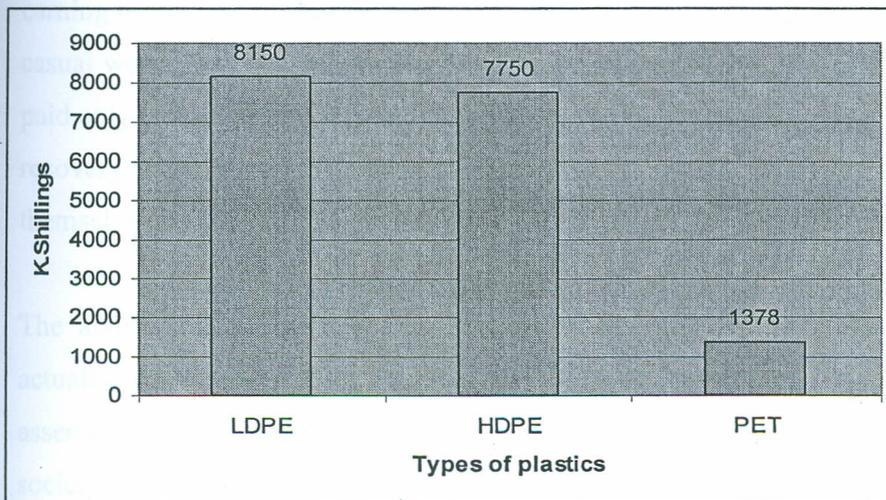


Figure 11 Total income for waste dealers per day

When waste pickers were interviewed, (52.5%) revealed that they earned an average of between Kshs 100 and Kshs 200 per day (Table 5)

Table 5 Total average income per day obtained by Waste pickers

No. of days operated per week	Daily average income-Kshs.					Total No of respondents
	30/=	30 – 50	50 - 100/=	100 - 200/=	More than 300/=	
3	0	1	3	2	0	6
4	0	1	4	3	0	8
5	2	2	9	15	6	34
6	0	0	0	2	0	2
7	0	3	5	20	2	30
Total	2	7	21	42=52.5%	8	80

This translates to Kshs. 6000 earning per waste picker per month if they work in 7 days (table 5, row 5). However, from the same table 18% of the respondents earned between kshs.100-200 per day, who worked for 5 days in a week; while, 21% of waste pickers worked for 7 days earning the same amount. The amount earned is more than the minimum wage in the Government which ranges between Kshs3,073 and Kshs.4, 458 per month inclusive of house allowance or Kshs. 127 per day for unskilled workers (GOK, 2009). The waste pickers earning per month is also far much higher compared to what is paid in the private sector like casual workers at the Indian shops, African business enterprises or even watchmen who are paid only Kshs. 3,514 per month. Despite the cultural attitude people have towards the waste recovery work, those in it do not regret since it enables them to purchase food and cloth themselves.

The above analysis reveals that although waste pickers are perceived as poor, they are actually able to meet their basic needs with the earnings they get daily. Medina, (2000) asserts that waste picker income is very low, although they are not necessarily the poorest in society. Their low income is due to the low position in the trade hierarchy for recycled materials. They are often unfairly exploited and paid very low prices for the materials collected. This is particularly true in markets where only one buyer exists. Such conditions often prevail for wastes collected from dumps, where the distance to the city makes transport impossible for impoverished waste pickers. In some cases, the pickers have to pay for the right to access the waste, and may also have to sell their materials to the same individual or

organisation. Such is the position at the MCK dump site at Kachok next to Nakumatt mega city in Kisumu.

The industries operating plastic recycling business include SONI Technical Ltd, Vyatu Ltd, Victoria Enterprises Ltd and Tuf-foam Mattresses Ltd. All except Victoria enterprises recycle plastics and therefore they attract a big market for the waste pickers and dealers in Kisumu. The results from the survey indicate that the waste pickers engage in productive activities that contribute to their livelihood thus reducing poverty levels within their families. Medina (2000) asserts that despite the lack of data at the national level, various studies have highlighted the economic importance of scavenging activities. For instance, in Bangkok, Jakarta, Kanpur, Karachi and Manila, scavenging saves each city at least U.S. \$23 million per year in lower imports of raw materials, and reduced need for collection, transport and disposal equipment, personnel and facilities. Indonesian waste pickers reduce by one-third the amount of garbage that needs to be collected, transported and disposed of. In the city of Nuevo Laredo, Mexico, the economic impact of scavenging activities has been estimated at nearly half a million dollars per month (Medina, 1997). Medina further says that scavenging can be a profitable activity when waste pickers are organized and authorities sanction –or at least tolerate– their activities. A strong case can be made that authorities should be supportive of scavenging activities. However, most often authorities consider scavenging as a problem to be eliminated (Medina, 1997). Scavenging also renders significant environmental benefits because recycling materials saves energy, water and generates less pollution than obtaining virgin materials. Further, scavenging reduces the amount of waste that need to be collected, transported and disposed of, lessening air pollution from fewer dump trucks, and extending the life of dumps and landfills

4.2.8 Waste materials preferences

Among the several types of plastic material collected, HDPE and LDPE were the most preferred with 45% of respondents, followed by LDPE, 14%; HDPE, 16%; Metals and HDPE, 11%; and finally 8% waste pickers collected all types (Table 3). One percent did not respond to the question on materials they preferred to collect. The reason given for the first choice of HDPE and LDPE was that they had more weight, good prices and they attracted a wider market.

Table 6 Materials preferences among waste pickers

Types of waste collected	No. of respondents	Percentage
HDPE and LDPE mixed	36	45
LDPE Plastics only	14	19
HDPE Plastics only	13	16
Metals, HDPE and LDPE	9	11
All types	7	8
No Response	1	1
Total	80	100

4.3 Formal and informal organizational networks in plastic waste management system

This section seeks to describe the linkages between various actors involved in SWM, before the focus narrows down to the activities of the informal recycling sector. The literature review and field surveys revealed that the major actors involved directly or indirectly in SWM activities in Kisumu include the Kisumu Municipal Council (MCK), Private Companies (PCs), Community Based Organizations (CBOs), Non-Governmental Organizations (NGOs) and the informal sector's agents (waste pickers, waste dealers and the Waste Recycling Industries (WRIs).

4.3.1 Actors involved in plastic waste management

There are various actors involved in formal and informal networks in plastic waste recovery in Kenyan towns. These include; Community Based Organizations, Small enterprises i.e. waste dealers, Waste pickers, Factories, Non-Governmental Organizations and the Private Sector Corporations (Klundert and Inge Lardnois, 1995b). The MCK collects and disposes waste at the dumpsite.

a) Municipal Council of Kisumu (MCK)

The normal practice globally is that municipal councils of most developing countries are responsible for managing MSW waste. They are also expected to provide containers, keep the streets clean, collect and transport solid waste process it in some manner. However in cities of developing countries this is not the case. Kenyan municipalities derives their funds for waste management either through funds designated by the Central Government or taxes as

well as Local Authority Transfer Fund (LATIF). These funds seem inadequate for most municipalities, considering the demands of urbanization. Due to budgetary constraints, inadequate equipment, poor planning and mismanagement, house to house collection is very rare in Kenya, particularly in low income areas where waste is not collected at all (Ikiara, 2002). It is estimated that only 20% of solid waste is collected and disposed in Kisumu (NEMA, 2005).

The Environment Department of MCK was established in the year 2000 with a new structure that has not gained enough support from the Central government although it is operational. The organizational structure in figure 12 in the next page shows that MCK has 2 key sections and 5 sub-sections. The department is headed by a Director, and the Assistant director. Under them, there are three sections namely environmental planning, urban aesthetics and environmental regulation. There are two sections under environmental planning section while the urban aesthetics section is charged with cleansing and park management. The environmental regulation has two sections namely monitoring control and community section. Interviews conducted involving the director indicated that most of these sections were well outlined on paper but existing practically for implemented on the ground. For example, there were no officers on the grounds that are trained in environmental regulations. There are also no inspectors who could conduct a survey on plastic bag thickness in order to regulate the production of the required gauge. The department has insufficient skilled and unskilled staffs that were retained from the previous Public Health Department (Interview with Director of environment MCK, 2006).

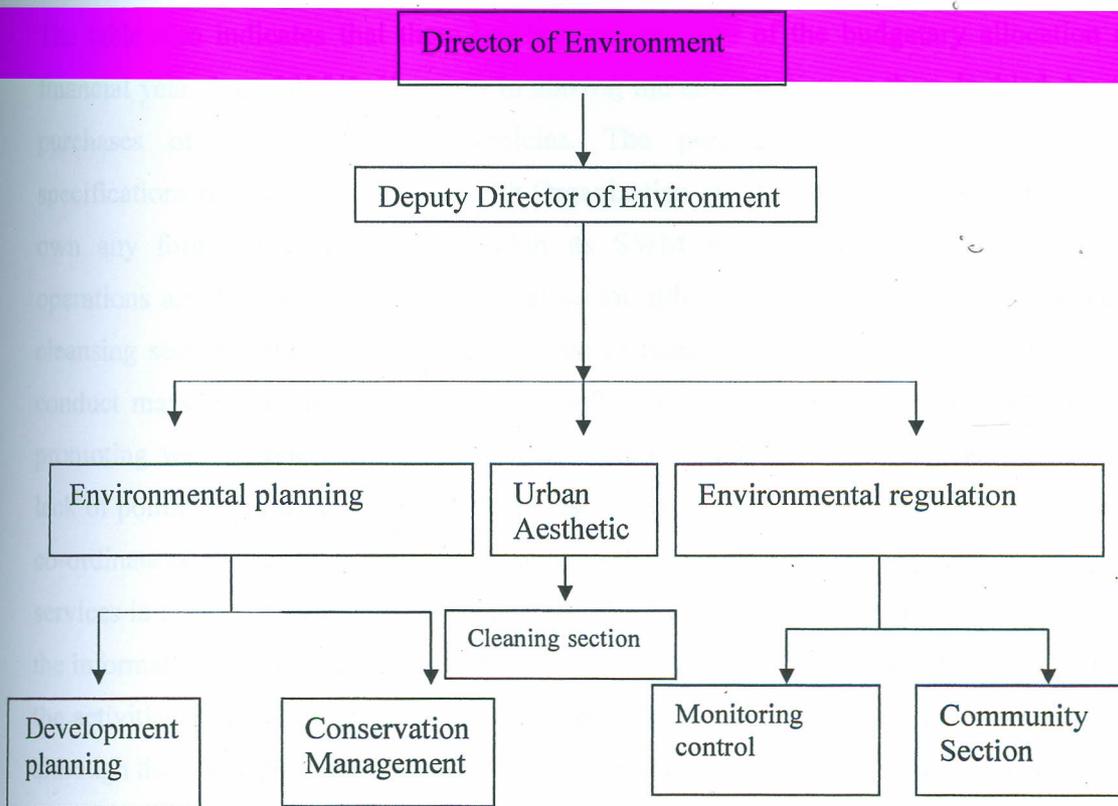


Figure 12: Organisational Structure of the MCK Department of Environment, MCK, 2007.

Figure 12 provides several sub-sections which are dormant in the environment department lacking staffs, resources or transport. Planning and management of the department is lacking. The study also, through interview of the Director of environment confirmed that no solid waste management plan or environmental management plan exists. Community section mentioned in the organ graph, meant to mobilise and link stakeholders lacks a staff and even office. The resource allocation is minimal yet demands for the service are increasing from the growing urban population. The department receives minimal operation votes every year to cater for all environmental services, despite the increasing population demands and slight improvement over the years (Table 7).

Table 7 Budget for Environment department (2005/2006 -2007/2008)

Year	2005/6	2006/7	2007/8
Amount	2,805,000	11,464,530	55,066,520

Source: MCK Reports, 2007

The table also indicates that there has been an increase of the budgetary allocation every financial year since 2005/6. However in 2007/8, the allocation more than doubled due to the purchases of waste collection vehicles. The purchased vehicles however, lacked specifications required by World Health Organization (WHO) standards. The MCK does not own any formal recycling plant within its SWM system. Currently, all the recycling operations are dominated by the informal sector although not all of them are licensed. The cleansing section officials recognise the need to reduce and separate waste at its source, to conduct mass media campaigns, and to develop clear and enforceable policies and by-laws promoting waste reduction, recycling, and community participation, but there appears to be lack of political will to do so. The survey also revealed that although the MCK is supposed to co-ordinate all the actors in SWM because it has the legal mandate in the provision of the urban services in town, it is operating almost in isolation from those of the other actors, for example, the informal sector agents. Further, the study shows that the MCK has not attempted to improve the activities of the waste pickers, waste dealers and the waste recycling industries at any stage although the MCK provides registration. This scenario is similar to that of Addis Ababa where despite the valuable role played by the informal sector, planners and policymakers ignore this sector (Bjerkli, 2005). Despite all these weaknesses at the MCK, the Director of Environment mentioned that, the UN-Habitat and the Government of Kenya have jointly pledged to support a project known as Kisumu Integrated Solid Waste Management Project (KISWAMP) whose intervention will include composting and waste management. The responsibilities of MCK include the following;

(i) Collection, Transportation and Disposal of waste

The local Authority Act Cap 265 of the laws of Kenya mandates the Municipal Council to ensure cleanliness in urban areas is maintained. This being the case, it is formally a responsibility of the environmental department to strategize on how to collect, transport and dispose all forms of solid waste. MCK has shortage of bins and receptacles to contain waste generated. In the whole town no single secondary bin (i.e. standard containers) is available except few primary storage facilities for instance one hundred litre half oil drum or fifty litre galvanized iron bin placed at strategic positions in the town centre. These are for primary storage of light waste e.g papers and polythene wrappings. Collection of waste is conducted from open dumping sites by the roadsides, and footpaths in slum areas while other garbage is collected from street dumping. The cleansing section has staffs who sweep the streets, parks

and markets. These places include the Bus Park, Jubilee market, fish market, Oile Park and the commercial streets within the town centre. The staffs also engage the street boys to load and off load the garbage to and from compactor and Lorries. This is done in anticipation of getting opportunity to select valuable items from the waste. Slum areas get no waste collection at all. No organized systems and schedules of collection exist, making the households resort to private burning of waste or digging their own pits. Because of political and economic powers of high-income areas, they received a more frequent and efficient service than the high-income areas. On average, high-income areas that are serviced by MCK received service once per week. The medium income-areas received a service after 1-2 months. The low-income areas received a service after 3-6 months or none. Slums and squatter settlements, in particular, received no service at all because of their illegitimate status and the fact that they never pay for the service according to the Cleansing Superintendent. According to Kibwage (2002) a similar situation exists in Nairobi city, where low income settlements don't get attention in terms of waste collection and disposal. UNEP (2005) also asserts that even the Nairobi City Council which has the social responsibility of providing SWM services to all citizens concentrates its efforts on residential areas and institutions that can afford private services at the expense of areas inhabited by the poor. These observations contravene Millenium Development Goals (MDG) status reports on goal number 7 on ensuring environmental sustainability by improving the lives of Slum dwellers (GoK, 2008).

(ii) Transportation

The Municipality operates one compactor vehicle and three Lorries for collection of waste. With such limited transport therefore, collection is concentrated in the CBD and some specific areas such as market places and hospitals and high grade housing estates (NEMA, 2005). According to the Director of Environment, there isn't sufficient funding to the department which limits the waste collection and inspection of the work. The crew size also is limited as shown on Table.8. This is due to retrenchment of staff in the department.

Table 8 Types of transport used by MCK and Private Collectors

Type of Vehicle	No.	Ownership	No. of Trips /Day	Crew size
Compactor	1	MCK	2	2-3
Lorries	2	MCK	6	2-6
Tractor	1	MCK	2	2-3
Private Lorry	1	Private	2	2-3
Pick ups	5	Private	3	2-3
Handcart	3	Private	-	6

Source: Interview, 2006

The private sector uses one lorry, 5 pick-ups and 3 hand carts all owned by different collectors. These transporters can manage about 5 trips a day. The private collectors have no harmonized system of waste disposal which makes it difficult to estimate their capacity. Most of these vehicles were not particularly made with specifications for waste collection and therefore spilled the waste especially plastic bags. The business also does not pay back since many residents do not pay in time for the collection services.

The municipality lacks compactor vehicles as the only one available was acquired in 1974 and regularly breaks down (Plate 2).

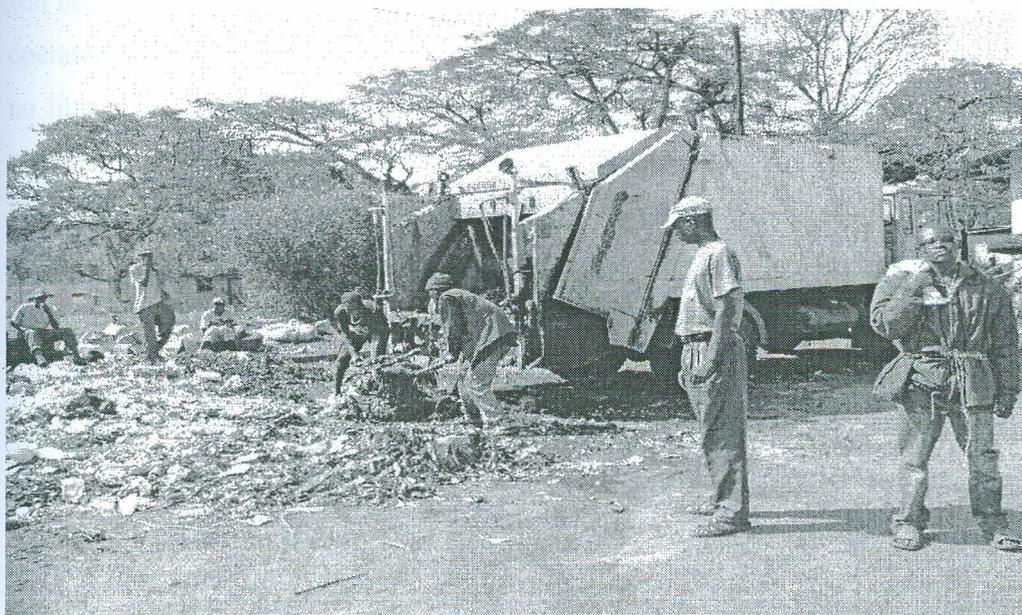


Plate 2: A Compactor being loaded at Jubilee fish market-Kisumu, Kenya, 2008.

As shown in plate 3 a driver (in blue T-Shirt) supervises the loading of solid waste by waste pickers who in return select valuable plastics for sale at Jubilee fish market, Kisumu. The lorry is the only compactor available acquired in 1974 by MCK. Shortage of staff is also experienced hence taking the advantage of waste pickers as available free labour.

(iii) Waste disposal (Land filling or dumping)

Final disposal of wastes at sanitary landfills is given the lowest priority in an Integrated Waste Management approach. A landfill is a facility designed specifically for the final disposal of waste that minimizes the risks to human health and the environment associated with solid wastes. According to JICA (2005) it is insufficient to meet the objective of "removing waste from the neighbourhood" without proper final disposal, all the proceeding processes do not solve the problem –they just transfer the problem to another location.

In this study, examination of the current disposal site and plans for a sanitary land fill for Kisumu town revealed that the said facilities are inadequate. Further, the study revealed that MCK has only one disposal site at Kachok, which has been in use for over 20 years. The 4-hectare Kachok disposal site was meant to be a sanitary landfill, but it was an open dump during the survey period. Since no environmental considerations have been incorporated into the location, operation and planning process of this unsanitary landfill, the site's conditions were observed to be poor and unsatisfactory. The waste was not covered with any layer of soil because the MCK had no bulldozer on site and yet one was required according to the site operators. There were also no vehicles to bring fresh soil for covering the waste. There was no litter and dust control in the site. Furthermore, the site had no essential amenities like water, fire fighting points, and communication facilities such as telephone. The site security is also wanting as reported by the MCK employees interviewed. The dumpsite is an eyesore because the Kachok dumping site is virtually controlled by the waste pickers who wrongly presume that both the landfill and the disposed garbage belong to them. Raw sewage, untreated industrial and hospital waste are also improperly dumped in the landfill. This is a health hazard to both the scavengers and the MCK workers on the site. Some waste pickers have even constructed temporary dwellings on top of the garbage. The dumpsite is also the source of objectionable smoke and odour to the surrounding residential areas.

(iv) Factors constraining operation, location and planning of sanitary landfills in Kisumu.

From the foregoing discussion on the current disposal methods in use, it is evident that open dumping handled all the amount of solid waste collected by both the public and private agencies. Sanitary land filling, being the most recommendable method for developing countries (Cointreau, 2007; Flintoff, 1984), because of its low cost, the researcher attempted to investigate the reasons that led the MCK not to incorporate environmental considerations into the current operations. When the site supervisor was interviewed on factors responsible for the current indiscriminate disposal at the damp site, he cited the following reasons:

- Current site was allocated in 1980s without proper planning by then.
- Crude dumping was cheap for the MCK and needed no planning.
- Lack of equipment. There was no bulldozer on the site as the only one owned by the municipality gets many assignments besides environmental activities.
- Open dumping was simple, reliable and adaptable.
- The dumpsite accommodates all types of waste without any prior treatment.
- Dumpsite never required any complex mechanical installations and skilled labour.
- The option of relocating the current landfill has been faced with a lot of challenges including the rejection of the project by the community.

The survey further revealed that the selection of sites in the past was merely based on the availability of quarries rather than on Environmental Impact Assessments (EIAs). The environmental implications that arose from such planning shortfall have already been outlined in the foregoing section. In a key informant interview with the environment supervisor he had this to say,

“The challenges of relocating a damp site from Kachok include lack of political will and awareness of the benefits of a landfill, need for environmental impact assessment, insufficient public participation, lack of an adequate legislative framework, lack of institutional base, insufficient skilled manpower, lack of research data, and insufficient financial resources.”
Acting Director of Environment, MCK, 2007.”

Location of landfills using the site availability criteria alone had proved unviable since many residents don't want a dumpsite next to their residence. Sanitary landfill planning is supposed to involve various key stakeholders; land use planners of the town, the community, MCK, the water authority and National Environment Management Authority (NEMA) (JICA, 2005). The

decision-making process should be embraced by all stakeholders to make it viable and sustainable.

b) Private collectors

Private collection services are delivered under open and unregulated competition. This means that private companies and other organizations are free to provide services on willing buyer willing seller basis i.e. to whom and where they like and collect tariffs directly from customers. The Municipal Council does not have contractual involvement with private companies and only regulates them through a license without monitoring. According to interviews done with the in-charge of cleansing department, there are 11 organizations engaged in private SW collection and transportation (see appendix VI). The private collectors provide black polythene bags to their clients who fill the bags at an agreed period usually twice a month at a fee of KShs. 200 per month. The vehicles go round the estates and collect the waste which is consequently disposed of at the dumpsite.

Companies cannot deal with defaulters while clients cannot secure legal redress when service quality is unsatisfactory. The wronged party simply walks out of the contract. The study found out those 9 out of 11 private companies were unreliable, disorganized and mismanaged. For instance, they didn't educate their customers or collectors on the need to separate waste at source. Thus there is need to embrace inter-sectoral partnerships advocated by Klundert (1995) which can make use of the unique talents of all sectors that have potential to result in sensible and efficient waste management systems at an appropriate level of technology.

c) The role of NGO and community based initiatives in SWM

Community Mobilization for Economic Development & Advancement (C-MEDA) and Sustainable Aid in Africa International (SANA) are local non-governmental organizations that support composting and plastic waste collection through community based groups in Obunga and Manyatta slums. One group out of four which were supported is called Manyatta Solid Waste Management project. The support given included; setting up of composting sites, purchasing of equipment and fencing. The group runs a composting project and uses plastic bags for tree nursery activities (Plate 3).



Plate 3 Use of plastic bags in tree nursery work

For those groups supported by the two organizations, the work started well but due to lack of sustainable strategies, some Community Based Organizations (CBOs) have failed to continue with the project. C-MEDA and Sustainable Aid in Africa (SANA) mainly targeted Manyatta and Obunga slums due to their vulnerability to solid waste related environmental and health problems. Manyatta Solid Waste Management project based at Manyatta primary school is one of the groups which succeeded to organize members and neighbourhood groups to collect plastics and sell them to local dealers. The group has plans to acquire a machine for making plastic poles using polythene papers in future.

d) The street and dumpsite waste pickers

There are four groups of people who collect waste and make a first selection of materials and sell it to buyers. They include the street and dumpsite waste pickers and itinerant or direct waste buyers. The material they collect are usually derived from the four sources of waste generation discussed earlier; i.e. (shops, enterprises, and institutions), house to house collection, commercial streets, from dustbin collection and transporters, transfers stations and disposal sites. The street waste pickers concentrate their work within the Central Business District (CBD), Bus Park, Railways Estate, and towards the Lake shores. They gather all kinds of materials of value from open dumping spaces, drains, waste receptacles or bins and streets. The dump site waste pickers also include the street waste pickers who sometimes bribe to be accepted there. Most of the dumpsite pickers live within and around the dumpsite and have made the place part of their identity. They have special attachment to it because some reside in the adjacent Nyalenda Slum.

The street and dumpsite waste pickers represent the lowest level 3 in the hierarchy in the recovery system (Figure13).

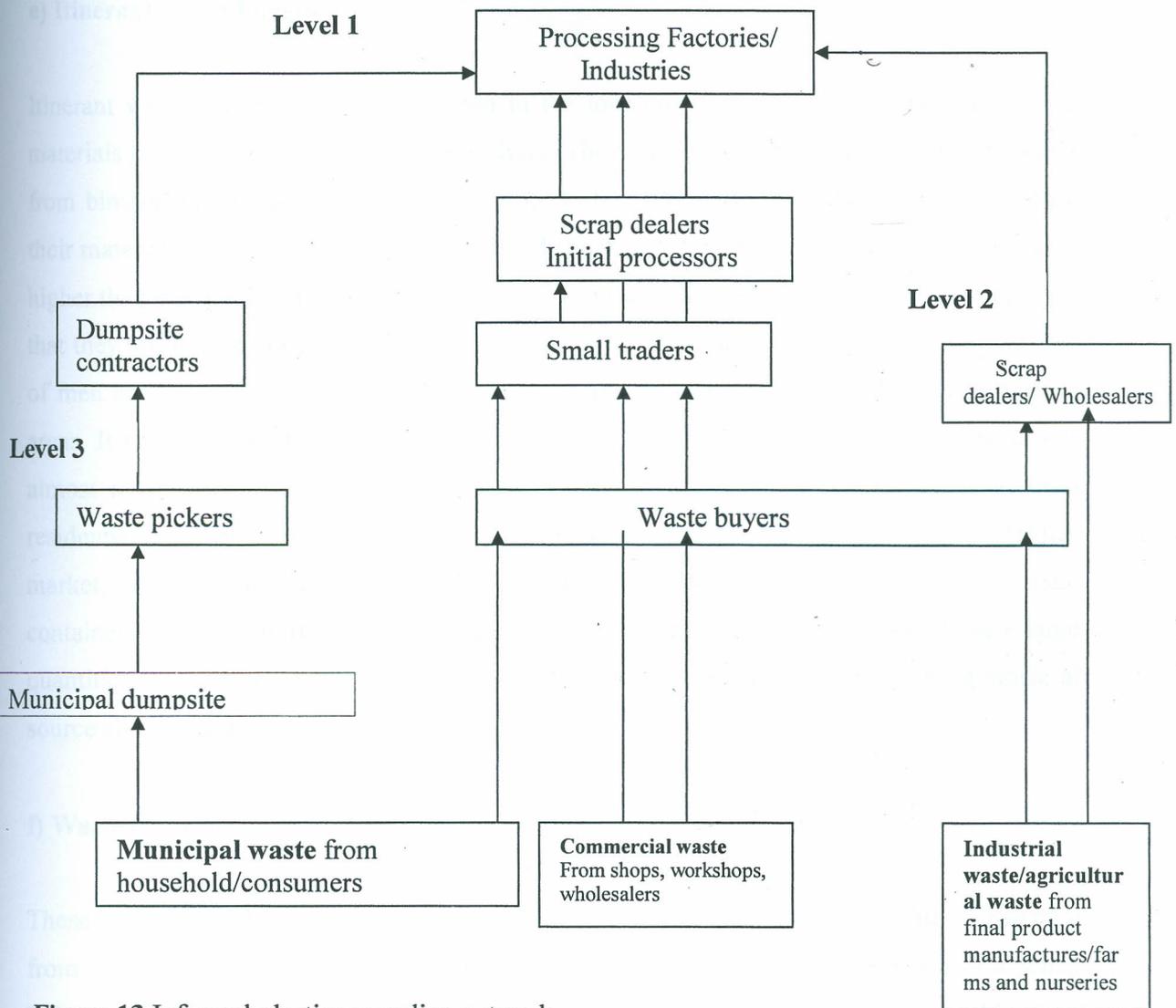


Figure 13 Informal plastics recycling network

Source: Adopted from Konings (1989)

The research noted that individual waste pickers are the most vulnerable as they do not have any organized supportive network or association. They have limited capacity for processing or storing materials and are easily exploited. Scholars in waste management have noted that to protect and enhance their position waste pickers can negotiate as a discrete entity with the local authority and the private sector and this legitimises their activities and increases income by circumventing middlemen (Medina, 2000). Dumpsite waste pickers rely on waste from

MCK and other private collectors for their livelihood. This as will be seen in chapter 6, involves women, children and the elderly. The dump site exposes waste pickers to high health risks.

e) Itinerant waste buyers

Itinerant waste buyers move about often in the localities to collect newspapers and scrap materials such as metals, plastics or used shoes. They are mobile and instead of picking waste from bins or dumpsites, go from door to door to buy the waste from the households. Since their materials have not been mixed with the disposable waste, the quality of plastics is much higher than that gathered by the waste pickers. The itinerant waste pickers have an advantage that they are not exposed to the occupational hazards facing the waste pickers. They include of men and women who conduct their business quietly in both residential and commercial areas. It was noted that the work of itinerant waste buyers and that of the waste pickers is almost intertwined. Itinerant buyers bought directly from the source for instance from residential areas or commercial places. These included small scale plastic dealers at Jubilee market, who get plastics from hotels, restaurants, residential areas and ask for plastic containers and PET bottles. Some of the traders sell at wholesale price when they have large quantities. In planning for SWM, the itinerant waste buyers can influence sorting waste at source since they are linked to the households where they get plastics.

f) Waste dealers

These are in level 2 in the hierarchy and are composed of dealers who are able to purchase from the waste pickers. They are brokers between waste pickers and the Waste Recycling Industries (WRI). The small dealers lived in low income estates namely Nyalenda, Manyatta and Kaloleni. One of the waste dealers was permanently residing at the dumpsite where some waste pickers live and work daily. Since it is important for a dealer to have access to constant supplies to waste materials, they usually attempt to bind the waste pickers by loaning some money to them for upkeep. Plate 4 shows a collection of plastics ready for transportation to a recycling industry.

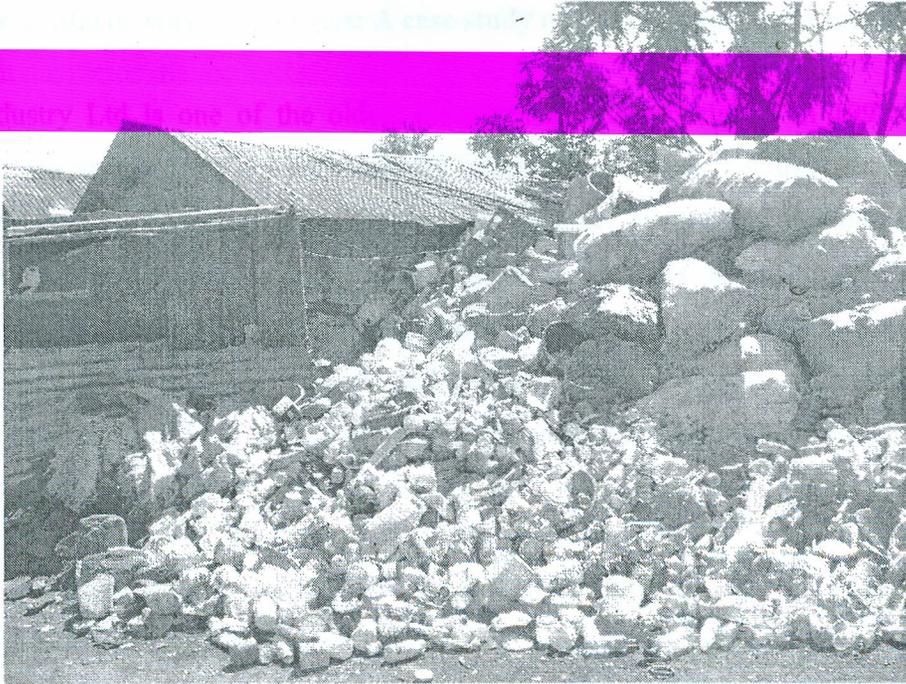


Plate 4: Assorted plastics: a resource for slum dwellers, Nyalenda -Kisumu.

For instance, in Bangalore, this was done by offering higher units of prices than other dealers or by giving out loans, means of transporting materials, clothes and food (Baud, 1994). Another scholar (Kibwage, 2002) noted that waste dealers operate on the supply and demand basis. The other primary role of waste dealers in the recycling network is to sort and prepare or upgrade various items such as papers, scrap metals, plastics, glass and bones bought from the waste pickers before they sell them to the WRIs and other market outlets. Waste dealers play an important role in the hierarchy to purchase all plastics from the waste pickers and store them in bulk before that transport them to factories thus reducing the volume of waste from the dump site. Incorporation of such activities in the formal waste management is vital in Kisumu town.

4.3.2 The plastic waste recycling industries in Kisumu

At the top of the hierarchy (level 1) there are plastic factories. In addition there is presumably also one small informal plastic enterprise for granulation only operating at *Jua kali centre*. There are four factories in Kisumu dealing with plastic recycling. They include Vyatu Ltd, Soni Ltd, Victoria Enterprises Ltd and Foam Mattress Ltd. The role of these factories is to offer market for plastic waste materials from dealers and sell products to the community within Kenya, East Africa and beyond.

4.3.3 Role of plastic waste industries: A case study of Vyatu Industries Limited

Vyatu industry Ltd is one of the oldest industries in Kisumu started in 1992 to deal in footwear. During interview, Vyatu industries informed us that their market extends to East and Central Africa. They also offer direct market to other institutions including schools or small scale industries for specific plastic products. Products from such industries are marketed within Western Kenya and the entire East African region. Their clients include supermarkets, wholesale shops, schools and colleges. Products include plastic plates, Jerry cans, buckets, basins, straws, water drums, sandals, plastic shoes, and other plastic household items.

Currently, they deal with three types of plastics, HDPE, LDPE and PP. The factory is one of the busiest, with a total of 40 workers. Its capacity stands at 3.5 tonnes per day and totalling to 150 tonnes per month. The factory operates below its capacity due to inadequate supply of raw material (plastic wastes). Industrial managers noted that there are a few challenges which the plastic industries are facing including high taxation due to the recent introduction of a 120% tax levy by the Minister of Finance for all plastic bags below 30 microns (GoK, 2007), water shortage and unreliability which leads to extra expenses in direct purchase. Power fluctuations, operating under capacity, lack of support and lack of recognition by the MCK for the industry's role and contribution in environmental sanitation are additional challenges the industry is facing. In addition, no incentives from the government for recycling activities like in other countries exist, and lack of trained personnel.

The Vyatu Industries Ltd is currently operating at a production capacity of 60%. The monthly plastic waste intake is about 60 tonnes. Only 50% of the plastic materials is supplied by the informal sector making the industry to operate below capacity. This shows that there are prospects for the informal sector to supply almost at 100%. Despite the fact that the company currently has inadequate space, the management blamed the economic slump in the local Kenyan economy as well as post election violence for the above reduction in the production capacity. The company intends to re-open half of its production lines and operate at 100% if the economy improves in future. The company also plans to request the MCK to provide land space for development expansion in future. Recycling of plastic waste has been the main business interest of the industry for the last 10 years, but sometimes, virgin material inputs are used to manufacture or improve the quality of some products, especially those on special order from other industries. Closed-loop recycling is used to maximize the profits of the

company by reducing material loss. Products made from virgin materials also sell faster than those from recovered plastic waste.

Other industries include Victoria Enterprises which does not deal with scrap plastics for making their products but imports all her virgin materials to make PVC pipes and water tanks. SONI Ltd. deals with plastic bags and other packaging polythene bags. The factory was started in 2006 with the objective of making profit as well as eradicating the littering menace of plastics. Tuffoam Ltd. is basically involved in making mattresses and recycling of plastics was started to supplement the packaging materials for mattresses. However in 2008 the factory expanded its recycling operations after realising the profit margin it earns.

4.3.4 Plastic waste upgrading process

There were three major plastic waste upgrading processes observed in the field. These include sorting, washing and drying. These were identified through observation and photography and are described in detail below.

Sorting: The waste pickers sell plastic materials to waste dealers sorted by type. Basically, the plastics are sorted out into two simple categories of low (soft) and high (hard) density plastics at the Waste Buying Centres (WBCs) (Plate 6). Reasons include; price differentiation, gauge identification and making the granulation process more organized. This simple process is also common in Accra, Ghana (Wiennaah, 2007). However, in Cairo, more detailed sorting takes place than the one in Kisumu. Another comparable difference which enables more detailed sorting in Cairo than in Kisumu is that the process takes place in the homes of the *Zabbaleens* and not at the WBCs (Abert, 1983; Kamel, 2000).



Plate 6: Plastics sorting at BAMATO recycling centre, Kisumu, Kenya.

At the WBCs, waste plastic is further sorted out into three categories because they attract different prices from the WRIs with Blow (Jerry cans, oil bottles etc.) selling at Ksh. 17.00 per kg, Injection High Density (e.g. bucket basins) at Ksh. 5.00 per kg and Injection PP (polypropylene) (e.g. *kimbo*, *kasuku*, *Joma* and other cooking oil containers) at Ksh. 8.00 kg. Blow type of plastic waste attracts the highest value because it is clear in colour and is the lightest. However, depending on the availability of the materials, these prices were reported as fluctuating from time to time. The prices also differ from one town to another because of distance and the transportation cost incurred. Young men, some women and children sort out waste plastics at the WBCs. However, the use of women and children at the WBCs is not so common in Kisumu and no case was reported by the WRIs as compared to the practice in Asian cities (Baud and Schenk, 1994). According to Lardinois and Klundert, (1995b), most women are employed in the sorting process in Asian cities because they are generally thought to be more accurate and careful than men. In Kisumu, men and women who work as sorters earn the same amount. It is only the age factor that is discriminative because children under 16 are paid less. This Kisumu situation is similar to what one finds in Philippines (Medina, 2000).

The sorting process is manual because of the existence of cheap labour as noticed previously. The sorting process also involves the removal of all attached materials like labels, nails and soil. After the initial upgrading stages at the WBCs, the plastic recyclables are sold to WRIs for further processing. Detailed sorting of plastics in terms of colour, densities and types take

place at the plastic WRIs' yards. At the factory level, mainly adult male are employed to perform the sorting exercise. Contrary to baling of plastic waste materials in the Indian cities (Vogler, 1981), in Kisumu, they are instead arranged by size and fitted into each other to minimize space and reduce transportation costs. This also prevents breakage of the materials into small pieces that would be difficult to sort out at the factory level. Because of their light weight, transportation costs are high compared to other waste materials.

Washing: After the primary and secondary sorting processes, the inputs are then crushed to reduce their size at the factory. The crushed products, i.e. granules, are washed before they are dried. At the Vyatu industries Ltd, washing takes place after they have been shredded into small pieces. Such upgrading process is manually undertaken in half-cut 200-litre oil drums using hot water with detergents to remove grease, oils and all dirt in general. At BAMATO recycling unit as well as other waste buying centres, no washing is done at all.

Drying and final processing: The drying of plastics is mechanically done unlike in Metro Manila and Calcutta, where it is sun-dried (CAPS, 1992; Ptr Services, 1992). The mechanical drying system used by Vyatu industries Ltd was reported as a major consumer of electricity because about 17% of its expenditure goes to the payment of the factory's electricity bill. This electrical energy could be conserved for other purposes by using direct solar energy to dry the waste plastics. This is important given that Kenya is a country which energy deficient (Daily Nation, November, 16th 2008). The dried pieces are melted, colour dyed and pelletized. The pellets are then mechanically molded or blown into final products. Occasionally, polythene, i.e. waste from other factories, and some clear sand is mixed with the plastic waste inputs to manufacture certain products. Some products undergo printing, especially those on special orders before being sold to the final consumers for purposes of identification and marketing or advertising. In brief, initial stages of collecting and sorting of plastics are labour intensive and require low capital investments and little or no specific technical skills unlike the final stages of reprocessing.

4.3.5 Level of plastic waste recycling

Four plastic waste recycling industries were identified. The study revealed that plastic waste recycling in Kisumu takes place on a large-scale in formally registered and licensed manufacturing industries. This situation is mainly due to lack of technical skills and lack of capital support to the existing small-scale groups in plastic waste recycling sector. This is

contradictory to the extensive existence of small-scale plastic re-processors in Cairo (Egypt), Istanbul (Turkey) and Bangalore (India) (EQI, 1991; Konings, 1989; Beukering, 1994). Likewise, in Manila, the plastic industry comprises more than 450 companies, the majority of which are small to medium-scale manufactures (Lardinois and Klundert, 1995a). Another contrast is the reprocessing in Cairo that consists of 450-500 workshops and small factories that use a variety of recycling processes (Kibwage, 2002).

The field surveys revealed that there exist opportunities of setting-up small scale plastic processing enterprises that can focus on the washing, sorting and shredding of plastic waste materials or pellets. Large-scale industries would be interested in buying clear and sorted semi-processed products. Such small enterprises would be able to benefit from the cheap labour available within Kisumu's informal sector. Such a system has been reported to exist in India and the Philippines and it has proved to be more efficient and effective (UNCHS, 1989; Narayan, 2001). This approach helps in improving working conditions and the quality of the final products. The existence of small-scale modern recycling plants is common in developing countries such as Philippines, as noted by JICA, 2005 contrast to remarks by Lardinois and Klundert, (1995b) that plastics recycling in developing countries are done in small informal enterprises that exclusively depend on recovered materials and outdated machinery.

4.3.6 The market for plastic products, re-use practices and future prospects

Vyatu industries Ltds' main products are sold out through a network of wholesalers who specialize in one or two products. There are about four major market channels for plastic products that are produced by Vyatu industries Ltd. First, there is a high demand for regular lower quality products, such as water containers of different capacities from 10 liters to 100 liters, washing basins, buckets, jerry cans, bowls, mugs, plates, dustbins, etc. from both the poor urban and rural populations. This has been the main production target of the company. However, more factories in the town also manufacture other several low quality plastic products like cheap toys, shoes, chairs and slippers. from plastic waste. Secondly, re-processing of packaging materials, such as crates for bread, milk and drinks, and oil containers, for other industries is a major business of the company. Such materials are directly received from relevant industries and *Jua Kali* industries not from the waste dealers. Furthermore, there exist specialised markets that demand high quality products that are manufactured from virgin polyethylene. Most of these markets are from some of the food

processing industries. Finally, Vyatu industries Ltd. also produces semi-processed materials, for example pellets, for other formal large-scale plastic processing industries that utilise them as inputs. According to the company's management, 80% of its products are sold locally in Kenya while only 20% is exported to neighbouring countries of Uganda, Tanzania, and Congo. The interviews conducted revealed that polyethylene bags were often re-used for shopping. In addition, they were useful in the making of baskets, beads and pillows for backrest. (Plate 6)



Plate 6: Innovative re-use of plastic bags at BAMATO Recycling centre, Kisumu

Secondly, it is common in Kenya for plastic bottles and containers to be retained in the household for re-use in the storage of water, milk, paraffin, medicines and other liquids. Some bottles are simply cut into mugs for use in the household. Some of the fairly big containers are re-used as flowerpots, seed boxes, dust bins and as toolboxes by the *jua-kali* artisans. Big plastic containers are also re-used in the brewing of *chang'aa*, a local illicit brew, and for its storage in the slum areas of Kisumu town.

Considering the above outline of market outlets and re-use practices for plastic products in Kisumu, it is evident that recent developments in the plastics industry have not been adopted in this part of Kenya. A major development in the plastics industry has been the manufacturing of durable and high quality plastic products like car bumpers, roofing sheets and fencing posts. For example, in the Netherlands, all-weather and super-durable fencing posts and other building components are manufactured from recycled plastic waste under a

high-pressure heating system (UNCHS, 1989b). These materials have proved to be marketable in industrialized countries than any other plastic recycled products.

4.3.7 Incomes and employment creation

The three main industries in Kisumu do contribute to employment creation by offering jobs to the local people. For instance, Vyatu industries Ltd industry has employed about 90 workers of which about 25 are females while the rest are men. Out of the workforce, the majority (about 93%) of them are casual employees. The company has also trained 2 experts from India who handle all the technical work in the industry. The unskilled workers are paid an average of Ksh. 200 per day as compared to Ksh.300 paid by the Chandaria Paper Industries Ltd in Nairobi (Kibwage, 2002). The management observed that importing skilled workers from India was inevitable due to lack of locally trained manpower in recycling skills. This was attributed to lack of a local training institution that can offer certificate or diploma in plastic recycling. People were also paid low wages because cheap labour was readily available. Moreover, the industry experienced minimal competition.

4.3.8 Advantages and disadvantages of plastic waste recycling in Kisumu

Advantages of plastic waste recyclers in Kisumu

- First, despite the unfavorable economic conditions in the country that has forced some manufacturing enterprises to reduce their operational capacities to half due to inflation and post-election violence, the profit margins are high i.e. over 23%. This was attributed to constant availability of cheap inputs locally according to the manager of Vyatu industries in Kisumu. The management of Vyatu Industries Ltd. estimated the profits of the company to be as high as 30% after taxes. This is comparatively high because in India, plastic waste manufactures obtain an average of 17.5% (Beukering, 1994). Beukering notes that an average profit of at least 13% is even sufficient to recuperate investment in equipment and working capital within a short period of one to two years in the plastic recycling industry. Another interesting aspect in India is that plastic recycling is more attractive than other branches because of the opportunity of entrepreneurs to evade taxes.
- Secondly, the company noted that a large pool of casual workers and technicians are easily available in Kisumu. As opposed to developing countries, recycling plastics is an activity that is rarely practiced in industrialized countries. The main reasons for this

are high labour costs and lack of demand. The costs of recovery are too high to make recycling of plastics profitable. This derives from the characteristics of plastic since it can only be recycled if the input is completely homogeneous (Vogler, 1984). Therefore, thorough sorting must occur to transform the plastic waste into useful raw material. Because of the lack of appropriate sorting technologies, this can only be done manually.

Disadvantages

- The study revealed that recycling of plastics is not always economical because final products do not always have the same quality as the original material. The recycled value of waste is low. Therefore, households have no incentive to separate plastics from other waste at source. Consequently, extraction of waste at a later stage will require cleaning hence a reduction in profitability. Otherwise, some plastics such as bottles and other containers) are recovered early in the disposal process. Vogler (1984) makes an observation that recycling processes produce material which is usually inferior and always different from the original one.
- Volger (1981) further notes that, because of the complicated laws that protect buyers in industrialized countries, such recycled products are unacceptable. He concludes that quality is the determining factor for the future of the plastics industry in the developed nations. The Vyatu Industries Ltd. management also noted that there is a general reduction in market or demand of purely recycled products because most Kenyans currently prefer products of better quality and design. However, both Vogler, (1981) and Beukering, (1994) expect prosperity of the plastic recycling industries in LDCs because of low investment requirements, large profit rates, labour intensive, relatively cheap inputs, and uncomplicated production process.
- The success of plastic materials has been based on their properties of resilience, resistance to moisture, chemicals and photo- and bio-degradation, their stability, and the fact that they can be molded into any desired form. These very properties that made plastics so attractive are now also regarded as disadvantages, especially in the industrialized countries.
- A government policy to control the manufacturing of plastic bags in terms of microns and standards is generally not implemented due to inadequate inspectors to enforce the regulations.

- Lack of sufficient funds due to poor foreign exchange that has been caused by the current adverse economic conditions in the country was mentioned by the manager of Tuffoam Industry Ltd as one of the major limitations facing plastic recycling industries. This affects profit margins considering the fact that some of the virgin materials have to be imported.
- There is also stiff market competition among the plastic recycling industries. Opening the plastic waste collection business to rural towns has realized an increase in materials granulated weekly from the factory.

4.3.9 Environmental and occupational health implications of plastic waste recycling

Recycling of plastics has a number of positive and negative environmental implications. Obvious benefits of recycling of plastic waste revealed by the Vyatu Industries Ltd. include the reduction of costs of input materials and energy savings by the industry. In addition (Medina 2000) asserts that scavenging renders economic and environmental benefits, such as providing an income to unemployed individuals, supplies inexpensive raw materials to industry, reduces the demand for collection, transport and disposal equipment and facilities. Further, materials recycling have a lower environmental impact compared to the use of virgin plastic materials. There are very few environmentally sound methods of disposing plastics, because most of them resist decay for a long period of time. The most serious environmental hazard now in Kisumu remains the non-biodegradable plastic bags which have littered everywhere in the town.

According to the UNCHS (1994), incineration or burning of plastic waste in open dumps releases highly hazardous environmental substances into the atmosphere which causes the 'greenhouse' effect and might be toxic to animals and plants. Hence, the recycling of plastic waste in Kisumu will obviously be an environmentally sound method that is sustainable in the long-term. Recycling of plastic waste also reduces the problems of littering especially at the collection points and at the dumping site. The MCK also indirectly benefits from plastic waste recycling because of the reduction of volume of transportation and space requirement for dumping at the only dumping site in the city. Since, the plastics produced in Kenya are not biodegradable, recycling protects agricultural fields, leisure parks and the city flower beds because plastics inhibit the growth of plants.

Since plastic waste recycling process involves melting the plastics to obtain pellets, gaseous substances deleterious to human health are released to the factory's working environment. This exposes the factory workers to toxic gases that adversely affect their health. Handling of plastic containers for packaging and dispensing a variety of chemicals was also noted to be a potential health risk to workers who were not using gloves on the excuse that plastics are not sharp to cause any injuries. The workers are provided with uniforms and masks. Though plastics are not sharp, they work without boots and gloves for protection of their feet and hands from contacts with toxic chemicals which are associated with plastic recycling processes. Since sorting of the plastic waste takes place before it is washed, the working conditions for those employed to carry out this task are quite unhygienic at the factory level currently. Waste picking activity risks from manual handling of mixed waste for instance direct contact with broken glass, human/animal faecal matter, paper that may have become saturated with toxic materials, containers with residues of chemicals, pesticides or solvents, and needles and bandages from hospitals. Inhalation of bio-aerosols, and of smoke and fumes produced by open burning of waste, can cause health problems. Although there are insufficient data on the long-term effect of exposure to air-borne bacteria as well as infectious or toxic materials present in solid waste, studies have shown that respiratory and dermatological problems, eye infections and low life expectancy are common. Vulnerable groups such as children, the elderly and women are in many cases the most exposed, as they often play critical roles in informal recycling activities (Cointreau, 2006).

4.4 Socio-economic issues, occupational and environmental conditions of waste pickers

This section describes the socio-economic profiles of waste pickers, their role in waste picking activities and challenges experienced in the informal recovery process.

4.4.1 Gender, age and marital status of respondents in waste recovery activities

According to the study results, 89% of the waste pickers were males while 11% were females. Results indicate that street waste picking, as an occupation, is virtually a men's activity in Kisumu (Table 9).

Table 9 Gender distribution

Sex	No of respondents	Percentage (%)
Male	71	89
Female	9	11
Total	80	100

In addition, female waste collectors were not free to be interviewed because most of them felt embarrassed to work in waste picking although it earned them a living. The higher percentage of males was attributed to the attitude women have towards the recovery activities. Contrary to women in Bangalore city in India who embraced waste picking as an occupation (Baud, 1994); women in Kisumu did not prefer the activity. The 11% engaged in the sector mostly perform the sorting and cleaning work since they are proven to be keener in identifying colours and density of plastics as per the requirement of the industries.

Apparently, men who are engaged in this activity are young and energetic to carry heavy loads of plastics to the dealers and wholesalers. Gender aspects in informal recycling are an important factor to consider in integrated solid waste management since the roles played by women and men sometimes differ. For example, at the household level, women are involved in disposing plastic waste on a daily basis which means that sorting can effectively be done at source where reduction is also undertaken. On age characteristics, the survey revealed that 47% of the waste pickers were of age 10-18 years which indicate that majority were young and out of school while 24% were aged between 20-25 years thus composing of adults (Table 10). The data shows majority (71%) of all the waste pickers is in the ages of (10- 25 years).

Table 10 Ages of waste pickers

Ages	No. of Respondents	Percent
Below 10 Yrs	8	10
10 - 18 Yrs	37	47
20 - 25 Yrs	19	24
Above 30 Yrs	14	17
No Response	2	2
Total	80	100

During the interview, it was discovered that the waste pickers who are older stole from those who are young by taking away their valuable sorted waste plastics. This habit was more common among dumpsite waste pickers as compared to street waste pickers. Children below 10 years composed of 10% which indicates that the existence of child labour in terms of waste picking is common but minimal in Kisumu.

These findings are an indication that 71% of the respondents are working as waste pickers because of a variety of reasons among which poverty and unemployment are predominant. Waste picking engages several young people in productive work hence contributing to poverty reduction among the poor communities in the rural and urban areas who are jobless. As young men have difficulty finding paid work, waste picking becomes an option for income earning. Unlike in Bangalore (Baud, 1994) where girls dominate waste picking and accompany their mothers to waste picking, the work is dominated by male pickers in Kisumu town. The study concludes that majority of the street waste pickers (71%) are young single men while 19% are married (Figure 14). The high percentage of unmarried workers among the dumpsite pickers and street waste pickers is attributed to the high rate of unemployment, poverty in rural and urban areas and the deterioration of social norms. The portion of widows was smaller (5%) as most pickers reported to have re-married in the case of death of a partner. On the other hand, the 5.0 % divorce cases are attributed to the high rate of drug addiction, e.g. consumption of *chang'aa* (a local illicit brew), drug abuse and the inherent violent character of the Kisumu waste pickers.

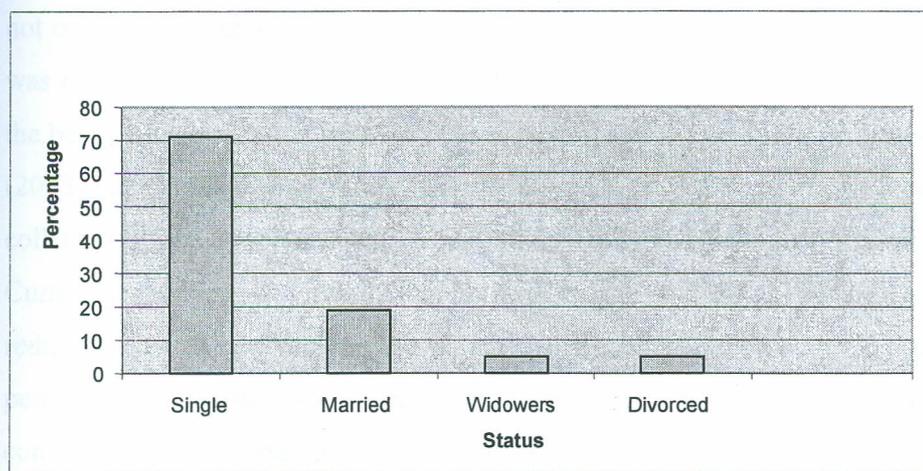


Figure 14 Marital status of waste pickers in Kisumu

Both the widowed and divorced female pickers were observed stressed and enjoyed little esteem among their colleagues. Waste picking activity has brought together all the above named categories of people not only to earn a livelihood from the work but also to promote environmental cleanliness in Kisumu.

4.3.2 Level of education for waste pickers

Most of the waste pickers have some level of education. At least 56% completed some level at primary school while 24 % were secondary school graduates and those who never went to school were 19% as in figure15. However, only 1% of the pickers hold university education.

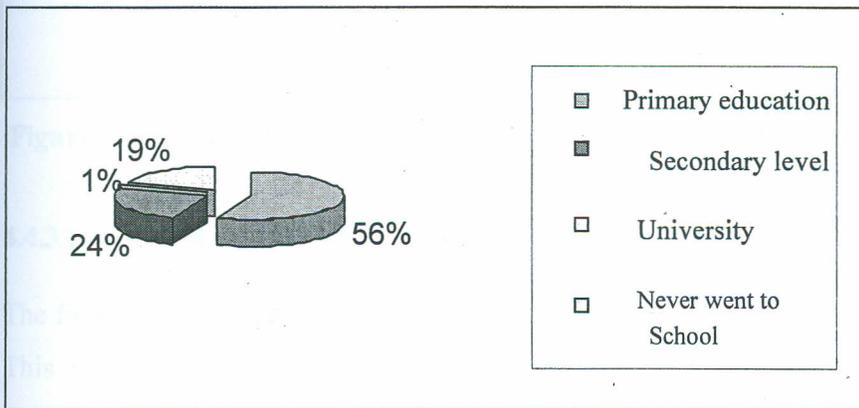


Figure 15 Education level for waste pickers

The above results compares well with Nairobi city where 71% of the waste pickers claim to have reached the level of primary school while 12.5% have secondary education (Kibwage, 2002). It was however discovered through personal interview that the level of education did not count in the recovery process since only basic knowledge for sorting by type and density was needed in the activity. Women and children who had never gone to school were among the best collectors and in selection of valuable waste. In planning for sustainable SWM, JICA (2005) recommends that efforts should be made to integrate waste pickers and recyclable collectors in the SWM framework instead of excluding them despite their level of education. Currently, the Kenyan Government emphasizes on basic education as a necessity and way of reducing poverty and making the young citizens self-reliant in development. Though a large percentage of waste pickers have attained primary level education, almost all the cases confirmed that they had dropped out at the lower primary school i.e. within the first 4 years due to lack of school fees, death of parents and social break-up of families or divorce. The few respondents of secondary level education reported that their children are attending school

instead of assisting in waste picking. This portrayed them as responsible people. Figure 16 shows the percentage of those who were positively willing to go back to school and those who were negative.

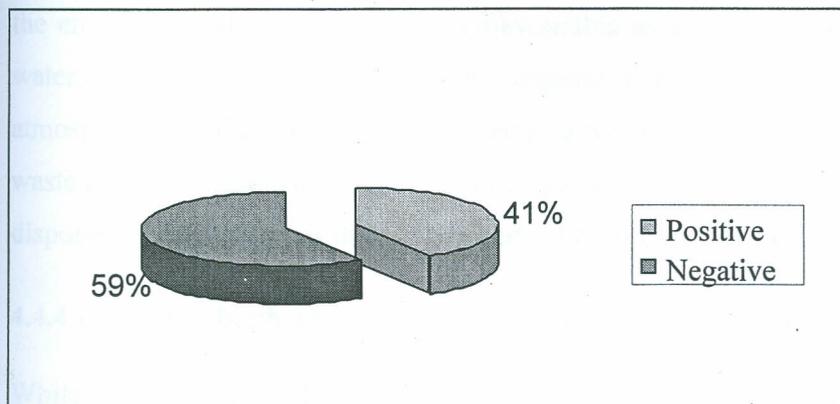


Figure 16 Attitude of waste picker towards resuming schooling

4.4.3 Household size for waste pickers

The findings show that the mean household size is 4 among the households of waste pickers. This result is within the average household size from the analysis of the 1999 Kenya population census which gives an average of 4 members nationally. It is also close to the size in Asian cities among waste pickers which puts it at 5 members. The size like other households in the community indicates that there is a responsibility to be met by the WPs for instance shelter, food and clothing among others. The 74% of the waste pickers (Table 11) who did not respond to this question were unmarried.

Table 11 Household sizes of waste pickers

Household size	Percentage(%)
Size 1-3 members	18
Size 4-5 members	4
Above 5 members	4
No response	74
Total	100

The findings show that most of those in waste collection are single and those who are married have smaller household size with an average of 4 children. This figure is not significantly different from the overall average family size of 4.4 persons in Kisumu according to the 1999

population census. Furthermore, this family size is almost similar to that of waste pickers in the Asian cities which literature indicates to be approximately five (UNCHS, 1994). The results imply that the larger the family sizes the more the needs that are to be met by the household head. The study noted that some waste pickers lived within the dumpsite where the environmental conditions were unfavourable as a result of poor hygiene, lack of clean water, pathogens from decomposing organic matter, toxic gases and a contaminated atmosphere. Similar conditions were being experienced in Dandora dumpsite, Nairobi where waste pickers are exposed to dangers of disposed syringes, swabs of tetanus, and other related disposables that endanger their health and contribute to high mortality rate Kibwage (2002).

4.4.4 District of birth and current residence for waste pickers

While there are about 160 districts in Kenya, surprisingly, there were only 11 districts that were represented by waste pickers. Most of the districts in Western Kenya were represented by waste pickers operating in Kisumu. According to the survey, Kisumu district is leading with 24% operators, followed by Kakamega 20%, Siaya 15%, Vihiga 14% and Kisii 12%. The districts with the smallest numbers of waste pickers by origin include Kiambu, Nyeri, Homa Bay, Busia and Rachuonyo with 2%, 2%, 1%, 1%, and 1% respectively as on table 12.

Table 12 Home district and period of stay in Kisumu

Original home district	Number of yrs. lived in Kisumu			Percentage (%)
	Below 1 Yr.	2 - 3Yrs.	4 years and above.	
Kisumu	0	4	15	24
Kakamega	1	11	4	20
Siaya	1	2	9	15
Vihiga	0	2	9	14
Kisii	0	4	5	12
Nyando	1	2	1	5
No response	0	1	1	3
Kiambu	0	0	2	2
Nyeri	0	1	1	2
Homa Bay	0	1	0	1
Busia	0	0	1	1
Rachuonyo	0	1	0	1
Total	3	29	48	100

The data indicates that most waste pickers originate from districts surrounding Kisumu town and the basic reason for migrating to the city was to look for jobs that can provide income.

Apparently most of these districts in Western Kenya have high poverty levels and high populations which can be attributed to high fertility rates, the push factors from rural to urban centres and vice versa to seek employment (GoK, 2005). Some children are abandoned or neglected due to inadequate food and money in the families. The above explanation agrees with Baud and Furedy's position that waste picking is an occupation mostly for abandoned and run-away children (Furedy, 1989; Baud and Schenk, 1994). These studies based in the Asian cities among others also agree that waste picking is generally an occupation for migrants who are unable to obtain employment in the formal sector. From the personal interview, 4 waste pickers had resided in Kisumu for a period of between 2-3 years which shows that most of those in the recovery system don't have long experience.

Figure 17 shows results on immigration to Kisumu which indicate that 29% of the respondents (waste pickers) came to seek employment, 33% said they came to stay with relatives while a majority (36%) said they were born in Kisumu. All the three reasons carried almost equal percentages. However, majority of waste pickers hailed from Kisumu district as their indigenous home. The proposition that population pressure in the rural areas is responsible for generating movement is applicable in this study. This is because Nyanza and Western Provinces are highly populated in Western Kenya (GoK, 2001).

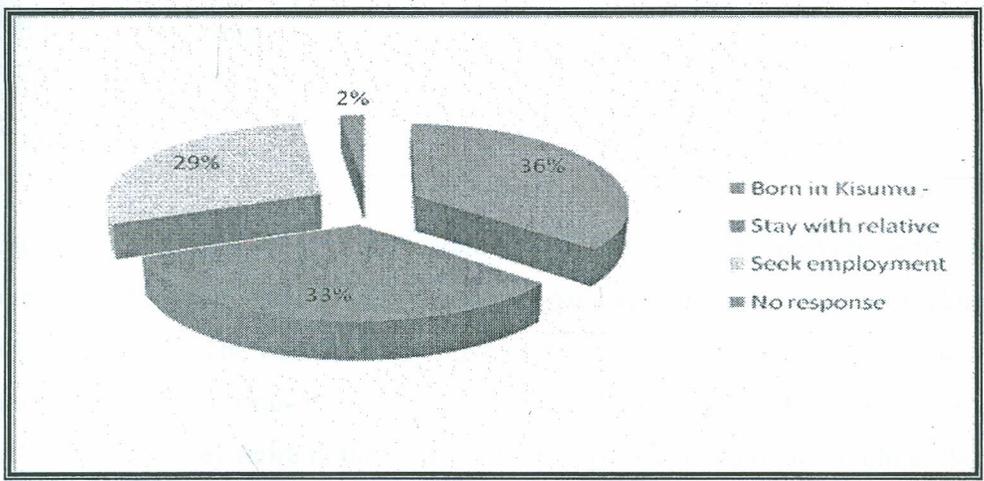


Figure 17 Reasons for migration of waste pickers to Kisumu

The results are an indication that waste picking can attract employment for various people. People also do not simply migrate, but look for opportunities that can facilitate income. Waste picking is not simply a dirty and less attractive occupation as people think. As Porter says if alternative employment opportunities and associated wages were higher, scavenging would be less financially attractive (Porter, 2002).

The study gathered results on current residence for WPs. They indicated that 82% of the waste pickers dwelt in slums of Kisumu town while 8%, 3% and another 3% represented the street, urban low-cost housing, and urban middle cost housing residents respectively (Table 13). 4% did not respond to the question. People residing in the slums or non-formal settlements in Kisumu namely Manyatta, Obunga, Nyalenda, Kaloleni and Bandani complained of lack of water, poor roads and lack of toilets within the residences. In addition, they lacked basic amenities like electricity, housing, and proper sanitation as well as waste disposal. Most of them said they lacked affordable housing. The street outdoor sleepers composed of 5% and spent their nights on the corridors of the main streets.

Table 13 Residence of waste pickers

Residence	No of Respondents	Percent (%)
Informal settlements/Slums	66	82
In street	7	8
No Response	3	4
Middle level housing	2	3
High level housing	2	3
Total	80	100

However, every morning they started the day at 5.30 am moving from street to street emptying bins selectively before the municipal staff start sweeping and picking plastics and other valuables. The waste pickers move to the estates and dumping joints where they recover more plastics of various densities. Selling of these wastes enables them to buy breakfast and supper before they retire to the streets. The purpose of spending the night at the bus park is to conduct other activities at night such as car washing and sweeping.

4.4.5 Experience in waste picking and reasons for joining the occupation

Majority of the waste pickers (83%) of all ages have been in waste picking operations for up to 3 years (Table 14).

Table 14 Waste picker's experience in scavenging

		Year started scavenging			No. of Responses.
		Less 1 yr. Ago	1 - 3yrs.	4 years and above	
Age in Yrs.	Below 10	5	3	0	8
	10 - 18	22	11	3	36
	20 - 25	3	13	2	18
	Above 30	1	5	8	14
Total		31	32	13	76

Only 17% of the respondents said they had an experience exceeding four years. The results imply that waste picking attracts youthful ages mainly for the first three years thereafter they join other fields of occupation. At least 70% of the waste pickers stated that their main reason for participating in waste recovery was a way of getting income to support self and their families (Table 15).

Table 15 Participation in plastic recovery occupation

Reasons for scavenging	Percentage (%)
Needed income	70
Diversify income source	5
Environmental cleanliness	5
Unemployment	4
All the above	15
No Response	1
Total	100

Most of the young adults engaged in this activity said they did not have alternative employment and therefore plastic waste recovery gave them readily available income that

was assured almost immediately after delivery to the waste dealers. During the interview one waste picker testified as follows;

“Before this work started, we used to rob people and could be chased, beaten, and some of us were killed but now I am happy I don’t rob anybody but “eat my sweat.” (Personal communication, Solo(not real name), 20 years old, at Manyatta slum March, 8th 2008).

According to the actors, the main reason why they participated in plastic recovery activities is not for environmental cleanliness, but rather for economic profits generated from these kinds of activities. In addition, unemployment rate in Kisumu is very high (UN-Habitat, 2005) as a result of the closure of industries in 1994 like Kisumu Cotton Manufacturers Industries Ltd and Kenya Breweries during structural adjustment programmes in Kenya. Another reason for the increased participation within this system is the increase in demand for plastic products within Kisumu and East African region hence creating markets for recycled plastic materials. The study also investigated participation of children in waste picking in which 92% indicated that they were not accompanied by children to waste picking while 8% admitted to have been accompanied by children to the same activity as shown in figure 20.

4.4.6 Type of shelter

On type of shelter, results indicated that 51% of the waste pickers lived in mud walled housing which reflects the common housing structures found in slums. Another 18% lived in polythene walled shelters while 18% lived in semi-permanent houses. In addition, 10% were occupying the streets and Bus Park while only 3% lived in permanent structures (Table 16).

Table 16 Type of Shelter

Type of shelter	No of Respondents	Percentage %
Mud walled	41	51
Polythene walled	14	18
Semi-permanent	14	18
Streets and bus park	8	10
Permanent	3	3
Total	80	100.0

Those settling in the streets and bus parks disclosed that they were homeless. This brings a concern about homelessness in developing countries where economic and social inequality is pronounced. The research also revealed that most street pickers did not have a dwelling. They spent in the streets covering themselves in plastic bags as “blankets”. Baud (1994), in his study to find out the economic value of waste recycling and the waste pickers he discovered that the infrastructure of slums at Rakeshwari Nagar in Bangladesh was very weak. Lack of water, electricity and sewerage systems exposed the residents to infections. Consequently, slums in Kisumu town had similar characteristics with poor housing, lack of water and electricity. In addition, residents complained that some of these structures erected illegally were used as a hiding sanctuary for robbers particularly those with temporary structures at the dumpsite at Kachok next to Nakumatt city in Kisumu. Given their contribution in SWM, there is need for local authorities to improve waste pickers’ living conditions by planning for affordable housing, water and sanitation.

4.4.7 Parents’ or guardians’ occupation

In our study, 35% of respondents stated that their parents were engaged in small farming activities, 30% recorded that their parents were incapacitated by ill health or deformed in one way or the other, 24% did not know where parents were and what they did while 6%, 3% and 1% were engaged in waste picking, *Kiosk* business and *Boda Boda* cycling respectively (Figure 18).

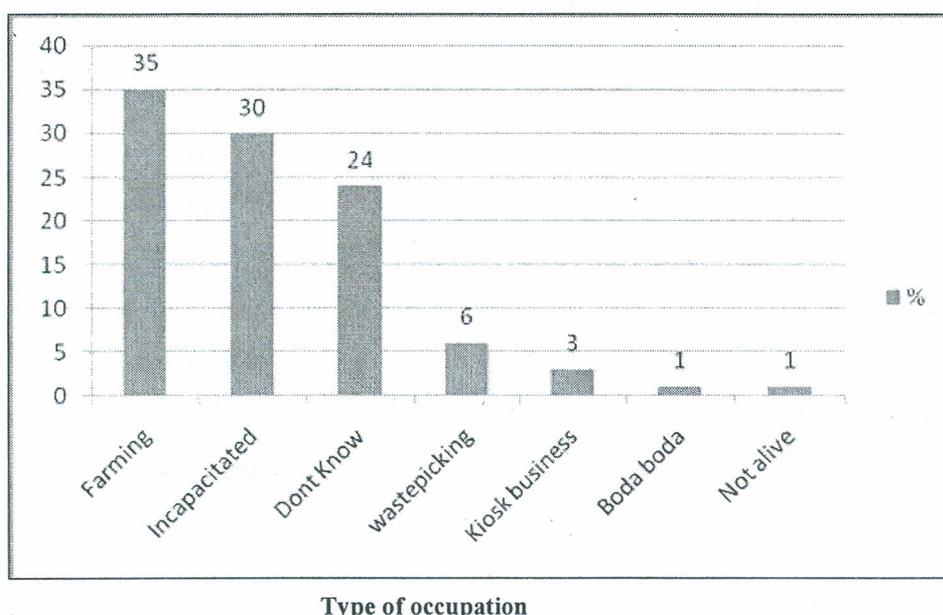


Figure 18 Parents’ occupation

Only 1% confessed that their parents were not alive. This data is a clear justification that most waste pickers majority of whom are young, originate from poor families and live under abject poverty, lacking parental care and guidance. Unstable parental occupation inhibits ability to care and support the family. As indicated earlier, 30% said their parents were incapacitated due to illnesses such as HIV/AIDS given its high prevalence in Nyanza which stands at 15.3% (NAS COP, 2007). Due to their background, the waste pickers are exploited by middlemen who pay them any amount of money they feel like (Medina, 2000). This diminishes their chances of growth according to Medina and the way to improve their livelihood and appreciate their work is to support them in forming cooperatives like those established by the Zabbaleen of Egypt, or Linis Ganda program in Manila, Philippines.

4.4.8 Average distance covered by waste pickers and their income Levels

The mean distance walked per day was 9.2 km per day according to 67 respondents. Due to inability to estimate cumulative distance covered per day, 13 respondents were unable to respond. The results show that the more the distance covered, the more the waste materials collected and hence the more the income earned.

The survey showed that different dealers paid varying amounts to the waste pickers for plastics weighed. However, majority were paid an average of Kshs.10 per kg for HDPE and LDPE while dealers paid an average of Kshs.3 per kg for PETS. PETS were the lowest priced and they were not popular among the dealers due to their poor pricing. From these findings, majority of waste pickers (52.5%) earned an average of between Kshs.100-200 per day while 26.3% earned an average of Kshs.50-100 per day. It can be concluded therefore that most waste pickers earned an average of Kshs. 5,000 per month which is untaxed. This amount also varied depending on how 'fortunate' one was on the day of picking waste. The number of days covered in a week determines the amount of money earned by a waste picker. The study revealed that most of the waste pickers (42%) worked for five days in a week followed by 37% who worked in 7days. Only 10% worked for 4days while 8% worked for 3days (Figure 19). In a similar situation, pickers at Bangladesh believe that working hours depend on the quantity and quality of the waste available (Baud, 1994).

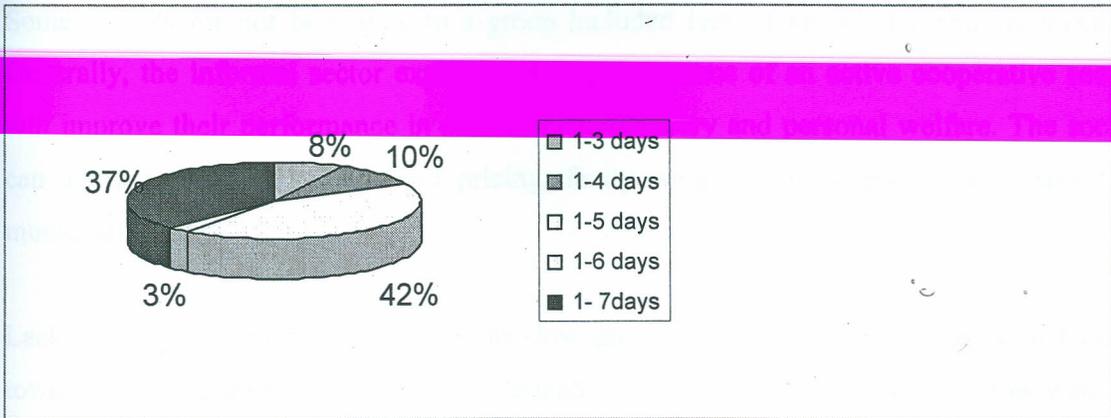


Figure 19 Percentage of waste pickers working in specified duration per week

The perception of waste picking by other people is a career for the rejected people. However, waste pickers view their work differently. For instance, during the study, the following testimony was made:

“Many people including you think we are mad to carry bags and pick valuable items for sale to dealers. You are wrong. Suppose you were me; your parents and brothers have all departed from you. What would you do? We have to survive!” (Personal communication, Otieno (not real name), 13, at Kachok -dump site May 15th, 2007)

4.4.9 Waste pickers’ membership to cooperatives

Cooperatives and Welfare groups enhance collective bargaining and networking. In the study, waste pickers were asked whether they belonged to any cooperative group and Figure 20 show the responses. In the study, results indicate that 83% who were the majority never belonged to any cooperative society.

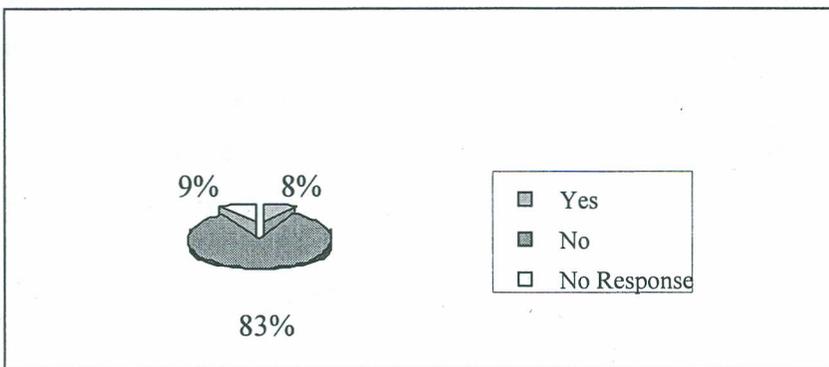


Figure 20 Percentage of waste pickers registered in cooperative societies

Some reasons for not belonging to a group included lack of knowledge and sensitization. Generally, the informal sector expressed that the presence of an active cooperative society will improve their performance in plastic waste recovery and personal welfare. The society can address issues including poor pricing, faulty weighing machines and harassment by municipality staff.

Lack of cooperatives has contributed to slow growth of the recycling industry in Kisumu town. According to the findings, 8% belonged to welfare groups whose structures were not well defined. Apparently, such welfare was formed in 2003 out of the waste dealers' networks but with no clear objectives. Cooperatives have been proved to be supportive to the scavenging communities from their work in various countries contrary to the situation in Kisumu. One of the better-known and longest established examples of an NGO-led supportive programme is that with the Zabbaleen in Cairo. The Zabbaleen are a Coptic Christian minority, who have been active in collecting, sorting and recycling a substantial portion of waste in Cairo since the 1930s (Iskandar, 2003). In the 1970s, the Coptic Church helped establish an association representing the interests of the community, the Zabbaleen Gameya. In the same way, MCK can promote sustainable integrated waste management through support of recycling networks. Unfortunately, for Kisumu municipality, the formal sector and informal sector have a gap in coordination unlike in Columbia where most vibrant and dynamic scavenger cooperative movement in the world exists (Medina, 1997).

4.4.10 Means of transport used to the dealers and conditions demanded by dealers

Results indicate that 84 % of the waste pickers transported their waste items to the dealers using human back Figure 21. This, they said was because it was cheap and the plastics were not very heavy. Those who managed to collect large quantities used pushcarts (6%) to transport their materials while 6% used bicycles. Only 4% did not respond to this question. The sacks used were dirty and many *boda boda* cyclists did not want to carry passengers who make their seats dirty.

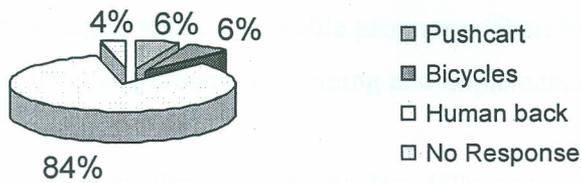


Figure 21 Mode of transport used by WPs' to buying centres and factories

Movement from one point to another on foot also provided them an opportunity to add more plastics to their collection bags. The high percentage (84%) of waste pickers using their backs is also attributed to high poverty and inability to afford payment for transport. They also cited exploitation from the dealers who pay them a small percentage while they take a larger percentage from waste plastics collected. In addition, cooperatives are lacking that can contribute to purchase a vehicle or other means of transport, protect members from exploitation and promote unity. This is unlike in Colombia where scavengers' cooperatives are strong with over 1,000 members (Medina, 2000). In Kenya, waste pickers are marginalized. Their health is endangered and they generally live in abject poverty. Most Municipal councils do not recognize their role as partners in solid waste management. The waste dealers on the other hand preferred to transport waste using push cart to reduce transport costs (Plate7).



Plate 7: Transportation of waste material to a recycling factory by pushcart in Kisumu.

They also do not enjoy provision of any basic social services and amenities thus subjecting them to health risks. When planning for integrated waste management, WPs are excluded from contributing towards achievable programs. Therefore there is need to consider their role and include them as partners in planning and implementation.

Regarding conditions demanded by dealers, 93% of the waste pickers said they were required to sort the plastics by type, gauge and colour before they were accepted. This shows that sorting was a serious requirement since there were some plastics which were not demanded. Only 2% said they were required to wash before weighing while 5% declined to answer the question. Sorting was said to be an advantage since it gave value to the materials salvaged. The pricing of sorted materials was also high. Interviews revealed that sorting was necessary since the waste pickers were crafty and could fill some plastic containers especially PETs with water to fetch more kilograms. Plastics were also of many types but industries in Kisumu preferred HDPE and LDPE.

4.4.11 Re-use of recovered plastic material by waste pickers

Only 16% of the waste pickers confirmed using recovered items within their homes while 84% responded to the contrary. The 84% did not retain them because they felt they needed money. However, those who retained the plastic containers and PETS re-used them for storing food stuffs, paraffin, water and milk. This re-use is compromised with the health risks brought about by such containers which are contaminated with chemicals or toxic substances.

4.4.12 Waste pickers co-operation with stakeholders and their perception towards MCK

At least 40% of the salvagers confirmed that they got support from residents and other stakeholders. Waste Pickers said they were not harassed when picking the plastics from households and dumping sites while others said residents cooperated in giving them broken basins, plates or cups without any payment. However, 43% observed that there was lack of cooperation since their colleagues were treated as suspected thieves when spotted collecting plastic waste at the dumping sites within the estates.

Residents lacked confidence in waste pickers as majority were doubtful in character. Some were apprehended for stealing clothes from hangers whenever they realized there was nobody in the compound. The waste pickers lamented that the worst collaborators were the municipal council staff who harassed them and even ordered council guards to beat them. They accused them spilling waste when they searched for valuable items despite the fact that the municipality lacked receptacles within town and in residential areas. The role and contribution of WP to reduction of waste at source before disposal and even at dumpsites was not recognized. During the research waste pickers were asked whether the municipality can take a leading role in controlling the plastic recovery sector. In the study, 95% of the WPs said municipality should not control the sector while only 5% said they don't mind if they take control.

Some of the reasons given against included the following:

- 1).Need to let the recycling industry to be managed by all stakeholders since Municipality had failed in the past;
- 2).Their role should be policy formulation and not implementation; since the sector employs many people who in turn have several dependants.
- 3).The sector should be regulated to suit collective participation; and finally the role and responsibility of the local government is to ensure that her residents are served with proper SWM services
- 4).Some said they will remain jobless
- 5). It is the only source of income they have.

Despite the fact that many cities in developing countries are using 20-50% of their budget in SWM, only 20-30% of the waste is collected (Anchankeng, 2003). The informal sector has taken up the challenge and in many countries; the informal sector is more active in waste recovery than the formal sector. It is therefore necessary for MCK to consider incorporation waste pickers into formal SWM. The results showed that 95% respondents would not like it to be controlled by the municipal council because composed a source of their livelihood. They were also confident that the municipality cannot on its own manage waste recovery. Awareness creation and training can improve their work if they are recognized and incorporated in the sustainable waste recovery programs.

4.4.13 Level of sanitation at work place and residence of waste pickers

At their workplace and at their residence, 57% of the respondents stated they lacked toilets while 43% reported to have toilets. However, most WPs agreed that the state of toilets was pathetic (see Plate 8) in residential areas as well as public ones within the municipality being popularly used.



Plate 8 The state of toilet facilities at Manyatta slum where majority of WPs' reside.

Municipal toilets had been made joints of operation by WPs to store their waste items as well use them as hide outs. Although some Municipal toilets had been rehabilitated for public use, the WPs claimed they were expensive for them. Those who worked at Kachok municipal dumpsite near Nakumatt city used the bushes (7%) around it as "toilets". Bushes appeared to be the most popular alternative (45%) followed by public toilets (12%) (Fig. 22). 36% declined to answer since they were suspicious of being apprehended for being a public nuisance according to the Municipal by-laws. Use of bushes was aggravated by inefficiency of the municipal council to clear bushes at the dump site regularly to enhance sanitation in the city. Medina, (2000) asserts that there is need to improve the skills of waste pickers beyond mere collection of waste. That will include protection against health hazards and public health education in general.

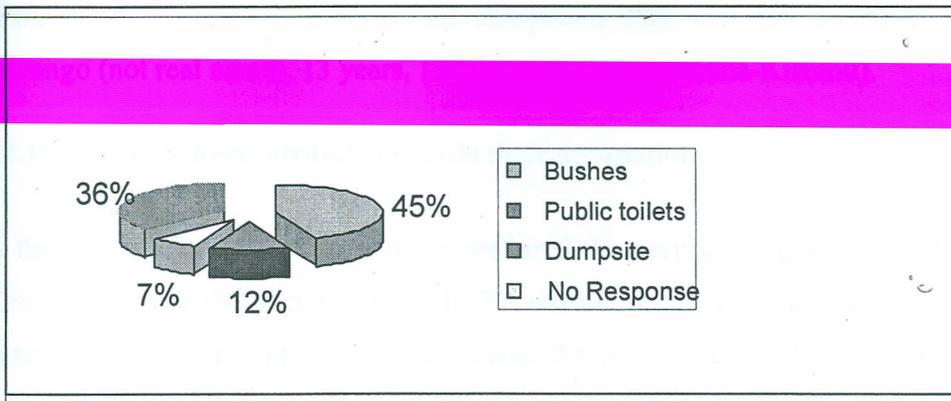


Figure 22 Percentage use of alternative sanitation facilities

4.4.14 Waste pickers' perceptions of workplace safety

The study revealed that 75% of the waste pickers did not feel safe at the workplace (Figure 23). This was because those who have been involved in the business for a long time dominate the activities particularly at the dumpsite. The forms of insecurity cited at the dumpsite included fighting where elderly waste pickers harassed and fought the younger ones and robbing them of their items by force, and petty quarrels. Only 25% said they felt secure giving reasons such as no great danger and that help each other in case of danger.

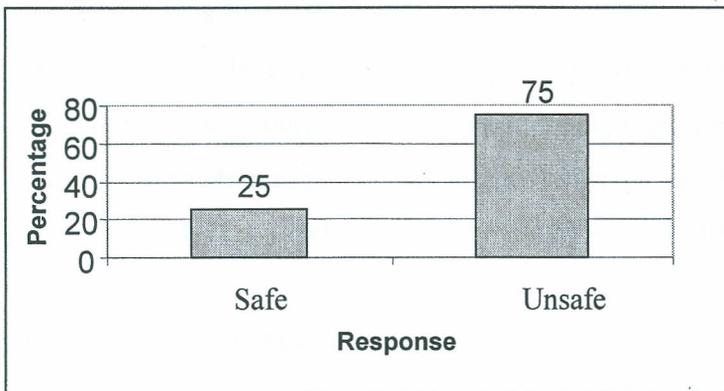


Figure 23 Perceptions of WPs' to workplace safety

A testimony by one of the WP was quoted during the study as follows:

"We do not have peace after we have collected our plastics, the elderly boys come pretending to keep them for us but when we resist they grab our bags by force and run away. There is nobody we can report to since the municipal security are against what we do and the police see us as Chokoras or boys feeding from the dustbin and have no right to complain,

furthermore if they are caught and disciplined they will kill us".(Personal interview: Onyango (not real name), 13 years, 13th July, 2007 at Nyalenda-Kisumu).

4.4.15 Waste pickers' attitude towards their occupation

In the study, 57% of the respondents preferred the occupation despite its challenges while 40% did not like the occupation. Only 3% did not respond to the question. Salvagers who liked the occupation said it was good because through it, they could get income to meet their basic needs, no school certificate which was required, no insurance was needed and finally it was good to clean the environment. They also pointed out that it pays well than other informal jobs in the city in spite of it being rated lowly. Waste picking, according to this group of respondents, has 'freedom of working' because; there is no 'boss' that controls one's operations.

Baud (1994) in his research done in Bangalore, observed that waste picking has advantages listed below:

- That waste pickers can work every day and have daily though fluctuating earnings
- Waste pickers have no formal boss or overseer and don't depend on others for work
- There is no restriction from bringing their children with them or having them involved in the work.
- The possibility to combine waste picking with fuel collection
- Waste pickers don't have to invest money, they don't have to be educated nor have any connection to people who matter to get the job. In fact, majority don't know each other as they compete in search of plastic waste valuables.

Some of the disadvantages include uncontrollable fluctuations of raw materials, competition from new comers in waste picking activity, many occupational health problems and insecurity. These advantages and disadvantages are as a result of lack of national policies and plans which are geared towards integrated solid waste management within local authorities. According to JICA (2005), National policies and plans for SWM are prerequisites for appropriate planning of municipal SWM for each city. He further adds that without master planning at the national level, there may be a lack of consistency in SWM among different cities. Therefore, the way forward is to involve waste pickers and waste dealers as stakeholders in policymaking and planning process to avoid exclusion of their concerns.

4.4.16 Challenges and suggestions to improve waste recovery

According to waste pickers, the activity has various challenges. Firstly they have to wake up by 6.00 am and walk from residence to residence and dumping areas. Secondly waste pickers have to learn to tolerate the odours and smell at the dumping sites, the abuse from the public and the hunger accelerated by the long trek. In a research conducted in various countries to identify and structure all SWM issues facing developing countries with reference to recent trends in the sector JICA (2005) identified major problems including disorderly picking of recyclables at kerbsides containers and waste transfer stations making the immediate environment unsanitary and extremely reducing the efficiency of public waste collection service. Secondly, waste pickers and collectors work in dangerous and unsanitary environment. For instance, they are highly susceptible to respiratory and dermatological ailments and injuries. Having experienced the problems, the WPs in Kisumu recommended the following solutions to be considered in the planning for PWM within the municipality:

- Cooperatives and other societies should be formed to facilitate improved participation in PWM
- Well wishers should donate working gear
- The government should encourage starting of recycling factories
- The formal and informal sectors should partner in training the waste pickers on SWM skills
- Government should initiate cooperative and welfare groups
- Involve of children below 12 years in waste picking should be discouraged

4.5 Plastic waste management policies development for five years (2002-2007) in Kenya

This section discusses the findings on evaluation of the existing plastic waste management policies and policy gaps in Solid Waste Management sector in Kenya and particularly within the context of Municipality of Kisumu. The study aimed at reviewing the policies addressing the problem of littering and existing regulations on plastic waste studied to understand the drivers for the policy, objectives of the policy, scope of the legislation and provision of instruments used to achieve the objectives in the last five years since (2002) in Kenya.

4.5.1 Policy analysis framework

The study adopted a simple policy framework from Narayan, (2001) in which various components that are essential were considered (ref. 3.8, fig.9). The reason for maintaining simplicity was to remain focused and cope with the time allocated for the study. Since plastic waste policies are relatively new in the country, SWM policies and related policies such as EMCA, 1999 Act, Public health Act and Local Authority bylaws for Republic of Kenya were referred to from government resource centre in Kisumu.

4.5.2 Statutes relating to SWM and plastic waste management in Kenya

The responsibility to protect the environment and enforce the existing regulation lies within two Ministries in Kenya. The first is the Ministry of Local Government and the other is the Ministry of Environment and Natural Resources (MOENR). The National Environmental Management Authority (NEMA) reports to the MOENR. It is an autonomous body formed by the government to enforce environmental policies through the Environmental Management Coordination Act (EMCA), 1999. The Ministry of local Government is responsible for collecting and disposing all solid waste through municipal and other local authorities.

According to Afullo (2006), lack of a SWM policy in Kenya has strongly affected service delivery in urban areas. He further adds that consequences of failure by civic authorities to incorporate garbage disposal in their long term planning are now becoming manifest. This is because only municipal or county councils' by laws govern waste management and due to their weakness and poor implementation, participants in the sector are ignorant about them. Private operators work without a proper regulatory framework while municipalities do not perform. Formal and informal recyclers, including community initiatives, are not officially recognized or supported. For the past 20 years, Kenya has not developed a comprehensive policy on solid waste management except municipal by-laws and policy guidelines on documents relating to SWM. However, NEMA, in 2006 came up with Waste Management regulations which are incorporated in the EMCA, 1999. The management regulations include guidelines on application and renewal for licence to own waste treatment or disposal site, application and renewal licence to transport waste and guidelines for waste management licence application. In spite of these regulations, NEMA as well as MCK has a challenge in

the implementation of the regulations due to understaffing, inadequate funding and lack of solid waste management strategies at the local level.

Implementation of the EMCA, 1999 was expected to deal with many of the weaknesses mentioned above via institutional reforms that allowed, among other provisions, the use of economic incentives and disincentives to influence waste management. The existing policy and legislative documents that directly or indirectly address Plastic Waste Management issues include Public Health Act, Cap 242; Local Authority Act, Cap. 265; Municipal by-laws on SWM; The Sessional Paper No. 6 of 1999 on Environment and Development; which remains a draft because it was never discussed in parliament and the Environment and Management Coordination Act (EMCA), 1999. Currently, there is also a draft Comprehensive Strategy on Plastic Waste Management for Nairobi City (2006). If approved, it will be the first strategy document on plastic waste management in Kenya although biased towards Nairobi city.

4.5.3 Analysis of existing policies

This analysis includes the objective of the policy, the specifications in the policy and also a case study of Kisumu municipality which will serve to illustrate the implementation of the rule. The policy instruments referred include:

a) Public Health Act, cap 242.

The objective of the Public Health Act is to regulate activities detrimental to human health. The owner(s), of the premises responsible for environmental nuisances such as noise and emissions, at levels that can affect human health are liable to prosecutions under this Act. An environmental nuisance is defined as an act that causes danger, discomfort or annoyance to the local inhabitants or which is hazardous to human health. For instance, depositing plastic waste where it is not required makes it a public nuisance and health risk. The findings revealed that in Kisumu, the Act is not effective. For instance, observation at the bus stage revealed that many food selling points were designated at less hygienic and unplanned places hence risking the health of many people. Plate 9 shows the situation at the bus park and its environs where eating places in form of "hotel" are located haphazardly and deposit solid wastes in the waste water drainage systems. The surrounding of bus park as indicated by the same plate has drainage systems clogged with plastic bottles and other forms of wastes.



Plate 9: Plastics choking drains at Kisumu bus park and its surroundings.

b) Local Government Act, Cap 265

In Kenya, the local Authority Act mandates all local authorities to establish and maintain a sewerage and drainage system and grants them immunity from liability for damage caused by the sewage disposal works if this is the “inevitable consequence” of the operation of works. It also mandates the councils to maintain cleanliness within towns and cities. Under cap 265 section 264, it is the responsibility of the local authority to collect, dispose and landfill the SW in collaboration with residents of the areas. Lack of a sanitary landfill has seriously affected the SWM practices. Kisumu municipality is also in deficit of vehicles for transportation of garbage; in addition workers lack gloves for health safety and inadequate receptacles for garbage storage. According to a Senior superintendent in Environment department, MCK has 2 lorries, 1 tractor, and only one compactor against a population of about 500,000 people (Personal interview: Mr. Aaron, 12.7.2008). Furthermore, no plastic recycling policy exists to streamline the activities in the town despite the existence of many informal waste dealers and factories that have emerged in the recent years.

4.5.4 Source reduction

The SWM systems in Kisumu municipality have adopted open dumping where the residents dump the waste on open grounds within the estates from where the municipal trucks collect the waste. The residents do not practice source separation or reduction due to; first, they lack sensitization on the same; secondly there are no receptacles positioned at the waste collection sites labelled for separation and finally public attitude towards waste is that it is anything useless that only waste pickers can come and collect. There are no existing source reduction guidelines on this aspect. Therefore this negates the true purpose of separation. These challenges are brought about as a result of poor planning in SWM within the municipality and lack of an integrated waste management strategy.

The findings established that there were several small hotels where food was kept in coloured plastic bags before it is served. At least three out of every ten food eating *kiosk* was using plastic bags for storing and keeping food warm. The Kenyan staple food called *ugali* being the most common. This type of storage endangered human health as coloured bags are toxic. It was realised that there is no policy guideline on discouraging the use of such bags. A public health officer who was interviewed confirmed that there was laxity in enacting the bylaws of municipality as well as the Public Health Act. This came about due to conflicting interests. For instance, most of those owning food kiosks are Councillors' and Municipal workers.

4.5.5 Recycling rule for plastics

The examination of the Local Authority Act, cap 265 of the Laws of Kenya ignores issues of recycling or even pickers of plastic waste in Kenya. Although the MCK had indicated that plastic waste used in most packaging is the most conspicuous nuisance, often littering in many parts of the town, the municipality did not take responsibility by talking about its role in recycling. The revised (draft) of the environment bylaws (2007) of Kisumu Municipality also did not mention about recycling policy or about public awareness creation on plastic bags which are an eyesore in the town.

4.5.6 Effectiveness

A policy is said to be effective if it achieves the goal(s) set forth in it. In the case of Public Health Act, one of the objectives of the policy was to reduce negative impact of poor

environmental health including poor disposal of coloured poly bags and PETS. The same mandate is given to NEMA with the objective of ensuring EMCA standards are followed. In the study, the problems of littering, careless plastic disposal and improper land filling constituted threats to the environment in Kisumu. Poor incinerators at the hospitals and related institutions should be checked to facilitate incorporated SWM.

The rationale behind increasing the thickness of plastic bags in Kenya to 30 microns and above, so that it becomes lucrative for the waste pickers to collect for recycling has also failed. The concern that the waste pickers have a better livelihood is justified, but this cannot be achieved by thickening plastic bags alone. There are no provisions in the policy that contribute to WPs empowerment, or lessen their vulnerability to occupational hazards (Chaturvedi, 1999). In fact, the government has yet to realise the unrecognised financial contribution of waste pickers to the waste management system. There is a need for rethinking the position of waste pickers by not seeing them as undesirable migrants, but as useful members of society whose services can be better utilised and focussed. Hence, the government should move from providing a piecemeal solution of thickening plastics, to improve the livelihood of waste pickers, to taking concrete measures to best utilise their services, and integrate them into the waste management system. Incorporating them into the formal waste management will enhance the SWM sector and empower them economically. Effective implementation calls for collective support from all stakeholders including the users. This can be done through awareness creation and change of attitude and behaviour.

4.5.7 Efficiency

A policy is cost efficient if it can produce the maximum environmental benefit for the resources being expended, or it achieves a given amount of environmental improvement at the least possible cost (Narayan, 2001). The poor SWM performance in Kisumu can be attributed to several factors including lack of appropriate planning and budgeting, inadequate political will and improper utilization of local resources. Costs are important, since the resources devoted to environmental improvements should be spent in ways that will have the greatest impact. On political will, if certain unplanned structures are demolished councillors in Kisumu protect the owners by saying people who vote for them should not be disturbed. This negates the efficiency of the environmental cleansing department. Poor technology and weak enforcement of the existing legislation as well as lack of fiscal incentives to promote good practice also contribute to this. Further, according to UNEP (2005), policy makers are

poorly educated and lack the power to discipline MCK workers. Consequently, mismanagement, corruption, laziness and general chaos become the hallmarks of the MCK. The dysfunctional local administrative system has led to decline in the efficiency of MCK operations

c) Environmental Management Coordination Act, 1999

EMCA Act was enacted in 1999 to provide for the establishment of an appropriate legal and institutional framework for the management of the environment and for matters related to it. The Act provides for environmental quality standards to be enforced in issues such as pollution of industries or agencies. In the year 2003, NEMA with support from UNEP conducted a study on appropriate economic instruments for plastic waste management in which a combination of strategies to reduce generation were suggested. The EMCA, 1999 also provides on the polluter-pays principle and the precautionary principle. Taking these into consideration, NEMA responded to public concern in the year 2003 over plastic waste and prepared an action plan to deal with such material over time (Table 15). Efforts to come up with a plastic waste management policy began in 2003 although there were other documents developed before addressing environmental issues. Despite the weight that has been given to the issues in the Act, NEMA has failed to implement the standards required due to; 1) Insufficient trained human resource; 2) Weak enforcers of the standards and poor management of the SW at the Local Authority levels. The implication of this is deteriorated state of environment in urban centres. The Act also did not provide the minimum gauge for plastic waste papers when manufactured thus giving leeway for industries to manufacture and sell at will.

A program for implementation of plastic levy and other instruments (Table 17) has experienced several setbacks since 2005. First, the Ministry of Finance delayed to act as scheduled. Instead of tabling the proposed Finance Bill in 2005, it was delayed until 4th June, 2007. The Bill contained a ban on all manufactured plastic bags below 30 microns and 120% tax on plastics.

Table 17: NEMA action plan on plastic materials

Activity	Immediate action to kick start and timing	Expected completion date	Targets
Recycling	Directive of NEMA immediately to stakeholders	By July 2006	15% recycling by manufacturers by 2005
Introduction of standard thickness	Finalize the standard of thickness immediately	By July 2005	All manufacturing concerns
Phasing out currently flimsy plastics	Phase out production and purchase immediately	By July 2005	All users and manufacturers
Economic measures	Drafting to start immediately	By July 2006	Finance bill 2005
Reduced tariffs on electricity	KAM to draft them immediately	By July 2005	Finance bill of 2005
Recovery by retailers	Cooperative awareness and directives	By 2005	Adopt recovery and reuse strategy
Enforcement of thickness standards	Publication of draft standards	By July 2004	Full scale enforcement within one year
Collection of plastics already in the environment	Instructions to local authorities and retail chains, etc	Immediately and continuous	No plastics in Kenya major cities by 2005
Legal measures on littering	Local and corporate regulations formulated	By July 2005	Each city and municipality to have a by-law on plastics
Selection of Disposal methods	Development of proposal guidelines	By July 2004	Disposal guidelines for plastics by 2005

Source: NEMA, (2003)

4.5.8 Social and political acceptability

The fact that littering is a problem has been realised by the public at large in Kisumu town. Hence this state has been seeking effective policy measures to handle the issues. The policies namely EMCA and Public Health Act, of Kenya have found acceptance at most levels. NGOs sensitize the public on the problems of littering, thereby supporting the government in environmental issues. However, the government is slow and inconsistent in implementation of the policies particularly through the Local authorities. The Kenyan citizens are willing including users and traders of poly bags to respond positively to the implementation of the policies. Although the government requires the recycling industries to adopt good recycling

technologies as per Kenya's Vision 2030 which is a government blue print on development, there are no incentives for the recyclers to adopt.

4.5.9 Proposed strategy for plastic waste management for Nairobi, 2006

In the year 2005, the KNCPC initiated talks with various stakeholders who included NEMA, KIPPRA, ITDG, Saachi and Saachi, KAM, UNEP and UNDP in order to search for a solution on plastic waste management in the city of Nairobi. The objective of the strategy was to reduce the generation of plastic waste and its environmental impact thereby ensuring that the socio-economic development of Nairobi, the health of the people and the quality of its environment is no longer adversely affected by uncontrolled and uncoordinated plastic waste management (KNCPC, 2006). The strategy, however, did not incorporate views from other towns such as Kisumu and therefore does not reflect the national picture concerning issues on plastic waste management especially in smaller towns for instance, motivation for new technological innovations.

4.5.10 National policy implementation and enforcement

The Kenya government has continued to encourage development without destruction of the natural resource base. The first initiative in this area was the Sessional paper No. 10 of 1965 on African Socialism and its Application to planning in Kenya. Kenya's commitment to environmental management has been demonstrated through various initiatives. Key among them was National Development Plans that have since 1974 addressed environmental issues, as well as the 1994 National Environmental Action Plan. Despite all these efforts, due to the increase in urban population and other challenges coming with urban development, there is need for an overall National Environmental Policy that incorporates Plastic Waste Management Policy which currently is non-existent.

An evaluation of development policy documents and reports in Kenya for instance the Economic Recovery Strategy Paper (2003-2004), Annual Monitoring and Evaluation Report (2004-2005), and Mid-Term Review (2003-2006) identifies; **a)** absence of a policy on recycling of waste materials and dysfunctional local authorities, **b)** inadequate information on technologies for the profitable recycling of waste; failure to include the informal sector, particularly slum dwellers, into viable recycling processes and **c)** increasing pollution from solid waste such as polythene and plastic generated waste due to lack of a national policy on

recycling of waste materials respectively as key challenges facing Solid Waste Management sub-sector (GoK, 2003; GOK, 2006a; GoK, 2006b). All the above named documents indicate that there are serious gaps and weaknesses in policy implementation. This is also attributed to shortage of staff to facilitate compliance at NEMA and Local Authorities, lack of incentives to informal sector, and lack of facilities in SWM practices.

4.5.11 Instruments used to implement waste recovery policies

Municipal Solid Waste Management which integrates informal recycling has not succeeded where there is limited understanding from leaders. A necessary first step is for those in authority to recognize the economic, social and environmental benefits that result from informal recycling. There also needs to be recognition of the limited effectiveness of simply copying approaches to MSWM used in more economically developed countries as these are unlikely to be appropriate. Perhaps the greatest challenge is to shift the perception and attitudes, particularly of local officials and also of the general public, towards those involved in informal waste recycling. The attitude of the formal waste management sector to informal recycling is often very negative, regarding it as backward, unhygienic and generally incompatible with a modern waste management system.

Kisumu Municipality as a whole has an estimated 800 people engaged in plastic waste recovery activities. The activities have attracted street boys and idle young persons who make a living daily out of the sales instead of begging in the streets. One step towards integration is to work with the informal sector, to help them organize themselves and to add value to their recycled materials before selling them on, i.e. to move up the hierarchy as seen in figure 13 earlier and to extract higher value from recovered materials. Another example would be efforts to expand door-to-door collection (itinerant buyers) by helping street collectors or dumpsite scavengers in Kisumu to enter this market. However, all such interventions do need to be planned and integrated if they are to achieve maximum effect. One area which has not received much attention is assisting waste pickers and scavengers to form Micro Small Enterprises (MSE) or cooperative societies in Kisumu. This was revealed from their views in the results presented in chapter 4. Manuals or policy documents and tool kits can be prepared for Municipal decision makers involving MSE in ISWM.

Public Private Partnership involving MSEs and the existing informal recycling network is one important option which needs to be considered more widely. For example *Vyatu* industry

which is involved in plastic recycling is also involved in Private waste collection. A successful recent example of Public Private Partnership incorporating the informal sector waste pickers is the case of Sao Sebastiao in Brazil where the Catadores created a cooperative and succeeded in legitimizing their profession (GTZ, 2004). There are a number of potential points of conflict between formal MSWM services and informal recycling activities that need to be recognised and addressed in attempting integration. When a collection crew also separate wastes, these increases the loading time and reduces their efficiency. Similarly, the presence of scavengers at transfer stations and landfill sites can interfere with vehicle movements, which are both dangerous and increases vehicle turnaround times and reduces efficiency (ISWA, 2002). However, it is not possible to solve the problem simply by ignoring the informal sector. One way is to invest in improved transfer stations or engineered landfill sites to replace exiting open dumps. The solution proposed by some experts is to provide separate areas of the sites where pickers could operate safely, without interfering with vehicle movements or with waste placement at the landfill face. Interviews from the field (chapter 4) reported various accidents that have occurred at the Kachok dumpsite when waste pickers run after trucks for waste. Some other challenges facing SWM sector include: lack of support from the leading agency (Municipality) and financial constraints.

5.1 Introduction

This chapter presents the conclusions according to the specific objectives and the recommendations and areas of further research.

5.2 Conclusions

The first objective of this study was to determine the sources, quantities and types of plastic waste materials salvaged by the waste pickers in Kisumu. Its corresponding research question was what are the main sources, quantities and types of plastic waste materials within Kisumu municipality? The study established that the major types of plastic waste recovered and recycled in Kisumu include Low density polyethylene (LDPE) and high density polyethylene (HDPE), PET and limited PVC. These plastics are obtained from household level, at working places, eating places and at the main dumpsite. PETs are commonly generated by travelers, working people and even from hospitals where use of bottled water by patients is common.

The findings show that the main sources of plastic waste include residential areas, dumpsite, commercial streets, industrial zones, construction and demolition sites and finally at *jua kali* garages where the waste pickers select only plastics of value.

The second objective of this study was to establish the major actors involved in PWM and investigate the inter-linkages that exist between the formal and informal waste recycling sectors. There were two corresponding questions to this objective. Firstly, how are the formal and informal linkages organized in the plastic waste sector? Secondly, what are the planning challenges experienced in the sector? It emerged from the study that, the collection and disposal of solid waste is legally the responsibility of local authorities in Kenya. The Municipal Council of Kisumu in particular, is often unable to cope with the ever growing quantities of waste because of inadequate funds, increasing populations, lack of equipment and spare parts and poorly trained management resources all of which pose planning challenges. Apart from the MCK, other major actors involved directly or indirectly in PWM activities in Kisumu town include the Private Companies (PCs), Community Based Organizations (CBOs), Non-Governmental Organizations (NGOs), and the recycling sector's agents (waste pickers, dealers and WRIs). The research established that there is quite a well-developed hierarchical structure of informal networks within which various waste recycling

actors operate. Recovery of plastic waste material takes place at all the stages along the waste management system, that is, at storage, collection, and disposal points and during the transportation process. The MCK's seem not to have any plans to fully and officially privatize the SWM services. This means that there is no arrangement to improve the SWM services or even integrate the services with the other stakeholder. This is also a planning challenge. A recent draft of the Environmental by-laws (Revised, 2007) lacks initiatives that are geared towards policy improvement on plastic waste management since it was not done under inclusive consultation to all stakeholders. However, the integration of this informal sector is inevitable because the town has a substantial number of the urban poor and unemployed. In brief the study concludes that informal plastic recovery and recycling activities are extensively developed, inter-linked and play a considerable role in urban SWM in Kisumu. However, the linkages that exist are exploitative in nature and built on suspicion. There are also no incentives to promote informal waste recycling in the city. Therefore this answers the question as to whether planning challenges exists.

The third objective of this study was to evaluate the socio-economic aspects, occupational health and environmental implications of informal plastic recovery activities. The research question stated that are there any negative occupational health implications, environmental implications that affect the plastic recovery sector at collection, transportation and processing levels? Are the implications linked with waste picking activities? The study also established that young men, mainly rural migrants from the Nyanza and Western Provinces of Kenya dominate Kisumu's waste picking occupation. The number of waste pickers, sorters, dealers and factory workers of WRIs is unknown as is their importance to the economy. It is therefore, difficult to quantify their overall role and plan for their development needs. However, the informal recovery activities play a major role in the reduction of waste both at the collection and disposal points. This leads to a reduction in waste collection, transportation and disposal costs incurred by the MCK.

The survey established that waste recovery leads to savings on foreign exchange earnings by reducing the dependence on imported raw material inputs for production. The sector is the major supplier of inputs required in the manufacturing processes of most industries that produce plastics of various gauges. The MCK also benefits directly and indirectly from the informal recovery processes because of the reduction in waste collection and disposal cost by reducing collection requirements and need for new landfill sites. In addition, waste recovery leads to a reduction of the risk to human health.

The study indicates that the plastic waste picking and dealership occupations in Kisumu are associated with high health risks because of the general lack of safety equipment. The people involved in the informal recovery practices work under unsanitary conditions. The environmental health conditions among the waste re-processing industrial workers are no better than those of the waste pickers and sorters operating at the WBCs. Dumpsite waste recovery has a higher environmental health risk than street waste recovery because most of the solid wastes in the town are contaminated, unsorted and generally dirty. The health hazards associated with recycling activities occur because the participants do not comply with labour and health regulations, which they are probably unaware of.

The fourth objective was to examine the developments in Kenya of the plastic waste recovery and recycling policies since (2002-2007). The corresponding research question was what are some of the positive and negative developments of plastic waste management policies in the last five years in Kenya (2002-2007)? The study found out that waste management policies are scanty and lack comprehensive guidelines that can provide regulatory framework. For instance, the MCK by-laws (2007) on environment lack a section for a plastic waste management policy. Lack of staff and instruments from NEMA and MCK has hampered implementation of available policies. The policies relating to waste management are also scattered in several implementing agents including; NEMA, Ministry of Local Authority, Ministry of Public Health and other the international policy guidelines. This brings disharmony in the whole context of SWM and leads to confusion. Analysis of the policies indicated that they are not specific and implementation strategies are not inclusive and collectively owned as stakeholders leave the implementation process to the government. NEMA has guidelines on waste management which came to effect in 2006 but is not comprehensive enough on plastic waste framework. Further there is no specific policy dealing with recycling of plastics as is the case in other countries like South Africa.

5.3 Recommendations

Based on the study, the following recommendations were made:

1. **Formulation of plastic recovery policies:** The MCK and the Government of Kenya through NEMA should formulate plastic recovery policies on the informal plastic waste recycling industry. Such policies would guide both the MCK's law enforcement officers and the actors of this sector on their legal rights and obligations. The waste

recycling policy should be directed at the waste producers and the SWM system as a whole. The formulation of these policies should be inclusive and participatory so as to cater for all stakeholders in the recycling sector.

2. **Source separation:** The idea of source reduction and decentralizing waste management clearly provides a long term solution to the problem of waste management in the country. It was realised in the research that source separation is not practised at the household level or even at the collection centres. Source separation would help to ensure quality of recyclables into the recycling sector. Furthermore, it will help reduce the burden of the waste pickers and the municipality. Therefore, a rule for the same should be introduced and municipality should ensure it is adhered to.
3. **Use of incentives and disincentives:** Both incentives and disincentives can be used to obtain positive results from the promotion of plastic recovery and re-use. Such incentives and disincentives will also improve the working conditions in this sector. Some of the incentives and disincentive which are applicable to Kisumu include a reduction of service charge for those waste producers that participate in source separation or alternatively increased fees to the non-participants. For instance supermarkets such as Tuskeys, Ukwala, Nakumatt, and Yatin can be awarded for promoting environmental friendly packaging for their customers.
4. **Policy legislation:** An adequate and integrated environmental legislation that promotes plastic waste recycling is recommended. Such legislation should emphasise and built its jurisdiction on the policy of the “Polluter-Pays-Principle”. The proposal should provide guidelines for the source separation, storage, collection, transportation, resource recovery and disposal of all types of plastic waste.
5. **Technology:** One of the main concerns in the recycling sector is the quality of recycled products. The study identified recycling centres within the town as collection and semi-processing points which are facing challenges. One of the challenges is lack of technological knowhow and the need to have machines that, for example, pelletize for several hours without overheating. In addition, personnel who are not well trained cannot deliver well. For instance BAMATO recycling centre, a community initiative at Nyalenda in Kisumu lacks trained manpower although they have enough machines for pelletizing. Recycling technology should be introduced in colleges and universities in order to solve the problem of skilled staff shortage. The recycling industry should be promoted as it

presents a source of livelihood to hundreds of people in Kisumu. Slight efforts would be required by the government to improve the quality of recycled products.

5. **Intensifying environmental preservation awareness:** Awareness creation on environmental issues is a good strategy in the country but in the past, it has been selectively and sparingly done due to the expenses involved. The initiatives of awareness creation should not be left only with local authorities or government. As a collective responsibility, everybody should participate. The conservation awareness programmes may be expensive to the government authorities, but we believe it is the most cost effective in the long-run. The awareness programs would aim at educating the communities, industries and other plastic waste producers on the consequences of their behavioural waste management practices on the local and global environment.
6. **Occupational health:** To improve the working conditions of the recovery a number of precautionary measures should also be taken, such as wearing protective clothing and use of safety gear. Mixed wastes like oil and acid plastics and bottles should be washed before sorting. Another barrier is the lack of knowledge of the precise dangers for human health in waste recovery and recycling. These considerations may pose a dilemma as to whether certain activities should be encouraged or not. This is because; these individuals are often struggling for survival and lack of access to basic needs and services. It is hoped that if these steps are implemented, then the working conditions will be improved gradually for all the actors involved.
7. **Role of Plastic waste recovery participation in SWM:** To bring change in attitudes towards waste management, it is important to cultivate ownership and participation for all stakeholders not only as a responsibility of the municipal body. It should be remembered that excessive Municipal control of waste management does not necessarily lead to significant economies of scale. The problem of formulation and implementation of incorporation of recovery of plastic into SWM system is of priority. The other step is to improve the welfare and working environment of the waste pickers and dealers by training on sanitation, occupational health and safety.
8. **Role of incorporating plastic waste recovery with formal waste management:** From the study, it is important to note the following issues: first, plans for revamping the formal system for example through KISWAMP should not ignore the social and economic dimensions of the informal sector in waste management process. Secondly, it is necessary to bring a change in attitudes, which views waste management as a

responsibility of the municipal body and treats waste picking as an illegal activity. Therefore, it is worth considering the integration of informal practices with the existing system and look into options of decentralising waste management with the involvement of waste pickers. However, due to the large number of urban poor in Kenya who cannot meet their basic needs and the lack of access to resources, prevention of waste generation will neither be a priority nor a cause of an immediate concern.

5.3.1 Areas for further research

Plastic recycling industry has some fairly good prospects in Kenya mainly because of the growing use of plastics resource base and demand for recycled products that are affordable during the current poor economic situation in the country and almost the entire world. If the urban poor populations in Kenya have to benefit, a range of small-scale, low-cost and environmentally sound options, as the above, need to be researched, developed and implemented. This study has made a contribution to these efforts. However, to develop a long term national plan or policy on plastic waste recovery and recycling, there is need for a comprehensive study of the government's regional, international, employment, fiscal trade and primary resource policies that affect waste recycling activities in Kenya. The study will provide a linkage with Kenya's Vision 2030 strategy in flag post on pollution and waste management (GOK, 2008). Further, areas of study on the formal and informal recovery networks used for other waste materials, for example, textiles, rubber and tyres, and automobile parts, is essential for a proper understanding of the sector. The activities of small-scale informal recycling industries like BAMATO in Kisumu need a special study to uncover more indigenous technologies that would be replicated and be promoted countrywide and elsewhere in the developing world to create extra employment opportunities. To improve and change the peoples' attitude towards SWM from being a municipality affair, there is need to conduct a Knowledge, Attitude and Perception (KAP) survey on plastic littering.

REFERENCES

- Abert, J. (1983). Resources Recovery: Economic and Institutional Aspects. *Conservation and Recycling*, 6 (3) 139-144.
- Afullo, A. (2006). The environment: Some concepts, issues and Concerns. Sustainable Futures, (Pty) Limited. Maun, Botswana.
- Afullo, A. (2003). Environmental and occupational health aspects of waste in Okavango Delta, Botswana. PhD thesis (unpublished).
- Achankeng, E. (undated). Globalization, Urbanization and Municipal Solid waste Management in Africa: African studies Association of Australasia and the Pacific. 2003 Conference proceedings.
- Baud, I. and Hans, S. (1994). Solid waste management: modes, assessment, appraisals and linkages in Bangalore, Monohar. New Delhi.
- Barlett, E.J., Kotrlik, J.M. and Higgins, C., (2001). Organizational Research: Determining Appropriate sample size in survey Research. *Information Technology, Learning, and Performance Journal*, 19 (1) 36
- Beukering, P.V., (1994). The Recycling Sector in Bangalore: An Economic Analysis of Different Types of Formal and Informal Entrepreneurs, Recovering Urban Solid Waste. Manohar Publishers, New Delhi.
- Bjerkli, C.L., (2005). The cycle of plastic waste: An analysis on the informal plastic recovery system in Addis Ababa, Ethiopia. M.Sc Thesis (unpublished) Norwegian University of Science and Technology.
- CAPS, (1992). Recycling activities in Metro Manila. Waren project. WASTE Consultants, Gouda, The Netherlands.
- Chaturvedi, B., (1999). Recycling in cities: A view from the ground. World Bank, Washington D.C.
- Cointreau, S., (1984). Recycling from Municipal Refuse: A state of the art review and annotated bibliography. Integrated Resource Recovery. Technical Paper no.30. World Bank, Washington DC.
- Cointreau, S., (2006). Solid Waste work at the Bank- My personal journey since 1978 – World Bank, Washington Dc. Available at <<http://www.worldbank.org/solidwaste>> (Accessed on 7th January 2009)
- Cointreau, S., (2007). The Growing Complexities and Challenges of Solid Waste Management in Developing Countries. The World Bank.

Columbia University, (2007). Invest in Kenya: Focus-Kisumu Kenya. Millennium cities Initiative (MCI). The Earth Institute.

Daily Nation,(23th October, 2007). Press Statement: Kenya Association of Manufacturers. Daily Nation, Nairobi.

Demographia, (2008). World Urban Areas: 2025 and 2030 population projections. Available at < <http://www.demographia.com>. [Accessed on 20th March, 2008].

Environnement Liaison Centre International (ELCI), (2005). Breaking free from plastics. ecoforum environmental solutions, Nairobi.

Environment Protection and Heritage Council (EPHC), (2002). "Plastic shopping Bags in Australia", National plastic bags Working Group Report to the National Packing Covenant Council, Environment Protection and Heritage Council, Australia.

Environmental Protection Agency (EPA), (1989). Decision Makers Guide to Solid Waste Management. EPA, Washington D.C.

EQI, (1991). The recycling of Solid Waste in Cairo, Egypt. WAREN Project, Waste Consultants, The Netherlands.

Flintoff, F., (1984). Management of Solid Wastes in Developing Countries. World Health Organization, New Delhi.

Fobil J. N., (2000). Municipal Solid Waste Characterization for Integrated Management in the Accra Metropolis, M.Sc. Thesis.(unpublished), University of Ghana

Furedy, C., (1989). Social Considerations in Solid Waste Management in Asian Cities. Regional Development Dialogue 10 (3) 54

Furedy, C., (1992). Garbage: Exploring Non-Conventional Options in Asian Cities. Environment and Urbanization Journal 4 (2) 40

Government of Kenya. (2006a). Annual Progress report 2004/2005. Economic Recovery Strategy. Ministry of Planning and National Development. Government Printers, Nairobi.

Government of Kenya., (2007). Budget Speech for the fiscal year 2007/2008. Ministry of Finance, Nairobi.

Government of Kenya.,(2005) Economic survey, 2005 Kenya National Bureau of Statistics, Nairobi.

Government of Kenya., (2003). Economic Recovery Strategy for Wealth and Employment Creation 2003-2007. Ministry of Planning and National Development. Government printers. Nairobi.

Government of Kenya.,(2006) Economic survey, 2006, Kenya National Bureau of Statistics, Nairobi.

- Government of Kenya, (1970). Kenya Population Census, 1969. Ministry of Finance and Economic Planning. Statistics Division. Government printers. Nairobi.
- Government of Kenya, (1981). Kenya Population Census, 1979. Ministry of Economic Planning and National Development. Government printers, Nairobi.
- Government of Kenya, (1994). Kenya Population Census, 1989. Ministry of Planning and National Development. Government printers, Nairobi.
- Government of Kenya., (2009). Kenya Subsidiary Legislation, 2009. Legal notice no. 69 the regulation of wages (General) Amendment order, 1st, May, 2009.
- Government of Kenya., (2001). 1999 Population Census Report. Ministry of Planning and National Development. Government printers, Nairobi.
- Government of Kenya, (2007). Kenya Vision 2030. Ministry of Planning and National Development and National Economic and Social Council (NESC). Nairobi.
- Government of Kenya., (2006b). Mid Term Review of the Economic Recovery Strategy for Wealth Creation and Employment. Ministry of Planning and National Development. Nairobi, Kenya.
- Government of Kenya, (2008). Millennium Development Goals: Status report for Kenya-2007. Ministry of planning and national development and vision 2030, Nairobi. Kenya.
- Government of Kenya,(2004). Statistical Abstract 2004. Central Bureau of Statistics. Government printer Nairobi.
- Gidman P., Blore, J.Loretzen and P. Schuttenbelt., (1995) Public –private partnership in urban infrastructure services. UMP Working Paper Series 4.Kenya.
- Goodstein, E.S. (2002). Economics and the environment. (3e). New York: John Wiley & Sons.
- Green peace, (undated) Plastics: An Environmental menace. [Online] Available at < <http://www.things.org/~jym/greenpeace/plastics> > [Accessed on 09 June 2006]
- Gunnerson, (1985). Technological, economic and environmental policies in resource recovery: An international perspective. Conservation journal.3 (44) 45
- GTZ., (2004). Partnerships in recycling management: Available At><http://www.gtz.de/en/themen/umwelt-infrastruktur/abfall/2196.htm> (Accessed on 10th July 2007)
- Ikiara, M. and Koech, C., (2002). “Impact of Tourism on Environment in Kenya: Status and Policy”. Discussion Paper No. DP/19/2002, KIPPRA, Nairobi.

Intermediate Technology Development Group. (2004). Regional Waste Management: Experience, Challenges and Opportunities of waste management in East African Urban Centres. Workshop Report Organized by WASTENET 26th -27th February 2004. Nairobi, Kenya.

Intermediate Technology Development Group, (2005). Environmental Sanitation: Salvagers: a people forgotten, field Update 02 July, 2005. Nairobi.

<http://www.practicalaction.org>. [Accessed on 10th July, 2007]

Iskandar, L. K., (2003). Integrating local community-based waste management into international contracting. In proceedings of solid waste collection that benefits the urban poor, 9–14 March, Dar Es Salaam, Tanzania. Switzerland: The SKAT Foundation [CD-ROM]. <http://www.skat-foundation.org/> [Accessed on 15th April, 2007]

ISWA. (2002). Industry as a partner for sustainable development. ISWA's contribution to the World Summit on Sustainable Development, one of 22 sector reports prepared jointly with UNEP. ISWA and UNEP.

Http://www.uneptie.org/outreach/wssd/contributions/sector_reports/sectors/waste_management/waste.htm [Accessed on 5th June, 2007]

Japanese International Cooperation Agency (JICA), (1998), The Study on Solid Waste Management in Nairobi City in the Republic of Kenya, Nairobi.

Japanese International Cooperation Agency (JICA), (2005). Supporting capacity development in solid waste management in developing countries: Towards improving solid waste management capacity of entire society. Japan.

Johnson, D. (1990). The future of plastics: Applications and markets worldwide. Financial times Business Information Ltd, London.

Kamel, L.I. (2000). Urban Governance: Informal Sector and Municipal Waste in Cairo. Proceeding of an Electronic Conference on Forum of Research on Human Settlements held on March – April, 2000, Cairo.

Kenya National Cleaner Production Centre. (2006). A comprehensive strategy on plastic Waste Management for Nairobi city (draft), Nairobi.

Kenya Institute of Public Policy and Research Analysis (KIPPRA). (2003). Micro-Infrastructure Project: infrastructures service entitlements and urban poverty in Kenya, Nairobi.

Kibwage, J. K., (2002). Integrating the informal Recycling Sector into Solid Waste Management Planning Nairobi City. PhD Thesis. (unpublished) Maseno University. Kisumu, Kenya.

- Klundert, V. (1995a). Plastic waste: Options for Small-Scale Resource Recovery – Urban solid waste series 2. WASTE Consultants, Inge Lardinois.
- Klundert, V., (1995b). Community and Private (Formal and Informal) Sector Involvement in Municipal Solid Waste Management in Developing Countries. Background paper for the UMP workshop in Ittingen 10-12 April 1995. WASTE, the Netherlands.
- Konings, P. (1989). Small-scale industrial reprocessing of plastics: A field-study in Istanbul, Turkey. WASTE Consultants/Delft University of technology, the Netherlands.
- Kreith, F., (1994). A Handbook of Solid Waste. McGraw-Hill, New York.
- Medina, M., (1997). Scavenging on the Border: A Study of the Informal Recycling Sector in Laredo, Texas, and Nuevo Laredo, Mexico. PhD. Dissertation, Yale University, 1997.
- Medina, M., (1998). Border Scavenging: A Case Study of Aluminium Recycling in Laredo, TX and Nuevo Laredo, Mexico. Resources, Conservation and Recycling Vol. 23. Elsevier Science, Philadelphia.
- Medina, M., (1999). Globalization, Development, and Municipal Solid waste Management in the Third World Cities. Tijuana, Mexico.
- Medina, M., (2000). Scavengers Cooperatives in Asia and Latin America Resources, Conservation and Recycling Vol. 31.
- Municipal council of Kisumu, (2005). A budgetary record for financial year 2005/06 and 2006/07.
- Narayan, P., (2001). Analysing Plastic Waste Management in India: A case study of Polybags and PET bottles. MSC. Thesis. (unpublished) Lund, Sweden.
- National Environment Management Authority., (2004). State of Environment for Kisumu District: Land use management. NEMA, Nairobi.
- National Environment Management Authority. (2005). State of Environment for Kisumu District: Pollution and Waste Management. NEMA, Nairobi.
- National AIDS/STI Control Programme (NAS COP), 2007. 2007 Kenya AIDS Indicator Survey: Final Report, Nairobi, Kenya.
- O'Halloran and Epstein David, (1999). Delegating powers: A transaction cost politics approach to policy making under separate powers, Cambridge university press.
- Personal Communication, John Otieno, a dumpsite waste picker, May, 2007. Kisumu.

Personal Communication, Onyango, July 2007 a dumpsite waste picker, Kisumu.

- Pollock, R. (1987). Mining the urban wastes: The potential for recycling, World waste paper No. 78. World Institute, Washington DC.
- Porter, C. R. (2002). The economics of waste. Washington, DC: Resources for the Future (RFF) Press.
- Powell, J., (1983). A Comparison of the Energy Savings from the Use of Secondary Materials. Conservation and Recycling. 6 (1) 2
- Ptr. Services, (1992). A Report on Recycling of waste in the City of Calcutta-WAREN Project. WASTE Consultants, Gouda, the Netherlands.
- Rakodi, C., (1997). Global forces, urban change, and urban management in Africa. The urban challenge in Africa: Growth and management of its large cities. Tokyo, The United Nations University Press.
- Saechtling, J. (1987). International Plastics Handbook for the Technologist, Engineer and User, 2nd edition. Hanser Publishes, Munich.
- Scheinberg, L. (2001). Financial and economic issues in integrated sustainable waste management. Tools for decision-makers. Experiences form the urban Waste Expertise Programme. The Netherlands. WASTE. [Http://waste.nl](http://waste.nl)
- Schouten, A.E. and Van der Vegt, A.K., (1991). Plastics, 9th edition. Delta Press BV, Amerongen.
- Tavares, A. (2001). State constraints and Local Environment progress: Solid waste management policy instrument choice. Florida State University.USA.
- UN-HABITAT., (2006). Kisumu Urban Sector profile. United Nations Human Settlements Programme. Nairobi.
- UN-HABITAT., (2005). Kisumu City Development Strategy. Kisumu.
- United Nations Centre for Human Settlement, (1994). A reference book for trainees on promotion of solid Waste Recycling and Reuse in Developing Countries of Asia.
- United Nations Centre for Human Settlement, (1989). Solid Waste Management in Low-income Housing Projects: The Scope for Community Participation. UNCHS, Nairobi.
- United Nations Centre for Human Settlement (UNCHS). 2001. The Urbanizing world : Global report on Human settlement. Oxford University Press, New York.
- United Nations Environment Programme., (2005). Selection, Design and Implementation of Economic Instruments in the Solid Waste Management Sector in Kenya: The case of Plastic Bags. UNEP. Nairobi, Kenya.

Volger, J. (1981). Work from waste: Recycling waste to create employment, Intermediate Technology Publication/Oxfarm, UK.

Volger, J. (1984). Small Scale Recycling of Plastics. Intermediate technology publications. ITDG, Nairobi.

Wiannah, M. M. (2007) Sustainable Plastic Waste Management: A case of Accra, Ghana. Master thesis (unpublished).

Wilson, D., Whiteman A. and Tormin, A. (2001). Strategic planning guide for municipal solid waste management. Washington, DC: World Bank.

http://www.worldbank.org/urban/solid_wm/erm/start_up.pdf [4th June, 2007]

World Bank. (1991). Urban policy and economics: an agenda for the 1990s. World Bank policy paper.

World Bank., (1995). Ghana, Growth, Private Sector, and Poverty Reduction, a Country Economic Memorandum. Washington D.C.

World Bank., (1996). Urban Environmental Sanitation Project, Staff Appraisal Report, Republic of Ghana, Africa Regional Office.

World Bank. (1999). What a Waste: Solid Waste Management in Asia. [Online].

Available:<http://www.worldbank.org/html/fpd/urban/publicat/whatawaste.pdf>

(Accessed on 3rd September, 2007).

World Resources Institute (WRI), (1996). World Resources 1996-97: The Urban Environment. Oxford University Press, New York.

Yankson, P. W. and Gough K.V., (1999). The environmental Impact of rapid Urbanization in the peri-urban of Accra, Ghana.

Yhdego, M., (1991). Scavenging Solid Wastes in Dar es Salaam, Tanzania. Waste Management and Research Vol. 9. ISWA, Copenhagen, Denmark.

Zerbock, O, (2003). Urban Solid Waste Reduction in Developing Nations. M.Sc. Thesis. (unpublished) Michigan University, U.S.A.