

SOLID WASTE SERVICE DELIVERY IN NAIROBI LOW INCOME SETTLEMENTS.

BY

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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This thesis has been submitted for examination with my approval as University Supervisor.

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ABSTRACT

This report is a study of solid waste service delivery in low-income areas in Nairobi. Solid waste management in low-income areas has received little or no attention from the Nairobi City Council. Limited resources have been cited as the major reason but there are other reasons as well. This study was set out to investigate the actual problems and constraints surrounding the issue and suggest appropriate solutions to the same.

Consequently, the study looks at the present solid waste management practices in the city and especially in the low-income areas. The problem of solid waste management in low-income areas is made evident by the heaps of garbage that occupy all open spaces between houses and on road reserves.

Although there is inadequate infrastructure in low-income areas and especially the unplanned settlements, it is not the only reason for poor solid waste service delivery in the area. Limited finances, inadequate storage and collection equipment, poor institutional management, lack of community participation and awareness are some of the other problems. This study has found out that apart from the problems mentioned above, lack of economic and political influence has contributed to the marginalization of low-income areas. Also the fact that

very little economic value is attached to solid waste in general no much effort has been put by either the local authority, the NGO's and the community to improve the situation.

This study has attempted to highlight the actual situation in low-income areas and has suggested ways and means of improving the situation. To do so the work is organized into six chapters. Chapter one which is the introduction considers the problems of solid waste service delivery in low-income areas and presents the study objective, assumptions and methodology.

Chapter two focuses on the general information on solid waste problems and solutions both in developed and developing countries. The chapter concludes by looking at the literature on solid waste problems in Kenyan context. Chapter three focuses on present administration and management of solid waste in Nairobi. Chapter four and chapter five are on data analysis and synthesis, whereas chapter six contains the suggested solutions to solid waste service delivery to low-income areas.

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CHAPTER ONE

1.0 Introduction

Environment issues have in the last few years attracted a lot of attention not only in Kenya but all over the world. The world conference held in Rio de Janeiro, Brazil in (1992) is evident of such global concern over the environment. The number of people in environmental related jobs is yet another indication of such concern. Environmentalists in Kenya however, have been rather silent on issues relating to solid waste pollution.

Solid waste from resulting from various human activities remain undisposed for long periods of time. Environmental and health pollution resulting from uncollected waste and burning of refuse at disposal sites affects the health of those living in the area. Air pollution resulting from burning of rubber, paper, plastic and other materials is by no means limited to the area of origin, but spreads around without any respect for boundaries.

Like other rapidly growing cities, Nairobi is unable to effectively dispose the refuse as soon as it is generated. The consequences of such limitations has resulted in heaps of uncollected garbage, poor aesthetic, bad odor, health hazards and fire. The problem is more pronounced in low income residential areas where refuse collection services are very poor or lacking. Garbage in these areas is deposited virtually everywhere with the

road reserves being the most vulnerable sites. This is particularly so where development has taken up space that would otherwise be used as collection points.

The huge heaps of uncollected refuse are reduced by burning and allowing animals like goats, sheep and cattle to feed on them. Scavengers too contribute a great deal in the reduction of solid waste at the disposal sites, and even at the land fill itself. Such refuse is mostly biodegradable, with vegetable matter standing at over 76 per cent (Mairura, 1988: SULO, 1988). Decomposition of such waste tends to generate a number of gases such as Carbon Dioxide, methane, Nitrogen, Ammonia and hydrogen Sulphide. The unpleasant odor from such gases is so offensive to most people. Efforts to control and prevent pollution resulting from uncollected refuse have yet to be sought. Presently, the management of solid waste in Kenya towns, and Nairobi in particular, has caused concern to residents of all walks of life. The "City in the Sun" that once symbolized modernization and progress is now identified with chaotic growth, uncollected garbage and enormous pot-holes.

This study is an effort to investigate problems and constraints experienced by the Nairobi City Council in providing solid waste services in low income settlement and try to suggest solutions. To appreciate the magnitude of the problem, the study looked at the present practices in the

generation, storage, transportation and disposal of solid waste in Nairobi, but paid special attention to the low-income residential areas.

Major problems encountered in the delivery of services in low income areas of Nairobi was highlighted, and both short-term and long-term plans were recommended.

1.1 Statement of the problem:

The problem of solid waste collection and disposal is experienced in most cities of both the developed and the developing countries. The only difference is the magnitude of the problem. In Nairobi, the problem is experienced in all residential areas, but more so in the low-income settlements. The inability of the City Council to deliver services in low income areas is the cause of all solid waste related problems.

Although solid waste management falls under the department of Health, whose management team is aware of several health problems that may result from uncollected solid waste or toxic waste from hospitals, industries, and residential areas, very little is done to ensure that precautions are taken against harmful practices.

The lack of concern that is evident in the departmental activities must be seen as a result of certain administrative, finance and technical problems or constraints that are experienced by the Cleansing Section.

Solid waste management is an aspect of the environment which has not been accorded the attention that it deserves. The environment has traditionally been seen as a public commodity to be used at zero price, and for a long time man has engaged himself in the pursuit of material wealth at the expense of long term environmental stability and sustainability. Material welfare and economic growth have generally tended to assume higher priority than environmental protection or improvement in national political decision making. Whereas other aspects of decision making are founded on economic cost-benefit analysis environmental impact cannot be measured in economic terms hence the underestimation of potential damage. As a result of this, conservation and recycling of resources are adopted only where they can be defended as viable or cost effective on purely economic grounds.

Environmental degradation has been as a result of high rate of population growth in urban areas. Rapid population increase has greatly contributed to the increase of solid waste generation in the city, hence the problem of solid waste disposal. Such growth in population has made it even more difficult for the Council to provide services to the low income areas where majority of the city residents reside. The increased demand on the existing infrastructural services like water, transport system, housing, education, healthy facilities and the cleansing services has not been

matched by provision of resources. Limited storage and collection equipments has left "mountains" of rotting garbage to characterize all types of low income residential areas.

Lack of planning in some low-income areas has made collection of refuse even more difficult since many parts of the residential areas cannot be reached by conventional means of garbage collection. This however does not mean that lack of planning is what prevents the provision of services, but is just one of the reasons. Lack of planning in some low-income areas has resulted to overcrowding hence leaving no space for compost pits or collection points.

The problem of solid waste management is not limited to low income areas alone but, is also experienced in some middle income neighborhoods as well. The only difference is that in middle income areas individual households are provided with dustbins, and unlike low-income areas refuse is collected once in a while. High income residential areas do not experience the problem of uncollected garbage like other areas that we have just described since that is where the senior officers in charge of refuse collection and other influential members of the society live. Residents in high income areas are themselves aware of the environmental and health hazards associated with uncollected refuse. As a result, they try to maintain a clean environment on their own even if it means transporting

refuse in the boots of their vehicles to a collection point away from their neighborhood. Community participation as well as political power has enabled the high-income areas to maintain a clean environment. Private companies like BIN Ltd. and Domestic Waste Collection Services have been contracted to collect and dispose refuse in some of these areas.

Other middle income areas have organized themselves in such a way that they contract people to sweep, clean the drains, or empty garbage cans to a nearby bulkbin or collection point. Prudential estate in Buruburu and Suna estate in Dagoretti Corner are good examples of such areas.

In low-income areas, the reverse is true. Garbage is not collected by the city Council and the residents themselves do not seem to be organized in any manner that would facilitate the collection of refuse from their areas of residence.

2

Plate No. 1.1 : Uncollected refuse



The uncollected refuse that builds up in these areas is a health hazard to the residents. This is more so because it contains human faecal matter due to the inadequacies of the sanitation infrastructure and management. Studies done in India have shown that two intestinal worms (roundworm and whipworm) are commonly found in refuse from low income areas. This could be said to be true of refuse from Nairobi low-income residential areas as well. Secondly, the decomposition by-product

of organic waste release chemical constituents like ammonia and hydrogen sulphide gases into the atmosphere producing an offending odor to residents who live in the area. The uncollected refuse is not only offensive in terms of odor but also provides a favorable breeding ground for disease causing vectors like mosquitos, flies and rodents. Some components of waste also attracts wild dogs to the area (Sewel, 1975: The standard Newspaper 27th April, 1993).

Noise and aesthetic is yet another problem in some low-income areas. Dandora for instance is most affected by the noise from trucks hauling waste at the landfill. The aesthetics of the area is also disrupted by uncollected refuse which leaves nylon and plastic papers being blown about by the wind.

Low income areas have shown a lot of ignorance in the collection and disposal of solid waste. Lack of awareness and low levels of general health education may have contributed to the uncaring attitude that is evident in low-income areas. Also the fact that most low-income are residents are tenants could have contributed to the indiscriminative attitude of refuse disposal (Merickel,1991). The fact that the City Council does not adequately collect refuse in these areas does not mean the residents should not do something to protect their own health and that of their fellow residents. Surprisingly so, the same people who are unable or

unable to clean up their neighborhoods have been able to connect water and construct houses for rental. This therefore is a clear indication that solid waste management is ignored in low-income areas not only by the City Council but also by NGOs and the residents simply because it is not an income generating activity. Lack of economic value has delayed or deprived the provision of solid waste services to low income areas. Other income generating services are always provided for by both the community and the NGOs as required.

Although ignorance cannot be ruled out, financial problems have been the main hinderance to proper functioning of the City Councils Cleansing Section. This is so because the revenue collected by the Local authority is forwarded to the Central Government from which the City Council later requests for money (SOLU, 1988). The whole process takes a lot of time and the small portion of the City Council budget, designated to waste management is insufficient to purchase sophisticated equipment required to effectively handle the nature and amount of solid waste generated in Nairobi. Implementation of alternative methods is also limited by the same.

The Central Government is also to blame for poor solid waste service provision. It has for a long time constrained City Council's activities in that it controls the "purse" in such a way that no capital

program, additional staff or financing of projects can be undertaken prior to ministerial approval. The ministry of Local Government requires the City Council's budget estimates to be submitted every November/December of each year. There are also ministerial orders to the City Council restricting the payment of overtime to the Council employees. In addition, all cases of merit increments and salary adjustments to any member of staff are also to be referred to the ministry for approval (SOLU, 1988). Such requirements are not only time consuming but uneconomical in many ways.

Lack of finances is no longer convincing to the low-income residents, but see it as an excuse for not providing services. This is so because they have witnessed the misuse of funds by some political appointees and the construction of unnecessary footpaths which have costed the City Council over Ksh. 40 million of tax payers money (The Sunday Nation November 15th, 1992). The same City Council that has constructed an underground tunnel to transport water from Dakaini Dam all the way to Nairobi City is unable to provide dustbins to low-income residents despite their monthly contributions of service charge, and in some cases the payment of Ksh. 10 a month for dustbin.

Further delays to service provision are as a result of the methods used to purchase equipments. The City Council requires all items whose

price exceed 100.00 Kenyan Pound, but less than 500.00 Kenyan Pound to be purchased by quotation. Those purchases in excess of 500.00 Kenya Pound have to go to tender. The whole procedure between the request for expenditure and final authority to spend takes at least two and a half months and sometimes more than that.

Another problem affecting the provision of services by the City Council is laxity among the city employees. Most low cadre employees of the City Council get their employment through a councillor, a senior officer, or other important people within the City Council. Because of this relationship with their "God-fathers" therefore, most people do not provide services the way they should because their employment and stay with the Council is almost guaranteed regardless of whether they work well or not. This puts the supervisors in a very difficult situation, because they cannot discipline those working under them without being victimized.

There is also a tendency of recruiting the least qualified personnel to the cleansing section where people are said not to require any education to be able to pick garbage or sweep the streets. Such lack of education or little education for that matter, makes it very difficult for the supervisors to recommend workers for promotion.

The present organization structure of the Cleansing Section is yet another limitation in that it lacks posts for professional and technical

officers like planners, engineers and environmentalists. Such deficiencies leave the section without adequate forward planning and useful statistics that could be used to make better decisions. Lack of specialized personnel in areas of engineering has also left a lot of operations and planning work undone for a long time. Enforcement of regulations and public health control of sanitary aspects are left out as well.

The complexity of the present legislation is also somewhat confusing to City Hall officials. This is particularly so because the provision for the same matters are found in different regulations and by-laws, whereby the interpretations are sometimes different. Legislation concerning land ownership for instance, has complicated the delivery of solid waste services in low and unplanned settlements. Present legislation do not allow public funds to be spent on unplanned or illegal settlements. For this reason therefore, the Council is not obligated to provide services to any unplanned settlement regardless of whether there are funds or not.

The type of equipment and vehicles used also complicates matters of solid waste service provision. Bulk Bin containers are very few in some areas. The distribution of such containers is uneven and that affects the collection efficiency and the time taken to collect garbage. The distance covered in transporting solid waste to Dandora dump site also makes the whole exercise of refuse collection expensive and time consuming. The

distance limits the number of trips that a certain vehicle can make in a day. Since transfer stations do not exist, all collection vehicles have to get to Dandora to dispose off their refuse.

Poor conditions of most city roads has also contributed to regular breakdown of collection vehicles. Discrimination towards the poor by urban bureaucrats also plays a major role in poor service delivery. This is not limited to solid waste collection alone, but stretches to other services as well. Bureaucrats working in City Hall tend to ignore low-income area residents and see them as less worth of attention. Its only when influential politicians interested in obtaining votes call for clean-up campaigns that low-income residents get some attention. Public bureaucracy in City Hall has greatly encouraged the perpetuation of the "underclass" who live in low-income areas. This is so because bureaucracy is organized according to the middle class norms while members of the underclass operate outside those norms. Further, the middle-class bureaucrats approach their downtrodden clientele with superiority and push their problems aside as if they do not matter. This explains why nothing has been done to improve the state of solid waste collection in Nairobi's low-income residential areas.

City hall politics have also caused a lot of disservice to Nairobi City Residents. Frequent appointments and sacking of certain individuals to the post of City Commission chairman did not improve the provision of

services in any manner. In a spell of slightly more than nine years, six City Commission chairmen were appointed. Despite the regular change of chairmen however, the problem of uncollected garbage still remained.

The post of the town clerk has not been spared of the reshuffle either. In the last nine and a half years, the City Council has had four Town Clerks. Such rapid changes are obviously deemed to have some negative effect in the running of the City Council's administrative affairs in that every one of them has his/her way of looking at things and approaching problems. It is unfortunate that garbage collection in Nairobi has not improved despite such changes.

This however does not mean that it cannot be done. Since effective solid waste management has been achieved in some cities of the developing countries, it can also be done in Kenya. To do so however, the cause of the present problems must be identified and solutions sought. It should be born in mind that the problem of waste management cannot be solved, unless environmental awareness is created among the residents. Cleanliness in any city can only be achieved when each individual identifies the need to maintain a sanitary and healthy environment. For this to happen however, some traditional behavior patterns have to be changed to allow for flexibility.

This study has highlighted some of the problems that have

contributed to poor solid waste service delivery in low-income areas and has tried to answer questions as to whether:

1. the planning of a settlement has improved the provision of services in low-income areas of Nairobi;
2. services in low-income areas are not provided due to lack of resources or because the society does not attach a lot of value to the service; and
3. the economic influence has a role to play in solid waste service delivery?

1.2 Study objectives:

The objectives of this study are to:

- 1: Study the present system of solid waste management by the Nairobi City Council and try to identify problems and constraints that have led to the present situation;
2. identify ways of garbage collection that will involve the public in low-income areas of Nairobi; and
3. propose ways of solving the identified problems and constraints so as to improve solid waste service delivery in low-income areas.

1.3 Study assumptions:

This study is carried out under the assumption that:

1. There are certain institutional limitations that have contributed to the present poor management of solid waste in Nairobi Kenya;
2. the population in the study area will continue to increase, thus increasing the volume of solid waste generation;
3. better planning and management of solid waste collection can greatly improve the situation in the study area;
4. continued absence of law enforcement will remain an hindrance to effective solid waste management;
5. policy makers attitude toward the poor is a major drawback to effective solid waste management in low-income settlements.

1.4 Study methodology

To illustrate the problems encountered in solid waste service delivery in low-income settlements, a field survey was conducted in three of the most affected areas (Dandora, Kibera and Kawangware) in Nairobi.

To identify the actual solid waste service delivery problems in Nairobi low-income areas, both secondary and primary sources were used.

The data collected included physical, social and economic background of the study area. Secondary data sources included library literature, Nairobi

City Council reports, research and seminar reports from Nairobi City Council, solid waste reports from (UNCHS), Mazingira Institute, United Nations Environmental Program (UNEP), Environmental Secretariat, Housing Research and Development Unit Library, and the World Bank Library.

Primary sources constituted the actual reconnaissance and physical survey of the study area; participation in the collection and disposal of refuse from various divisions of Nairobi City; household questionnaire; interviews and informers.

A household questionnaire was administered in three low-income residential areas (Dandora, Kibera and Kawangware) which were selected at random from a list of other low income settlements. In Kibera, three of the seventeen villages were selected at random for the administration of the questionnaire. The three villages were Makina, Silanga and Mashimoni. Ten questionnaires were administered in each residential area. The total number of households interviewed in each residential area was as follows: Dandora = 30; Kawangware = 20; and Kibera = 30. Systematic sampling was used to select households. The number of questionnaires administered were determined by dividing the total population of each area by five (average family size) and then dividing by the number of villages or phases as the case may be. Since Kawangware does not have such

divisions, the total population was divided only by the number of households. Only ten percent of households in each area was interviewed. All interviews were administered by the author to maintain uniformity in the manner of questioning. Research assistants were only used to provide guidance and security since they were residents of the area. Interviews were conducted in English and Kiswahili.

The household survey aimed at establishing the problems of solid waste and the nature and extent of the problem. To acquire such information, there were questions on; the number of people in each unit, frequency of refuse collection by the City Council, inconveniences caused by uncollected refuse, and other related questions. Residents were also asked to give recommendations on what they thought could be done to improve the situation.

To determine institutional limitations, certain questions were set for City Hall officials. Some of the funding agencies (World Bank in particular) declined to be interviewed.

1.5 Data analysis:

In data analysis, simple methods such as description of absolute frequencies, percentages and averages were used to show characteristics of the phenomenon under investigation. Classification and cross tabulation

of data, as well as cartographic methods which include devices such as tables, maps, charts and figures have also been used. Finally, Pictorial presentation and quantitative presentation in form of a report was done.

Visual observation is another research tool that was used to record information regarding land use patterns and the degree of cleanliness in the study area. Photographs of the study area were also taken to communicate the real situation of solid waste management to the present and future readers of this report. Due to limited time and funding, only 80 questionnaires were actually administered and analyzed.

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CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

The problem of garbage collection and disposal is not limited to the cities of the developing countries alone, but is experienced in most large cities of the developed world as well. This chapter will look at certain aspects of solid waste management and will attempt to highlight some of the problems and solutions in both the developed and developing countries.

2.1 Solid waste generation

Although much waste may be produced in a certain country, households differ in their income, cultural background, age, and variety of other factors. In Spain for instance, every inhabitant of the Spanish capital city of Madrid generated 1.1 kg of rubbish each day and a daily total of 36,000 tones. One household may generate twice as much paper as another or triple the food refuse per person. Paper in any form account for over half of the total weight.

Although similarities exist in solid waste throughout the world, there are extremely wide variations in the proportion of the components. This can vary not only between countries but even between regions within

the same country.

Refuse production is believed to be increasing at a rate of 4 per cent in the United States. That is from 160 million tons a year in 1980 to 180 million tons in 1991 and an estimated 216 million tons by the year 2,000 (Warmer 30, August 1991 p.9). This is so because a large fraction of consumer goods end up as solid waste. Such high rate of solid waste generation is not typical of developing countries. While an American generates an average of about 1.6 kg of solid waste each day, an Indian city dweller generates about 400 grams (Warmer. 33, 1992 p.18; The Standard, July 10th 1992).

Like in the United States, paper is German's major waste composition. Waste paper is the primary raw material used by the German paper and board industry. In 1990, about 5.8 million tones, waste reused was for the manufacture of new paper (Warmer Bulletin No.33, 1999 p.13).

2.2 Waste Collection and Transportation

Waste collection in most developed countries is contracted to private companies. In Netherlands for instance, approximately 25 per cent of the waste generated is handled by the VAM Company, which operates a network of railway transit stations and reception facilities with an annual capacity of some one million tones of waste (The Standard, July 31st 1992).

Most developed countries have realized the necessity to separate refuse at the source before collection. Such separation continues even in other stages. At Wilster Plant in Holland, paper is separated from the plastics by wet processing. Separation of refuse is done to fit various collection and disposal methods. Some of the most common methods of disposal that require separation include: Central grinding; incineration; open burning; open dumping; and composting. Some methods require dry refuse to be separated from wet refuse, but others require removal of certain items like glass and metal which are disposed by other methods.

2.3 Waste recycling:

Recycling in many countries is not widely practiced despite its economic and environmental advantages. This is usually the case because people performing the various steps of retrieval, sorting, recovery and reuse do not receive enough tangible benefits to compensate them for their time and effort. Also, the owners of discarded material have little incentive to prepare them for recycling. Since the volume of waste tends to increase as the income level of the population increases, more compensation is required to convince people with rising incomes that is worth their time and effort to continue to recycle. Populations with high income require to be motivated not only by monetary means but by any other means like

asking them to donate their used goods for others to reuse. Successful recycling requires a lot of encouragement by compensation.

In countries that have succeeded in recycling, it is evident that there are a set of conditions that are favorable to the establishment and their continued success in the venture. The success factor in one country may not necessarily be the same in another. Factors like official attitude, as expressed by laws, regulations, ethical codes or behavior patterns, may be so opposed to reuse of certain products such that all other factors have little influence. The following are some of the countries recycling facilities of one kind or another.

Recycling in U.S.A: Recycling in the United States of America is at a very advanced stage. Its success is attributed to by several factors such as:

1. The nature of products;
2. a supporting infrastructure and activities that provide goods and services needed to keep the recycling in operation (these range from a distribution network, transportation system, to trainable work-force);
3. available capital funds required to provide the plant and equipment working capital for inventories, accounts receivable and operating cash;
3. Legal and regulatory leeway favorable to recycling

environment; and

4. Management skills and warranties to boosted buyer confidence in the recycled products.

Recycling in the United States conserves more energy materials and products than it uses. It also saves material, money, environmental degradation, and reduce dependence on foreign imports. It creates employment and small scale enterprises, as well as build up skills of industrialization through repair and remanufacturing (Warmer No. 29 1991 p.12).

The Northerⁿ Recycling Corporation (NRC) of Fort Wayne, Indiana is experimenting with 1.5 inch cubes of compressed organic solid waste for use as a supplementary of the inert portion of the municipal refuse from the organic fraction. The organic fraction is then compressed and extruded into "cubettes" which are approximately 1.5 by 2 inches in size using a modified alfalfa hay baler (Warmer No. 29, 1991 p.21).

New technology advancement has been extended by the Northern Recycling Corporation (NRC) by designing a six hundred-ton-per day reclamation plant. This has been as a result of a successful construction of a pilot five-ton-per hour pyrolator (Resource Recovery from Municipal Solid Waste by National Center for Resource Recovery, Inc 1974).

Recycling in Holland: The largest processing plant is at Wijstyer in

northern Holland. VAM has also constructed a new plant at Mierlo near Eindhoven in Southern part of the country. Methane gas from VAM landfill is captured and used to generate electricity to power the nearby located plant.

Recycling in Britain: In Britain, a polystyrene plant has been opened by Linpac Plastics International Ltd in Cheshire. The new plant is meant to process 2,500 tones per annum of used polystyrene from a variety of sources. There are plans also to build a state-of -the-art refuse-fired power station on the Thames estuary. Once completed, the plant will be the largest in Europe and will provide a long-term disposal solution to the densely populated areas of London (Warmer No. 30 1991 p.4).

Many mechanized waste-sorting facilities are in operation in the United Kingdom. A refuse derived fuel production facility with ferrous metal separation has been operating for a number of years at the Wotton (Birmingham) plant of the Impural Metal Industries.

Generally speaking, waste processing in Europe has advanced significantly since the late 1970's because the traditional mass burning became more and more expensive. The waste management authority at both Central and Local Government levels, as well as the private entrepreneurs, is seeking less expensive alternatives involving the realization of some of the material and off-site utilization of energy values inherent in

municipal household discards. In 1990, a total of 6.3 million tones of waste paper was collected by waste management companies, charities and associations. Out of the total amount collected, about 2.1 million tones was from households (Warmer Bulletin No.33, 1992).

In Austria, the federal government has undertaken an extensive recycling study. A number of research and demonstration projects have been undertaken before. These include the burning of waste in cement Silos, the use of waste materials in road construction, and burning of refuse as fuel for power plants (Warmer No. 30 1991 p.2).

Many mechanized waste-sorting facilities are in operation in the United Kingdom. A refuse derived fuel production facility with ferrous metal separation has been operating for a number of years at the Witton (Birmingham) plant of Impural Metal Industries. There are 30 schemes of so that collect bottles in UK at the present. RECOUP (is the industry backed organization responsible for initiating and developing plastic container collection and recycling in UK) places a high emphasis on the quality of material specification in conjunction with processors. Also important is the requirement to remove caps and to squash them prior to depositing.

Recycling in Japan: Incineration and landfill technologies are the most important elements in Japanese waste management. However, since the

middle of the 1970s more emphasis has been placed on recycling and reuse of waste. Materials collected for recycling purposes are not referred to as waste since "waste" in Japan refers to unusable materials which have no value. According to 1986 survey by the Clean Japan Center, more than 90% of local communities practice source separation of one kind or another. In the source separation programs, six different waste classifications are widely accepted (Warner No. 30 1991 p 6,8).

- (1) Mixed waste
- (2) Bulky waste
- (3) Combustible waste
- (4) Incombustible waste
- (5) Valuables (recyclable)
- (6) Special Waste (hazardous)

To finance solid waste management activities, a 5% of the purchase amount is donated to environmental organizations through the secretariat, at any time one uses the credit card for shopping.

Waste recycling in Denmark: Waste recycling in Denmark has been almost totally confined to household separation. However, the government recently appropriated funds for the development of a number of pilot/demonstration plants to mechanically separate both household and industrial waste.

A separate collection program for recyclable has been developed in Højne Tastrup, Denmark whereby paper, glass and metals are separated for pick-up from homes using trucks with compartments and adjustable partitions. Apartment buildings use a central container, with compartments. Free collection of recyclable is offered to business firm that separate materials. All collection materials are sorted at the municipal recycling station where reusable bottles and other materials are salvaged.

2.4 Waste disposal

Different countries use different methods of waste disposal. In Barcelona, Spain, waste is managed by a combined public and private ownership waste management company. The company operates the municipal refuse incineration plants and manages landfill sites. Generally speaking, most countries use the following methods to dispose their waste.

Incineration: This is the burning of waste under controlled conditions. It is one of the most commonly used methods of waste disposal in many developed countries. In third world countries however, mass incineration has been rejected for being too costly (Sewell, 1975 p.45). The cost of constructing an incinerator is only part of the total cost. There are other costs that come with the running of an incinerator. However, the low volume of residual waste from incineration plants and the potential for

heat and power generation, have to be set against the higher landfill costs.

Landfills: A sanitary landfill is the controlled burial of wastes under compacted earth. Lack of clear environmental requirement regarding dump-sites has however, contributed to soil and ground water contamination. Studies carried out in Poland showed that the major ground water contaminants are chlorides, sulphate, nitrates and bacteria. Sulphurated hydrogen, and ammonia are some of the explosive landfill gasses. Extraction of energy from landfill gas is lacking due to inadequate funds and lack of technology (Warmer No. 1991 p.5).

Composting: Various composting systems are currently under investigation in German. It is estimated that 500,000 tones of compost can be produced annually from 1 million tones of organic household waste (Warmer No.29 1991 p.10).

Grinding: Grinding of garbage is a very convenient way of disposing household garbage. In developed countries like the United States, the home grinder is connected to the kitchen sink drain. This enables garbage to be shredded into small particles while being mixed with water and is discharged to the house sewer. This system is not only convenient but simple and time saving. It reduces the volume and cuts the cost of disposable bags.

The other system is whereby garbage is collected as before but

dumped into large, centrally located garbage-grinding stations that discharge garbage to the municipal sewage system. This method is disadvantaged in that it requires additional sludge digestion and drying facilities to handle the increased volume of garbage.

Processing: This is another method that is used in developing countries to reduce the amount of disposable garbage. This method involves the cooking of garbage under pressure. In the process, fat is melted out and separated from the remaining material which is then dried, ground and sold for fertilizer and cattle food manufacturing. The melted fat is used to manufacture soaps or glycerine.

Digestion: The digestion method of disposing waste has been used for many years in some developed countries. A year long British study on Anaerobic digestion concluded that Anaerobic digestion is an "expensive" risk and largely untested option to use as a major part of solid waste management. The Cardiff City Council never-the-less decided to go-ahead with Britain's first commercial anaerobic digester despite a cautious report by the Environmental Resources Ltd. (ERL) consultants.

2.5 Waste minimization

Waste minimization is the most important of the many steps in the waste management hierarchy. But, despite that consensus, all the legisla-

tion, the inducements, and the attention is seen to focus of material recycling. In Kenya for instance, this is particularly so due to the fact that a lot of poor people earn some income from recycling activities than they would if some financial rewards were awarded to industrial of institutions which reduce waste production.

Waste minimization in Nairobi or any other urban center in Kenya for that matter, is entirely in the hands of the manufacturing industry. If all industrialists are mindful of the environment, they could device alternative materials that can be reused, and are less pollutant.

2.6 Kenyan situation

There are very few published reports available on solid waste management for Kenyan urban centers and even Nairobi. This however does not mean that data is not available on various aspects of solid waste management. In some reports, it is estimated that in the year 2000, the amount of solid waste produced in Nairobi per person per day will be 1.5 kg and that the total domestic solid waste will be about 4,500 tones per day (Ministry of Environment and Natural Resources Vol. 3 page 813).

The actual amount of solid waste generated in Nairobi is not known because different studies have reported different figures. A solid waste project undertaken by the ministry of local government has given an

average per capita solid waste production in Nairobi at 0.375 kg per person (Kenya Waste Project, 1988). Another study carried out by the United Nations Development Program estimates the production of solid waste to be 1,36 kilograms per day (Nairobi City Council Annual Report, 1984). According to the Cleansing Section of Nairobi City Council however, the amount of solid waste generated per person per day is 0.4 kg (Annual report, 1990). The average growth rate of solid waste in Nairobi has been estimated to be approximately 24 per cent per annum, and the total amount generated in Nairobi to be about 800 tones daily. The amount of refuse collected per day ranges between 270-350 tones per day. Another 100-150 tones is delivered by traders directly to Dandora, and 20 tones or so collected by private contractors. The amount that is left uncollected per day is what builds up to form "mountains" which pollute the environment.

A 1989 study conducted in Nairobi by the United Nations Center for Human Settlements (UNCHS) estimated the per capita refuse generation per day to be 0.5 kg (UNCHS 1989). The same study revealed that the average garbage collection frequency achieved by NCC in low-income residential areas was once every 7-14 days. However, this is no longer the case.

Waste collection in Nairobi has been studied by various scholars. In 1988 for instance, 'Sulo' carried out a study for upgrading the existing

refuse collection system in Nairobi. Their survey covered the whole of Nairobi, but focused attention on upgrading of refuse collection in Nairobi East. The selected area for refuse collection pilot project included: Kimathi, Harambee, Lumumba, Jericho, Makadara, Maringo Ofafa, Bahaati, Uhuru, Shauri Moyo and part of Kariokor, Ziwani, Umoja, Buruburu, Pumwani and Eastleigh. The population to be served was 504,000 people. This area was selected due to its increased problem of refuse collection, and the fact that it is a mixed housing residential area.

In 1991, Allums, consulting firm was also contacted to prepare a report to be submitted to the City Council's request to World Bank to fund imported specialized garbage collection vehicles. Instead of funding the importation of vehicles, the World Bank proposed the sub-contraction of garbage collection to private entrepreneurs who would supply collection vehicles and manage the collection operation.

The pilot phase was to be sponsored by the World Bank but thereafter the commission would carry on with the implementation. For actual provision of services, the proposal suggested private entrepreneur to be sub-contracted to collect a specified number of bags in a designated area once per week. That would mean 4 collections for each household per month. The contractor would then be paid according to the volume collected and deposited at Dandora. City Council was to foot the bill for

inspectors, bag counting personnel, book keepers and operation managers.

The target areas were:

- 1) Ngei-Otiende Estate
- 2) Buruburu Estate, and
- 3) Parklands area.

The proposed pilot study duration was one year, and the number of households to be served in each estate was 10,000. During that period however, the World Bank was prepared to provide 30,000 households with a bag each week which would total to (1,440,000). The cost of one bag at the time was sh. 50.00, and is now sh. 120. This means that their proposal did not target the low-income.

Another study for the feasibility, of the implementation and management of the collection, transportation and disposal of urban waste in the towns of Nairobi, Mombasa, Nakuru Kisumu and Eldoret was developed by FARID SPA on request by the Italian Foreign Ministry. The need for the project arose from poor hygienic and sanitary conditions in Kenyan urban centers. The report recommended a Central Workshop to be set up exclusively for the collection vehicles and that it be separated from the municipal workshop. This recommendation was given after a thorough study of the present situation of vehicle repair and maintenance work. The report noted that no motor pool or equipment can ensure a good service

if it is not backed up by the collect servicing.

Waste recycling in Kenya has been looked into by several scholars. Khadaka's report of (1988) focused on the present methods of recycling and the type of materials that are recycled. It came up with the conclusion that recycling has greatly improved the disposal of solid waste in Nairobi. If recycling is to continue in Kenya, as an alternative method of solid waste disposal, then the scavengers who make the operation possible should be compensated equally. In the current recycling system, it is the rich man who decided how much the poor scavenger should be paid. For the present situation to change, the scavengers need to organize themselves into registered groups so that they can somehow monopolize the activity and get direct access to the recycling industries. This will give them a better bargaining power than when they act individually. Right now the scavengers are not able to sell their salvaged material directly to the industries because they cannot afford to transport their small volumes of material to the industries which are located outside the city center. They are therefore forced by circumstances to sell their salvaged material to middle men who buy them at very low prices of one shilling and fifty cents to two shillings and later sell them to the industries at more than twice the price (field survey, 1993).

A regional symposium on solid waste held in Washington DC. in

1978, recommended commercial recycling to be encouraged, and scavenging discouraged due to its 'high social cost'. The two activities are however difficult to separate where formal separation of solid waste is not practiced or encouraged.

Bushra (1992) in his paper presented in an inter-regional research workshop in Nairobi, pointed out that solid waste collection and recycling can improve the environment as well as reduce unemployment rate. He also noted that waste processing in Kenya is carried out at a very small scale, compared to the available potential. However, no studies have been done yet to show clearly what limits the advancement of processing in this country. Some work done on developed countries has shown that; one of the major shortcomings of waste processing is lack of market for secondary materials. Since materials separated from household waste is seldom of the best grade, it is difficult, if not impossible to market the material extracted from the waste at any price. The main difficulties, however, are technical. The problem of separating reasonable quality materials on a day-by-day operational basis is not as easy as imagined. The waste material is difficult to handle because of its great variability in composition, size, moisture content and others. As a result it has not been easy to devise appropriate equipment to handle such materials over the range of variability exhibited. The same problems could be experienced in

developing countries which have ventures into waste processing activities.

Bushra pointed out that the process of collection and recycling waste generates employment in the areas of waste collection, sorting, transportation, processing, recycling, and the selling of waste components and its by-products. He argued that the solid waste management system begins with the generation of wastes, followed by collection, transportation and disposal of the same. His study looked at the quantities, qualities and composition of waste generated in three countries of varying income per capita. The three countries were:

Low-income - Pakistan

Middle income - Singapore

High income - USA

He come up with the conclusion that industrialized countries like USA have the highest rate of waste generation per capita, but waste densities in low-income countries are the highest among the three levels of income due to a high level of moisture content which is attributed to increased amounts of vegetable and putrescible among the components of waste in low-income countries.

The reasons for low density solid waste in industrialized countries is due to usage of secondary material or "packaging materials" such as paper, cans, plastic and other materials that serve to decrease to density of

waste.

Several documents containing legislation laws of this country have clearly highlighted another problem. Of interest to this study is lack of enforcement of the stipulated standards which are a major limitation to service delivery in Nairobi residential areas. The laws dealing with the problem of solid waste disposal are contained in the following chapters.

1) The Public Health Act, chapter 242 section 116: outlines the duty of every local authority to take all lawful and reasonably practical measures for maintaining its districts at all times in clean and sanitary condition; to prevent the occurrence of or for remedying or causing to be remedial, and nuisance or condition liable to the injurious or dangerous to health. And to take proceedings to law against any person causing or responsible for the continuance of any such nuisance or condition.

Section 118 (1): Outlines nuisances liable to be dealt with, for instance and accumulation or deposit of refuse, offal, manure or any other which is offensive or injurious or dangerous to health and accumulation of stone, timber or other material likely to harbor rats or other.

In addition to the Kenya law, the Nairobi City council By-laws also play a major role in regulating the handling of solid waste in the city. Section 7 part two of Nairobi City Council By Law of 1981 restricts deposit and debris on any land in the city. There are no legislation however that

regulate the collection transport, storage, recovery and disposal of both toxic and non toxic solid wastes. There are only a few regulations dealing with general health and public nuisance issues and thus are concerned only with illegal dumping and littering. There is great need for more details and specific legislation related to solid waste disposal in Kenya. The ambiguity of the Act governing pollution has created more problems than solving them.

2) Cap 13 section 24 of the Laws of Kenya on townships is meant to protect water pollution and dumping of waste into rivers. Unfortunately, this law is more on paper than in practice.

3) Wildlife Conservation and Management Act (Cap 376) states that no one should be allowed to introduce into the environment elements which can be hazardous to the animals and plants.

4) The Local Government Act cap 265 section 162 gives the Local authorities the responsibility of controlling activities which could be injurious to health of life of inhabitants. Such include offensive trades and obnoxious industries.

In addition to nationally applicable legislation, matters relating to water supply, sewage and pollution control in Nairobi are governed by the following By-laws:

1. The Nairobi (general) By-law of 1948;

2. The Nairobi (conservancy) By-law of 1961;

3. The Nairobi (Water Supply) By-law of 1974

Hazardous wastes that are characterized as ignitable, corrosive, explosive, or toxic are supposed to be removed from industrial waste prior to discharge to a municipal sewer. Many toxic wastes are known to upset biological waste water treatment processes and are transferred to the sludge, adding to the disposal problem.

The need to review and enforce the existing laws have been voiced by many Kenyans. Speaking at the "Environment 2000" Conference at UNEP headquarters at Gigiri, Nairobi in October 1991, the assistant director of the NES pointed out the need to review the existing laws that touch on water and industrial pollution.

2.7 Summary

The literature cited above is a clear indication that solid waste is a problem that all cities across the world have to deal with. Those of the developed countries have tried to tackle the problem by using some of the most modern methods of collection and disposal of waste. Recycling of solid waste is the most common method of reducing disposable waste in most developed countries.

Nairobi has also ventured into recycling but only at a very small

scale compared with the developed countries. A few reports that are available on recycling in Kenya indicate that it has greatly reduced the volume of disposable waste and has been a source of disposable waste and has been a source of income for some families (Khadaka, 1988 p.127). Recycling of solid waste if encouraged can improve the environment in low-income areas and help create employment for more low-income earners. The next chapter will focus on the present solid waste management techniques in Nairobi.

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CHAPTER THREE: SOLID WASTE MANAGEMENT AND ADMINISTRATION IN THE CITY OF NAIROBI

3.0 Introduction

In accordance to the Public Health Act, Chapter 242, Laws of Kenya, the local authorities are required to maintain cleanliness and prevent nuisance. The same requirement is enforced by the Nairobi City By-Laws, but despite these legislative, the Mairobi City Council has not been able to maintain a clean environment as is required. The Cleansing Section has not received the financial and administrative support that it requires to provide its services effectively.

3.1 Governing of the City Council

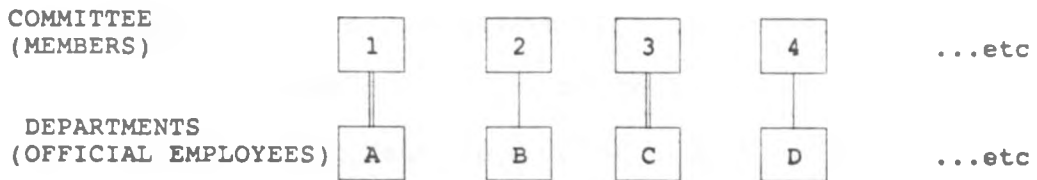
Since Kenya is a former British Colony, it has structured its local authority like those of Britain and is characterized by a very strongly developed departmental structure. That is, both their bodies of elected members and their employees are divided into committees and departments respectively. These committees and departments are closely related to a specific function of local government, usually defined by a particular Act (or series of Acts) of parliament.

The Council consists of the Town Clerk as the Chairperson of the

Council and a number of Councillors. The Councillors act in plenary assembly as well as in various committees. The NCC appoints the following ten committees from among its members: Finance Committee, General purpose Committee, Staff Committee, Works Committee, Town Planning Committee Water and Sewerage, Public Health Committee Housing Committee Social Services Committee and Education Committee. The City Council Functions by way of committees. These committees discuss matters relating to the Council's functioning and make recommendations to the full Council for adoption. In the case of controversial issues they are referred back to the appropriate committees or are given more time for investigation.

The Department- Committee relationship is not always one-to one. Sometimes a department may be required to report to several committees. For example, engineering department to the highways, finance and public works committees) and conversely several departments may report to one committee.

The reporting and supervisory relationship between committee and departments in British local government as well as the Nairobi City Council can best be represented diagrammatically as shown below.



The thicker lines represent a greater volume of reporting and direct control (Mcloughlin, 1973). A major factor that tends to reinforce the compartmental, "vertical" structure and behaviour is professionalism in their staff. This could be said to be the same in some departments of the City Council but not all. The Public Health Department under which the Cleansing Section falls is definitely not one of them.

Nairobi City Council like Local Authorities in Britain, has a program with a set of planned activities with the town clerk as the head. It is a social system deliberately established to provide services to Nairobi residents and all who come to the city for one reason or another. It consists of the following ten departments:

- The City Engineers Department;
- Water and Sewerage Department;
- Education Department;
- Housing and Social Services Department;
- City Planning & Architectural Department;
- Public Health Department;

City Treasurer Department;
Dousing Development Department;
City Inspectorate Department; and
Town Clerks Department.

Each of these Departments consists of a number of people in a pattern of relationships. The pattern is not entirely dependent on a particular persons who belong to the organization at a given time. The City Council assigns a position to each of its members, and the incumbent of a position has a set part to play in the Council. Each of the departments can also be said to be an organization in its own right.

Nairobi City Council- is characterised by a collective identity; a roster of employees, a program of activities and a time schedule to go with it; a table of organization; a set of formal rules partly contradicted by informal rules, procedures for adding and removing members; a history, a special vocabulary and many others. It also has has a division of labour that allocates specialized tasks to its members and a status order that awards them unequal shares of authority, honour, and influence.

Administratively, the cleansing Section is not accorded the power and authority that it requires in

decision making processes. Being a Section of a department, means reporting to departmental Head before taking important decisions. The cleansing Superintendent is placed on scale 6 whereas other Section Heads are on scale 4, and yet he heads one of the most important and demanding Sections in the Department.

3.2 Finances:

Nairobi City Council has time and again cited financial limitation as one of the major obstacles that effective solid waste serve delivery. This though does not mean that the Cleansing Section activities do not raise enough funds to purchase all the required equipment, but that the required budget allocation to the Cleansing Section by the City Treasurer is what is limited (Ksh 8,932,400). The table below is an indication of what the Section spends in a given year.

**Table 3.1: Cleansing Section Expenditure in Kenya
ponds for 1989.**

SECTION	EXPENDITURE K£
CENTRAL ADMINISTRATION	291310
CONSERVANCY NIGHT SOIL	15510
REFUSE REMOVAL	1311000
GENERAL CLEANSING	2051380
PUBLIC CONVENIENCE	157410
SWEEPING SERVICES	9590
TOTAL (K£)	4,466,20

Source: NCC records, 1989

Apart from revenue raised by various departments, Nairobi City Council is empowered to impose taxes on property, Service charge, property taxes and others to finance her activities. The Nairobi City Councils get her revenues mainly from the following resources: land and property rates; nursery school fees; other fees and charges for services rendered and goods supplied; licences from certain trades, occupations, people and items; profits like trading undertakings like restaurants, canteens, hotels, bus services, stalls, parking meters and use of other facilities (NCC. re-

cords). When the City Council finds that its tax revenues are insufficient to finance all the expenditures that it has budgeted for, there are other options that can be used to finance the deficit. These include:

- . Raising taxes;
- . Borrowing form external sources; and
- . Seeking assistance in form of grants.

The City Council also tap some leading international agencies like the World Bank, the OPEC, USAID, NORAD, Overseas Development Assistance (ODA) and others. Service charge is greatly relied upon by the City Council and therefore deserves some attention in this report.

The Local authority Service Charge Act, of 1988, was enacted to enable local authority to levy service charge. The local authorities service charge regulations, were published under legal Notice No. 525 giving details of its implementation and operation.

It is the need for increased revenue that prompted the government to levy service charge. Service charge was chosen for various reasons. Instead of charging for direct benefits received, it enables residents in local authority area to contribute to the provision of both public and mixed services of which they cannot be excluded from. Service charge has another advantage in

that it has some relationship with the ability to pay. Unlike the former Graduated Personal tax, Service Charge is payable by all employed persons thereby creating a wider target group while at the same time those who benefit from public services and are registerable are made to pay.

Employed persons residing in Kenya, and with a monthly income exceeding Kenya Shillings 700 are liable to pay service charge at a rate set out in the first schedule to the local authorities service charge Regulations, 1988. The minimum charge payable is Ksh 10 per month, while the maximum charge payable is KSH.100 per month. This tax is progressive on income between sh.700 to Ksh.6,000 above which it becomes regressive.

The tax is inequitable in that people with lower income are taxed at higher rates than those with high incomes. For instance, a person earning Ksh. 6,000 and another earning Ksh.20,000 all pay Ksh.100 per month.

Table 3.2: Rates of service charge payable by employed persons.

Basic income: ksh. Per month		Service charge per month Ksh.
Nil and not exceeding	700	nil
Exceeding 700 but not exceeding	999	10
'' 999 '' '' ''	1,499	20
'' 1,499 '' ''	1,199	30
'' 1,199 '' ''	2,999	40
'' 2,999 '' ''	3,999	50
'' 3,999 '' ''	4,999	60
'' 4,999 '' ''	5,999	70
'' 5,999 and above		100

Source: Local Authority Service (Chapter 274 p.18)

Since service charge is a relatively new tax and no research has been carried out to clearly show its success and weaknesses, only a few administrative problems can be highlighted.

1. delay in remitting the money deducted from the employees;
2. self employed persons are difficult to get to make the payment.
3. Inadequate staff in the service charge department.

4. Increased pressure to provide services to justify the use of service charge revenue;
5. Too much demands placed on service charge.

By 1966, County Councils used to receive 33 per cent of their annual revenues from Central Government while Municipal Councils got only 3 per cent. All such grants were withdrawn in 1970, and by 1974, the graduated personal Tax (GPT) was also abolished. This left municipal Councils with property rates and fees and charges as the only source of revenue.

Reliance on limited revenue base has made it impossible for local authorities to provide quality services. The expected revenue always lags behind expenditure leaving no choice but to default in debt servicing, service delivery, payment of creditors and remission of statutory deductions.

3.3 Waste management

The beginning of solid waste management in Nairobi can be traced as early as 1901 or thereabouts. The population of Nairobi at the time was only 8,000. As the population continued to grow, a private company was contracted to collect garbage, clean the drainage system, sweep and light the streets. The contract though did not

last long as the company failed in its duties (White, 1948).

The Nairobi City Council Public Health Department-Cleansing Section has since then been responsible for waste collection in residential, commercial and industrial areas. It is also responsible for night soil collection, street sweeping and dead animal collection. To provide services, specialised refuse containers are required. These must be supported by properly equipped workshop facilities to provide efficient maintenance and repair services. Infrastructure in form of offices and storage yards must also be provided. Qualified persons to carry out the repair works are also necessary. Sufficient funds should be availed to cover day to day running cost like fuel, maintenance and labour charges. Funds for equipment renewal must also be set aside.

The cost for refuse collection is currently shared between the local government and the community, but the budget barely cover the running costs. The current charges of sh.10 are not adequately collected and that is why the funds collected are lower than they should. Also the fact that only people with water meters are charged dustbin fee, leaves out many city residents to enjoy free services. Dustbin charges should be levied with the

ability to pay rather than a standard charge. Ability to pay should be determined by use. Those who use more water should be able to pay more for dustbin.

3.3.1 Organizational structure: Cleansing section

The responsibility of solid waste management is vested in the Cleansing Section of the Medical Officer of Health (MOH) Department. The sections area of jurisdiction is divided into two divisions:

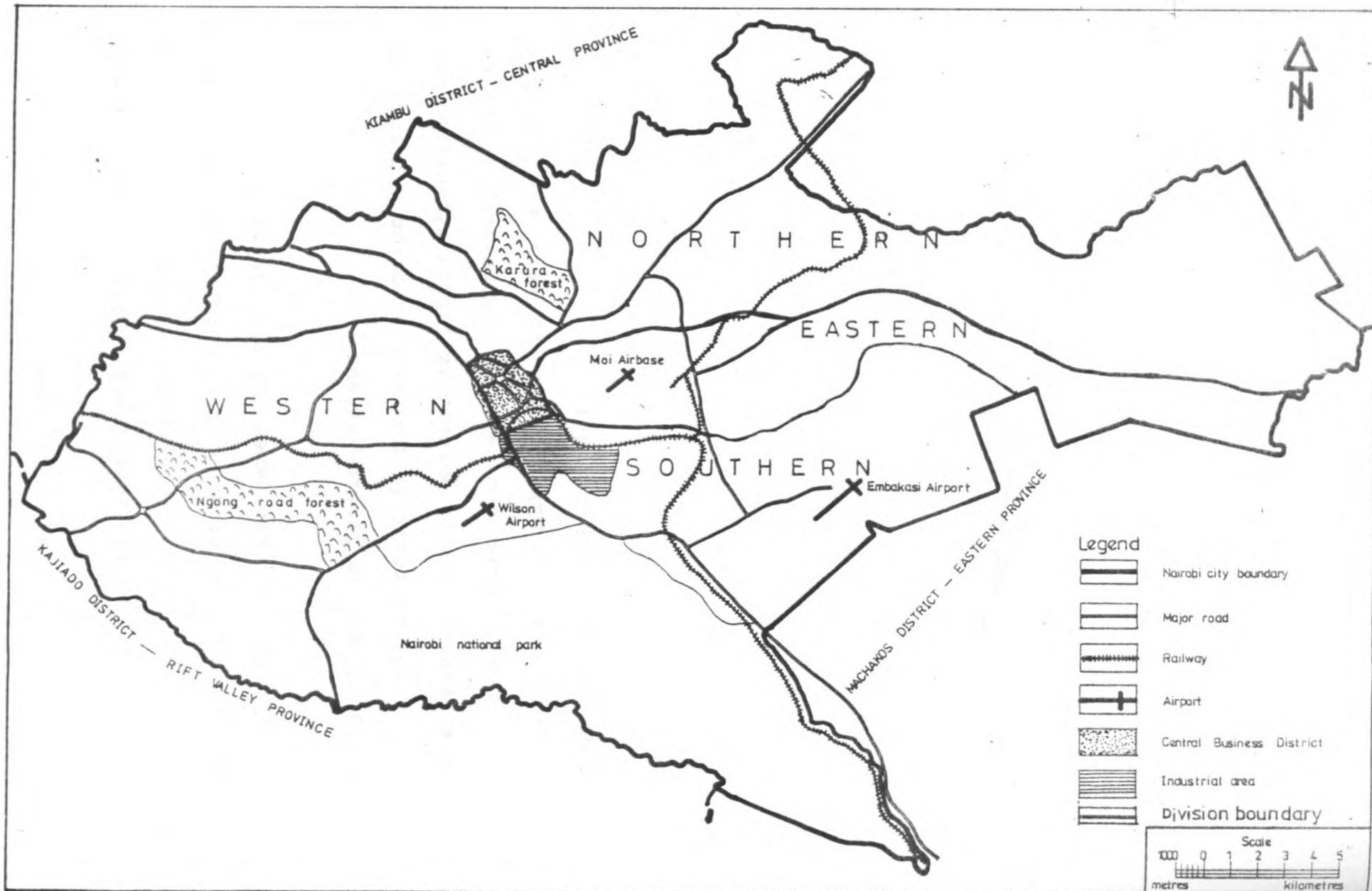
- (1) The First division comprises of the Northern, Eastern and Southern Districts; and
- (2) The Second division comprises of the Western, Central and the Central Business District (CBD).

The areas served under those divisions include:

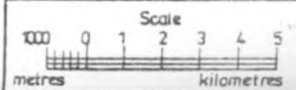
- (a) Western - Kilimani, Kibera, Kawangware, Lavinton, Karen;
- (b) Northern - Ngara, Lower Kabete, Muthaiga;
- (c) Southern - Industrial area;
- (d) Eastern - Eastlands;
- (e) Central - City Centre;
- (f) Night Operation - CBD.

The whole section is headed by a Cleansing Superintendent; and each of the two divisions is headed by an

CLEANSING DIVISIONS



- Legend**
-  Nairobi city boundary
 -  Major road
 -  Railway
 -  Airport
 -  Central Business District
 -  Industrial area
 -  Division boundary



daily trips, environmental and health issues, accidents and deaths and other matters concerning the sections activities. Lack of such vital information has affected the planning and management of the cleansing section.

3.3.3 Cleansing Section Personnel

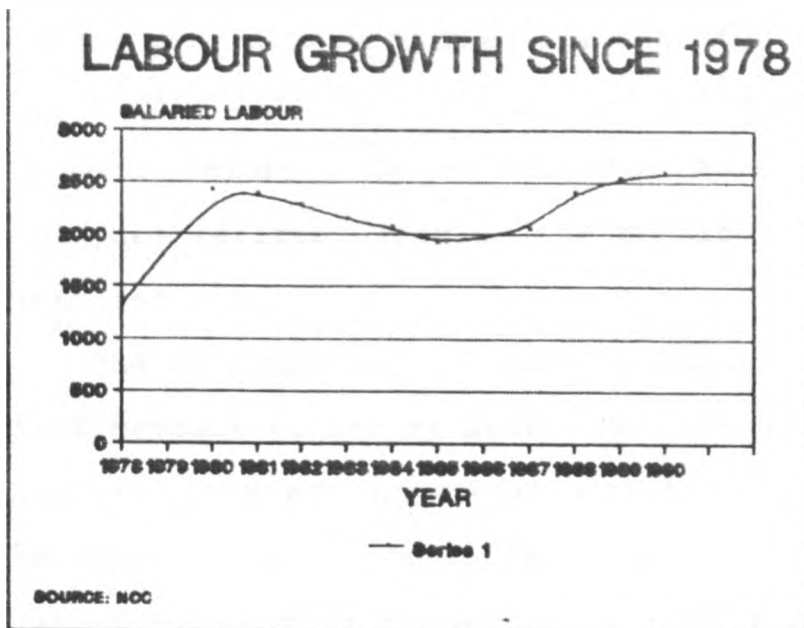
A lot of posts in Cleansing Section are unfilled. This leaves a lot of workers in acting capacities for a long time. Also shortage of supervisory staff over burdens the few making them to work even over the weekends (NCC records,1990).

Table 3.3: Staff analysis

	Present Assignment	Establishment	Vacancies	Recommended
Cleansing Superintendent	1	1	1	1
Asst. Cleansing Superintendent	Nil	2	2	3
Add. Asst.	Nil	1	1	1
Inspectors	Nil	5	5	8
Senior F/men	7	9	2	12
Foremen I	1	12	11	15
Foremen II	2	3	11	15
Senior H/men	34	36	2	50
Senior C. O	1	2	1	2
Clerical Officer I	Nil	Nil	Nil	4
Clerical Officer II	4	2	1	2
Clerical Officer III	8	10	2	36
Headman	Nil	Nil	Nil	225
Manual workers	2616	3214	598	6000

Source: NCC Records, 1990

Chart 3.1: Labour growth since 1974



Source: NCC Records, 1990.

The data above gives the number of salaried employees only, although casual workers play a major role in the actual collection of refuse and street sweeping. The sudden increase in the number of employees after 1978 was due to the presidential directive of 10% labour increment. The low-labour growth since then can be attributed to financial constraints facing N.C.C as a whole.

3.3.4 Cleansing Section Death rates:

Death rate of the section's employee is very high compared with other sections of the same department. In

1990 for instance 12 deaths were recorded and another 17 workers were dismissed the same year for abscondment of duty. This left the section with 29 workers less than the year before. By end of that same year, 92 more employees retired, leaving the section in a worse off situation.

The City Council's Cleansing Section loses a lot of staff members either by death, retirement, abscondment, dismissal or transfers to other sections or departments. The section is comfortable only with the number of drivers. According to Section's (1990) annual report, there were 140 drivers against 73 vehicles. This indicates that there are about 2 drivers to one vehicle.

3.3.5 Nairobi City Council Political appointees

These are not fulltime employees of the City Council and are therefore not included in the organizational structure. In most cases, men and women who are appointed chairman of the city council, are usually skilled politicians. Most of them know what to negotiate and where to hold firm, but they do not have the specialized knowledge on how to run an organisation which is common knowledge to higher administrators. Despite this lack of knowledge in administrative matters, most chairmen may not wish to take the advice of their senior civil

servants, except when they are forced by circumstances to do so since there is no other well-informed and disinterested source to which they can turn. Such pride creates information gaps that may disadvantage the running of the council and the provision of services.

3.3.6 Departmental Communication

Nairobi City Council being a large communication Network has certain limitations that hinder effective communication. Some of them may include:

- (1) Memos between and within departments are not explicit.
- (2) Memos once written are not always responded to in time.
- (3) One's level in the department may increase the difficulties in communicating with someone on another level.
- (4) Faulty transmission of information as it passes through many people, and
- (5) Bypassing people in the communication channel.

For effective communication to be achieved, the MOH has to see to it that there is adequate flow of information upward, downward, inward and outward. The adequacy of this information flow can be measured by the extent to which members of staff get their needs attended to by the

right people and at the right time. The fact that some cases of employees injury at work do not get any attention means that there is a communication breakdown within the department.

The study found out that some areas were no longer receiving collection services and no reports to that effect had reached the Cleansing Superintendent at City Hall.

Effective communication is limited by poor routine reports prepared for the department. Lack of graphic or numerical forms of presentation is an hinderance to effective communication. Physical separation of district offices and City Hall also contribute to communication breakdown.

3.4 Waste Generation

Studies carried out in the past have indicated that solid waste continue to be generated faster than it can be disposed. According to the UNCHS report of (1988) each person generates 0.5 Kg of waste per day, and the daily volume of waste generated in Nairobi currently stand at 800 tonnes. Of that amount only an average of 300 tonnes is collected (NCC records, 1990). The major type of waste generated in the city is domestic waste also referred to as household garbage or residential refuse. It comprises

wastes that result from household activities. Other sources of waste include commercial and institutional waste, street sweeping construction materials, industrial waste product, garden waste, and sanitation residues. The type of waste vary according to the dominant land use and the socio-economic status of the residents.

3.5 Storage equipment

Solid waste containers range from small to large. The requirement of refuse receptacles is that they should be waterproof, durable, easy to clean and handle, and should have a tight fitting cover to prevent entry by flies, rodents and wild dogs. Refuse receptacles are designed to serve varying residential densities, some are designed for high and others for low density residential areas. There are some too for business districts.

The official storage containers are standardized. There are also non standardized containers that are used by various households who do not have access to the standardized ones. Receptacles of various sizes and shapes are handled differently during collection and transport transportation. Plastic containers are most preferred by many in that they are easier and lighter to handle. They do not rust and can therefore last longer. Plastic bags are mostly preferred because they are easy

to handle, are highly sanitary, and require no return operation.

Bulkbins and other large open containers are supplied to commercial industrial institutional and some high density residential areas where a lot of refuse is generated. The following containers are provided by the Nairobi City Council for refuse storage although in limited numbers.

**Table 3.4: Refuse storage receptacles
1981 - 1990**

YEAR	DUSTLESS CONTAINERS	BULK CONTAINERS	STANDARD CONTAINERS	DUSTBIN
1981	60	117	1441	184,916
1982	123	119	1526	199,224
1983	186	139	1572	210,234
1984	222	149	1599	218,991
1985	238	159	1609	232,166
1986	238	169	1614	241,340
1987	238	169	1624	254,284
1988	238	169	1624	259,684
1989	238	189	1891	273,034
1990	238	189	1891	278,187

Source: NCC. Records, 1990

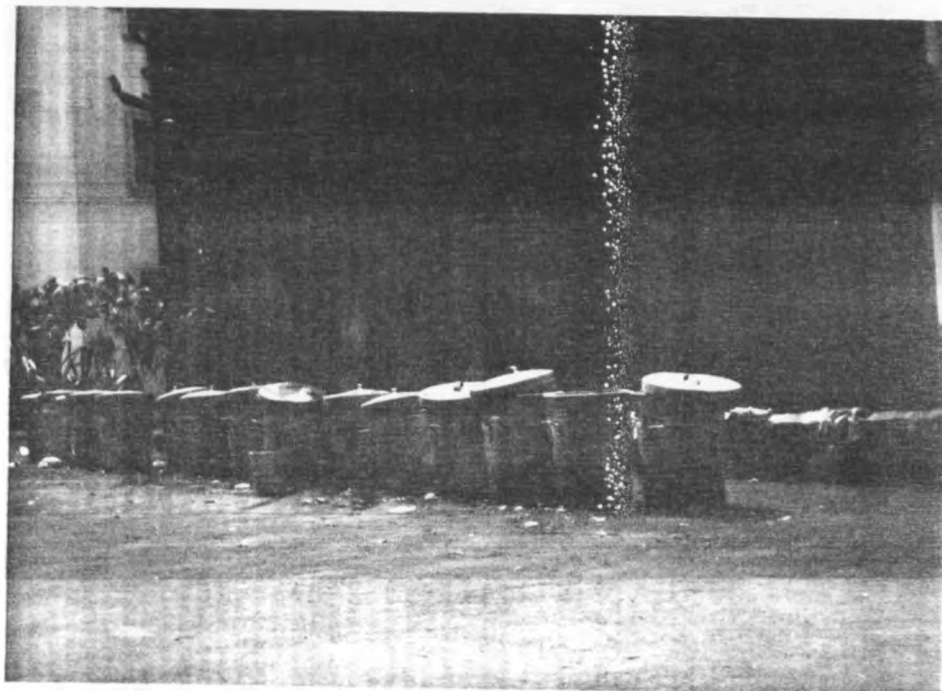
The figures shown above shows an increase in the number of dustbins between 1981 and 1990. The increase is insignificant compared to the need for dustbins in both new and old residential areas.

3.5.1 Dustbins

Dustbins are the standard containers for household garbage storage (plate N0.1). The most common dustbin is

made of steel sheet, but the new type is mostly plastic. They all have a capacity of 70 litres. The metal containers are locally made and are designed to last for three years, but usually last for 12 months (SULO, 1988 p.18). They are short lived because of poor quality material and they are not emptied frequently. In 1988, there were 250,00 dustbins distributed within the City (SOLU,1988). The few that are distributed are usually vandalised because the demand for dustbins is so high in the "Jua Kali" market that containers cannot be left out for any length of time in some areas. Such vandalism has rendered the use of Kerbside and tractor-trailers useless.

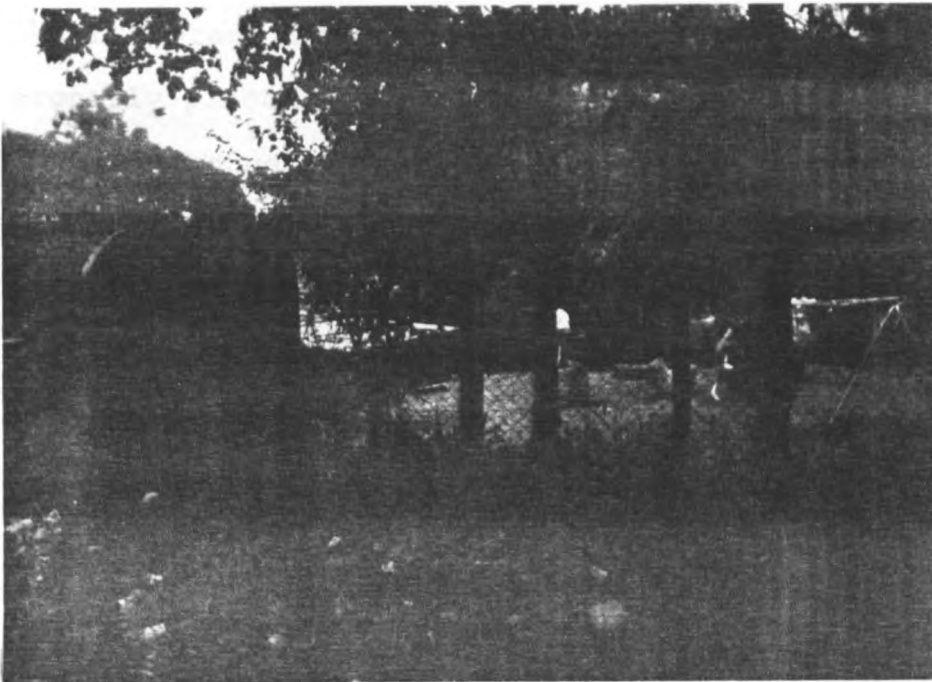
Plate 3.1: Dustbin



3.5.2 Standard containers

These are in short supply and therefore rare to find in residential areas. They are used for bulk storage. They roll on wheels and are thus easy to handle. Their capacity is about 1.30 m and are made of heavier gauge metal than the dustbins. They are emptied mechanically by special designed transportation truck.

Plate 3.2: Standard Container



3.5.3 Bulkbin containers

These are the largest receptacles supplied by the City Council. Their capacity is about 15m, and are meant for densely populated areas. There were approximately 189 and 8 bulkbin vehicles bulkbin containers in the

City by 1990 (NCC records). They are placed at strategic points so that dustbins and other smaller storage devices can be emptied into them. Once filled, they are transported to disposal sites by the bulkbin collector lorries.

Bulkbin containers have an advantage in that they increase speed and efficiency of handling large quantities of refuse, and reduce the cost of collection. The cost per unit of solid waste is lower than that of any other storage device. They can serve a large area if properly placed and emptied regularly.

To reduce corrosion due to contact with wet soil, and to facilitate their hoisting on trolleys of collection vehicles, the containers are supported by four steel legs of appropriate height.

Bulkbin containers can also serve as a collection point for refuse from gravity chutes in high-rise apartments and office buildings. For ease of collection by the trucks, all bulkbin containers are standardized. During collection, the filled container is usually replaced by an empty one so that storage is guaranteed at all times.

Plate 3.3: Bulkbin



3.5.4 Paper or plastic sacks

Paper sacks or plastic sacks are occasionally use as an alternative to dustbins. In Nairobi, no serious attempts have been made to introduce the system fully except for a few people who can afford it, and those that receive services from Bins (Kenya) Ltd. The sacks are placed in stands to keep them open and to protect them against the wind, rain and animals.

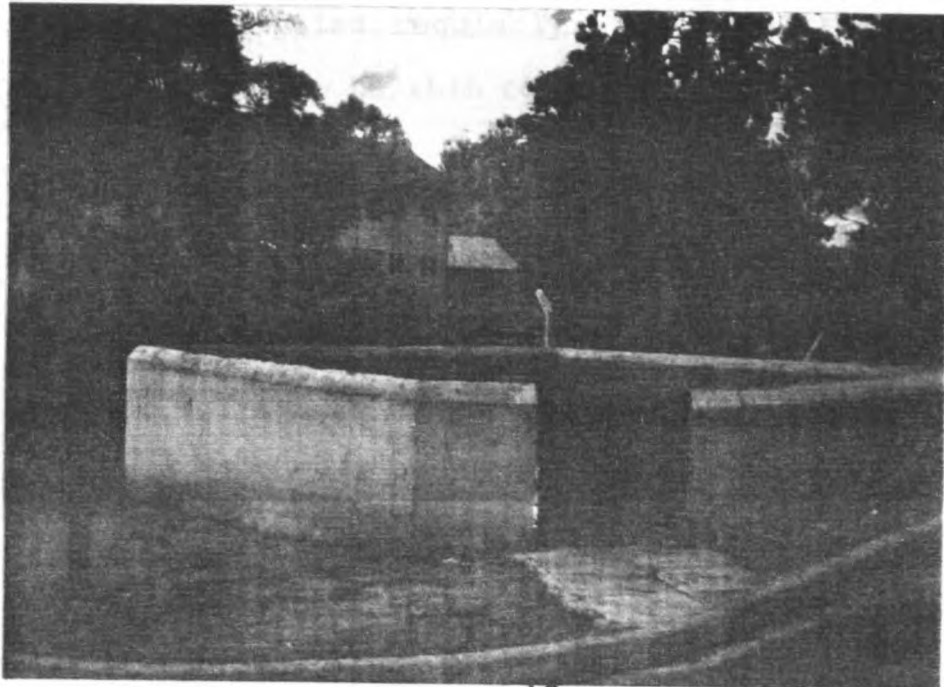
Collection is advantageous in that the sacks are easy to empty. Unlike the dustbins, they do not require to be cleaned and are therefore more hygienic. They reduce spillage, odour and are faster to collect. The major shortcoming of sacks is the high cost which many

households cannot afford, and the fact that they don't easily decompose once deposited at the dump site. Paper sacks are more available but are disadvantaged in that they cannot handle wetness. They are easily torn by sharp objects. They also increase the volume of waste to be disposed.

3.5.5 Cubicals

These are unmovable garbage containers constructed to store refuse before collection. They are most suitable for low and middle income areas where a number of houses are constructed together. These are also advantageous in that they cannot be vandalized. If constructed, they can handle very large volumes of garbage.

Plate 3.4: Cubical



3.5.6 Other containers

These include small litter bins mounted on stand, buckets of all types and shapes, tins and such. They are used by households who are not supplied with dustbins.

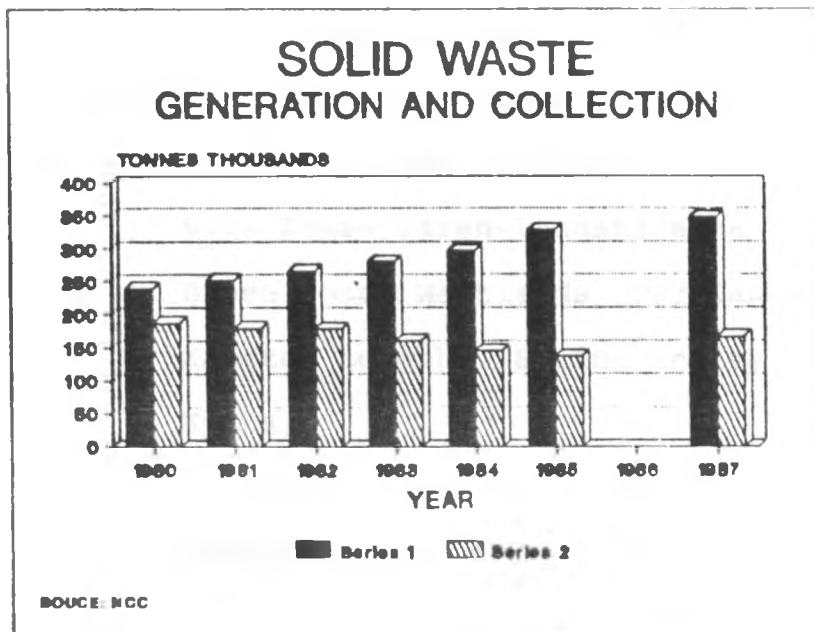
Litter bins have a capacity of about 15m³ and are located only in market places of the study area, where smaller storage receptacle are emptied. Due to their limited numbers, they usually fill up almost as soon as they are emptied. The number of bulkbins is so limited that it cannot meet the demands of waste storage in high density residential as well as market places. More bulkbins would reduce the need for so many families to use one container. Bulkbin containers are very convenient when placed in strategic places to serve a certain number of households. They can serve a large number of people if placed and emptied regularly. They are transported to disposal sites by bulkbin collection lorries where their contents are emptied.

3.6 Refuse collection

Refuse collection in Nairobi is the responsibility of Nairobi City Council. In most other cities of the world however, the collection and disposal of solid waste is contracted to private companies. The Nairobi City Council has allowed private collection only in a few high

income residential areas but City Council services are also offered there as well. Refuse in Nairobi is supposed to be collected every day in the City centre, three times a week in low income areas, two times in high income areas and every working day in the industrial areas, hotels, large institutions and hospitals. Unfortunately, the city council is unable to effectively collect refuse as it is supposed. As a result, low-income areas suffer most because collection is left undone in most cases.

Chart 2: Garbage collection



Source: Nairobi City Council records

The chart above shows that garbage collection has been deteriorating since early 1980's despite the

increase of garbage generation. According to the Nairobi City Council annual report of (1988), 60% of the urban population is settled in low-income areas and more so in unplanned settlements. Since refuse is rarely collected in low-income areas, it can be concluded therefore that the figures shown above do not include low-income areas.

3.6.1 Privatization

Solid waste collection by private companies has not fully been ventured into in Kenya. Private collection is presently carried out by two major companies: the BINS (Kenya) Services Limited; and Domestic Refuse Collection Services. The companies and especially the BINS have divided the City into Zones and given them names of colours or direction as follows.

- i) Blue Zone- Karen-Langata area;
- ii) Green Zone- Westlands, Parklands, Lower Kabete, Loresho, Spring Valley, Lake View and Kyuna;
- iii) Red Zone- upper hill, Woodly, Thompson Estate Kilimani and milimani;
- iv) South Zone- South B, South C, Plainsview and Nairobi West;
- v) White zone- Muthaiga Rosyelyn and Runda;
- vi) Yellow Zone- Lavington and Kileleshwa; and
- vii) Central Business District and Industrial

area (Collection is on daily basis) (Kihiu, 1990).

Garbage in these areas is collected once a week at a fee of about Sh. 240 a month (except the CBD and industrial areas). The population served in all zones is about 4,000 to 5,000 households. There are plans to extend private garbage collection to other residential areas but details have not been finalised. According to Kihiu, (1990), more people would be willing to engage private collection but they feel that the City Council should provide the services.

3.6.2 Collection frequency

The collection frequency in Nairobi depends on the availability of collection vehicles and their type. It also depends on the method of collection used, the type of storage containers, the quality and quantity of refuse to be collected and the socio-economic status of the area served. The weather may also influence the collection frequency in one way or another. In western division for instance, a side loader makes two trips a day, but a bulkbin carrier can manage seven trips a day. Tippers on the other hand can manage only a few or many trips a day depending on the method of loading. If loading is done mechanically, then many trips may be achieved. If the

loading is done manually by use of shovels then only one or so trip/s can be made. Generally speaking, the available number and type of collection vehicle plus the method of loading is what determines the number of trips achieved in a day, hence the volume collected. According to SWECO report (1974), refuse collection stood at 2 times a week in high-income areas. The total garbage collected then was 173,783 tonnes compared with 66,248 in 1987. The variation in the amount of waste collected in a certain year is shown below.

Table 3.6: Waste collected (monthly)**1986 - 1990 In Tonnes**

YEAR	1986	1987	1988	1989	1990
Jan	9271	9771	5903	6368	10541
Feb	8136	9675	5345	6779	9601
Mar	9490	10448	5166	7403	8519
April	9958	10168	5647	6975	8602
May	9221	8762	4983	7391	9482
June	9792	8618	6796	9509	9976
July	9716	8806	7734	8586	10737
Aug	10135	7921	8790	8872	10932
Sept	9413	9070	6720	9456	10188
Oct.	9094	7916	8164	10060	10699
Nov.	7789	6686	7090	11558	9090
Dec.	10409	6614	6611	12464	9602

Source: NCC Records, 1990

According to the figures above, there was a great decrease in waste collected during the first six months of 1988. Due to poor vehicle maintenance. The amount of refuse collected picked up from October 1989. This was due to the newly purchased trucks during the month of July 1989. In October of the same year private vehicles were hired to help clean up the city in preparation for the 10 Nyayo Anniversary.

Table 3.7: Solid Waste Generated and Collected 1980-87

YEAR	GENERATED TONNES	COLLECTED TONNES
1980	238,274	187,395
1981	250,692	178,834
1982	264,480	178,136
1983	279,179	159,974
1984	295,179	144,650
1985	327,644	136,805
1986	-	110,424
1987	346,665	166,248

Source: N.C.C Records, 1989

3.6.3. Methods of refuse collection

So far the City Council has evaluated a few alternative methods for better service delivery but has not adopted any for various reasons. One such method is the use of "Mkokoteni" (handcart) in planned settlements. Discussions on this matter were interrupted by political changes at the City at City Hall. Hopefully the new Councillors will continue with the discussions. Sub contraction is yet another option that is currently under discussion at City Hall. The idea of sub-contraction was

brought about by the World Bank as an alternative to importation of expensive collection vehicles. No final decision has been taken on this matter as yet. There are many technical details to be worked out first although the City Council supports the idea (Allums, 1992). The other alternative method of introducing an incinerator was recommended by SULO (1988) and is also still being discussed because the cost must be quite high although the report never gave the actual amount. Lack of adequate finances is the major reason given for not adopting such alternatives hence the continuation of poor solid waste management in the city. Finances are just a part and not the only problem in waste management. Some of the other attributes include total dependency on vehicles, fuel and spare parts that are imported. There is also limited source of income but a flow of expenditures. What has so far facilitated the management of solid waste in low income areas is informal collection through scavenging and burning of refuse.

3.7 Collection vehicles

Presently, there are various types of vehicles used to collect refuse. Some of the lorries used have closed sides with or without compactors and have either side or rear loading facility. Open trucks are also used.

3.7.1 Trucks

These are open and used for collecting solid wastes from dustbins and any other containers. Even waste that is deposited on the ground is also scooped into these vehicles.

Trucks are the cheapest to acquire and maintain. Their constraint lies in that they cannot control the spread of refuse by the wind as the truck moves on. This therefor makes them unhygienic.

Closed lorries without compactors: They have greater capacity than ordinary trucks. They are mostly used to transport domestic waste from residential area. Their enclosure prevents the waste from being spread by the wind and are hence more hygienic than the trucks.

Closed lorries with compactors: There are two kinds of compactor trucks. The rear loaded and side loaded compactor trucks. They are much more efficient than other kinds of trucks in that they grind and compact the refuse, hence the ability to transport more waste in a single trip. Unfortunately, the few side loaders that exist are grounded due to lack of spare parts. There are however four rear loaded truck still on the road.

3.7.4 Side loader with cranes:

These can be loaded mechanically or manually. They

are mostly used for door to door collection of refuse in high and middle-income residential areas served with dustbins. They are emptied mechanically.

Plate 3.5 Side loader



3.7.5 Bulkbin collector vehicles:

They are designed to collect bulkbin containers. They have cranes that hoist containers for emptying and replace them with empty ones.

3.7.6 Tractors

Tractors are used at the dump sites or at the collection points to load the trucks. Since they are few in number, they keep on moving from one division to another to offer the services.

3.7.7 Cars, "matatus" and others

These are mostly used to transport workers and supervisors to various collection and disposal sites in Nairobi. They are also used to transport equipments and spare parts in cases of breakdown of other vehicles in the department. "matatus" in this respect does not mean public transport but the body type of the vehicle.

Table 3.8: Class of Vehicles 1990

Class of vehicles	NUMBER
Refuse vehicles compactors (Rear loading)	4
Refuse vehicles (side loading)	30
Bulkbin vehicles	8
bull dozers - pool	2
Tractor shovels - non pool	1
Scooters	17
Tippers	5
Pick ups	6
total	63

Source: NCC records, 1990

3.8 Disposal methods

The major waste disposal method in Nairobi is by controlled tipping in a former quarry site at Dandora.

Other disposal methods used in Nairobi City include composting (pits), open air burning, incineration (limited to hospitals) and open dumping along streets and fields being the most common in low-income areas where population densities are high and collection poor, open burning is very common in low-income areas and market places.

Incineration is limited to hospitals and research institutions where some of the solid waste is burnt using special incinerators to avoid contamination of less harmful wastes.

Composting is most common in high and middle-income areas, as well as schools and other institutions with large compounds. Composting requires digging a pit in the backyard where vegetable waste, paper and garden trimmings are deposited. The pit is finally covered with soil to reduce odour.

Unlike the developed countries where rubbish is used to generate gas, solid waste in Kenya is left to rot away without being put into further use.

3.9 Summary:

Solid waste management in Nairobi has always been a problem. Lack of adequate funds, appropriate storage equipment and transportation vehicles has dragged the

collection and disposal of solid waste in Nairobi. Poor management and limited personnel has greatly contributed to inadequate solid waste management not only in the low-income areas, but also in the whole city.

The next chapter will highlight some of the major problems experienced in low-income areas in Nairobi and what is being done to improve the situation.

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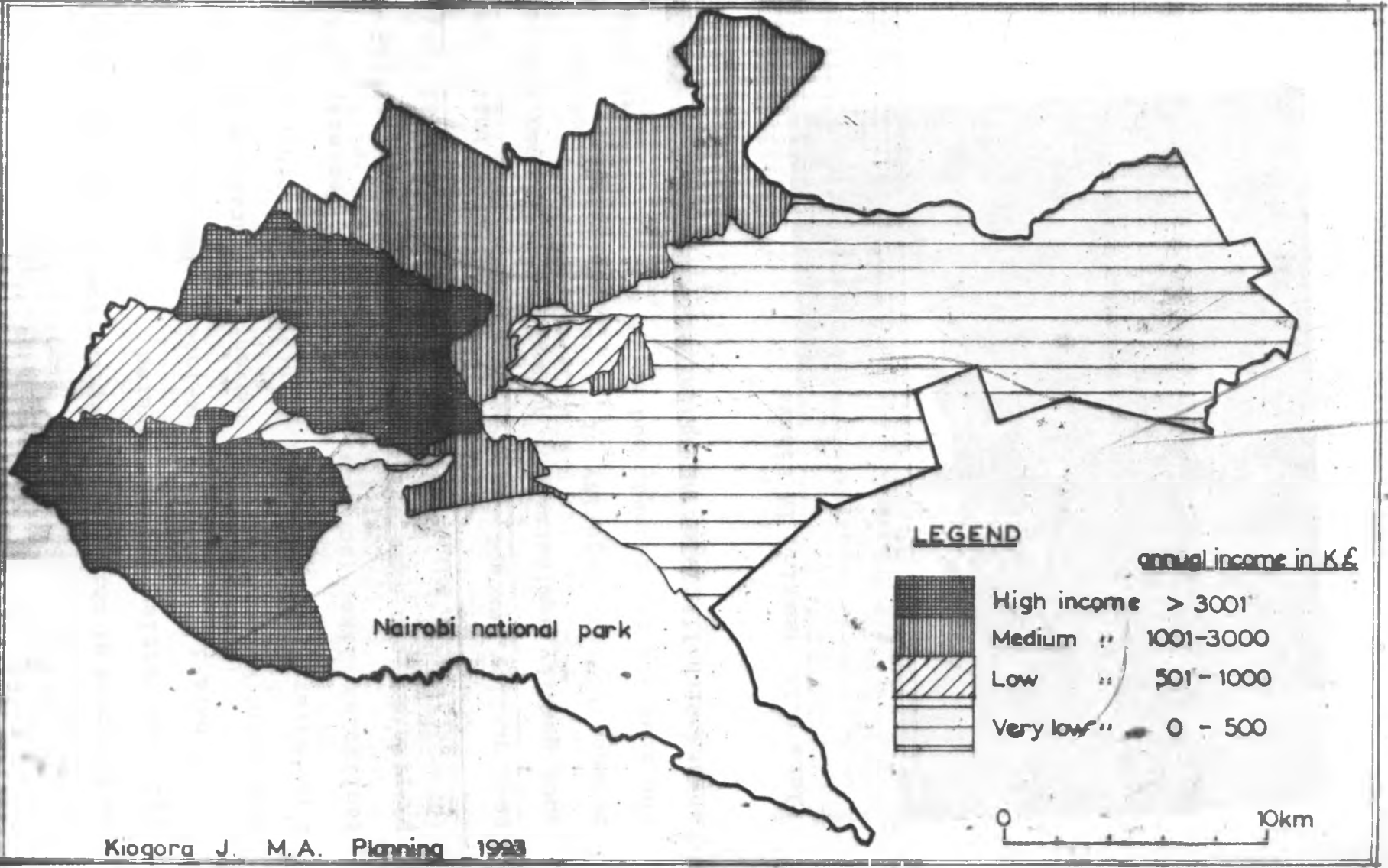
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NAIROBI - DISTRIBUTION OF INCOME

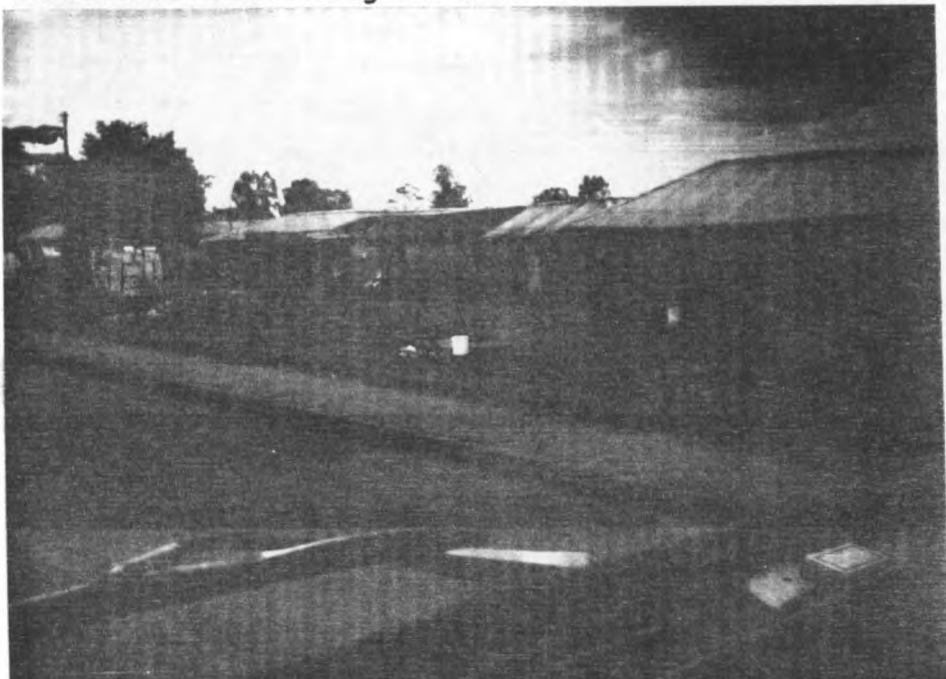


For purposes of this study, only the low-income area (the unplanned settlement) was covered.

Kibera is not just a low-income, but an unplanned settlement with no roads, no conventional drainage system a few water points and a few public toilets. Other public facilities like (schools, health care centers, and playfields) can also be said to be missing or limited.

Shelter in Kibera like other slum areas is of very poor quality, except for the Old Kibera where there are good quality semipermanent houses and some open spaces between houses. Majority of the dwellings elsewhere in the area are one roomed, mud walls and roofed with Iron sheets with little or no space between them.

Plate 4.1: Housing in Kibera



Unlike Dandora and Kawagware, Kibera has no access roads and therefore most parts cannot be reached by conventional method of solid waste collection. Lack of finances has held the City Council from installing a refuse system which does not require transporting waste by road. Other alternative methods are also lacking in the area.

The condition of solid waste in Kibera could be described as pathetic. The actual situation cannot be described in words, but only photographs like the ones below can attempt to deliver the message.

Plate 4.2: Uncollected garbage in Kibera.



The congestion of dwellings in Kibera has left very little room for dumping solid waste leave alone collecting it. Drainage is yet another major problem in the area. The swallow trenches that are dug for drainage are in most parts clogged by refuse that is carelessly disposed of. Such refuse does not only contain household waste but human waste as well. The resulting odor is too much for the residents to bear.

4.2.2 Household size

Field survey results from Kibera have shown that women are mostly involved in the disposal of household refuse. Of all the respondents interviewed, 88.6 percent were females and only 11.4 per cent were males. This is also an indication that most women in Kibera are unemployed and to a large extent depend on their husbands salaries to meet their basic needs. House hold sizes in Kibera are as follows:

Table 4.1: Household size

FAMILY MEMBERS	Percentage of household
1-3	31.4
4-6	31.4
7-9	31.4
10 and above	7.7

Field Survey, 1993

4.2.3 Family Income

The average income of Kibera residents was found to be Ksh. 650.00/month. The table below show the categories of Kibera residents total monthly income.

Table 4.2: Total monthly Income

Total Income	Percentage of households
0-499	14.7
500-799	29.4
800-999	17.6
1000-1199	20.6
1,200 and above	17.6

Source: Field survey, 1993

4.2.4 Waste generation

The major waste generated in Kibera is waste paper (42.9%). The main reason for so much waste paper generation is due to wrapping of all kinds of things purchased from the market or elsewhere. There is a tendency these days to wrap things even when wrapping is really not necessary. Wrapping of items especially vegetables has become a way of pleasing the customers. The previous practice of ladies carrying baskets to the market has died out and now people must have their things wrapped with or without a basket. The table below is an indication of how waste paper compares with other types of waste in terms of volume.

Table 4.3: Type of Waste Generated

Type of waste	percentage of household
food waste	40.0
plastic	5.7
paper	42.9
all	11.4

Source: Field survey, 1993

4.2.5 Waste storage

Household waste generated in Kibera is stored in all kinds of containers. Some households store their refuse in basins or buckets, others store theirs in cartons, and

others in tins. The figures below show that nobody in Kibera owns a dustbin.

Table 4.4: Type of Container used

container	percentage of household
basin/bucket	65.6
tin	9.4
plastic container	12.5
carton	12.5

Source: Field survey, 1993

4.2.6 Waste collection

Solid waste from Kibera (study area) is never collected by the City Council. The generated refuse is thus left to decompose and degenerate. The process of decomposition causes a lot of inconveniences. Some of the inconveniences caused by uncollected refuse are: smell, blockage of walkways, health hazards and aesthetic.

4.2.7 Waste transportation

Solid waste from Kibera residential areas is actually not transported but moved to a collection point not far from the dwelling unit (62.9% of the households have their disposal sites less than 50 meters). Most people do not have an access to a bulkbin container since it is placed far away from where most people live. The

table below is an indication that most residents have no access to a bulkbin and therefore they empty their garbage on the ground. The frequency of disposal depended on the nature of waste at the time and the type of container used for storage. 32% of the households indicated that they empty their containers twice a week.

Table 4.5: Where Waste is Deposited

Container	Percentage of household
bulkbin	5.7
cubical	2.9
ground	71.4
fallow	5.7

Source: Field Survey, 1993

4.2.8 Waste Disposal

The most common methods of waste disposal is burning, whereby refuse is heaped together by volunteers and set on fire. Whatever does not burn is left to decay with time. Another way of refuse disposal is by recycling, although there is very little of value to be salvaged from low-income areas. Most residents (70.6) of those interviewed indicated that they separate refuse before disposal, and that most of the separated material is reused. (2.9 per cent of the respondents use the paper

separated from garbage for starting fire. This therefore leaves behind very little waste paper to be salvaged for sale. Nevertheless, human scavengers frequent the site to pick whatever little they can get from the disposed refuse.

4.3 Dandora

Dandora residential settlement was developed for high-density low-income families. The two major developments are those of phase 1 (area 1) and phase 2 (areas 2-5). Phase 3 (area 6) has not been developed yet. The total population in five phases was about 50,000 according to 1979 Census. The housing characteristics of phase 2 is further divided into areas 2-5 referred to as phase 2 phase 3 and so on. Unlike Kibera, the housing units in Dandora are more permanent and the plots are in serviced plots. Roads are paved and street lights provided. Unlike the other two areas of study, Dandora is a planned low-income area.

4.3.1 Family Size

An average family size in Dandora has about three persons. This is much smaller than the other two areas under study. Like Kawangare, Dandora does not have very large families of ten people and above. The table below



is an indication of family sizes distribution in Dandora.

Table 4.6: Family Size

Family members	percentage represented
1-3	44.8
4-6	41.4
7-9	13.8

Source: Field survey, 1993

4.3.2 Income

Dandora tend to have a total monthly income below that of Kawangare but above that of Kibera. The total monthly income recorded in Dandora is as indicated below, whereby the average income is about Ksh.800.00. Unlike Kibera, there are no residents in Dandora with a total monthly income of less than Ksh.500.00.

Table 4.7: Total Monthly Income

Total monthly income	Percentage of household
500-799	17.9
800-999	25.0
1,000-1,199	39.3
1,200 and above	17.9

Source: Field survey, 1993

4.3.3 Waste Generation

A lot of waste is generated in Dandora because of the high population in the area. According to the 1979 census, 50,000 people lived in Dandora. This means that if every resident of Dandora produces 0.5 Kg of waste, there is a total of 25 tones or refuse to be collected each day. Most of the refuse generated consists mostly of paper and food remains. Since the dumpsite is next to the estate, one collection vehicle would be sufficient to serve the whole area.

4.3.4 Waste Storage

Residents of Dandora store their refuse in nonstandardized containers like the basin, cartons and tin. Most residents of Dandora phase one own dustbins, but those of other phases of the same Estate don't. 31 percent of all the residents interviewed indicated ownership of dustbin. Other residents who do not own dustbins use other containers as indicated below.

Table 4.8: Type of container

Type of container	Percentage of residents
bucket/basin	30.4
tin	4.3
plastic container	30.4
carton	34.0

Source: field survey, 1993

4.3.5 Waste collection

Waste collection in Dandora is not unified. Some phases receive services while others don't. Those that receive collection services are Dandora phase 1 and phase 2. Phase one receives regular services of once a week whereas phase 2 receives services once in a while without any definite period. The other three phases do not receive services at all. The reason why phase 1 alone receives regular services was not known but most probably is because of the City Council Deport that is located in the area.

For those other phases where services are not extended, the residents empty their containers on the ground like those other areas that we have discussed before.

4.3.6 Waste transportation

For those parts of the Estate that receive services, the waste thus collected is transported to the dump site a kilometer or so away. Those other areas where collection services are not provided, the residents carry their containers a few meters away and empty them on the ground.

4.3.7 Waste disposal

Solid waste disposal is either to the dumpsite, or to some heap on the ground. Waste deposited on the ground is left to decompose or to be eaten by animals. During the time of the study, there were many animals feeding on the heaps of garbage. Animal scavengers are also involved in the disposal since they salvage large volumes of useful materials.

4.4 Kawangware

Is located 10 kilometers from Down Town Nairobi. It is an upgraded slum and much better than the other two areas of study in that streets are swept every day although refuse is not regularly collected. Secondly, water is available, and all roads are paved. Kawagware is also advantaged in that it has street lights in good condition. Community participation has contributed a

great deal to the security and maintenance of certain services like water points and security lights.

The type of housing in Kawagware is also different from that of Kibera in that it is mixed. There are permanent buildings as well as semi permanent ones. Some of the permanent houses are even electrified. The development of Kawagware has been facilitated by the fact that the land tenure is different (freehold or leasehold from that of Kibera where the land belongs to the government.

4.4.1 Family size

The average family size of Kawagware residents is five persons. Unlike Kibera, no families had more than nine family members. The table below show the distribution of the family sizes.

Table 4.9: Family Size

Family members	percentage of respondents
1-3	25.0
4-6	62.5
7-9	12.5

Source: Field survey, 1993

4.4.2 Source of income

Most of the respondents indicated that they were self employed. It can therefore be said that self employment is the major source of income for Kawagware residents. The table below is an indication of the major sources of income. It can be noted here that no families depended on income from relatives as was the case in Kibera.

Table 4.10: Source of income

Source of income	Percentage of respondents
formal employment	37.5
self employment	62.5

Source: Field survey, 1993

The survey also found out that majority of the residents in the study are have a monthly income of Sh.1,000.00. The table below shows the total monthly income of the respondents, hence an average income of more than Ksh. 1,000.00. It can be noted here again that no households reported a monthly income of less than Ksh.800.00.

Table 4.11: Total Monthly Income

Income	Percentage of household
0-499	---
500-799	---
800-999	12.5
1000-1199	31.3
1200 AND ABOVE	56.3

Source: Field survey, 1993

4.4.3. Waste generation

The major waste generated in Kawagware is household waste consisting mainly of paper (43.8) percent. It should be noted that not all waste that is generated that is disposed. Some of the waste generated is separated to be used in other ways. One of the most common use of salvaged materials is starting fire. Waste paper is very much used to start fire since most people in low-income areas use charcoal as fuel for cooking. Kawagware residents however, tended to use "paraffin" more than they did Charcoal. That is why the percentage of the residents using paper to start fire was smaller than the other two areas. It was also noted that most Kawangare residents use fresh milk from the farms nearby, so they do not generate a lot of paper from milk packaging like other residential areas.

4.4.4 Waste storage

Solid waste generated in the study area is mostly stored in buckets/basins. Although 31 per cent of the respondents own dustbins, still a greater percentage use all kinds of containers to store their refuse.

Whatever kind of storage devise was used, most respondents tended to empty their refuse twice a week. Other emptied their refuse either once a week or three times a week as indicated below.

Table 4.12: Frequency of emptying the container

Container emptied	Percentage of household
once a week	31.3
twice a week	37.5
three times a week	31.3

Source: Field survey, 1993

Since like in other low-income areas Kawangare is not well served with communal storage containers, most residents tend to empty their refuse on the ground (75%). Only 18.8 per cent of those interviewed had an access to the Communal bulkbin by the market entrance. The remaining 6 percent emptied their refuse in a pit somewhere near their residential unit. Most residents indicated that their collection points were about 50 meters away.

4.4.5 Waste collection

Like other low-income areas, no collection services are extended to the residential areas of Kawangware. The only collection that is done takes place along the road and at the market place. Cleaning services (sweeping) are however provided to the market areas and along the major streets. This makes the place look much cleaner than most other low-income areas. Unlike Kibera where refuse is thrown everywhere, Kawagware residents tend to empty their refuse at a certain point where it can easily be burnt.

A lot of variable waste is also collected by scavengers for sale. Nearly everyone who was interviewed reported to have seen scavengers on site picking one thing or another, although most (68.8) were seen picking paper.

4.4.5 Waste Transportation

Since solid waste is not collected from the residential areas it is therefore never transported. The only collection that takes place is that of the communal bulkbin and the heaps along the road. Since the bulkbin is not meant to serve the residential areas it was difficult to establish how often its content is collected and transported for disposal.

4.4.6 Waste disposal

The most common method of disposal is burning. Apart from the little garbage that is separated to feed animals, make fire and for other uses, most of the refuse is collected in one area and set on fire by volunteers who are themselves residents of the area. Refuse that is too wet or too difficult to burn is left to decompose with time. That is usually the garbage that usually forms the "mountains" that characterize low-income areas.

Lack of adequate disposal of refuse from the collection points has caused Kawangware residents a lot of inconveniences. Some of those noted were as follows:

Table 4.13: Solid Waste Inconveniences

Inconvenience	Percentage inconvenience
Smell	23.1
Blockage of way	46.2
Health Hazard	23.1
Aesthetic	7.7

Source: Field survey, 1993

It is once again noted that heaps of uncollected garbage tend to block the way for most low-income residents, thus causing them a lot of inconveniences. Aesthetic and health related issues are not so much

valued since the residents are not fully aware of the dangers associated with them.

4.4.7 Solutions

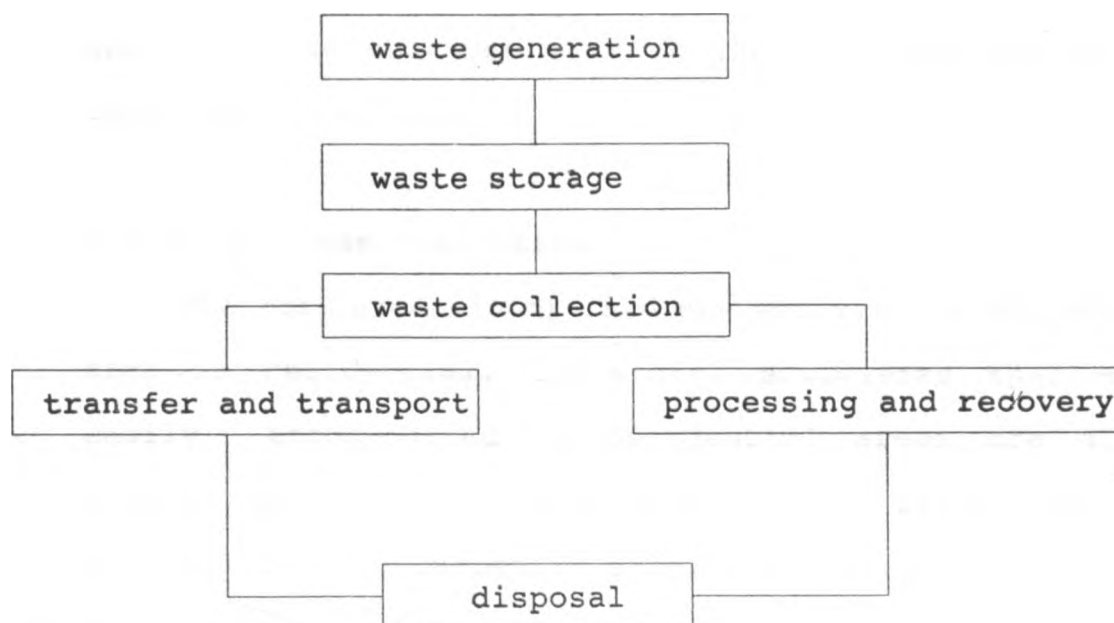
Uncollected solid waste in low-income areas is a major problem that require both the community and the local authority to offer solutions. To solve this problem, Kawangware residents feel that the City Council should provide bulkbin containers, and collect garbage regularly. Most (80%) of Kawangware residents were also willing to pay for private services if necessary, although 68 per cent of Kawangare residents pay service charge. The remaining (20%) felt that the City Council should provide services without asking for more payment.

4.5. Solid waste management in the study area

Solid waste management is the control of generation, storage, collection, transfer and transport, processing and disposal of solid waste in the most efficient, economic and aesthetic manner. The Nairobi City Council is supposed to provide solid waste collection services to all residential units regardless of their size, shape and where they are located in the city. This is not always the case in other developing countries. In Kanpur, India for instance, refuse collection services in unplanned

settlements are provided by the landlord. The level of service provided though depend on his sense of responsibility to his tenants. The refuse thus collected is taken to the periphery of the "shanty" to a municipal collection point (Cointreau, 1982). Solid waste management process provided by the Nairobi City Council can be represented by the following flow-chart.

Figure 4.1: Solid waste management



Source: Khadaka, (1888 p. 119)

4.5.1 Service Charge Fees

Apart from the Sh.10 that is paid with water bills and the service charge received from all employees with an income of sh. 700 a month or above, there is no other fee that Nairobi low-income residents are required to pay in order to enjoy the services. It may be argued that most residents in the study area do not pay the sh 10 because they do not have a water meter, but it is not their fault that the City Council devised that method. The residents know that they are entitled to receiving services like everyone else in the city and therefore they expect them.

4.5.2 Land use activities

The most predominant land use activity in the study area is residential. Commercial activities that are easily accommodated in residential areas are also common. These include vegetable "kiosk" retail shops, charcoal vender, carpentry shops and others.

As the city grows in population and its physical size, the land use activities become more complex. This complexity in turn increase the volume of solid waste generation. Residential solid waste accumulates very fast because of the many activities that take place in the area and if not removed in time may be hazardous to

health (small 1971). The socio-economic structure of study area determine the nature and quantity of refuse generation. Whereas the high-income residential areas tend to generate more waste per person, the low-income areas generate more refuse by volume because of their densities and the many activities that take place in the area.

4.5.3 Family size

Although the study sample did not cover all low-income residential areas, the results shown below gives an indication of the distribution of family size in Nairobi. The study showed that family size in low-income areas vary from 1 to 10 with most families ranging between 4-6 persons. Large families in low income areas tend to increase the volume of disposable solid waste. Taking an average of five persons per family this would imply that every household produces two and a half Kilograms a day.

Table 4.14: Family size distribution in the study area

Family member	percentage of respondents
1-3	44.8
4-6	41.4
7-9	13.8

Source: Study Survey, 1993

4.5.4 Sources of Income

Families in low-income areas have different sources of income. Some of them are employed on full time bases while others are on part time. Those that are not formally employed have either started their own business or work in other peoples homes as house girls, gardeners or watchmen. According to the study survey most of the residents raise their income from self employment.

Table 4.15: Sources of Income

Sources of income	Percentage
Formal employment	41.8
Scavenging	1.3
Self employment	53.2
Relative support	3.8

Source: Field survey

4.5.5 Sources of Waste:

Like any other residential neighborhood in Nairobi, the major source of solid waste in the study area is the household. Various household activities, which may include, the cooking, sweeping, cleaning and others, generate a lot of refuse. According to this study, the major waste generated in the study area was food remains (38%) and paper (38%).

Table 4.16: Major waste generated in the study area

WASTE GENERATED	PERCENTAGE
food waste	38.0
plastic	6.3
cans	1.3
paper	38.0
all	16.4

Source: Study survey, 1993

The explanation given for the production of such waste was that most families use a lot of vegetables in their meals and that most of the foodstuffs is wrapped with paper at the time of purchase.

In addition to household refuse, there are other activities in the study area that add to the disposable

garbage. Such activities include; retail, car garages, wood sheds, shop, vegetable sheds, and other "Jua kali" activities within the residential area.

The nature of solid waste generated in the study area was mostly organic. Food remains as noted above contributed the most amount of waste generated in various households. Inorganic materials were not common because most of them were salvaged for reuse in various ways. According to some studies carried out in various residential estates in Nairobi, the per capita refuse generated per day is 0.5 Kg which amounts to a total of 800 tones per day. The study area alone could have contributed over 70 tones (derived from the population figures of 1979).

4.5.6 Waste composition

The type of waste generated in the city include domestic refuse, commercial and institutional, street sweeping construction materials, industrial waste product and garden waste. The type of waste vary according to the dominant land use and the socio-economic status of the residents. The socio-economic status did not make a noticeable difference in waste content since the study was carried out only in low-income residential areas. The nature of solid waste tends to vary from season to season but not from one low-income area to another.

The University of Nairobi, Department of Chemistry carried out Nairobi Waste analysis to determine moisture content but not the composition. The results were as follows. No waste analysis has been done specially for low-income areas in Nairobi, However, visual examination show that the contents of organic refuse is very high. according to the literature that is available, garbage from low-income areas tend to contain more moisture than that of high-income (Cointreau, 1982).

Table 4.17: Moisture content of refuse in Nairobi

Type of waste	Moisture content
Vegetable matter	60- 75
Ash content	6- 10
Volatile matter	25 - 30
Paper	20 - 30
Plastics	25-58

Source: NCC records

4.5.7 Waste storage

Where refuse is temporarily stored on the premises, an adequate number of suitable containers are required to store accumulated garbage between collections. This has not been the case in Nairobi Low-income residential area

and especially in the study area. Field survey has shown that only 21.3 percent of the study sample had access to dustbins. The remaining percentage use other kinds of containers to store their refuse. Majority of residents who do not own a dustbin prefer to store their refuse in buckets/basins (see table below).

Table 4.18: Storage containers used in the study area

Container	Percentage
bucket/basin	50.7
tin	6.0
plastic containers	17.9
cartons	25.4

Source: Field survey, 1993

Although water tight rust-resistant containers with tight-fitting covers have been issued to residents in other residential areas, none of them was cited in the study area during the study period.

The few dustbins available to low-income residents were metal cans. No bulkbins or any other large storage devices are provided in the study area. The few bulkbins cited were mostly for market and commercial use.

The number of storage containers in Nairobi has been increasing every year but the increase has not caught up

with the rapid population growth. The number of dustbins is yet to be increased to meet the demand for new subscribers and to replace the ones in bad condition. Lack of storage containers and collection of the same is what has resulted to open dumping. Such dumping does not only interfere with aesthetics of the area but also contributes to rain water drainage system.

4.5.8 Waste Collection

Nairobi residential areas vary in location, affluence, and other factors that influence service delivery to the community. Regardless of the residential class, a good refuse collection service requires citizen cooperation in the use of the available receptacles in order to keep the place clean and free from mosquitoes, rats, flies and other vermin. To acquire this cooperation the community has to be enlightened on their rights and the environmental hazard associated with uncollected refuse.

Community participation has greatly contributed to solid waste management in Nairobi's low-income areas. Without community participation, all walkways in the study area and especially in Kibera would be blocked by refuse. Since the City Council does not attend to Kibera slum area, the community has taken the responsibility of

burning their own waste and digging pits whenever possible.

There are two types of conventional processes employed in the study area. These include the direct collection in which a door-to-door method is adopted (Dandora phases 1&2), and indirect collection system in which separate containers are placed near market places, and shopping centers.

The two methods are applied at a very small scale, but the major method of collection is by scooping garbage from the ground on road reserves where it is dumped in heaps.

The present collection system is biased and tends to favor high and middle-income areas. The low-income residential areas receive little or no services at all. The council argues that the people who live in unplanned settlements do not pay water bills so they don't contribute toward the cost of solid waste collection. This is just an excuse because some planned low-income areas like Dandora phases 3, 4 and 5 do not receive city council services at any time, although they pay water bills.

Lack of accessibility is yet another excuse given by the city council for not collecting refuse in some low-income areas. Although some parts of the low-income areas are unaccessible by conventional collection vehicles, it

should not be the reason for not providing services. Both Kawangware and Dandora are very accessible and yet they receive little or no services at all.

In an effort to reach low-income residential areas, the City Council has suggested other collection systems that can be adopted to serve those areas that are not reached by conventional methods. One of the systems suggested is the use of hand cart or "mkokoten". These carts are advantageous in that they can reach areas that are not served with road network, or where roads are too narrow for heavy vehicles to make a turn. Kenya will not be the first developing country to use hand-carts. The "Kampungs" of Jakarta and Surabaya, Indonesia use pushcarts to provide door-to-door service to residents and transfer of the wastes to metal containers which can be lifted or trailed to a disposal site (Cointreau, 1982).

Solid waste collection and storage prior to transporting it is of crucial importance to the City Council, and yet the most problematic stage in waste management.

Widespread littering and uncontrolled open dumping of refuse is a major problem facing the study area. The problem is more pronounced, due to shortage of storage devices and lack of collection. Although refuse collection in Nairobi is the responsibility of Nairobi City

Council, in most other cities of the world, the collection and disposal of solid waste is contracted to private companies.

Open dumps are worsened by scavengers who scatter refuse around as they struggle to salvage whatever little they can. Open dumps are a health hazard to the Scavengers. They get injured in the process and suffer from various illness related to handling of garbage without proper equipment.

Lack of adequate and poor distribution of dustbins is what has necessitated the dumping of refuse in open spaces and has made the collection exercise more difficult and time consuming. Most residents of low-income areas are not provided with dustbins or bulkbins. They are left to figure out how to handle their own garbage. As a result, they identify several sites along the road reserves, between houses or other open spaces and turn them into dump sites. In high income areas where nearly every household is supplied with a dustbin, the collection exercise is easier and takes less time. However, less than 50 per cent of all the waste generated in Nairobi is collected. The daily collection is about 270-350 tones. This leaves behind about 500 tones of the 850, tones generated each day uncollected.

4.5.9 Community participation in refuse collection

Field data show that 51.9 percent of the residents interviewed were willing not only to participate but to contribute money to improve the situation. Despite their low monthly income, 59.4 per cent were willing to contribute Ksh.10 per month for garbage collection or waste management in general. Others too were willing to contribute as shown in the table below:

Table 4.19: Willingness to pay

Ksh./month	percentage
5	9.4
10	59.4
20	18.8
as income allows	6.3
as agreed	15.6

Source: field survey

The City Council needs to take advantage of the positive attitude that the community has toward improving the situation of solid waste service delivery to their respective residential areas.

4.5.10 Collection frequency

From statistical data gathered in the field, most households tended to empty their containers households after three days. This shows that collection should be carried out twice a week. 47.6 per cent of those interviewed preferred twice a week but the majority (52.4) thought that once a week was the best.

4.5.11 Separation during collection

Prior to collection of garbage by City Council crew and the scavengers rummage through bins on roadside dump sites for useful items like cartons, paper, cans, rubber, metal and other items. The scavengers use their bare hands or sticks to sort out whatever they need to take away in sacks. Although scavengers reduce the volume of disposable solid waste, they are also responsible for the spread of waste at the collection points. The scattered refuse not only looks messy but costs the City Council crew a great deal of time to gather waste together before scooping it into collection vehicles.

Scavenging is a very common activity in Nairobi It supplements Nairobi City Council's effort in garbage handling. Scavenging has not only reduced the volume of waste to be disposed but has also provided a source of income for many families in Nairobi. There is no fixed

price set for waste paper. The price that garbage collector charge for their merchandise vary considerably. Scavenging is now considered a part of the informal sector for the urban economy. There are many families that depend on income from scavenging activities. Prices tend to vary from one collection point to another and from one residential area to another.

Despite scavenging being a source of income, the stigma attached to it puts a lot of people off. The method of recovering variable items is also very unhygienic. According to this field survey paper is the most variable of the scavenged material. 38.0 percent of the material salvaged was paper. scavenging is common in the whole of Nairobi although it is an illegal activity. Most respondents reported seeing scavengers at their dump sites.

According to Mwaura (1991) most scavengers live in single-roomed mud or wooden houses in sprawling slums of Nairobi. His study findings showed that 9.4 of the scavengers slept on street pavement of the city center. Most of the scavengers are jobless and have no other source of income and therefore have no much choice of where to live. Scavengers are used to living in congested areas where cleanliness is not a big issue and therefore they don't mind what they see.

The health of the scavengers is not the only one at risk, even that of the residents is equally affected. Although there no data is available to show the actual damage in the study area, findings from other countries low-income areas can be assumed to be true of Kenyan situation.

Accidents related to solid waste include, deep cuts (this was observed to be the case with many scavengers on site who wore no gloves to protect themselves). Fire hazards are also common in the study areas. It is because of such hazards that the Kibera dump site was closed. Other fires result from burning waste in the open where fire spread with the wind.

Bodily harm is not also restricted to scavengers alone, many children in the study area have fallen victims of scattered garbage where broken bottles and sharp objects are trashed without control. Even deaths of children have occurred (especially in Kibera) after drinking unknown liquids from discarded bottles.

4.6 Transportation of Solid Waste

Collection and transportation of solid waste to disposal sites is of vital importance to overall waste management, public convenience, aesthetic and public health. Transportation of refuse to disposal sites has

been one of the major obstacles for effective solid waste service delivery. The number and maintenance of collection vehicles has left a lot to be desired. Out of the 100 vehicles required, only 45 vehicles available, and only 25 are operational (NCC, Records).

The transportation system is faced with great organization problems due to unexpected breakdown of vehicles resulting from overuse, poor maintenance, as well as careless driving. The limited number of trucks also contributes to the problem. The two trucks with compactors are no longer there, hence the delays in refuse collection. Lack of spare parts and finances to purchase new ones has been a real problem. The responsibility of vehicles and drivers are under the cleansing section, but the maintenance of vehicles is still under the City Engineers Department.

Transport of solid waste from collection points to dump site is usually done by City Council vehicles. The major vehicles used to transport refuse include tippers, trucks with side or rear loading facility, and the tappers. The number of such vehicles is so limited that they cannot handle the amount generated each day.

Traffic during the day causes a lot of delays in transporting refuse. According to Khadaka, 1988 a trip from the city center to Dandora dumpsite took 30 min.

This study also found out that a side loader operating from Western Division managed only two trips a day. Such delays do not only increase travel time, but also fuel consumption. Finally the cost of transporting refuse increases more than it could without such delays.

Transportation of solid waste to the dump site has no set routes to be followed to and from Dandora, although drivers tend to follow certain routes more often than they do others.

4.7 Solid Waste Disposal

Once solid waste is collected, it is either processed or disposed. Solid disposal is the most crucial stage of solid waste management in any urban center. The problem is most acute in urban setting due to lack of adequate space for individual household to dispose their refuse as it is generated. Inadequate disposal sites within an individual plot is what call for mass collection and disposal of domestic refuse. Once proper disposal of refuse is nor provided, the heaped garbage starts to decompose thus producing gases of various types. The most common of such gases include ammonia, hydrogen sulphide and others. The unpleasant smell of those gases is what polluted the air in the study area. The odor of such gases is not limited to the site of

generation but spreads around the immediate vicinity. According to Revelle (1966), the problem of air, water, and land pollution have little regard for political boundaries.

Solid waste from the study area is eliminated mostly by burning and reusing. The first method though tend to produce problems of air pollution. The later method of disposal is safer and should be encouraged. The little waste that is collected is transported to Dandora since the closure of Kibera dump site. The demand for waste disposal site calls for alternative methods of solid waste disposal that do not require much space. Some of the possible alternatives available include the construction of incinerators, resource recovery facilities or processing facilities or the transportation of waste longer distances to new sites. However, as the distance from the point of solid waste generation increases, the cost of direct haul to the site also increases.

Lack of sufficient collection has left low-income areas to solve their own problems of solid waste. Air pollution resulting from burning of waste in the study area has been allowed to continue without any measures being taken to discourage the action.

Burning of waste is not the only source of air pollution in the study area. Even when the solid waste

is not burned, the decaying organic materials generate methane gas that causes irritating odors and blackens the paint on nearby buildings. If left to continue, they can also become explosive.

4.8 Waste Minimization

Wrapping materials contribute a lot to waste generation. Reduction in wrapping materials can greatly reduce waste generation on site. Field study show that a lot of waste generated in the study area is a result of too much wrapping. 38.0 per cent of those interviewed said that paper was the major waste generated in their households. When asked why that was so, 38.8 percent said it was due to wrapping of almost every item that is purchased from shops or elsewhere.

4.9 Waste reuse and recycling

Presently, most residents separate garbage for their own use. The table below is an indication of how the separated waste is used by various people.

Table 4.20: How the Separated Garbage is Used

Uses of garbage	Percentage
To reuse	69.4
To store things	2.8
To grow flowers	2.8
To sell	8.3
To feed animals	5.6
As manure	2.8
To start fire	5.6
To avoid liquids	2.8

Source: Field survey

According to the results of this field study, 49 per cent of the residents separated their garbage before disposal. This is a clear indication that if there was good reason to separate garbage, more people would have participated.

Once separated the unwanted garbage is disposed at different sites as shown in the table below. Since there are no communal storage facilities, 78 per cent of those interviewed emptied their refuse in different sites at different times. This means that residents tend to empty their refuse at the most convenient place at a particular time.

Table 4.21: Disposal Site

WHERE DISPOSED	PERCENTAGE
Another site	78.6
To the shamba	7.1
To a pit	7.1
To bulkbin	7.1

Source: field survey, 1993

According to this study results, 53.8 percent of the respondents reuse some items from their waste. Out of those interviewed, 77 percent indicated use of milk packets and other types of paper for starting fire. This was confirmed by observing dump site for quality waste paper but finding none.

The separation and reuse of solid waste is carried out at a very small scale and yet it contributes a lot to volume reduction of disposable waste. The most common items separated at site include bottles, newspapers, cartons, cans, plastic containers, milk packets and others. Food wastes were in some cases used to feed pets (cats or dogs) or sold to neighbors to feed cattle (This was noted only in Kawangare area). Milk packets are mostly used to start fire or grow house plants. Other containers are used in many ways depending on the size and shape of the container. Cartons are mostly picked by scavengers since they fetch more money per kilogram than

ordinary paper. Cartons are not always sold but are sometimes used for wall insulation, roof ceiling and for storing clothes, charcoal, books and other items. The recycled material is used to manufacture paper tissue, paper bags, packaging materials etc. Waste paper in Kenya is now being used without recycling to make all kinds of things. Some of the most common items being made from waste paper pasted with "unga" paste and natural dyes are chairs, tables, toys, bowls all sorts of furniture. The technology is new in the country and is becoming very popular.

Glass: Pieces of waste glass are some of the basic materials for manufacturing of new glass. Bottles, broken window panes, car windscreen, are recycled here in town.

Rubber: Scrape tire, obtained from vehicles are reused sometimes without recycling to make shoes, and in "Jua kali" sheds for insulation. Whole tires are also used for marking boundaries and as raised ground for corn roasting. Play grounds for nursery school children also tend to use tire as play equipment.

Others: Various type of waste material are salvaged by different people for different uses. Waste metal for instance is put into many uses at various "Jua-Kali" sheds.

According to Bushra (1992) recycling of solid waste is not only the best choice for waste management system, but the only means for surmounting problems concerning environment unemployment and limited resources.

Tukuza (1988) also argues that recycling has greatly improved the disposal of solid waste in Nairobi. Field study findings have revealed the involvement of scavengers in recycling industry. 92.4 percent of those interviewed reported to have seen scavengers on solid waste dump sites trying to salvage whatever useful items they could find. All salvaged items are sold for income.

Recycling is the final step of solid waste management before disposal. The recycling is either major or minor parts of the household waste. It is usually recycled to its original form or into something completely different.

4.10 Dump site

Dandora dump site is the largest and the main dump in the city. a few other dump sites are located elsewhere in Nairobi but they are usually in private land. Dumping on such site is usually done on request by the owner. Such dump sites are advantageous in that they save the City Council both time and money that would otherwise be used to transport refuse to Dandora.

For major dumping, NCC has adopted controlled tipping at Dandora which is located 12-25 kilometers from various collection points. At the dump site, a bulldozer is used to spread, level and compact the refuse, but no cover or sealing material is used. Dandora dump site was not initially planned or earmarked for purposes of dumping, but a residential area. The site consists of pits left behind by quarries. The area is now used for dumping and cannot be assumed to be sufficient for all the waste collected in the city for the next ten years or so.

4.11 Summary

Solid waste service delivery in the study area is so limited that the whole area is covered by heaps of uncollected garbage. The most affected sections of the study area are Dandora phase 3, 4, and 5; and the whole of kibera. Dandora phase 1 seems to be attended to more regularly than any other area under study. Households in the same area also tended to own individual dustbin which is not the case in other areas. The actual reason for this was not established but it is assumed that some influential people live or own property there.

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CHAPTER 5: DATA SYNTHESIS

5.0 Introduction

This chapter is an overview of the study and is going to highlight some of the aspects that were discussed before, but in more details.

5.1 Management

The Nairobi City Council has adopted a management system whereby refuse collected is administered under the department of Health, but the fleet is centrally maintained for all city vehicles by the engineering department. Refuse collection is placed within the health department, but at the bottom of the organization's entire structure. The Cleansing Superintendent who is head of the section is placed on scale (6) while the other section heads in the same department are on a higher scale (4). The low placement of refuse service personnel leaves them with virtually no say when it comes to obtaining funds or making decisions. The low status of workers makes recruitment and retention of competent personnel difficult. Another aspect of this arrangement of responsibility is that the department performing the collection is not responsible for purchasing or maintenance of collection vehicles. Preventive daily maintenance

of refuse equipment should be in the hands of the Medical officer of Health Cleansing Section but it is not.

5.2 Finances

Lack of adequate budget has featured as one of the major causes of poor service delivery in low income-areas. Unequal distribution of material resources was yet another. As mentioned earlier in chapter 3, the current budget designated for Cleansing activities is way below what is required to deliver the services effectively. Revenue raised by cleansing related activities become part of the general City Treasury thus making it available to other city expenditures.

Lack of planning unit in the Cleansing Section, results in limited access to the budget due to inability to justify budget needs. Unless these problems are adequately dealt with by projecting requirements of the solid waste management, determining their affordability relative to revenue generating ability of the City Council and then arranging institutional and financial mechanism, the provision of solid waste services to low income areas will never be achieved.

5.3 Waste storage

Field survey has clearly indicated that both

standardized and non standardized containers are used in the study area although the nonstandardized containers are used in greater numbers. Literature cited in chapter two pointed out that there are many more types of storage containers used in other parts of the world as well as in high income areas of Nairobi. Their use and distribution depends on the community to be served.

Plastic containers are mostly used in Nairobi by residents of high income areas and especially those that receive private collection. Plastic containers are usually purchased by individuals but not provided by the city council. Their cost limits their use in low income areas and the fact that most households in low-income areas have no fences to protect them from being tone by scavenging animals, and people as they try to recover some food or other items.

Cubical too were not cited in the study area despite their ability to take large volumes of waste. Cubical are common in other low income areas of Nairobi like Otiende, Kenyatta village and many others. Cubical are very convenient storage containers if properly constructed and emptied regularly.

5.4 Social-cultural

Each residential neighborhood has its own personal-

ity. Its people have developed a unique behavior pattern which automatically get adopted by the new comers. Since low-income neighborhoods in Nairobi are not concerned about maintaining a clean environment, all the immigrants to the area adopt the same altitude hence making the situation even worse. Waste generation

A lot of waste is generated in the study area not because the residents generate more waste than in any other area, but because of high population density. As was discussed earlier in chapter two, solid waste generated in low income areas is usually of very high density and of biodegradable materials. Field survey has conformed that solid waste from low-income areas mostly consists of food waste and paper.

5.5 Refuse densities

Refuse densities in the study area are not known, but according to the literature available from other developing countries like Nigeria, Indonesia and India, it is quite evident that refuse densities are higher than that of the developed countries. The density of refuse in india for instance is 500 kg/cubic meter (Cointreau, 1982).

5.6 Moisture content

Food component has a higher moisture content than other types of household waste. Studies carried out in various cities of the developing countries have shown that food waste has a higher percentage , and a higher moisture content. It is also apparent that moisture content of refuse in developing countries is somewhat dependent on climate, especially in places where waste is stored on open ground while awaiting collection.

5.7 Waste collection

The most problematic stage in solid waste management in low-income areas is the collection. Field survey has shown that solid waste collection in low-income areas is rarely collected and in some areas it is never collected. For those areas where garbage is collected, the collection is carried out by the City Council workers using the collection vehicles. During a collection tour, a waste collection vehicle leaves the cleansing Section Depot with a crew designated for a particular area (as marked in the Schedule for the day). Once the crew gets to site, the City Council refuse collectors get the storage containers from wherever they are placed along the road (in cases like Dandora) and transfer their contents to the truck and then return the containers to their initial

for efficient method of collecting refuse in low-income residential areas where the roads are narrow, congested and impassable by smaller vehicles.

Although the City Council has always maintained that standardized citywide fleets of sanitation trucks is the most cost-effective because it permits efficient maintenance and supervision, this principle was revisited by the former City Commission who come up with a proposal to use "Mkokoteni to reach those areas that cannot be reached by conventional trucks. Now that most citizens are paying service charge, the City Council should extend services to them by whatever means possible.

5.7.1 Privatization of refuse collection

Privatization of refuse collection has not yet been extended to the study. This is so because the City Council has not given approval to residential areas other than those of high income areas, and also the fact that the conventional methods of waste collection can not fit some of the low-income areas (the unplanned settlements) where accessibility is still a problem. Finances are the major problem facing privatization of solid waste collection in low-income areas. The fact that residents of low-income areas cannot afford conventional methods of refuse collection and disposal does not mean they are not

interested in the service. One important fact that emerged from the views expressed by the respondents is that they are more than willing to engage private contractors of their own to provide the solid waste collection and disposal services. Their commitment to a cleaner environment is clearly indicated in their willingness to volunteer some time to burn the accumulated waste. What is lacking so far is leadership to provide guidance and to get people organized.

5.7.2 Planning and waste collection

Nairobi City Council has tended to ignore low-income areas whether they are planned settlement or not. This is mostly so because residents living in those areas lack the economic support and political power to influence City Hall officials. According to the field survey results, provision of road network in both Kawangware and Kibera did not make any difference service delivery. None of the three areas was adequately provided with dustbins and none received regular collection. So planning of a residential area did not influence solid waste service delivery.

5.7.3 Economic Influence to waste collection

Field survey results have indicated that solid waste

from low income areas is rarely collected, whereas in high income areas it is collected at least once in every 7 days (SULO, 1988).

Nairobi City Council is not the only local authority that does not provide services to low-income areas, and especially the unplanned settlements. Many local authorities in developing countries question whether refuse collection services should be extended to those areas or not.

The Nairobi City Council has tended to ignore low-income areas. Their constant complaints about lack of service provision are side tracked when they get to City Hall. Unlike residents from high-income areas, poor people living in low-income areas cannot afford to engage a private company to collect refuse from their area of residence.

In most cases, people who live in high-income residential areas are not only economically capable but are also politically powerful. Since the two cannot be separated, their influence over City Hall Officially is clearly indicated in the manner of service provision. Lavington (a high-income area) receives services once a week whereas Kawangware (a low Income area) receives no services at all. This discriminatory attitude is influenced by both economic and political power.

5.7.4 Value of collected waste

Although lack of adequate resources is one of the reasons why services are not adequately delivered in low-income areas, there are other reasons too. According to Cointreau (1982), there tends to be a discriminatory attitude on the parties in power against people living in low-income areas, on the assumption that their neighborhoods are dirty because the people too are dirty and lazy. Urban poor are not usually provided with services because they cannot afford private service fee and because their refuse is not sufficiently high in recyclable to justify the service.

5.7.5 Collection routes

The existing collection routes cannot be rationalized because they tend to serve only those areas the superintendent is interested in, and leave out those areas that he considered not very important regardless of the need.

5.8 Disposal methods

There are various alternative disposal methods for the city Council to choose from. The choice of any of these methods should be dictated by availability of funds, technical staff and efficiency.

5.8.1 Composting

Composting is a process through which raw refuse is treated and recycled as a soil conditioner. It is advantageous in that it facilitates recycling of sewage sludge, organic garbage, metals, glass, paper; plastic etc. Composting does not produce air or water pollution where plans are properly designed and requires small land fill sites for materials which cannot be composted or recycled.

The process of composting though is not without constraints. It requires high investment and operating costs as well as complex and fragile installations. The garbage must also be sorted before composting. Since compost is only a soil conditioner it requires to be enriched with fertilizer or sewage sludge, to enrich the soil (Warmer Bulletin, No 29 1991).

5.8.2 Incineration

Incineration is the oxidation or burning of solid waste at very high temperatures 100-250°C. Incineration as a method of waste disposal reduces volume by 90% and weight by 80-90 per cent. Residues resulting from burning are absolutely sterile and may be used in the construction industry like any other burn residue. Heat may also be recovered and used for other purposes.

Finally, the process accepts hazardous and bulky wastes (Sewel, 1975).

Like other methods of refuse disposal, incineration requires high investments and operational costs, high skilled and operations personnel. When refuse burns, non-combustible materials remain to be landfilled, whereas Soot, corrosive gases and other may be released into the atmosphere.

5.8.3 Polroysis:

Polroysis or distillation of wastes is accomplished by heating refuse at temperatures of up to 1,000 degrees Centigrade. The advantages of using this method are that refuse is converted into, high value gas and residue is easily marketed. Heat is almost completely recovered with limited pollution problem. The method accepts all types of waste for complete conversion and requires limited land for disposal.

Pyrolysis, is an advanced and untested technology, so it required high investment costs and highly trained personnel. Condensed, water from the product gas also requires treatment.

5.8.4 Vermiculture-earthworms

The concept of vermiculture is simple and is based

on the natural processes of biodegradation. The use of earthworms is an alternative technology, which is not capital-intensive and which is appropriate for organic waste. The earthworm technology also known as vermiculture, is a simple method that utilizes the habits of earthworms. Worms multiply fast during their short life cycle, and use their digestion process to turn waste into soil conditioner.

All this method requires is to ensure that all non-biodegradable items are removed from waste and that both humidity and temperature which provide optimum conditions for the earthworms to survive and function is maintained.

The refuse which turns into compost in 30-40 days is known as worm culture and can be used for the gardens and forests within the city. Vermiculture is hereby recommended as the best alternative in solid waste disposal in Nairobi because it does not involve foreign technology and does not need heavy capital investment and does not require continuous monitoring or elaborate administrative backup.

5.8.5 Grinding

The development of trash shredders should be encouraged or introduced whenever possible. Shredding will allow paper and other dry solid wastes to be

disposed of in the sewage system. This method of disposal would save the time spent on collection and transportation of waste; reduce the volume of disposable waste; and reduce the City Council burden of disposing all household waste.

Since this method of disposal would use the sewage water as the medium for solid collection and transport, there would be no extra expense to be incurred. This method of disposal can be enforced by requiring developers to include trash shredders in their buildings.

5.9 Recycling

Recycling is not yet an integral part of the Local authority waste management strategy, but is more pronounced in Jua Kali artisans where most waste is being recycled. The more established recycling industries like the Chandaria, recycle more paper related items than anything else. Some of the items manufactured from waste paper include, stationary, wrapping materials, toilet tissue and packaging cartons. 90% of the companies's raw material is waste paper collected all over Nairobi and its environs (Khadaka, 1988 p. 127-130).

Waste recycling is an important step in waste management in that it reduces the volume of disposable waste and also helps protect the environment by reducing

the hazards that are associated with uncollected waste. For recycling to be effective in Nairobi it will require residents to be educated on its benefits so that they can participate in the separation of refuse at the source. The recycled material should also have a ready market to keep the process going. Once recycling is established in Nairobi, residents will be interested in separating waste at the source so that they can sell the recyclable materials for extra income. Scavengers too will have a more ready market whereby they can sell their salvaged items.

5.10 Dumping

Dumping as we have seen takes places wherever space is available. But the little waste that is collected from streets, river banks, and other parts of the study area is all transported to Dandora dump site. Open dumping is a cheap way of waste disposal compared with sanitary dumping or land fill, whereby certain measures are taken to prevent any contact between waste and underground water or air as well as to prevent any damage in the case of a gas explosion. The later option is not as detrimental to the environment as the previous option, but the costs associated with the construction of sanitary landfills are a detriment to developing countries

financial resources. Even the technical equipment needed for construction may not be available.

5.10.1 Dumpsite

At the time of the study there was only one major dump site (Dandora) where refuse from all three areas under study was deposited. The Kibera dump site just next to the study area is no longer functional. Other small dump sites like the one in Riruta area is private and can take only refuse for a short time. Another dump site is proposed in Langata but is not in use yet. Once it becomes operational, it will greatly cut down on transportation cost and the time spent transporting refuse to Dandora.

5.11 Pollution control

Despite the availability of laws (Public Health Act of 1875 and the 1920 Public Health Ordinance) and By-laws concerning the management of solid waste; the problem has persisted and become worse.

The laws and regulations that have been formulated to forbid the throwing of garbage indiscriminately have not been effective since the community has not internalized the need to maintain a clean environment. It is not until every individual consciously engages on those

activities that are environmental friendly and avoid those that might affect the environment in a negative way that a clean environment will be achieved without much effort. This can be done at a personal level or through an institution.

Since the problem of air, water, and land pollution have little regard for political boundaries, the pollution arising from the slum areas spreads all the way to the high-income areas.

Kawangware for instance is just next to Lavington (High-income area) and pollution from water source would affect the two areas equally.

Pollutant emissions in the study area adds to the atmospheric pollution from other sources and contribute to reduced visibility. Such pollutants are capable of darkening house paint, disintegrating stone statues, corroding metals dissolving nylon - stockings, and embrittling of rubber.

The waste management and control report of 1966 has shown that there is some evidence that atmospheric pollution is also increasing the turbidity of the atmosphere, that is the concentration of very small particles suspended in the air. at low concentrations, urban atmospheric pollution aggravates asthma and some other chronic respiratory illnesses and it can cause

transient eye respiratory tract irritations. Common sense suggest that pollutants capable of damaging property must also be injurious to the delicate bronchial tissues. The effects of pollutants would be more serious if it were not for the fact that poisonous gases like ammonia and sulphur dioxide are absorbed in the aim and diluted to tolerable levels. According to the 1963 environmental pollution report, many city dwellers are now known to have asbestos fibers in their lungs, and that same types of asbestos are strongly associated with lung cancer and other respiratory diseases.

5.11.1 Disposal of toxic waste:

The term "hazardous waste" means a solid waste, or combination of solid wastes, which because of its quantity concentration, or physical, chemical, or infectious characteristics may

- (1) Cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or
- (2) Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of.

Hazardous wastes include chemical, biological, flammable, explosive, and radioactive substances. They may be in solid, liquid, sludge, or gaseous state (Cheremisinoff, 1976) various federal acts regard waste as hazardous if it is lethal, non degradable, persistent in the environment, can be biologically magnified (as in the food chain) or otherwise causes or tends to cause detrimental cumulative effects (Water Pollution Control Act, 1972).

Management of hazardous waste in Kenya is completely neglected. Even the long lived chemicals that should be destroyed in special incinerators are all dumped in Dandora together with other waste. The most common sources of toxic waste being the hospitals, industries and some "Jua Kali" activities. Although numerous techniques for toxic solid waste management are in use in other countries, Kenya is still quiet about it. As with all other pollution control activities, certain general and basic control principles can be applied, as appropriate to hazardous waste. These may include; Elimination and reduction of wastes at the source, recovery, reuse, and recycling of wastes, Concentration of waste by treatment, thermal decomposition chemical treatment.

5.12 Summary

Adequate solid waste management can only be achieved by involving all communities and not just a few. This goal will be realized by implementing some if not all of the recommendations suggested in the following chapter.

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CHAPTER 6: RECOMMENDATIONS AND CONCLUSION

6.0 Introduction

Based on the field experience, secondary data and discussions with various authorities in the area of study, the author wishes to make both short and long-term recommendations which the administration might find useful in providing the service required by the Nairobi residents living in low income areas.

The recommendations given below are to be effected in all three areas of the study. The use of "Mkokoteni" is however limited to Kibera area where accessibility is limited.

6.1 Short-term

The following are the methods recommended for immediate action to improve solid waste service delivery in low income areas of Nairobi.

6.1.1 Community participation

The first and foremost recommendation is that of community participation. Residents in low-income areas should emulate other residential areas and participate in cost sharing of service provision. The cost can be in monetary or in terms of labor. Presently, both high and middle income residential areas are contributing to cost

sharing by paying for private service provision whenever possible. According to the data collected at the time of the study, residents of low-income areas are also willing to contribute to the provision of private services. To take advantage of this positive attitude, the City council should require all low-income residential areas to make their own arrangements to have the garbage collected and

transported to the identified collection points along the road reserves. For the unplanned settlement residents, the "Mkokotenis" can be used to haul the refuse to the collection points. At the collection points the Council should make sure that there are huge cubical constructed whereby the Mkokotens can empty their contents. Once the refuse is transported to the collection points, it will be the responsibility of the City Council to collect and transport it to Dandora or any other dumping site at their disposal. This way the burden of waste management will not entirely rest on the City Council or the community, but will be a joint venture.

6.1.2 Sub-contraction

The second short term solution is to sub-contract the collection of solid waste. The City Council should subcontract garbage collection to private entrepreneurs for better solid waste service delivery. This should

start by identifying one or a few low-income residential areas as the target area for a pilot study. Once the population to be served is agreed upon the contract should be signed between the City Council and the contractor, and then following activities should take place:

1. The City Council should provide each household with a dustbin;
2. The contractor should collect refuse in the specified days (City Hall officials to confirm that the collection is done);
3. All refuse collected should be transported to Dandora dumpsite;
4. End of the month payment to be made according to the agreement and not according to the volume;
5. And penalties for incomplete work should be worked out and included in the contract.

The funding of the pilot phase should be done by the Council or any willing donor. The World Bank is already willing to sponsor a similar project but in a middle income residential area, so it is up to the City Council to decide what their priorities are.

Once the pilot phase is over, the City Council will decide whether to renew the contract or to take over the responsibility. The one year pilot phase will have given

city Hall officials enough experience to carry on smoothly. All problems identified during the pilot phase should be sought out in the following phases before the responsibility is passed on to the residents.

6.1.3 Reducing solid waste at source

Reduction of solid waste at source is something that can be achieved immediately with little of public education. Reducing waste generation at source means reducing both time and money that would otherwise be spent collecting and transporting waste. It is therefore one of the most effective method of solid waste management for any city. The reduction of waste generation at source can be achieved by encouraging recycling, and reduction of goods packaging at any stage. So far, Scavenging and recycling of solid waste has greatly reduced the volume of solid waste to be collected and transported to Dandora dumpsite. Use of plastic containers to package things has also encouraged reuse, thus reducing the amount of disposable waste. People have now to be encouraged to use baskets for shopping so as reduce wrapping of every single item purchased from the market. This will greatly reduce the need to use a lot of plastic bags.

On site processing to reduce volume and weight of solid waste would be a welcome change in most Nairobi

residential areas, whereas grinding of waste would be the most appropriate in high and middle income areas where running water is available in most houses. This method should be encouraged not only by the solid waste management planners but also by architects who design houses. The advantage of this method over many others is that the Nairobi City Commission will not incur any expenses in the installation of the grinders. The full cost will be met by the developers who will recover the cost from the tenants or house-owners. Garbage-grinders are so convenient that if introduced now most residents of middle and high income will go for them. This will in turn release the city Council Vehicles to concentrate their services in low-income areas. The administration can improve waste management in low-income areas by introducing new technologies to new developments.

6.1.4 Storage and collection equipment

On-site storage equipment can greatly improve the collection time and aesthetic of the area. The installation of Bulkbin containers at reasonable distances depending on the population to be served can prolong the collection period. Bulkbin containers are also hygienic in that they are not so easily accessible by scavengers.

In addition to bulkbins the City Council should provide dustbins to all residents who pay the Sh.10.00

dustbins fee. Once most families are supplied with dustbins, the door to door waste collection will be easier to adopt in all residential areas. This will ease the burden of scooping rotten garbage from the ground and will greatly improve the health of low-income residents as well as that of workers and reduce waste related accidents.

Failure to involve the community in refuse collection is blamed on the administration in general and not only the cleansing Section of the NCC. Politicians are also to blame for many of them have not taken the problem seriously.

The fact that many people are willing to contribute towards maintaining a clean environment, shows that the residents are ready to do something, but lack the leadership and guidance toward a cleaner environment.

In high income residential areas where garbage is collected once a week on a given day, residents move containers from doorways to curbside to await collection. Vandelism in these areas is not so high due to fear of being caught by the watchmen who watch over properties during the day. Also the fact that most households own a dustbin reduces the need to look for another.

In addition to the conventional methods of garbage collection, other methods of collection should be used

depending on accessibility of the area. In planned low-income areas, collection exercise can be improved by providing storage equipments and increasing the number of collection vehicles.

The number of collection vehicles is presently far short of what is required. Although it is recommended here that all types of collection vehicles be increased, priority should be given to side loaders with compactors for door-to-door collection, bulkbins collectors and tractors to scoop waste into tracks. Compactor vehicles will greatly increase volume of waste transported, hence reduce the number of trips that could be made if other vehicles were used to collect and transport the same volume of waste.

Hand carts (mkokoteni) should also be used to collect refuse in certain areas of unplanned settlements like Kibera where access by conventional collection vehicles is not possible. The administration should also take advantage of the railway line that passes through the area. Refuse from Kibera area can easily be transported by railway to a another dumping site where the railway has easy access. Fortunately, the railway line passes through the area so no extra expense will be incurred in introducing a new line.

The idea of Mkokoteni (handcart) may be new in

Kenya, but not in Bangkok, Thailand where they have been in use for many years. In narrow streets of Thailand, the collection crews collect and carry waste using handcarts and bamboo baskets.

The use of Mkokoten is however, constrained in that although it can manage to reach areas that are unaccessible by conventional means, their capacity is limited and therefore requires many trips to transport refuse to the collection point. Mkokoten is also an health hazard to workers because it has to be loaded manually and sometimes without the right equipment.

6.2 Long-term

In order to provide efficient solid waste collection and disposal services, the City Council has to plan ahead. The following recommendations are proposals for long term solid waste management.

6.2.1 Structural organization

We have noted earlier in this discussion that the cleansing Section of the MOH Department would function better if it was made a full department and be referred to as the Department of Public Cleansing. Once the Section becomes a full department, more administrative positions will be created. That will not only ease the burden currently placed on the Cleansing Superintendent

but will create posts for a Director who will then have more bargaining powers, a Deputy Director and Assistant Directors for the department. Instead of Cleansing Superintendent being on scale 6, he will be elevated to scale 4 as one of the Assistant Directors. Such changes will also create room for Engineers, planners and Environmentalist to be absorbed between scale 8-5 or higher if possible. The present arrangement does not allow graduates to be recruited in the department because there will be no chances of their promotion. Presently, the Cleansing Section is without University Graduates. It therefore recommended that in the process of creating a new Department, the following criteria be followed.

Effectiveness: The new Department should be organized in such a way that it meets the test of supplying goods and services (Cost, revenues, teamwork, morale etc) which the section does not supply adequately.

Efficiency: That the Department should be able to fulfil all financial obligations. This will require direct collection of dustbin moneys that are currently collected by water and sewerage Department. The Department should also be structured in such a way that it will fulfil personal and individual objectives of all who are connected with it. Proper organizational structure should

have clear cut lines of authority and responsibility, participation in the policy making, the right to be heard, the opportunity to develop to the full measure of its potential and other conditions that contribute directly to personal satisfaction as well as individual effectiveness.

Division of work: In promoting the Section into a Department, the primary step of determining and establishing the smallest number of dissimilar functions into which the work of the Department may be divided will be required. The nature and number of the basic functions should be determined by their relative importance in contributing directly to the purpose of the department.

Authority and responsibility: The functions or job contents necessary to reach objectives must be defined.

This will be governed by two precepts:

1. Clear duty definition; whereby each man in the management should be confined to the performance of a single leading function.
2. The work of each person in the management should be confined to the performance of a single leading function.

Both authority and responsibility are important in the management of any organization. These two are currently missing because the head of the Cleansing Section is

placed in a position that does not carry the authority that is required to make certain decisions.

The chain of command: The chain of command is necessary in every organization. It is the chain of superiors ranging from the ultimate authority to the lowest ranks. The route of authority is the route followed by all communications which start from or go to the ultimate authority (Fayol, 1949). Chain of authority should therefore be identified very clearly in the new department.

Channels of contact: The nature and need for channels of contact should not be limited by lines of responsibility and authority of the organizational structure. The plan of organization should permit and require the exercise of common sense and good judgement, at all levels in determining the best channels of contact to expedite the work.

Balance: All sections of the new department should be kept in balance by proper proportions between centralization, decentralization, and flexibility.

Centralization: Responsibility, authority and accountability should be centralized at key points to provide leadership direction, and control. This will aid in the establishment of major objectives and policies as well as maintain consistency of action. It will also facilitate

dealing with emergencies and routine. These will be matters requiring top executive attention.

Decentralization: There should also be decentralization of responsibility to place the ability to decide and act within.

6.3 Legislation

- a) The Nairobi City Council should be allowed to collect revenue and budget for it without reference to the central government and later account for it;
- b) The council should be technically and financially aided in waste management;
- c) Illegal dumping by the public should be discouraged by formulating and enforcing law to that effect;
- d) Resource recovery and reuse should be encouraged;
- e) All Estate developers should provide a cubical or bulkbin for a certain number of units (eg.30).
- f) All middle and High-income developments should be equipped with waste disposal sinks.

Although some of the above recommendations do not directly relate to low income areas alone, their benefits

will filter down to the low-income areas.

6.4 Summary

The accumulation of solid waste in collection points or any other area is not without social effect. One such effect is the interference with the aesthetic of the area . The scene of so many heaps of uncollected refuse is associated with dirt which gives a negative connotation of the area. The negative feeling is associated not only with dirt but also with poverty. This is so because low-income areas are the ones associated with uncollected garbage. In high and middle income residential areas, the problem of solid waste management is not so pronounced despite the high volume of refuse generation.

Planning of solid waste management in Nairobi has lagged behind technological developments. The very costly and outdated concepts are still used. The cost of collection continue to increase as a result of fuel cost increase as well as the cost of vehicles and labor. Despite such increases, the city council continued to change the Sh.10.00 that it has always charged to supply of dustbin. The extra cost in what has reduced the capability to offer adequate services to Nairobi residents.

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FACULTY OF ARCHITECTURE, DESIGN AND DEVELOPMENT
DEPARTMENT OF URBAN AND REGIONAL PLANNING
UNIVERSITY OF NAIROBI

DATE 13/7/1992

RESEARCH SUBJECT: PROBLEMS OF SOLID WASTE SERVICE
DELIVERLY IN NAIROBI LOW-INCOME SETTLEMENTS

GENERAL INFORMATION

Date of the interview-----
Name of the Interviewer -----
Name of residential area -----
Name of respondent (optional) -----
Sex of respondent -----
Number of years in school-----

QUESTIONS:

1. Are you a resident of this area?
 1. Yes
 2. No

2. If yes, how long have you lived in the neighbourhood
 1. a few months
 2. one year
 3. many years

3. How far is the collection point from your house?
 1. less than 50 metres
 2. less than 100 metres
 3. more than 200 metres

4. Do you own a dustbin?
 1. Yes
 2. No

5. If No, where do you store your garbage?
 1. doll/basin
 2. tin
 3. plastic container
 4. carton

6. How often do you empty your dustbin?
 1. after a few hours
 2. once a day
 3. twice a week
 4. others (specify)

7. Where do you empty your dustbin?
 1. In a bulkbin container
 2. In a cubical
 3. On the ground
 4. Others

8. What is the major waste generated in your house?
 1. food waste
 2. plastic
 3. cans
 4. others

9. Why is that so

10. How many members are in your family?
 1. 1-3
 2. 4-6
 3. 7-9
 4. 10 and above

11. What is your source of income?
 1. formal employment
 2. scavenging
 3. self employment
 4. others

12. What is your total monthly income?
 1. 0-499
 2. 500-799
 3. 800-999
 4. 1,000-1,199
 5. 1,200 and above

13. Do you separate garbage before disposal?
 1. yes
 2. No

14. If yes why

15. Do you always empty your garbage at the same site?
 1. Yes
 2. No

16. If No, Where else do you take it?
 1. to another site
 2. to the 'shamba'
 3. others (specify)

17. Do you use you solid waste for other purposes?
 1. Yes
 2. No

18. If Yes, How do you use it?
 1. to start fire
 2. as manure
 3. to make money (through sales)
 4. others

19. How often is the refuse collected by the Council?
 1. once a week
 2. twice a week
 3. once a month
 4. never
 5. no information

20. In your opinion, is the frequency of refuse collection sufficient?
 1. Yes
 2. No

21. If no, how many times a week do you think would be sufficient?
 1. daily
 2. twice a week
 3. others

22. Do you see human scavengers near or around the collection point?
 1. Yes
 2. No

23. If yes, what do they normally pick?
 1. bottles
 2. paper
 3. cans
 4. all of the above
 5. Others

24. Where do you think they take the materials they pick?
 1. to sell
 2. to use
 3. others
 4. I do not know

25. Do you experience any inconveniences as a result of uncollected garbage?
 1. Yes
 2. No

26. If Yes, How are you inconvenienced?
 1. smell
 2. fire
 3. others

27. What do you think should be done to improve the situation?
 1. garbage should be collected more often
 2. more dustbins should be provided
 3. size of dustbin
 4. others

28. Do you think the residents can also contribute in improving the situation?
1. yes
 2. No
29. If Yes, how can they do it?
1. burning the waste
 2. separating waste from the source
 3. disposing waste in the right place
 4. others
30. Do pay service charge?
1. Yes
 2. No
31. If No would you be willing to pay for services?
1. Yes
 2. No
32. If No 29 is yes, how much would you be willing to pay. Ksh...
33. If No 29 is No, give reasons.....