AN ASSESSMENT OF THE MANAGEMENT OF GARBAGE COLLECTION AND DISPOSAL IN NAIROBI.

BY

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A THESIS SUBMITTED IN PART FULFILMENT OF THE DEGREE OF MASTER OF ARTS (PLANNING) IN THE UNIVERSITY OF NAIROBI.

JUNE, 1991
NAIROBI, KENYA.

DECLARATION

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

Signed _____
Candidate

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

Signed _____
Supervisor

June, 1991.

DEDICATION

To my Mother, Father, Brothers and Sisters for their constant source of inspiration, assistance and encouragement.

ACKNOWLEDGEMENT

I owe my gratitude to the Government of Kenya through the Ministry of lands, Settlement and Physical Planning for sponsoring me to take the post-graduate course in Planning. I wish to convey my sincere appreciation to the supervisor of this thesis, Mr. George Ngugi for his guidance and regular monitoring of the progress of this work, for the provision of the relevant references and for enduring with me to the end.

Special mention must also be made to the co-operation received from the various organisations, and especially the Cleansing Section of Nairobi City Commission in the provision of data. All the staff of the section especially Mr. Wamwiri were most helpful.

Let me also express my heartfelt gratitude to my family who have been very helpful and a constant source of inspiration to me. I wish also to register my sincere appreciation to Sarah Wanjiku for her tremedous assistance during the research.

Many persons contributed to this study, for most part unknowingly. I have benefitted greatly from the ideas of many people who through discussions made pertinent comments and suggestions. To list them all would be impossible. I express my sincere thanks to them.

Finally, while I thank all the above people, I alone remain responsible for the ideas and opinions that follow in this study.

ABSTRACT

This study has been presented in order of introduction of the study, background of the garbage problem at various levels, analysis and findings, and then recommendations and conclusions.

This study critically examines the nature of garbage management practices in a low income area (Dandora Settlement) and high income estate (Plainsview) in Nairobi and the resulting problems. It consequently gives suitable recommendations to resolve the problems. Viable garbage management alternatives have been considered and they include measures such as privatization of garbage services, and garbage collection by scavangers with a view to reducing the current phenomenon of rapdily accumulating garbage heaps in the study areas which the Nairobi City Commission (NCC) cannot handle effectively

Besides, the study has also examined the various benefits arising from using the alternative garbage management techniques. In the case of garbage collection by scavangers, the social and economic benefits that arise such as creation of employment opportunities and income generation have been analysed besides examining the lifestyles, habitats, and saving and investments patterns of the garbage collectors. Appropriate recommendations to enhance this activity have been given.

In general the study established that the problem of garbage management in Dandora area especially is escalating with the increasing population of the area and falling garbage handling capacity of the Nairobi City Commission's Cleansing Section. The result has been increasing uncollected garbage heaps in the study areas whose adverse effects if not remedied immediately will seriously affect the quality of life of the residents and the environment. Proposals to the problems both in short and long term have been given to attempt to improve the situation and hence make contribution to further development of the economy of Nairobi.

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CHAPTER ONE

INTRODUCTION

1.0 INTRODUCTION

Nairobi City may be viewed as an organism and therefore a generator of waste. It has inputs which it utilizes and outputs which are either used or must be disposed of. This metabolic nature of the city calls for proper urban management practices. One of the most visible outputs from Nairobi city is garbage which is generated by residential land use. These garbage must be disposed of properly if health and environmental problems are to be averted. Garbage disposal is imperative for both aesthetic and hygienic reasons.

Solid wastes are all the wastes arising from human and animal activities that are normally solid and are discorded as useless or unwanted. Garbage one form of solid wastes, refers to animal and vegetable waste resulting from handling, preparation, cooking and serving of foods. It is composed largely of putrescribe organic matter and its moisture. Garbage originates primarily in home kitchens, stores, markets, restaurants and other places where food is stored, prepared or served. The term does not include food processing waste from industrial activities (Tchobanglous, 1977).

This study looks at the management of garbage collection and disposal in a low income residential settlement - Dandora estate, Visa Viz a high income

residential area - Plainsview estate. This is with a view to planning for and providing better and efficient garbage collection and disposal services especially to the currently underserved low income residential settlement of Dandora as well as improving garbage services provision to a residential settlement like Plainsview.

This study attempts to look at efforts that can be put to improve garbage management by the relevant authority the Nairobi City Commission in Dandora and Plainsview areas as well as the whole of Nairobi. Consequently it also looks at the constraints and potentialities that arise thereof as well as the necessary remedial measures in order to attain a more effective garbage management system.

The problem of garbage management in Dandora and Plainsview areas in being looked at against the background of that broad problem in the whole of Nairobi (see maps numbers 1 and 2). Garbage handling services in Nairobi have been deteriorating for some time. The early 1970s saw more waste being collected than it is today although the population and refuse production has increased (see table 1).

MAP NO.1 LOCATION OF THE STUDY AREA IN KENYA

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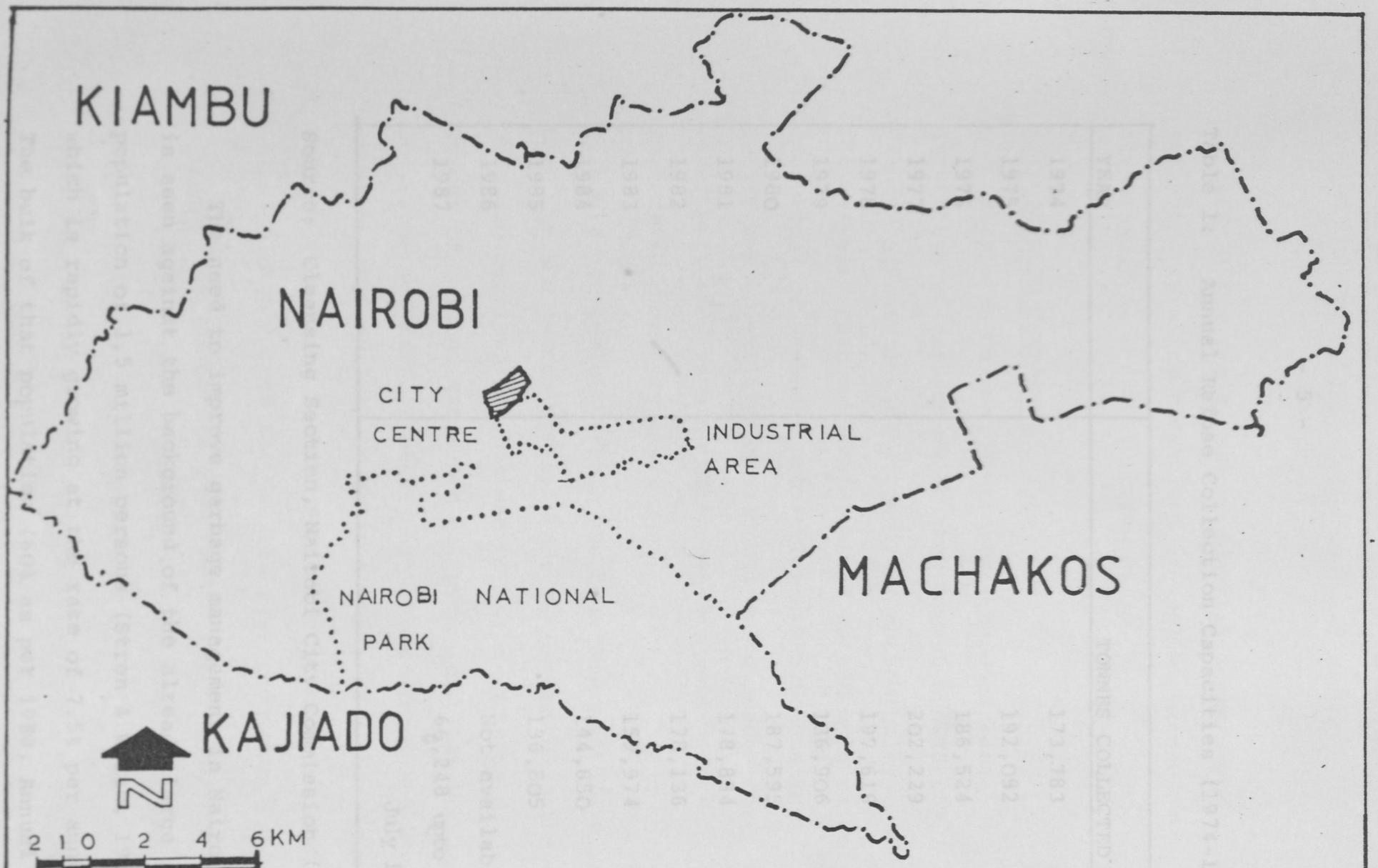

MAP NO. 2 NAIROBI IN REGIONAL CONTEXT

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Table 1: Annual Refuse Collection Capacities (1974-1987)

YEAR	TONNES COLLECTED
1974	173,783
1975	192,092
1976	186,524
1977	202,229
1978	197,619
1979	136,906
1980	187,595
1981	178,834
1982	178,136
1983	159,974
1984	144,650
1985	136,805
1986	Not available
1987	66,248 upto July 1987

Source: Cleansing Section, Nairobi City Commission (NCC).

The need to improve garbage management in Nairobi is seen against the background of the already large population of 1.5 million persons (Stren & White, 1989) which is rapidly growing at the rate of 7.5% per annum. The bulk of that population (60% as per 1988, Annual Report by Nairobi City Commission's Planning Unit) is

settled in the low income residential areas where infrastructural services such as health, garbage etc. are already in a deteriorating state.

1.1 PROBLEM STATEMENT

People in Nairobi continously produce large quantities of garbage which they cannot ordinarily dispose off safely, effectively or economically themselves. Such materials cannot be accumulated on individual or communal properties without menacing public health, utilising valuable space needed for other purposes, causing nuisances and generally detracting community appearance.

The problem of garbage has been found to hit more hard the low income areas, where the amount of garbage produced continue to increase not only in terms of pounds of garbage generated per person per day but also in volume (Jackson, T 1989). In these areas, health and environmental quality is being threatened by excessive dumping of garbage on open spaces, road reserves etc. which go uncollected for several days and weeks.

Dandora estate has been chosen for this type of study, because there, garbage is generated in a highly densely populated area, where virtually all land available is covered by buildings and other developments and hence no space is left for storing waste. Secondly due to

the increasing population in Nairobi and also the increasing population proportion of those in low income bracket, we find that the influx of people into Dandora and other low income residential settlements is very high and hence of great concern.

According to the Nairobi Metropolitan Growth Strategy study (1973), Dandora area is one of the industrial zones in Nairobi that has been set for further industrial expansion and this might attract more workers to reside there. Besides, going by the Nairobi City Commission (NCC) housing and planning standards, Dandora represents a typical low income residential area. Development conditions in that area portray typical problem situation that affect the development of garbage management services in low income areas.

In Plainsview area, the problem of garbage services is relatively not of as great magnitude as in Dandora estate. Social and economic conditions of the two areas differ to some extent. In view of this, garbage handling in the two areas is being studied with an aim of providing appropriate recommendations that will see the improvement of garbage management in those areas. Besides, solutions to garbage management problem are never of a general application - solutions need to be tailored at least to the local behavioural, environmental and social conditions (Subrahmanyan & evjetanovia, 1986).

A 1989 study in Nairobi conducted by United Centre for Human Settlements (UNCHS) revealed that the average garbage collection frequency being achieved by NCC in low income residential areas was once per 7-14 days, against once per 7-10 days in high income areas. In 1989, there were 38 vehicles being used for garbage handling in Nairobi against the present (1990) average of 32 vehicles whose number usually goes down to 27 due to regular mechanical breakdowns. This has affected garbage services especially in the low income areas. More evidence of deterioration of garbage services provision in Nairobi has been provided by a special technical study prepared for World Health Organisation (WHO) on, Solid Wastes by SWECO (1974). It was found out that the performance of refuse collection as per 1974 stood at 2 times a week. A decline in the provision of garbage services in Nairobi overtime can also be witnessed from the falling refuse collection capacities (see table 1).

According to the 1969 Kenya National Population Census Report, Dandora had a population of 22672 persons which grew to 77,000 persons in 1979, and was estimated at 149,000 in 1985 by the Third Nairobi Water Supply Project Report (1983). The same study projected that Dandora estate would have a population of 219945 in 1990 and 326,000 persons in 1995 using a 1985-95

population growth rate of 8.1% per annum. A UNCHS refuse study (1989) estimated that in Nairobi, the per capita refuse generation per day is 0.5 kg. And the NCC's Cleansing Section annual report (1990) on refuse capacities estimated that they collect between 270-350 tonnes per day depending on vehicle availability against an estimated daily waste generation of about 850 tonnes. A further 100-150 tonnes is delivered by traders directly to Dandora tip site and approximately 20 tonnes is collected by private waste contractors.

If these figures are accepted it represents a daily per capita garbage collection of between 0.25 to 0.32 Kg. Even when allowance is made for the recycling of materials such as paper, cardboard, metal, glass plastic and kitchen wastes etc. it is a reasonable assumption that some 30-40% of NCC refuse is disposed of by illegal dumping on waste ground (eg. on open spaces, road reserves) particularly in the low income and underdeveloped housing areas where NCC garbage collection frequency is erratic.

1.2 STUDY OBJECTIVES ARE:

1. To identify and assess the nature and magnitude of the problems facing garbage management in Dandora and Plainsview areas.

2. To evaluate the alternative methods of garbage management and the accruing benefits.

1.3 STUDY ASSUMPTION

1. A higher proportion of the city population will continue to seek for housing within the low income areas as the level of urbanization rises.

1.4 SCOPE OF STUDY

This study has been carried out to examine, the NCC's present garbage services provision to Dandora and Plainsview areas, the garbage management problems and also make proposals for improving the efficiency of the present garbage services in those study areas and Nairobi as a whole. The study has also examined the various adverse effects caused by uncollected garbage.

Besides the study has also examined the various alternative methods of garbage management in Nairobi and finally given appropriate recommendations to preferred alternative strategies. It has also given a set of proposals on institutional, managerial, financial and technical matters relating to NCC's

operations so as to enhance its performance on garbage services. This is to enable the NCC to provide improved and sustainable garbage services especially to residents living in low income areas as well as other settlements in Nairobi.

This study is organised in five chapters. Chapter one forms the introduction of the study whose elements include problem statement, objectives of study, assumption, data collection methods and analysis, scope, limitations and literature review. Chapter two looks at the background of the problem at global and Kenyan levels as well as in Nairobi and at the level of the study areas Dandora and Plainsview. Chapter three and four look at field study analysis and findings while chapter five is on study recommendations, proposals and conclusions.

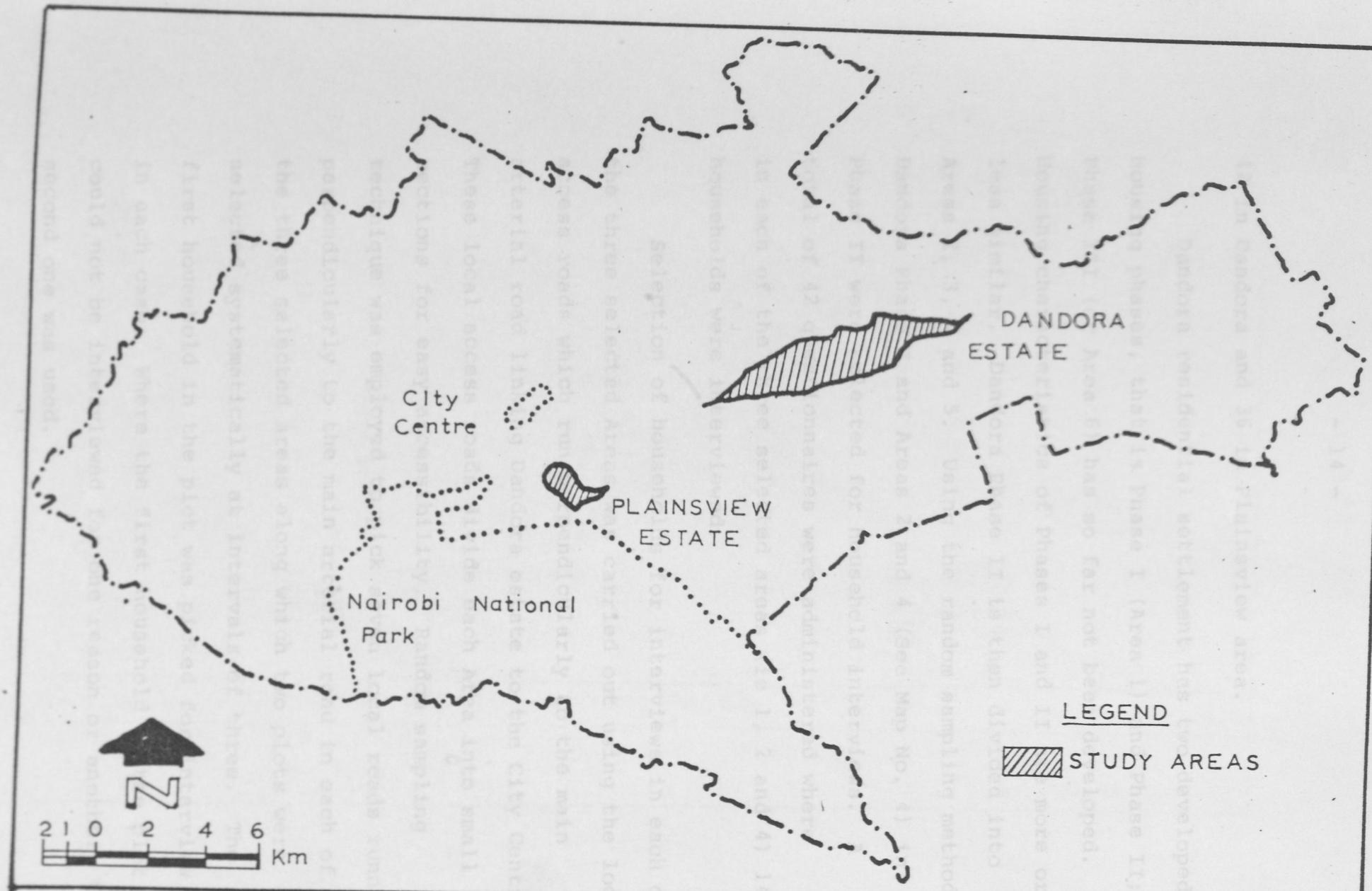
1.5 DATA COLLECTION AND ANALYSIS METHODS

To understand the magnitude of garbage management problems in the study areas, data on garbage handling practices as well as trends in the study areas was collected from secondary and primary sources. This included data on economic, social and physical conditions of those areas and the entire Nairobi. Secondary sources of information included:- annual refuse reports, research reports and seminar reports from NCC, solid waste reports from Tekuza Research Institute, United

Nations Centre for Human Settlements (UNCHS), Mecca, Sulo and Future Fuels Ltd. institutions among other sources. Other sources of secondary data included Library Literature Sources, Local Government Ministry Reports, and Research Reports from Mazingara Research Institute, United Nations Environmental Programme (UNEP), Environmental Secretariat, Ministry of Economic Planning and National Development among other sources.

Primary sources of information were also used. This entailed actual reconnaisance and a physical survey of the study areas, use of household questionnaires and interview guides which were supplemented by direct and indirect observations as well as the use of key informants. The household questionnaire was used to provide community input at the recommendations and design stage by generating information on community perception of the garbage problem. One questionnaire was administered to households while a second set was administered to garbage scavangers in the study areas. An interview guide was used on Nairobi City Commission (NCC) officials.

In administering the household questionnaire, random, systematic and stratified sampling methods were used in Dandora and Plainsview settlements. (See Map No. 3). Due to the limitation of time and finance, a total of 78 questionnaires were administered,



MAP NO. 3 LOCATION OF STUDY AREAS

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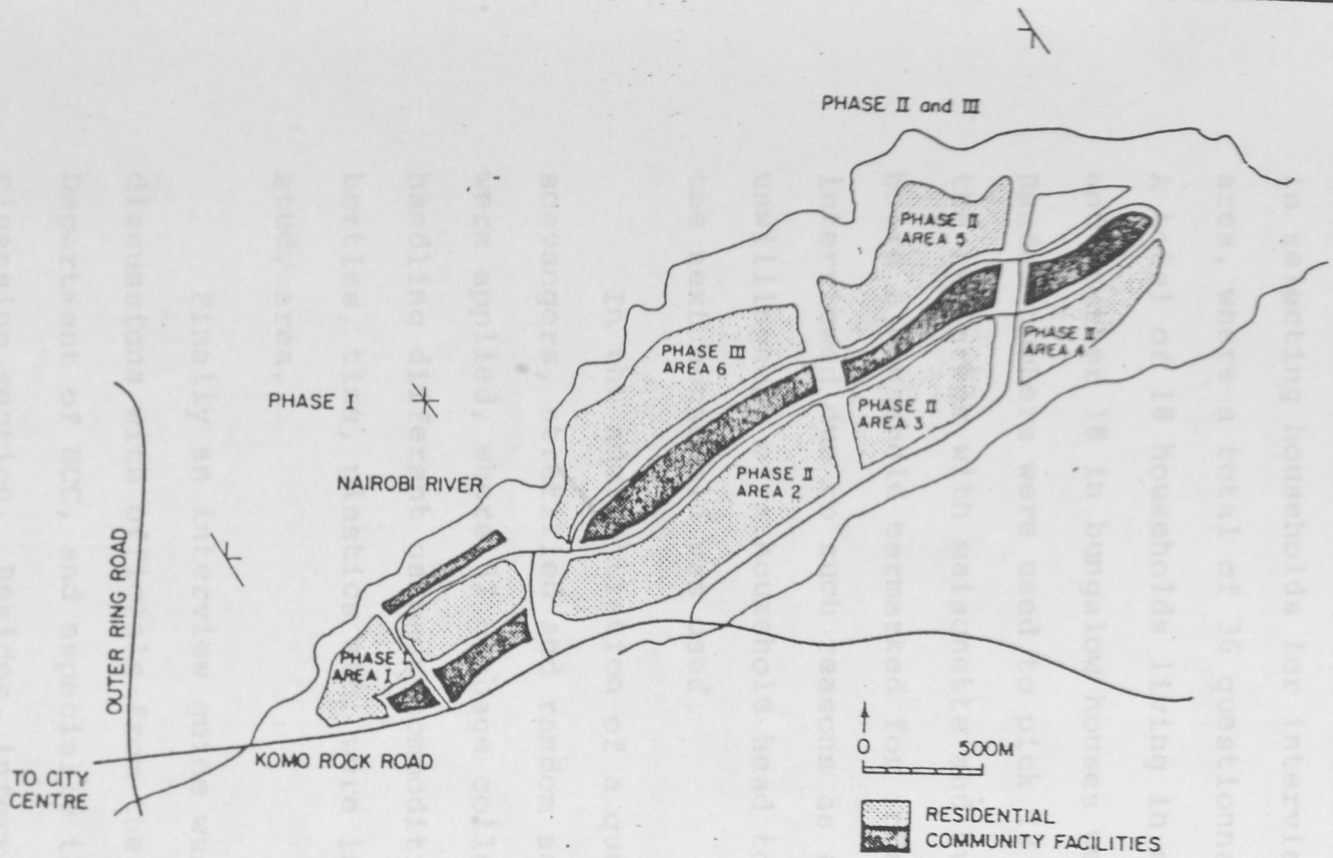
42 in Dandora and 36 in Plainsview area.

Dandora residential settlement has two developed housing phases, that is Phase I (Area 1) and Phase II; Phase III (or Area 6) has so far not been developed. Housing characteristics of Phases I and II are more or less similar. Dandora Phase II is then divided into Areas 2, 3, 4 and 5. Using the random sampling method, Dandora Phase I and Areas 2 and 4 (See Map No. 4) in Phase II were selected for household interviews. A total of 42 questionnaires were administered where in each of the three selected areas (ie 1, 2 and 4) 14 households were interviewed.

Selection of households for interviews in each of the three selected Areas was carried out using the local access roads which run perpendicularly to the main arterial road linking Dandora estate to the City Centre. These local access roads divide each Area into small sections for easy accessibility. Random sampling technique was employed to pick seven local roads running perpendicularly to the main arterial road in each of the three selected areas along which two plots were selected systematically at intervals of three. The first household in the plot was picked for interview in each case. Where the first household in the plot could not be interviewed for one reason or another, the second one was used.



MAP NO. 4 DANDORA ESTATE LAYOUT PLAN

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Random and stratified sampling methods were used in selecting households for interviews at Plainsview area, where a total of 36 questionnaires were administered. A total of 18 households living in maisonette houses and another 18 in bungalow houses were interviewed. Random numbers were used to pick 18 houses from each of the two areas with maisonette and bungalow house types. Where a household earmarked for interview could not be interviewed due to such reasons as absenteeism, unwillingness of a household head to be interviewed etc., the next household was used.

In the administration of a questionnaire to garbage scavangers, stratified and random sampling techniques were applied, where 32 garbage collectors (Scavangers) handling different garbage commodities, that is paper, bottles, tins, plastics etc. were interviewed in the study area.

Finally an interview guide was used to hold discussions with officials from the Public Health Department of NCC, and especially those from the cleansing section. Besides, informal discussions on garbage management were held with key informants.

Methods of data analysis that have been used in the study include the descriptive statistical methods, such as percentages and averages, as well as classification and cross tabulation of data. Finally cartographic

methods have been used which include maps, graphs, tables, figures, pictorial presentation and quantitative presentation in form of a report.

1.6 STUDY LIMITATIONS

The following were the limitations that were experienced during the study.

One limitation experienced was that of scarcity of relevant data. There was lack of relevant data in the NCC records on garbage management in Dandora and Plainsview areas as well as the whole of Nairobi.

Besides, the time taken in the field was only three months, which proved a very short period for such kind of study.

There was also the problem of actual time to administer the questionnaire and suspicion on the part of some respondents. Some respondents with sheer disinterest in the study chose not to be interviewed. Due to the fact that it was not possible to get household heads during the working times, interviews were mostly done during the weekends and evenings.

Long hours were spent when interviewing and cross-checking the respondents in order to generate very accurate information since a number of them at first instance attempted to exaggerate on the garbage problems

in the study areas and make inaccurate picture of the real situation due to emotions.

Lack of sufficient funds was yet another limitation experienced during the study.

1.7 LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

There are very few studies that have been conducted on garbage management in Nairobi and other major urban centres in Kenya. Perhaps this can be explained to some extent by the fact that it is in recent times that the magnitude of the garbage problem has attained uncontrollable proportions in Nairobi City and hence attracted the public attention. The following is a review on the few research studies on garbage problem that have been carried out in Nairobi.

Liyai (1988) undertook a research study on solid waste management in the entire of Nairobi. It attempted to investigate the problems surrounding solid waste collection methods only with no attention being given to garbage disposal methods. That study looked at the city as generally one homogenous system without regard to the differing social, economic and environmental conditions in existence in different residential settlements. Moreover the garbage problem in the low income residential areas whose population form the bulk of the city population was not given the attention it

deserves. The study that is now being carried out will attempt to fill these gaps as well as look at the phenomenon of garbage collection and disposal by scavengers which might currently be playing and will further play in the future a significant role in income and employment generation especially to the largely unemployed persons in the city.

Brown and Vickers (1988) carried out a study on domestic waste disposal in Nairobi. The study focused attention on waste processing plant as a possible domestic waste disposal method in Nairobi. It ignored the other disposal methods. It suggested this method which was to involve the provision to the Nairobi City Commission of a waste processing plant based on anaerobic digestion of waste where the biogas produced in the digester would be used to provide electricity. A plant with a capacity of 300 tonnes a day was proposed. However, this study did not address other possible garbage disposal methods in Nairobi neither did it pay attention to garbage collection and transportation methods and how they can be enhanced. This study will address these important issues and gaps. Besides their study did not take into account the financial implications of such a waste disposal method neither the environmental and safety implications of such a method.

Jackson D. (1989) in a study on Solid Waste Management in Nairobi focused his attention on the disposal of hazardous and toxic industrial wastes. The study looked at the tariff structure for industrial solid waste management services and its legal framework. No attention was given to garbage management issue which is now being looked into in detail my study.

A study by Mecca (1989) on the proposal for cleaning the City of Nairobi recommended that Nairobi City Commission adopt improved technology in its domestic waste collection, transportation and disposal efforts. This called for importation of highly efficient capital equipment eg. trucks, compactors, but with little attention on the local social and economic conditions nor the local needs. In the study that is being carried out, on attempt has being made to take into considerations, the local needs, unemployment situation, income levels and technology adoptable to the local situation, when examining and searching for effective garbage management practices.

Another study by Ayres, B. (1988) for SULO Incorporation on - Nairobi East Technical Assessment And Proposal For Upgrading the Existing Refuse Collection System, focusseed attention on mainly collection methods of refuse with little or no regard for disposal methods. If garbage management practices are to be sound, then due attention must be given to the appropriate garbage

disposal methods. Again this research recommended the use of advanced and imported garbage collection capital equipment with little understanding of the local social economic and environmental conditions and needs. Nairobi, faced with abundance of unemployed labour force for instance needs labour-intensive garbage handling techniques. The study that I am carrying out is seriously taking into consideration all these conditions and aspects. Besides during that study, since only partial data on refuse generation, density, composition etc. was available, comparable data of similar cities in the world were used during analysis. This then further casts suspicion on the suitability of that study findings and recommendations.

Besides, in 1988 Tekuza Research Institute carried out a study in Nairobi on recycling activity as a feasible solid waste disposal method for the City of Nairobi. However this study did not examine alternative methods of garbage disposal, neither the collection methods that need be adopted in the City to resolve the problem of garbage. Furthermore the study did not pay attention to to the important issues of financial, technical and organizational requirements of the activity in a city like Nairobi.

At a global scale, there are a number of studies that have been carried out on solid waste management especially in the developed world. One such study has been carried out by Lohani (1982) on recycling activity as a solid waste disposal method. Benefits from this method such as employment creation and other economic and environment merits have been discussed. But it was mentioned that plastics recycling processes are complex and need advanced technology and organization. In Nairobi, such an option requires thorough feasibility studies before its adaption in the face of limited financial and technological resources.

Experience from other countries such as Indonesia confirm the economic importance of scavenging activity (Vorsnol, 1982). This Indonesian study recommended that measures adopted towards scavengers should aim at their total integration into the urban society since they benefit both the urban and the national economies. The same study also recognized the importance of improving the health and living conditions of the scavengers. On the local scene, the Nairobi City Council commissioned a special technical study (May 1973) on solid waste . The report included recommendations on the management of the cleansing department on collection, transportation and disposal of solid wastes.

The organisation of garbage collection for recycling can be a very rigid phenomenon as exemplified by the Egyptian case (Haynes and Hakim, 1971; Elghayati, 1988). In Cairo, this collection is entirely in private hands administered by a hereditary occupational group known as Wahis and no other group can get into this occupation without the consent of the monopoly group. This method of waste disposal has proved to be effective, and is an important way of creating employment and generating income.

Other works include on Indonesian study by Bindu et. al. (1981) which places emphasis on social and economic aspects of scavenging of solid wastes with respect to "The role of women in the scavenging system in Bandung, Indonesia." Fatimah and Utami (1982) have clearly shown the role the informal sector plays in scavenging and the changing roles of women from traditional to modern society where they contribute to the welfare of their families.

Several other authors have attempted to shed light on the solid waste subject. A local study on environment and development (an unpublished report prepaired by The National Environment and Human Settlements Secretariat in 1981) for the need to change the present tipping system was prepared. It is then noticed that in most cities in the developing countries scavenging

occurs on dump sites, with various degrees of sophistication. It is often an obscure and despised activity which has attracted little attention from outsiders. Most of the workers especially in Nairobi concern themselves with the extraction of a specified material in order to collect saleable quantities, eg. paper and glass. The purchasers of the materials are wholesale dealers who are usually secretive about the processing and destination of their specialized goods.

The low status of scavengers at the periphery of society virtually deprives scavengers of the protection of the law. Their low educational achievements, weak social network in the city (scavengers are often new migrants into the city) and the revulsion waste evokes in others forces them into a position of being outcasts. In my study, scavenging activity is being given considerable attention with a view to examining how this activity can be activated and encouraged since it contributes to income and employment generation besides being an alternative method of garbage collection and disposal.

The work of keeping the environment clean requires the co-operation of both the public being served and the authorities charged with the responsibility of keeping the environment clean. The authorities charged with the responsibility of keeping our urban areas clean

must exercise that perseverence, patience and give public education when dealing with the community. The people's culture, customs, peculiarity of conditions in certain areas and special needs of a community must be considered.

Recent surveys by Habitat (Ramachandran, 1987), indicate that despite recorded impressive levels of economic growth in developing countries, the solid waste management was bad, if not worsening (Subrahmanyan and Cvjetanovia, 1986). The problem is particularly acute among the low income urban settlements and also because it inhibits the path towards the community's improved health.

The provision of adequate containers for solid waste storage before collection has met a lot of obstacles (Pacione 1981). Although this might be attributed to lack of suitable regulations, the community also may fail to observe the regulations and the officials may not enforce them. Despite the stipulations for approved refuse containers, these stipulations are not uniformly followed. It has been observed in Nairobi that, occassionally there is failure to provide adequate containers throughout the Municipality. This study will attempt to look at this aspect and to determine the extent to which it has contributed to garbage management problem in both Dandora and Plainsview areas.

Focusting attention on garbage, Hagerty (1976) points out that a considerable portion of all expenses incurred in solid waste management arise from collection. But within the Nairobi City Commission budget, little money is set aside to ensure the refuse collectors' safety in their job. The studies by the American Public Works Association (1978) on Municipal refuse disposal and the Handbook of Solid Waste Management by Wilson (1978) both call for the recognition of the fast growing problems of solid wastes and their disposal.

Besides the streamlining of scavenging activity and the application of recycling techniques have been shown to have positive effects on the economy in general and therefore should be encouraged. These issues are being addressed to in this study.

This study was prompted by the gaps which exists in literature on the management of garbage collection and disposal in Nairobi, and more so as concerns the situation in the low income residential settlements.

A number of arguments have been raised with a view to explain and solve the garbage management problem. One of the arguments that have been advanced relates to economic and financial aspects of garbage management. Resources for garbage management such as land, labour, capital and the tax funds are scarce painfully so in some communities. This case is especially true of Kenya,

a developing country. The use of resources in any one activity automatically precludes those same resources from being employed elsewhere. If a growing garbage load becomes very costly to manage, any increases in taxes for that purpose precludes those same taxes from utilization for another purpose.

Continued population and economic growth in Kenya has caused resources to become more scarce, and consequently more valuable in their alternative uses (Wilson, 1970). The cost of maintaining those resources in their alternative uses is rising and there is a welfare loss to individuals and society. This loss will occur either through continued degradation of the environment due to pollution by solid waste accumulation and attendant health and welfare effects, and/or increased expenditures to reduce the environmental impact.

One of the responsibilities of the local authorities is to provide efficient and comprehensive garbage handling services, which should suit the problems and needs of the whole economy. Within the operation of Nairobi City Commission (NCC) this includes the supply of sufficient equipment, manpower and management to ensure that the garbage handling services are carried out on a continous basis.

In Nairobi, there are many factors which affect the costs of garbage handling in various areas. These factors include the physical conditions, climate, topography, length and development of streets, conditions of pavements, type of dwellings, zoning, the population density, type of equipment and vehicles used, social and economic levels of the population among other factors. Consequently with such a large number of variables, it becomes exceedingly difficult to assess the importance of one factor over another as a cause for increase or change in the costs. By obtaining the available data of this kind in this study will provide a basis for a comprehensive approach to a viable and feasible garbage management programme for especially low income residential areas operations as well as others.

The revenue budget for Cleansing Section of the NCC's Public Health Department for 1988/89 financial year was: (Jackson, D. 1989) Expenditure K£ million 4.5 - Income K£ 1.1 giving a Net of K£ 3.4. This income derives from conservancy charges recovered as an addition to water charges which are billed to users monthly by NCC's Water Department, the conservancy element being credited to the Public Health Department and Charges for other services provided on request. The problem of funds limitations makes it necessary that the most

suitable garbage management system has to be used by NCC, which should provide maximum productivity, minimum costs, customer convinience and utmost hygiene.

Given the above income base of the NCC, the residents expect and want sound and quality garbage services. A recent study (by Mecca USA Incorporation 1989) showed that in the low income areas and squatter settlements where population densities are high and awareness of the hazards of uncontrolled garbage disposal are low, the need for garbage service is greatest.

In Nairobi, the present dustbin charges of Kshs. 10 per household per month is insufficient income to meet the needs and scope of the present City Cleansing operations. Taking into consideration that many households pay Kshs. 120 per month to private contractors to have their refuse collected (Jackson, D. 1989), there seems to be little doubt that many households could afford to pay slightly more especially those in the high and middle income areas.

If funds derived from charges of this magnitude should be available to the NCC, it would go a long way to provide a more efficient garbage service. Consequently, it seems appropriate to apply alternative means of charging the public by relating the amount charged for refuse collection to property rates, a system used in many countries.

Another strand of argument that explains the phenomenon of solid wastes relates to the legal aspects in refuse management. When we look at the powers and duties of a Local Authority Public Health Act, Chapter 242 under the Laws of Kenya we notice that the Public Health Act provides the local authority with an obligation to maintain cleanliness and prevent nuisance in its district. Nuisance is defined in Section 118(b) as any accumulation or deposit of refuse, offal manure, or other matter whatsover which is offensive, injurous or dangerous to health.

Section 168 (A) (i) gives power to Municipal Councils to make By-Laws for preventing and abating conditions, permitting or favouring the breeding of moisquitoes and flies and generally for the prevention of malaria and other insect-borne diseases. Such conditions are defined in section 136(a), as all collection of water, sewerage, rubbish, refuse, ordure, fluid or solid substance.

But critically looked, both the Public Health Act and the Local Government Act remain silent on various activities related to solid waste management. There is lack in the provisions as to the nature of storage facilities, and extent to which the refuse collection service should be offered, and how far the local residents

should participate in the activities that will keep our city clean. There is therefore need for a thorough review of the legal framework of the local authorities in order to accomodate and incorporate these aspects above.

In the planning of residential areas, the Medical Officer of health should be involved fully so that his advice on provision of optimal accessibility and connectivity in those areas is fully cartered for. It has been observed that in many low income areas and slum areas of Nairobi, inaccessibility has militated against garbage collection and disposal.

According to the Laws of Kenya, Local Government Act, Chapter 265, Section 213, the Minister shall consider the annual or supplementary estimates as submitted and may either approve or disallow one or more of the items contained therein, and may make such modification, or conditions as he thinks fit. Section 148(2) talks about fees and charges, which are major sources of revenue for the Local Authority. These should be regulated by By-Laws, or if not may be imposed by resolution of the Minister, and such consent of the Minister may be given in respect of specified fee or charge.

This shows that the Minister has such wide powers as concerns financial matters of the Local Authority. This then calls for the need to review relevant legislation to confirm that the preferred garbage handling strategies can be implemented within the existing powers of NCC in consultation with the appropriate Government Departments, and consequently make recommendations for any ammendment or additional legislation that may be required. Besides there is need for consideration for a detailed legislation on a national basis on pollution control in respect to solid wastes.

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CHAPTER TWO

BACKGROUND OF GARBAGE PROBLEM

The management of large African cities today is taking place in very difficult circumstances. The population is still growing rapidly and the rate of urbanisation is increasing. Over the past ten years, urban conditions in Africa have been rapidly deteriorating. Many urban areas are increasing their population by 7-8% per year, and in some cities, the annual increase is over 10% per annum. For instance, the annual population growth rate of Nairobi is estimated currently at 7.5%. (Stren & White, 1989).

Urban settlement is increasingly becoming the ultimate form of human settlement in the world. In 1920, about 19.4% of the world population lived in towns of 20,000 inhabitants and above. This figure had reached 41% by 1980 and is projected at 51% by the year 2000 (El Sakhs and Amirahmadi, 1986). Though the figures for the African continent are below the global average, the current rates of urbanization in African countries are among the highest in the world.

Because of the concentration of people in the urban centres, development policies of many African governments have tended to attract more people from the rural areas into the cities which have very weak economic basis. Unemployment and urban management problems have consequently been exacerbated.

The rapid urbanization in the developing countries has overwhelmed planners and administrators responsible for urban development in recent decades and led to the deterioration of living conditions. The growth of spontaneous and often illegal settlements has been staggering, leaving the conventional city management institutions unable to serve the citizens equally and adequately. This is particularly the case with infrastructural facilities provision which normally are built and managed by the municipal authorities.

Consequently, infrastructural services often do not reach the low income residential areas while the level of municipal services in these areas and other older areas deteriorates. The municipal service that seems to fail most strickingly is garbage collection and disposal because it causes littering and untidiness which has an immediate adverse psychological impact. The lack of adequate garbage disposal in an area often results in negative attitudes that contribute to a general deterioration of community development and cohesion.

As Kenya's urban areas grow in population at historically unprecedented rates, the government is facing increasing pressures to provide efficient services and effective infrastructure, and to co-ordinate and "manage" a wide range of public and private sector activities at the local level. In urban areas such

services include garbage collection and disposal, housing, water supply, road repair, health and educational facilities which especially in the capital City Nairobi, are inadequate and in a deteriorating state (Mecca, 1989).

Until recently in Kenya, garbage disposal was a small-scale issue that could be taken care of within the municipal boundaries. But in many urban centres of Kenya, the problem of garbage management has become particularly significant in recent times.

In the kind of society that men finds himself in today, the question of getting rid of the garbage in the most convinient manner poses a great challenge to all. This is because the community in urban areas is concentrated over a small area and yet the same community is engaged in intensive economic and social activities. Consequently with the high rate of garbage generation, it becomes extremely difficult to handle the waste unless appropriate measures are taken. This is why in most urban centres in Kenya, there are local authorities which are charged with the responsibility of collecting, transporting and disposing garbage in the most appropriate and economc manner. The solution to the garbage problem must be approached by considering all the possible alternatives taking into account the capital and reccurring costs apart from studying the social and ecological implications.

Like other cities in developing countries, Nairobi has been growing fast during the last two decades. Prior to 1963, Nairobi occupied some 77·7 km^2 extending about 9.6 km east to west and some 8 km north to south. At the moment, Nairobi covers 861 km^2 with a population of over 1.4 million persons and is growing at a rate of 7.5% per annum (Stren & White, 1989). The city now includes the peri-urban areas and the adjacent national park. The figures in table 2 illustrate the rates at which Nairobi's population has been growing.

Table 2: Population growth rates of Nairobi

Year	Population	Intercesal growth Rates in percentage (%)
1948	118,976	5.9%
1962	266,794	9.7%
1969	509,286	9.7%
1979	827,775	5%

Source: Central Bureau of Statistics.

According to the Nairobi City Commission 1988/89 Development Plan (prepared by City Planning Department) the population of Nairobi as per 1989 was estimated at 16.3 million persons.

The rapid rate of increase of population implies that infrastructural services must also be expanded to match this growth. This puts serious strains on the meagre resources of the city administration. Because of this population pressure, land uses are also changing fast. The available infrastructure was intended for a comparatively smaller population then is currently served. Hence some of Nairobi's problems include: a high rate of open unemployment, inadequate transport services, inadequate sewage disposal system and uncollected garbage.

The problem of garbage management in Nairobi is a serious one and is receiving much attention from both the city administration and the residents. Environmental pollution resulting from uncollected garbage has become a serious problem of concern to the residents. With increase in the volume of production of garbage, the situation has become intolerable due to lack of concerted action to control and prevent land pollution.

Due to the rapidly growing population of Nairobi, space for large sanitized waste disposal is required, perhaps planned over twenty years period. If such plans cannot be made, then two problems will build up. One is that the level of conflict between the city and the surrounding jurisdictions will increase. Secondly pollution of the ground water through seepage from the overfilled land used for dumping may result (Jackson, 1989).

Hence it is of paramount importance that management of garbage disposal in Nairobi is enhanced to improve the environment and protect people from health calamities arising from uncollected garbage. As the central government is less and less able to maintain services, such as garbage services, the obligation is falling on Nairobi's urban population itself. This then calls for considerable efforts to keep the city clean not only from the City Commission, and other organisations, but also utmost co-operation from the Nairobi Community.

In Nairobi, there has been extensive media coverage of the menace posed by uncollected garbage. The city administration has apprently been unable to cope with this problem. The frequency of garbage collection has declined considerably, and in certain areas of the low income settlements such as Dandora estate, as well as slum areas, gargage is not collected at all. Even though the problem of garbage is widespread in most residential areas of Nairobi, it has been found to be hitting more hard the low income areas than the high income settlements. In the Dandora area for instance, the amount of garbage produced continue to increase not only in terms of pounds of garbage generated per person per day but also in volume. (Kenya Waste Project Report, on Solid Waste Management in Nairobi, 1986).

In the low income residential areas due to the problem of excessive dumping of garbage on open spaces, road reserves etc. land pollution and consequently a decline in environmental quality has been observed to be a common phenomenon. Another problem associated with this inadequate garbage management is that of water contamination, mauseating adours and fly menace. Open dumps are particularly common in Dandora area as well as to some limited extent in Plainsview settlement.

2.1 HISTORY OF PLANNING AND GARBAGE MANAGEMENT IN NAIROBI

The City of Nairobi began less than a hundred years ago when a depot was established there during the construction of the Uganda railway. Nairobi first started in 1899 as a transport centre and a railway depot, and thereafter as the headquarters of the provincial administration. It's position midway between Mombasa and Kisumu made it a suitable stopping place before climbing into the difficult terrain of the Rift Valley. (Halliman & Morghan, 1977). Amazingly in 1980 Nairobi accounted for 50% of the total urban population. Today Nairobi has outgrown all other urban centres in Kenya in spatial scale, population size and physical development (Werlin, 1974).

As a colonial city, Nairobi was born firmly within a socio-economic framework of imperial expansion. The Nairobi Township Committee formed in 1900 with a mere six

members marked the birth of local government in the town. The permanence of Nairobi was confirmed in 1905 and in 1907 when it became the capital of Kenya with a population of 10,000 persons. In 1919, Nairobi became a municipality with corporate rights and defined by an area extending 1.5 miles in radios from the town centre. The town's growth continued being controlled by economic forces and with no co-ordination of development other than by the layout of a grid-iron street pattern in the centre.

In 1919, the boundary of Nairobi was slightly expanded to include some of the outlying residential areas and particularly parklands area to the north. Within the first few years of Nairobi as a Municipal Council, the racial segregation zones had been quite distinct (White et. al. 1948). Towards the end of 1920s was an important time when Nairobi had its plans and zoning arrangements and boundary extension that was to remain in force throughout the remaining part of the colonial rule in Kenya that is upto 1963.

In the colonialists endeavour to implement the proposals of the 1948 Master Plan, the City Council of Nairobi (Building) By-law, 1948 (Planning) was enacted. This building and planning by-laws laid out in detail the planning zones, land and building densities over the entire Nairobi Muncipality in accordance with the Master Plan. The obligation of the Master Plan was to relate

social and physical objectives by attempting to conserve land and prevent sprawl and at the same time to promote stabilization of the African population and reduce horizontal spread.

In effect the Master Plan had a planning strategy that depicts its certainity about how people ought to live and how the city ought to look. This Master Plan advice resulted into a nearly static plan of a population of 250,000 persons and an area of 21,489 acres. However, the population size reached the targeted population of 250,000 in 1954 which was not envisaged by the Master Plan.

Emig et. al. (1980) observes that the Master Plan was planning for the colonialists and not for the colonised. In this context he observes that while Europeans were sited in the wooded ridges of fertile red soils to the north and west which were well served with infrastructural facilities, residential areas of the Africans were left to develop towards the East away from the major trunk road, although this area accomodated the vast majority of the city's population, it was characterised by poor social infrastructural facilities provision.

The origin of Nairobi hinged on the need to accomodate people of different races and ethnic origins, of whom none were original of the immediate vicinity. The major influence that set the frame of the city was

racial segregation, a practice of colonial masters that prevailed until as late as early sixties. (Stren et. al. 1989).

In 1950, Nairobi was granted a city status with an area of 90 km^2 (35 square miles). The area enclosed by the city boundary was extended at independence from 35 to 266 square miles, which included the peri-urban areas such as Nairobi National Park, the Airport and Government Ranching. The Master Plan for the colonial City which was commissioned in 1948 by the British Administration was a blue print for the planning of Nairobi. Most of the current layout of Nairobi today strongly bearers from the 1948 Master Plan. This plan had assumed low population migration into Nairobi.

Nairobi as a rapidly growing city has the problems of urbanization and urban development. For instance the increasing construction of residential houses in Nairobi has seen the loading of the environment by the enormous generation of domestic refuse or garbage.

Looking back, we see that, as a colonial City, Nairobi was born firmly within a socio-political framework of imperial expansion. Racial segregation was implicit and controlled much of colonial plans which had seperate zones for Africans, Asians and Europeans. Nairobi's land use development was fixed within this racial influence. The street layout, residential locations

and the functional layout of the Central Business District (CBD) itself all portrayed colonial planning concepts eg. the grind iron road system.

The African residential areas were invariably outside the interest and activity spaces of the colonialists, hence the problem of lack of social infrastructural facilities passed largely unnoticed. This spontaneous growth of the African areas, together with the generally unco-ordinated growth of Nairobi led to the appointment by the Nairobi Municipal Council of a town planning consultant team in 1926 to attempt to re-order the situation (Hake, 1977).

The 1948 Master Plan for Nairobi Municipality laid down guidelines for the development of Nairobi for the next twenty years. It earmarked land for residential and industrial areas, proposed further extensions for the road network as well as the commercial area of the town. The present layout pattern of Nairobi's C.B.D. area is as a result of the implementation of the proposals of this 1948 plan. Prior to 1948, the CBD was characterised by large open spaces which the plan proposed be filled up and the CBD area be prevented from spreading beyond Nairobi river in the north and the railway line in the south, thus making a compact area. One reason advanced for this kind of compactness was to facilitate in the provision of social and economic infrastructural facilities.

The situation inherited at independence was that of a city destined for capitalist expansion with extreme inequalities in the level of services provided in different residential areas. The city grew tremedously in population especially as the African population tempararily experienced a state of Leisez faire, a situation which encouraged migration to urban centres particularly Nairobi which attracted most of the job seekers.

The rapid population growth and migration into Nairobi was perhaps due to the new government's employment policies which expanded African representation in government and industry. Towards the 1970s a new population distribution began to emerge with the low income group being pushed further away from near the C.B.D area and its adjacent industrial area, which are their main working places. This followed the government's policy on facing out squattor settlements sited near the CBD like Pumwani, and the introduction of site and service schemes like Dandora and Kayole. Other sprawling settlements like Kibera and Soweto also began to emerge on the peripheries of the city. This expansion of the City was however not proportionately matched by a similar expansion in solid waste collection and disposal services and hence the beginning of the problem of uncollected garbage, especially in the low income residential settlements.

The city government therefore within the first decade of independence began to face an uphill task of providing adequate urban services including garbage handling. Yet there was no co-ordinated plan to guide the city's growth and development, despite the tremedous extension of the city boundary from 90 km^2 (35 square miles) to 690 km^2, the equivalence of 266 square miles (Nairobi Urban Study Group, 1973). Development control was only attempted through sectoral plans which however only gave prima facie solutions to the city's development problems. Hence the first post independence planning started in 1970 with the commissioning of Nairobi Urban Study Group (N.U.S.G.) which culminated in the 1973 Nairobi metropolitan growth strategy.

2.2 HISTORICAL DEVELOPMENT OF GARAGE PROBLEM MANAGEMENT IN NAIROBI

Currently as a result of changes in our consumption patterns, population distribution between low and high density urban residential settlements and between villages and urban centres, as well as attitudes towards the environment, the success rate of garbage management in the village has not been replicated in the town and city. Garbage problem presently has become one of the most serious environmental problems in Nairobi and other urban centres of Kenya.

The beginning of garbage management in Nairobi can be traced from the early twentieth century when a plague visited the town, claiming some 50 deaths, and a subsequent one in 1904. As at 1901, Nairobi's population was 8,000 and due to its growth, a private company was given the responsibility of cleaning, collecting garbage, cleaning drainage systems, sweeping and lighting the city streets. However, the company failed in its duties (White, 1948). As a result, rules were laid out in 1904 for the whole colony with regard to sanitary matters. In 1905, another ordinance relating to Nairobi only was formulated with a further enactment in 1906 to the Dhobi (Washermen) quarters.

The various ordinances contained many useful regulations. Many on the other hand were vague and difficult to follow, and some were absolutely senseless, for example, houses in Nairobi were being built without plans and the Municipal authority had no power to pull down the buildings.

The modern system of refuse collection and disposal by the local authority derives from the Public Health Act of 1875 in London. This Act made provisions for removal by the sanitary authority on appointed days of accumulations of refuse from premises. In Nairobi, the modern system was started by the introduction of a Public Health Ordinance in 1920. Each occupier of a premises was obliged to place the refuse in a movable

receptacle and thus - the first legal recognition of the dustbin. The sanitary authority was directed to employ or contract with a sufficient number of scavengers to ensure the sweeping and the cleaning of the several streets within the town and the collection and removal of street house refuse. The authority later was given power to make By-laws with regard to these services.

Resulting from unprecedented swelling of urban populations, is the gradual emergence of the city as what Wehwein (1942) has called an "institutional desert"- a situation of grossly inadequate and largely unresponsive legal and legislative provisions for the control and management of development and its environmental consequencies. It has been argued that garbage is an inalienable product of sophisfication and development (Small, 1971). However the concentration of the indicators and proceeds of development in the city has not been matched by the institutional provision to control and monitor the collection, storage and disposal of garbage. By-laws setting standards and guidelines on environmental sanitation have either been lacking or where they exist they have been enacted at the level of government incapable of managing the environment.

Since residential land use constitutes the single most important generator of garbage in the city (Small, 1971) and because residential solid waste is the most troublesome, because it is the most difficult to destroy

satisfactorily, and most obnoxious because it commonly accumulates near communities where it may pose grave health hazards as well as insulating to sight and smell, the socio-economic structure of urban populations becomes a major determinant of the spatial structure of solid waste problems in the city.

It has been observed that it is not just the volume of garbage that will determine the extent to which the environment will be polluted. If the waste can be disposed of satisfactorily and as fast as it is generated and collected, there would be no accumulation and hence no pollution of environment. Garbage becomes an environmental hazard when its disposal perpetually lags behind the rate of generation. So garbage management therefore concerns the interplay among generation, storage, collection and disposal, in which feasible alternative plans are utilised to solve the problem of garbage. In Nairobi, there are two broad systems of garbage management, that is public and private, with the former being the more conventional and traditional and is undertaken by Nairobi City Commission.

In Kenya, after realisation of the problems and non-performance of local councils' garbage disposal units regarding urban environment, and also realising that even the intervention of higher order authorities has not produced noticeable results, the government set up an

office of the Directorate of Civil operations in 1986, whose task is to ensure environmental sanitation in the City of Nairobi. Recently, the functions of the office have been expanded, to even include elements of development and land use control.

In Nairobi private garbage disposal system has been used to complement the efforts by the Nairobi City Commission on a limited scale. Private companies have collected and disposed garbage in some affluenced residential estates at a small fee. Besides these are some informal groups of people in Nairobi that are involved in scavenging activities that also assist in collecting and disposing garbage.

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CHAPTER THREE

DATA ANALYSIS AND FINDINGS

To identify and assess the nature and magnitude of the problems facing garbage management in Dandora area and Plainsview estate, the following issues and aspects were examined; population dynamics, financial aspects, garbage types and rate of generation, institutional, legal, management and technicals aspects, as well as community perception and participation aspects related to garbage management.

3.0 POPULATION DYNAMICS OF THE STUDY AREA

According to the Third Nairobi Water Supply Project population projections the total population size of Dandora area grew from 20,000 to 77,000 persons from 1969 to 1979 by a growth rate of 14.4 percent (%) per annum (p.a), to to 149,000 persons in 1985 by 1979-85 growth rate of 11.6% p.a., and the population grew to 219,945 persons in 1990 using an 8.1% growth rate per annum for the years 1985-1995. The population of Dandora is projected to grow to 326,000 (using 8.1% as that growth rate) in 1995, and to 654,000 persons in the year 2010 at the 1995-2010 projected annual growth rate of 4.8%.

The field data analysis revealed that there are about 981 households in Plainsview area whose total population was estimated at 3924 persons using an average household size of 4 persons, as was found out in the

field survey. As is observed in table 3, the field survey showed that Dandora estate has an average household size of about 5 persons while in Plainsview it is 4 persons. Besides, 88.1% of Dandora households have between 5 and 8 members while Plainsview had 41.6% of households in the same range.

Table 3 Household Size

	PLAINSVIEW AREA		DANDORA AREA	
Size	Frequency	Percent (%)	Frequency	%
1	-	-	-	-
2	3	8.3%	-	-
3	6	16.7%	3	7.1%
4	12	33.3%	4	9.6%
5	10	27.8%	21	50%
6	3	8.3%	5	11.9%
7	2	5.6%	6	14.3%
8	-	-	3	7.1%
Total	36	100%	42	100%

Source: Field Survey. By household we mean the "Cooking Unit".

* Average Household Size in Plainsview: 155 56 = 4.30 4 persons.

Average Household Size in Dandora: 226 42 = 5.38 5 persons.

Other important socio-economic characteristics of the study area include the following. While 91.7% of Plainsview respondents were married only 61.9% of those in Dandora were married. Single motherhood was found to be common in Dandora as was identified with 23.8% of household heads. Besides the average age of respondents in Plainsview is 34.6 years and 28.2 in Dandora thereby revealing a more youthful population in the latter settlement which is continuing to accomodate new city dwellers from the rural areas who are seeking for jobs (See Table 4).

Education levels of a given population is necessary as it is one major indicator of how quickly a community will respond to environmental awareness campaigns as well as strategies and programmes of improving the sanitary and aesthetic conditions of a given settlement. The study revealed that 91.7% of Plainsview household heads have at least secondary school education out of which 25% have attained University education. On the other hand (as shown in table 5) 21.4% of Dandora respondents have primary education while 9.5% are illiterate.

Table 4: Age of Respondents

AGE (years)	PLAINSVIEW		DANDORA	
	Frequency	%	Frequency	%
Less than 21	-	-	4	9.5%
21 - 25	3	8.3%	12	28.6%
26 - 30	12	33.3%	13	30.6%
31 - 35	9	25%	7	16.7%
36 - 40	10	27.8%	3	7.1%
41 - 45	2	5.6%	2	4.8%
46 - 50	-	-	1	2.4%
TOTAL	36	100	42	100%

Source: Field Survey.

Table 5: Education Levels of Respondents

Education levels	PLAINSVIEW		DANDORA	
	Frequency	%	Frequency	%
No education	-	-	4	9.5%
Primary	3	8.3%	9	21.4%
Secondary	15	41.7%	29	69.1%
Diploma	9	25%	-	-
University	9	25%	-	-
TOTAL	36	100%	42	100%

Source: Field Survey.

The nature of occupations of household heads is closely related to their education levels. While 63.9% of Plainsview respondents were found to be in professional employment eg. Engineers, Accountants, Bankers etc. only 16.7% of those in Dandora area were found to be in the same. 35.7% of Dandora respondents are engaged in informal business activities eg. kiosks and Jua Kali activities. Otherwise, the rate of unemployment was found to be considerably high in Dandora as was affirmed by 21.4% of those interviewed, while there was none in Plainsview area. This unemployed labourforce is seen as a potential which through sound planning can be utilised in improving garbage management practices in Dandora area and the city as a whole.

3.1 GARBAGE TYPES AND VOLUME

The main sources of household or domestic waste (garbage) in Plainsview and Dandora areas are kitchen organic food remnants, paper (packaging and wrapping papers) as well as bottles and tins. As shown in table 6, organic food remnants component of garbage was found to feature more in Dandora than in Plainsview, while bottles and tins component featured more prominently in Plainsview than in Dandora area. The considerable importance of certain garbage components in one area than

Table 6: Main Components Comprising Garbage

	PLAINSVIEW		DANDORA	
Components	Frequency	%	Frequency	%
Organic food remnants	36	25.9%	42	40.4%
Paper	33	23.8%	36	34.6%
Broken utensils such as cups, plates, plastics	29	20.9%	7	6.7%
Bottles and tins	32	23%	11	10.6%
Old worn-out clothes	7	5%	2	1.9%
Domestic animal waste eg. goats, rabbits	2	1.4%	6	5.8%
TOTAL	139	100%	104	100%

Source: Field Survey.

another was found to be determined by the socio-economic conditions and the general standards of living of the community concerned.

The field data anlysis also revealed that the average per capita garbage generation per day is about 0.38 kg. in Dandora and 0.63 kg. in Plainsview area. This then indicates that the total daily garbage production load for the entire population of Dandora area is about 83.6 tonnes (219945 x 0.38 kg) as per 1991

population figures, while for Plainsview is estimated at 2.5 tonnes (3924 x 0.63kg.).

3.2 MANAGEMENT AND INSTITUTIONAL ASPECTS

Garbage management in the City of Nairobi is the responsibility of the Nairobi City Commission (NCC) and is carried out by the cleansing section of Public Health Department which is headed by the Medical Officer of Health (MOH). The Public Health Department is usually called the MOH's Department. The collection and disposal of refuse, street sweeping as well as town cleansing are the responsibilities of the MOH. The Cleansing section which is one of the main sections of the MOH department has the immediate responsibility for the Public Cleansing Services.

The NCC appoints various committees from among its members. The Public Health Department reports normally to the Public Health Committee but for budget, establishment and finance matters, approval of other committees are also required.

Responsibility for the maintenance and repair of the Public Health Department garbage handling vehicles and equipment rests with the City Engineer and is carried out at the NCC Central Workshops.

The present organisation of the cleansing section is such that the section is headed by the cleansing superitendant who is directly responsible to the MOH. The cleansing superitendant is at fourth ties management level in the Public Health Department and at sixth ties level in the NCC salary structure.

The build up city area is divided into six working districts under two assistants cleansing superitendant as follows:- One Assistant Cleansing Superitendant for Western, Northern and Eastern Districts, and another assistant superitendant for southern, central and Night Districts. Each District is further subdivided into subdistricts called beats. In addition to the Districts, there is the industrial relations division which deals with all staff problems, the project division, which deals with all building plants, and the Accounts division. The duties of these divisions are divided among the two Assistant Cleansing Superitendants.

3.2.1 Insufficient supervision of the working crew

There was a general complain and disappointment by residents on the conduct of the NCC working crew, especially their undesirable way of handling dustbins. 19.5% of Plainsview households expressed disappointment at the very cruel mishandling and banging of dustbins by the NCC working crew in the process of collecting and

emptying garbage into their trucks. Besides, 8.3% of all respondents interviewed arqued that drivers of these trucks occassionally do divert trucks from official duties to private work for a payment.

Another problem revealed by 68.4% of the respondents in the study areas is that of nuisance caused by the unnecessary loud and provocative hooting by trucks collecting garbage around the estates. It was also observed that overspeeding of these vehicles is posing a danger to residents, besides the scattering of garbage due to this careless driving. Furthermore, it was reported by 22.2% of Plainsview households that the working crew when collecting and emptying dustbins do damage qates when they dangerously jump over gates to pick dustbins.

3.2.2 Manpower Resource

Deficiency of some form of manpower in the Cleansing Section of NCC has adversely affected qarbage services in the study areas and Nairobi as a whole. These includes supervisory and administrative staff and drivers. The field survey and reports from the cleansing section revelead that the section has the following manpower:-

Manpower	Establishment	In post
Supervisory staff	69	46
Administrative staff	16	13
Drivers	100	66
Refuse collection	-	453
Refuse disposal	-	15
Street sweepers	-	1696
TOTAL		2289

Source: Cleansing Section, (NCC)

Besides the above shown manpower pitfall in supervisory and administrative staff as well as drivers, the field survey revealed that the manpower in refuse collection and disposal, and street sweeping is falling short of the Cleansing Section's requirements, hence affecting adversely its ability to discharge its responsibilities adequately. For these latter three forms of manpower i.e for refuse collection, disposal, and street sweeping, the Section requires a total of about 2500 personnel against the 2164 at work currently.

Furthermore, the researcher was informed that through administrative Leave in Lieu of overtime annual leave, sickness etc, the number of manual workers actually reporting for duty each day is reduced by

approximately 16-20%.

Sweeping of streets in residential areas like Plainsview and Dandora is determined by the importance of the street or road concerned, varying from several times per day in the City Centre to once in two to three weeks in some residential areas, though this requirement is rarely met. Desired street sweeping frequencies are not being maintained due to shortage of supervisory staff and suitable vehicles among others.

3.3 TASK ASSIGNMENT AND ROUTE PLANNING

Crew scheduling and collection - vehicle routing are interdependent. The type of route used may be fixed on a daily basis, weekly routes, single-load routes, or any other system appropriate to achieve efficiency. Collection services which require customer set-out allow less flexibility in routing.

Crew scheduling basically involves a choice between a fixed working hour system and an incentive work system. The former involves a fixed work day (say 8-hours), with an assigned task, rather than a specific number of hours worked. Although incentive system may result in more users serviced per working day, there are disadvantages. Workers who are hurrying to finish may be less careful and consequently handle containers roughly and create excessive spillage.

Effective planning of a garbage collecting system covers optimum types of vehicles and their most efficient combination, optimum crew composition and optimum collection routes. The planning system also requires that there be a means of continously monitoring of garbage collection performance and controlling costs. There is need for sound route planning to optimize vehicle use and operating hours.

3.4 FINANCIAL CONSTRAINT AND RELATED ASPECTS

The cleansing section of the Public Health Department (MOH) is faced with financial constraints which have adversely affected procurement of adequate physical resources such as vehicles and other equipment, manpower and other necessary inputs and has consequently affected garbage managemenent in Plainsview and Dandora areas as well as the whole of Nairobi.

The revenue budget for the cleansing section for 1988/89 financial year was as follows in K£ million: 4.5 (expenditure) - 1.1 (income) = 3.4 (Net). The income derives from conservancy charges recovered as an addition to water charges which are billed to users monthly by NCC Water Department, the conservancy element being credited to the Public Health Department, and charges for other services are provided on request.

The balance of cost of solid waste management operations is met from Nairobi City Commission general revenues generated from property tax, licence fees etc. and from the new Local Authorities Services Charge Act, 1988. This Act places a duty on all employers to make deductions, ranging from Kshs. 10 to 100 from each of their employees monthly, ralative to their wage or salary scale, and remit this to their local authority each month.

For efficient garbage management, sufficient funds must be available to cover the day to day running costs of this service. This include fuel, maintenance, labour charges and interest rates on loans. Reserves must be created to enable equipment to be renewed when necessary. If the equipment is well maintained, the working life of the equipment can be extended and the annual amount of new capital required can be reduced.

What should be considered an appropriate amount or charge for garbage services provided by the NCC authority? If the charge is too low, the funds generated are too low and the services to the community will deteriorate and eventually break down. The failure would put the health of the population at great risks and eventually also the reputation of the city. Should the charges be too high and excess profit would be generated, and consequently the public demand for reduction of the charges levied would result.

For the determination of the "appropriate" charge the following principles have to be considered by the City Cleansing Management:-

(1) The garbage collection and disposal service has to be carried out efficiently.

(2) The costs have to be kept as low as possible but at the same time be sufficient to support and finance the operation.

(3) Health standards have to be kept as high as possible. These are related to the collection frequency, containers used and the removal of untreated garbage from public places.

(4) The NCC should explore all alternatives and exploit where reasonable the possibility of obtaining additional income for its services.

Majority of the communities in the low income areas may not be able to pay if billed for garbage collection, infact some of these do not pay Municpal taxes. These areas therefore require special attention from NCC. Their billing would be negotiated at Ksh. 25 per household per month.

3.5 TECHNICAL ASPECTS OF GARBAGE HANDLING

3.5.1 Dustbin Problem:

There is an acute shortage of dusbins especially in Dandora and to a limited extent Plainsview area, where 69% and 11.1% of households in the two areas respectively do not have dustbins. NCC has failed to supply the demanded number of dustbins in these areas. Uneven distribution of dustbins is yet another problem. 35.2% of households in Plainsview area had at least two dustbins while 11.1% do not have dustbins in the same estate, and 69% of Dandora households do not have any.

Consequently, residents without dustbins use cartons, plastic buckets and other forms of containers to store garbage. Due to lack of bulk containers in both Plainsview and Dandora areas 42.9% and 88.1% of households in the two areas respectively empty their garbage containers regularly on road reserve and open spaces.

The problem of rapid wear and tear of dustbins was reported by 11.7% of Plainsview respondents which they attributed to the problem of careless and irresponsible handling of dustbins by NCC working crew, who also scatter garbage all over in the process. The total number of registered dustbins in Nairobi is about 140,000 whose average weight when full of refuse is 15 kg. The main problem here as mentioned above is that

of uneven distribution among households in the various residential areas.

Besides, the problem of rapid depreciation of dustbins and damage was observed to be due to misuse of the same by the residents. The problem given here by 11.1% of residents in the study areas was that when garbage is not collected by NCC, some residents usually burn the garbage while still inside the dustbins therefore destroying and reducing their lifespan to only 12 months while their designed lifespan is 3 years.

In Dandora area, 13.7% of households expressed apathy amongst plot tenants in as far as emptying dustbins is concerned. It was found out in the few plots where there are dustbins, that it usually takes along for users to empty the already overflowing dustbins thereby then adversely affecting the general cleanness of plot compounds besides producing bad smell.

The study also revealed that storage of garbage (in whatever form of containers) within the plots is quite difficult due to the very limited space in the houses and plots to provide adequate storage. This problem was found to be most critical in Dandora area as affirmed by 28.6% of households whose number exceeding eight in non-storeyed buildings, but could exceed sixteen households in the high rise buildings.

Vandalism is yet another problem that has affected the availability of dustbins especially in Dandora where it was reported by 19% of households. When dustbins are placed just outside the gates of plots, they become vulnerable to thefts, after which they are sold to Jua Kali artisans or to maize roasters for their work.

Finally it was observed that the present dustbins of about 15Kg. will in the future be too small and inappropriate for the great amount of bulky garbage anticipated. This then calls for use of either larger dustbins or use other alternatives.

Plate 1: Availability of dustbins to most households in Plainsview has helped to reduce the garbage storage problem. As seen here, locked gates in that area normally do hinder the Cleansing Section's working crew from emptying dustbins.

Plate: 2 Households without conventional dustbins have improvised plastic containers to store garbage, as seen here with one Plainsview household.

3.5.2 BULK CONTAINERS PROBLEM

There is an acute shortage of bulk containers in Plainsview and Dandora areas but is more acute in the latter settlement. 83.3% and 88.9% of households in the two areas respectively do not have access to these containers (where inaccessibility was used to mean that the distance to the nearest bulk container from the house was more 200 metres). The field survey revealed that there were only 4 bulk containers in Dandora and only 1 container in Plainsview area. Each bulk container has an average capacity of 3 tonnes. This indicates that in Dandora area only 12 tonnes out of the possible daily garbage production load of about

83.6 tonnes (219945 x 0.38 kg = 83.6 tonnes) can be stored. It should be noted that the field study found the daily garbage production per capita to be about 0.38 kg. in Dandora and 0.63 kg. in Plainsview area. With this information it shows that in Dandora 71.6 tonnes of garbage is dumped either on the road reserve or on the open spaces daily from where it may or not be collected fully by the NCC authority.

The field study also revealed that there is only one bulk container with a capacity of 3 tonnes, in Plainsview while the estimated population of that area is 3924 persons. This then shows that in Plainsview the total daily garbage production load is 2.5 tonnes (3924 x 0.63 = 2.47 tonnes). But since the average garbage collection being achieved by NCC is once in 7-10 days, it indicates that a considerable volume of garbage has to be dumped on the road reserves and open spaces.

3.5.3 VEHICLES AND PLANT REPAIR AND MAINTENANCE

The study found out that the work of vehicles and plant repair and maintenance for the Cleansing Section is carried out for the section on a rechargeable basis at the Central Workshops of the City Engineers' Department, under the supervision of the Chief Mechanical Engineer, but the vehicles stores and spares are the responsibility of the City Treasurer's Department. Here the researcher gained the impression that spare

parts procurement procedure was slow, that only basic equipment was available and that productivity was low as a result.

During the field study it was also found out that, the Cleansing Superitendant has no control over workshop repair schedules, and collection vehicles have to take their chance in the conflicting priorities of the other NCC departments. There was not even a section set apart for handling specialised collection vehicles such as compactor and bulk container vehicles so that mechanics could become familiar with this type of equipment. For instance out of the 15 compactor and bulk container vehicles on fleet strength only 6 are in working order.

The field survey also revealed that the frequent vehicles mechanical breakdowns can partly be explained by the old age of vehicles on use which have not been replaced since then, and also by lack of a mobile workshop complete with equipment and fittings for field service.

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Furthermore the new cleansing vehicles are purchased through the City Engineer's Department which has the final decision on the choice of vehicle. The present system with repair and maintenance of vehicles at the depot is not functioning satisfactorily and a great number of vehicles are left idle and unused for various reasons.

3.5.4 Shortage of Vehicles and other Technical Equipment

The study found out that the cleansing section is faced with a shortage of the necessary garbage handling vehicles and other technical equipment. The section has a total of 32 serviceable vehicles on use but the number normally do go down to 27 due to mechanical breakdowns. This can be attributed to the old age of vehicles without being matched with appropriate replacement, as well as long delays before repair and maintenance work is undertaken. Besides these vehicles, the cleansing section has two Bulldozers that are used at the garbage disposal site. Regular Mechanical Breakdowns has been one problem that has hit these Bulldozers.

The Cleansing section has two High Ratio compactor vehicles which can carry each 1 tonne of refuse, the equivalence of 67 dustbins of each 15 kgs. It also has in use 4 Bulk Container Vehicles where each has an average capacity of 3 tonnes, while the average

number of trips per vehicle is 6 trips. The NCC has attributed its failure to have adequate number of vehicles and other equipment to financial constraints.

3.6 GARBAGE COLLECTION

For refuse collection purposes, the City of Nairobi is divided into 5 operational districts, namely the Central, Northern, Southern, Eastern and Western Districts. These in turn are subdivided into 56 sub-districts while the area in the city centre where refuse collection is carried out by a night-shift operation forms the Night-Shift District. Dandora area falls under the Northern District while Plainsview is under the Southern District. Prior to the current garbage handling vehicles shortage, garbage collection was organized into 61 collection routes to provide a more frequent collection service but these have been replaced by the present task system, output being governed by the number and type of vehicles available for work each day.

The field study revealed that as per 1990 the average garbage collection frequency being achieved by the Cleansing Section was as follows:-

Area	Collection frequency
City Centre	about once per 1 - 2 days
High income areas	about once per 7-10 days
Low income areas	about once per 7-12 days
Underdeveloped areas	about once per 7-28 days.

As per 1974 Special Technical Study: Solid Wastes in Nairobi, that was prepared by SWECO (Stockholm) for World Health Organisation (WHO), the collection of refuse in Nairobi as per that time was being performed as follows:-

Area	Collection frequency
City Centre	6 times a week
All other areas in Nairobi	2 times a week.

Source: SWECO Report; Solid Wastes in Nairobi, 1974).

The above data indicates that garbage collection services provision has declined generally for the whole of Nairobi. It also shows that the low income residential areas such as Dandora and the underdeveloped residential settlements are very poorly served with garbage services. The provision of these services in these areas has deteriorated in the face of the

falling number of garbage vehicles and other garbage technical equipment due to regular mechanical breakdowns, age factor and inadequate replacement of the highly depreciated of the same.

Garbage collection in Dandora and Plainsview area is not efficient, but worst hit is Dandora 61.1% and 31% of households in Plainsview and Dandora areas respectively contended that garbage is collected at least once a week, while 28.5% of Dandora residents reported that garbage is collected once in a month and a further 35.7% from the same area reported that garbage is not collected at all there (as shown in table 7). Due to the inconsistent, irregular and inadequate collection of garbage from these residential areas, residents have resorted to dumping garbage on road reserves, open spaces and on the back lanes, which is causing considerable environmental hazards. Besides, there is enough evidence in the study areas that residents are trying to keep the environments clean by burning the garbage alongside their houses.

3.7 GARBAGE DISPOSAL

All wastes collected by the NCC is disposed on a site at Dandora, approximately in the centre of the NCC area. Haul distance to Dandora from the five collection zones varies from 12 to 25 kms. away. Subject to plant

Plate 3: Inadequate garbage collection by the NCC has given rise to increased dumping of garbage on open spaces and burning activities in Dandora area.

Plate 4: Dumping of garbage on foot paths along the roads is hampering pedestrian movements in Plainsview area.

availability, a bulldozer is used to spread, level and compact the refuse, but no cover or sealing material is used. At present rate of use, the remaining life of this site is estimated by NCC to be 2-3 years.

The field survey found out that waste disposal at Dandora site is by semi-controlled tipping. At the tipping site, no leachate or gas monitoring has been carried out, but as there is no underground water extraction or sealing of refuse, no problems as yet have been identified. The study revealed that NCC has long-term waste disposal plan.

There were found to be several areas of burning or smouldering waste on the Dandora disposal site, a high level of fly infestation and considerable unofficial "scavanging" activity. The disposal site adjoins a high density, low income housing area (Dandora estate), and in the researcher's opinion it does not meet an acceptable level of operation from both environmental and aesthetic standards.

37.6% of Dandora residents especially those residing near the dumping site were of the opinion that the NCC should look for an alternative waste disposal site far away from Dandora area and at least 4 km. from any housing area. The reasons given to support this call were that, the site makes the

surrounding environment filthy due to scattering of refuse by wind, birds, human scavangers etc. and hence the aesthetic of the residential area around is seriously interfered with, besides the irritating smell (adour) that emanates from the site.

A considerable amount of industrial and commercial waste is delivered to the site by private vehicles as the field survey revealed. Whether or not any of these loads of hazardous or toxic materials must remain a matter for conjecture. The researcher also found out that the waste disposal sites at Dandora were not initially planned and earmarked for that purpose during the preparation of the Physical Plan for that area. Rather these sites were stone quarries sites that have come to be utilised for waste disposal purposes.

3.8 ADVERSE EFFECTS BROUGHT ABOUT BY UNCOLLECTED GARBAGE

The field study revealed that there are various adverse effects that have resulted from uncollected garbage in Plainsview and Dandora settlements. Consequently this has been causing various health hazards, besides adversely affecting the environmental quality and general aesthetic of these areas and others in Nairobi.

Between the two study areas, Dandora is the most hit by the phenomenon of uncollected garbage where

for instance as reported by 35.7% of households (shown in table 7) garbage is never collected, while in Plainsview 8.3% of respondents said the same. Consequently residents in those areas have been indescriminately dumping garbage on the road reserves, open spaces and in some areas of Dandora on access roads. The following are the major adverse effects resulting from uncollected garbage.

Table 7: Frequency of Garbage Collection by NCC

Frequency of collection	Frequency	Percentage (%)	Frequency	%
Two times in a a week	9	25%	6	14.3%
One time a week	13	36.1%	7	16.7%
One time in a fortnight	11	30.6%	2	4.8%
One time in a month	-	-	12	28.5%
Not collected at all	3	8.3%	15	35.7%
Total	36	100	42	100%

Source: Field Survey.

One effect is that heaps of uncollected decomposing garbage is emitting irritative smell as reported by 25% and 43.9% of Plainsview and Dandora households respectively. This has made the areas concerned unsightly and uncomfortable for residents. Scattering of these garbage by such agents as wind, birds (such as crows) goats, dogs and human "scavangers" has made the surrounding environments (especially in Dandora estate including the areas around the dumping site) very filthy, besides adversely affecting the natural aesthetic and environmental quality of these areas. Such a phenomenon reduces the attractiveness and values of a given residential settlement.

Besides, uncollected garbage in these areas is providing a suitable breeding haven for flies, rats and other vermins, as well as attracting stray dogs which are a threat to human life. Discussions with medical experts revealed that rats for instance do cause bubonic plague, flies cause diarrhoea, dysentry and cholera while affected stray dogs are a cause of rabbies. The table below 8 shows the degree of nuisance that is been caused by flies, rats and stray dogs in Plainsview and Dandora areas, where it is observed that flies and rats are the worst menace.

Table 8: Degree of Nuisance being caused by flies, rats and stray dogs in Plainsview and Dandora areas.

Vermin/animal	PLAINSVIEW		DANDORA	
	Frequency	%	Frequency	%
Flies	22	57.9%	32	49.2%
Rats	12	31.6%	23	35.4%
Stray dogs	4	10.5%	10	15.4%
TOTAL	38	100%	65	100%

Source: Field Survey.

Other health problems that were identified included feet injuries caused by broken glasses and bottles and which was found to be more prominent among Dandora residents. Vomitting problem was also identified among residents, some of who reported to be allergic to the stench and unsightly look of garbage. Table 9 below shows diseases and other health hazards that have been experienced by residents directly or indirectly as a result of uncollected garbage. As noted above, residents have become vulnerable to feet injuries and especially those who walk without shoes. Children have become even more prone to feet injuries and other health hazards when they are playing on heaps of uncollected garbage.

Table 9: Diseases and other health hazards experienced by residents (directly or indirectly) as a result of uncollected garbage

	PLAINSVIEW		DANDORA	
Diseases	Frequency	%	Frequency	%
Dierrhoea	1	14.3%	6	28.6%
Dysentry	-	-	5	23.8%
Feet injuries (inflicted by pieces broken Bottles, and glasses	2	57.1%	5	23.8%
Vomiting	4	57.1%	4	19%
Rabbies	-	-	1	4.8%
TOTAL	7	100%	21	100%

Source: Field Survey.

Other adverse effects revealed by the study is that widespread accumulations of uncollected garbage especially in Dandora area has blocked storm drainage channels and clogged up the sewerage networks in the latter case, especially in areas where manhole covers are missing. Residents consequently are subjected to untold suffering and inconviniences. During the rainy season, floods have become a common phenomenon in areas

of Dandora due to clogging of the drainage system. In some sections of that estate, due to increased volume of uncollected garbage, that garbage has now spilled over onto the roads consequently aggrevating the situation.

Besides the field study revealed that in Dandora especially during the rainy season stagnant pools of water resulting from clogged up drainage channels do normally create a breeding haven for mosquitoes which makes residents of the areas concerned become vulnerable to malaria and other ailments. Furthermore, the problem of clogged and blocked drainage and sewerage channels would normally call for hiring of labourforce to clear these systems which then increases the financial burden of the NCC which is already currently faced with shortage of finance to run its services efficiently.

Failure by the NCC to collect garbage in many parts of the study areas has compelled residents to resort to the indiscriminate and at times uncontrolled burning of garbage. But the fires resulting thereof currently are posing a great danger to lives and property of residents as was reported by 16.7% of all the households interviewed. In Plainsview area for instance, one household reported that it was a victim of this type of fires which burnt down a considerable section of their fence of trees in 1985, which even nearly burnt down their house.

Finally, it is observed that Littering of uncollected garbage all over the ground makes garbage management more difficult as more time and money has to be spent when sweeping this garbage, besides causing air and land pollution. In addition uncollected garbage affects adversely the general image of the city of Nairobi by unnecessarily letting it appear permanently untidy dirty and filthy.

Besides there are external costs associated with landfills. This is particularly true of improperly managed landfills (actually dumps) where adours, fires and blowing refuse are presenting problems. These are some of the problems that face Dandora disposal site. Even with properly managed landfills, there are external costs; these can be managed but at high costs. These result from the production of leachates and methane gas in the completed landfill.

Leachate is a solution containing dissolved and suspended materials and microbiological waste products. It is produced in landfills by the infiltration of rain and/or groundwater through the degrading organic wastes. It may exist from the landfill at the surface as a spring, or percolate through the soil and rock that underlie and surround the wastes. It is a potential source of groundwater contamination.

Plate 5: In Dandora, dumping of garbage just next to the houses by residents is a common phenomenon. This is causing bad smell, fly menace, is unslightly, besides being dangerous to children playing on that open space.

Plate 6: In Dandora area, dumping of garbage on road reserves is common which is not only an environmental hazard but is also blocking the water drainage channels as shown here.

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CHAPTER FOUR

EVALUATION OF ALTERNATIVE METHODS OF GARBAGE MANAGEMENT AND THE ACCRUING BENEFITS

The study has already examined the garbage management problems that the NCC is faced with and how upgrading of the present garbage handling services can be attained. In this section, the study makes an evaluation of alternative methods of garbage management and the accruing benefits in the study areas (Plainsview and Dandora areas) and Nairobi as a whole. These methods are discussed below.

4.0 GARBAGE COLLECTION BY SCAVANGERS AND THE RECYCLING ACTIVITY

The objective of the study of garbage collection by scavangers was to determine the volume of waste and income generated in the garbage collection business and the socio-economic dynamics of recycling and scavanging activity.

The study in this section begins by examining the socio-economic characteristics of garbage collectors "Scavangers"). Table 10 below shows the ages of scavangers (respondents).

Table 10: Age of Respondents in Years

Age category	Frequency	Percentage (%)
⩽20	8	25%
21 - 25	7	21.9%
26 - 30	9	28.1%
31 - 35	3	9.4%
36 - 40	1	3.1%
41 - 45	2	6.25%
46 - 50	2	6.25%
TOTAL	32	100%

Source: Field Survey.

The mean age was 27.4 years; the youngest scavanger was 17 years and the oldest was 49 years. Those below 35 years of age constituted 84.4% of the sample. This is the energetic age category. It means that garbage collection in the study areas Plainsview and Dandora, and therefore generally Nairobi is a job for the energetic. Garbage collection was found to be a predominantly male activity as was found out with the 100% of respondents interviewed. Besides, the majority of the respondents comprising 62.5% of the sample population are small size households of 1 member (ie singles and living alone). This is quite small by

Kenyan standards (See Table 11). By household we mean a "cooking unit".

Table 11: Household size

Size	Frequency	Percentage
1	20	62.5%
2	-	-
3	-	-
4	3	9.4%
5	1	3.1%
6	2	6.25%
7	4	12.5%
8	-	-
9	2	6.25%
TOTAL	32	100%

Source: Field Survey.

A number of conclusions can be drawn from the above information. That one the majority of garbage collectors are young whose age is less than 35 years (84.4%) and are single (75%). They are mostly primary school drop outs (53.1%) or illiterate (46.9%) faced with acute unemployment problems. They take to garbage collecting as the only legitimate means of earning a living.

100% of these garbage "scavangers" are males as noted earlier on.

4.1 TYPE AND VOLUME OF GARBAGE COLLECTED, AND LEVEL OF ENGAGEMENT IN THE ACTIVITY

Scavanging activity is playing an important role in the collection and disposal of garbage in Plainsview and Dandora estates, and also generally in the whole of the City. While 90.6% of the respondents are fully engaged in only garbage collecting activity, 9.4% are partially engaged in this activity, while they reported that the rest of their working time is used on farming activities e.g along Mathare River. But still the 9.4% of scavangers reported that they spend ¾ of their working time in garbage collection.

In as far as types of garbage collected is concerned, the study revealed that the most important garbage component collected is paper (See Table 12). The reason given for this is that,paper fetches a relatively good price per Kilogramme (Kshs. 1.40) in the Market. The

Table 12: Types and level of importance of garbage components

Type of garbage	Frequency	Percentage
Paper	32	62.8%
Bottles	12	23.5%
Scrap metals & plastics	4	7.8%
Tins	3	5.9%
TOTAL	51	100%

Source: Field Study.

scavangers normally sell their daily collection to middlemen at certain collection or assembling centres within Dandora and Plainsview areas. The middlemen then deliver their garbage in bulk to certain industries in Nairobi. At times the industries do provide transport for that service. The buying industries in Nairobi include Chandaria and Madhupaper Industries for paper component and EMCO industry for scrap metal component. Besides there are Jua Kali artisans from Dandora area and Gikomba who buy some of these garbage components, especially scrap metals and tins.

The industries mentioned above use those garbage components in their production process as raw materials. These industries engage in the recycling activities of these garbage materials. In so doing, an important role in the collection and disposal of garbage is played. In the first instance, the activity provides employment to the scavangers, as shown later it provides an income to the collectors and provides a means of livelihood to those depending on the scavangers. Besides it also provides a source of raw materials to industries that would otherwise have to import such inputs, hence helping to save the scarce foreign exchange.

By and large scavanging activity forms an essential supplementary to Nairobi City Commission's effort in garbage handling. Table 13 show average weights of

paper garbage collected by scavangers per day. The study revealed that in Dandora and Plainsview estates, the estimated weight of garbage collected on a daily basis

Table 13: Weight in Kilogrammes (Kg) of paper garbage collected per day.

Weight	Frequency	Percentage
≤40	4	12.5%
41 - 50	6	18.7%
51 - 60	8	21.9%
61 - 70	8	28.1%
71 - 80	-	-
81 - 90	3	9.4%
91 - 100	-	-
101 - 110	3	9.4%
TOTAL	32	100%

Source: Field Survey.

(The largest average weight of this type of garbage (paper) collected per day is 110 Kg., while the smallest of the same is 35 Kg. Besides, the average weight is 55.6 tonnes).

is 2.68 tonnes, which gives an impressive average monthly collection weight of 80.4 tonnes, and annual figure of 964.8 tonnes (See table 14). This is besides the

Table 14: Daily, Monthly and Annual Garbage Collected by Scavangers

Garbage type	Daily collection	Monthly collection	Annual collection
Paper	2.15 tonnes	64.5 tonnes	774 tonnes
Scrap metals, tins plastics	0.53 "	15.9 "	190.8 "
Bottles (pieces	414 pieces	12,420 pieces	149040 pieces
TOTAL	268 tonnes plus 414 pieces	80.4 tonnes plus 12,420 pieces	964 tonnes plus 149040 pieces

Source: Field Survey.

estimated daily collection of 414 pieces of bottles, while the monthly collection is estimated at 12420 pieces as already shown in the table. Annual bottles collection estimates are also given as 149,040 pieces.

4.2 INCOMES FROM AND PRICES OF GARBAGE COLLECTED

The prices that garbage collectors are paid for their merchandise vary considerably. This is because there is no price control in the business. It is considered part of the informal sector of the urban economy (ILO, 1972) prices were found to very from one residential

area to the other and from one garbage collection centre to the other.

The computation of incomes is based on the prices quoted by the garbage collectors individually. In average the prices were as follows (table 15.)

Table 15: Prices of Major Garbage Types

Item	Average price
Paper	Kshs. 1.40 per kg.
Bottles	Kshs. 1.00 per piece
Scrap metal	Kshs. 1.00 per piece

Source: Field Survey 1990.

It is envisaged that with the recent increase (8.2 1989) in the price of empties (beer bottles) by the Kenya Brewaries Ltd., they will now compete with paper for top position. The new prices are, 500 Ml beer bottles fetch Kshs. 2.80 each from the previous Kshs. 1.00, and 300 Ml ones Kshs. 2.50 up from 70 cents a piece. Earlier on (late 1988) Uchumi Super Market had started paying Kshs. 250 per unit of soda bottles returned to them. The increase of the prices of bottles was to encourage return (recovery) of bottles. The company had been faced with acute bottle shortages. But on the other hand, the garbage

collectors are being paid Ksh. 1.00 for each piece of bottles when sold to middlemen, hence there is an element of exploitation in the face of the new prices.

The field study found out that garbage collectors or scavangers are earning relatively good incomes (as shown in table 16) on monthly basis.

Table 16: Monthly Incomes earned by Garbage Scavangers in Dandora and Plainsview

Income (Kshs)	Frequency	Percentage
⩽1300	2	6.25%
1301 - 1800	10	31.2%
1801 - 2300	5	15.65%
2301 - 2800	4	12.5%
2801 - 3300	5	15.65%
3301 - 3800	2	6.65%
3801 - 4300	3	9.4%
4301 - 4800	-	-
4801 - 5300	1	3.1%
TOTAL	32	100%

Source: Field Survey 1990.

The lowest average income per month was found to be Kshs. 750, while the highest average income per month was Kshs. 4890 and the average (mean) income per

Plate 7: This shows a garbage collection point in Dandora area where scavangers can be seen sorting out paper garbage and organising it into bundles.

Plate 8: This shows a garbage collection point (in Dandora) for tins and plastic garbage components. These materials are then put into sacks to ease the work of middlemen during delivery.

month was Kshs. 2077.20. The total turnover for the 32 garbage collectors studied was Kshs. 62316 monthly. This approaches sixty thousand shillings per month, which is quite an impressive income generated. Besides, the average incomes in scavanging activity do compare quite well with incomes with other activities in the informal sector.

The computations on incomes reveal that on average a garbage collector in Plainsview and Dandora areas earns Kshs. 69.20 per day, with a minimum daily income of Kshs. 25 and a maximum of Kshs. 163. The monthly average income was Kshs. 2077.20 with a minimum monthly of Kshs. 750 and a maximum average of Kshs. 4890.

The point to be made here is that this steady increase in income is not always possible in practice. Quite a range of factors combine to determine a collector's daily and monthly incomes. These factors include luck, weather, health of the garbage scavanger (collector) and haulage capacity.

CONCLUSIONS ON INCOMES FROM SCAVANGING

From these findings it becomes quite obvious that garbage collection is a source of fairly good income for the urban poor in Nairobi. Nevertheless there are a number of observations that can be made.

Firstly, the computation of daily incomes (and monthly totals) was based on the verbal information provided by the respondents. They gave figures on their daily sales and the prices at which they sell them to the sub-contractors (middlemen). The garbage components depending on the type are eventually delivered by the sub-contractors to the recycling industries and Jua-Kali artisans. From these set of information, daily and monthly totals were calculated. The researcher did not have access to the relevant documentary evidence to help counter-check the information. This makes the findings on income levels become almost estimates of earnings. But the data were the best available to the researcher at that stage of the study. They provide quite a favourable overview of the situation.

Secondly, there are always daily, weekly and monthly fluctuations in income from scavanging. One's fortunes are never stable. For instance, paper, the dominant item in the garbage collection business brings in good business only during the dry season as the buyers do not accept wet paper. The respondents complained that in the wet season the paper business is not good and they go hungry. This is even more so among the mono-culture garbage collectors. Those scavangers who were collecting paper among other products comprised 90.6% of the total scavangers, while

those collecting paper only (mono-culture garbage collectors) comprised 37.5% of the total collectors. So then, it can be observed that there is the risk of concentrating on one item (mono-culture garbage collection).

It was also found out that the majority of the scavangers (62.5%) combine two or more articles in their business. The highest income earned by a collector per day on average was Kshs. 163 where Kshs. 140 was earned from paper item (100 kg.) while Kshs. 23 was earned from sales of bottles (23 pieces of bottles). The lowest daily average income from garbage collection was Kshs. 25 where the scavanger only specialised in paper collection (mono-culture garbage collection). Thus the combination of articles appears to be a perfectly rational economic behaviour to guard against risks and to maximise earnings.

4.3 LIFESTYLES OF SCAVANGERS

The field data survey indicates that 53.1% of scavangers were born in Nairobi, while 68.8% of the respondents indicated that they have been in garbage collection activity for at least 8 years. This then indicates that only 31.2% of garbage collectors are relatively new in that business if we use eight years as the criteria. The field survey also revealed that only 21.8% of collectors are recent migrants into the city. By recent migrants here we mean those collectors

who been in the city for less than 8 years. As shown in table 17 the majority of those new migrants into the city hail from Kiambu District.

Table 17: Place of Origin of Garbage Collectors

Place of Origin	Frequency	Percentage
Nairobi	25	78.2%
Kiambu	4	12.5%
Murang'a	2	6.2%
Nakuru	1	3.1%
TOTAL	32	100%

Source: Field Survey.

The conclusion from this analysis is that garbage collection (scavanging) is not a job for newcomers to the city (or recent migrants). The job requires a bit of experience in the city. One must have detailed knowledge of where to find the garbage, when and at what price. Secondly, the garbage collector must have established linkages in the market so as to enable him to sell, and at the maximum price possible.

4.4 HABITAT OF SCAVANGERS

One of the most disturbing findings of this study is that whereas garbage collection generates quite handsome incomes for the scavangers, they remain in a class of their own at the fringes of the society. They live in makeshift dwellings or in single-roomed mud or wooden houses in the sprawling slums and shanties of Nairobi. These include areas such as Mathare, Korogocho, Kiamaiko, Ngomongo and Kijijini at Mariakani. But amazingly 9.4% of the scavangers were found to be sleeping on street pavements of the city centre.

The majority of the garbage collectors (75%) were found to be living in one-roomed houses in the slum areas given above, 15.6% live in two-roomed houses while 9.4% sleep in the open on the street pavements of the city centre. In other words the latter are people with no fixed abode. Where the scavangers live are areas with serious sanitation and health problems, and with limited access to the basic social amenities such as piped water, electricity, schools, health centres and recreational facilities.

A further informal discussion with the scavangers revealed that their health status is appalling to say the least. They are ill-fed, just as they are ill-sheltered. A majority of scavangers were found to be

alcoholics and drug addicts. Those of them who have fallen into these bad habits demonstrated unstable personality. They appear to live in despair and life for them was a hopeless drift into the unknown future. Many of the scavangers complained of wounds, that are never healing, malaria, diarrhoea and headaches.

By all accounts garbage collectors live in poverty defined as lack of access to the basic necessities of life. The pertinent question that must then be asked is: where do their seemingly "fat" incomes go? There nobody can explain. But it can be speculated that it is carelessly squandered away as soon as it is earned.

4.5 EXPENDITURE, SAVINGS AND INVESTMENTS BY SCAVANGERS

Experience has taught us that men must save and invest if they are to lift themselves out of the poverty. But do garbage collectors ever save or invest part of their incomes? Information collected during the field study revealed that 90.6% of the respondents do not at all save any money irrespective of their "fat" earnings. While 9.4% of the scavangers do save, the highest amount of savings was found to be Kshs. 200 per month. Among the expenditures that scavangers incur include on such services and goods as food, rent, dressing, education, while the largest portion of their earnings was not accounted for. 25% of the garbage collectors were married and they argued that the largest proportion of

their earnings go to household expenditure (see table 18).

Table 18: Total Household Expenditure per month

Expenditure (Kshs)	Frequency	Percentage
100	4	12.5%
101 - 200	12	37.5%
201 - 300	2	6.25%
301 - 400	3	9.4%
401 - 500	5	15.6%
501 - 600	-	-
601 - 700	3	9.4%
701 - 800	1	3.1%
801 - 900	-	-
901 - 1000	2	6.25%
TOTAL	32	100%

Source: Field Survey.

The study found scavanging activity to be amazing in that no scavanger or garbage collector was found to be involved in any form of investments. So again the question that remains is: Where do the collectors take their "fat" incomes?

Finally, the activities of garbage collection by scavangers and recycling have been found to bring various benefits which include; the reduction of the amount of garbage placed on the landfill and thereby extending the lifetime of the landfill; the recovery of valuable raw materials through recycling, the production of compost from organic garbage that is used as fertilizers for agriculture; the creation of employment locally, and also the creation of a source of income for the city of Nairobi dwellers.

4.6 CONCLUSION ON SCAVANGING ACTIVITY

Scavangers sell their garbage materials to private establishments who make use of the recovered items for recycling purposes. Salvaging operations of waste are entirely private and are unco-ordinated. The scavangers operate at all stages of storage, collection and disposal site.

Scavanging is prohibited by the city authorities especially when this involves the waste in the storage containers or at the disposal site. The reasons for the ban is that the practice is unhealthy and that the scavangers tend to scatter the waste and even steal the containers. This ban, however, exists in the legislation books only since the degree of the scavanging is quite high within Dandora residential area and at the disposal

site. The reasons for this include the absence of those enforcing the law and also the authorities realise that the scavangers actually reduce the quantity of waste to be handled. The scavangers also make some living out of this activity.

The study found out that the degree of scavanging is so intensive at the main Dandora waste disposal site such that a visit to the site during the day appears as if the scavangers are people working in a rice-field.

4.7 PRIVATIZATION OF GARBAGE COLLECTION

Privatization or contracting means the use of the private sector to deliver services historically provided directly by the government or local authority employees. One of the most trying objectives of a municipal or city government (such as NCC) is to provide a cost-effective service to its citizens.

In his (Donahue J.D., 1989) book called - The Privatization Decision, his main subject is the extent to which we should turn over the activities of the government to private business. For his general conclusion, he says that, "it depends" on what the task is, the difficulties are, and the objectives may be. Privatization has two meanings; one is whether

government - owned facilities should be returned to private management, and secondly has to do with the transfer of public services into the hands of profit-oriented contractors.

The study found out that the NCC Cleansing Department was under-financed. The cleansing service is supposed to be financed mainly from the General Rate Fund, but this has been showing an increasing deficit over the years. The overall NCC deficit has been increasing at about $10 million per year (Urban Perspectives Volume 1 - No. 3, 1991). For example, although all water consumers have a "dustbin" charge of Kshs. 10 added to their bill monthly, this covers less than 70% of the cost of a new dustbin over the usual life of three years. The dustbin charges are collected through the water and sewerage bill, but large numbers of accounts are more than three months in arrears.

As a result of these financial problems the NCC has not been able to buy new vehicles to replace those that are unserviceable due to age or accidents. This has put pressure on the operators not to send those vehicles which are on the road for their routine servicing. As a result of this, it is estimated that vehicle life has been reduced by 20% or more. The problems have been increased by the fact that NCC workshops, do

not carry sufficient stocks of spares, and vehicles can lie idle for long periods waiting for spare parts.

The actual management of the operation has not received much attention. The routing of the vehicles and performance standards of the crews have not been systematically monitored. A significant amount of vehicle time is spent in carrying the personnel from their homes to their jobs and vice versa as was found out by the field study.

The causes of these problems can be traced back to a lack of appropriate skills and a lack of capital. The problems are undoubtedly made worse by the public sector system which makes it difficult to displine workers or to introduce new procedures. On the face of it, privatization of garbage services is an obvious way of remedying these deficiencies.

While this in general sounds desirable, there are several issues that require to be resolved. One of the immediate problems is whether there is the capacity in Nairobi for a private sector operation to be developed on the scale required. Another problem is how to recover the costs of running the operation. Lastly, but by no means least, there is the problem of what to do with the existing employees of NCC's Cleansing Section if garbage handling services is privatized.

The study found out that due to the inability of NCC to provide the required standard of garbage services, 85.7% and 76.2% of households in Plainsview and Dandora areas respectively expressed willingness to have private garbage handling services introduced there. But whereas 88.9% of Plainsview households can financially afford to pay for such services (that is pay Kshs. 140 per month) only 19% of Dandora households can afford. The question of affording to pay for those services is related to the income levels of households (see table 19).

Table 19: Household income levels in Plainsview and Dandora areas

Income levels (Kshs)	Plainsview		DANDORA	
1000	Frequency	%	Frequency	%
1000	-	-	12	40%
1001-2000	-	-	14	45%
2001-3000	1	2.9%	3	10%
3001-4000	2	5.9%	1	5%
4001-5000	3	8.8%	-	-
5001-6000	2	5.9%	-	-
6001-7000	3	8.8%	-	-
7001-800	1	2.9%	-	-
Over 8000	22	64.8%	-	-
TOTAL	34	100%	30%	100%

Source: Field Survey.

It was found out that whereas 95% of households in Dandora earn monthly incomes of Kshs. 3000 or less 97.1% of Plainsview households earn incomes of over Kshs. 3000 monthly. The purchasing power of residents and consequently their demand for private garbage services will normally determine the willingness of a private company to venture and serve those residents. Consequently private garbage collecting companies have in the past expressed preference in the high income residential settlements. Financial inability by low income residents remains a constraint in their hiring private garbage services.

Private garbage collection has succeded in many other major cities of America (such as Newark city in New Jersey, U.S.A.), Europe and Japan. Privatization of garbage services has a number of benefits. Briefly these are; one the private company or contractor can utilize more efficient vehicles, that is can more readily respond to the technological changes. Secondly the contractor could more easily displine the ineffective or inefficient employees and consequently improve the operations. Besides, contractor's routes of operation during the garbage handling process could be more efficient than those of the Nairobi City Commission. Finally a private garbage collector's increased efficiency and monitoring of collection activities would improve the quality of the work-in terms of missed collections, spillage, cleanup and mishandling of garbage containers.

4.8 COMPOSTING

Composting is yet another garbage disposal alternative which the study has identified as suitable for application in Nairobi. This is a further garbage management method where great amount of refuse can be converted into a humus like substance instead of being dumped on the landfill. From household waste or garbage, the organic material from food and partially paper as well as plants are used as raw materials in the composting process.

This would be especially beneficial to Kenyans in view of the importance of agriculture in Kenya where this compost could serve as a valuable material fertilizer and may replace some of the imported chemical additives and fertilizers. Consequently Kenya would save the limited foreign exchange that is currently being spent on importing fertilizers. Besides sales of these fertilizers would also create a source of income for the City of Nairobi.

However, compositing is a very capital intensive venture, but if it is successful, it could reduce large imports of fertilizers for an indefinite period of time. The study observes that this possibility can be undertaken since information on refuse composition, quantities, source of generation and its distribution are already known.

4.9 SANITARY LANDFILLS

The study found out that waste disposal at Dandora disposal site is done by semi-controlled tipping method. Hence there is urgent need to improve and upgrade the Dandora landfill operation. This entails monitoring of landfilling activities, including the building of access roads, compaction methods, covering and sealing of garbage, collection of drained leachate and venting of landfills.

The establishment and operation of sound landfills by NCC will serve as an economically and environmentally acceptable method of refuse disposal. This involves proper site selection.

Landfill improvement will create a pleasant environment in the area of the landfill at Dandora site. Furthermore pollution of air, land and water as well as health hazards caused by solid waste that is not disposed well can through improved landfilling be kept under control. Consequently the chances of an outbreak of diseases will be reduced for those residents living around Dandora area, or any other area where a landfill is located.

The field study found out that the Dandora disposal site is open all year round. The site is located on one side of a Rift (Valley), but at the bottom of the valley is a riverbed. The river is dry for most of the

year, but during the rainy season, the river is very active. The water is heavily polluted and poses a health hazard to people using it.

It was also found out that due to lack of compaction equipment no proper compaction of refuse can be carried out at the disposal site. In addition the refuse is not being sealed with soil, therefore, large areas (up to 0.5 km^2) of deposited refuse are burning. The slope into the Dandora site is gentle and the discharging refuse trucks can drive deep into the site.

The researcher was informed that no leachate or methane gas monitoring has been carried out at Dandora disposal site, but as there is no underground water extraction or sealing of refuse, no problems have as yet been identified. Leachate is a solution containing dissolved and suspended materials and microbiological waste products.

The escape of both leachate and methane gas from the landfill can be controlled to an appreciable degree. If the landfill is lined with an impermeable membrane, the leachate can be collected at the bottom, pumped to the surface, and treated as long as it is biologically active. It may be possible to collect methane gas and use it a fuel and hence can be beneficial.

CHAPTER FIVE

RECOMMENDATIONS AND CONCLUSIONS OF THE STUDY

In this particular chapter recommendations are given on improvements of the garbage handling system in Plainsview and Dandora estates and Nairobi as a whole. Not all the recommended improvements should be initiated at once. They should instead be introduced gradually, in line with the population increase in the study areas and Nairobi as a whole.

5.0 TECHNICAL AND ECONOMIC ASPECTS

(i) Master Plan and detailed Plan

A Master Plan for the handling of garbage should be prepared by the Medical Officer of Health (MOH) Department through UN - experts or consultants. The Plan should cover the period up to the year 2010 and be based on actual population forecast, actual Plans for the development of the city and experience from the present works.

The Master Plan should outline in suitable development phases:-

(a) Expected quantities of garbage within various residential areas e.g. Plainsview and Dandora;

(b) Appropriate collection system;

(c) Transport system and the need of various vehicles;

(d) The main routings for the transport of garbage;

(e) Location of transfer stations and central depots;

(f) Disposal process and sites for disposal plants;

(g) Economic and financial aspects;

(h) Organization and management matters; and

(i) Legal matters.

The Master Plan should be regularly reviewed, at least every five years, and modified according to the actual development.

In conformity with the Master Plan and the findings from various studies the MOH's Department should prepare through UN-experts or Consultants a short-term plan for the nearest period, say five years. This plan should be prepared in detail and show the needs and requirements year by year together with cost benefit analysis, financial projections and a list of staff requirements. Also this plan should be regularly reviewed, at least every other year, and modified according to the actual development and experience gained.

Regularly all relevant data, both qualitative and quantitative should be analysed by the MOH's Department as a basis for short and long-range plans.

(ii) Economic Aspects

Economic studies should be undertaken or made by the MOH's Department on:-

(a) The transport system and operation at the existing disposal sites, and the feasibility of starting new ones.

(b) Income from and expenses for the handling of garbage with due consideration to covering the deficit by increased rates or allocation of funds from the City Commission.

(c) The procedures for collection of fees and debts in arrears.

(iii) Organisation

A study on the possible organisation of a seperate Cleansing Department and the suitable time for the establishment of the Department be undertaken.

(iv) Atmospheric Pollution

The MOH's Department should consider inclusion in its programmes a programme of atmospheric pollution control.

It is recommended that the MOH's Department prepares an environmental plan investigating the various sources

of air pollution and their influence on the environment. As there are at present no Officially issued regulations stating the highes- allowed amount of pollution in the air, it is recommended that the MOH's department study the matter, prepare the required regulations and organize necessary supervision and control of the development.

5.1 MANAGEMENT

Recommended Organization of the Cleansing Section

Adjustments in the present organization are required in order to make the Cleansing Section to cope with the increased requirements which will naturally follow with the foreseen, rapid increase of the city population. The section is already weak especially in planning and transport. I recommend a reorganization of the section which in itself implies extensions of functions already included in the section and strengthening of some functions to meet the coming demand. The recommended organization structure is shown in table 20.

The Cleansing Section would be divided into the following five divisions with heads directly subordinated to the section Head and fully responsible for the operation of their respective divisions:-

Table 20: Proposed Organisation of the Cleansing Section

CLEANSING SECTION

Section Head

ADMINISTRATION DIVISION	PLANNING DIVISION	COLLECTION DIVISION	TRANSPORT DIVISION	DISPOSAL DIVISION
Division Head	Division Head	Division Head	Division Head	Division Head
Accounting	Planning and Development	Central District	Transport Administration	Disposal Plant 1
		Night District		
		South District		
Purchasing	Organization	West District	Repair and Maintenance	Disposal Plant 2
		North District		
		East District		
Statistics	Surveying	New Districts	Service of vehicles	Disposal Plant 2
Personnel		New District	Storage Fuel Lubricant	
Office Service		Industrial inventory		
		Other Services		

Immediate:- - Administration Division
- Planning Division
- Collection Division
- Disposal Division
- Transport Division.

Administration and Planning would be service functions while collection, Transport and Disposal would be operation activities.

The work of the cleansing section in the face of the rapidly growing population has become enormous. It is therefore recommended that the Cleansing Section be organized into a seperate department. It is recommended that the organization of the section be reconsidered in every 5 years, in order to find ways of managing the over increasing volume of garbage.

Administration Division

It is recommended that the Administration Division deals with the following functions:- Accounting, Purchasing, Statistics, Personnel and Office service.

Accounting would include preparation of budgets, cost reports and cost analysis. It should also handle investment plans to clarify the financial situation and to calculate the fees and charges necessary to obtain vital undertaking.

Purchasing would include keeping stores ledgers and preparation of the annual purchasing budget for vehicles, spare parts, fuels, lubricants. It should be in charge of purchasing orders and co-operate with the Purchasing Officer in the City Treasurer's Department.

Statistics would include preparation of different kinds of monthly statistics, technical as well as commercial, in order to keep the section Head well informed. The information will also be used for future planning.

Personnel would include preparation of a running manpower plan showing the need for personnel during a 2 year period. It should also draw up and supervise training prpgrammes for technical staff, handle the safety control and welfare regulations, carry out part of the recruitment work and keep employees records.

Office service would include assistance in such work as copying, mailing, typing, recording and also taking care of office supply and equipment.

The head of the Administration Division should be a Senior Administrative Officer. The division could be built up with the personnel already available.

Within the section, there would be need for an additional Senior Administrative Officer and an accountant experienced in budget work and cost analysis.

Charges are at present billed on the water consumption bills where possible and in other cases direct to the consumer as in the case of the newly introduced service charge. The charges are collected by the City Treasurer. No change in this procedure is suggested in this recommended re-organization.

PLANNING DIVISION

It is recommended that the Planning Division deals with the following functions:- Planning and Development, Organisation, and surveying.

Planning and development would include technical planning for future, collaboration with consultants and also research as to collection, transport and disposal of domestic refuse (garbage).

Organisation would include the organisation of collection, transport and disposal of garbage and drawing up proposals for new collection districts including new driving routes for the vehicles, purchase of new vehicles, tools and machinery.

Surveying would include surveying and drawing up proposals for new collection places. It would also handle investigations of domestic refuse contents.

The head of the Planning Division should be a Deputy Cleansing Superitendant with high managerial as well as technical qualification. The planning and development need a Senior Civil Engineer with experience from technical planning and analyses in public cleansing. The organisation needs a Senior Transport Officer, with experience from transport planning and cost analysis. The surveying needs a graduated civil or sanitary engineer.

Collection Division:

It is recommended that the Collection Division deals with the following functions:- Working Districts, industrial inventory, and other services.

Working districts would cover collection of garbage or domestic refuse. In this study it is not recommended that the six present districts be changed. New districts would be formed when the development of the city makes this necessary.

Industrial inventory would include the co-ordination of industrial solid wastes treatment, whether transported to the disposal plant by the Cleansing Section or by the industries. Special attention should be paid to toxic wastes, and used oil.

Other services would include the same activities which the cleansing section is carrying out at present besides collection and disposal of solid wastes. These are: street cleansing, estates cleansing, Night Soil collection and disposal, cleansing public conviniences, grass cutting and drain clearing and disposal of dead animals.

The head of the collection division should be an assistant cleansing superitendant. The division would comprise personnel already employed within the Cleansing Section.

Transport Division

It is recommended that the new Transport Division deals with the following functions:- Transport administration, and, Repair and Maintenance.

Transport administration would include the responsibility for the proper functioning of the transportation and the vehicle fleet and condition of the vehicles.

Repair and maintenance would include the responsibility for proper repair and maintenance and keeping records of the vehicles.

The head of the Transport Division should be a Transport Manager with experience from lorry transport firms

or big garages. The division would comprise personnel already employed within the Cleansing Section.

Disposal Division

It is recommended that the Disposal Division deals with the disposal operation function. This would include the reception of solid wastes collected by the cleansing section or transported by industries or individuals.

The head of the Disposal division should be an engineering assistant with experience from similar activities. The division would comprise personnel already employed within the Cleansing Section.

MANAGEMENT STAFF REQUIREMENTS

With the creation of the above Divisions in the Cleansing Section, the following additional staff would be required:-

- Administration Division: A Senior Administrative Officer and an Accountant.
- Planning Division: The staff required here are, a Deputy Cleansing Superintendant, a Senior Civil or Mechanical Engineer, a Senior Transport Officer, and a Graduated Civil or Sanitary Engineer.
- Under the Transport Division, a Transport Manager is required.

- An Engineering Assistant is required under the Disposal Division.

Within the coming five years, the Cleansing Section's work will increase considerably. The organization of the section should be reviewed within that period and the feasibility to establish a seperate department considered.

5.2 IMPROVEMENT OF THE EFFICIENCY OF MANAGEMENT PERSONNEL AND WORKING CREW OF THE NCC CLEANSING SECTION:

The NCC Cleansing Section should immediately employ more qualified, committed and honest personnel at the management level so as to step up planning, management and supervisory roles. In-training of the management personnel should be undertaken in order to raise their efficiency and productivity.

There should be improved supervision of the field working crew to avoid wastage of man-hours by these workers when collecting and disposing garbage, as well as to totally eliminate misuse of garbage handling trucks by drivers who occassionally do use them for commercial purposes, especially in the industrial area. There should be an improvement in the supervision of the street sweepers in the residential areas so as to perform their work perfectly and by so doing will keep these areas clean. To undertake this role effectively for instance,

the Cleansing section inspectors should be deplored for cleanness spotchecks in the residential areas. In addition, in order to reduce mishandling of dustbins by the working crew, the NCC should instil displine and good conduct in their workers through use of a appropriate displinary measures and enlightment.

5.3 HIRING AND TRAINING OF PERSONNEL

The hiring of garbage collectors and drivers presents one of the most important problems to the NCC. The garbage collector is considered by most people to be at the very bottom of the social-economic labour ládder, and available positions hold little appeal to those seeking work, even in times of high general unemployment. A better image of such work should be propagated by the City Commission, either in terms of supply of incentives, such as uniforms, health, insurance, retirement benefits, and other quota based incentives and programmes. The following measures should be taken into account in hiring and retaining capable staff as waste collection personnel;

(i) Improved wage structure for these employees. Besides wage hikes, employees within an organisation need to be informed of prospects and potentialities in their work if their performance is good. Organizational work charts should be used to help

show the dedicated employees paths for possible advancement within an organization like the NCC. Besides the salary ranges and compensation should be clearly delineated to employees of this organisation.

(ii) Careful selection of applicants for garbage collection and disposal. Among the important attributes that need to be observed during this exercise include, physical capabilities, ability to follow instructions among others. A past history of bad work habits, lack of honesty, frequent absenteeism and poor moral fiber should be considered as causes to disqualify the applicant.

(iii) Training:- Training new employees is necessary to familiarize them with procedures in the garbage handling system as well as routes. Safety instructions is mandatory. A portion of the training should be supervised work in practice and it is during this period that individual problems and incapabilities can be detected and corrected. The training process should also be to tell the employee on the importance of his job to the proper functioning of the city of Nairobi in which he is working for.

Training should also be formalised so as to ensure it is part of the new employees matriculation. If a new equipment is purchased, or a new administrative policy is adopted, supplementary training may be required to update the employees skills and knowledge.

In effect the researcher has proposed that the following training measures be introduced by the NCC cleansing section:-

(a) Collection Staff

New employees to be informed by the foreman as to how the garbage disposal is organized in general and about the work they will carry out in detail. New employees should initially work closely with experienced workers. The foreman's course should be repeated at the end of the first month.

When new collection methods are introduced the whole group is to be given instruction in these. The instructor in this case should be the supplier's agent, who should also be obliged to instruct personnel in the maintenance of the plant.

(b) Transport Staff

New employees should be given a short training course by an experienced foreman on the actual type of vehicle they will drive. The course is to include routes and loading and unloading procedures. After this the

new employee should work initially under the supervision of an experienced colleague, and then be checked again by the foreman, before working independently.

When new vehicles are introduced, the whole group should receive a training course run by the supplier's agent. The supplier's agent shall also instruct both the transport personnel and mechanics in the maintenance of the vehicles.

(c) Disposal Staff

New employees need to be instructed in their duties by a foreman. As for collection staff above, they need to work with an experienced colleague and have a repetition of foreman's course after one month.

When new machines or plants are introduced the whole group should be instructed in their operation and maintenance by the supplier's agent.

Where a completely new method is introduced the leaders of the working team should be given the chance to study the new method at an existing plant.

(d) Section and Divisional Heads

Staff at this level should be given opportunity to study the working of similar plants elsehwere. The experience they gain should be passed on in courses to their subordinates.

The Chief of the Section or his Deputy should have the opportunity to take part in relevant international and regular inter-states conferences on public cleansing and solid wastes disposal and management conferences.

5.4 TASK ASSIGNMENT AND ROUTE PLANNING

Routing should be flexible enough to absorb seasonal-waste generation variations and should avoid heavy traffic or left-hand turns. Route-collection management supervision should immediate be improved through use of incentive systems if high work standards are to be maintained, poor services (such as missed stops) avoided, and customer compaints minimized.

Route Planning should be developed and improved further to minimize the length of garbage collection route for a specified collection area which will increase overall efficiency and reduce costs of operation. There should be garbage collection from both sides of the street during a single pass, minimizing the number of the left turns into thorough fares, and will also minimize the loading per stop.

In addition, route planning should be improved further to ensure that all parts of Dandora and Plainsview estates are well and evenly served. One major problem identified in Dandora in particular as reported by 33.3% of households was that there are some parts of the estate especially in Dandora Phase Two where garbage is not collected at all. In those areas, garbage has been heaping up for a long period of time, consequently posing a threat to health and environmental quality.

5.5 POTENTIAL SOURCES FOR FINANCE FOR NCC

The NCC should explore all alternatives and exploit where reasonable the possibility of obtaining additional income for its services.

The community should bear the total cost of garbage collection and disposal services, which the NCC authority provide. Therefore the residents should be charged an appropriate amount for the services. At the present time in Nairobi, the charges barely cover the running costs and any interest for possible loans to finance the purchase of the equipment.

The present charges of Kshs. 10 per household per month in Nairobi is insufficient income to meet the needs and scope of the present city cleansing operation. Taking into consideration that many households in the high income

areas pay Kshs. 120 per month to private garbage contractors to have their garbage collected, there seems to be little doubt that many households in those areas could afford to pay more.

If funds derived from charges of this magnitude should be available to the NCC, it would go a long way to providing a more efficient service. Therefore, it seems appropriate to apply alternative means of charging the public by relating the amount charged for refuse collection to property rates, a system used in many countries. The size of property and ratable value is usually related to the "ability to pay". In this way the charges would be distributed according to the wealth of the property owners.

In view of the important part that the city of Nairobi plays in the tourist industry, it would be reasonable to expect that some income from tourism would be channelled towards garbage collection and disposal service in order to preserve the pleasant beauty of the Nairobi City and protect its reputation. Consequently this source of income should be fully exploited and utilized accordingly by the NCC.

A further alternative source of income should come in form of Levies or charges imposed on recycling of valuable garbage materials and other wastes. Currently there are

a number of industries in Nairobi such as Madhupaper, Chandaria and Emco industries which engage in recycling of garbage components such as paper component, by the first two while the latter industry recycles bottles and tins. There are also a number of Jua Kali artisans in the informal sector who use garbage materials such as scrap metals, bottles, and tins. in their recycling activities as inputs. So at the present there are some individuals who do a crude form of recycling for which they obviously have found a market. To the best of our knowledge the NCC does not obtain any revenue from their operation. So NCC should explore and fully exploit this potential source of revenue.

An additional source of income should be obtained from human garbage "scavangers" (garbage collectors) who collect garbage components such as paper, bottles, tins, plastics, scrap metals and later sell to middlemen who on the other hand sell that waste to recycling industries and individuals e.g. Jua Kali artisans. NCC should formalise scavanging activity and consequently licence the "Scavangers" from who the city authority can obtain revenue on a regular basis.

Another alternative source of income for the NCC could come from the compositing of the organic part of the garbage. In view of the importance of agriculture in Kenya, fertilizers made from composted refuse could greatly reduce the amount of foreign exchange currently

spent on imported fertilizers. Through the sales of this type of fertilizers, NCC could generate extra revenue to finance its services such as garbage service.

5.6 DUSTBINS ASPECT

This study recommends that those households in Dandora and Plainsview areas that currently do not possess any dustbin be immediately supplied with one by the NCC. Provision of a dustbin whose current capacity is 15 Kilogrammes (Kg) to each household in Dandora would go along way to reduce conflicts between households in a given plot in as far as emptying garbage containers is concerned, and consequently this would ensure more care and prompt emptying of the same is attained.

Secondly the NCC should totally discourage residents from bunning garbage inside the dustbins through use of strict punitive measures. One such punitive measure that is being recommended here is the imposition of a fine or charge to those residents committing that offence before the NCC issues them with another dustbin.

It has also been observed that the present dustbins of 15 Kg. capacity will in the future be too small and inappropriate for the great amount of bulky garbage anticipated. This study recommends that larger dustbins with a capacity of 25-30 Kg. when full of garbage be used especially in the high density areas such as Dandora.

5.7 REPLACEABLE PLASTIC SACKS

Another possibility and alternative to dustbins that is recommended for both low-density and high-density areas is the use of Replaceable plastic sacks with a holding capacity of about 20-30 kg. of garbage so as to decrease the collection costs. The weight of such sacks when filled with garbage is such that they can easily be lifted by hand and carried or transported on truck to the delivery lorry.

The idea of replacing the dustbins with replaceable plastic sacks was suggested by 35.9% and 20.7% of households in Plainsview and Dandora areas respectively. This sacks should be either supplied by the NCC or freely sold in the open market.

Plastic sacks are being successfully applied in other major cities of the world such as New York. The major advantages of using plastic sacks in Nairobi would be ease of handling, transportation, and are hygienic and cheaper in cost in relation to dustbins. If the replaceable plastic sacks are taken care of well, they have a lifespan of about 5 years, while dustbins have 3-5 years of the same.

5.8 BULK CONTAINERS

On the basis of total daily garbage production load, total population size and frequency of garbage collection, the study recommends that 48 more bulk containers should

be supplied by NCC to serve Dandora estate, while 3 more should be taken to serve the Plainsview population. The current average garbage collection frequencies for the two areas was considered. But it is also important that these bulk containers be evenly distribution to ensure that all households get good access to them.

5.9 VEHICLES AND PLANT REPAIR AND MAINTENANCE

In order to allow the Cleansing Section to operate a hygienic and effective refuse collection and disposal system and to maintain the supplied vehicles it is recommended that a Cleansing Central Depot be created immediately by the NCC.

Cleansing Central Depot

In order to have the transport system working satisfactorily a suitable vehicle fleet is required together with possibilities to maintain and repair the vehicles. The transport section with the drivers and vehicles, which is now subordinated to the City Engineer's Department should obviously be part of the cleansing section to ensure efficient operation and maintenance. The section would be responsible for recruiting, maintenance and attendance.

The New Cleansing Central Depot recommended should include amongst other things, transport administration, workshop and vehicle service facilities. The Depot should provide appropriate training and facilities for handling specialised collection vehicles such as compactors and bulk containers vehicles so that mechanics could become familiar with this type of equipment.

It is recommended that that the Depot be decided on as soon as possible as it is a necessary unit in creating a transport system which functions well. The realization of the Depot would prefarably be performed in two stages as follows:

First Stage

This should involve immediate reorganisation of the transport within the present structure and construction of the new depot. The advantages of this arrangement are given below:-

(a) Financial planning of the cleansing vehicles would be facilitated.

(b) With the cleansing section managing the vehicle fleet, it would be easier to plan the availability of the vehicles and thereby the work in the various cleansing services.

(c) Facilities for training staff would be provided in the new depot. This would greatly improve the services.

(d) The efficiency of the cleansing service is judged by the speed at which it fulfills public demand and requests. The new depot would consolidate efforts and make faster communication possible, thus improving the speed at which work and reports would be attended to.

Second Stage

This should involve the development of the depot with the workshops and facilities for maintenance and repair and for garaging. The advantages of this arrangement are given below:-

(a) The cleansing section would maintain and repair all the special vehicles belonging to the cleansing section. The workshop staff would be trained specifically on those vehicles, which would contribute to an efficient service.

(b) The workshop services would be arranged such that the field work would not be delayed.

(c) The new depot with garaging for the vehicle fleet would be so centrally located that time would be saved when driving to the working district.

(d) The Engineering Workshop would have more time to specialize in the important heavy plants and major repair works without having the time - consuming obligation of carrying out routine maintenance of cleansing vehicles. Also, by the establishment of a Cleansing Central Depot the existing Transport Depot would become less overloaded than at the present.

Finally in order to enhance maintenance and pair work, there is need to step up routine check on equipment and vehicles after approximately 3 months of operation. In addition after 7-8 months of operation, there should be technical assessment of equipment, vehicles and assistance in ordering spares which is necessary. An economic-based spare parts purchasing and management system is a further prerequisite for optimum maintenance.

5.10 GARBAGE HANDLING VEHICLES REQUIREMENTS

THe field study coupled with discussions held with NCC officials revealed that for adequate garbage collection and transportation services the following vehicles are urgently required:-

Type of Vehicle	Number
High Ratio Compactors	52
Standard Bin Vehicles	12
Bulk Bin Vehicles	10
Side loaders	5
Tippers	5
TOTAL	84

Source: Field Survey.

Currently the required total number of garbage handling vehicles is 84 against the present 32 whose number goes down usually to 27 due to mechanical breakdowns.

5.11 GARBAGE COLLECTION

Besides the various strategies that have so far been recommended to improve garbage services in Dandora and Plainsview areas, as well as the entire Nairobi, the following are other supplementary recommendations.

The study recommends that the Cleansing Section should establish on Advisory Unit whose duties will entail sound route planning which are necessary to optimise the equipment use (trucks, bins and other

technical equipment). This will involve:-

(a) establishing refuse districts, number of routes and frequency of services.

(b) careful selection and establishment of refuse districts which includes collection routes, time requirement and positioning of bins.

(c) Calculation and provision of adequate reserves in form of vehicles and manpower.

The Advisory Unit will also be involved in:-

(1) Training operators and drivers on equipment handling to ensure optimum efficiency of the collection system.

(2) Establishing of optimum distribution of garbage collection containers, monitoring their use by the inhabitants, and spoting of potential problem areas.

(3) Advising on container and equipment maintenance and cleaning.

(4) Monitoring of collection productivity and assist in remedial actions through special training of skills, including safety aspects.

The above detailed combination of equipment supply and advisory services as proposed will ensure the remedy of the present shortcomings in the garbage collection within a reasonable short time. It is also recommended that the Cleansing Section (NCC) should collect garbage at least 4 times in a week if the residential settlements are to be kept clean. The collection should be done following a particular fixed time schedule by the NCC which they should certainly let the residents know. Through improved regular garbage collection service, the overall efficiency of garbage handling in the study areas and the entire Nairobi will be increased tremedously.

5.12 GARBAGE DISPOSAL

In view of the fact that, the remaining life of Dandora disposal site is estimated by NCC to be 2-3 years at the present rate of use, then time is appropriate to identify and plan for alternative disposal sites. With continued use of the existing quarries at Dandora for that expected remaining period of time, this study recommends the use of controlled tipping other than the presently used method of semi-controlled tipping.

Within the scope of this study, suitable disposal areas have been visually identified and consequently are being recommended for waste disposal purposes. These

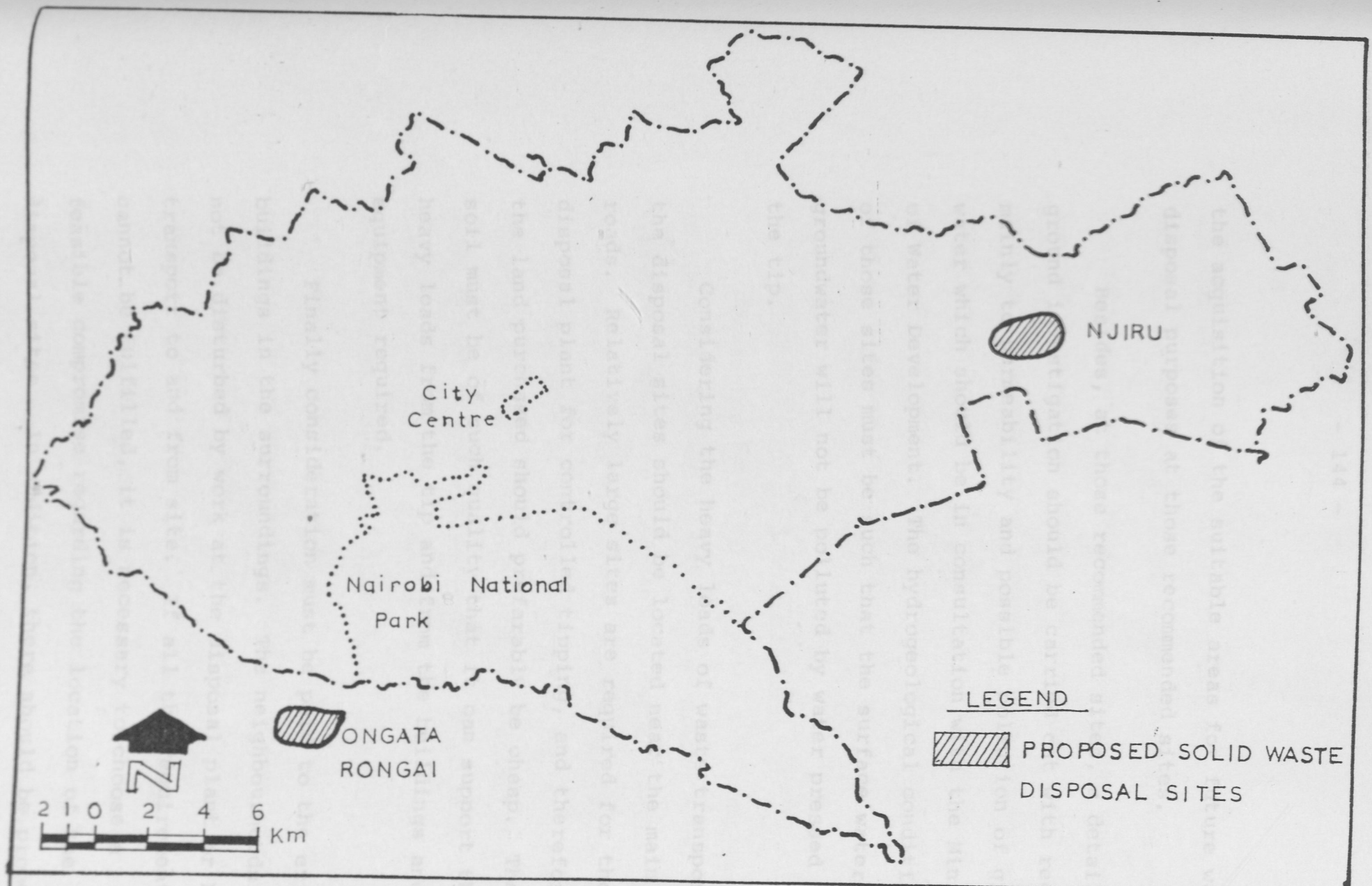
are:- (See Map No. 5).

(a) Eastwards at Njiru area

(b) Southwards at Ongata Rongai.

These areas are suitably located considering transport and disposal. The ground bearing capacity seems to be sufficient for all of them. At Njiru area for instance there are several abandoned stone quarries (there are a few such quarries in Ruai area) that could be used for waste disposal purposes through controlled landfilling. At Ongata Rongai, Njiru and Ruai areas, the solid rock is near to the surface. The possible influence on the groundwater seems to be insignificant. The conditions for acquiring the land should be investigated.

At the present, possibilities for disposing of solid wastes are limited in time, and as a result, areas for increasing disposal of waste must be reserved. A comprehensive study on all possible tip sites within reasonable distance from Nairobi should be undertaken. As soon as possible the availability of also other suitable tipping sites should be studied. For this study an engineer should be appointed either from the City Engineer's Department or from outside. This new engineer should make inventory of available quarries (in Njiru, Ruai and Ongata Rongai) regarding capacity and legal matters. He should also make preparations for



MAP NO.5 PROPOSED SOLID WASTE DISPOSAL SITES

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the acquisition of the suitable areas for future waste disposal purposes at those recommended sites.

Besides, at those recommended sites, a detailed ground investigation should be carried out with regard mainly to permeability and possible pollution of ground water which should be in consultation with the Ministry of Water Development. The hydrogeological conditions of those sites must be such that the surface water and groundwater will not be polluted by water pressed from the tip.

Considering the heavy loads of waste transported, the disposal sites should be located near the main roads. Relatively large sites are required for the disposal plant for controlled tipping, and therefore the land purchased should prefarably be cheap. The soil must be of such quality that it can support the heavy loads from the tip and from the buildings and equipment required.

Finally consideration must be paid to the existing buildings in the surroundings. The neighbourhoods must not be disturbed by work at the disposal plant or by transport to and from site. If all the requirements cannot be fulfilled, it is necessary to choose a feasible compromise regarding the location of the disposal sites. In addition, there should be proper site establishment and environmental protection which

are crucial. Further protection measures should include the careful selection of the proper underground and protection measures like drains and pipings against leachates as well as fences against wind- blown items, animals and unauthorised persons. There should also be proper site selection to ensure that access road, site location and energy supplies remain operational under all weather conditions.

5.13 GARBAGE COLLECTION BY SCAVANGERS

Scavanging activity is playing a significant role in the urban economy of Nairobi in various ways. The activity is becoming important in the collection and disposal of garbage in Nairobi therefore playing a significant role of supplementing the NCC efforts of clearing garbage. For instance the estimated average daily weight of garbage collected in Plainsview and Dandora areas is 2.68 tonnes, which gives monthly and annual weight figures of 80.4 tonnes and 964.8 tonnes respectively. The activity is also contributing considerably in employment creation, income generation and in improving overall standards of living of especially the urban poor.

Consequently the job of scavanging should be made more attractive and secure than it is at present. The Government of Kenya in the Sixth National Development

Plan (1989-1993) has laid great emphasis on promoting the informal sector activities in order to boost employment creation and accelerate economic and social development. This study recommends therefore that the Government of Kenya give more recognition to this activity (Scavanging) and also provide the necessary technical, economic and legal assistance to enhance scavanging activity.

The Government of Kenya, the NCC and other Non-Governmental Organisations should make the appropriate arrangements that will assist in organising Nairobi garbage scavangers more so that they can benefit more from that activity. This assistance should not only organise and manage garbage collection but it should help in the control of garbage prices so that exploitation of scavangers by the middlemen in that business activity is totally eliminated. The study recommends that garbage collectors be licensed (by the NCC) and be granted the legal rights of operating that business activity. By formalising scavanging activity, more people will be encouraged in that business activity which is currently being looked at by many with suspicion besides, harassment of scavangers by the NCC authorities. Furthermore by licensing garbage collectors, and the middlemen it will provide an extra source of revenue to the NCC which will help boost provision of other services to the city residents.

Garbage collectors should be assisted to learn how best to channel their incomes into more productive ends (investments) rather than squandering it away as soon as it is earned. These are some of the sociological dimensions of scavanging in the City of Nairobi which need to be clearly understood as we takle the scaring unemployment problems in the city some of which scavanging could help alleviate with proper planning.

On the basis of the already important role that garbage collection by scavangers is playing on Nairobi economy, there is urgent need for the law against waste salvaging to be ammended accordingly.

When one visits residential areas like Dandora and views the garbage scavanging activities, the whole business looks legal and genuine. But as a whole, the business is carried out with fear as the garbage collectors are always on the look out for any NCC's cleansing section trucks that may be approaching and taking away their hard earned "waste". This is also one reason why scavangers were adamant about giving information about their business.

There is need to set up an organised system of recycling garbage right from the household producers. The system would best operate under private establishment although the City Authorities or the Central Government

could help in terms of providing initiative in reach. Already there exists a great demand for garbage by pig farmers who come from districts neighbouring Nairobi such as Kiambu and Murang'a. The major institutions and hotels in the city already provide the bulk of this garbage. Household garbage from residential areas like Dandora and Plainsview could be used for that purpose as well.

5.14 RECYCLING OF GARBAGE

Recycling activity can play an important role in strategies for solving both the immediate and long-term problem of the city's waste management. In practice, recycling already takes place everyday in Nairobi city ranging from industries that reuse their own waste materials to scavangers who sort through refuse at the City dumping and residential areas.

The recycling of waste products is governed by the economic returns. For example, manpower costs rise continually while the value of raw materials remains constant or decreases as long as the supply is good; however diminishing supplies of a raw material can cause sharp increases in its value. Also increased pollutions of the environment gives additional grounds on which to evaluate recycling.

Recycling of solid wastes is today a source of energy and raw materials. At the Dandora landfill site and in some residential areas of Nairobi, some sort of crude refuse sorting is already done. This shows that these recyclers have found a market for their products. Today the recycled materials include paper, bottles, tins, scrap metal and plastic. depending on the household or industry and the waste they generate. These recycled materials provide inputs which are used in the production process by such industries in Nairobi like Chandaria, Madhupaper and Emco as was found out in the field study. Chandaria and Madhupaper industries do engage in recycling of paper, while Emco recycle scrap metals.

The benefits of resource recovery are considerable and in some cases very rewarding. Recycled materials can reduce imports of raw materials and consequently valuable foreign exchange can be saved. Jua Kali artisans also do utilize certain refuse components in their production activities. In Dandora estate for instance, tins, plastics and scrap metals are being used by Jua Kali artisans. Consequently it is noted that solid waste through recycling activities provide not only finished products to residents but also provide employment to residents engaging those business activities ranging from the garbage collectors and middlemen to the recyclers.

For the most part, recycling activities are carried out informally by loosely organised networks in the private sector. They are the result of economic necessity - a source of subsistence income to street peddlers and scavangers, a means of cutting costs or obtaining scarce materials for industries. However, says Carl Bartone,[1] these activities are rarely taken into consideration as part of an official approach to waste management. Private recycling, notably by the "Jua - Kali" artisans at Gikomba, is ignored or, in some cases, discouraged.

Various methods already exist for recycling and new methods are being developed gradually. Recycling can be either direct or indriect. Direct recycling means that certain products are collected at the source, in the households, or in centrally arranged sorting plants for re-use in their original form. Indirect recycling means that the original matter is modified on recovery such as gas (pyrolsis) for heating or the production of chemicals or as compost for improving the quality of soil.

In Nairobi, recycling by the informal sector is one of the principal means of recovering city wastes. However these activities are also raise complicated issues that must be resolved by the Nairobi City Administration. For example, scavanging provides employment and plays a vital role in resource recovery. Yet scavangers often work under extremely unsanitary conditions and are

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1. Carl Bartone was a Senior Project Officer in an Integrated Resource Recovery Project sponsored by U.N.D.P. (World Bank) in a project undertaken in Shanghai, China in 1982.

subject to abuse by scrap dealers and others.

Sanitation crews often sort and recycle refuse as they collect it, an activity that both contributes to resource recovery and slow collection work. Recognizing the positive contributions that these activities make to waste management in the city should be the starting point for solving the associated problems. Hence there is urgent need for the NCC and the Central Government to recognise, legalise and assist those involved in scavanging and recycling activities.

5.15 PRIVATIZATION OF GARBAGE COLLECTION

It is hereby recognized from this study that its possible to organize and deliver an important public service (such as garbage service) through the private sector while the NCC retains adequate public control.

Consequently this study recommends that a single private garbage company or contractor would be the most desirable, but if this is impractical, the current move by the Nairobi City Commission to have the City subdivided into municipalities or zones would be sound, in that then, the contract for each zone can be awarded seperately. Thus there is the possibility that there will be many contractors involved, but if one has the capacity and offers competitive prices the operation could go to a single firm.

This study recommends further that the contract should be a franchise for all cleansing duties including street sweeping in the residential areas such as Plainsview and Dandora. Besides the study recommends that the existing system of using dustbins be replaced in such a system by plastic bags which are significantly cheaper, cleaner and more convinient to all parties. Here the contractor would be responsible for collecting the charges from the residents. Users who do not pay should be reported to the NCC Water Department, and in cases of severe delinquency water should be turned off.

It is also recommended that, garbage charges should be higher than the present ones probably about two times as high. However, the city should be divided up into zones or municipalities in such a way that each contractor gets a responsibility for some informal housing and low income areas as well as high income areas. Collection of garbage in the informal housing areas should be free of charge. Thus the higher income earners should subsidise the poorer people in the low income areas.

It is further recommended that in view of the existing staff shortages in other departments of NCC, the staff of the NCC's Cleansing section should be absorbed by other departments without difficulty.

The next step recommended should be to engage a specialist consulting firm to initiate the privatization

process. The firm should prepare the documents for tendering, manage the tendering process and evaluate the tenders. Tenders should be evaluated on the basis of the contractor's past performance, if any, financial, technical and managerial competence, availability of vehicles and equipment and the proposed charges to the users.

The consultants should be responsible for monitoring the early stages of the implementation and to ensure that the contractors are being properly managed. When the system is fully operational they should progressively hand over this management role to the NCC.

5.16 COMPOSTING

This study recommends the use of composting as a garbage disposal management alternative. It recommends the building of a pilot plant for open composting from which experience can be gained besides the possible value and the agricultural use of the produced compost among the many benefits that would accrue from the activity.

After the garbage has been pulverized in a hammer mill and at the same time sorted out to some extent, it should be spread into approximately 1.5 m thick layers without compressing and without cover. The wastes should be watered to maintain the humidity required for the decomposition.

After 6 - 12 months time the solid wastes are converted into compost. Following additional pulverizing and screening, the compost is suitable for use as a soil fertilizer.

Drainage water from the fill is collected in a pond. Part of the water is pumped back and sprinkled on the newly spread refuse. This maintains the required humidity in the refuse and speeds up decomposition.

5.17 CONTROLLED TIPPING, LANDSCAPING

The final disposal of the garbage is an essential and decisive question in the overall solid wastes system. Pollution of ground, water and air must be avoided.

This study recommends the use of controlled tipping, and landscaping method for the final disposal of garbage. The controlled tipping location areas should be sufficiently close to the garbage collection areas to minimise transportation times and costs.

This method would require a plot of land situated in a suitable location and well isolated from the co-community but comparatively near the collection place. The ground should also be suitable with regard to bearing capacity and hydrogeology so that pollution of the groundwater is avoided. The slope of the terrain should be such that the surface water from nearby areas can easily be diverted away from the tipping area.

When using controlled tipping systems, the refuse should be spread and compressed into layers of about 2.5 metres (m) thickness. The wastes should then be gradually covered with a layer of soil of about 0.3 m thickness.

Bulldozers or heavy tractors (compactors), with chopping wheels of steel should be used for spreading and compacting the solid wastes. The wastes should be pilled in several layers according to a decided plan. Gradually a new landscape is formed which can be cultivated and is suitable for the planting of trees.

Drainage water from the fill should be collected in a pond. Part of the water should be pumped back and sprinkled on the newly spread refuse. This maintains the required humidity in the refuse and spreads up decomposition. The pond is designed as an oxidation pond. The effluent (if any) from the pond should either be treated seperately at site or pumped to the main sewerage system.

5.18 OTHER RECOMMENDATIONS

The cleansing service should fully decentralise to the sub-district level and managed from that level, all with a permanent staff. The City Hall should then oversee that all is well at each subdistrict through sound co-ordination and management practices. If possible, the decentralisation should be in line with the provincial administrative boundaries but with the consideration to the quantity of refuse produced and the

area covered.

Finally through the use of public media, thorough campaigns should be launched to educate the public on the importance of keeping the residential surroundings clean. But the success of this programme will depend on how NCC's cleansing section can effectively organise itself and prove to the public that it is committed to keep the city clean. For instance, it is in the low income settlements (such as Dandora) where population densities are high and awareness of the hazards of uncontrolled garbage disposal are low that the need for environmental and health education and enlightment is greatest.

5.19 CONCLUSIONS

Initial emphasis to improve garbage handling services in Plainsview and Dandora areas as well as the whole of Nairobi City may be placed on actions such as the following:-

(i) Optimize the ratio of supervisory personnel to direct labour, and provide equipment and facilities to their work.

(ii) Optimize the ratio of inspection personnel to direct labour, and provide equipment and facilities to facilitate their work.

(iii) Optimize the ratio of maintenance personnel to equipment and provide the workshop tools and infrastructure needed for ease in making repairs.

(iv) Adopt a system of record keeping of maintenance equipment and other maintenance supplies, so that an adequate supply of spare parts and materials is available at all given times for typical maintenance needs, and so that, adequate time is given for ordering special parts for a pending repair needs.

(v) Clarify responsibilities by such action as making specific collection crews responsible for specific routes or area of service, and similarly assigning equipment to individual drivers or operators. Also there is need for clearly designated chain of communication and co-ordination for workers to be utilized in reporting problems and issues in service provision and for citizens to utilize in making complains or recommendations.

(vi) Establish City ordinances or By-Laws that spell out citizen participation in the solid waste management system, by outlining methods of household storage, placement of wastes for pick-up, as well as payment of charges and responsibilities for keeping their kerbside property clean for pedestrian and vehicular traffic.

The importance of an efficient and locally appropriate garbage handling system need not be overstressed at this point. Garbage collection by scavangers should be seen as a means of lessening the burden on the clearly over-burdened garbage handling system of the NCC's Cleansing Section, while the issue of legalising of scavanging activity should be looked into immediately.

In general the study on garbage collection by scavangers found out that the low status of garbage collectors at the periphery of society virtually deprives scavangers of the protection of the law. Their low educational achievements, weak social networks in the city (garbage collectors are often new migrants into the city) and the repulsion garbage evokes in others forces them into a position of being outcasts.

Besides it is felt that there is urgent need to motivate the NCC's cleansing officers not only by improving their technical knowledge but by providing training to the management which is not yet provided at the moment. The decentralisation of the cleansing section to the sub-districts would ensure that closer monitoring of garbage accumulation is quickly undertaken and the appropriate remedial measures taken.

Every future garbage handling system for the Nairobi City Cleansing has to be compatible with the habits and attitudes of its citizens. The system has to

take into account the present handling system of garbage with its intermediate storage and collection points. The system also has to give due consideration to the specific difficulties associated with the City Planning and Urban Construction. Besides, the garbage handling system has to be undertaken with due regard for local laws and regulations concerning health and hygine.

Furthermore the planning of garbage handling system in Nairobi requires that there be a means of continuous monitoring of garbage collection and disposal performance as well as controlling costs. Yet, in view of the dynamic social, economic and environmental conditions of the study areas (Plainsview and Dandora) and Nairobi as a whole, there is need to undertake regular reviews of the garbage handling strategies that are being used by the NCC.

The present deficiencies of garbage management operations in Dandora and Plainsview areas as well as the whole of Nairobi can be summarised as follows. It can be seen as due to acute shortage of supervisory staff within the Cleansing Section of NCC. Secondly, it is as a result of inadequate legal framework, particularly for waste disposal especially in respect to disposal of hazardous or toxic wastes.

It is also observed that the tariff structure for solid waste management services does not reflect actual

operational costs and has not been revised since 1983/84. Besides, insufficient provision of vehicles and equipment as well as the poor standard of vehicle maintenance has resulted in failure to achieve the desired garbage collection frequencies. In addition there is unacceptably low standard of final disposal of wastes, both environmentally and aesthetically for a capital city like Nairobi which has a high tourist profile.

Garbage collection by scavangers has also being found out in this study to be one of the most viable garbage management alternative in Plainsview and Dandora areas and perhaps the entire of Nairobi. Two important points can be emphasized here. One point is that garbage collection activity generates good incomes for these collectors, but the majority of them remain poor and pulverised due to carefree lifestyles. They spend the money as soon as they earn it. It is a kind of "subsistence" urban economy.

Another important point that can be emphasized from scavangers is that their "peasant attitude precludes savings and any form of investment or organised decent lifestyles. The scavangers appear victims of helplessness and marginalization characterised by despair and lack of confidence. Monetary gain alone are not enough to raise the standard of living of the urban poor, or anybody else for that matter. It has to

combine with many other factors such as job security, stable incomes, avenues for investments and savings, confidence on oneself and dignity. We must also add creativity and high achievement motivation.

The psychlogy of the worker is therefore as much an asset in development as the cash returns from his labour. For the overwhelming majority especially the youthful and unmarried, the job of scavanging is almost a hopeless drift into the unknown future although it generates incomes as the last resort when everything else has failed.

5.20 AREAS FOR FURTHER RESEARCH

A further study on the economic and technical viability of using plastic bags in place of dustbins in the storage of garbage is necessary. A cost benefit study should be conducted based on actual quotations from presumitive suppliers of plastic bags and on actual costs and lifetime for dustbins and present costs for transport and handling before the final decision is taken on the trial.

Furthermore, the study has generated limited data on expenditures, savings and investments of garbage scavangers. As a result further research work is required to improve our knowledge of these aspects.

Before considering recycling of garbage and other solid waste products a detailed study need to be performed on the various advantages and disadvantages of the possible methods for the collection and recycling as well as a survey of the possible markets for the products.

So far at the Dandora waste disposal site, there is no clear geological and hydrological investigations that have been conducted, and neither has any leachate or methane gas monitoring been carried out. Consequently, there is need for these studies to be carried out so as to determine the performance of the waste disposal process at the site.

5.21 ESTIMATED COSTS OF THE PROPOSED GARBAGE MANAGEMENT IMPROVEMENTS

1.	Preparation of Master Plan, economic studies, and detailed plan.	- 720,000
2.	Organisation study	- 400,000
3.	Study and introduction on trial of paper sacks at Dandora and Plainsview areas	-4,800,000
4.	Complementary renewal and addition to the vehicle fleet that is 52 High Ratio Compactors, 12 standard bin vehicles, 10 bulk bin vehicles, 5 side leaders, 5 tippers	-96,100,000
5.	Investigation of existing quarries and new sites for disposal plants, a new engineer should be appointed to manage this exercise	- 2,400,000
6.	Planning for a pilot disposal plant	- 1,200,000
7.	Preparation of training programme, training courses, international conferences	- 2,400,000
8.	Complementary addition to Bulk containers (51 in number)	- 1,020,000
9.	Study of pollution resulting from unmanaged garbage	360,000
10.	Establishment of vehicles and plant repair and maintenance depot for the cleansing section	- 3,000,000
11.	Establishment of a recycling plant	- 2,600,000
	TOTAL = Kshs.	115,000,000

OPERATIONAL DEFINATIONS

1. "Collection" shall mean the act of removing garbage from the central storage point of the primary source.

2. "Disposal" shall mean the orderly process of discarding useless and unwanted national.

3. "Dump" shall mean a land site where solid waste is disposed of in a manner that does not protect the environment.

4. "Pollution" shall mean the condition caused by the presence in the environment of substances of such character and in such quantities that the quality of the environment is impaired or rendered offensive to life.

5. "Salvage" shall mean the utilization of waste materials.
6. "Sanitary Landfill" shall mean a site where solid waste is disposed using sanitary landfilling techniques.
7. "Sanitary landfilling" shall mean the engineered method of disposing solid waste on land in a manner that protects the environment by spreading the waste in thin layers, compacting it to the smallest practical volume, and covering it with soil by the end of each working day.
8. "Garbage Management" shall mean the purposeful, systematic control of the generation, storage, collection, transport, seperation and disposal of residential solid waste.

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APPENDIX 1

HOUSEHOLD QUESTIONNAIRE

Name of Interviewer ----------

Name of Respondent (Optional) ----------

Date of Interview ----------

Name of Residential estate ----------

Household Data

1. Sex of household head Male ------- Female----
   (tick one)
2. Age of respondent (in years) ----------
3. Marital status of household head: Married ----------
   Single ----------
4. Occupation of respondent ----------
5. State your level of education ----------
6. Give the number of persons living in the house unit------
7. Give the number of rooms used by the household ----------
8. Who owns the house unit? Self/Landlord/Private Company
   Government . (Tick one).
9. How much do you pay for your house as rent per
   month? ----------

Garbage Menace Data

10. What are the main types of your garbage? ----------
11. Estimate the weight (in kg.) of garbage that you
    generate per day? ----------
12. Do you have a dustbin? Yes/No. Is it individually
    or communally owned? Yes/No. ----------

13. If you do not have a dustbin, what do you think are the necessary measures to provide solutions to that problem? ----------

14. a) Do you have a bulk container near you house? Yes/No. ----------

    b) Estimate the distance (in metres) from your house to the bulk container.

15. In your opinion, do you think there are sufficient bulk containers within your locality? Yes/No. Explain ----------

16. How many times in a fortnight (in two weeks) does the Nairobi City Commission (NCC) collect garbage from your locality ----------

17. In your opinion, does the NCC provide adequate garbage collection services in your locality? Yes/No. If No, suggest appropriate solutions to this problem ----------

18. Do you find storing garbage a problem? Yes/No. If Yes, what kind of storage problems do you experience such as . lack of space in the house/plot, pollution. ----------

19. What kind of problems do you experience with garbage collection and transportation to the local disposal site? Suggest solutions to these problems in garbage services in your estate and Nairobi as a whole ----------

20. Are you willing and able to pay more for an improved garbage service? Yes/No. Explain ----------

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21. Where do you dispose your garbage? (on road reserve, open spaces etc.). Explain ----------

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22. What problems does the uncollected garbage around your house and estate cause? ----------

23. Do you have a problem with dogs/rats/flies or any other vermin within your locality present because of uncollected garbage? Yes/No. Explain ----------

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24. Give suggestions of how the environment of your locality could be improved? ----------

25. Which mass media are accessible to you? ----------

26. Within your locality, do you have any private company that is engaged in garbage handling? Yes/No ----------

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27. Do you see the need to engage private company(s) in provision of garbage services? Yes/No. Explain----------

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28. Would you willing and able to make payments to a private company to collect garbage from your locality? Yes/No. Explain ----------

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29. How much money do you pay as service charge per month?

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30. Kindly indicate your monthly income or wage (Kshs)

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31. Give your monthly expenditure on household food.----------

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32. What health problems (if any) have you or your family experienced resulting from garbage menace? ----------

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33 (a) In general, what are your views about the garbage services that NCC renders to residents in your locality and Nairobi as a whole? ----------

(b) Suggest ways in which the efficiency in garbage services provision can be improved by the NCC --------

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THESIS QUESTIONNAIRE

TO GARBAGE COLLECTORS (SCAVANGERS)

Name of interviewer ----------

Name of respondent ----------

Name of residential estate where interview was conducted------

Date of interview ----------

1. Sex of garbage collector. Male ---------- Female --------
   (tick one).
2. Age of Respondent ---------- Years
3. Where did you originally come from? ----------
4. Marital status of Respondent. Married ----------
   Diverced single ----------
5. State your level of education ----------
6. For how long have you been engaged in garbage
   collection work? ----------
7. Are you partially or fully engaged in garbage
   collection activity? ----------
8. If partially engaged, then what other work do you
   engage in? ----------
9. What is the size of the household that you support? ------
   ----
10. Where do you live or reside? ----------
11. Give the number of room(s) used by your household---------
    ----
12. How much do you pay as house rent per month? ----------
    ----
13. How much do you spend on household food per month? ------
    What are the other monthly expenditures that you

incur? ----------

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14. Estimate your total household expenditure per month ----------

15. What garbage types/components do you collect? ----------

16. Estimate the weights (in kg.) of the garbage components that you collect per day ----------

17. How many days in a month do you collect garbage?---------

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18. How much is paid for every kilogrammes of garbage that you collect? ----------

19. Estimate your monthly income from this activity of garbage collecting? ----------

20. From that income generated, estimate your average savings per month? ----------

21. What investments have you undertaken using incomes your garbage collecting activity? ----------

22. What are the general problems that garbage collectors experience? ----------

23. Give suggestions on how garbage collection by scavangers can be improved in your locality and Nairobi as a whole ----------

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