

**DENSIFICATION OF URBAN RESIDENTIAL SPACE
AND IT'S EFFECT ON SOLID WASTE MANAGEMENT:
A CASE STUDY OF KAWANGWARE RESIDENTIAL
NEIGHBOURHOOD – NAIROBI, KENYA.**

by

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**A thesis submitted in partial fulfillment of the
Degree of Master of Arts in (Planning)**

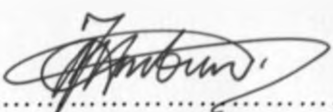
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August 2010

Declaration

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

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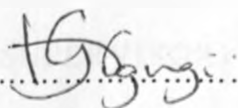
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Dedication

I dedicate this work to my wife Beatrice Mwangi, and my children – Lilian, Catherine, Joan and Kevin, for their constant encouragement and prayers.

Abstract

One of the key problems that Kenya and most other developing countries have in common is the high population growth-rate, which has become an impediment to growth and led to poverty-ridden slum cities. "This is threat to development since the population growth rate of 3 percent is higher than the economic growth of about 2.6 percent recorded last year," according to reproductive health experts (*Daily Nation*, June 28, 2010, p 17). Most informal developments in the area of study, as is the case in similar areas, included illegal extensions and high rise buildings that attracted a large a population. This increased population outreached the infrastructure, leading to burst sewers, heaps of uncollected garbage, water rationing and overloaded transformers.

This study focused on issues surrounding solid waste management services. The study endeavored to investigate how the concentration of people with their myriad activities, and the densities of buildings impacted on solid waste management in a social environment. It also offered suggestion on ways resolve related problem issues. The study area was one of Nairobi's densely populated and low-income neighbourhood of Kawangware. The neighbourhood is located 12 km to the west of the City's CBD. Kawangware borders the high-income residential area of Lavington to the west, Nairobi River to the north and Riruta Satellite to the south

The study documented real cases within the study area and elsewhere, on how solid waste, particularly from household, is managed. The methodology used in the study largely involved sourcing and analyzing data and information from the study area, libraries and past researches, on solid waste management and related issues. Primary data was acquired through reconnaissance survey, personal observations, questionnaires, maps and interviews. Lack of

sufficiently documented information in the field was a major drawback as regards secondary data acquisition.

The units of observation for solid waste management in Kawangware included residents and their homes in the built-up environment. The sample size was selected randomly from residential clusters that make up the neighbourhood. The analysis of the primary and secondary data and information obtained helped in the better understanding of the existing state of affairs on solid waste management.

The study established that poor solid waste management in the area was not only a result of habitation densification but of other factors such as ineffectiveness of services providers and indifference among many residents especially in poor neighbourhood. Most people from such neighbourhoods were found to be more concerned about their basic survival to give needed attention to standard solid waste handling measure. The study recommendations included strict enforcement of local authority planning by-laws, particularly to ensure that developments are done in right places and within set standards that take infrastructural services such as roads, sewerage and waste handling into consideration. Developers would, for example, be obliged to reserve a site for the waste collection within compounds and localities. The local authorities would also be expected to play their full part in facilitating an effective waste handling service.

Acknowledgement

The author wishes to acknowledge the contributions of various individuals who helped in the successful completion of this study. Foremost among them are the course instructors, Dr. G.Ngugi, Dr.A.M.Mwaura and Dr.S.V.Obiero: They gave invaluable guidance during the duration of the study. Thanks also go to fellow students, for their worthy contribution to the study, the research assistants and many friends from the study area who helped in data collection; the research assistant and knowledgeable friends who rendered varied services including data analysis; and to Miss Jane N.Gichohi who typed the report.

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ACRONYM ABBREVIATIONS

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MWMT	Municipal Solid Waste Management
CUN	Clean up Nairobi
NCC	Nairobi City Council
NYSAA	Nairobi Youth Sports Association
FSDA	Foundation for Sustainable Development Africa
CUO	Community United Organisation
NELC	Nairobi Environmental Commission
NABE	Nairobi Backyard
MLG	Ministry of Local Government
MCIT	Ministry of Commerce and Industry
MINRE	Ministry of Environment and Natural Resources

ACRONYMS AND ABBREVIATIONS

MSW	-	Municipal Solid waste
MSWM	-	Municipal Solid Waste Management
CUN	-	Clean up Nairobi
NCC	-	Nairobi City Council
MYSA	-	Mathare Youth Sports Association
FSDA	-	Foundation for Sustainable Development Africa
CBO	-	Community Based Organization
NGO	-	Non Governmental Organization
NIMBY	-	Not-in-My-Backyard
MLG	-	Ministry of Local Government
MCI	-	Ministry of Commerce and Industry
MENR	-	Ministry of Environment and Natural Resources

CHAPTER ONE:

INTRODUCTION

1.0 Introduction

Urban areas hold the most promising opportunities for social and economic progress and environmental improvement both at the local, national and global levels. They are areas with relatively high population densities and where people mainly deal with non-agricultural activities such as high yield manufacturing, commercial and services delivery (e.g. administration).

Rapid urbanization in Kenya has led to an equivalent rate of concentration of built-environments and their inhabitants. This has often impacted adversely on the built environment in different ways. Infrastructural and other public services such as roads, sewerage, sanitation and waste disposal have been overstretched or in some instances collapsed. In some residential neighborhoods, for example, the management of solid waste generated by the residents as a result of human concentrations has degenerated into a crisis. This critical condition is characterized by the poor waste storage, collection, transportation and disposal. Although population densities of a locality had a bearing on this problem, how waste was managed within the space available was also among the determining factors towards better waste handling. This study, for example found waste management was better in compounds where a particular site was set aside for waste collection before it was transported for disposal.

Just over a half of the world population of six billion people lived in urban areas by the end of the first decade of the 21st century. The urban population was projected to grow from 2.86 billion in 2000 to

4.98 billion by 2030 when about 60% of the world population will be expected to live in cities (National Research Council, 2002).

That high figure of urban population, its consumption patterns and its economic activities will have a correspondingly heavy demand on the environment in terms of resource consumption and waste discharge.

Most urban settlements such as the one used for this study, lacked physical infrastructural services or, if they were there, they were inadequate or in poor condition. Solid waste management was one of such services that received little or no attention from local governments. In Nairobi for example, solid waste management had been the domain of Nairobi City Council (NCC). Nairobi City Council had been able to collect only 400 tonnes of solid waste out of 800-1,000 tonnes generated. Most of the remaining solid waste was what was seen in garbage heaps around neighbourhoods. Most of the remaining solid waste was what was seen in garbage heaps around neighbourhoods. It should be noted that Nairobi City Council had, towards the time of the end of this study launched its Solid Waste Management Plan that was expected to enhance efficiency in the collection and disposal of waste. The plan envisaged "seeking safe disposal of residue waste, replacing current disposal sites" (*The Standard*, July 15, 2010).

The study observed that mismanaged solid waste collection and disposal therefore contributed to environmental pollution while endangering the health of the society. Problems involved in the generation, collection and disposal of waste is probably the most immediate in terms of direct environmental impact on everyday lives. Generation and disposal of solid waste has far reaching effects on e.g. water and air quality, on landfill sites and numbers on recycling programmes and on every person's tax bill hence being a big issue in

many municipalities. The waste therefore needed proper management right from the source to its disposal or other processes.

Random dumping or disposal of solid wastes in drains, rivers, waterways and other informal sites aggravates pollution of underground water around households. Food-crops grown off polluted rivers or fish-catch from polluted fishing points, poses a health risk to the consumers. The problem is further complicated by rapid urbanization as well as poor service delivery and failure in the enforcement of relevant regulations through "ineptitude and negligence of local authorities entrusted with the responsibility of ensuring order" (Olima, undated).

Obudho (1989) states: "For the past three decades, urban population in Kenya has grown tremendously within a range of 6.5 to 7.5 percent per annum. Since 1962, the total share of urban population has increased from 7-8% to over 16% in 1987. A great proportion of that urban growth was accounted for by rural-to-urban migration as opposed to natural increase. That rural-urban exodus indicated a significant movement of labour force from subsistence agriculture-based economy to the more attractive opportunities offered in a budding, commercial and service-based economy in towns.

On the other hand, the high rates of urban growth continued to add strain on housing and other basic services and facilities in urban areas. Consequently, increased inhabitants of Kenyan towns lived and worked within a built environment that had developed at a slower pace to comfortably accommodate the new town dwellers. Most of the new inhabitants were additionally, in cultural, psychological and financial shock in the new environment.

Manifestations of urbanization growth rates that outpaced those of economic development include high population densities in informal

settlements, poverty, strained services, environmental pollution, conflicts and other related problems. High densities for instance, have been associated with psychological stress and when these are translated into human activities; they lead to hostility and even conflicts among residents (Ekistics, 1975).

Environmental quality of an area depends mainly on how well the land utilization is undertaken. If there is over-use of land, through crowding of residential houses, for example, there would be limited space for waste management and environmental quality would be lowered from scattered heaps of uncollected solid waste.

An elaborate approach would be needed in solid waste management so as to safeguard human health and prevent environmental pollution. Household waste therefore, has to be dealt with, right from the source because it constitutes a significant percentage of solid waste generated in urban areas.

Past researches on the study area indicate that European Community (EC) had initiated an upgrading scheme that was expected to provide solution to poor waste management there, though little came out of it. The scheme only managed to create communal dumping points, which with time were grabbed by land speculators. The collection and disposal of solid waste remained a problem for many Kawangware dwellers who just had to dump their house-hold waste along roads, in drainage channel and in other unauthorized points.

This study attempted to investigate the effects of population densification on solid waste management in Kawangware neighborhood with an aim to recommend better ways of reversing the deteriorating state of waste handling. The study area is in a low-income residential neighborhood to west of Nairobi CBD. It borders

the Lavington high-income residential area to the west, Nairobi River to the north and the mixed-class Riruta Satellite to the south. The units of observation, as far as solid waste is concerned, included households and facilities in the Kawangware neighborhood.

Organization of the Study

The study is divided into five chapters. Chapter one is introductory and starts with a brief description of solid waste management, why it was a major concern in urban residential neighborhoods and why this study is necessary for the study area.

A section on the statement of the problem explains the problems to be investigated, and gives a short background to the problem areas. This is followed by an overview of researches done in the related field, the justification and objective of the study, questions to be answered and the methodology on how the study was conducted.

Chapter two covers the literature review on related researches and how other countries handled the issues of solid waste management.

Chapter three gives the background of the study area and its current status. It also explores the implication of existing legal and institutional framework in respect to solid waste management in urban areas.

Chapter four deals with data findings and analysis while chapter five covers conclusion and recommendations.

1.2 Problem Statement

The problems surrounding solid waste management is not unique to any part of the world. Kirov (1971) affirms that it is indeed a problem, of worldwide concern. The problem is worse in urban areas in Africa and in other developing countries where it is a major threat to public health and to the environment. In Kenya, the management of solid waste in urban areas has often received minimum attention or none at all. The evidence is heaps of stinking garbage especially in residential areas.

Largely because solid waste management is a costly service to ensure, and which typically absorbs a large proportion of a municipal city operating budget, the service is often inadequate in Nairobi, where large parts of the city receive irregular attention or none. Future demands are certainly to rise as city residents multiply and commercial, industrial and service sectors expand. It is imperative that measures towards better and effective solid waste management should be instituted to meet changing needs (Liyai, 1988).

As stated above, the problem of solid waste management is acute in low- and middle-income urban residential neighborhoods. It has also been noted that the amount of waste generated in these areas continues to increase not only in terms of kilograms per person per day but also in volume. Moreover, the volume of waste is increasing at an even greater rate of about 25 percent per annum, thus posing an even a greater problem in its management as the population in these already densely populated areas grew exponentially. The population growth rate exceeded the budgetary capacity of local authorities to adequately provide housing, water, roads, waste disposal and other services. These issues characterized the study area, which is a low-income residential neighborhood with high population densities.

Solid waste management is associated with the control of generation, storage, collection, transfer and disposal of solid wastes in a manner that is in accordance with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations and which is also responsive to public attitudes. This ideal waste control, (Liyai, 1988) adds, involves all administrative, financial, legal, planning and engineering functions to help surmount a whole spectrum of problems encountered in solid waste management.

Increases in the volume of urban waste are due principally to increasingly affluent lifestyles, rather than urban growth. During the latter part of 1990's annual waste production ranged between 300-800 kg per person in the more developed countries and a little less than 200 kg per person in the least developed countries, though the figures were rising where the standard of living has risen markedly. The composition of waste differs between high- and low income countries with more of the former effecting both recycling and commercial reuse of solid waste. Further in developing countries, "The hazardous household waste and wastes from small industries and medical clinics also continues to increase" (World of Urban Cities – Habitat, 2003).

Largely due to the high cost of municipal solid waste services, service coverage in cities in developing countries is low. As a result, uncontrolled dumping is widespread with resulting environmental problems. One solution commonly proposed is to enlist the services of the private sector in the belief that service efficiency and coverage would improve and environmental protection ensured.

The level of private participation and means to achieve its effectiveness received priority in joint initiative of the Swiss Agency for Development and Cooperation (SDC), the Urban Management Program (UMP), the World Bank and the Swiss Centre for Development

Cooperation in Technology and Management (SKAT), along with a host of other collaborating external and local support and organizations.

Success in private sector participation has been noted in Kenya and other parts of the world. In one such good example in Hong Kong provided an incentive for many Asian countries who sought to replicate the initiative. The public-private partnership programme initiated by the government of Hong Kong and repeated elsewhere, entailed the government undertaking to construct and profitably operate a local solid waste transfer station, in an exercise dubbed design, build, transfer ownership and operate (DBTO). Ownership of the station was transferred to interested parties upon the completion of construction and one year of satisfactory start-up operations.

In Kenya much research has been done to investigate how solid waste management can be improved. Syagga (1992) supports the involvement of the community sector as an effective way of increasing access of the poor to urban services, which in this respect, is waste disposal. In Nairobi, neighborhood or community-based organizations, charities and other associations are already providing many of the relevant services where municipal services have failed or are unpredictable. Syagga further notes that the involvement of women is also crucial to the success of community-based solid waste management.

Questions arise about the attitude of women towards solid waste issues, their general awareness, their concerns for neighborhood cleanliness, and how they view perceived their role in solid waste management as a business. Women are the generators of most of the household solid waste in Nairobi, and therefore their involvement in waste management as a duty or a profitable undertaking, would be a

major entry to community-based solid waste management (Syagga, 1992).

This study contributes to the research on problems surrounding solid waste collection methods in Nairobi (Liyai, 1999) by further investigating the problem associated with space-use within the living areas which is a contributing factors in solid waste management. This study notes that waste processing plants would be a possible domestic waste disposal method in Nairobi (Brown and Vicker, 1988) but suggest all process of waste generation from source to disposal need to be investigated in the search for better solid waste management strategies. The study also consider the research on the problem of waste management in Nairobi and Dandora in particular (Mwaura 1991), and proposes that the aspect of densification (which is detailed in this study) could significantly contribute in Mwaura's and other studies on solid waste management.

This study therefore gave a particular attention to an investigation on the effect the concentration of people on solid waste management in an urban residential neighborhood, in this case, Kawangware. The following issues were considered in the investigation:

- a) The relationship between densification and inadequate solid waste management.
- b) How plots size contributes towards inadequate solid waste management.
- c) The issue of tenureship and its contribution towards inadequate solid waste management.
- d) How inadequate planning had contributed towards inadequate solid waste management in the study area.

1.2.1 Research Questions

The research questions that the study sought to answer were as follows:

- a) What relationship population densification had towards solid waste management;
- b) How had the plot size in relation to ground covered by buildings contributed towards solid waste management;
- c) How tenureship contribute towards solid waste management; and
- d) How policy guidelines and strategies or lack of them contributed towards solid waste management in Kawangware neighborhood.

1.2.2 Objectives of the Study

There were a number of objectives of this study as listed below, with the main goal being to recommend strategies and policy towards sustainable solid waste management in the urban residential neighbourhood of Kawangware:

- a) To investigate the relationship between densification and solid waste management.
- b) To investigate the relationship between size of plots and solid waste management.
- c) To examine the relationship between tenureship and its contribution towards solid waste management.
- d) To propose policy guidelines and strategies towards improvement of solid waste management.

The study adhered to the principles of sustainable waste management strategies which according to (Schubeler, 1996) include: maximization of waste generation; maximization of waste recycling; and ensuring the safe and environmentally sound disposal of waste

1.2.3 Hypothesis

Densification of residential space never in itself signifies inadequate solid waste management in urban residential neighbourhood although it may, with other factors, contribute to that inadequacy.

1.3 Justification and Significant of the Study

Kawangware neighbourhood was among the urban residential neighbourhoods that were growing rapidly with the phenomenal urbanization increase in Nairobi. Services provided were deteriorating as a result as did other urban social-economic problems such as increased crime rate, poverty, diseases and pollution. The neighbourhood provided affordable houses for many low- and middle-income earners. The houses ranged from numerous unplanned structures with bare necessity to a growing number of modern buildings. An improvement in infrastructural services like solid waste management would help in making Kawangware a better neighborhood in which to live. The study sought to offer a starting point in the quest for better handling of waste in Kawangware and suchlike neighbourhoods, through an investigation of the relationship between densification and inadequate methods of solid waste management.

The rising demand for housing and space for economic activities within Kawangware residential neighborhood had given added incentive for land owners to try meeting the demand with supply through the construction of mushrooming mixed structures for the increasing population. Increased number of inhabitants meant the generation of more waste and related problems unless measures are taken to address the problem. At the same time, there appeared to be a stiff competition for space between residential and economic functions, in which business appeared to winning as informal businesses 'popped up at every next residential structure in

Kawangware. That also meant that more people were 'squeezing' into the same land for these purposes and consequently generating more solid waste. The study however found the state of affairs in Kawangware was not hopeless as there was still, for example, some open spaces where planning code could be enforced in any new developments. Adherence to planning regulations ensures that facilities for such services as solid waste management are provided within developments and therefore contribute in facilitating better solid waste handling and cleanliness in the neighbourhood.

Further, the study found that the local authority had increased capacity to act against uncontrolled commercial and residential developments that are taking more than their authorized land in disregard for spaces provided for such other services as passageways, sewerage and waste disposal. Such municipal intervention would also help in improving solid waste management in Kawangware.

Government's plan unveiled towards the end of the first decade of the century to create administrative boroughs for Nairobi city, offered the basis for a deeper understanding and devolved funding of the service provision in such areas as waste management, with the main aim to improve the services. This final goal of improved services corresponded with the broad aim of this study which was also to contribute towards improved services especially in respect to municipal solid waste management.

With Nairobi River flowing next to Kawangware, the effects of household/solid waste pollution on the natural stream were explicitly evident. The river was seriously polluted with solid waste from residential areas of Kawangware and other upstream localities. Scholars had decried how uncontrolled settlements had been set just next to the river and also about the high level of household waste that was being emptied into the water. The laudable effort to clean Nairobi

River further down-town, towards the end of the decade appeared to have received little attention in city neighbourhoods such as Kawangware. A better understand of the root cause of the problem was needed to reduce the menace.

The government was involving local communities, schools and other institutions in a multi-sectoral environmental awareness creation programme through *barazas* and seminars. That campaign involved tree-planting and site clean-up to improve the environment. These activities came along with increasing societal preference for better environment and environmental practices. This eventually led to the enactment of the Environmental Management and Coordination Act (1999) whose effect was increasingly being felt virtually in all aspect of societal endeavours (Ngugi, 2007).

The Act established the National Environmental Management Authority (NEMA), which *inter alia* requires all developments with significant impacts to the environment, to have a prior impact assessment approval as explained further in chapter three.

The significance of the study lay in its search for ways to tackle haphazard waste disposal through an environmentally compliant solid waste management for the benefit of all stakeholders. Among the key stakeholders to benefit from the provision of better solid waste management and consequent cleanliness were households, communities, the local government, the central government, non-governmental organizations and businesses with a stake in better solid waste management.

1.4 Scope of the Study

The study restricted itself to household waste within households in Kawangware residential neighbourhood, which comprised the following residential clusters:

- a) Kawangware village
- b) Kanungaga village
- c) Coast village
- d) Muslim village and
- e) Gatina village

1.5 Limitations to the Study

Time taken on the field was too short for the collection of all the necessary data, e.g. data on actual assessment of the amount of waste generated in the area per day. For the same reason, building plans on all individual plots could not be obtained, hence the use of a few selected cases to help in explaining densification within the plots in relation to the space left open for solid waste handling.

Time limit also meant the activities investigated for solid waste management were in households and some commercial premises while there were other activities like educational and training institutions that needed investigating. There was praiseworthy urban agriculture and informal agricultural activities next to polluted rivers or in which pigs, chicken, goats and cattle entirely depended on scavenging in rotting garbage heaps, ingesting poisons residues, which was in turn passed on to unsuspecting consumers who are exposed to a variety of health hazards. There were formal businesses in licensed shops and informal businesses on the roadside, on narrow alleys, etc., or well established business which however operated outside areas allowed in zoning regulations. All the above activities add to the urban waste-

load that was worth assessing but could not all be investigated because of the aforementioned limitation.

Limited time also meant minimum time was given for the collection of sufficient secondary data from libraries, for example, while the existing researches lacked comprehensive data for solid waste management. Collection of data through questionnaire was hampered by reluctance to cooperate among some of the residents targeted for interview. At some homesteads, landlords declined to give information, alleging that local authority agents would use their responses to harass them. The study was also limited to the meager funding that was available.

1.6 Assumptions of the Study

- a) Solid waste management will continue to be a major challenge in the management of urban areas especially in the developing countries as long as intensification within residential areas continues without proper planning.
- b) Waste disposal would continue to be a major problem within residential neighborhoods in absence of a proper government/legal control in solid waste management.

1.7 Methodology

The methodology involved data gathering through door-to-door interviews with heads of sampled household, photographing of relevant images, random survey of homesteads, businesses and the open spaces; and data analysis in relation to solid waste management.

1.7.1 Reconnaissance Survey

Reconnaissance survey confirmed that the area could be studied by grouping clusters according to their similarities which resulted with three distinct clusters (Map3.2, chapter three). Cluster A comprised Kawangware, Coast, Msalaba which are sandwiched between Naivasha road and Gitanga road and route 46 and part of Muslim road. Cluster B comprised Muslim village, Kanungaga, Gatina which are between Nairobi River and Musa Gitau road while Cluster C comprised Kamitha, Kabiro and Congo area.

The study investigated the distribution of built-up areas (compound), the number and sizes of plots, the area occupied by the houses in relation to the remaining open spaces, how each household managed its waste and how the overall group within the compound managed its waste.

1.7.2 Data Collection Instrument

The instruments for data collection were observations (of necessary details that did not need questionnaires or interviews to understand), questionnaires (for standard data) and informal discussions which were held where it was not possible to obtain information in any other way.

1.7.3 Data Collection Techniques

(i) Primary Data

Personal Observations

Primary data was gathered through direct observation at various activities within each plot or compound in order to verify and comprehend the sources of solid waste generated, storage and disposal.

Questionnaire

Questionnaires were prepared and distributed to help in obtaining information or data that could help explain reasons behind inadequate solid waste management in the study area. Some of the questions in the questionnaire asked how one handled the waste within his/her territory (household or compound). This method also helped in getting closer to the respondents, hence enhancing the ability to understand the tenants' and owner's attitude to solid waste management and how they viewed each other in relation to waste handling for the benefit of the study.

Interviews and Informal Discussions

Organized interviews and informal discussions were held with household and business owners to help in filling in any gaps in information that could not be captured well in the questionnaires. Impromptu discussions and informal interviews were also held with small organized groups of residents who could not be reached with questionnaires but had valuable information for the study.

(ii) Secondary Data

Secondary data was mainly obtained from library material on past research on municipal solid waste management in Kenya and other countries and from government documents on policy issues on solid waste management in urban area.

1.7.3 Sampling

Kawangware neighbourhood comprises three major villages namely Kawangware, Kamitha, and Gatina. This three neighbourhoods guided the author in characterizing them as study clusters A,B and C as the clusters have independent identities and virtually cover the entire Kawangware neighbourhood (Map 3.2).

a study of individual clusters confirmed their distinct characteristics in terms of house types, access, plot sizes, economic status, nature of upcoming developments, population densities, provision of infrastructure like sewer and waste collection. Random sampling was used for each cluster selected for study interviews because it ensures that every member of the population had an equal chance of being included in the sample. Due to time factor, the study conducted interviews on 100 randomly selected households within each cluster. Therefore, 300 households in three clusters were selected for study interviews (See appendix I) from approximately 48,000 households that are within the various compounds in three clusters that covered the whole neighbourhood.

1.7.4 Data Analysis Techniques

The collected data was subjected to a simple data analysis technique using graphs, tables, photographs and percentages with the aid of statistical package for social scientists (SPSS). A cross tabulation of the data was undertaken to examine issues related to objectives of the study of the neighborhood. The analysis of both the quantitative data collected was presented using simple frequency distribution and analytical tables while the analysis of the quantitative data collected was presented by use of maps, plans, sketches and photographs. The overall information and findings are finally interpreted and

synthesized to help in formulating proposals, policy recommendation & strategies for adequate solid waste management.

1.8 Definitions of Terms and Concepts.

Densification: 'Density' in Lynch and Rodwins view, is expressed either as a single measure or range of measures that have to do with compaction of people, facilities, and vehicles per unit of space (see also density, which according New York City Regulation handbook (www.nyc.gov>NYC Department of City Planning), refers to the intensity of development within a zoning district. In residence districts, density is generally measured by the maximum number of dwelling units permitted on a zoning lot. The maximum number of units is calculated by dividing the maximum residential floor area permitted on a zoning lot by the applicable factor for each zoning district.

Emission: One or more substances released to the water, air or soil in the natural environment. See also environmental release, pollution and environmental intervention.*

Environment: Surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelations. This definition extends the view from a company focus to the global system.*

Environmental Aspects: Elements of an organization's activities, products or services which can interact with the environment (ISO 14004). A significant environmental aspect is an environmental aspect which has or can have a significant environmental impact. See also environmental interventions, environmental problem.*

Environmental Effect: Any direct or indirect impingement of activities, products and services of an organization upon the environment, whether adverse or beneficial. An environmental effect is the consequence of an environmental intervention in an environmental system. See also environmental impact, environmental problem. *

Environmental Effects Evaluation: A documented evaluation of the environmental significance of the effect of an organization's activities, products and services (existing and planned) upon the environment. *

Environmental Impact: Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products or services. An environmental impact addresses an environmental problem. Also see environmental effect. *

Environmental Intervention: Exchange between the economy and the environment including resource extraction, emissions to the air, water, or soil, and aspects of land use. If resource extraction is excluded, the term used in this case is environmental release. See also emission and pollution. *

Environmental Issue: A point or matter of discussion, debate, or dispute of an organization's environmental aspects. *

Environmental Management: Those aspects of an overall management function (including planning) that determine and lead to implementation of an environmental policy. See also environmental management system. *

Environmental Problem: An environmental problem is a description of a known process within the environment or a state of the environment which has adverse effects on the sustainability of the environment including society. They include resource consumption and environmental impacts. See also environmental effects, environmental aspects.*

Intensification: This is commonly understood as a process whereby, new buildings in the cities are built at higher densities, or vacant land in urban areas is developed and high-density re-development takes place. Urban intensification is also associated with increases in the amount of activity that takes place within cities, and what increases in population density and the extent of economic and social activity.

Interested Party: Individuals or groups concerned with or affected by the environmental performance of an organization. Interested groups include those exercising statutory environmental control over an organization, local residents, an organization's investors, insurers, employees, customers and consumers, environmental interest groups and the general public.*

Neighborhood: The neighbourhood concept have been defined (Olima, (undated) as physical places and a social community, having some discrete feature by which it can be noticed from the rest. They are a limited territory within a larger urban area where people inhabit dwellings and interact socially. On the other hand, Neighbourhood associations (NAs) are local organisations through which many developing countries meet their collective and individual need especially when the state is unable to meet its social and political obligations. Kangai, (1990) defines neighborhood as a unit or a scheme of arrangement for a family life within a community.

Plot Coverage: Plot ratio is the allowable area of a development in relation to the size of the plot (see also lot coverage, which is that portion of a zoning lot which when viewed directly from above, would be covered by a building or any part of a building (New York Zoning Book www.tenant.net/other-laws/zoning/zonig02.html).

Plot Ratio: Plot coverage is the area covered by a development in relation to the size of the plot (see also, below, Open Space and Open Space Ratio as quoted from New York Zoning Regulation Book. Open space is the part of a residential zoning lot (which may include courts or yards) that is completely open and unobstructed and accessible to and usable by all persons occupying dwelling units on the zoning lot. Depending upon the district, the amount of required open space is determined by the open space ratio (described below), minimum yard regulations or by maximum lot coverage. Open Space Ratio (OSR) is the amount of open space (in square feet) required on a residential zoning lot in non-contextual districts, expressed as a percentage of the total floor area on the zoning lot. For example, if a building with 20,000 square feet of floor area has an OSR of 20; 4,000 square feet of open space would be required on the zoning lot ($0.20 \times 20,000$).... Residual discharges of emissions to the air or water following application of emission control devices (EPA 1993b). See also environmental release and environmental intervention.*

Pollution: Pollution is also described as an act of making natural resources dirty or impure by adding harmful and unpleasant substances. It is any direct or indirect alterations of the physical thermal chemical biological or radioactive proportions of any part of the environment by discharging, emitting or depositing waste as they affect any beneficial use adversely to cause condition which is hazardous or potentially hazardous to public health safety or welfare and also to animals, birds and plant.

Pollution Prevention: The use of processes, practices, methods or products that avoid, reduce or control pollution. These may include recycling, treatment, process changes, control mechanisms, efficient use of resources and material substitution.*

Recycling: The process of reusing material for the production of new goods or services on the same quality level. If the quality of the goods and services produced with recycled material is lower, then the process is known as downcycling. See also close-loop recycling and open-loop recycling.*

Solid Waste: Solid products or materials disposed of in landfills, incinerated or composted. See also waste.*

Waste: An output with no marketable value that is discharged to the environment. Normally the term "waste" refers to solid or liquid materials.*

Solid waste - classification

Garbage: decomposable waste from food.

Rubbish: non decomposable waste either combustible (such as paper, wood, and cloth) or non combustible, such as metal glass and ceramics and ashes residues of the combustion of solid fuels.

Municipal Solid Waste: Schubeller (1996) defines municipal solid waste to include refuse from household non-hazardous solid (excluding sludge or semi solid) waste from industrial commercial and industrial establishment (including non-pathogenic waste from hospitals, market-yard waste and street sweepings).

Municipal Solid Waste Management: Municipal solid waste management involves planning, forecasting, organizing and execution of the functions of collection transfer, treatment, recycling hence recovery and disposal of solid waste (Schubeller, 1996).

Solid Waste Disposal: Disposal of ordinary, unwanted and occasionally hazardous solid and semi-solid materials, resulting from human and animal activities.

Disposal Methods: Ways or means through which solid waste is disposed these include: landfill; incineration of combustible solid waste at established incinerators; composting of decomposable domestic and agricultural waste at reserved grounds; recycling of most non-decomposable waste; resource recovery of e.g., iron, aluminum and copper from separated waste; and hazardous waste disposal of e.g. poisonous chemicals at secluded sealable dumps.

Resources: Materials found in the environment that can be extracted from the environment in an economic process. There are abiotic resources (non-renewable) and biotic resources (renewable).*

Reuse: The additional use of a component, part, or product after it has been removed from a clearly defined service cycle. Reuse does not include reformation. However, cleaning, repair, or refurbishing may be done between uses.*

Urban Space: This space is geometrically bounded by a variety of elevations. It is usually the clear rigidity of its geometrical characteristic and aesthetic qualities, which allows us consciously to perceive external space as urban space (Krier R).

*Reference:

<http://www.gdrc.org/uem/ait-terms.html>

LITERATURE REVIEW

Introduction

The rapid growth of impoverished informal settlements in South Africa, of which KwaZulu-Natal is one of the poorest provinces, has led to a number of environmental and social problems. These high population density, informal settlements often lack basic services such as roads, drainage, and refuse collection, leading to serious waste management problems. The high density of these settlements may be difficult to manage and maintain, especially in these localities. These informal settlements are often situated in areas with steep slopes, which might have been previously forested. These conditions lead to soil erosion and landslides, which are a major concern for the residents. The lack of proper waste management in these areas leads to the accumulation of waste, which might have been previously forested. These conditions lead to soil erosion and landslides, which are a major concern for the residents. The lack of proper waste management in these areas leads to the accumulation of waste, which might have been previously forested. These conditions lead to soil erosion and landslides, which are a major concern for the residents.

CHAPTER TWO:

LITERATURE REVIEW

2.0 Introductions

The rapid growth of impoverished informal settlements in Kenya's urban areas, of which Kawangware is one of the, present a particular challenge to MSWM. Their high population density, poverty and inadequate infrastructural services such as roads, drains and sanitary facilities, often exacerbate waste management problems. The access of collection vehicles or pushcarts may be difficult where roads and footpaths are undeveloped as they are in these localities. Existing drains are often clogged with waste which might have been contaminated with faecal matter. These conditions lead to proliferation of vermin and disease vectors and consequent increase in environmental and health risks. An understanding of the issue involved is necessarily for the challenges posed by the settlements to be overcome.

Solid waste management encompasses the following functions:

- i. Collection of solid waste
- ii. Transfer
- iii. Treatment
- iv. Recycling
- v. Resource recovery and
- vi. Solid waste disposal, especially as concerns solid waste from urban households, is characterized by a number of problems such as inadequate collection and disposal service, as has been highlighted in the chapter one.

This study as mentioned in chapter one, investigate the effects of the concentration of people on solid waste management in urban residential area, in this case Kawangware neighbourhood, with the main goal being to contribute to deeper understanding of challenges posed by solid waste management in Nairobi.

Literature review on MSWM in Kenya largely acknowledge the need for this kind of understanding. Korir (1971) concludes that the management of solid waste in Kenya often receive minimum attention while Liyai (1988) calls for better and effective waste management. This chapter highlights literature on how MSWM has been handled in developing country or on what scholars and authorities state should be done towards tackling the challenges posed.

2.1 Global View on Waste in Urban Areas

2.1.1 Waste Handling as a Growing Problem

Increase in the volume of urban waste partly due to increasingly affluent lifestyles, rather than mere urban growth. Municipal solid waste production therefore continues to grow both in per capita and in overall terms. In 1997, waste production in Rio de Janeiro, Brazil, was 8,042 tonnes/day compared to 6,200 tonnes/day in 1994, despite the fact that population growth during that period was practically zero. In Norway, waste production increased by three percent per annum between 1992 and 1996, while in the USA the figure was 4.5 percent per annum for a similar period while population growth rate was negligible.

During the latter part of the 1990's, annual waste production ranged from 300-800 kg per person in the more developed countries to less than 200kg per person in the least developed countries. Furthermore,

the composition of waste differed between high and low income regions with waste recycling and commercial re-use being a feature more common in developed countries than in third world nations where the management of increased hazardous and household waste and waste from small industries and medical facilities is a growing problem.

2.1.2 Increasing Waste Handling Costs

Municipal authorities often spend between 20 and 30 percent of their budgets on cleaning and waste disposal, with around 70 percent going to transportation costs. These cost increase are exacerbated by poor garbage vehicle routing and inadequate maintenance. Increasing land prices had made availability of adequate or suitable disposal sites more difficult and costly to acquire. Furthermore, long haulage distances significantly reduced profits for private waste management companies.

Municipal authorities had become aware of the high costs incurred through inefficient collection and disposal of solid waste, and were seeking more efficient options. More solid waste recycling and incineration technologies increasingly being available to municipalities and, consequently, there was progress in formal solid waste disposal in many countries.

2.1.3 Local and Appropriate Technologies

Despite many good practices from around the world, ineffective solid waste collection and disposal practices still existed in many developing countries. Donor-provided equipment was often inappropriate to the nature of the waste handling, while collection vehicles were frequently ill-suited to extremes in climate and roads conditions, resulting in a large proportion of vehicles being out of use

for most of the time. Poor handling and lack of maintenance of equipment and vehicles was a major cause of breakdowns. For example, Harare, Zimbabwe, reported in 1999 that only 7 of its fleet of 90 garbage trucks were on the road due to the above factors. However, efficient solid waste collection and disposal equipment are increasingly being produced in many developing countries, through locally developed technologies. The equipments are expected to ease problems in the collection and disposal of solid waste in these countries.

2.1.4 Private Service Waste Disposal Provider.

Although the role of the small-scale private waste management sector was often underrated, it could play an important role in a city's overall waste management strategy if it was given a chance and incentive. Privatization contracts and legislation should, for example be flexible enough to permit the entry of small-scale service providers particularly in lower income areas. In New Delhi, 100,000-150,000 rag pickers collected 12-15 percent of the 6,000 tonnes of waste generated daily by the end of the first decade. Rationalization of waste collection, however, would be insufficient without enhancing sanitary disposal capacities, in the form of sanitary landfill sites, recycling and incineration plants.

2.1.5 Waste Recycling and Reuse

As much as 70 percent of urban solid waste is inorganic waste material in developing regions. Recycling not only avails reclaimable materials for profitable re-use but also helps in reducing demand for valuable and scarce landfill space. As for inorganic and plastic waste, its disposal at landfills greatly increases greenhouse gas emissions. In cities where its use in agriculture is a possibility, composting would be a sensible option. Significant technological advances in recycling

have been made to allow for large scale recycled of materials of high standard, e.g., paper plastics. Strict waste disposal regulations in many developed nation place limits on the degree of waste disposal. These regulations limits include: a total ban on land filing of biodegradable waste; a ban on landfill of paper, card and putrescent waste from municipal sources; restrictions on the tonnage disposed at a particular landfill; permits for disposal of biodegradable waste; and increased the landfill tax on disposal of biodegradable material.

2.1.6 National and Local policy on Solid waste Management

Local authorities often see solid waste management as a poor cousin of other basic services, because they can barely recover operational costs. There is an urgent need to increase awareness of the importance of solid waste management and its contribution to a healthy living environment. National and local governments should promote public awareness on the issue and encourage waste producers to take more responsibility for treatment and disposal.

An efficient urban solid waste management service should have public, private and community involvement, and allow the use of local service providers. Indeed, informal sector waste recycling in developing countries needs more government support. Small-scale waste recycling initiatives provide much-needed income for the urban poor. Although many countries are undertaking recycling initiatives, too little attention is paid to waste minimization. A large source of waste in highly industrialized countries is the marketing and packaging industries. Waste minimization in these industries could have significantly positive impacts, including huge saving from reduced need for landfills, collection vehicles and equipment.

However, such waste minimization and high level of waste recycling, re-use and disposal of organic waste would require coordinated effort

and proper monitoring and evaluation by parties and authorities concerned. Suitable monitoring and evaluation indicators that had been considered by European governments for incorporation in national legislation include:

- i. Municipal recovery rates;
- ii. Household recycling rates;
- iii. Household waste composted; and
- iv. Home composting participation rates.

Proper land filling management requires demonstrating how landfills taxes and other such economic instruments can help local authorities maintain stricter environmental standards. Solid waste management equipment producers need to ensure that they produce equipment suited for the differing needs of cities and local authorities around the world. Information on good practices from the informal solid waste sector should be factored in the management strategies of cities.

2.2 Overview of Solid Waste Management in Developing Countries

Solid waste management is becoming a major public health and environmental concern in urban areas of many developing countries. In most African countries, poor waste management poses a threat to human health and to the environment. The public sector in these countries is unable to deliver waste disposal services effectively and regulations to allow private participation are nonexistent or insufficient where they exist. Illegal dumping of domestic and industrial waste therefore becomes a common practice. Solid waste management appears to be a matter of low priority in these countries as only limited funds are committed for the service. Inadequate funding for solid waste management results with poor service delivery, degraded environment and a health hazard. The problem is

acute at the local government level where the local taxation system is inadequately developed and, therefore financing for public services, including solid waste management, is weak.

Improper solid waste management leads to adverse environmental impacts such as, pollution of the air and water and the generation of greenhouse gases from burning landfills. Other adverse impacts include health and safety problems such as diseases spread by insects and rodents attracted by garbage heaps and diseases associated with different forms and pollution. Municipal (or local) authorities charged with responsibility of providing municipal solid waste management services (together with other municipal services) have found it increasingly difficult to adequately play their role. The difficulty has been aggravated by lack of effective legislation, inadequate funds and services and inability of municipal authorities to invest in cost-efficient service delivery. Changing lifestyles such as use of canned soft drinks, mobile phones, and disposable diapers (movement towards a "consumer society" in general), moreover, will pose special waste management challenges, as waste management systems in developing countries are incapable of frequent adjustment to match these lifestyle changes.

Cities in both developed and developing countries generally spend less than 0.5 per cent of their per capita gross national product (GNP) on urban waste services, which covers only about one-third of overall cost (World Bank, 1999). The responsibility over solid waste collection and disposal is thus well beyond the capacity of municipal governments. More than 80 per cent of the total waste management costs in low-income countries are collection costs (World Bank, 1999). In Latin America the cost of waste collection was about 46 per cent of the total municipal solid waste management cost. Cost recovery in SWM service is difficult because, even though there is some willingness to pay for waste collection service, there is little

such willingness to pay for waste disposal. Traditionally, therefore, many municipal authorities have financed the services through general revenues or attempted to charge for the service through inefficient property tax. Owing to the willingness of many urban dwellers to pay "whatever" for garbage to be cleared from their homes, enterprising garbage collectors have seized the opportunity to exploit the potential offered by the gap in public waste management. In addition, limited economies of scale and ease of entry and exit in waste collection imply that competition can keep the price of the private service competitive.

The upshot is however that an increasing proportion of urban dwellers in developing countries, particularly the urban poor, will lack access to municipal solid waste management services and, consequently, suffer from pollution-related environmental and health problems. There have been ways of dealing with or, at least, mitigating this problem through, for example, financial incentives that are explained in the next few paragraphs

While waste control laws and regulations are generally termed as 'command and control' instruments (CACs), and are the most prevalent ingredients of solid waste management, interest in the use of what is called economic instruments (EIs) is growing. Whereas CACs prescribe the standards to be complied to and what, how, when, where and how much to produce, consume, emit and clean-up, EIs are much more flexible and non-prescriptive over actions required. They allow economic agents to pragmatically innovate ways of cost-effectively complying with the minimum specified standards for waste disposal.

The CAC approach is designed in such a way that the motivation for agents to comply comes from fear of fines and penalties. For this disincentive to work, however, vigilance and enforcement capacity must be adequate. Most developing countries lack such capacity and,

generally, tend to have a variety of problems with their CAC approaches. These problems include: inadequate detail in law; lack of inspection staff; lack of transport; inadequate empowerment of inspectors to ticket offenders; political intervention to quash tickets; disinterest by the courts for these minor offences; inadequate courts to deal with offenders; inadequate police coverage to enable arrests and follow-up through the court system and insignificant and therefore non-detering fines and penalties (IDB, 2003).

Where there are such weaknesses in performance, monitoring and enforcement capacity, economic instruments offer a viable alternative (IDB, 2003). The 1992 Rio Declaration on Environment and Development endorsed the use of EIs for the achievement of sustainable development. In solid waste management, EIs promise to improve the delivery of services and thus lessen the solid waste problem. The main strength of EIs as policy instruments is the potency of incentives or disincentives in making polluters go beyond what is required by laws and regulations.

Clearly, therefore, the success of EIs is dependent on successfully implementing regulatory controls. For EIs to work effectively, the regulatory standards need to be clear and the compliance enforcement capacity adequate. In a given country, the harmonious balance between CACs and EIs depends on local conditions and preferences. In many developing countries, for example, where inspection and enforcement resources are limited, political interferences may lead to inequitable compliance requirements. However, EIs need to be designed for such countries even for modest standards of performance because of their potential benefit.

2.3 Overview of Solid Waste Management in Nairobi

Nairobi Metro 2030, (2008) paints a bright future for the growth of the city and its service delivery in its Metropolitan Plan. These services include disposal of waste for which it projects that solid waste generation of a little over half a million tonnes in 2010 would increase to 1.8 million tonnes by 2030. It points to the need to commit funds and do what is necessary to ensure better waste management for the present and for the future, given that poor "land use planning, poor service delivery and attendant urban poverty" continue to be some of the obstacles to surmount. Mediocre municipal waste disposal service delivery in Nairobi had seen mushrooming private waste collectors. Some of them have dubious credentials might be among those who dumped waste in forests and rivers. Although conditions were changing gradually as the local authority sought to gradually regain control especially in waste disposal, poor neighborhood remained without service and saw no 'light at the end of the tunnel'.

That is why effort from any quotas, to provide the waste disposal service in such neighbourhoods is welcome to the residents and well well-wishers. Neighbourhood-supported waste management schemes in poor areas of Kenya gained impetus in 1987 when a sports association, the Mathare Youth Sports Association (MYSA) combined its sports activities with community self-help service. The community service was given in lieu of sports fees, which the youth group had to pay the Nairobi City Council (NCC) but could not afford. Clean-ups were carried out once a week in the low-income settlement Mathare. These involve garbage collection and clearing of drainage ditches. The youths were aided in that weekly work by NCC, who provided support staff and equipment. Scandinavian donor agencies also assisted the group by providing the salary for a coordinator and money for equipment.

Earlier in 1992, Nairobi residents had formed a so called 'Coalition for a Clean-up Nairobi (CUN)' campaign. The coalition was interested in participating in waste reduction and composting but needed support. NCC initially helped coalition by providing equipment but the coalition collapsed, as the NCC ended its support. It has been found that success in waste management for environmental purposes in Kenya depends considerably, on motivational factors such as sports in the case of MYSA. In the Clean Up Nairobi campaign there was no incentive for people to continue, particularly after the Nairobi City Council interest ebbed.

Local NGOs had been active especially in the low- and middle income neighbourhoods although their activities received little publicity. Among the notable NGOs cited in the study are the Uvumbuzi Club, the Foundation for Sustainable Development in Africa (FSDA) and the Undugu Society of Kenya. The Uvumbuzi Club, which had a sizeable membership, had four programme areas: environmental conservation and fundraising activities; promoting non-motorized transport; organizing trips to areas of environmental interest; and providing members with material on environment issues. As part of its conservation programme, it started a "Garbage is Money" campaign in 1992 when five groups were involved in this campaign initially. Uvumbuzi assisted the other groups in transporting and marketing compost from decomposable waste.

The Foundation for Sustainable Development in Africa was independent of donor funding as it operated as a commercial entity. As one of its many activities, it trained self-help groups in waste composting and had an extension worker visiting the groups every two weeks. It assisted in packaging and marketing the compost whenever possible. The Undugu Society of Kenya's focus was on rehabilitation of street children. It became involved in the composting efforts of Uvumbuzi club and FSDA because it wanted to promote an integrated

approach to environmental problems through its twin programme on clean environment (particularly through waste recycling) and on food security (mainly urban agriculture). Two other groups assisted by the society were in Kibera, where one group carried out urban agriculture at a farm along the edge of Kibera neighbourhood. The other group, Kinyango had a similar farm further away. Both group made compost for use in their farms and for sale.

Although various stakeholders had generally been cooperating, their degree of commitment differed. The public sector, namely the city council, gave its initial support, for example initially to MYSA, but eventually stopped it. That was despite the fact that part of the support it was giving was towards the services which any local authority is expected to give. The situation was not helped by City Hall's apparent conflict of interest: the groups operated in informal settlements that were often targets of forceful eviction to give way for 'authorized land-use'.

Local NGOs' involvement with the groups was mainly in the provision of basic start-up assistance and training in waste management techniques as they had strict financial limits on how much help they can provide. Women dominated CBOs faced the same problems. Thus both the NGOs and CBOs were handicapped when it came to expanding the capacity of composting groups and in helping in the marketing of compost. However, some composting groups which started with heavy dependence on NGO support were later to grow and become largely self-reliant despite the help they received from time to time.

It should be noted that although only a few local NGOs were previously concerned with waste related activities, perhaps because waste disposal was considered an issue of little priority by most organizations, that view was changing, as more groups and NGOs

enter the scene. Private participation was therefore viewed as an opportunity to provide service to the society, not a panacea. Important questions to be asked are whether and how to involve the private sector in provision of municipal solid waste services. These questions received attention in a joint initiative of the Swiss Agency for Development and Co-operation (SDC) the Urban Management Programme (UMP) the World Bank and the Swiss Center for Development (SICA) along with a host of other collaborating external support agencies, professional associations and non governmental organizations.

2.4 Solid Waste Management Problem/Best Practices

The rapidly growing informal low-income settlements in urban areas present a particular challenge to MSWM. Their high population density, poverty and inadequate infrastructural services such as roads, drains and sanitary facilities, often exacerbate waste management problems. Studies show that the problems could be overcome over time through concerted efforts of the stakeholders.

2.4.1 Public Attitude

Waste generated is also conditioned by people's attitudes. The waste generated by a population is primarily a function of the public consumption patterns and thus of their socio-economic characteristics. Waste generation is conditioned to a large degree by people's attitude towards waste, their patterns of material use and waste handling, their interest in waste reduction and minimization and the degree to which they separate wastes and refrain from indiscriminate dumping and littering. There is what is termed in waste handling jargon, the selfish NIMBY (Not-in-my backyard) attitude which require overcoming through public understanding, communication and participation.

Public understanding and participation is also important in the development and use of large centralized facilities such as waste transfer stations and landfill sites. While particular residents may understand the need for such facilities, they would rather have them located elsewhere. This is the typical 'not in my backyard' attitude. Overcoming the attitude requires public appreciation of the convenience provided by such a waste management facility. This means there is a need for effective communication to ensure that the public is educated on the need for such a facility and its importance in waste management and cleanliness in their area. Public education should also appeal to their participation.

2.4.2 User Co-operation in Municipal Waste Collection

Even where waste collection services are provided by municipal authorities, user co-operation is also essential as regards such factors as proper storage of household waste, waste generation, placement of household waste containers and discipline in the use of public collection points. Households and community participation in the proper operation and maintenance of waste collection and disposal system may be promoted by broadly conceived awareness-building programmes that also deal public health and environmental enhancement, with a focus on MSWM issues. Awareness and user-participation in MSWM would also be improved if relevant issues are incorporated in schools' education curriculum and in training programmes for CBOs, NGOs and local leaders.

2.4.3 Solid Waste Collection

Many central and local governments have often experienced monitoring problems in the collection and dumping of solid waste. Problems in high-income countries usually center on the difficulties

(and high costs) of depositing of the large quantities of waste generated by household, business and industry.

In low- income countries the problems have more to do with collection. Between a half and one third of the solid wastes generated within urban centers remain uncollected in most cities in these countries. Such wastes generally accumulate on open spaces, wasteland and streets and bring with them serious health and environmental hazards. Most of this waste is organic matter that adds greatly to water pollution as waste is swept into water bodies when it rains.

In many of the urban centers in these countries, 10-20 percent of the solid waste is collected. For example in a survey of 34 municipalities in the more developed India, more than three-fifths of the municipalities collected less than 40 percent of the wastes generated daily.

2.4.4 Cities With Inadequate Provision for MSWM - Waste Collection and Disposal

Dar es salaam, Tanzania: Some two thirds of all solid waste from both residential areas and from commercial enterprises remain uncollected.

Kinshasa, Congo: The collection of household waste is only undertaken in a few residential areas. In the rest of the city household waste is put out on the road, on illegal dumps or in storm water drains or buried on open sites.

Karachi, Pakistan: Only two fifths of the solid waste produced by households in the city is collected and transported to dump sites.

Sao Paulo, Brazil: Only 95 percent of households have a regular garbage collection service although the proportion of population received the service.

Bangkok, Thailand: By 1990s up to 80 percent of the solid waste generated was being collected.

Among many municipalities in the Southern hemisphere, solid waste collection and management often consumes as much as 20-40 percent of the municipal revenue and it often suffers more than other municipal services when budget allocations and cuts are made. The agencies responsible for collection and disposal of household wastes are often under-funded and since collection works is still under their charge in the eyes of the public, they often face public wrath for their apparent failure to deliver.

Uncollected waste or irregular collection lead to problem such as foul smell, the disease vector and pests attracted by garbage (rats, mosquitoes, flies etc and the diseases they cause), as well as clogged drainage and rivers. There are also the environmental problems caused by residents who try to get rid of their own waste, for instance, by burning it. A study of household level environmental problems in Jakarta in 1991 found that the prevalence of respiratory diseases in children and mothers was connected to a problem of uncollected garbage.

Waste as a Resource

Most waste materials can be regarded as unused resources. Therefore, sustainable waste management entails the reduction of waste in production and distribution process as well as increased reuse and recycling. Most developed countries endeavor to attain this sustainable solid waste management practices through government regulations, stakeholders' cooperation and citizen's initiatives. Some

countries in the developing world have strived to leap-frog to that level as their counterparts merely focused on improving the conventional waste control systems essentially for the collection, transportation and disposal of wastes. A clear understanding of the benefits to be obtained from waste as a resource is needed at household and other levels, for the promotion of waste recycling and reuse programmes.

Actors in Waste Separation

These actors include:

- a) Households themselves, who often keep aside some recyclables for sale or separate waste as a requirement by waste collection bodies which supply three bins to each household: one to deposit metallic wastes, e.g. tins/cans and metallic pots and other utensils; another bin is for organic waste like food left-over and papers; while the third bin holds plastics, e.g. plastic containers for e.g., salad oil, milk and chemicals, controversial plastic bags given lavishly to shoppers. Plastics form the bulk of garbage heaps where they may take years to decay and have harmful pollutants when they burn.
- b) Waste pickers who may pick from household garbage cans or pick garbage on the street or at the transfer stations or at the city dump.
- c) The staff of garbage collection trucks who look for valuable recyclables materials or other items that can be resold.
- d) Waste buyers who range in scale of their operation from itinerant buyers, through small waste purchasing enterprises to factories or business that use the waste for various purposes.
- e) Those involved in collecting, repairing and selling specific items in second hand markets.
- f) Those involved in composting of decomposable waste.

2.4.5 Minimizing Wastes

While focus on improved waste management through better ways of collection and disposal, has helped towards making many cities cleaner, there has also been a growing interest in “waste minimization”. This concept seeks to reduce waste at all points from the extraction of raw materials, their use in production, in packaging and distribution for use and disposal.

For a municipality, encouraging waste minimization among households and commercial enterprises can considerably reduce the cost of disposing of solid waste. Municipal efforts could be boosted by combining this with such incentives as recycling credits in which local authorities pays household or business for paper, glass, metal or other materials they separate and make available for collection. The authorities can also lower rates for households or reward those who generate minimal waste.

2.4.6 Examples of Countries With Best Practices.

(a) Household Solid Waste Management, Egypt:

Egypt is one of the developing countries with remarkable record in household solid waste storage, collection, separation, disposal and recovery. One Cairo-based company, Zabbaleen-garbage Collectors, collected and recycled over 600 tonnes of domestic waste a day in the first decade of the century. This was approximately one third of the waste produced by the residents of Cairo. The recycling activities focused on the production of affordable goods such as toys and combs that are especially appreciated by low-income groups. Revenues collected from these are reinvested in housing, infrastructure, basic services as well as business development. As a result of the initiative, 90 percent of the waste is sorted out and recovered for recycling on a

daily basis, and there has been overall improvement in the health of urban dwellers as a result of reinvestment of the proceedings in the construction of dispensaries. (www.Nga.org; www.bestpractices.org)

(b) Community Recycling of Household Waste by Women, Dakar, Senegal

Before the initiative started Dakar municipal services collected only 35% of the 263 cubic meters of waste produced per day. Much of the remaining garbage ended on the street. As a result, many neighbourhoods in the city had a high prevalence of typhoid and malaria. Women in the community then embarked on a waste management project to clean up urban environment through simple processes, ranging from waste collection, separating and treatment at homes for reuse and disposal as a commercial undertaking. The project created jobs for women groups especially through waste recycling and reuse. The project resulted in regular waste collection, composting of bio-degradable waste for use in urban agriculture and three-planting, recycling of metallic, plastic and paper waste for sale. Jobs were also created for youths and investment made in disease eradication by cleaning up sites where disease vector could be found (www.bestpractice.org).

(c) Mathare Youth Self-Help Slum and Environmental Clean-up Project, Kenya:

Mathare slum is among Nairobi's largest informal settlements. Uncollected garbage, contaminated water, blocked drains were major causes of dirt and diseases in the slum. The Mathare Youth Sports Association (MYSA), a self-help youth sport and community service project that started in 1987 successfully responded to residents' call for help. The group undertook to link environmental clean-up with sport. Youth football teams participate in environmental clean up projects, with its sporting activities. The group would for example, earn its team six points for its community service while a victory in

a match would earn the team three points. The points were converted into money that the group would claim from funding bodies. MYSA was able to acquire tipper trucks and tractors that periodically cleared all accumulated garbage. The association had its membership grow to 24, 000 youths, aged between 11 and 18 years. The association was run for and by the youth of the Mathare slums. Most of its elected officials and trainers were under 16 years of age (www.best.practice.org). These activities demonstrate the potential role that the youth can play in the success of MSWM.

2.5 Pollution as a Result of Solid Household Waste

Pollution is any direct or indirect alteration of the physical, thermal chemical biological or radioactive proportions on any part of the environment by discharging, emitting or depositing waste so as to affect any beneficial use adversely or to cause a condition which is hazardous or potentially hazardous to public health safety or welfare and also to animals, birds and plants. Haphazard waste handling is a potential cause of air and water pollution and causes a number of harmful effects on human, animals and other organisms and ecosystems. Effects of air and water pollution on humans include diseases, poisoning and loss of livelihood from loss of affected domestic animals, crops, pastures and forests.

Urban dwellers, particularly those living in marginalized neighbourhoods in developing countries, are the ones who are most at risk of being victims of environmental pollution-related dangers. As a way of averting the danger, major environmental focus at global and national level has been to make cities and other settlement healthy and livable for their inhabitants through pollution prevention, better planning, funding and related measures.

Pollutant levels exceeding WHO or national standards have adverse health effects ranging from loss of IQ points on children due to airborne heavy metal particles; cardiovascular and respiratory disorders due to particulates and sulphur dioxide and cancers due hydro-carbons residuals. Human activities not only accelerated local air pollution but also contributed to long term effects on ozone depletion and climate change.

Pollution control measures were minimal in the study area, as rampant and uncontrolled dumping on roads, and undesignated landfills contributed to greenhouse gas emission and unpleasant smells and smoke when the waste was destroyed by burning. Such dumping also clogged drainage and rivers and polluted underground water.

CHAPTER THREE:

BACKGROUND TO THE STUDY AREA

3.0 Introduction

The study area of Kawangware neighborhood (see Map 3.1) is located in the Western part of Nairobi and is about 12 Km from central business district. It is better known for its giant market – the Kawangware Market, of Nairobi suburbs' dilapidated markets. It has become a market of choice, because of its affordable and fresh market produce whose clients include residents from the neighbouring high-income areas and from nearby upcountry districts. Administratively, it is within Riruta location of Dagoretti constituency, which forms the western part of Nairobi city. It is among Nairobi's largest low-income neighborhoods, which include Mathare, Kangemi, Korogocho, Mukuru and Kibera which is Africa's second largest slum with 1¹/₂million inhabitants within 2-square kilometer.

Map 3.1 Kawangware Study Area in Relation to Nairobi City Centre and Other Suburbs



Source:

Ministry of lands and Housing

3.1 Geographic Location of the Study

The position of Kawangware relative to CBD is as indicated in section 3.0, while Nairobi itself is positioned at 1°17min S, 36°49min E and 1,680m above sea level. Kawangware is located next to key Naivasha Road and mid-day between CBD and the next major township of Kikuyu, which is further to the North-West (Maps 3.1 and 3.2). It is surrounded by Lavington to the east, Kangemi to the north, Rituta Satellite to the east and south.

3.2 History of Development of Kawangware

The study area of Kawangware neighbourhood is located in the western part of Nairobi and is about 12 Km from the central business district (CBD). It is within Dagoreti Constituency of Nairobi city. With independence in 1963, Dagoretti residents, in recognition of their contribution in fighting for independence, had their area exempted from taxes and from strict building and planning regulation

as a way of political concession for the Kikuyu ethnic group (Mutua, 1992). This concession prompted an influx of city workers from all parts of the city, who were seeking cheaper accommodation near the city.

This resulted with a housing shortage and Kawangware's population increase which also came with the growth of the capital city. The proximity to the CBD gave it an additional impetus for growth. Kawangware is administered through a chief and a sub-chief and has a councilor who represents the local authority. It is bounded by the high-income residential estate of Lavington, to the east; Naivasha Road and Riruta Satellite middle-class neighbourhood to the south; and Nairobi River and Kangemi mixed neighbourhood to the north.

The neighborhood is made up of several settlements including the main Kawangware village, Congo, Gatina, Kabiro, Kanungaga, Muslim village and Kamitha. The largest settlement is Kawangware proper, which according to 1999 census had a population of about 27,872 people whereas 19,733 people were scattered throughout Muslim village, Gatina, Kanungaga, Kabiro, Congo and Kamitha.

There are conflicting accounts as to the origin of the name Kawangware. According to some residents, Kawangware was named after a businessman called Ngare. However, according to Mulinge (1986), the name Kawangware in Kikuyu means the place of the Guinea Fowl. It is derived from the name of large flocks of guinea fowls, which were attracted to the area by millets plantation that used to be there.

The initial population of Kawangware was small but as Nairobi grew as the nation's tourism, commercial and industrial hub, and increased its population, Kawangware grew correspondingly, as was the case with other city neighbourhoods. This resulted with a growing need for

housing, which in turn encouraged many landowners to build rented buildings for shelter-hungry city workers. Up until a certain time, after independence, Kawangware had been almost totally occupied by indigenous Kikuyu's while many new settlers were from all other Kenya's provinces. The trend has changed over the years and rental rooms are being built constantly as the rental population increases but the occupants from outside the area form the majority among Kawangware population. The minority home-tenders and their families however, still live in their permanent houses in Kawangware, where they virtually own the entire land.

Traditionally Kawangware was a sub-urban settlement outside the Nairobi city limits. It was not until 1964 that Kawangware became part of Nairobi city. Kawangware was before that, part of Dagoreti location in Kiambu district. Dagoreti division is today part of Nairobi with Kawangware among its locations.

Before 1964 the settlement had rural characteristics with tiny mud-walled, or wooden or iron sheet houses scattered within patches of fertile farm-lands. But through the effort of private entrepreneurs (largely individual landowners) Kawangware has grown to be a more urban and relatively modern settlement with improving houses that are affordable to most low income workers, many of whom have no formal employment.

Thus, the area had been changing over time from an agricultural area to a low-income residential neighborhood. It is now a residential area for middle and low-income group intermixed with varying commercial activities. This peculiar growth of Kawangware has led to crowding within small plots, leading to over-production of solid waste, while waste control means were seriously lacking. This however called for urgent and imaginative

measures to revert the negative impacts that had already been made to the environment.

3.3 Physical Nature and Environment of Kawangware

Kawangware lies on elevated land, relative to CBD, towards higher altitudes locations of Kikuyuland. Its climate is therefore relatively cooler and wetter, which explains ample urban agriculture and surrounding by such well-wooded suburbs as Lavington, Kileleshwa.

It is generally sunny around the year, with two rainy seasons towards the beginning and the end of the year. Kawangware enjoys a network of roads, ranging from well paved tarmac to earthen roads, which offer convenient access to its various settlements, shopping centers, schools, churches, etc., and which connect it to surrounding areas. Buildings include modern high-rise residential, commercial and office blocks and a decreasing number of temporary residential structures, informal businesses sheds and kiosks. Nairobi River to the north and Naivasha Road to the west (which gives access to CBD as well as to upcountry regions) are the other main features for Kawangware (Maps 3.1 and 3.2).

Kawangware neighbourhood was estimated to have a high population of over 150,000 for its size, going by the projection that its population doubles every 10 years. Thus the population increased from 43,8115 in 1989 (Table 3.1) to 86,824 in 1999 (those were the latest official census figure by the study period as the figure for 2009 had not been released). Kawangware has a high population density of 35,033 persons per sq.km...

Its relative proximity to high -class residential and shopping suburbs of Lavington, Kileleshwa, Hurlingham, Westlands; its location on

Naivasha Road that leads to the city; and its proximity to the CBD means its population has ample marketing (it indeed has the big Kawangware market) and job opportunities. However, Kawangware shared the problem that other poor neighbourhood had, e.g. poor housing and poor municipal services (note also that Kawangware still enjoys some of the city's remaining green spaces, unlike most other similar neighbourhood (Landsat image 3.1)). Like other poor settlements around Kenya's capital, Kawangware is within a densely populated limited space. Of the total residential land in Nairobi, 5-percent comprises informal settlements accommodating about 70 percent of Nairobi's [3-4] million people. The rest of the land, representing 95 percent is home to about 30 percent of the urban population, and is developed with housing of different design and categories (Olima undated). The growth of these slums is largely a result of urbanization, poor town planning and unavailability of housing loads for low income earner.

3.4 Population and Demographic Trends for Kawangware.

Table 3.1 Population and Households Projections in Kawangware and Nairobi

		Male	Female	Total	No. of households	Land in sq. Km	Density persons sq. Km
1989	Nairobi	752,597	571,973	1,324,570	382,863	693	1,911
	Kawangware	25,290	18,525	43,815	14,882	4	10,954
1999	Nairobi	1,153,829	989,426	2,143,254	643,426	691.1	3,073
	Kawangware	47,555	39,269	86,824	29,918	4	22,164
2006	Nairobi	1,556,133	1,452,074	3,008,307	925,373	692	4,337
	Kawangware	73,989	66,443	140,132	48,777	4	35,033
2020	Nairobi	2,820,319	2,918,981	5,864,284	1,539,084	692	8,474
	Kawangware	178,158	189,019	367,177	96,696	4	91,794

Source: 1999 National Census and authors projections

The study area is approximately 4 km² and had a population of approximately 86,824 people (according to 1999 census). Currently the population at the time of the study was approximately 140,136, (through interpolation).

In 1989 population in the study area was 43,815 with a density of 10,954 persons per square Km. It doubled in 10 years whereby, in 1999 the population increased to 86,824 with a density of 22,164. If the same trend continued, the population would be about 140,132 by end of the first decade and have a density of 35,033 persons per sq.km, implying that in year 2020 the approximate population of the area will be 367,177.

This would seriously overstretched infrastructural services, like sewerage and waste control, unless the rate of improvement corresponded to that of population increase. This study restricted itself to household waste, which constitutes a significant percentage of wastes in urban areas. The study investigates how it is generated, stored, and collected within household level and how it is transported, and finally disposed by private collectors or NCC at designated landfills.

3.5 State of Land-use and Physical Development Units

Land ownership in Kawangware was mostly freehold with owners having individual title deeds.

3.5.1 Housing

Kawangware neighborhood comprised clusters of large number of concentration of houses and people in a limited area (compounds), implying it had high densities of people and houses. There were both formal and informal dwellings of differing sizes from single rooms to self-contained 2-bedroom houses or even bigger. Field survey found that a large number of the dwellings were unplanned and that more than 60% of them were not served by sewer. The overcrowding of the

houses has aggravated the problem of waste management, especially the household related waste.

3.5.2 Densities

The study established that, densities of residential houses varied from area to area within the neighborhood. Population concentration also differs from area to area.

3.5.3 Accessibility

Within the assumed cluster, accessibility also differed from area to area except for the main spine roads that were tarmac. The rest of the access roads were either muram or earthen roads. Access within the houses also differed from one area to the other, but many areas had sufficient access pathways to the residential houses especially in areas with single or fewer households. Access footpaths to residential buildings ranged from a meter in width to 1.5 m. The prevalence of narrow roads have been blamed on the landowners disregard for planning regulations on the building lines, which they 'squeezed' from either side of the allocated accesses.

3.5.4 Plot Size

Plot sizes in Kawangware study area differed from area to area. Some few large plots were of one acre or more though the trend was to have smaller plots of 1/8 acre, ¼ acre, ½ acre. Areas that were noted to have more than one acre of land are those whose owners had not subdivided their land due, for example, to family feuds, or because of complex subdivision procedures or the owners lacked documents to facilitate subdivision.

3.5.5 Settlement

Landsat Image 3.1 – Kawangware Neighbourhood



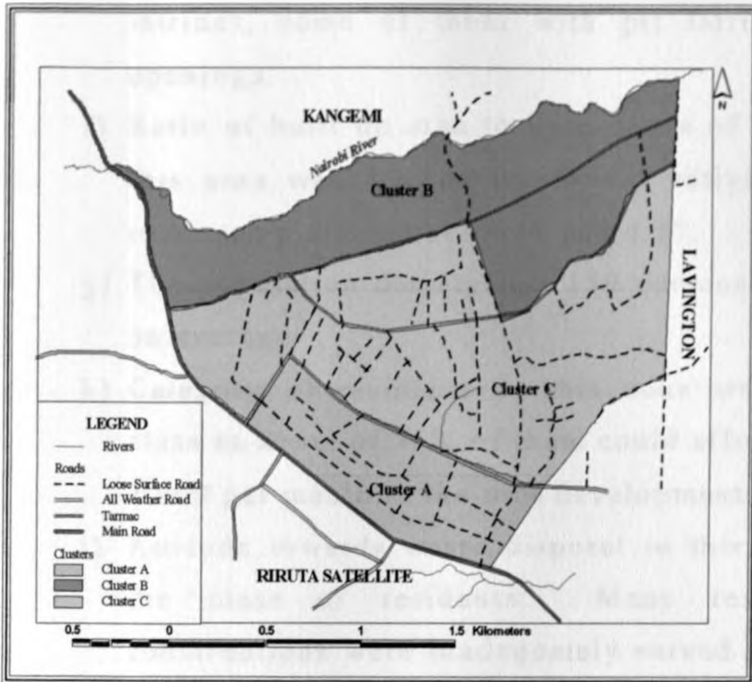
Source: Ministry of land and housing 2006

Settlement type ranged from structures that were informal (they made up over 50% of dwellings in the settlement, according to the field survey), to formal settlement where we find permanent buildings constructed with conventional construction materials. Based on the above settlement patterns, the study identified three separately defined clusters as listed below:

- a) Cluster A – main Kawangware village
- b) Cluster B – Muslim village, Kanungaga and Gatina
- c) Cluster C – Kabiro and Kamitha

Each cluster is marked on the map 3.2 below.

Map 3.2 - Kawagware Neighbourhood (clusters)



3.5.6 Characteristics of Clusters

Cluster A- The Main Kawangware Village

Field survey from this cluster made the following observations:

- About 20% of the old non-conventional buildings were rapidly being replaced by formal building constructed using conventional materials.
- 60% of plots were 1/8 of an acre with access to each plot well demarcated especially in respect to recent developments.
- Sizes of average houses differed from single rooms, double rooms to self contained 1-bedroomed and 2-bedroomed modern developments.
- Solid waste management, especially as regards disposal was poorly as heaps of largely domestic waste could be seen in open spaces (see plate 4.3).
- The available infrastructural services included sewer line, which mainly served only formal developments. There were

few informal structures which are connected to the sewer, although most of the developments were served by pit latrines, some of them with pit latrines above manholes openings.

- f) Ratio of built up area to open space of the analyzed plots in this area was 4:1. Some informal activities extended to the road, see plate number 4.16 and 4.17.
- g) The population density was 150 persons per 0.125 of an acre on average.
- h) Category of residents in this zone was above low-income class as about of 75% of them could afford rents of more than 2,000 per month in the new developments.
- i) Attitude towards waste disposal in this cluster depended on the class of residents. Many residents in informal constructions were inadequately served with sewer and other services and therefore appeared not too bothered how they got rid of waste from their structures even if they had to haul it out through the door onto the street. Residents in the formal constructions understandably showed more care as they had the service contracted private collectors.
- j) Institutions found within the cluster include a primary school, a secondary school, a public health clinic and some private clinics, a market, a bank and a number of churches.
- k) Commercial activities were mainly distributed along the main access roads.

Cluster B

Cluster B comprised Muslim village, Kanungaga and Gatina. Noticeable boundaries of this cluster are Nairobi River and the main access to the area Musa Gitau Road. The study established the following details:

- a) Fifty-seven percent of the plots were of 0.5 of an acre and more. The plot sizes were therefore relatively larger than

those found in other clusters. They were predominantly family owned, apparently as a bureaucratic procedure in sub-division had hindered processing of titles for smaller units.

- b) Seven percent of the plots were less than 0.125 of an acre depending on number of family members who shared the land.
- c) Some demarcation had been done or was underway and some owners were just waiting for titles.
- d) Fifty-percent of the houses were informal, and were generally constructed using non-conventional materials.
- e) Old structures built during the colonial period still existed as could be seen in this cluster, see plate 4.10.
- f) Concentration of buildings was noticeable in sub-clusters such as Muslim village, Kanungaga and Gatina. There are open grounds without any construction, as most owners lacked funds for development. Such open spaces were found on the hilly ground slopping towards Nairobi River.
- g) Formal constructions were taking place but at slow pace mainly along busy roads.
- h) Solid waste management in this cluster was no better, as littering was noticeable along the main access within compounds and in open grounds. Waste disposal is through burning, composting and random disposal in any open space.
- i) This area mainly housed the low-income group as confirmed from field survey (informal interview), who paid less than Ksh.500 per month per single room which in some cases is shared by more than one family.
- j) Fifty-five percent of the compounds analyzed had landlords residing in them, though in better houses than the rest.
- k) Attitude towards waste disposal like in the other two clusters was the same for 48% of tenants. Without NCC or private services, there was nothing to stop many of them disposing solid waste by their doorstep.

- l) Provision of infrastructural service in this cluster was minimal. Piped water still lacked in some compounds and tenants had to buy it from neighbours. There was no sewer and most compounds had pit latrines and conservancy tanks.
- m) Roads were earth road, which made access within plots almost impossible when it rained. At the time of the survey, the main access road serving this cluster was being graveled.
- n) Among the institutions noted in the area were a mosque, a primary school and a clinic. Drainage channels were usually clogged with waste and dirty water flowed mainly from the compounds. See plate 4.7 and 4.8.

Clusters C

Cluster C lies between cluster B and cluster A and is usually identified with Kabiru and Kamitha villages. The following observations were made:

- a) Of the 69% of informal houses, Kamitha area had the largest shares followed by Kabiro.
- b) Only 33 percent of houses in this cluster were built formally using conventional materials.
- c) Waste management in this cluster, like in other clusters was inadequate in that littering of the access road, vacant compounds, open grounds was widespread. There were however isolated cases of tenants who showed care for the waste disposal and had strived engaged private collectors.
- d) Infrastructural services provided included electricity and piped water.
- e) Tarmac road passes close the cluster and terminates at cluster C (see map 3.2).
- f) Institutions include churches, a primary school and a clinic.
- g) Some modern residential developments could be noted next to Lavington boundary. Here waste was managed fairly well, though using private collectors.

- h) Some areas due to flat terrain had smelly, waste-clogged stagnant water (see plate 12).
- i) The area neighboring cluster B had more informal structures constructed of non-conventional material.
- j) Land sizes were generally 0.25 of an acre with isolated cases of 0.5 of an acre and 1 acre land. The bigger plots were open and had few buildings and show open green areas.
- k) Concentration of buildings especially along Gitanga road (Kabiro area) was high and access to individual plots difficult.
- l) The number of households within this cluster per compound was high, with average 50 households per 0.25 of an acre, which translates to more than 200 people per 0.25 of an acre.
- m) Few compounds were connected to sewer along Gitanga road.
- n) Other activities within this cluster are commercial activities carried out by informal traders along the two main accesses Kanungaga and Macharia road.

3.6 Institutional, Legal and Financial Framework for MSWM

3.6.1 Legal and Policy Framework

A review of legislations relating to solid waste management

Local authorities in Kenya as it is the case in most of the world are mandated by law to manage solid waste in their area of jurisdiction. Although there are other players in waste handling, two notable points are that: Firstly, the central government retains an important role in solid waste management through its various ministries and department, e.g., the Ministries of Environment and the Ministry of Nairobi Metropolitan Development; secondly other organizations had come into being in various localities, rather to fill up the gap where local authorities had failed in service delivery, than to supplement municipal services. This service with full consultation with municipal

authorities although it becomes unclear who to when something went wrong in waste management in the circumstances as these organizations appear to be accountable only to their leaders.

Legislation that touches on solid waste management include: The local government Act, cap. 265 of the Law of Kenya and the Public Health Act cap. 242 of the Laws of Kenya. Under section 160 of the Local Government Act, the local authority has power to establish and maintain sanitary services for the removal and destruction of, or otherwise, dealing with all kinds of refuse and effluent and where any such service is established, to compel the use of such service by persons to whom the services is available. However, the local authority has been unable to provide adequate services in waste disposal, sanitary and other services. This is evidenced by overflowing garbage containers, unplanned dumpsite and open dumped waste within the central business district and in many residential areas in Nairobi.

Both sections 201 and 168 of the Local Government Act and the Public Health Act respectively empower local authorities to make by-laws regarding matters which are necessary or desirable for the maintenance of health, safety and well being of the inhabitants. Since the role of solid waste management is charged with local authority, if the waste is not collected and disposed at the selected dumpsites, the local authority creates nuisance to the public. In such a case, the local authority is required to make by-laws against it. This makes solid waste management by the local authority difficult. Section 116 of the Public Health Act provides that it is the duty of every local authority to take all lawful, necessary and reasonably practical measures for maintaining its district at all times in clean and sanitary conditions and for remedying any nuisance or condition liable to be inglorious or dangerous to health and to take proceedings against any

person causing or responsible for the continuance of any such nuisance or condition. The Act in this case is no categorical as to who should carry out solid waste management, as there is no sole statutory body to enforce the management of waste by the local authority. Therefore, the Act does not appear to limit solid waste management solely to local authorities: local authorities, non-governmental organizations, industries, individuals and the public at large are called upon to take part in solid waste management for better or cleaner environment.

Section 119 the Public Health Act empowers the Medical Officer of Health, if satisfied with the existence of a nuisance, to serve a notice on the author of the nuisance or if he cannot be found, on the occupier or owner of the dwelling or premises on which the nuisance arises. The section requires the officer to remove the source of the nuisance, if it continues, within the time specified in the notice and to execute such working and do such thing as may be necessary for that purpose and if the medical officer of health thinks desirable specifying any work to be executed to prevent occurrence of the said nuisance. However, in most cases the medical officer is an employee of the local authority and he or she may find it hard to compel his or her employer to carry out solid waste management with all these powers of the local authority as pertain to solid waste management. The local authorities especially the Nairobi City Council (NCC) has been ineffective in the performance of its duties and this has led to the privatization of solid waste management.

National Environmental Management Authority (NEMA)

NEMA was established by the Kenya Environmental Management and Coordination Act (1999), with powers that *inter alia*, require all developments with significant impacts on the environment to have prior impact assessment approval.

The Environmental Management and Coordination Act (1999) provide for an appropriate legal and institutional framework for the management of the environment, including the establishment of (NEMA) in s.7. The mandate for NEMA is to supervise and coordinate developments and other matters with an impact on environment as well as to overseeing the implementation of policies related issues. The Act set up Provincial and District Environmental Committees responsible for proper management of the environment within their areas of jurisdiction. They are also to prepare after every five years (5) years provincial and District Environmental Action plan for their area for incorporation into the National Environmental Action Plan respectively. These ensured environmental concerns were taken at the grassroots level, which contracted the traditional 'top-down' approach to planning and management of natural resources. The Act also provides for protection of rivers, lakes, wetlands, hilltops, hillsides, mountain areas, forests and coastal zones among other sensitive ecosystems. Section 3 provides that every person in Kenya is entitled to a clean and healthy environment and also has a duty to safeguard and enhance the environment and that if any such person notes any threat to the environment; he or she has, as a right, as an interested party, to apply to the high court for redress. In giving judgment the High Court is to be guided by the principle of public participation in environmental planning and management. The Act affirms the need for international cooperation in environmental management, inter and intra generation equity, the polluter pays principle as well as the precautionary principle (s.3) (5). It also makes it mandatory for preparation and submission of Environmental Impact Assessment (EIA) reports (at ones own expense) for any proposed development before any works on it are financed, commenced, carried out, executed or conducted. NEMA requires developers to publish the report in both the Kenya Gazette and a local newspaper. The authority is also responsible for carrying out environmental audit of all activities that are likely to have significant impact on the environment

(S. 68). The Act also confers any concerned party/s the right to bring court action against any environmental offender including the government thus obviating the archaic common law requirement for *locus standi*. The Act represented an unprecedented attempt in the country, towards a comprehensive legal and policy framework for environmental management.

3.6.2 Environmental Pollution and Waste Management

Good air quality is an essential requirement in the socio-economic well being of a population. Studies indicate that there is high presence of oxides of sulphur and nitrogen, carbon monoxide particulates, hydrogen sulphide and other gaseous pollutants, particularly in the air and water in the main urban centers in the country. The prevalence of diseases is closely related to the air and water quality and acute respiratory infections account for almost half of the hospital visits and 22% of Kenya's medical conditions.

High population increase and urbanization had led to a correspondingly high consumption rate of natural resources and consequently to a high generation of solid wastes. Most local authorities had been unable to cope with collection, treatment and disposal of wastes due to inadequate capacity and financial constraints. Nairobi city, for example, produced 1000 tonnes per day of solid wastes and only 20% of the waste is collected and taken to approved dump-sites. Sewage and solid waste disposal services were deteriorating and remedial measures were urgently required. Proper management of solid waste is necessary if the country is to achieve harmonious urban growth in commerce and industry amid increased urbanization. Waste management is also critical as it has serious implications on public health, recycling and in reduction of harmful gaseous emissions in the air.

The role of local authorities in waste management is crucial. In collaboration with other related agencies, the Government, through local authorities was expected to ensure a smooth entry by the private sector in waste management by contracting out services, and helping in identifying suitable landfill sites.

The Government needs to support water resources assessment studies to improve planning and exploitation of water supplies in the urban areas along with the corresponding sewerage development systems to handle wastewater. The government also needs to take the following measures so as to minimize environmental pollution and further improve waste management:

- a) Develop air quality standards and monitoring network;
- b) Promote capacity building within regulatory institutions to monitor and promote technologies that minimize harmful emissions;
- c) Provide adequate resource allocations for pollution and chemical management;
- d) Enforce the provisions of the Environment Management Act.
- e) Promote the adoption of environmentally sound management systems, such as ISI 14000, EMS, and ISO 9002 quality standards
- f) Establish a data base on chemical waste, chemical stockpiles and obsolete pesticides and establish an inventory of green house gases;
- g) Develop a waste management policy
- h) Strengthen the Kenya National Cleaner Production Centre;
and
- i) Strengthen capacity for the Provincial Environment Committees (PECS) and District Environment Committees (DECs) to effectively respond to pollution issues at the local level. (source National Development Plan 2002-2008).

3.6.3 Government Policies and Regulation on Solid Waste

After independence and until the year 2001, the government gave little emphasis to the issue of solid waste management. There was hardly any mention of this especially in the development plans made before 1994. It was in the national development plan of 1997 – 2001 when the subject of solid waste management was given a fairly substantial attention.

National Development Plan 2002-2008

The issue of solid waste management is mentioned under environment and natural resources management while issues on pollution are mentioned in relation to waste management. Article 10.1.13 stated that: “High population increase and urbanization has led to high consumption of natural resources and generation of substantial wastes.

National Development Plan 2002 – 2008 was formulated in line with the government’s aim towards rapid industrialization for economic development, which formed the theme of national development plan. The government saw the need to address the problem of solid waste because the amount of solid waste generated in our urban areas was bound to increase with the anticipated rapid industrialization.

The government also noted that it would be no longer feasible to dispose off waste by natural means. As a result of this the government saw the urgent need for consider waste as a resource but also explore ways of not only minimizing it to save on waste processes costs, but also minimizing its environmental impact.

The plan noted that the biodegradable solid wastes could be utilized commercially. The document further stipulated that given the volume of waste production especially in urban areas, there was need to adopt sound waste management measures such as recycling of waste using

appropriate technology focusing on generating as little waste as possible so that minimize resource loss and waste processes costs.

The government also noted the need to assess the quantities of various agricultural wastes to identify their economic viability with a view to encouraging their exploitation. The plan stipulated that before the end of 1998 the Ministry of Commerce and Industry (MCI) in collaboration with Ministry of Local Government (MLG) and the Ministry of Environment and Natural resource (MENR) would co-ordinate a study to achieve this primary objective.

The government also noted the increase in the use of plastic products in the country and suggested recycling and incineration as the only practical options. No mention was made on the need for the establishment of plastic recycling plants to deal with the problem. This could be achieved by extending incentives such as free site for construction of recycling factories, tax relief and acquisition of material at less cost (without duty), among others. Neither was a ban on plastic use mentioned. Other aims of the policy strategies, which the government was to institute in the plan period, included:

- i. To conduct a study on subjects, such as methods for collecting used products and the potential markets for recycled products.
- ii. To assess commercial utilization of agricultural wastes with a high calorific value, e.g., rice husk, bagasse from sugar manufacture, saw dust from saw mills and coconut shells which could be used as fuel for firing small scale kilns in the manufacture of building materials e.g. bricks and tiles. Rice husks could also be used as pozzolanic additive to mortars and plasters, reducing the need for cement and lowering the embodied energy requirements. Rice husks could also be used as natural glaze for ceramics. Efforts should be directed at

quantifying the amount generated by rice growing areas such as Mwea and Ahero irrigation schemes for exploitation.

iii. Briquetting was to be encouraged to reduce density and ease combustion. Bulk biomass materials could be dried and reduced in size by chipping before they are briquetted. Small powered briquetting machines and animal and human powered machines are also available with capacities as low as 10 kg per hour. During the plan period, the government will publicize the technologies that are available in this field. This was to be done through KIRDI, which was to spearhead investigations on which materials are available in commercially viable quantities while the ministry of finance (MOF) and Ministry of Commerce and Industry (MCI) were to work out modalities to encourage the use of waste raw materials.

iv. With the challenge for Kenya attaining NIC status by the year 2020 [now rescheduled to 2030], the government was to make use of the locally available raw materials such as waste. In order to achieve this, the government needed to develop a sound metallurgical industrial base. This was to be realized by carrying out feasibility study to be coordinated by the MENR and MCI within the first two years of the plan period, on the exploration, evaluation and utilization of the available raw materials in Kenya.

It is noted that the government appeared to have realized the current and anticipated future problem in solid waste management through the formulation of this document. It was not clear how its implementation would help in problems that beset solid waste management. However the need for a solid waste management master plans to guide solid waste management in our urban centers was paramount (Mutai, 1970).

The governments' policy on increased income for its citizens, reduced illiteracy, poverty, disease and slums as well as to provide water, sewer, and other services, have also been shaped by other global and national policy documents such as the Millennium Development Goal (MDG) and Vision 2030.

3.6.4 Planning and Waste Management Requirement

Within the overall framework of urban management, the scope of MSWM encompasses the following functions and concerns:

- a) Planning and management
- b) Strategic planning, legal and regulatory framework
- c) Public participation
- d) Financial management (cost recovery budgeting accounting etc).
- e) Institutional arrangement (including private sector participation)
- f) Disposal facility siting

Planning and management approaches, methods and techniques employed in MSWM by most local authorities are often inadequate. Their need integrated management approaches based on adequate information systems, decentralized responsibility, interdisciplinary interaction and co-operation.

Based on the defined role of the local government in MSWM, local authority should focus on sound planning and financial management methods with the aim to improving refuse handling. This would include cost-oriented accounting systems, budgetary planning and control, unit cost calculations and financial and economic analysis. For the optimization of operational planning and appropriate management methods and skills, there should be proper data collection techniques; better analysis of waste composition, waste generation projection and scenario techniques; formulation of equipment specifications; better procurement procedures; and a better

information management systems for effective monitoring, evaluation and planning.

3.7 Intensification Effects in Urban Areas

Densification in urban areas can be attributed to a number of factors that include human and social factors.

3.7.1 Human Factors

Human factors may be social, where people of the same background settle in the same settlement and their numbers grow to be the predominant group in that area; factors may also be social-economic as in cases where people of the economic-group/class settle in the same place to constitute a high-, middle-, low-class settlement or Ifa settlement based on any other criteria.

3.7.2 Social Factors

Intensification of built environment in urban areas is not static and tends to be modified as social values changes, in response to changing lifestyles and social-economic organization. This is well explained by the built environment mainly housing which will describe the quality of an urban social environment. The focus would include the conditions of streets and buildings as aspect of built environment.

The quality of the residential environment can be assessed from the presence or absence of any negative or positive environmental attributes in respect to the buildings. Thus, the environment can be satisfying and attractive and provide scope for individual development or it can be poisonous, irritating and stunting. The quality of

environment in which people live, work and play has much influences on the quality of life they experience.

3.7.3 Housing

Housing determines the social well-being/status, personal security, autonomy and comfort of the owner. Its location determines access to other scarce resources, such as education, medical and leisure facilities, and gives an idea of character of the neighborhood. The structure should provide the necessary comfort in relation to insulation from noise, protection from extreme weather, dust and infestation from harmful insects and rodents. The quality should be such that the structure is located in an area that is safe from flooding and where the relative crowding does not lead to increased vehicular accidents or airborne and other infections associated with overcrowding.

Rent rates for structures/houses often have a bearing on the social status of the house owners and on the standard of the locality housing. High rent housing areas are associated with high-income earners while low rent neighbourhoods have houses that are affordable to low-income earners. Infrastructure services to an area, for example, street, sewer etc., tend to vary with the quality of the neighbourhood. Where there is congestion of people and structures, the services deteriorates and pollution levels rise. Congested areas often have narrow foot paths or streets between houses and without street lights, they inconveniences residents and hampers access into the area that become ideal for criminals. Solid waste that is often thrown along these streets attracts rodents and become breeding ground for flies, which spread a variety of diseases. All these impacts negatively on the social environment and many residents could be adversely affected or rendered unproductive when they fall sick.

3.7.4 Economic Status

Economic standard has a bearing on social well-being of a locality. This is expressed, for example, in terms of income per capita, employment opportunities or the general welfare of the individual and the people therein. Thus, if the income per capita of the individual or the neighbourhood is low as a result of underemployment or unemployment, their welfare will be adversely affected, as they shall be considered among the poor.

Poverty among urban dwellers has often been blamed on urban environmental degradation. Their area rarely have adequate sanitation, waste disposal services and their waste end up in dirty streets or in filth-clogged rivers which add to urban environmental pollution and health hazards. Such is the plight of people who live in Nairobi's congested mega-slums like Kawangware, Mathare Valley, Mukuru Kwa Njenga and Kaiyaba. This study found that the residents constituted the majority of the many unemployed Kenyans. Some of them were under-employed in the more developed areas of the city, or depended on small-informal business activities with meager incomes that they shared with numerous dependents.

Most well-off urban people work in the CBD or relatively dense areas but their luxurious residences are in stark contrast to the poor neighbourhood 'on the other side of town'. They enjoy high standards of living and their work-places are within their exclusive and well serviced residences. Their areas have expansive and pollution-free open spaces with houses well served with paved roads, sewer-line and private or public sewage services. Examples of such localities are Karen, Langata and Lavington.

3.7.5 Political Institutions

Political institutions play role in influencing social environment. In Kenya, the central government formulates policies on land utilization and controls, e.g., planning regulation, standards and zoning. These usually dictate the sizes of plots, what structure are needed and what materials are used. It is on the other hand the role of the local authority to implement the policies and regulations of the central government.

Through zoning, various types of urban environment have come into being. We have for example, the high-density areas like Kawangware, low-density areas like Langata, etc. The local government is entrusted with controlling developments within urban areas. Where there is weak control and implementation mechanisms, illegal structures have been erected especially by poor people who cannot afford to build houses of the required standards. The situation becomes complicated where the local authorities failed in services delivery. Lack of services like proper roads, sewer and water therefore fuels environmental pollution.

Poor sanitation has forced majority of the people in urban areas to, at best, opt to pit latrines which sometimes fill up and discharge into the open drains and rivers. This was evidence at Kawangware, Mathare Valley, Kibera and Mukuru kwa Njenga in Nairobi, at the time of the study.

3.7.6 Other Social and Environmental Factors.

Other factors, which affect the social environment include: Solid waste; poor sanitation; urban farming; and toxic and hazardous waste. Most households' disposable waste that is generated in developing countries is result of changing lifestyle. This waste in most cases is

not collected but thrown anywhere to become a source of pollution. Some of it rot and become breeding grounds for insects that cause diseases to the inhabitants.

In parts of Kawangware, ill-structured and abandoned septic tanks were found to overflow with filth that added to the environmental pollution. Toxic or hazardous waste mainly from factories could be inflammable or poisonous or have disease causing agents. Some of these wastes are dumped in water bodies or dumping sites which in most cases are always burning and emitting the harmful fumes. This negatively affects the environment.

Urban design is another factor that affect social environment. Material used most in urban areas is concrete which store much heat that some people feel uncomfortable with while reflective roofs and wall used in some buildings are uncomfortable for other people who find the structures to hot to work or live in during hot seasons and too cold in cold weather.

Urban crop and livestock farming may have positive environmental impacts in that manure from the animals, can be used to grow other crops or vegetation which contributes to greener environment. A negative effect could also be seen where livestock farming is carried out in small plots, which are shared with residential houses. The waste from the animals is thrown on the pavements and any where else. This was true in parts of Kawangware area for example, during the study period.

Rapid urbanization at current pace of urban growth would require governments in developing countries to facilitate access for buildings, on average, a new city of 1 million people every week for the next 40 years. The scale of densification and intensification in the cities of developing countries is three times high in densities than in

developed countries. This condition is associated with a range of problems including infrastructure overload; overcrowding; congestion; air pollution; severe health hazards; lack of public and green space; as well as environmental degradation.

Urbanization scholars wonder why there should be further densification in poor urban neighbourhood, given that densities are already high. Proponents of compact cities recommend policies that restrict urban expansion and seek to reduce the amount of land for absorbing more urban population growth. They suggest such measures as maintaining existing densities levels; encouraging adequate landfill; zoning and land subdivision; and instituting regulation to control or limit urban growth enhance land conservation.

“Compact city approach”, therefore seeks to, *inter alias*, retain or increase built-up area and residential population densities at sustainable level, but at the same time intensifying urban economic, and social and cultural activities within environmentally sustainable levels and functioning services.

Some scholars theorize there is relationship of land use and the living space which ensures that congestion intensifies as population densities in a given land portion increases. Small urban space would also mean increased congestion and related urban problems unless the levels of services and amenities that are availed are commensurate.

Competing demand on land in urban areas can arise not only because of the absolute shortage of land, but also because of the relative scarcity of suitable locations. Under these conditions land-use with the greater economic or social viability finds place in these suitable location while relegating the less competitive uses to less desirable locations.

Other scholars state that high population density has been maligned at least as it affects people without supportive evidence, and hence maintain that people who live under crowded conditions do not suffer from being crowded but rather from lack of services and amenities. Otherwise, they say, the people are no worse off than others

Nevertheless, the degree of population concentration into urban centers is generally believed to be very closely associated with levels of economic development. The degree of density in cities has a tendency towards differentiation and specialization; the separation of workplace and residence; the functional segregation of areas; and the segregation of categories of residents, thereby creating a residential mosaic.

To work out the relationship between density and population (density size rule) in measuring density of developments, a figure of persons per hectare is commonly adopted. As the population size of the settlement increases the land provision (ha/1000) decline exponentially (i.e. the density of development in persons per hectare rises at a decreasing rate - density size rule).

3.8 Planning Implication on Urban Space

The main goal in land-use planning in a social environment is to reconcile conflicting pressures on land and to determine the best use of land within the restraints imposed by physical, economic, social and political factors.

Planning involves various components, such as problem identification, goal setting, predicting and projection, design, evaluation and implementation. It requires that the stakeholders are involved at all stages as factors affecting the social environment have to be assessed in relation to those involvement and other components of urban

planning. The planner assesses the physical condition of the area, the social set up and political interference or lack of it, before coming up with a plan.

At the heart of the relationship between authorities, the society and built environment in urban areas, are the city planners who, through a mixture of default and intent, find themselves being the arbiter between the conflicting interests of different classes of people and communities.

Although city planners are concerned with improving the physical environment, they have for long been oriented towards certain people even if only indirectly and implicitly (Gans, 1969). These people have been within the planning profession itself, its political link and a special group within the middle-class. Bias towards the middle-class means the planner seeks to create the kind of city the class desired with, for example, their favoured single-family dwelling and the creation of facilities that cater for middle-class tastes.

3.8.1 Standard and Urban Planning

Traditional master planning has often relied on rigid regulations using, zoning, subdivisions, building policies and standards. Although master plans have excessive regulations, they often are ineffective in addressing environmentally sensitive areas such as steep slopes, wetlands and earthquakes prone land. Traditional planning approach has also rarely concerned itself with the critical issues of impact on low-income households. A well-planned settlement is one in which everybody is satisfied, and in which there is a balance between nature and land use. To achieve these standards, there are a set as regulation tools to help in achieving this standard/goal. Examples of these tools are building by-laws.

In developing countries, standards seem deficient and unrealistic because they do not appear to equitably cater for all classes of people especially in relation to shelter provisions. For example, the standards set for acceptable building materials leaves the poor with no alternative but to settle in slum areas as the prescribed conventional material is out of his/her reach.

Standard in developed countries are set to protect all, including the weaker member of the society. In developing countries, standards tend to protect the wealthy elite from the interests of the rest of the citizenry. In Kenya, local or national, code regulations or requirements make excessive demand on building materials, size, plot coverage etc. The main criticisms of the regulations are that they reflect indifferences of local authorities to the issues of public concern; they represent inherited policies of our colonial masters; they are irrelevant to local culture e.g. space requirement. Rigid regulations prescribe conventional material and leave little room for pragmatism or imagination in finding acceptable standards that would consider the welfare of the low-income groups. The regulations also involve strenuous paperwork, that even daunting for potential developers.

Existing standards and requirements in Kenya are explained in Building Code Grade 2. By laws which are applicable in high density or low-income areas. This is divided into planning and design.

3.8.2 Planning and Design

Planning and design expounds on the requirement of plot size; maximum plot coverage; and minimum space around a building. Urban planning and design is also determined by accessibility to services such as water and sewer.

3.8.3 Urban Construction

Type of foundation for example reinforced concrete foundation and required mix ratio of sand, cement and aggregate which should be 1:2:4. The construction of different type of floors, walls and even roof cover are also specified in the building code.

3.8.4 Other Regulations for Urban Structures

The building code also include such other specifications as roads width, permissible building materials and compatible connection to water and sanitation systems that ensure developments that have minimum adverse effect on the environment. Largely because of the rigid standards required by local authorities, many households and businesses are forced to move into the informal and unregulated settlements in environmentally sensitive locations. Some of these regulations are poorly designed and impact adversely on historic sites and designated areas that are often subject to laws and regulations with restrictions on use and rent charged. These regulations limit the possibilities for economics activity in the area concerned and lead to their deterioration.

Complex development permission procedures built into the planning and land development process further limit affordability and efficient access to land is also affected where there are. Realistic standards would ease applications and contribute to effectiveness of land use regulations.

CHAPTER FOUR:

A SYNTHESIS OF RESEARCH FINDINGS

4.0 Introduction

The data obtained from the field was analyzed by use of simple statistical methods such as description of absolute frequencies, percentages that show characteristic of the phenomenon under investigation.

Tables, figures, maps and photographs were also used. Three hundred questionnaires which were distributed throughout the neighborhood by use of simple random selection were subjected to further synthesis in order to come up with frequencies and percentages which helped in comparing the phenomenon in each cluster and therefore, the overall neighborhood. Some data was subjected to simple statistical tabulation in order to test on the hypothesis:

Densification of residential space never in itself signify inadequate solid waste management in urban residential neighbourhood although it may with other factors contribute to that inadequacy

Among the key variables noted were:

- a) Plot sizes
- b) Plot coverage
- c) Households densities
- d) Dwelling units densities
- e) Solid waste quantities

The above variables were arrived at through data needs from the objective of the study, which are expounded in the foregoing synthesis.

**Study Objective 1 – To Investigate Relationships Between
Densification and Solid Waste Management.**

Data need: The following information solicited through the study questionnaire was used to obtain data to support the above first objective of the study.

- a) Household sizes within a compound (Table 4.4).
- b) Densities within plots (Table 4.4).
- c) Means of disposal from the plots
- d) Volume of waste generated at household level
- e) Frequency of collection from the plots
- f) Means of waste storage within the plots

Table 4.1 Frequency of Collection From the Compound

	Cluster A	Cluster B	Cluster C	Total response	Total Percentage
Several times each day	0	9	2	11	3.7%
Daily	12	40	29	81	27%
3 times a week	6	13	3	22	7.3%
Twice a week	31	10	18	59	19.7%
Once a week	25	4	11	40	13.3%
Less frequently	18	10	21	49	16.3%
Don't know	8	4	1	25	4.3%
Not at all	0	10	15	0	8.3%
Total	100	100	100	300	100%

Source: (Author) field survey

Table 4.2 Means of Disposal by the Household

	Cluster A	Cluster B	Cluster C	Total response	Total percentage
Use of plastic bags	64	32	45	141	47.0%
Plastic container	19	50	17	86	28.7%
No formal method	17	18	38	73	24.3%
Total	100	100	100	300	100%

Source: (Author) field survey May 2006

4.1 Plot Sizes

Majority of the analyzed plots were of $\frac{1}{4}$ acre or less (Table 4.3). This constitutes 67.4% of the total number of the analyzed cases. Plots of more than $\frac{1}{2}$ acre were few at 12.7%. Majority of these were within cluster B some of land, which was yet to be subdivided, although there were little on-going subdivision (mainly in plots owned by families).

Table 4.3 – Comparison of plot sizes analyzed in different clusters

Plot size	Cluster A	Cluster B	Cluster C	Number of plots	Total percentage
More than $\frac{1}{4}$ Acre	60	7	46	113	37.7%
$\frac{1}{4}$ Acre	19	36	34	89	29.7%
$\frac{1}{2}$ Acre	13	36	11	60	20.0%
More than $\frac{1}{2}$ Acre	8	21	9	38	12.7%

Source: (Author) field survey May 2006.

4.1.1 Household/Dwellings

Table 4.4 Number of households within plots

Number of households	Cluster A	Cluster B	Cluster C	Total number	Total percentage
<3	16	33	55	104	34.7%
3 - 5	64	41	36	141	47.0%
5 - 10	17	25	7	49	16.2%
>10	3	1	2	6	20%
Total	100	100	100	300	100%

Source: (Author) field survey May 2006

The number of households has a relationship to the amount of waste generated, which is also determined by level of income of the household (The higher the income levels the more the amount of solid waste generated and vice versa).

As confirmed from the study, majority of the households generated between 1 kg and 5 kg of waste per week each. If more than 30% of the analyzed cases had more than 10 households, therefore 30% of 300 are equal to 90 households, meaning that a total of 90 x 100 x 5 kg that is, 45 tons of waste, is produced within those compounds within one week.

The study established that different compounds had different number of households depending on the number of rental units. There are

some rental units, which were shared by more than one household especially in clusters B, and C. Table 4.2 shows distribution of dwelling units within each compound, which in most cases correspond to number of households. More than 30% of the analyzed cases confirmed that there are more than 10 households in majority of the plots. There are compounds with even more than 50 households (see plate 4.1) Very few compound had 1 household 8.3% mainly in cluster A and B. These were the few landlords who did not mix with their tenants.

Table 4.5 - Number of Dwellings Within Plots

Number of dwelling	Cluster A	Cluster B	Cluster C	Total number	Total percentage
1	8	17	0	25	8.3%
1 < 5	56	41	18	115	38.3%
5 < 10	24	22	23	69	23.0%
>10	12	20	59	91	30.3%
Total	100	100	100	300	100%

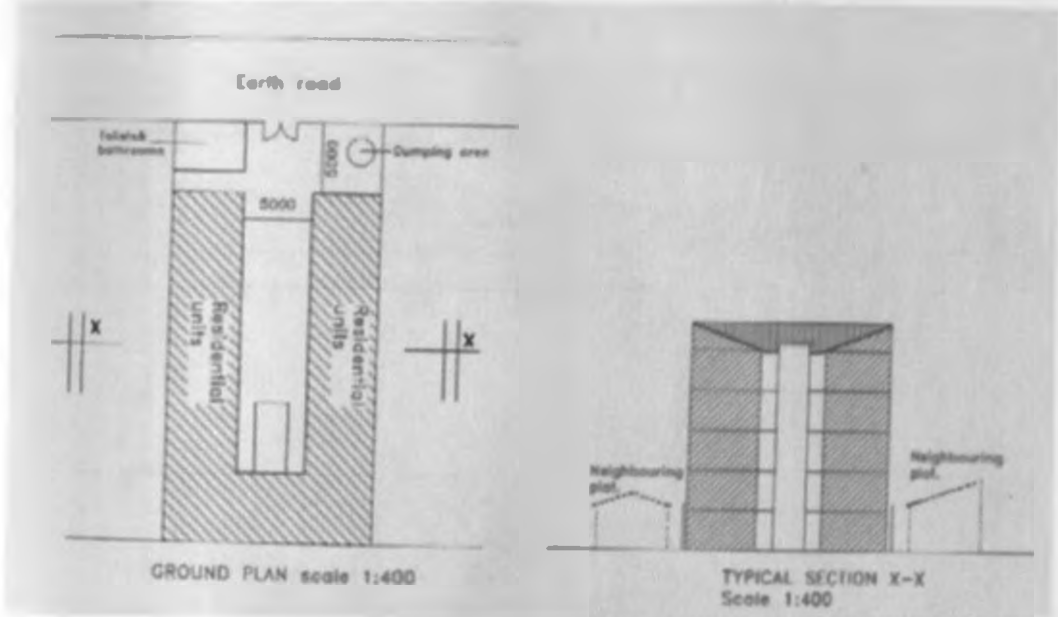
Source: f(Author) field survey May 2006

Similarities noted in the assumed clusters like nature of dwelling units which are either constructed from conventional materials or temporary structures can be explained in the following illustrations

Relationship Between Open Space and Built-up Area Within the Plots.

Case 1

Figure 4.1: A five storey residential development for 47 families. Plot size is $\frac{1}{4}$ acre with a building coverage of over 80%. Access is by earth road.

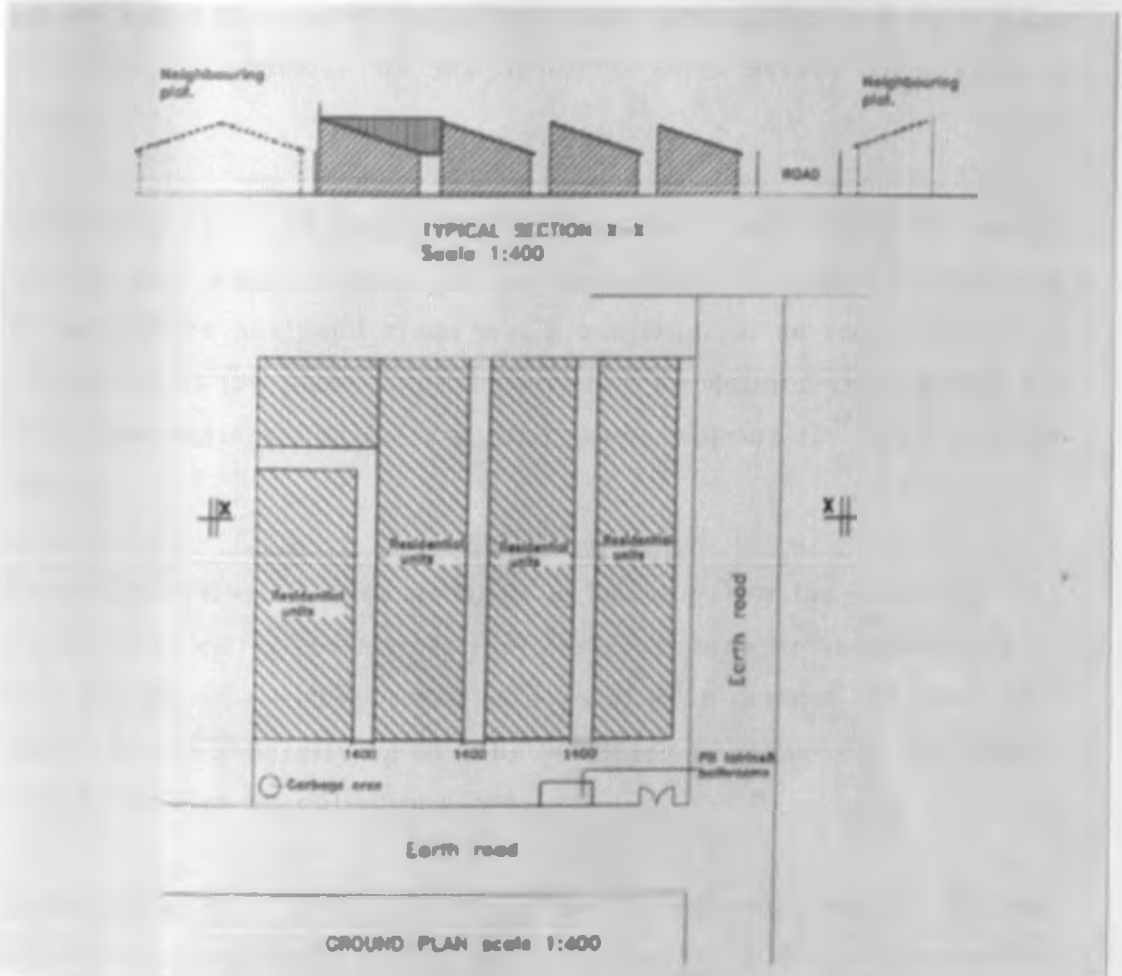


Source: (Author) field survey 2006

As noted from field survey, most houses are informal. Depending on the cluster area analyzed formal houses made with conventional materials were increasing especially in cluster A followed by cluster C then B in that order. The sketch which is shown in figure 4.1 shows some of the upcoming high-rise development. Majority of them do not follow planning by-laws (see also plate 4.2).

Case 2

Figure 4.2 Single storey units for 50 families. Plot size is ¼ acre with a building coverage of over 80%. Access is by earth road



Source: Field survey (Author) May 2006

Figure 4.2 show a plot of ¼ acre with an approximate population of 250 residents. The area covered by buildings is more than 80%. The open space left is less 20%. This type of development is a 4-storey building with approximately 50 numbers of households, assuming that each household has 5 people then the total number of people living

within such a compound is 250 persons. A number of similar developments were selected for study in relation to waste handling.

4.1.2 Findings

Waste Generation – The main source of waste was foodstuff remains and wrapping papers, which was approximately 250 kg of solid waste per week per household (based on study finding that is 5 kg average per week to majority of the residents who occupy such kind of houses).

Waste Storage - Majority of the households had means of storage ranging from paper bags to plastic containers. Common storage area in most of the analyzed areas was a container or an area set-aside at one corner of the plot. Where plots had no defined storage area for waste, residents simply threw their waste outside the compounds at night.

Waste Collection - means of waste collection from the compound was not well known to the majority of residents who bothered less about that except where they were responsible for disposal of their own waste. It was generally up to the landlords to organize mkokoteni or private vehicles for collection.

Waste Disposal - Disposal from the compound was by private collectors through arrangement by occupants or by owner. Destination was unknown to majority of occupants. Presence of waste within or near the houses in the compound except for cases of uncollected waste in a well-marked area was a common scene. Generally, compounds of this nature were clean but outside the compound, just a few meters away, heaps of solid waste could be seen.

Conclusion

Despite the fact that, plots were congested with buildings, they were clean inside meaning that the occupants or owner were concerned of waste handling. Human congestion or buildings in this case does not necessary affect handling of waste within. The presence of waste outside the compounds could be as a result of other factors, for example, such kinds of developments don't exist in isolation: there are a number of other developments which could be the source of the solid discarded waste.

Absence of a nearby collection point could also be another factor in that waste from this kind of development would have to end somewhere, including open spaces if collection points were beyond reach. Another problem was that, not all owners of developments of such properties cared much about the waste they deposited outside their compounds and where it bothers them, they simply went for informal collectors whom they hired to get rid of the waste for them. The informal collectors in turn could discard the waste in any available open space.

Case 2 (figure 4.3)

Figure 4.3 shows an example of informal construction, which covers most of the study area. According to an informal structures survey done by Ngau (1995), Kawangware had the biggest share of informal structures in Dagoretti constituency. At the time of this survey, the situation is no better as informal structures continues to increase. As in case 1 the area occupied by the buildings is more than 80%, living less than 20% of open space. The open space left is used for other activities such as circulation, waste handling, drying of clothes, sanitary facilities such as toilets and showers. Unlike case 1, the volume of waste generated here is less, despite the fact that number of occupants is the same - that is 250 people, and less similar number of households.

Findings

Waste Generation - As in case 1 the main source of waste was foodstuff and wrapping papers and less than 200 kg per week based on average of 3 kg per week per household (study finding per week per household).

Waste Storage - unlike case 1, there were no defined method of storage as waste and was disposed off almost immediately it is generated by throwing it outside the compound or within the compound anyhow. There were some cases where a common drum or pit within the compound was used as a temporary storage area.

Collection - waste collection from the compound was not clearly defined. Waste could remain uncollected within the compound for long hence spill over onto most of the remaining open space. Wastes thrown outside the compound was found to spread over to the entrance to the compound in some cases. There were few landlords who organized for collection from the temporary storage area outside the compounds to unclear destinations. That is probably the origin of most waste found on road and open spaces.

Disposal - method of waste disposal included burning it, burying within compounds or throwing it onto the roads and open spaces. There are very few cases of formal disposal methods such as involving licensed private collectors.

Conclusion

Unlike what was found in case 1, the compounds in this case were not as tidy as in case 1. The study found the dwellings involved were for the majority poor who had least concern for waste management. The plots were congested with buildings leaving very little space for management of waste. Lack of consistent waste collection from the

plots made the area dirty and foul smell was common in most of the compounds as decomposing waste accumulated for a long period.

Majority of the house owners don't stay within and therefore care least toward waste management. Lack of co-operation among the tenants meant every individual handled his own waste the way he deems fit. Without sufficient funds, as it was the position in case 1, hiring of private collectors was difficult and this led to accumulation of waste within the compound and foul smell in the compound.

Plot Coverage

The ratio of the built-up area within a given plot is regulated in by-laws which define the allowable size of development in the plot in relation to what should be left as open space. This ratio varies from place to place in urban areas, depending largely on zoning regulations on land use, i.e. residential, commercial or industrial. This is also dependent on other requirements like availability of infrastructural services such as sewer.

The study area is allowed to have plot coverage of 50 percent which is rarely followed as is seen from Table 4.6.

Ratio of Built-up Area to Open Space

Of the analyzed plots, only 10.7% had open space of 25% compared with built-up area while majority had up to 58% of the area covered by buildings. About 30.3% of the analyzed plots had building-covered area of more than 80%, meaning that space left for other activities was minimal. The remaining space had varying activities to compete for: access to the houses; clothes drying; waste collection and some cases of burning as means of disposal; animal keeping in some cases; and circulation within the compound.

Table 4.6 – Ratio of Built-up Area to Open Space

Area covered by buildings	Frequency of analyzed plots cases			Totals	Percentage
	Cluster A	Cluster B	Cluster C		
25%	0	15	2	17	5.7%
25% - 50%	26	17	12	55	18.3%
50% - 80%	40	46	48	134	44.7%
>80%	34	22	38	94	31.3%
Total				300	100%

Source: (Author), field survey 2006

Figure 4.1 and figure 4.2 - show an example of space use within a given plot in terms of development. Most of the development in zone C are of this type and were constructed using non-conventional materials mainly timber or iron sheets for walls. There are also some cases whereby there are mud-walled houses. Majority of residents were found to be low-income earners and are tenants. Except for few

cases the plots were accessible through small footpath that was hardly wide enough to allow vehicular movement. The same type of development can also be found in other zones. Spatial distribution within the site differs with configuration of the plot and room sizes.

Access Within the Plot

Passage within the plot was usually a narrow space of about 1.4m, which was also used for other activities like cloth drying and even storage of excess furniture during the day.

Household

The size of each household averaged between 3 – 5 people, as it is the case in most areas reviewed. The study found an average of 50 households in each unit that was analyzed, giving an average population of 250 people within a space of 900m². There are cases in which more than one family shared individual unit. This meant the population size may have been higher than 250 people per plot.

Activities Within Compounds

Among the common activities noted within the compounds include: washing; waste dumping; and animal keeping.

Services Provision

Services provision deferred from compound to compound within the entire neighborhood. Majority of the compound had electricity and water while a few in zones A and B are served by sewer service. Majority of the compounds had pit latrines and a few of them used septic tanks or conservancy tanks. Roads type as an infrastructural service also varies from zone to zone. The main access roads serving the neighborhood were constructed with tarmac and murrum, although majorities were earth roads or murrum.

4.2 Solid Waste Management

Solid waste management encompasses varying functions are explained in the next few paragraphs as such an understanding is crucial in the search for a solution to the prevalent poor MSWM in the study area and related suburbs. The functions are:

- a) Waste generation
- b) Collection
- c) Storage
- d) Transfer
- e) Disposal
- f) Recycling and
- g) Resource recovery

4.2.1 Solid Waste Generation

The major waste generated here is household's, consisting of mainly papers, vegetable or food materials. It is noted that not all generated waste is disposed off in better methods.

Table 4.7

Approximate Volume of Solid Waste Produced Per Week in Kg

	Cluster A	Cluster B	Cluster C	Total response	Total %
Less than 1 Kg	6	23	32	61	20.3%
More than 1 kg	63	49	44	155	52.0%
More than 5kg less 10 kg	29	24	9	62	20.7%
More than 10 kg	2	4	15	21	7.0%

Source: (Author) field survey May 2006

From the above table it is noted that majority of the residents (73.3%) produce less than 5 kg of waste per week per household while 27.7% of them produce about 5 kg or more in a week. Those households who produce less than 5 kg of waste per week were in the low-income group residing in the informal structures as confirmed from the field survey. Landowners and a few other residents were well above the low-income bracket and lived in households, which produce 5 kg of waste and above.

Past research indicate that well off urbanite produce more solid waste in a day than the low income group, meaning that majority of the people in this neighborhood were in the low income bracket and therefore produced less waste.

Also, from the amount generated in a day, assuming an average of 5 kg per week per household, then with population of approximately 48,777 household, it can be assumed that waste generated per week was

approximately 243,885 kg in the entire neighborhood, meaning that in a month, a total of 975,540 kg, was generated which is equivalent to 975 tons of waste was produced in the study area. This was a lot of solid waste which would continue increasing with time and needed necessary measures to be put in place for better management and cleaner environment.

4.2.2 Waste Storage

Waste generated in the area was mostly found stored in plastic paper bags within compounds and a in a few metal containers. Some 61.7% of those interviewed have at least some means of storing waste from source (see table 4.4). Most of the waste was either stored at one corner of the compound or outside the compound on any empty space available. About 38.4% had no waste storage facility hence constituted the group who threw the waste anywhere including the road reserves. There were hardly any communal storage containers or clearly demarcated storage or collection area.

Table 4.8**Means of Storage of Household Waste**

	Cluster A	Cluster B	Cluster C	Total response	Total %
Metal/plastic container	58	49	25	132	40%
Basket/carton	1	12	40	53	17.7%
No container	41	34	35	110	36.7%
Don't know	0	5	0	5	1.7%

Source: (Author) field survey May 2006

4.2.3 Solid Waste Collection

Collection within the compounds was minimal unless landlords were there to show the lead for tenants to follow. The tenants mainly cared for the waste from their houses which they took to any collection point within or outside their houses or threw it way to a place of their convenience, further away from their compound.

4.2.4 Waste Disposal Methods

Waste disposal in most of the analyzed compounds was through dumping within or outside the compound, often along the access roads or in any open space near the compounds. Some residents usually burnt the waste when it accumulated at a certain collection point (see plate 4.11 and 4.12). Other methods of disposal included scavenging by street boys who later sold waste to recycle dealers near the neighborhood. Some landlords made manure through composting. Domestic animals also scavenged vegetable matter and food remains, thus serving as informal agents of disposal.

4.2.5 Waste Transfer

The study documented the nature of transfer within the neighborhood and especially within compounds. It was noted that, method of transfer from generation points differed from one user to the other. There were those users who had no temporary storage area/containers within the compound and who after temporary storage in a polythene paper bag in their houses, only to throw it outside the compound either in a common area or non-defined area used by residents of that cluster.

There are those who used private collector to transfer the waste from their compounds to other disposal sites that were unclear to them. This class of people is mainly those above the low-income group. There was also transfer of waste from accumulated illegal sites by NCC personnel who usually transported the waste to established landfills. It was not clear whether the officials used the nearby private disposal site or the otherwise Dandora disposal site that was far away. Transfer therefore which is a temporary measure of removing the waste from source is not restricted to one method in the neighborhood.

4.2.6 Recycling/Resource Recovery

The study found that there was one area along the road reserve within cluster A, set aside by an informal trader as undesignated disposal point where they bought recyclable materials like papers, plastic items from the street boys who scavenged from disposal sites within the neighborhood. As it has been noted the potential for waste recovery has not fully exploited, as there is a lot of recyclable material seen within illegal dumping sites that could be utilized for the purpose.

Study objective 2: To Investigate the Contribution of Plot Sizes to Solid Waste Management.

Data needs: data based on the (study questionnaire) information obtained from questionnaire (see sample questions in point form below) responses was need in the investigation for study Objective 2.

- a. Sizes of plots**
- b. Ratio of built up area (coverage ratios)**
- c. Land ownership**
- d. Provision of collection points**
- e. Number of dwellings**
- f. Collection service from plot**
- g. Access to plots planning regulations**

Table 4.9 Tenancy

	Cluster A	Cluster B	Cluster B	Total response	Total percentage
Tenant	60	55	88	203	67.6%
Owner	40	45	12	97	32.4%
Total	100	100	100	300	100%

Source: (Author) field survey May 2006

Table 4.10 Provision of Collection Point Within the Plot

	Cluster A	Cluster B	Cluster C	Total response	Total percentage
Collection point	79	47	44	170	56.7%
No collection point	21	53	56	130	43.3%
Total	100	100	100	300	100%

Source: (Author) field survey May 2006

Table 4.11 Collection Service From Plot

Provision of collection service from the plot	Cluster A	Cluster B	Cluster C	Total response	Total percentage
Yes	69	20	43	132	44.0%
No	26	77	54	157	52.3%
Don't know	5	3	8	11	3.7%

Source:(Author) field survey May 2006

Table 4.12 Types of Access to the Plot

Size type of access to the plot	Cluster A	Cluster B	Cluster C	Total response	Total %
Too narrow	40	30	17	87	29
Enough for vehicular access	60	70	83	213	71
Total	100	100	100	300	100
Earth road	80	81	94	255	85
Murram	17	12	3	32	10.7%
Tarmac	3	7	3	13	4.3%
Total	100	100	100	300	100%

Source: (Author) field survey May 2006

Study objective 3: To Investigate the Relationship Between Tenureship and Solid Waste Management

Data needs

- i. Method of waste disposal
- ii. Tenants attitude towards waste management
- iii. Level of education
- iv. Number of tenants
- v. Sizes of household

Table 4.13 Level of Education of Interviewees

Level of education	Cluster A	Cluster B	Cluster C	Total response	Total percentage
Primary	1	27	34	62	20.7%
Secondary	54	31	41	126	42.0%
College	45	32	16	93	31.0%
None	0	10	9	19	6.3%
Total	100	100	100	300	100%

Source: (Author) field survey May 2006

Plate 4.1: Space Use Within Plots. Horizontal intensification of space with background showing alternative to vertical intensification.



Source: (Author) field survey November 2005

Plate No.4.2: Concentrated Neighborhood. Most neighborhoods are concentrated with unplanned residential developments.



Source: (Author) field survey November/December 2005

Plate 4.3: Littered Streets in Concentrated Neighborhoods.
The photo also illustrate how the neighborhood is concentrated with mixed residential developments.



Source: (Author) field survey November/December 2005

Plate 4.4: Development disregards Planning by-laws.
As can be seen from this photo storey buildings are put up to the boundary of the plot.



Source: (Author) field survey November/December 2005

Plate 4.5: Garbage Heaps Blocking Roads. Plate 4.5 and 4.6 show garbage-clogged roads, especially in areas congested with buildings. Note handcarts parked on rubbish, perhaps for lack parking space.



Source: (Author) field survey November/December 2005

Plate 4.6: Garbage in the Middle of the Road.



Source: (Author) field survey November/December 2005

Plate No.4.7: Plate 4.7 and 4.8 show waste-clogged drainage channels for storm water which residents turn into disposal trenches



Source: (Author) field survey November/December 2005

Plate No.4.8: Pigs Scavenging from Clogged drainage channels



Source: (Author) field survey November/December 2005

Plate No.4.9: 'Unsubdivided' land for Waste Management. Both 4.9 and 4.10 show 'unsubdivided' land that can be acquired to create temporary collection points.



Source: (Author) field survey November/December 2005

Plate No.4.10: Open Spaces as Potential Collection Point.



Source: (Author) field survey November/December 2005

Plate No. 4.11 Burning of Waste as a Means of Disposal. Fumes emitted by burning garbage in 4.11 and 4.12 add to environmental pollution.



Source: (Author) field survey November/December 2005

Plate No.4.12 Garbage heaps Burn 'At Every Corner'



Source: (Author) field survey November/December 2005

Plate No. 4.13: Incomplete developments used for waste disposal. Residents use these incomplete structures for waste disposal for lack of alternative accessible waste disposal site within the compound.



Source: (Author) field survey November/December 2005

Plate No.4.14: Undesignated waste collection and burning points



Source: (Author) field survey November/December 2005

Plate 4.15: Hawking Block Street Pavement and the Street. Photos in 4.15 and 4.16 show a concentration of hawking within limited space leads to a spill-over of the activities onto the streets, leading to littering the street and obstruction as is evidence from the pictures.



Source: (Author) field survey November/December 2005

Plate 4.16 Hawking Spill Over Littered Street



Source: (Author) field survey November/December 2005

Plate 4.17: Vacant Plots Used for Waste Disposal. Spaces that are empty pending developments turn into accessible disposal sites for garbage from the neighbourhood (Plate 17, 18,19).



Source: (Author) field survey November/December 2005

Plate 4.18: Littered Roadside Plots and Drainage Channels



Source: (Author) field survey November/December 2005

Plate No. 4.19: Waste Left to Rot in Vacant Plot. Dumping waste on an undeveloped plot in densely built neighbourhood is common alternative to 'administration-risky' disposal onto the road.



Source: (Author) field survey November/December 2005

Plate 4.20: Waste-Littered Roadside



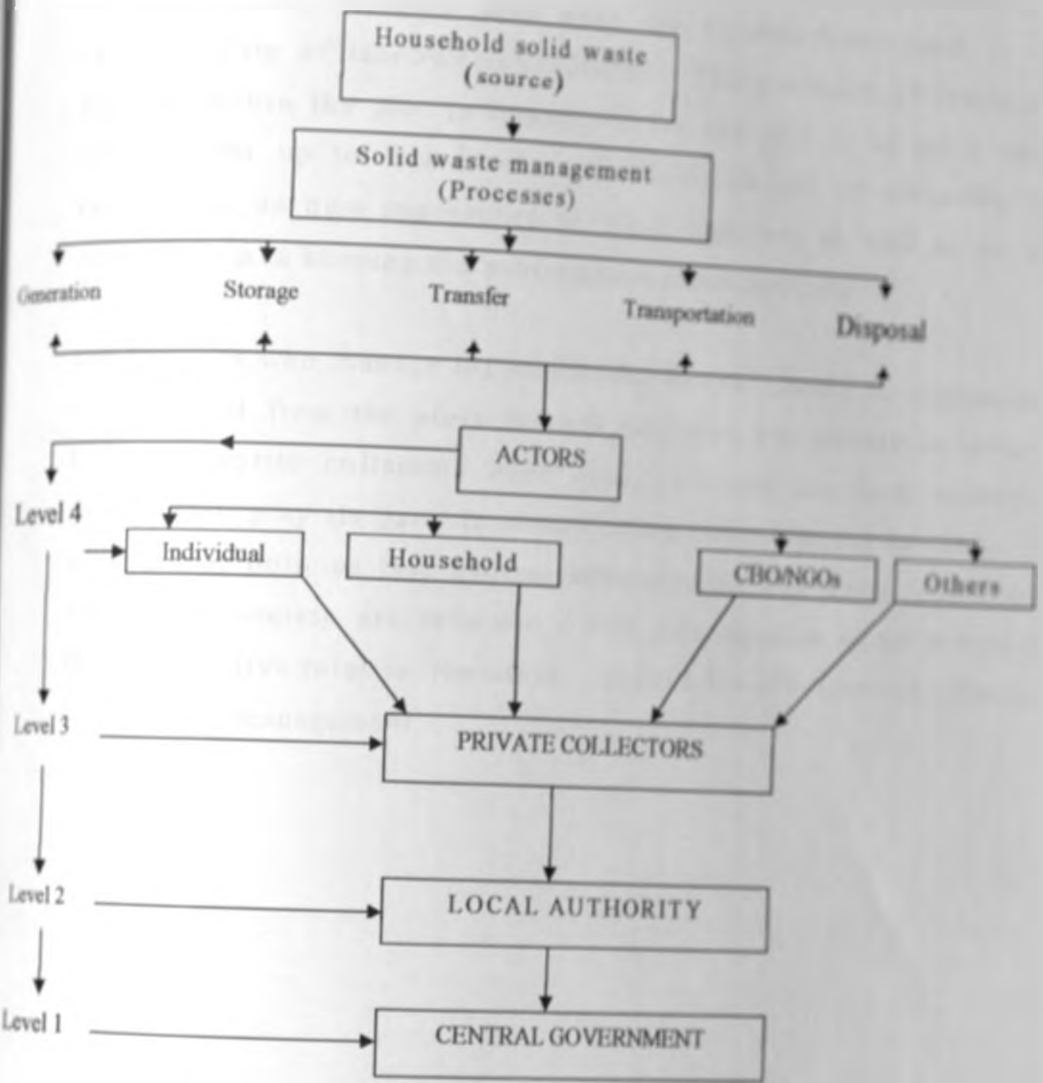
Source: (Author) field survey November/December 2005

4.3 Conceptual Framework

The study confirmed the general view that that increase in affluent lifestyle rather than population and developments growth of the study area was attracting new tenants from the Middle-class and that this group was replacing the previous low-income occupiers. The volume of waste was increasing and there was an unsatisfied demand for better waste management processes, namely, better methods for collection, storage and disposal especially from the household. Alternative and environmentally sustainable methods, such as recycling, minimization of waste at source might be a better option but this requires awareness creation and good will of the residents.

The local authority needs consonant review of its solid waste management in order to improve on the efficiency in waste handling and encourage greater community participation and private collectors. Figure 4.1 illustrate an effective solid waste management process in a residential neighborhood.

Figure 4.1 Conceptual framework



Source: (Author), 2006

Solid waste management processes, that is, generation, storage, transfer, transportation and finally disposal need to be well coordinated at household and other levels for it to be effective. Individuals in households, waste collectors and other interested parties need to know and play their role as far as waste handling inside and outside the house is concerned. Appropriate refuse storage within the house and its eventual transfer to a bigger storage within the plot, need to be the main concern of households. Availability of

storage facilities within the plot and method of transfer from the plot to a temporary holding area near the neighborhood need is the responsibility of landowners/landlords. The provision of temporary storage within the plot is imperative for the success of solid waste management up to this level. NGO/CBO should be educating the community on new approaches in waste handling as well as on the need to help in keeping the environment clean and safe.

Landowners who manage the residential houses should be responsible for disposal from the plots through engaging the private collectors. Local authority collectors have gaps, although the local authority should also play its part. It should enforce the relevant by-laws to ensure that policies that address adherence to laid down regulations within the society are followed. Full participation of all actors in their respective roles is therefore needed for efficient and effective solid waste management.

CHAPTER FIVE:

CONCLUSION AND RECOMMENDATIONS

5.0 Conclusions

The study noted that congestion of buildings and people was not necessarily the only contributing factor of waste mismanagement problems but that there are also other factors. Although it was a general that residents in the study area had little waste for their number, the study found that their general indifference towards to their 'little' waste in particular or about waste management in general. The study found that this was one of the contributing factor to the poor the waste handling in the study area. There were particular tenants who view the issue of waste handling process as the duty of their landlords. There were some residents who were concerned with waste management and kept their compounds clean even by hiring private waste collector.

Lack of storage facilities within the compounds was another major contributing factor toward mismanagement of waste. The study confirmed there were no provisions of storage facilities within most of the compounds. Local authorities lacked working programme of collecting waste from the neighborhood of this study and accumulation of waste in many areas remained uncollected.

In some compounds, there are no spaces to store the waste, and occupants threw the waste in open space.

There was virtually total disregard of building code laws or ignorance on the part of landlords whose developments extended beyond the authorized plot coverage and set back of buildings away from the plot

boundaries. This left little space for other activities like solid waste management.

Enforcement of environmental laws as relates to waste management was lacking and here was no effort to guide residents on waste control.

There lacked adequate programmes to motivate local people to venture into economic activities like, recycling projects, composting which can minimize on the amount of solid waste generated in the area with some benefit.

The study confirmed the general view regarding the problem of solid waste management in the generally a low-income residential area that, majority of the residents had more priorities as they survived their harsh conditions, to give any significant attention to matters about clean environment. In most cases where they cared, they lacked the ability and help to get rid of the waste around them as was evident during the study. The seriousness of the problem is illustrated in plate 4.5, 4.6, 4.8, 4.18 and 4.20.

From sample survey carried out the issue of waste management problem is partially explained by long delay, resulting to pile-up and lack of storage means for household use. Also wastes collected in specific took too long to dispose or was sometimes never collected, and became eyesore heaps of stinking refuse that posed danger to the health of the residents.

5.1 Recommendations

5.1.1 Local Level

5.1.2 (Neighbourhood) Transfer Station

There is need to start transfer station within neighborhood. Such waste management facilities like transfer stations, processing sites should be subjected to a simple approval process before they can be operational.

5.1.3 Waste Minimization

Although waste recycling and reuse need to be encouraged, waste reduction from the source need a special emphasis in MSWM because is more cost effective and also minimizes environmental pollution.

5.1.4 MSWM Focus

Solid waste management should focus on disposal methods as this was a major problem in the study area. Efficient collection of waste should be preceded by providing or encouraging and facilitating each household to have a standby of storage facility (dustbin). NCC or private collectors as noted should undertake regular collection of waste. There was as is indicated above, a long delay in collection, resulting in piling up of the waste.

5.1.5 Awareness Creation

Awareness creation among residents on the importance of clean environment this is crucial as it was evident that many residents had no interest in whatever happened with the waste from their houses and from neighbourhood, although they should also be facilitated as necessary by the authorities concerned. Educating the locals through NGOs, chief's baraza can help residents to stop throwing their waste carelessly. As noted from interviews, majority of the residents are educated above standard eight 62.7%. This means that they can easily

grasp the basics of clean environmental requirements or impact of dirty environment.

5.2 Local authority Level

5.2.1 Plan of Action

As for planning requirement we should have a solid waste management plan for every residential neighbourhood, approved by the necessary authority enforced at law.

5.2.2 MSWM Recycling

Solid waste recycling or incineration technology, which is now available in many countries, should be encouraged in our residential neighborhoods.

5.2.3 Waste Minimization

While the initial interest in waste management centered on better ways to collect and dispose it, there should be interest in what is termed as "waste minimization", which seeks to reduce waste at all points from the extraction of raw materials, their use in production, in packaging, in distribution and in use and disposal. For a municipality, encouraging waste minimization among households and commercial development can considerably reduce the costs of collecting and disposing of solid wastes. The controversial ban of light plastic bags, which was briefly effected towards the end of the first decade need to be revisited especially because the plastics continue to endanger the environment and their ban, would also help in minimizing waste. The ban had the full backing of the environmentalists, but faced fervent opposition from the business community.

5.2.4 MSWM Authority

Government should create a solid waste management authorities e.g. states solid waste management responsible for regulations and permitting and enforcement in their areas of jurisdiction.

5.3 National level

5.3.1 Master Plan

There should be a master plan on solid waste management and a special solid waste plan for county councils with a special technical team to assist the local authorities and neighborhood staff. This should particularly incorporate: a) private and government upgrading programmes, research, proposals, and other initiatives, whether they are for water provision, sewerage and waste management or for slum upgrading, for which the government provides enabling environment and leadership; b) programmes to enforce building regulations that are widely ignored although this should require the removal of processes which hindered innovation and development; c) the relevant provisions in national and municipal master plans; d) the description of roles about who or which department does what; and provision for funding. This study has established that inadequate provision of sewerage, water and waste disposal services are largely due to the failure in public service delivery and the ignorance or disregard of building regulations by developers and informal structure initiators.

5.3.2 Modernizing MSWM Technology

Inappropriate technology for waste collection and disposal should be avoided currently in use in many developing countries.

5.3.3 Promoting Waste Recycling/Reuse

Authorities and institutions concerned should encourage recycling process in order to reduce waste of resources that go with waste disposal.

5.3.4 Private Sector/Community Involvement

Stakeholders' full involvement should be ensured for the success of solid waste management in urban areas. Among the actor and partners to be involved are:

- i. Households, neighbourhood associations and other service users.
- ii. Non-governmental organizations.
- iii. Local government and
- iv. National government
- v. Private sector and
- vi. External support agencies.

Although donor-supported waste control programmes, had made substantive positive contribution to environmental conservation and management, their sustainability have been poor. The programmes were at times, adversely affected by poor coordination between relevant governmental institutions and local communities and groups, which adversely their effectiveness in waste controls. Just as it was generally the case with public- or other privately funded initiatives in solid waste management, many of these donor-supported programmes were underfunded, badly managed and made little contribution towards reducing environmental pollution. Neighbourhood or Community-based organizations are among the most effective stakeholders at the grass-root level: Olima (undated) states that the neighbourhood associations need to be strengthened by legalizing their status through legislations, and with the formation of coordinating and supervisory umbrella body.

High poverty level in the country, present was another issue that that made an integrated approach to waste management, a matter of priority. Poverty often leads to overuse and destruction of the natural resources, as has been seen in the study area where undesignated dumping by poor urban dwellers, may be out of options, has led to increased air and water pollution. High population growth rate in this and other similar neighbourhoods in Kenyan cities meant the available resource base was increasingly unable to support the population.

Sustainable development in urban neighbourhoods therefore required that the government and other interested parties to take a holistic approach, which addresses the prevalent illiteracy poverty, disease and environmental issues, while pursuing diverse social-development programmes while pursuing diverse development programmes (Ngugi, 2007).

Gulis, (2008) notes in a study on the health status of the people living in slums in Nairobi, that big numbers of them are rendered unproductive after contracting preventable diseases such as respiratory and gastrointestinal ailments that are most prevalent there. “[The] problems signify that improvements in air pollution reduction, drinking water provision, and waste management in slums can lead to more significant and sustainable improvements in health status than just simple treatment”, adds the study. It concluded that more investment and planning in health and environmental programmes would provide a need relief in the poor neighbourhoods

This study therefore suggests waste disposal and other infrastructural municipal services should be important ingredients in the developmental programmes that should ideally, be well funded through

devolved structures, backed by research in all the areas of concern, have community participation and private-public partnership.

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Appendices I

Summary of data analysis: interviewees responses

Total number of households interviewed 300

Questionnaires number

1. Household head	-	Male	-	69.0%
	-	Female	-	31.0%
2. Age	-	under 24	-	22.3%
	-	25-34	-	17.3%
	-	35-44	-	6.3%
	-	45-54	-	37.7%
	-	55-64	-	4.3%
	-	Over 65	-	3.7%
3. Level of education	-	Primary	-	20.7%
	-	Secondary	-	42.0%
	-	College	-	31.0%
	-	None	-	6.3%
4. No of member of family	-	Less than 3	-	34.7%
	-	3-5	-	47.0%
	-	5-10	-	16.2%
	-	More than 10	-	2.0%
5. Occupation	-	Self employed	-	58.0%
	-	Employee of a private	-	19.3%
	-	Employee of a government public sector	-	6.0%
	-	Retired	-	7.0%
	-	Other	-	9.7%
6. Principle commercial activity of the establishment	-	Trading in ready made goods	-	25.7%
	-	Trading in farm produce	-	15.5%
	-	Restaurant café bar	-	4.7%
	-	Bank	-	1.7%
	-	Other (specify)	-	33.6%
7. Tenant/owner	-	Tenant	-	67.6%
	-	Owner	-	32.3%
8. No of household	-	1	-	7.7%

	-	More than 2 and less than 5	-	12.0%
	-	More than 5 and less than 10	-	16.7%
	-	More than 10	-	63.6%
9. Size of plot	-	Less than ¼	-	37.7%
	-	¼ Acre	-	29.7%
	-	½ Acre	-	20.0%
	-	More than ½ Acre	-	12.7%
10. Build up area	-	Less than 25%	-	5.7%
	-	25% -50%	-	18.3%
	-	50% - 80%	-	44.7%
	-	More than 80%	-	31.3%
11. Type of residence	-	Single Storey	-	84.0%
	-	Double Storey	-	7.7%
	-	More than 1 Storey	-	6.3%
12. No of dwelling units	-	1	-	8.3%
	-	More than 1<5	-	38.3%
	-	More than 5<10	-	23.0%
	-	More than 10	-	30.0%
13. Type of construction	-	Conventional	-	35.0%
	-	Non conventional	-	65.0%
14. Waste disposal	-	Use of plastic paper bag	-	47.0%
	-	Plastic containers	-	28.7%
	-	No formal method	-	24.3%
15. Approximate volume of waste per week	-	Less than 1 kg	-	20.0%
	-	More than 1 kg and less than 5 kg	-	52.0%
	-	More than 5 kg and less than 10 kg	-	20.7%
	-	More than 10 kg	-	7.0%
16. Any collection point	-	Yes	-	56.7%
	-	No	-	43.3%
17. Any collection service	-	Yes	-	44.0%
	-	No	-	52.3%
	-	Don't know	-	3.7%
18. Any container for storing-solid waste	-	Yes metal or plastic container	-	44.0%
	-	Basket or carton container	-	17.7%
	-	No container	-	36.7%
	-	Don't know	-	1.7%
19. Where is container	-	Within Compound	-	48.7%

emptied	-	Collection point	-	15.3%
	-	Outside compound	-	36.0%
20. Frequency of emptying	-	Several times each day	-	3.7%
	-	Daily	-	27.0%
	-	Three times a week	-	7.3%
	-	Twice a week	-	19.7%
	-	Once a week	-	13.3%
	-	Less frequently	-	16.3%
	-	Don't know	-	4.3%
21. Who collects waste from collection point	-	Owner	-	13.0%
	-	City council employees	-	0.3%
	-	Private people employee	-	42.3%
	-	Self	-	20.0%
	-	Neighborhood group	-	8.0%
	-	I don't know	-	16.3%
22. How often is waste collected from the compound	-	Daily	-	10.7%
	-	Once a week	-	40.0%
	-	Once a month	-	23.7%
	-	None at all	-	16.7%
	-	I don't know	-	9.0%
23. How far is the collection point	-	Less than 30 m	-	76.0%
	-	More than 30 m but less than 50 m	-	19.0%
	-	More than 50 m	-	2.0%
	-	I don't know	-	3.0%
24. Who pays for collection?	-	Self	-	16.3%
	-	Owner	-	53.0%
	-	NCC	-	1.7%
	-	Private collector employer	-	3.7%
	-	Other (specify)	-	19.7%
25. If you pay for collection How much?	-	Less than 100 per month	-	3.3%
	-	More than 100 but less than 300	-	14.7%
	-	More than 500 per month	-	8.7%
	-	Other (specify) 900 per month	-	45.0%
26. Who cleans the litter?	-	Residents	-	77.3%
	-	NCC	-	15.3%
	-	None	-	4.0%
	-	Other (specify)	-	6.3%
27. Disposal site	-	Next to Naivasha road-Nairobi River junction	-	18.7%

	-	Dandora disposal site	-	0.7%
	-	To the farm	-	14.7%
	-	Not known	-	66.0%
28. Is location of collection point a nuisance	-	Yes	-	66.0%
	-	No	-	34.0%
29. Access to residence	-	Too narrow for vehicle access	-	29.0%
	-	Enough for vehicle access	-	71.0%
30. Type of access	-	Earth road	-	85.0%
	-	Murram	-	10.7%
	-	Tarmac	-	4.3%
31. Problem of solid waste collection	-	Very serious	-	61.7%
	-	Somewhat serious	-	18.0%
	-	Not serious	-	19.7%
	-	Other (specify)	-	0.7%

Appendices II

Sample questionnaire

**UNIVERSITY OF NAIROBI
DEPARTMENT OF URBAN AND REGIONAL PLANNING**

**TITLE OF STUDY: DENSIFICATION OF URBAN RESIDENTIAL
SPACE AND ITS EFFECT ON SOLID WASTE
MANAGEMENT: A case study of Kawangware
Residential Neighbourhood**

Any information provided during the study shall be kept confidential and used for academic purposes only.

Name of interviewer:

Date of interview:

Place of interview (zone):

Name of interviewee: (optional)

QUESTIONNAIRES

1. Household head

a) Male

b) Female

2. What is your age?

a) Under 24

b) 25 to 34

c) 35 to 44

d) 45 to 54

e) 55 to 64

f) Over 65

3. What is your level of education?

- a) Primary
- b) Secondary
- c) College
- d) None

4. How many members of the household?

- a) Less than 3
- b) 3 – 5
- c) 5 – 10
- d) More than 10

5. What is the occupation of the principle income earner in the household?

- a) Self employed
- b) Employee of a private company
- c) Employee of a government public sector
- d) Retired
- e) Other

6. (If an establishment) what is the principle commercial activity of this establishment?

- a) Trading in ready made goods
- b) Trading in farm produce
- c) Restaurant café bar
- d) Bank
- e) Other (specify)

7. Are you a tenant/owner?

- a) Tenant
- b) Owner

8. How many households are there in the compound you are residing?

- a) 1
- b) More than 2 and less than 5
- c) More than 5 and less than 10
- d) More than 10

9. How big is the plot in which you are residing?

- a) Less than ¼ Acre
- b) ¼ Acre
- c) ½ Acre
- d) More than ½ Acre

10. What is the ratio of built up area to open space?

- a) Less than 25%
- b) 25% - 50%
- c) 50%-80%
- d) More than 80%

11. Type of residence

- a) Single storey
- b) Double storey
- c) More than 1 storey

12. Number of dwelling units

- a) 1
- b) more than 1 < 5
- c) more than 5 < 10
- d) more than 10

13. Type of construction materials

- a) Conventional

b) Non conventional

14. How do you dispose solid waste from the house to the collection point?

- a) Use of plastic paper bag
- b) Plaster containers
- c) No formal method

15. Approximate volume of waste per week.

- a) Less than 1 kg
- b) More than 1 kg and less than 5 kg
- c) more than 5 kg and less than 10 kg
- d) more than 10 kg

16. Is there a nearby collection point?

- a) Yes
- b) No

17. Does your household (or establishment) receive a collection service of any type?

- a) Yes
- b) No
- c) Don't know

18. Does your household (or establishment) have a durable metal or plastic container for storing solid waste?

- a) Yes we have metal or plastic container
- b) We have a basket or carton container
- c) No we don't have a container
- d) Don't know

19. Where is your container emptied?

- a) Within compound

b) Collection point

c) Outside compound

20. How frequent is your container usually taken out to be emptied?

a) Several times each day

b) Daily

c) Three times a week

d) Twice a week

e) Once a week

f) Less frequently

g) Don't know

21. Who collects solid waste from the collection point within your compound?

a) Owner

b) City council employees

c) Private people employ

d) Self

e) Neighbourhood group

f) I don't know

22. How often is solid waste collected from within your compound?

a) Daily

b) Once a week

c) Once a month

d) None at all

e) I don't know

23. How far is the collection point?

a) Less than 30 m

- b) More than 30 m but less than 50 m
- c) More than 50 m
- d) I don't know

24. Who pays for the collection of solid waste?

- a) Self
- b) Owner
- c) NCC
- d) Private collector employer
- e) Other (specify)

25. If you pay for the collection

How much?

- a) Less than 100 per month
- b) More than 100 but less than 300
- c) More than 500 per month
- d) Other (specify)

26. Who is responsible for cleaning of the littered solid waste in the neighbourhood?

- a) Residents
- b) NCC
- c) None
- d) Other (specify)

27. When solid waste is collected from your neighbourhood where is it taken?

- a) Disposal site next to Naivasha road
- Nairobi river junction
- b) Dandora disposal site
- c) To the farm
- d) Other (specify)

28. Is presence of collection point within your neighbourhood a nuisance?

a) Yes

b) No

29. How is the access to your residence

a) too narrow to allow vehicles access

b) enough for vehicle access

30. What type of access?

a) Earth road

b) Murrum

c) Tarmac

31. In your opinion how serious is the problem of solid waste collection in this area?

a) Very serious

b) Somewhat serious

c) Not serious

d) Other (specify)