Solid Waste Management and Risks to Health in Urban Africa

A Study of Nairobi and Mombasa Cities in Kenya

African Population and Health Research Center

Urban Africa Risk Knowledge

Table of Contents

List of Tables

List of Figures

List of Equations

Abbreviations

ARK	Africa Risk Knowledge
APHRC	African Population and Health Research Centre
CBO	Community Based Organization
DFID	Department for International Development
EA	Enumeration Areas
EIA	Environmental impact assessment
EMCA	Environmental Management and Coordination Act
ESRC	Economic and Social Research Council
FGD	Focus group discussion
GFDR	Global Facility for Disaster Reduction
HBM	Health belief model
HPN	Humanitarian Practice Network
IDI	In-depth interviews
IETC	International Environmental Technology Centre
IFRC	International Federation of the Red Cross
KII	Key informant interviews
MSW	Municipal solid waste
NEMA	National Environmental Management Authority
NGO	Non-governmental Organization
ODK	Open data kit
PPS	Probability proportional to population size
PSU	Primary sampling unit
SW	Solid waste
SWM	Solid waste management
UN	United Nations
UNEP	United Nations Environment Programme
UNDESA	UN Department of Economics and Social Affairs
UNDSDR	UN Strategy for Disaster Reduction
USU	Ultimate sampling unit

Acknowledgements

The Urbanization and Wellbeing Research Program of the African Population and Health Research Center acknowledges the contributions of many individuals and organizations, which led to the successful implementation of the Solid Waste Management and Risks to Health in Urban Africa study in the cities of Nairobi and Mombasa, Kenya. The team would like to particularly appreciate the Urban Africa: Risk Knowledge (Urban ARK) consortium under which the Solid Waste Management project is a partner and Professor Mark Pelling, the Urban ARK Principal Investigator, for his leadership and support. We acknowledge the funding of the Urban ARK research program by DFID and ESRC United Kingdom. The Urban Africa: Risk Knowledge Programme is funded by the Economic and Social Research Council (ESRC) and the UK Department for International Development (DFID) Humanitarian Innovation and Evidence Programme, grant code:ES/L008777/1. The views expressed do not necessarily reflect those of the donors. We thank the Executive Leadership Team of African Population and Health Research Center, led by Dr. Alex Ezeh, for their support and guidance of the team. We acknowledge the support of Sammy Oyombe and the Kenya National Bureau of Statistics for providing a sampling frame and for offering their expertise in mapping and other field logistics.

We acknowledge the support of the late Elijah Agevi and his team at Research Triangle Africa, led by Paul Mbatha, who kept his legacy alive by working with the APHRC team to implement the qualitative fieldwork in both Nairobi and Mombasa. We would like to appreciate the field staff whose dedication to their work was exemplary. We also acknowledge the office staff who worked together with the field teams to ensure data collected were of high quality. We are indebted to stakeholders in the SWM sector and community leaders - chiefs and village elders - who were the first port-of-call in the study areas. Their support to field teams was critical to the success of this study. We are especially appreciative of the community members who took time off their busy schedules to respond to the survey, providing us valuable data without which this report would not have been written. We would also like to acknowledge the contribution of numerous internal and external reviewers of the report who gave valuable input during the report writing process.

Executive Summary

Introduction

This report documents household characteristics, solid waste management (SWM) and the associated risks to health in two cities in Kenya. The study was conducted in the communities of Korogocho/Dandora, Saika and Makadara in Nairobi, and Bamburi and Kisauni in Mombasa. Korogocho/Dandora are slum and low income locations primarily bordering the main municipal dumpsite (Dandora); Saika is located farther from the dumpsite but exposed to SWM-related secondary hazards such as pollution and flooding; Makadara is a non-slum comparison study site. In Mombasa, the study sites were Mwakirunge in Bamburi location that is the proximal community to the city's dumpsite, and Bombolulu, a non-slum settlement in Kisauni location, which is prone to flooding.

The selection of the communities was informed by the need to examine the commonalities and differences as well as the magnitude of perceived risks vis-à-vis SWM practices in the respective locations. Having a clear understanding of the issues in each of the locations is important for informing context-specific policies and programmes aimed at mitigating risks associated with SWM in the respective communities. There was, however, no clear distinction between slum and non-slum communities in Mombasa. In particular, Mwakirunge settlement has a sparse population that is made up of small-scale farmers. Bamburi itself is a large area with a mixture of middle class and gated communities about 15 kilometres away from the dumpsite. Kisauni location also has a mixture of slum and non-slum settlements that are both exposed to garbage heaps/temporary dumpsites created by waste collectors and residents besides being prone to flooding.

Background

Solid waste -- which includes household refuse, non-hazardous solid waste from industrial and commercial institutions (including hospitals), market waste, yard waste and street sweepings -- have been identified as an indicator of societal lifestyles and production technology. However, improper solid waste management is linked to a wide range of risks including the stagnation of economic development, incidence of diseases, environmental degradation, climate change, and deterioration of livelihoods. This is especially the case in urban settlements where huge amounts of municipal waste is generated. In many cases, municipal waste is not well managed in developing countries, as cities and municipalities are unable to cope with the accelerated pace of waste production. The level of waste collection is often lower than 70% in low-income countries while more than 50% of the collected

waste is often disposed of through uncontrolled landfilling and about 15% processed through unsafe and informal recycling. In cities throughout Africa, as in other developing regions, rapid population growth as well as expansion of service and manufacturing sectors have led to an increase in the amount of solid waste produced, while its management has remained highly deficient. This is especially the case in poor areas such as slums where limited or no waste collection takes place. If waste is collected, it is improperly disposed of, typically in open dumpsites or landfills, which are frequently situated in close proximity to urban informal settlements. The consequences of poor SWM within cities and big municipalities in relation to public health and the environment, and ultimate adverse impacts on the quality of life of all citizens, are well documented in the literature.

Lack of formal systems to sort waste at source, and to control leakages and gas from dumpsites exposes surrounding communities to a spectrum of health risks and threatens the environment. At the same time, materials that are recovered for recycling – mainly by informal and small-scale operations – are likely contaminated, thus affecting their safety for re-use. Existing evidence points to disproportionate expenditure on collection versus disposal, poor municipal administrative capacity, lack of public funding, and lack of adequate skilled staff and equipment as key institutional constraints to appropriate SWM. The SWM system in Kenya is not different. Municipalities all over Kenya are faced with a huge challenge in managing the increasing production of municipal waste. For example, the Dandora dumpsite in Nairobi is overflowing with waste, with negative consequences on the environment and health of the surrounding communities. However, lack of data at local levels across African cities has been identified as a major hindrance to answering questions critical to the health needs of the urban poor, addressing the great health inequities in urban areas, pinpointing priorities and improving urban health programming (Satterthwaite, 2014). In order to address these gaps, the African Population and Health Research Center launched a solid waste management research project in Nairobi and Mombasa that focuses on the man-made hazard of poor SWM, the consequent loss to health, and associated secondary hazards. It builds on the primary goal of SWM, which is to protect the health of the population, particularly that of low-income groups, as well as the secondary goals of promotion of environmental quality and sustainability, support of economic productivity and employment generation. The summary of the key findings are presented below.

Households' and respondents' characteristics

Chapter 2 examines the characteristics of the sampled households as well as respondents. A total of 1158 and 1237 households in Nairobi and Mombasa, respectively, were included in the study. The average household size in Nairobi and Mombasa was 3.5 and 3.3, respectively. Slum communities in both cities had larger households (3-6 members) than non-slum locations. The main sources of drinking water in both cities were water piped into dwellings and compounds as well as public tap/standpipe. Residents in Korogocho/Dandora accessed

drinking water through water piped into their compounds (46%) or public taps (47%), while in Makadara majority of residents (64%) had water piped into their dwellings. In Mombasa, most of the residents in Bamburi and Kisauni (52% and 41%, respectively) accessed drinking water through public taps, while a higher proportion of those in Kisauni than Bamburi (37% and 14%, respectively) accessed the commodity through water vendors.

Regarding the age structure of the study population, more than one-third of household members were below 15 years of age in all the study sites except in Makadara, where the proportion was lower (21%). The age structure of Makadara community was also different in that it had a higher proportion of the study population aged 45-54 years (28%) and 55 years and above compared with other sites. Majority (95%) of the study population had ever attended school (93% in Mombasa and 98% in Nairobi). In both cities, over 90% of children aged 5-14 years were attending primary school at the time of the survey.

Solid waste storage, collection and disposal

Chapter 3 describes SWM practices such as storage, collection and disposal. The results showed differences in waste storage practices between communities in the two cities. Majority of households in Nairobi (85%) and 52% of those in Mombasa used plastic bags to store their waste. Open containers were the second most common forms of waste storage in both cities. There were also differences in the use of common collection points, with more households in Mombasa (15%) than Nairobi (0.7%) using such points. Results also indicate that majority of households in the study sites had their garbage collected between 4-6 times in a month, although the proportion was substantially higher in Nairobi (92%) than Mombasa (49%). Majority of households reported disposing waste together with toxic waste, with the proportion being higher in Nairobi (87%) than Mombasa (76%). Although most respondents had heard about recycling and composting, waste reduction practices through these methods were very low. This presents an opportunity for community sensitization to raise awareness among the public on the importance of waste reduction. A considerable proportion of households reported not receiving any waste collection services although majority of respondents indicated willingness to sort household waste, which also presents opportunities for authorities in both cities to encourage safe disposal of waste while protecting recyclables from contamination by other waste streams. At the community level, majority of respondents indicated that garbage from streets was taken to dump sites, while burning of wastein the street was a more common practice in Mombasa than in Nairobi.

Health and environmental risks associated with poor solid waste management

Chapter 4 examines the perceptions of risks associated with exposure to solid waste, potential associated health risks, and how actions have been or have not been taken to respond

to and mitigate the risks that could affect health. In Nairobi, 87% of respondents indicated that there are health risks associated with poor solid waste management. In Mombasa, 99% of respondents who reported that there are risks associated with exposure to solid waste mentioned health concerns. Households primarily exposed to dumpsites perceived themselves at high or very high health risks compared with non-exposed communities. In Nairobi, a higher proportion of respondents from Korogocho/Dandora (80%) than from Saika (57%) or Makadara (54%) rated their health risk emanating from poor solid waste as moderate, high or very high. In Mombasa, 56% of respondents in Bamburi and 61% of those in Kisauni rated their health risks associated with poor solid waste as moderate, high or very high, respectively. In all sites in Nairobi and Mombasa, about 97% of respondents reported that children are the most-at-risk group in terms of exposure to solid waste and associated health effects. Self-reported health outcomes in the past 12 months preceding data collection are related to exposure to dumpsites, especially in Nairobi where a higher proportion of households in Korogocho/Dandora (36%) than in Makadara (6%) reported an illness. In Mombasa, there was no major difference in self-reported illnesses between the two sites (15% in Kisauni and 14% in Bamburi).

Similarly, specific self-reported illnesses -- diarrhoea, respiratory and skin problems -- follow similar trajectories across the two cities, with higher incidence being reported from households primarily exposed to dumpsites, especially in Nairobi, than in non-exposed sites. In all sites, diarrheal diseases were the most commonly reported illness associated with exposure to poor solid waste management. Respiratory conditions, malaria and allergies were the other important conditions associated with poor solid waste management. Respiratory conditions were prominently mentioned in Korogocho/Dandora in Nairobi compared with other sites. This is likely due to the location of the site near the municipal dumpsite where pungent fumes from the burning waste emanate and affect the dense population living in the neighbourhood.

Violence and crime in solid waste management

Chapter 5 examines community perception of violence and crime in the solid waste management (SWM) sector in Nairobi and Mombasa. The results showed that a higher proportion of respondents in Korogocho/Dandora (62%) and Saika (60%) than in Makadara (27%) reported that their communities had experienced related crime/conflict. Respondents attributed conflict to competition among SWM players. In Mombasa, a higher proportion of respondents in Kisauni (36%) than Bamburi (29%) reported that their community had experienced related crime/conflict during the period preceding the survey. Low prevalence of crime in Bamburi (official dumpsite) relative to Kisauni was attributed to some level of trust between dumpsite users and members of the neighbouring communities. The common type of crime that the communities experienced was armed robbery, reported by 51% of respondents in Korogocho/Dandora, 50% of those in Saika, and 46% of participants in Makadara. This was followed by fights and disputes, with Makadara reporting the highest proportion of fights (14%) and disputes (27%). In Mombasa, a higher proportion of respondents in Kisauni (78%) than

in Bamburi (38%) reported armed robbery as a type of crime their community experienced. In the two cities, women were identified as the primary victims of violence and crime. The extent to which these incidents can be attributed to struggles by different interest groups in the SWM sector requires further investigation, but it opens an important area for research investment in the search for pathways to build safe neighborhoods and inclusive cities.

Community voices regarding improving solid waste management

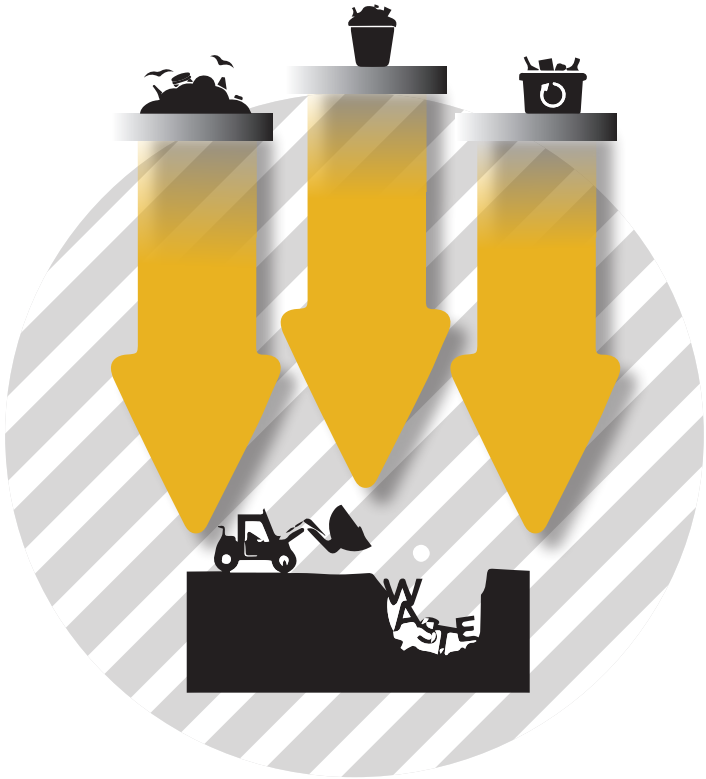
Chapter 6 assesses community voices on what needs to be done to improve the state of SWM in the study sites. Results revealed that lack of awareness among the residents of the two cities was the main cause of poor SWM. People seemed unaware of the need to keep the environment free of litter and instead, there was indiscriminate dumping within residential areas.

Participants from informal collection groups expressed a need to have better equipment to improve service delivery to households they serve, as well as transportation of waste to the designated dumpsites. Besides equipment, they also needed protective gear to avert adverse effects of exposure to solid waste on their health. They further called for support from county governments through recognition of their roles as complementary service providers rather than a hindrance to the achievement of better solid waste management.

Informants from civil society organization (CSOs) and non-governmental organizations (NGOs) working in informal areas of Nairobi called for stronger partnerships between the county government and their institutions as well as with community-based organizations (CBOs) providing waste collection services to residents in under-served areas. The results also indicated that policy considerations needed to be given priority especially with regard to land use and city planning to ensure proper siting of landfills/dumpsites.

Some participants were of the view that the county governments and the National Environment Management Agency (NEMA) had roles that needed to be harmonized or synchronized. There was concern over the continued dumping of mixed waste streams with no attempt to separate at source. Whereas this was not a popular opinion among waste pickers who were concerned that waste separation at source would rob them of their incomes, local authority officials and bilateral agency officers felt this was a necessary step towards improving the solid waste management situation in the country. In addition, respondents emphasized the need for the county governments to invest in the latest technologies to safely handle waste and move away from open dumpsites.

Chapter 1



INTRODUCTION

Blessing Mberu Tilahun Haregu Kanyiva Muindi

1.1 Background

Half of the world's population currently lives in urban environments, a share that is set to rise further in coming decades, partly reflecting the perceived attractiveness of cities – compared to rural settings – as they offer a potentially greater choice of housing, employment opportunities, education and health services (Royal Tropical Institute, 2013). It is, however, estimated that one-third of the world's urban population (about one billion) live in slums, most of them without access to decent housing or basic services such as clean water supply and decent sanitation, and where disease, illiteracy and crime are rampant (UN-Habitat, 2006). These factors impact the health and well-being of slum dwellers due to exposure to non-communicable diseases, alcohol- and drug-abuse, psychiatric problems, accidents and injuries, as well as infectious diseases (Royal Tropical Institute, 2013).

According to estimates by UN-Habitat, 200 million people in sub-Saharan Africa lived in slums in 2010, representing 62 per cent of the region's urban population, which was the highest rate in the world (UN-Habitat, 2013). Within this context, and as part of broader debates on the implications of further rapid urbanization for development and poverty reduction in the region, there is growing attention to urban environmental risks that threaten the well-being and prospects of city dwellers, especially the poor. Key among these concerns is the primary man-made hazard of poor solid waste management (SWM) and associated secondary hazards such as increasingly frequent flooding in the context of climate change and an expansion and densification of urban settlements (Adelekan, 2010; Jabeen et al. 2010; Sakijege et al. 2012).

Solid waste, which includes household refuse, non-hazardous solid waste from industrial and commercial institutions (including hospitals), market waste, yard waste and street sweepings have been identified as an indicator of societal lifestyles and production technology (Schubeler et al. 1996). However, improper solid waste management (collection, transfer, treatment, recycling, resource recovery and disposal of solid waste) is linked to a wide range of risks including the stagnation of economic development, the proliferation of disease, environmental degradation, a threat to climate change and ultimate impact on livelihoods. This is especially true in urban settlements where huge amounts of waste are generated within a very small area. In particular, disastrous impacts of poor solid waste management within cities and big municipalities in relation to public health, the environment and quality of life of all citizens have been well documented (National Environment Management Authority, 2014).

The estimated quantity of Municipal Solid Waste (MSW) generated worldwide is 1.7 – 1.9 billion metric tons (UNEP, 2010). In many cases, municipal waste is not well managed in developing countries, as cities and municipalities cannot cope with the accelerated pace of waste production. Waste collection rates are often lower than 70 per cent in low-income countries and more than 50 per cent of the collected waste is often disposed of through uncontrolled landfilling while about 15 per cent is processed through unsafe and informal

recycling (Chalmin & Gaillochet, 2009). In cities throughout Africa, as in other developing regions, rapid population growth as well as expansion of service and manufacturing sectors have led to an increase in the amount of solid waste produced, while its management has remained highly deficient (UN-Habitat, 2013). On the one hand, especially poor areas experience limited or no waste collection and on the other, refuse is removed but improperly disposed of, typically in open dumpsites or landfills, which are frequently situated in close proximity to the city, especially near informal settlements.

A dearth of formal systems to sort waste at source, and to control leakages and gas from dumpsites, exposes surrounding communities to a spectrum of health risks and threatens the environment due to the contamination of ground water and soil, as well as air pollution resulting from the combustion of untapped gases. By the same token, materials that are recovered for recycling – mainly by informal and small-scale operations – are likely contaminated, which negatively impacts their safety and potential for re-use (CalRecovery Inc. & UNEP International Environmental Technology Centre -IETC- 2005; Hoornweg & Bhada-Tata, 2012). Existing evidence points to disproportionate expenditure on collection versus disposal, poor municipal administrative abilities and a lack of public funding, staff and equipment as key institutional constraints to appropriate SWM (UN-Habitat, 2010).

Cities are placed at the nexus of further threats to the environment through the production of a rising quantity and complexity of wastes. Furthermore, city dwellers are increasingly exposed to a multitude of hazards, across a range of natural and human-induced disasters, a broad spectrum of infectious and parasitic diseases and accidents, including shack fires and road accidents (Humanitarian Practice Network, 2006; International Federation of the Red Cross-Crescent Societies, 2010; Pelling & Wisner, 2009; The World Bank and Global Facility for Disaster Reduction, 2010). However, the impacts of everyday hazards and small-scale disasters are widely under-estimated mainly because they fail to meet the criteria to qualify as disasters by international standards, resulting in a significant share of damage to housing, local infrastructure, and livelihoods while low-income households affected by such disasters are overlooked (Pelling & Wisner, 2009; United Nations Strategy for Disaster Reduction, 2009). Further, little is known about the nature and scale of such disasters in urban areas due to the longstanding rural bias within policy, aid and research agendas (Humanitarian Practice Network, 2006). In addition, lack of data at local levels across African cities has been identified as a major hindrance to answering questions critical to the health needs of the urban poor, addressing the great intra-urban health inequities, and improving urban health programming by implementing agencies and local governments (APHRC, 2014).

It was against the backdrop of limited information on SWM in urban areas of developing countries that APHRC and other partners designed the SWM research agenda in order to generate context-specific information to enhance our understanding of local challenges and inform strategies for addressing them. In this report, we present evidence from a study on SWM and associated loss to health in Nairobi and Mombasa cities in Kenya as part of the wider SWM project in Kenya and Senegal which, in turn, is part of the bigger research program on Urban Africa: Risk and Knowledge.

Nairobi and Mombasa Cities – An Overview

Kenya's urban population grew from 5.4 million in 1999 to 12.5 million by 2009 (Kenya National Bureau of Statistics, 2010) and about 50% of the country's population is estimated to become urban by 2050 (United Nations Department of Economic and Social Affairs, 2014). Nairobi, the country's capital city, is a typical example of an African city that is growing at a rapid rate of over 4% per annum, with a population of 3.1 million in 2009 up from 2.1 million in 1999 (Kenya National Bureau of Statistics, 2010). At the same time, estimates indicate that Nairobi residents produce between 3,000 and 3,200 tons of solid waste (SW) each day while only 50% of this waste is collected, with about 25% of the produced waste reaching the city's municipal dumpsite at Dandora location (United Nations Environment Programme & City Council of Nairobi, 2010). The municipal dumpsite, located 7.5 km east of the central business district, was initially planned as a temporary disposal site for the city, but was declared the official dumpsite in the mid-1970s. It covers an area of 30 acres and receives all types of waste including household, agricultural, industrial and medical. The dumpsite is located close to public institutions like schools and the residential areas of Dandora, Kariobangi and Korogocho, posing a range of health risks to the over 250,000 people estimated to be living adjacent to it, in addition to causing extensive damage to the environment (Kimani, 2007), the close proximity of the dumpsite to the Nairobi River, whose waters are used to grow vegetables that are later sold at various city markets, indicates the potential exposure of almost all residents in the city to contaminants from the dumpsite (Kimani, 2007).

SWM in the city has been characterised by major inefficiencies in waste collection and disposal as well as the absence of a waste reduction and recycling culture among relevant stakeholders. Service provision in SWM has concentrated on collection, transportation and disposal, with little effort geared towards waste reduction and recycling. Much of the recovery of materials is carried out by individual waste collectors who work on the dumpsites or collection points while waste recovery remains low -- accounting for only 10% of waste stream. Stakeholders in the sector have identified challenges of crime and conflicts such as illegal operation by some waste transportation vehicles, vandalism of security fences and equipment on dumpsites and insecurity at disposal sites due to the existence of criminal gangs. Other challenges include land use conflicts between waste management and other competing uses, as well as political interference and patronage, all of which pointed to several policy and program interventions that have been proposed and implemented over the years, including private public partnerships in SWM (National Environment Management Authority, 2014; United Nations Environment Programme & City Council of Nairobi, 2010). However, deterioration in service delivery in the sector has persisted (Fentress, 2012; UN-Habitat, 2010) which suggests the need for new evidence and thinking to inform policy decisions and programmatic actions. This study builds on this gap to challenge the status quo and generate new evidence and new thinking to inform policy and action in the city.

Mombasa is the second largest city in Kenya and is also an important tourist destination and port city on the Indian Ocean. The city's population grew from 665,018 in 1999 to 939, 370 by 2009 with an estimated 299,439 households (Kenya National Bureau of Statistics, 2010). It is characterized by dense residential patterns and high flooding levels associated with poor SWM. It is estimated that between 700-800 tons of solid waste are produced every day; with 68% of the waste being collected and disposed of in the city's open dumpsites while the remainder is dumped on roadsides, open spaces and along the shoreline or burnt (Tan, 2012). The municipal council has been in charge of all SWM services; however, operational challenges including lack of vehicles to transport waste led to the privatization of some SWM services such as the collection and transportation to disposal sites (Tan, 2012). Some challenges still persist owing to poor road networks especially in poor neighbourhoods and those leading to the dumpsites, resulting in indiscriminate dumping of waste on streets and open grounds. Similar to Nairobi, several policies and programs have been implemented in Mombasa, including public private partnership (PPP) with two cement manufacturers based in the city to create a lasting solution to poor SWM through a system of using waste to generate energy (Agevi, 2015). Despite the policy and programmatic interventions, managing the solid waste sector in Mombasa remains a daunting task, suggesting the need for new evidence to reinvigorate actions aimed at addressing the intractable challenge.

1.2 The Urban ARK Programme

A key question regarding urban growth is how cities in Africa, which are experiencing some of the fastest rates of urbanization in the world, can leverage that growth to stimulate economic opportunities, reduce poverty and build resilience. Governments, development agencies and citizen groups in cities across Africa, and globally, are recognising that existing urbanisation trajectories are both part of the solution and part of the problem for a sustainable and resilient future. Addressing the tension between risk and development requires a better understanding of urban processes, improved data collection, and support for city and neighbourhood capacities. The Urban Africa: Risk Knowledge (Urban ARK) programme (funded by DFID-ESRC) responds to the urban resilience agenda by providing a focal point for knowledge generation, policy analysis and capacity building. In urban areas, local governments are responsible for ensuring the development of safe and resilient settlements, but their capacity is weak due to their limited power and resources and often ambivalent relationship with the poorest and most vulnerable groups (Satterthwaite, 2011), underscoring the need for capacity building at local levels. The overarching aim of the Urban ARK programme is evidence generation on the nature and distribution of urban risks, good practices in urban planning and governance, climate change adaptation for environmental and public health, and the institutional arrangements at the local government levels that are required to reduce risk and build resilience to multiple hazards in specifically African urban contexts (Adelekan et al., 2015). Different components of the Urban ARK programme are being implemented across

seven African cities, namely Mombasa and Nairobi (Kenya), Dakar (Senegal), Ibadan (Nigeria), Karonga (Malawi), and Niamey (Niger). The SWM project (an integral part of the overarching Urban ARK's objective) focuses on the man-made hazard of poor solid waste management and consequent loss to health and associated secondary hazards. It builds on the primary goal of solid waste management, which is to protect the health of the population, particularly that of low-income groups, as well as the secondary goals of promotion of environmental quality and sustainability, support of economic productivity and employment generation (Schubeler et al., 1996). The project adopted a three-pronged approach: policy reviews, demographic and epidemiological quantitative and qualitative empirical field studies, and biomedical tests of health and environmental outcomes related to SWM. This report presents the results of the health and epidemiological quantitative and qualitative empirical studies in Nairobi and Mombasa.

1.3 Overview of SWM Policies and Systems

Kenya has more than 77 statutes that relate to environmental concerns. The evolution of Solid Waste Management policy frameworks in Kenya started in the 1960's and includes National Frameworks, Legal Frameworks, Regulatory Frameworks and Implementation guidelines. The main policy documents that preceded the current SWM policies include Penal Code of 1948, Local Government Act, cap 265 (1963), Public Health Act, cap 242 (1986), and Environmental Management and Coordination Act (1999).

The Constitution of Kenya (CoK, 2010) provides the basic foundation for solid waste management policy formulation in Kenya. The National Environment Policy (2013), formulated by the Ministry of Environment, Water, and Natural Resources, contains policy statements relevant to solid waste management. Besides these policy statements, the National Solid Waste Management Strategy (2014) of the National Environment Management Authority (2014) was developed by the National Environment Management Authority (NEMA) and is the most recent government undertaking establishing a common platform for action between stakeholders to systematically improve waste management.

The first set of City of Nairobi by-laws that addressed solid waste management were passed in the 1950s and 1960s while the second set were formulated 40 years later - between 2006 and 2007. Current policy initiatives that inform solid waste management in the city are the Nairobi City Integrated Solid Waste Management Plan (2010-2020), the Nairobi City County Solid Waste Management Bill (2014), and the Nairobi Metro 2030 Strategy (2008). The Municipal Council of Mombasa passed Environmental Management by-laws in 2008. These by-laws were formulated in line with the Environmental Management and Coordination Act (EMCA) of 1999 and are the only policy framework for addressing solid waste management in the city.

The institutional systems for the implementation of solid waste management policies in Kenya have evolved over the years. Before 1990, the two main institutional mechanisms were local authorities (municipal/urban/town councils) and public prosecution (penal code). In the years between 1990 and 2010, additional institutional mechanisms were established. These included the National Environmental Management Authority (NEMA), National Environment Council, Provincial and District Environment Committees, and Public Complaints Committee. In the post-2010 period, other mechanisms to inform SWM were formulated, including Environmental and Land Court; Land, Physical Planning and Environmental departments (country level); National Ministries of Environment and Health; County governments; and Kenya National Cleaner Production Centre. The reports of the analyses of these SWM policies in relation to their evolution, priorities, implementation strategies, and practices have been published elsewhere (Haregu et al. 2016 and Haregu et al. 2017).

1.4 Objectives of the Survey

The overall goal of the SWM project was to generate evidence to inform strategies for managing solid waste in urban areas of developing countries. The specific objectives of the study that was conducted in Nairobi and Mombasa cities of Kenya were to:

a. Explore vulnerability to solid waste hazards and associated health loss and environmental challenges for residents of slum settlements and less deprived areas of the cities;

b. Assess capacities for risk reduction across SWM actors - at government, civil society, and private sector levels;

c. Assess knowledge, attitudes and practices associated with solid waste management and health loss among key stakeholders: generators, handlers, scavengers, and those living in neighbourhood of disposal sites; and

d. Examine the nexus between poor SWM and secondary hazards such as flooding and air pollution.

1.5 Study Design and Approaches

This was a cross-sectional study involving both quantitative and qualitative data collection approaches in purposively identified slum and non-slum settlements in Nairobi and Mombasa cities of Kenya. Data collection on vulnerability encompassed a combination of qualitative and quantitative methods. Investigation of the extent and nature of community-level components of vulnerability drew on key informant and semi-structured interviews with local

level government role players[1], environment and health practitioners[2], cartel leaders and civil society actors. Investigation of individual-level underpinnings of vulnerability employed focus group discussions and key informant interviews, followed by a community based quantitative survey. Investigation of SWM-related health losses employed formative qualitative explorations, entailing focus group discussions and key informant interviews, followed by community-based quantitative surveys. Data collection focused on direct or relevant proxy indicators for health impacts that cannot feasibly be measured in the study settings. Analysis of existing capacity among relevant governance, civil society and private sector actors employed qualitative key informant and semi-structured interviews. Data collection focused on actors' perspectives on their present practice; and key barriers to/enablers of their capacity.

1.6 Study Sites

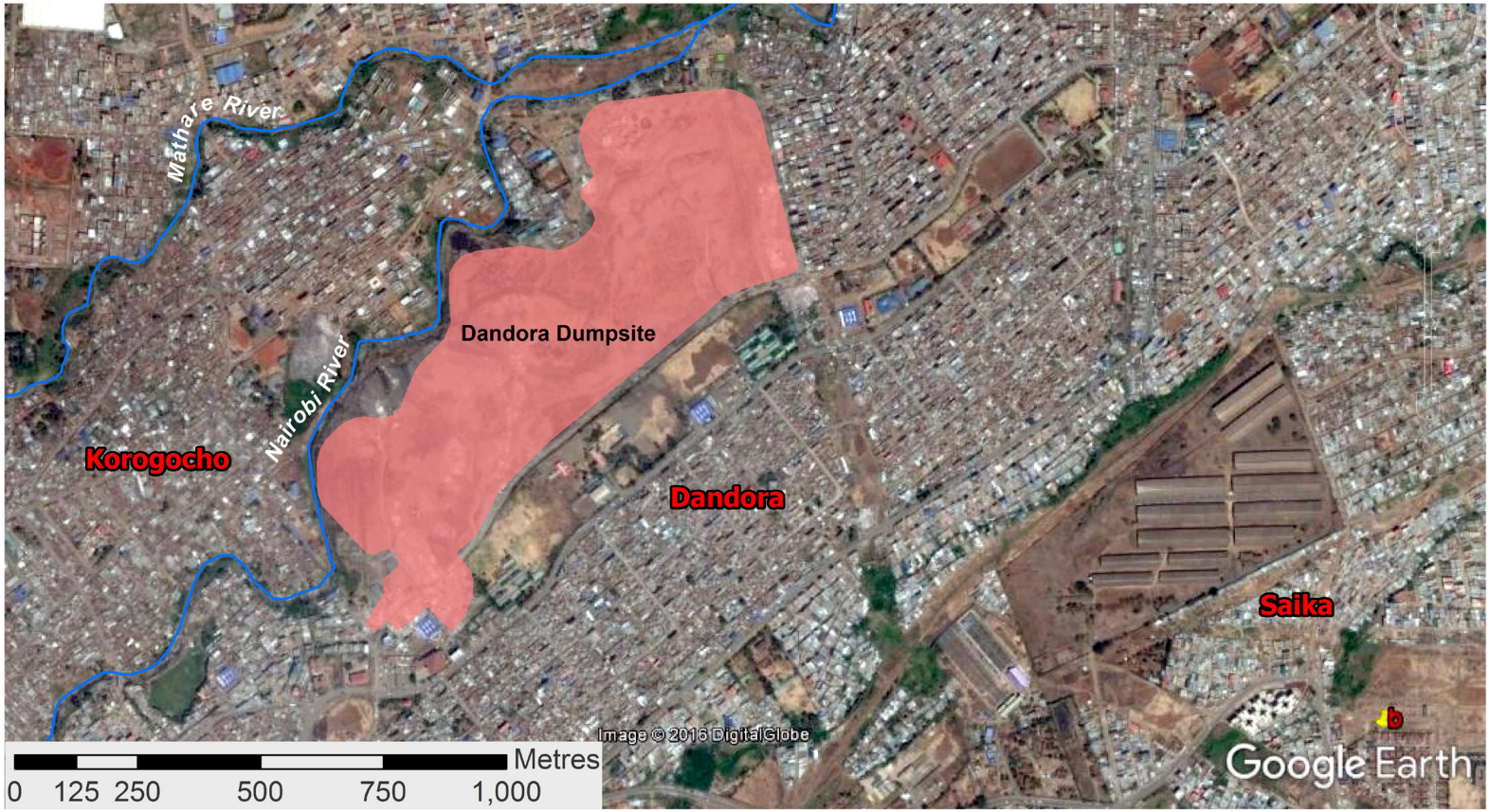
In Nairobi, the study was conducted in Dandora and Korogocho locations that are proximally bordering the main municipal dumpsite (Figure 1); Saika sub-location in Njiru location, which is farther from the main municipal dumpsite but exposed to related secondary hazards of pollution and flooding; and Harambee and Jericho settlements that are the non-slum sites for comparison. In Mombasa, Kenya's second largest city, the study was implemented in Mwakirunge in Bamburi location — which is the proximal community to the city's dumpsite — as well as in Kisauni settlement (prone to flooding) and Bombolulu (a non-slum comparison site) in Kisauni location.

The selection of the communities was informed by the need to examine the magnitude of perceived risks vis-à-vis SWM practices in the respective locations. Understanding the issues in each location for informing policies and programs was aimed at mitigating risks associated with solid waste in the respective communities. There was, however, no clear-cut distinction between slum and non-slum settlements in Mombasa. Mwakirunge settlement in Bamburi location has a sparse population that largely comprises small-scale farmers. However, Bamburi is a large area with a mix of middle class and gated communities about 15 kilometres away from the dumpsite. Kisauni location has also a mix of slum and non-slum settlements that are exposed to garbage heaps and temporary dumpsites created by waste collectors and residents in addition to being prone to flooding.

[1] Chiefs, sub-chiefs, elders (central government), ward representatives, sub-county administrators (county government); local health administration representatives

[2] Ward level supervisors of the county environment/cleansing department; facility and community-based health staff

Figure 1.1: Proximity of Korogocho, Dandora and Saika study sites to the main dumpsite (Dandora) in Nairobi.



Footnote: Harambee and Jericho sites in Makadara (not shown on map) are located approximately 7 km away from Dandora.

1.7 Sample Design

1.7.1 The Sampling Frame for the Quantitative Survey

The sampling frame for the study was the enumeration areas (EAs) in Nairobi and Mombasa, which were generated for purposes of the 2009 Kenya Population and Housing Census, the most recent census in the country. All EAs in the selected locations in the two cities -- Korogocho, Dandora, Harambee (Harambee and Jericho) and the sub location of Saika (Maili Saba) in Njiru Location for Nairobi; Bamburi (Mwakirunge) and Kisauni (Kisauni and Bombolulu) for Mombasa -- had full geographic identification information and maps that were used to identify them on the ground.

1.7.2 Sample Size and Determination

About a total of 2,480 individuals were targeted for inclusion in the quantitative survey (1,240 in each city). The following formula was used to determine the sample sizes:

$$n = \frac{t^2_{\frac{\alpha}{2}} p(1-p) . D_{eff} . Nresp}{\varepsilon^2} \quad \text{.......} (1)$$

Equation 1: Sample size calculation

Where:

n = estimated sample size.

t = is the desired confidence level (at 95%).

p = is the proportion of the population that possesses a given attribute that is key for the survey.

α = the level of statistical confidence, 5% in the case of this study, with which it is desired to conclude that the observed indicators did not occur by chance.

ε = the margin of error to be tolerated, which is 5% in the case of this survey.

$Deff$ = is the design effect which arises from the effect of clustering of individuals within an enumeration area; in this study a design effect of 2 was used.

$Nresp$ = is the potential non-response due to various factors, which include refusal by some respondents; an adjustment of 5% was applied in the calculations to account for non-response.

The sample was allocated to the various locations of Nairobi and Mombasa proportionately to the population sizes of the areas within each of the two cities as described in Section 1.7.3.

1.7.3 Sample Allocation

Stratified cluster sampling was used to identify study participants, with the locations being the strata and EAs within each location being the Primary Sampling Units (PSUs). The targeted sample size for the quantitative survey was proportionately allocated to the selected locations in each city based on the 2009 population sizes.

The procedure for allocating the sample sizes was as follows: First, let $N_1, N_2, N_3, \ldots, N_h$ be the population sizes of each of the strata (location), such that $N= N_1+ N_2+ N_3+\ldots+ N_h$ where N is the total population for all strata and **h** is the number of strata. Likewise, let $\mathbf{n_1, n_2, n_3, \ldots, n_h}$ be the samples allocated to the various strata, such that $\mathbf{n = n_1 + n_2 + n_3 + \ldots + n_h}$ is the total sample size for the survey. The allocation of the sample n to each stratum was done using the following formula:

$$n_h = \frac{N_h}{N} . n \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

Equation 2: Allocation of sample to strata

1.7.4 Cluster Sizes

In each city, a total 62 EAs were targeted for inclusion in the study. The number of EAs was based on the sample size and the targeted number of households for interview in each EA, which was fixed at 20.

1.7.5 Sample Selection

In each city, individuals for the quantitative survey were selected in two stages, starting with the selection of EAs/clusters as the Primary Sampling Units (PSUs) followed by households as the Ultimate Sampling Units (USUs). In each sampled household, the head, or in his/her absence the next senior-most member, was targeted for interview.

1.7.5.1 Selection of Clusters

The number of EAs (clusters) selected in each stratum was proportionately determined based on the number of households in each EA.

1.7.5.2 Selection of Households

Households were systematically identified in each sampled EA/cluster. The survey team carried out a quick count of all the households in each structure in the EA and, based on this information, determined a sampling interval for the selection of the households. The team then moved from one end of the EA to the other selecting households for interview based on the sampling interval.

1.7.6 Computation of Sample Weights

Sampling weights are important for adjusting estimates for unequal selection probabilities, non-response, or known differences between sampled units and reference populations. Cluster weights were computed by taking the inverse of the probabilities of selecting EAs. The procedure for computing the sample was as follows:

Consider that a stratum (location) has a clusters selected for the survey. Assume that the size of the ith EA is mi. Also, let $\sum_{i=1}^{M} m_i$ be the total for the overall size of the stratum (location). The probability of selecting an EA is then given by Equation 3:

$$p_i = \frac{a.m_i}{\sum_i^M m_i}$$

Equation 3: Sample weights

Where:

p is the probability of selecting a given EA.

a is the number of EAs selected in a stratum (location).

m_i is the number of households in the i^{th} EA.

and $\sum_{i=1}^{M} m_i$ is the total number of households in the stratum.

The weight for a given cluster in this case was obtained by taking the reciprocal of p_i, i.e. $w_i = 1/p_i$.

1.7.7 Estimation of Population Parameters

In estimation of weighted population parameters, the sample values for a given variable were multiplied by the cluster weights to obtain weighted estimates. The weighted estimate, T, for a variable x in a given location was given as follows:

$$\hat{T} = \sum w_i \, x_i$$

Estimates involving ratios were obtained by taking the ratio of the weighted estimates of the variables. In particular, the weighted ratio estimate, R, for variables x and y, was obtained as follows:

$$\hat{R} = \frac{\sum w_i x_i}{\sum w_i y_i}$$

Equation 4: Estimating population parameters

1.7.8 Computation of Sample Standard Errors

Standard errors were computed for selected key variables in the study to assess the reliability of the estimates.

1.8 Survey Tools

Structured and semi-structured tools were used to collect quantitative and qualitative data, respectively.

1.8.1 Quantitative Data Collection

A structured questionnaire administered at the household level captured information on knowledge, attitudes and practices regarding SWM. The questionnaire specifically captured the background characteristics of all household members; household characteristics including assets and amenities; household practices regarding solid waste storage, collection and disposal; and health risks related to household exposure to solid waste. The questionnaire was mainly administered to the head of household or, in his/her absence, the next senior-most member.

1.8.2 Qualitative Data Collection

Qualitative tools comprised interview guides for focus-group discussions (FGDs), in-depth interviews (IDIs), and key informant interviews (KII). The FGDs targeted waste pickers, food sellers and community members living around the Korogocho/Dandora (Nairobi) and Mwakirunge (Mombasa) dumpsites to understand their knowledge and perceptions of the risks related to exposure to solid waste. The IDI guide was administered to selected stakeholders including health facility managers around the dumpsite, garbage management authorities in the study sites, garbage collectors and dumpster drivers in order to understand their roles in, perceptions of, and capacity to address the issue of SWM. The KII guide, on the other hand, targeted higher level stakeholders and officials including garbage trucks owners, representatives of the garbage collectors unions, and government officials in charge of SWM at county and national levels. The KIIs captured information on policies around SWM in Nairobi and Mombasa and opportunities for better SWM practices. The number and cadres of participants in the qualitative interviews are summarized in Table 1.1.

Table 1.1: Qualitative interviews by type and cadre

Type of interview	Cadre of respondent	Number	
		Nairobi	Mombasa
Focus-Group Discussions	Waste pickers	2	2
	Community members	1	2
	Collectors	0	1
	Community based organizations (CBOs)/groups	0	1
	Recyclers	0	1
	Total FGDs	3	7
In-depth Interviews	Waste collection company/groups	1	1
	Government representatives in communities	3	4
	Cartel leaders	2	0
	Scavengers	1	0
	Civil society organizations/CBOs	1	1
	Total IDIs	8	7
Key Informant Interviews	Staff from County/Government agencies	6	3
	Bilateral partners	2	1
	NGOs	1	1
	Recyclers	1	0
	Total KIIs	10	5
Total interviews		**21**	**19**

1.9 Fieldwork Procedures

1.9.1 Fieldworker Training

The project recruited 22 competent and experienced research assistants for the quantitative and qualitative data collection processes. The research assistants underwent a three-day intensive field work training using APHRC's training protocol. The training was facilitated by researchers from APHRC who included the principal investigator, project manager, the field coordinator and qualitative specialists. The objective of the training was to provide the field workers with skills regarding their role in the data collection process to ensure high quality data. The training consisted of a combination of theoretical training and practical exercises focusing on the overall aims of the study, the study tools, research ethics and mock interviews. A field-based pilot was also conducted in Korogocho and was followed by a debrief session to learn from the experience.

1.9.2 Fieldwork

Field work was conducted for about three months between April and June 2016. In each city, data collection was undertaken by a team of field workers comprising one supervisor and ten interviewers. In addition, there was a dedicated office editor who was responsible for reviewing the electronic data on a daily basis and providing frequent feedback to the supervisors. We implemented a continuous process of data quality checks in the field using spot checks, sit-in interviews, and editing of completed surveys. For the spot checks, team leaders randomly selected 10% of the households for revisits after the household had been interviewed. Spot checks included a combination of both blinded and non-blinded interviews, with the number of spot checks conducted being equally divided between the two approaches. Non-blinded spot checks involved randomly selecting already collected information and going back to verify the information collected with the concerned households or respondents. In some circumstances, blinded spot checks were carried out by conducting an entirely new interview and comparing with what was originally collected. In rare circumstances, where the inconsistency realized was more than 5%, complete re-interviews were conducted.

The supervisor/team leader was also tasked with investigating any systematic patterns in responses to questions that could be indicative of threats to data quality. The office editor's role was to review all completed interviews, to: a) check for completeness of the data; b) ensure that all relevant questions had been answered; and c) check for data inconsistency. Consistency checks were also built into the quantitative data capture software to ensure that no missing information or implausible values were entered. For qualitative data collection, data were captured on digital recorders in both Kiswahili for local communities and in English for officials. Sit-ins by supervisors were key to ensuring quality data.

1.10 Data Processing

Quantitative data were collected using tablets with the tool programmed in Open Data Kit (ODK). After data collection each day, data were synchronized on a safe APHRC server using Survey CTO from where the information was extracted into analytical software. Further data management in terms of verifying response gaps and missing cases as well as data cleaning were conducted using Stata software. The qualitative data captured on digital recorders were transferred to computers for transcribing by a professional transcriber. Kiswahili interviews were translated into English by the transcriber.

Quantitative data analysis was performed using Stata version 14.0, and for this report, it was involved in generating descriptive statistics (percentages, means and medians). The qualitative data were transcribed, typed in Word and exported to NVivo 9 for analysis. The data were synthesized using thematic, content and narrative analyses. The findings were triangulated with the quantitative results to provide a robust picture of people's perspectives regarding solid waste management and health-related risks arising from poor solid waste management practices.

1.11 Response Rates

The overall response rate out of 2480 sampled households was 96.6% (93.4% in Nairobi and 99.8% in Mombasa; Table 1.2). At site level, the response rates ranged from 78.5% in Makadara to 99% in Korogocho/Dandora and Kisauni. The response rate in Nairobi was lower following refusal of entry to field workers into two clusters in Saika and Makadara locations despite all efforts at community mobilization. The challenge is consistent with the difficulty of interviewers in accessing middle class and high income neighbourhoods and households.

Table 1.2: Response rate for Nairobi and Mombasa

	Clusters	Sampled households	Completed households	Response rate
Nairobi				
Korogocho/Dandora	41	820	812	99.0%
Saika (Maili Saba)	11	220	196	89.1%
Makadara	10	200	157	78.5%
Total	62	1240	1158	93.4%
Mombasa				
Bamburi	26	520	519	98.5%
Kisauni	36	720	719	99.0%
Total	62	1240	1237	98.8%
Overall response rate	**122**	**2480**	**2395**	**96.6%**

1.12 Ethical Considerations

No physical harm to the study communities was anticipated in the course of this study. To minimize other potential social and psychological stress on our respondents during data collection, field workers were trained to ensure that interviews are conducted in a suitable, comfortable and private environment according to participants' preferences. The research team was also trained to listen and observe without displaying any judgmental attitude towards the informants or the information received. They were trained on the meaning and process of informed consent, and the importance of protecting the privacy of participants, and confidentiality of the information obtained from the participants.

Participants were also provided with information about the study before obtaining consent. They were adequately informed about the purpose of the study and methods to be used;

institutional affiliation of the researchers; the right to abstain from participating in the study, or to withdraw from it at any time, without reprisal; and measures to ensure confidentiality of information provided. All participants provided written informed consent. Permission was also obtained from participants in the qualitative interviews for audio-recording the conversations. Participants in the qualitative interviews were identified by code names and interviewed in private settings. Transcripts were stored in password protected computers only accessible to the research teams. To protect the data while in the field, the tablets were password-protected and data were automatically erased as they were transmitted to the central server on a daily basis. Ethical clearance to conduct the study was obtained from Amref Health Africa Ethics and Scientific Review Committee (Ref: AMREF-ESRC P201/2015).

References

Adelekan, I. (2010). Vulnerability of Poor Urban Coastal Communities to Flooding in Lagos, Nigeria. *Environment and Urbanization, 22*(2), 433-450.

Adelekan, Ibidun; Johnson, Cassidy; Manda, Mtafu; Matyas, David; Mberu, Blessing; Parnell, Susan; Vivekananda, Janani. (2015). Disaster Risk and its Reduction: An Agenda for Urban Africa. *International Development Planning Review 37*(1). http://dx.doi.org/10.3828/idpr.2015.4

Agevi, Elijah (2015). *Media Coverage: Solid Waste Management Crisis in Nairobi and Mombasa.* Research Triangle Africa.

APHRC (2014). *Population and Health Dynamics in Nairobi's Informal Settlements: Report of the Nairobi Cross-sectional Slums Survey* (NCSS) 2012. Nairobi: APHRC.

CalRecovery Inc., & UNEP International Environmental Technology Centre (IETC) (2005). *Solid Waste Management* (Vol. II).

Chalmin, Philippe, & Gaillochet, Catherine (2009). *From Waste To Resource: An Abstract of World Waste Survey, 2009.* France: Cyclope and Veolia Environmental Services.

Fentress, K. (2012). Nairobi is Drowning in its Waste. Retrieved 24/5/2016

Government of Kenya (2010). *The Constitution of Kenya 2010.*

Hoornweg, Daniel, & Bhada-Tata, Perinaz (2012). What a Waste: A Global Review of Solid Waste Management *Urban Development Series:* The World Bank.

HPN (Humanitarian Practice Network) (2006). Humanitarian Exchange: Humanitarian Practice Network (HPN).

IFRC (International Federation of the Red Cross-Crescent Societies) (2010). *World Disasters Report 2010: Focus on Urban Risk.* Geneva: International Federation of Red Cross and Red Crescent Societies.

Jabeen, H., Johnson, C. & Allen, A. (2010). Built–in Resilience: Learning from Grassroots Coping Strategies for Climate Change. *Environment and Urbanization 22*(2), 415–431.

Kenya National Bureau of Statistics. (2010). Population Distribution by Age, Sex and Administrative Units. *The 2009 Kenya Population and Housing Census.* Nairobi: KNBS.

Kimani, N. G. (2007). *Environmental Pollution and Impact to Public Health: Implication of the Dandora Municipal Dumping Site in Nairobi, Kenya.* Nairobi: UNEP,

National Environment Management Authority, Kenya (NEMA) (2014). *The National Solid Waste Management Strategy.* Nairobi.

Pelling, M., & Wisner, B. (Eds.) (2009). *Disaster Risk Reduction: Cases from Urban Africa.* London: Earthscan.

Royal Tropical Institute (2013). Sick Cities or Healthy Habitats: Facing the Healthcare Challenges of Global Urbanization Retrieved 26/08/2013, from http://www.nvtg.org/userfiles/files/webversie_congres_sick_cities_2013.pdf.

Sakijege, T., Lupala, J., & Sheuya, S. (2012). Flooding, Flood Risks and Coping Strategies in Urban Informal Residential Areas: The Case of Keko Machungwa, Dar es Salaam, Tanzania. *Jàmbá: Journal of Disaster Risk Studies.*

Satterthwaite, D. (2014). Health in Urban Slums Depends on Better Local Data. Paper presented at the 11th International Conference on Urban Health Manchester, United Kingdom.

Satterthwaite, D. (2011), 'How Can Urban Centers Adapt to Climate Change with Ineffective or Unrepresentative Local Governments?' WIREs *Climate Change*, 2, 767–76.

Schubeler, Peter; Wehrle, Karl; & Christen, Jürg. (1996). *A Conceptual Framework for Municipal Solid Waste Management in Low Income Countries. Urban Management Program.* SKAT. St. Gallen.

Tan Y. J. (2012). The Management of Residential Solid Waste in Mombasa, Kenya: SIT Graduate Institute/SIT Study Abroad.

The World Bank and GFDRR (Global Facility for Disaster Reduction). (2010). *Report on the Status of Disaster Risk Reduction in Sub-Saharan Africa.* Washington, DC: The World Bank.

Tilahun Nigatu Haregu; Abdhalah K. Ziraba; Isabella Aboderin; Dickson Amugsi; Kanyiva Muindi; Blessing Mberu (2017). An Assessment of The Evolution of Kenya's Solid Waste Management Policies and their Implementation in Nairobi and Mombasa: Analysis of Policies and Practices. *Environment and Urbanization,* May-23-2017, 10.1177/0956247817700294.

Tilahun Nigatu Haregu; Blessing Mberu; Abdhalah K. Ziraba (2016). Evolution of Solid Waste Management Policy Landscape in Kenya: Analysis of Evolvement of Policy Priorities and Strategies. *African Population Studies, 30 (2) Supplement:* 2876-2885.

UN-HABITAT. (2006). *The State of the World's Cities Report 2006/2007: 30 Years of Shaping the Habitat Agenda.* Nairobi, Kenya: UN-HABITAT.

UN-Habitat (2010). *Solid Waste Management in the World's Cities: Water and Sanitation in the World's Cities 2010.* London: UN-Habitat.

UN-HABITAT (2013). *State of the World's Cities 2012/2013: Prosperity of Cities* New York: UN-HABITAT.

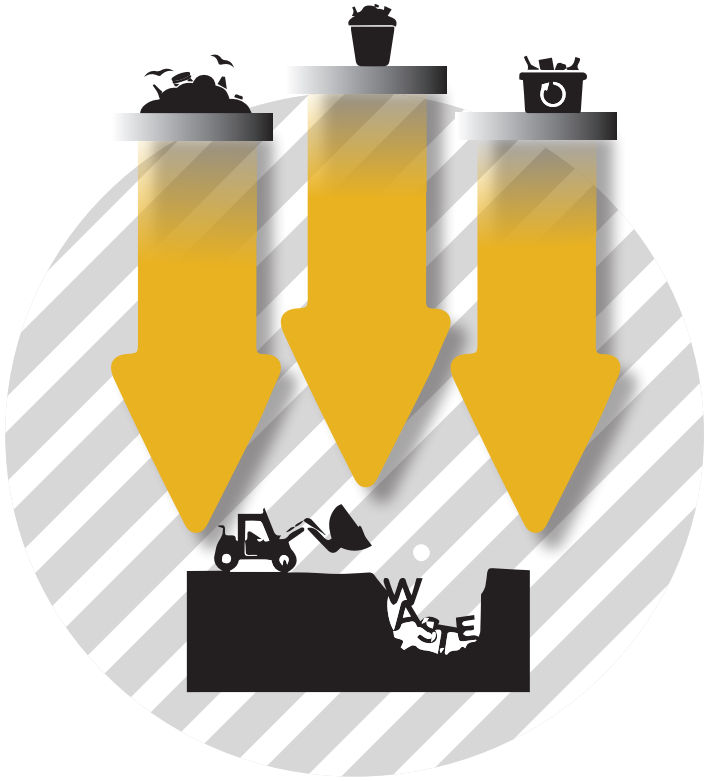
UNDESA (United Nations Department of Economic and Social Affairs) (2014). *World Urbanization Prospects: The 2014 Revision, Highlights*

UNEP. (2010) *Framework of Global Partnership on Waste Management,* Note by Secretariat, from http://www.unep.or.jp/letc/SPC/news-nov10/3_FrameworkOfGPWM.pdf

UNISDR (United Nations Strategy for Disaster Reduction) (2009). *Risk and Poverty in a Changing Climate: The 2009 Global Assessment Report on Disaster Risk Reduction.* Geneva: UNISDR.

United Nations Environment Programme, & City Council of Nairobi. (2010). *Integrated Solid Waste Management Plan for the City of Nairobi, Kenya 2010 – 2020.* Nairobi.

Chapter 2



CHARACTERISTICS OF HOUSEHOLDS AND RESPONDENTS

Blessing Mberu Tilahun Haregu

2.1 Background

This chapter presents an overview of the demographic and socioeconomic characteristics of the households sampled in Nairobi and Mombasa during the quantitative surveys. The chapter covers information on the conditions of the households in which the survey population lives, relating to sex of household head, duration of stay in the community, family size and household wealth status calculated from the source of drinking water, availability of electricity, sanitation facilities, building materials, and possession of household durable goods. The characteristics of household members captured include gender distribution, age, ethnic origin, marital status, educational attainment, engagement in income generating activities and type of employment. These characteristics are useful in assessing a household's vulnerability to exposure to poor solid waste management and associated health risks and loss, as well as capacity to address related health challenges.

2.2 Household Characteristics

Interviews were completed with a total of 1,158 and 1,237 survey households in Nairobi and Mombasa, respectively. Slightly more than a quarter of households in Nairobi and nearly one-third of the households in Mombasa were female-headed (Table 2.1). This structure of household headship is true of all households whether in communities located nearest to the dumpsites or otherwise.

2.2.1 Duration of Stay in Community

The median duration of stay in the community for household heads was 6 years in Nairobi sites and 7 years in Mombasa. About 48% and 58% of household heads in Nairobi and Mombasa, respectively, stayed in the community for less than 6 years. About 15% and 10% of household heads in Nairobi and Mombasa, respectively, had lived in the study communities for more than 20 years. An important dimension of the data is that duration of stay in Nairobi's informal settlements proximally located nearest to the dumpsites is as long as duration of stay in non-slum communities located far from the dumpsites. Table 2.1 shows that over 50% of households had stayed for at least 6 years and perhaps up to 20 years in both areas, with as much as 14% of heads of households having stayed for over 20 years in the communities of Dandora and Korogocho locations that are proximally bordering the main municipal dumpsites in Nairobi. This long duration of stay in such known adverse urban environments presents a different perspective of slum residence and exposure to its squalid conditions as a temporary stop-gap for migrants, as they seek opportunities for a better life in cities. The implication of such long duration of stay for loss to health is an important question relevant to understanding and addressing the challenges of SWM among the urban poor.

2.2.2 Household Size

The average size of the households in Nairobi and Mombasa were 3.5 and 3.3 members, respectively. However, the median household size for both Nairobi and Mombasa was 3 members. Smaller household sizes were more common in Mombasa than Nairobi as 30% and 39% of households in Nairobi and Mombasa, respectively, had 1-2 household members. Majority of households with 3-6 members were resident in communities proximally located nearest to the dumpsites in both Nairobi and Mombasa vis-à-vis households in non-slum locations. In Nairobi, the result shows a 10% age point difference (69.5% versus 59%) and in Mombasa the difference is an 8% age point difference between Bamburi within which is located the Mwakirunge dumpsi.

Table 2.1: Characteristics of households

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Sex of household head							
Male	74.3	67.6	75.5	73.3	69.1	68.8	68.9
Female	25.7	32.4	24.5	26.7	30.9	31.2	31.1
Total (N)	**806**	**193**	**157**	**1,156**	**518**	**719**	**1,237**
Duration of stay in the community							
< 1 year	7.2	19.5	3.5	8.9	2.8	14.7	9.5
1 - 5 years	39.3	52.4	21.1	39.4	47.7	50.0	49.0
6 - 20 years	39.1	24.9	39.2	36.7	34.6	29.4	31.7
> 20 years	14.4	3.2	36.2	15.0	14.8	5.9	9.8
Total (N)	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**
Ownership status of dwelling							
Owns or co-owns	9.0	24.9	33.3	14.6	37.2	23.0	29.2
Rent	90.0	74.6	65.6	84.5	60.5	76.6	69.6
Other	1.0	0.6	1.2	1.0	2.2	0.5	1.3
Total (N)	**806**	**195**	**157**	**1,158**	**518**	**719**	**1,237**
Household size							
1 - 2	26.0	41.5	36.6	29.9	31.9	45.1	39.3
3 - 6	69.5	56.9	59.2	66.2	58.7	51.0	54.4
7 - 10	4.4	0.3	4.3	3.7	8.4	3.9	5.9
> 10	0.0	1.2	0.0	0.2	1.1	0.0	0.5
Total (N)	**806**	**193**	**157**	**1,156**	**518**	**719**	**1,237**

2.3 Household Amenities and Wealth

Regarding the ownership status of dwellings, the majority of the dwellings of the study participants were rented. Only 29% of the dwellings in Mombasa and 15% of the dwellings in Nairobi were owned or co-owned by the resident households (Table 2.1). An important picture however is the glaring difference in ownership status of dwellings in Nairobi, with 90% of residents in Korogocho and Dandora (communities located nearest to the municipal dumpsite) renting their dwellings, whereas the renting status of dwellings in the non-slum Makadara study site stood at 66%.

Table 2.2 shows that the main sources of drinking water in Nairobi sites were water piped into dwellings and compounds and public tap/standpipe. In Mombasa city, the common sources of drinking water were public tap/standpipe and water sellers/vendors. In terms of specific locations, 93% of residents of Korogocho and Dandora accessed drinking water through water piped into their compounds (46%) or public taps (47%). In Makadara, the non-slum comparative site, majority of residents (64%) had water piped into their dwellings. In Bamburi in Mombasa, which is the location of the city's dumpsite, majority (52%) of residents' accessed drinking water through public taps (52%) whereas 41% of Kisauni residents accessed drinking water through the same source. However, 37% of residents accessed the commodity through water vendors.

More than two-thirds of the households in Nairobi and about half of the households in Mombasa were using a flush toilet at the time of the survey. However, about 35% and 25% of the study households in Mombasa and Nairobi, respectively, were using a traditional pit latrine. Over 90% of the households in both Nairobi and Mombasa had at least one mobile telephone at the time of the survey. A substantial proportion of the study households also owned radio and television. Analysis of overall wealth index showed that most of the households in Makadara site fell under 'rich' category.

Table 2.2: Household amenities

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Main source of drinking water							
Water sellers/vendors	2.3	34.9	2.2	7.9	14.4	36.6	26.9
Piped into dwelling	2.2	6.3	63.7	10.2	17.6	9.5	13.0
Piped into compound/plot	45.4	48.3	22.8	43.2	9.8	9.1	9.4
Public tap/standpipe	47.9	7.7	1.1	35.4	52.2	40.8	45.8
Well on residence/plot	1.1	1.0	1.3	1.1	0.6	0.7	0.6
Public well	0.0	0.6	0.0	0.1	1.5	0.7	1.0
Bottled water	0.0	0.0	3.5	0.4	3.8	2.5	3.1
Other	1.2	1.2	5.4	1.7	0.2	0.1	0.1
Types of toilet							
Flush or pour flush toilet	66.8	71.5	81.1	69.3	48.1	47.9	48.0
Traditional pit latrine	28.2	26.5	0.0	24.6	35.6	34.7	35.1
Ventilated improved latrine	2.2	0.0	0.0	1.6	8.3	7.3	7.7
Flush trench toilet	2.8	1.5	18.9	4.5	5.1	9.6	7.6
Bucket toilet	0.0	0.5	0.0	0.1	0.0	0.0	0.0
No facility/bush/field	0.0	0.0	0.0	0.0	2.8	0.1	1.3
Other	0.0	0.0	0.0	0.0	0.1	0.4	0.3
Floors, Walls, and Roofs *							
Improved floor	84.7	88.1	88.7	85.8	71.0	79.4	75.7
Modern wall	76.4	82.4	97.9	80.0	82.6	93.7	88.8
Modern roof	87.9	91.5	85.6	88.3	91.4	99.6	96.0
Selected durable goods*							
A radio/cassette player	75.7	81.0	93.1	78.6	58.0	68.2	63.7
A television	70.2	66.3	97.9	72.8	51.5	61.8	57.3
A mobile telephone	94.7	92.8	99.0	94.9	87.2	93.7	90.9
A refrigerator	5.0	8.7	81.7	14.7	21.9	21.4	21.6
An electric/gas stove	32.9	32.2	92.1	39.8	28.9	31.9	30.6
A car	3.3	3.0	49.8	8.7	7.6	4.4	5.8
A motorcycle	4.0	6.5	1.5	4.1	5.1	5.6	5.4
An electric iron	31.7	19.9	92.4	36.8	43.9	50.6	47.7
Wealth index							
Poor	31.4	27.2	0.4	27.0	44.4	38.0	40.8
Middle	43.2	48.9	3.6	39.5	24.7	30.3	27.9
Rich	25.4	23.8	96.1	33.4	30.9	31.7	31.4
Total (N)	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**

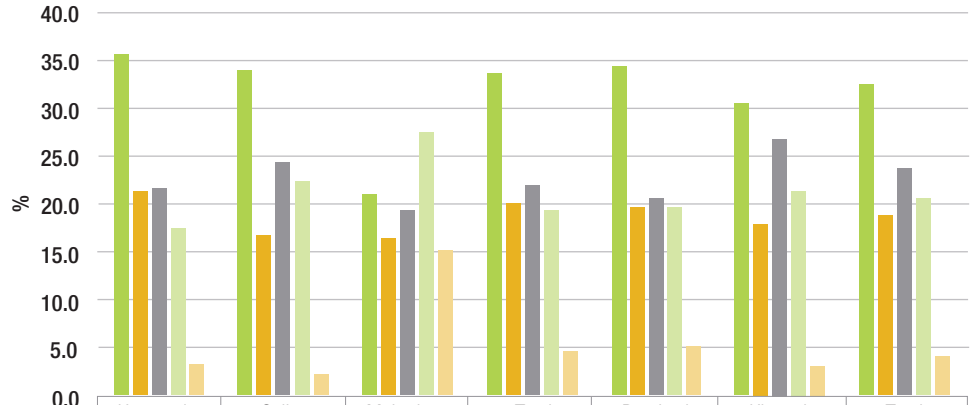
**: Multiple responses*

2.4 Background Characteristics of Household Members

2.4.1 Age-Sex Composition

Households surveyed in Nairobi had a total of 4,012 members while those in Mombasa had 4,071 members. The sex ratio was 0.91 and 0.98 in Nairobi and Mombasa, respectively (not shown). More than one-third of household members were below 15 years of age in all the study sites except Makadara where 21% were under 15 (Figure 2.1). The age structure of Makadara community was also different in that it had a higher proportion of the population in the age range of 45-54 and 55 years and above compared with other sites (Figure 2.1).

Figure 2.1: Age categories by sites in Nairobi and Mombasa



	Korogocho	Saika	Makadara	Total	Bamburi	Kisauni	Total
		Nairobi			Mombasa		
<15	35.7	34.1	21.3	33.8	34.5	30.6	32.5
15-24	21.5	16.9	16.5	20.2	19.7	18.1	18.9
25-43	21.8	24.4	19.4	21.9	20.8	26.8	23.8
45-54	17.6	22.5	27.5	19.5	19.8	21.3	20.6
55+	3.5	2.2	15.2	4.7	5.2	3.2	4.2

The age-sex structures of the study populations in Nairobi and Mombasa are presented in Figures 2.2 and 2.3. The age-structure in Mombasa shows that females aged 20-34 years constituted a significant proportion compared with other age-sex groups. Similarly, in Nairobi, females aged 20-29 years constituted a substantial proportion of the total population compared with other age-sex groups.

Figure 2.2: Population pyramid of Mombasa sample

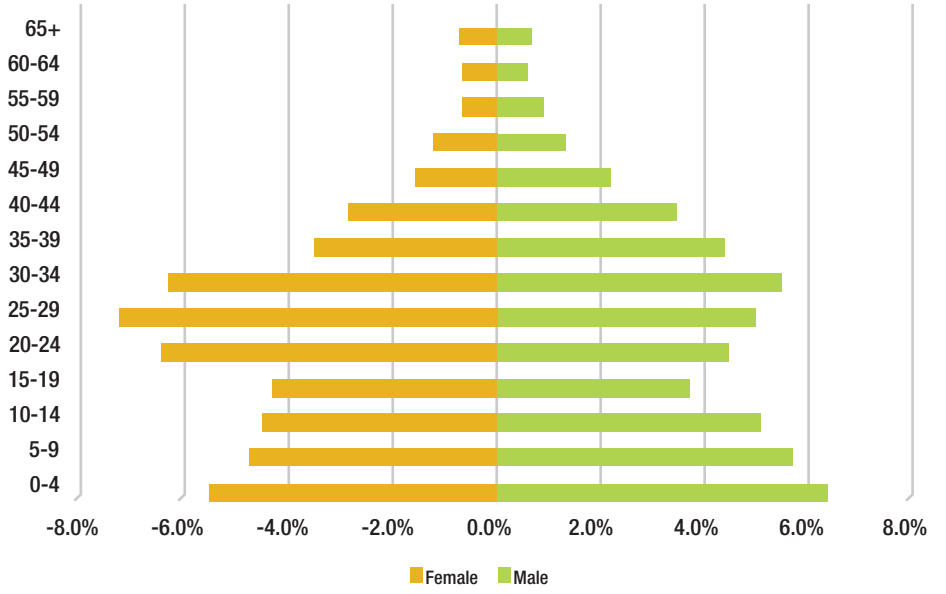
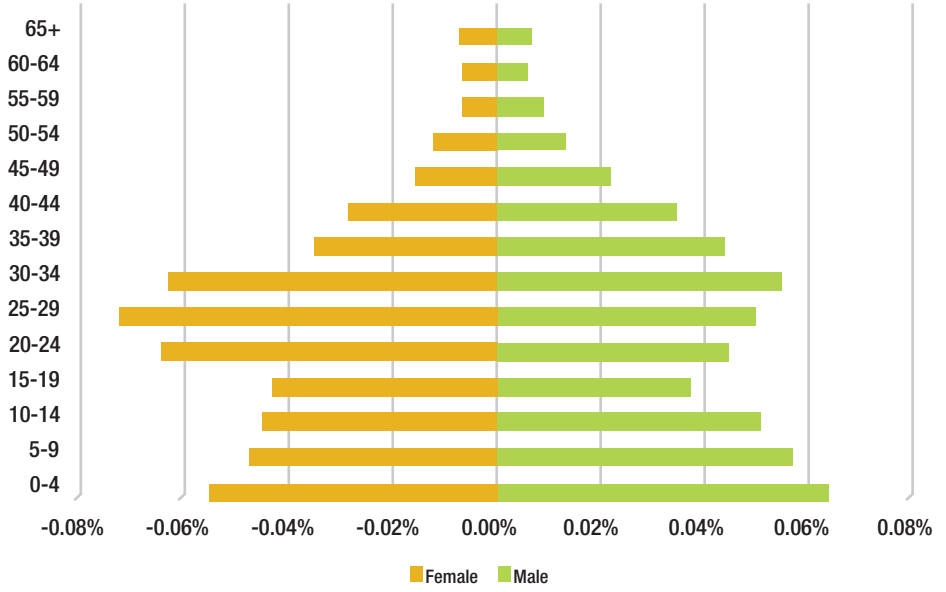


Figure 2.3: Population pyramid of Nairobi sample



With respect to ethnic composition, the three most common ethnic groups in the Nairobi sites were Kikuyu (35.5%), Luo (32.2%) and Luhya (14.9%). Luos were the dominant ethnic group in Korogocho, while Kikuyus were dominant in Saika and Makadara (Table 2.3). The study population in Mombasa had a more homogenous ethnic composition with about 50% belonging to the Mijikenda ethnic group. About 60% of all household members above 15 years of age in both Nairobi and Mombasa were married or living together with a partner at the time of the survey.

2.4.2 Educational Attainment

The majority (95.3%) of the study population in both cities had attended school (92.6% in Mombasa and 98.0% in Nairobi). Among those who were not attending school at the time of the survey, the highest levels attained were incomplete primary (24.8%), secondary (47.1%), and tertiary (27.5%), with no significant variations between Nairobi and Mombasa. In both cities, about 92% of children aged 5-14 years were attending primary school at the time of this survey. Besides, education attendance rate among this age group did not vary by gender. In relation to location of households vis-à-vis the dumpsites, there is clear educational disadvantage of households living closest to the Nairobi dumpsite. While 33% of household members in Korogocho slums and low income Dandora settlements had no education, only 17% of those resident in non-slum Makadara have no education. At the lower levels of education, a higher proportion of household members living nearest to the dumpsites than those living in non-slum areas attained primary education (19% versus 6%), while for secondary education it was 40% versus 27%, respectively. However at college/university levels of education, the proportion reversed in favour of households in non-slum Makadara area relative to those living nearest to the dumpsite the figures being 50% versus 9%, respectively. In Mombasa, educational variation between households in the study sites was blurred following the mixed residential neighbourhoods in the city.

2.4.3 Income Generating Activities

About two-thirds of the working age population (15-64 years) in either city was involved in income generating activities (62% in Nairobi and 64% in Mombasa). The main income-generating activities were own business (17% in Nairobi and 23% in Mombasa), own unestablished business (23% in Nairobi and 19% in Mombasa), informal employment (34% in Nairobi and 30% in Mombasa) and formal employment (22% in Nairobi and 26% in Mombasa). In relation to proximity to the dumpsites, there is marked variation in the nature of employment. While formal employment is higher in non-slum settlements farther off dumpsites than in slum communities near dumpsites (46% in Makadara and 15% in Korogocho/Dandora), informal employment is higher among slum and low income areas (40% in Korogocho/Dandora and 13% in Makadara). Similar outcomes were observed in

relation to own businesses that were established versus those identified as unestablished. Unestablished own businesses were more dominant in slum than non-slum areas (24% in Korogocho/Dandora and 12% in Makadara), while established own businesses were more dominant in non-slum areas relative to slum and low income settlements (17% in Korogocho/Dandora and 24% in Makadara). Again in relation to Mombasa, the outcomes under focus showed no marked differences and this is attributable to the mix of residences within census clusters and enumeration areas in the city. While the outcomes in Nairobi suggest social and economic disadvantages of slum and low income households located nearest to the waste dumpsites, the implications of that proximity to loss to health and other associated risks are the subject of subsequent chapters in this report.

Table 2.3: Background characteristics of household members

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Sex							
Male	47.5	49.0	47.2	47.7	49.4	49.6	49.5
Female	52.5	51.0	52.8	52.3	50.6	50.4	50.5
Age group							
0-4	13.7	13.5	6.8	12.8	11.9	12.3	12.1
5-9	12.2	12.9	8.0	11.8	11.9	9.7	10.8
10-14	9.8	7.7	6.5	9.1	10.7	8.6	9.6
15-19	9.3	8.1	6.9	8.8	9.0	7.1	8.0
20-24	12.2	8.8	9.6	11.4	10.7	11.0	10.8
25-29	12.3	14.3	10.8	12.5	11.7	12.9	12.3
30-34	9.4	10.1	8.6	9.4	9.1	13.9	11.5
45-54	17.6	22.5	27.5	19.5	19.8	21.3	20.6
55 +	3.5	2.2	15.2	4.7	5.2	3.2	4.2
Total (N)	**2,877**	**589**	**546**	**4,012**	**1,939**	**2,132**	**4,071**
Ethnic group							
Kamba	7.9	16.2	14.3	9.9	10.1	7.6	8.8
Kikuyu	32.0	53.1	35.5	35.5	6.1	7.2	6.6
Luhya	16.0	7.9	16.9	14.9	8.1	8.6	8.4
Luo	37.8	13.3	21.2	32.2	6.1	11.3	8.8
Mijikenda	0.0	0.0	0.1	0.0	54.0	44.4	49.2
Other	6.3	9.5	11.9	7.4	15.6	20.9	18.3
Total (N)	**2,874**	**573**	**540**	**3,987**	**1,939**	**2,125**	**4,064**

Table 2.3 continued

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Marital status							
Never Married	32.4	27.2	41.7	33.0	34.9	28.4	31.5
Married/Living together	61.0	63.9	52.5	60.2	56.3	63.6	60.1
Widowed/Divorced/Separated	6.6	8.9	5.8	6.8	8.8	8.1	8.4
Total (N)	**1,820**	**376**	**424**	**2,620**	**1,276**	**1,458**	**2,734**
Highest level of education							
No education/incomplete primary	32.7	28.4	16.8	30.0	37.5	28.4	32.8
Complete primary	18.8	16.7	5.9	16.8	18.2	21.1	19.7
Secondary	39.5	43.2	27.3	38.5	30.7	36.2	33.5
College/University	9.0	11.8	50.1	14.6	13.6	14.4	14.0
Total (N)	**2,380**	**494**	**487**	**3,361**	**1,539**	**1,708**	**3,247**
Income generating activity							
Formal employment	14.7	29.8	45.9	21.9	27.1	24.3	25.6
Informal employment	40.1	29.9	12.8	34.3	29.5	30.0	29.8
Own established business	17.0	11.6	24.3	17.2	21.7	24.9	23.4
Own unestablished business	24.0	27.6	12.3	22.8	19.1	18.8	19.0
Waste collector	0.5	0.0	0.0	0.4	0.0	0.3	0.2
Waste picker	0.7	0.0	0.0	0.5	0.0	0.1	0.1
Urban agriculture	0.2	0.4	0.0	0.2	0.0	0.0	0.0
Rural agriculture	0.1	0.0	1.4	0.3	1.3	0.0	0.6
Other	2.6	0.6	3.4	2.4	1.2	1.5	1.4
Total (N)	**1,100**	**264**	**294**	**1,658**	**797**	**971**	**1,768**

Chapter 3

SOLID WASTE STORAGE, COLLECTION AND DISPOSAL

Kanyiva Muindi Blessing Mberu

3.1 Introduction

Solid waste storage at source, collection and disposal are key stages in the waste management continuum as they determine safety at source, during collection and at the disposal sites, and are key indicators of a well-functioning solid waste management system (UNEP & CalRecovery Inc., 2005). How waste is stored at source, the collection systems available to households and subsequent disposal of the waste are critical in safeguarding both human and environmental health. Studies have documented the role of lay perceptions and attitudes towards solid waste management in ensuring households' adoption of sound waste management practices such as waste separation and recycling (Yoadaet al., 2014). Proper waste storage at source ideally should be in closed containers which would ensure waste is unexposed while also ensuring that vermin and insects are kept away (UNEP & CalRecovery Inc., 2005; Yoada et al., 2014). A study on waste management in East African cities found that closed containers were more common in wealthier neighbourhoods while poorer households used less than ideal storage such as plastic bags, cardboard boxes and sacks that are often disposed of with the waste (Okot-Okumu, 2012).

Regarding collection, an efficient waste management system must pick up waste from collection points at regular intervals, preferably daily especially in tropical weather to avoid decomposition of waste and of the resultant bad odours (UNEP & CalRecovery Inc., 2005). This is, however, one of the areas waste management systems in cities of developing countries have failed. It is not uncommon to find waste accumulated in collection points for too long, which results in bad odours, damage to the aesthetics of neighbourhoods as well as the hatching of flies. On the disposal end, it is ideal that solid waste is disposed of in a sanitary land fill; however, even where open dumping is practised, it is important that all collected waste is disposed of in the designated site. This ensures that waste is contained in one defined area as opposed to being indiscriminately dumped in any available open space.

Solid waste management in Nairobi and Mombasa cities has undergone drastic changes since independence. With the growth of city populations and the spatial expansion of both cities, collection services by municipal authorities became more irregular. Limited municipal resources have led to declining frequencies of waste collection and the entry of alternative service providers, mostly private businesses. Although city authorities still provide solid waste collection services in non-residential and low income residential areas in Nairobi and in both residential and non-residential areas of Mombasa, private providers dominate the sector (Kasozi & von-Blottnitz, 2010). The entry of private businesses in waste management has brought inequities in coverage with upper and middle income areas of the cities receiving regular garbage collection services while low income areas are generally left out. This has led to the emergence of community-based organizations, mostly unemployed youth who fill the service provision gap at a cheaper cost. Regardless of the presence of cheaper service providers, there are households that cannot afford to raise the fees charged by waste collectors. These households often use other methods to discard their waste including burying, burning or indiscriminate disposal within the communities.

This chapter highlights how household solid waste is stored at source, its collection, including by the service providers used by different households, and handling of toxic and electronic waste. The chapter also discusses waste reduction efforts in study communities as well as the challenges households face in the process of solid waste collection.

3.2 Solid Waste Storage in Households

How waste is stored within households has implications for exposure of members to associated risks. The results in Table 3.1 indicate that an overwhelming majority of households use plastic bags to store their waste, with Nairobi leading at 85.1% and Mombasa following at 51.8%. Open containers were the second commonly used storage devices in both cities while differences emerged in the use of common collection points, which was reported by more households in Mombasa (14.8%) compared with Nairobi (0.7%). In terms of solid waste storage practices by location of households within the cities, the use of plastic bags was generally high with minor variations in Nairobi (85% use in Korogocho/Dandora and 83% use in Makadara). There are marked differences in the use of closed containers in Nairobi's different study sites (3% in Korogocho/Dandora and 13% in Makadara). In Mombasa, use of closed containers occurred in 5.5% of households in Bamburi and 8% in Kisauni, where the non-slum Bombolulu settlement is located. While common waste collection points were almost non-existent in Nairobi slum, low income and non-slum settlements with exception of households in Saika, where 2% of them indicated use of common waste collection points, Mombasa households noticeably use common collection points, with 23% of households in Bamburi and 8.4% of households in Kisauni using such points.

3.3 Frequency of Waste Collection from Households

We asked respondents about the frequency of waste collection from households. The results indicate that majority of households had garbage collected between 4-6 times in a month, with the proportion being nearly twice as high in Nairobi (92.1%) compared with Mombasa (49.0%). In terms of household locations vis-à-vis proximity to the dumpsites, slum and low income settlements are disadvantaged in both Nairobi and Mombasa. In Nairobi, 100% of households in Makadara and 76% in Korogocho/Dandora receive waste collection services. In Mombasa services were received by 42% of households in Bamburi nearest to the city's dumpsite and 64% of households in Kisauni, where the non-slum Bombolulu neighbourhood is located. The opposite is true with higher proportions of households in slum and low income settlements not receiving waste collection services.

3.3.1 Providers of Garbage Collection Services

With respect to providers of garbage collection services in both cities, the findings show that the role of municipal authorities that were once the main providers of these services has diminished, if not non-existent, with less than 1% of households receiving services from the city authorities. Instead, in both cities, community-based organizations are the key service providers offering their services to 61.5% and 50.5% of households in Nairobi and Mombasa, respectively. Within Nairobi, a total of 68% of households in slum and low income settlements of Korogocho and Dandora receive services from CBOs. The equivalent for non-slum Makadara location receiving services from CBOs was 35% of households, with larger proportion of them (61%) receiving services from private providers. Consistent with capacity to pay for services, only 1.6% of households in Korogocho/ Dandora receive services from private providers.

3.3.2 Payment for Collection Services

Considering that majority of households in the study communities relied on private garbage collectors, we asked the payment schedule and amount paid for the services. The results indicate that in Nairobi, weekly payment was more common (55.9%) while in Mombasa, payment per collection was the most common mode (56.2%). Monthly mode of payment was the second most common in both cities, reported by 31.9% and 30.1% of households in Nairobi and Mombasa, respectively. Only a minority of households reported not paying for services (1.0% in Nairobi and 0.5% in Mombasa) and this is mostly among households in Korogocho/Dandora in Nairobi and Bamburi in Mombasa. In Nairobi, we found marked variations between slum/low income households and non-slum households. While 67% of Korogocho and Dandora households pay weekly for services, only 5.4% of households in Makadara pay for services weekly. Conversely, while 21% of households in Korogocho and Dandora pay for services monthly, a total of 94% of households in non-slum Makadara pay for services monthly. In Mombasa, the data showed a more even distribution of payment duration options.

The average amount households paid per collection was 20 Kenya shillings in Nairobi and 25 Kenya shillings in Mombasa (1 USD = KSh. 103 at the time of the survey). Weekly payments were 30 Kenya shillings in Nairobi and 100 Kenya shillings in Mombasa, while monthly fees were 150 Kenya shillings in both Nairobi and Mombasa. Within cities, however, we found marked differences in the amount of fees paid for services. In Nairobi, the median monthly fees varied from 80 Kenya shillings in Korogocho/Dandora to 250 Kenya shillings in Makadara. In Mombasa the fees varied from 120 Kenya shillings in Kisauni to 200 Kenya shillings in Bamburi. What comes out clearly from these results is evidence that people of all socioeconomic backgrounds are willing to pay some fees for their household garbage disposal. Understanding the factors that determine the cost of services will be an important

question that needs investigation beyond this report as that will be a veritable input in the search for pathways for sustainable waste management options across different urban settlements inhabited by households of different socioeconomic standings, especially the poorest urban residents.

Table 3.1: Garbage storage and collection from households

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Storage within households (%)							
Closed container	2.9	0.0	12.5	3.6	5.5	8.2	7.0
Open container	8.7	7.1	4.1	7.9	21.7	15.3	18.1
Plastic bags	84.8	87.8	82.8	85.1	36.8	63.5	51.8
Pile in the yard	0.2	2.2	0.0	0.5	9.4	3.5	6.1
Common collection point outside plot	0.4	2.4	0.0	0.7	23.1	8.4	14.8
Other	3.1	0.5	0.6	2.3	3.4	1.1	2.1
N	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**
Household receives garbage collection services (%)							
Yes	75.7	62.1	100.0	76.2	41.9	64.3	54.5
No	24.3	37.9	0.0	23.8	58.1	35.7	45.5
N	**805**	**196**	**157**	**1,158**	**518**	**719**	**1,237**
Garbage collection service providers (%)							
County government	0.4	1.9	0.4	0.6	1.5	0.3	0.7
Private companies	1.6	10.3	60.7	12.0	44.2	21.8	29.3
CBOs	67.8	59.3	34.8	61.5	36.3	57.7	50.5
Other	30.3	28.4	4.2	26.0	18.0	20.2	19.5
N	**605**	**120**	**157**	**882**	**217**	**471**	**688**
Frequency of collection per month (%)							
1-3 times	2.1	2.1	0.0	1.8	10.8	5.1	7.0
4-6 times	93.7	93.1	83.9	92.1	49.5	48.8	49.0
8-10 times	3.6	2.6	13.8	5.0	22.7	34.2	30.3
>10 times	0.6	2.2	2.4	1.1	17.0	11.9	13.6
N	**605**	**120**	**157**	**882**	**218**	**472**	**690**

Table 3.1 continued

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Payment schedule (%)							
Per collection	9.8	22.8	0.0	10.1	50.0	59.3	56.2
Weekly	66.8	57.1	5.4	55.9	17.2	10.1	12.5
Monthly	21.4	17.2	93.5	31.9	31.0	29.7	30.1
Don't pay	1.2	0.8	0.4	1.0	1.5	0.0	0.5
Other	0.8	2.1	0.8	1.0	0.4	0.9	0.7
N	**605**	**120**	**157**	**882**	**218**	**472**	**690**
Median amount paid (KES)							
Per collection	20.0	30.0	0.0	20.0	20.0	30.0	25.0
N	**65**	**27**		**92**	**96**	**279**	**375**
Weekly	20.0	30.0	225.0	30.0	100.0	120.0	100.0
N	**408**	**69**	**8**	**485**	**41**	**47**	**88**
Per month	80.0	125.0	250.0	150.0	200.0	120.0	150.0
N	**120**	**20**	**147**	**287**	**74**	**141**	**215**

3.4 Disposal of Household Waste

Disposal of household waste especially in the context of the study communities is important as it has a bearing on general cleanliness and levels of associated health risks.

3.4.1 Alternative Disposal Practices

In cities where service provision is provided at a fee, there are bound to be households that do not pay for the service either due to poverty or other reasons. Even households that pay for the services can at times default or collection can be irregular, leading to adoption of alternative disposal practices. We asked if households that received garbage collection services were at any point in time forced to use other avenues of waste disposal. Results reveal that 12% and 16.7% of households in Nairobi and Mombasa, respectively, did so. Further, the question was posed to those who do not receive garbage collection services to find out where they dispose their household waste. The avenues used included dumpsites, rivers, pits and burning with the latter being practised more in Mombasa (41.3%) while dumping in the river was reported by more households in Nairobi (28.7%). The proportion of households that reported taking their garbage to a dumpsite was higher in Mombasa

(31.2%) than in Nairobi (13.6%). Respondents were further asked if their households routinely burnt solid waste. The results show that the proportion of households that burned waste was highest in Bamburi (61.2%) and lowest in Makadara (10.6%).

Overall, more households in Mombasa routinely burned solid waste (47.1%) compared to Nairobi (18.5%). What is profound is evidence from the results that alternative problematic waste disposal practices are highly related to location of households in both Nairobi and Mombasa. In Nairobi's Korogocho and Dandora slum and low income settlements, alternative disposal practices include dumping in the river by households (32%), on the rail road (17%), drainage trenches (14%) and burning (12%). In the non-slum Makadara settlements, the equivalent disposal alternatives are: on the rail road (12%) and burning (46%). In Mombasa a whole lot of burning of waste was done by households in Bamburi (45%) and in Kisauni (37%). The linkage of these practices to specific study cities and locations speaks to the need for appropriate interventions tailored to locally-specific SWM challenges in urban Kenya.

3.4.2 Toxic Household Waste

Toxic household waste poses health hazards to people who come into contact with it. While posing a risk to household members, these types of waste also contaminate other wastes that might be collected for recycling or re-use. We asked about how toxic waste was disposed of. Majority of households reported disposing of toxic waste together with other household waste, with the proportion being higher in Nairobi (86.6%) than in Mombasa (75.9%). Other disposal avenues included pit latrines (14.0% in Mombasa and 2.3% in Nairobi). In terms of practices within specific locations, the data show no difference in disposing of toxic waste together with other household wastes in slum and low income Korogocho and Dandora (89%) and in non-slum Makadara (88%). There is minor variation in throwing toxic waste into pit latrines by 2% of households in Korogocho and Dandora, while this was not a practice in Makadara, perhaps related to the lack of pit latrines in the settlement. In Mombasa, similar practices are demonstrated in terms of disposing of toxic waste together with other household waste in Bamburi (73%) and in Kisauni (78%). However, disposal in pit latrines was more rampant in Mombasa with 15% of households in Bamburi and 14% of households in Kisauni disposing toxic waste into pit latrines. The health implications of this practice, especially the potential to contaminate underground water sources highlights a knowledge gap in study communities that needs to be addressed through information, education and communications interventions.

3.4.3 Electronic Waste (e-Waste)

E-waste is increasingly becoming a concern not only in Kenya but globally as the use of electronic equipment increases, especially mobile phones. The results show that disposal of broken electronics was similar to that of toxic waste, with disposal alongside other waste

being the most common practice in both cities (65.6% in Nairobi and 60.5% in Mombasa). Less than 10% of households in both cities reported giving broken electronics to someone for reuse (7.3% in Nairobi and 5.4% in Mombasa). In terms of locations within the study cities, similar e-waste disposal practices prevail, with higher proportion of households in slums and low income settlements of Korogocho/Dandora than in non-slum Makadara in Nairobi (69% versus 50%) disposing e-waste alongside other wastes. In terms of giving broken electronics to someone for reuse the practice prevails more among Makadara households than in Korogocho/Dandora (21% versus 6%), perhaps reflecting economic capabilities.

3.4.4 Measures to Reduce Waste at Household Level

Beyond identifying and understanding the SWM challenges, the study sought to identify solutions building on the experiences and voices of the study participants. There are a range of actions that can be taken to reduce waste volumes in households. We asked respondents about the measures their households took to reduce waste. Majority of households reported not taking any measure, with the highest proportion being in Kisauni location in Mombasa (71.3%), followed by Saika location in Nairobi (65.7%). Overall, the proportion of households reporting taking no measure was higher in Mombasa (68.5%) than in Nairobi (56.8%). In Nairobi, higher proportions of households in Korogocho/Dandora, located near the dumpsite than in non-slum Makadara and Saika (56% versus 47%, respectively) did not take any waste reduction measure. The equivalent in Mombasa was 65% of households in Bamburi and 71% of households in Kisauni.

Among those who took waste reduction measures, reuse of items was more prevalent across the locations, reported by 28.1% and 20.7% of households in Nairobi and Mombasa, respectively. Use of long life shopping bags was practised by 15.5% of Mombasa and 1.8% of Nairobi households while composting was the least practised waste reduction measure (reported by 1.1% and 1.2% of households in Nairobi and Mombasa, respectively). In specific locations in Nairobi and Mombasa, re-use of items and use of long life shopping bags were more evenly distributed with minor variations across study sites. However, the composting of organic materials was dominant in non-slum Nairobi than elsewhere. What is key out of these results is the potential that needs to be expanded in waste reduction measures for sustainable economic development and household wellbeing.

Table 3.2: Disposal of household solid waste

	Nairobi				Mombasa		
	Korogocho/Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Household use other disposal avenues							
Yes	11.9	20.6	4.8	12.0	24.5	12.8	16.7
No	88.1	79.4	95.2	88.0	75.5	87.2	83.3
N	**604**	**120**	**157**	**881**	**215**	**469**	**684**
Garbage/other disposal avenues							
Garbage dump	11.3	19.6	14.6	13.6	25.4	38.3	31.2
In the river	32.1	21.6	0.0	28.7	3.5	1.0	2.4
On the road/rail	16.8	7.6	11.8	14.3	0.5	2.3	1.3
In drainage/trench	13.6	12.8	0.0	13.2	0.2	0.0	0.1
In private pits	0.0	0.0	0.0	0.0	11.5	5.3	8.7
In public pits	1.6	0.0	0.0	1.1	3.4	3.2	3.3
Vacant/abandoned house/ plot	0.7	0.0	12.6	0.7	0.0	2.6	1.2
Burning	11.9	31.5	45.5	17.7	44.6	37.3	41.3
No designated place/ all over	0.9	3.7	0.0	1.6	8.0	8.4	8.2
Other	11.2	3.2	15.6	9.1	2.9	1.6	2.4
N	**272**	**98**	**7**	**377**	**348**	**306**	**654**
Disposal of toxic substances							
Together with other trash	89.1	75.4	88.3	86.6	73.0	78.1	75.9
Throw into pit latrines	2.1	4.7	0.0	2.3	14.5	13.6	14.0
Throw on road/rail	0.3	0.0	0.0	0.2	0.8	0.9	0.9
Other	8.5	19.9	11.7	10.9	11.7	7.4	9.2
N	**804**	**196**	**155**	**1,155**	**473**	**687**	**1,160**
Disposal of broken electronics							
Together with other trash	68.7	63.0	50.2	65.6	57.0	63.0	60.5
Throw on road/rail	0.0	0.7	0.0	0.1	0.6	0.5	0.5
Give/Offer to someone else for reuse	6.3	1.9	21.2	7.3	4.2	6.3	5.4
Other	24.9	34.4	28.6	27.0	38.2	30.2	33.6
N	**795**	**194**	**156**	**1,145**	**481**	**690**	**1,171**
Measures to reduce household waste*							
Re-use items like bottles, plastic bags	27.9	24.3	34.6	28.1	22.2	19.6	20.7
Use long life shopping bags	12.3	26.4	13.0	14.8	18.3	13.3	15.5
Compost organic waste	0.5	1.6	4.3	1.1	1.7	0.8	1.2
No measure taken	56.3	65.7	46.9	56.8	64.8	71.3	68.5
N	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**
Routinely burn some household waste							
Yes	16.4	32.8	10.6	18.5	61.2	36.1	47.1
No	83.6	67.2	89.4	81.5	38.8	63.9	52.9
N	806	196	157	1,159	518	719	1,237

**: Multiple responses*

3.5 Solid Waste Recycling and Composting

Households can take part in waste reduction through their participation in recycling and composting efforts.

3.5.1 Recycling

We first asked respondents if they had heard about recycling and if they responded in the affirmative, we found out if their households were involved in recycling of household waste. A considerable proportion of households reported that they had not heard about recycling (21.8% in Nairobi and 35.2% in Mombasa). Participation in recycling was quite low, with 4.7% of households in either city reporting involvement in such an activity. The most recycled material was plastic waste (90.5% in Mombasa and 60.5% in Nairobi) followed by paper recycling. In Nairobi study sites, there was more recycling of paper and plastics in non-slum Makadara (39% versus 74% of households) than in Korogocho/Dandora (31% versus 56%, respectively). On the other hand, the proportion of households involved in glass and tin/metal recycling is higher in Korogocho/Dandora (24% versus 23%) than in Makadara (12.7% versus 12.7%, respectively). In Mombasa, most of the paper, plastics, glass and tin/metal recycling was in Bamburi households than in Kisauni.

3.5.2 Composting

Similar to recycling, we asked if respondents had heard about composting of organic household waste. Results indicate that 76.9% of households in Nairobi and 63.9% in Mombasa had heard of composting. However, the level of composting was quite low, with 1.8% of households in Nairobi and 5.6% of those in Mombasa reporting taking part in the activity. A follow up question was posed to respondents asking if they would be willing to sort household waste if there were programs to recycle and compost. The majority of households expressed willingness to do so (86.5% and 86.7% in Nairobi and Mombasa, respectively). Willingness to sort household waste if there were programs to recycle and compost was more evenly distributed across all study locations. This result points to an opportunity to introduce and promote recycling and composting interventions in slum and non-slum urban locations.

Table 3.3: Solid waste recycling and composting

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Ever heard about solid waste recycling							
Yes	78.3	64.7	97.2	78.2	61.9	67.0	64.8
No	21.7	35.3	2.8	21.8	38.1	33.0	35.2
N	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**
Household member in recycling							
Yes	5.3	1.5	4.6	4.7	4.3	5.0	4.7
No	94.7	98.5	95.4	95.3	95.7	95.0	95.3
N	**629**	**125**	**153**	**907**	**328**	**483**	**811**
Types of waste recycled by member*							
Paper	31.2	0.0	39.3	30.9	36.0	13.9	22.3
Plastics	55.8	100.0	74.3	60.5	92.3	89.4	90.5
Glass	24.4	0.0	12.7	21.6	15.1	14.9	15.0
Tin/metal	23.4	0.0	12.7	20.8	27.6	18.7	22.1
Bones	4.8	0.0	0.0	3.8	14.2	6.2	9.3
Other	26.5	0.0	12.7	23.3	7.7	0.0	2.9
N	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**
Ever heard about composting							
Yes	78.2	60.4	93.6	76.9	62.7	64.8	63.9
No	21.8	39.6	6.4	23.1	37.3	35.2	36.1
N	**802**	**193**	**151**	**1,146**	**507**	**712**	**1,219**
Household member composts waste							
Yes	0.9	4.5	3.9	1.8	11.4	1.6	5.8
No	99.1	95.5	96.1	98.2	88.6	98.4	94.2
N	**621**	**116**	**141**	**878**	**328**	**464**	**792**
Willing to sort HH solid waste							
No	12.7	16.9	13.3	13.5	16.6	10.8	13.3
Yes	87.3	83.1	86.7	86.5	83.4	89.2	86.7
N	**805**	**196**	**157**	**1,158**	**514**	**718**	**1,232**

**Multiple responses*

3.6 Solid Waste Management Outside Households

3.6.1 Stakeholders/Actors Involved in Community Cleaning

To understand how communities especially those in informal settlements who are under-served by both county governments and private waste collectors keep they their communities clean, we asked about the actors whose responsibility it was to clean community streets. In both cities, residents were the most commonly mentioned actors responsible for clean-up, followed by the county government (Table 3.4). In relation to specific locations, the roles of residents and county authorities was more evenly distributed. However, we find variations in the roles of other stakeholders. In Nairobi, the National Youth Service (NYS) was identified as active in environmental cleaning in Korogocho/Dandora (7% of households) but non-existent in Makadara. In Mombasa, 4% of households in Bamburi and 11% in Kisauni identified NYS as stakeholders in community cleaning. Further, the role of volunteers in Nairobi was identified only in Korogocho/Dandora by 4% of households. In Mombasa, volunteers were identified by 6% of households in Bamburi and 11% of those in Kisauni.

3.6.2 Collection and Disposal

Upon collection of garbage from the streets in communities, where and how it is disposed of matters, as certain practices may lead to higher exposures to harmful waste. The majority of respondents indicated that the garbage from community streets was taken to dumpsites (58.5% in Nairobi and 52.1% in Mombasa). Burning of street garbage was more common in Mombasa than in Nairobi (reported by 21.3% and 3.3% of households, respectively). Beyond minor variations in the distribution of these practices between study sites, two problematic inactions were identified, with 6% of households in Korogocho/Dandora and 2% of those in Makadara in Nairobi indicating that nothing is done to collected garbage from the streets in their communities while 6% of households in both Bamburi and Kisauni identified the same issue in Mombasa. Further, in Nairobi, 20% of households in Korogocho/Dandora and 13% of those in Makadara indicated that waste gathered in their communities is piled up in the streets, while in Mombasa the equivalent response was 15% in Bamburi and 14% in Kisauni.

3.6.3 Problems the Community Faces Regarding Waste

In seeking to understand the various challenges in waste management, we asked respondents to mention the problems their communities face regarding solid waste management. In Nairobi, respondents mentioned illegal dumping of waste, littering the community and dumping in other people's plots, in that order. In Mombasa, the most dominant problem identified was littering the community, followed by illegal dumping of waste and dumping in other people's plots. Other issues mentioned were disposal of toxic waste, burning of waste at dumpsites

and consumption of food grown near the dumpsite. In Nairobi, all these challenges identified by study participants were more dominant in slum and low income settlements of Korogocho/ Dandora than in non-slum Makadara. In Mombasa, the challenges were not so skewed towards one study community. For instance, while littering the community, illegal dumping of waste and dumping at other people's plots was more common in Kisauni, burning of wastes and consuming food grown around dumpsites was common in Bamburi, where the city's dumpsite is located and surrounded by farmer settlers.

3.6.4 Community Perceptions about Existing Waste Management Systems

Community perceptions regarding solid waste management is an important aspect as it has a bearing on the up-take of services and the adherence to laid down guidelines, for instance, in the sorting of waste. We asked respondents if they thought the city had a proper solid waste management system. Only 26.4% and 21.9% of respondents in Nairobi and Mombasa, respectively, felt that there was a proper waste management system in their city. Qualitative data revealed that residents felt that the solid waste management systems in place in both cities were faced with numerous challenges including collection from source, lack of transportation and dumping sites. In Nairobi, it was felt that the city was declining in terms of waste management, with poor collection of waste, the abysmal state of the Dandora dumpsite and illegal dumping.

3.6.5 Stakeholders' Perceptions about Existing Waste Management Systems

All stakeholders interviewed expressed the need for improvement in several aspects. Informal collectors felt that there was a need for the county governments in both cities to embrace them as partners in an effort to reach more people with their services and help keep communities clean. Similar sentiments were expressed by waste pickers who are viewed as a nuisance by both communities and local authorities, yet they provide important services in the waste management sector. They further called for a safe working environment through the establishment of collection points from where they can pick waste without being exposed to the main dumpsite where many health challenges exist. County officials indicated the need for better planning of the city and for implementing the new waste management strategy with support from bilateral partners who have worked with them to come up with cleaner waste handling systems. Participants also felt that the existing system is not competitive enough to encourage contracted companies to provide the best services; they therefore called for improvements in the contracting process and putting in place measures to punish errant

contractors. There were also suggestions for initiatives aimed at promoting waste separation at the household level by almost all stakeholders except the waste pickers who pointed out that such initiatives should also ensure that households do not retain recoverable waste but hand it in for collection, so that their income-generating activities that rely on recovery of materials are not affected.

3.6.6 Challenges and Expectations

Respondents were asked about their views regarding the challenges in the city's waste management system. The results indicate that inefficient collection of solid waste was the leading challenge, with the proportion being highest in Kisauni (72.5%), followed by Bamburi (64.5%) and Korogocho/Dandora (58.2%). Unsafe disposal in open dumpsites was the second most mentioned challenge (reported by 50.4% and 46.7% of households in Mombasa and Nairobi, respectively). In the specific locations, unsafe disposal in open dumpsites was identified as a major challenge in Kisauni (55%), Korogocho/Dandora (54%) and Bamburi (44%). Lack of control over illegal dumpsites was the third most frequently mentioned concern in Nairobi (33.2%), with 41% of respondents from Korogocho/Dandora versus 26% in Makadara. In Mombasa, the third mentioned challenge was lack of public sensitization on solid waste management (37.9%), with 35% of households in Bamburi and 40% of households in Kisauni. Other challenges mentioned include lack of waste sorting, absence of recycling options and lack of waste treatment. What is outstanding in these results is the level of knowledge of the challenges among participants and the gaps that need to be filled in terms of defining and implementing interventions among a well-informed population that seems ready for change.

Table 3.4: Solid waste management outside households

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Stakeholders in cleaning community*							
Volunteers	3.7	4.0	0.0	3.3	6.4	10.6	8.7
CBOs/Organized cleaning groups	10.5	2.5	7.3	8.8	8.0	10.3	9.3
City Council	40.1	22.6	54.5	38.8	32.3	43.1	38.4
No one in particular	0.8	0.5	0.8	0.8	3.4	4.4	4.0
Self/Residents	48.3	56.1	48.5	49.7	63.6	61.2	62.3
National Youth Service (NYS)	6.7	3.2	0.0	5.3	4.3	11.0	8.1
Other	25.4	22.4	21.8	24.5	17.1	13.0	14.8
Don't Know	5.3	4.1	1.4	4.6	3.4	1.1	2.1
N	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**
Disposal of trash from the streets*							
Taken to dump site	61.9	45.8	56.3	58.5	43.1	59.0	52.1
Burned	3.7	3.1	1.3	3.3	32.8	12.4	21.3
Gathered & piled on the streets	19.9	3.7	12.8	16.3	15.0	13.8	14.3
Sold to scavengers	2.4	1.5	0.7	2.0	7.8	8.5	8.2
Nothing done	6.1	8.9	2.2	6.2	5.6	2.6	3.9
Don't know	18.6	32.9	36.6	23.2	18.6	21.4	20.2
Other	11.7	8.6	1.3	9.9	12.0	8.4	10.0
N	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**
Overall state of environment							
Very dirty	29.7	2.6	0.6	21.6	13.0	15.1	14.2
Dirty	27.4	12.8	14.7	23.4	16.8	29.6	24.0
Average	26.1	51.7	34.3	31.5	43.6	39.5	41.3
Clean	16.1	32.9	50.5	23.1	25.5	14.9	19.6
Very clean	0.7	0.0	0.0	0.5	1.1	0.9	1.0
N	**806**	**196**	**157**	**1,159**	**517**	**719**	**1,236**
Problems faced concerning waste*							
Burning of trash at dumpsite	74.5	27.0	14.1	59.2	30.7	21.5	25.5
Disposing toxic waste e.g. chemicals	75.2	43.9	14.6	62.6	24.9	28.2	26.8
Illegal dumping of trash	87.4	83.7	57.4	83.3	64.3	77.0	71.4
Littering the community	84.6	82.1	58.5	81.0	64.8	76.9	71.6
People dumping trash in others' plots	72.9	76.3	35.1	69.1	56.7	70.9	64.7
Consuming food grown near dump	45.7	44.9	7.5	41.1	18.3	10.0	13.6
Don't know	0.5	0.4	0.4	0.5	5.8	4.3	4.9
Other	1.0	1.4	3.5	1.4	0.3	0.1	0.2
N	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**

Table 3.4 continued

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Does city have proper SWM							
Yes	27.1	27.9	20.4	26.4	22.4	21.6	21.9
No	72.9	72.1	79.6	73.6	77.6	78.4	78.1
N	**738**	**180**	**152**	**1,070**	**463**	**654**	**1,117**
Challenges in SWM in the city*							
Inefficient collection	58.2	42.7	48.2	54.3	64.7	72.5	69.1
Lack of waste sorting	26.1	3.9	14.6	21.0	22.2	23.1	22.7
No control over illegal dumps	41.2	5.4	25.6	33.2	26.4	41.9	35.1
No recycling options	21.1	2.3	5.1	16.0	17.1	18.8	18.0
Lack of public education on SWM	32.1	10.7	25.2	27.6	34.7	40.3	37.9
Lack of waste treatment	25.1	4.2	5.7	19.2	12.0	13.6	12.9
Unsafe disposal in open dumps	53.9	31.4	25.8	46.7	44.1	55.3	50.4
Other	23.4	19.2	23.7	22.7	3.3	5.0	4.2
N	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**

**: Multiple responses*

3.7 Summary

This chapter addressed storage, collection and disposal of solid waste in Nairobi and Mombasa. The results highlight differences in waste storage between communities in the two cities with the use of plastic bags for storage being more pronounced in Nairobi compared to Mombasa. Common collection points within communities were reportedly used by a higher proportion of households in Mombasa as opposed to Nairobi. A considerable proportion of households in either city reported not receiving any waste collection services, which suggests a need for appropriate action by the relevant stakeholders to ensure proper solid waste management. In addition, understanding why some households that receive waste collection services resort to other forms of disposal including open burning of waste is important for informing the design of appropriate interventions. At the very least, it points to the need for community sensitization on proper waste management and the risks to human and environmental health associated with improper disposal, including burning. None of the cities has a system in place that households can use to properly dispose of toxic household waste such as paint, batteries, and e-waste. Instead, these are mixed with other household waste for onward conveyance to the dumpsites. The findings further showed that although most respondents had heard about recycling and composting, participation in these waste reduction activities was very low. This presents an opportunity for community sensitization to raise awareness about the importance of waste reduction. The finding that majority of

respondents expressed willingness to sort household waste provides further opportunities for promoting safe disposal of waste while protecting recyclables from contamination by other waste streams.

Respondents identified challenges facing SWM across the study cities and within locations within each city. In Nairobi for instance, all the challenges of the SWM system were more dominant in slum and low income settlements of Korogocho/Dandora than in non-slum Makadara locations. In Mombasa, the challenges were not so skewed towards one study community. For instance, while littering the community, illegal dumping of waste and dumping at other people's plots was more common in Kisauni, burning of wastes and consuming food grown around dumpsites were common in Bamburi, where the city's dumpsite is located and settled by farmers. What is outstanding in the findings is the high level of knowledge of the challenges that need to be addressed related to defining and implementing interventions among the apparently well-informed population, which seems ready for change.

References

Kasozi, Allison and von-Blottnitz, Harro (2010). Solid Waste Management in Nairobi: A Situation Analysis. **Technical Document Accompanying the Integrated Solid Waste Management Plan.** Nairobi.

James Okot-Okumu (2012). Solid Waste Management in African Cities – East Africa, Waste Management - An Integrated Vision, Dr. Luis Fernando Marmolejo Rebellon (Ed.), InTech, DOI: 10.5772/50241 .

UNEP and CalRecovery Inc. (2005). Principles of Solid Waste Management. *Solid Waste Management* (Vol. 1): UNEP.

Yoada, R. M.: Chirawurah, D.: & Adongo, P. B. (2014). Domestic Waste Disposal Practice and Perceptions of Private Sector Waste Management in Urban Accra. *BMC Public Health, 14,* 697. doi: 10.1186/1471-2458-14-697

Chapter 4

HEALTH AND ENVIRONMENTAL RISKS RELATED TO POOR SWM

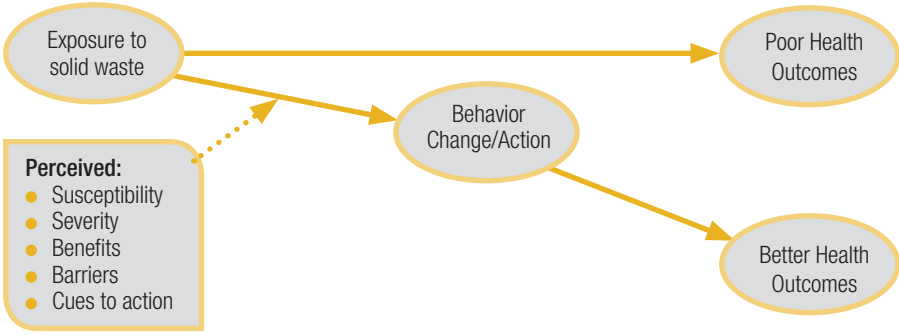
Abdallah Ziraba Tilahun Haregu Blessing Mberu

4.1 Introduction

This chapter is about perceptions of exposure to solid waste, potential associated with health risks and how actions have been or have not been taken to respond and mitigate the risks that could affect health. Solid waste is a known source of ill-health ranging from infections, bodily injury, chronic and non-communicable diseases, and death (El-Wahab et al., 2014; Boadi & Kuitunen, 2005; Grant et al., 2013; Rushton, 2003; Ryu et al., 2015; Song & Li, 2015). Responding to solid waste management challenges can benefit from changes to individual behaviours, household and community practices as well as higher level actors such as government. The results in this chapter are mainly perceptions from individual standpoints. The potential application of such knowledge -- or lack of it -- can be maximized by applying the conceptualization of behaviour change in health as envisaged in the Health Belief Model (HBM) (Rosenstock, 1966). The HBM predicts changes to health behaviour if the concerned individuals perceive that they are susceptible; that the exposure is severe enough to merit avoidance; that there are benefits in embracing change; and that perceived/potential barriers to change must be overcome. In addition, presence of cues to action is important for effective behaviour change (Carpenter, 2010; Janz & Becker, 1984; Rosenstock, 1966). Figure 4.1 summarizes the conceptualization of the relationship between the risk of exposure to solid waste and poor health outcomes and how behaviour change facilitated by an appreciation of one's susceptibility, severity of consequences, benefits, and barriers to be overcome, can lead to better health outcomes.

Solid waste management and health: Applying the Health Belief Model

Figure 4.1: Solid waste management and health: Applying the Health Belief Model



A good starting point for understanding the social and health challenges posed by poor solid waste management is to characterize and understand community perceptions around the challenge. This is important because communities are major stakeholders in addressing and responding to the challenge of solid waste. Without their appreciation of the challenge and its

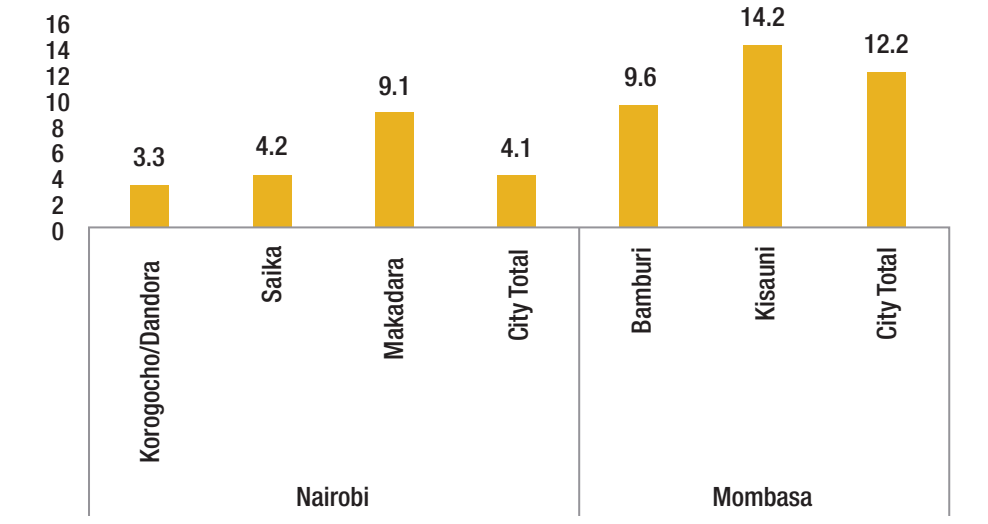
potential risk to their wellbeing, no interventions can have meaningful impact on improving solid waste management. Results presented in this chapter provide insights on how communities understand and appreciate the challenges associated with solid waste and its potential to harming their health. This is critical to informing policies and interventions geared towards proper and more efficient management of waste. Success in proper waste management is likely to be realized when communities are involved as stakeholders; otherwise the vicious cycle of poor solid waste management and poor health associated with it will continue to grow.

The results in this chapter are in three parts: perceived exposure to solid waste; perceived health risks; and actions taken to respond to the challenge. The chapter ends with a reflection on a discussion of the existing challenges to be addressed and opportunities that could be leveraged to improve solid waste management and ultimately improve health.

4.1 Exposure, Knowledge and Perceptions of Risks

Four percent of respondents in the three Nairobi sites and 12% of those in the two sites in Mombasa indicated that there was no risk associated with poor solid waste management (Figure 4.2).

Figure 4.2: Proportion of respondents who do not perceive that there are risks associated with solid waste



In both Nairobi and Mombasa, the proportion of respondents that did not perceive any risks associated with poor solid waste management was lowest in communities residing closest to the dumpsites (Korogocho/Dandora slums in Nairobi and Bamburi in Mombasa).

4.1.1 Perceptions about Risk of Exposure to Solid Waste

Table 4.1 shows the distribution of perceived risks of exposure to solid waste. Most respondents in Nairobi (87%) and Mombasa (99%) who reported that exposure to solid waste is a concern indicated that there are health risks associated with poor solid waste management. The other risks mentioned include poor hygiene (dirt), air pollution, presence of vermin and flooding. There were some stark differences between sites within the two cities. For example, in Nairobi city, the proportion of respondents that mentioned environmental hygiene (dirt) as a concern was more than two times higher in Korogocho and Makadara (over 55%) than in Saika (22%).

Table 4.1: Perceptions about risks of exposure to solid waste

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Daily risks faced by community due to SWM*							
Health risks	94.0	63.9	74.7	86.7	99.2	98.1	98.6
Fire risks	5.6	0.0	0.6	4.1	5.9	6.2	6.1
Dirty environment	58.0	22.0	55.7	51.5	62.3	74.8	69.2
Flooding	21.7	1.2	21.2	18.1	15.6	32.4	24.8
Vermin	29.7	2.3	26.7	24.7	15.0	23.6	19.7
Pollution of rivers and water	28.8	4.9	4.8	22.0	24.2	19.3	21.5
Air pollution	65.0	18.3	51.7	55.4	50.2	55.4	53.1
Other	8.3	21.6	16.9	11.6	1.1	0.4	0.7
N	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**
Rating of health risk due to poor SWM							
No risk at all	6.1	13.2	10.2	7.8	19.0	10.7	14.4
Little risk	14.2	29.6	35.3	19.2	25.4	28.6	27.1
Moderate risk	19.4	40.9	23.1	23.5	30.9	29.4	30.1
High risk	25.9	15.9	11.4	22.5	19.6	23.0	21.5
Very high risk	34.5	0.4	19.9	27.0	5.1	8.3	6.9
N	**779**	**189**	**143**	**1111**	**467**	**617**	**1084**
Most affected individuals							
Children	99.4	96.8	98.6	98.9	97.0	98.1	97.6
Older persons	0.5	1.4	1.4	0.7	0.6	0.6	0.6
Adult Women	0.1	1.9	0.0	0.4	2.2	1.2	1.6
Adult Men	0.0	0.0	0.0	0.0	0.2	0.2	0.2
N	**779**	**188**	**143**	**1,110**	**459**	**613**	**1,072**

** Multiple responses*

Over 20% of respondents in Korogocho/Dandora and Makadara reported flooding as a key issue associated with poor solid waste management compared with less than 2% in Saika (Table 4.1). Similarly, 65% of respondents in Korogocho/Dandora and 52% in Makadara

mentioned air pollution as a risk compared with 1% in Saika. In Mombasa, the proportion of respondents mentioning vermin, flooding and environmental hygiene as risks associated with poor solid waste management was higher in Kisauni than in Bamburi by more than 10 percentage points (Table 4.1).

Respondents were asked to rate the level of their household's exposure to health risks arising from poor solid waste management. In Nairobi, the proportion of respondents that rated the health risk emanating from poor solid waste as moderate, high or very high was higher in Korogocho/Dandora (80%) than in Saika (57%) or Makadara (54%; Table 4.1). In Mombasa, the proportion was higher in Kisauni (61%) than in Bamburi (56%). In all sites in Nairobi and Mombasa, at least 97% of respondents reported that children are the most-at-risk group in terms of exposure to solid waste and associated health effects.

Table 4.2: Perceived exposure to health risks associated with solid waste

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Pathways of exposure to health risks due to poor SWM*							
Unpleasant smell	85.3	34.1	61.0	74.3	79.1	85.6	82.8
Smoke	56.4	19.9	6.3	45.0	48.0	35.3	40.7
Contamination of water used in house	36.5	35.3	24.6	35.0	44.3	59.4	53.0
Contamination of food in house	25.6	15.4	0.9	21.3	15.5	12.0	13.5
Other	13.3	30.0	22.0	16.9	0.6	0.1	0.4
N	**806**	**196**	**157**	**1159**	**518**	**719**	**1237**
Food crops grown in community using compost made from waste at a dumpsite							
Yes	25.2	8.1	0.9	18.6	11.5	1.9	6.3
No	74.8	91.9	99.1	81.4	88.5	98.1	93.7
N	**597**	**175**	**137**	**909**	**468**	**616**	**1,084**
Food crops grown in community using water drawn next to a dumpsite							
Yes	34.4	17.6	0.0	26.8	2.1	0.3	1.1
No	65.6	82.4	100.0	73.2	97.9	99.7	98.9
N	**646**	**174**	**139**	**959**	**500**	**635**	**1,135**
Degree of contamination of water in community by solid waste							
Not contaminated at all	41.8	42.9	59.0	43.9	43.2	30.4	36.2
Somewhat contaminated	36.7	43.1	25.4	36.5	30.3	44.6	38.2
Very contaminated	8.5	3.5	3.7	7.1	10.7	11.6	11.2
Unsure/don't know	13.1	10.6	11.9	12.5	15.9	13.4	14.5
N	**780**	**189**	**143**	**1,112**	**468**	**617**	**1,085**

** Multiple responses*

Table 4.2 shows the distribution of perceived pathways through which exposure/ contamination from solid waste occurs and the extent of contamination. In Nairobi, the proportion of respondents who reported that their households were exposed to unpleasant smells was highest in Korogocho/Dandora (85%) and lowest in Saika (34%) while in Mombasa, the difference between sites was small.

The proportion of respondents in Nairobi reporting that food crops in their community were grown using solid waste compost from open dumpsite was highest in Korogocho/Dandora (25%) and lowest in Makadara (1%) while in Mombasa, it was highest in Bamburi (12%) and lowest in Kisauni (2%; Table 4.2). Similarly, the proportion of respondents in Nairobi indicating that water drawn downstream of the dumpsite was used to irrigate food crops was highest in Korogocho (34%) and lowest in Makadara (<1%) while the proportion in Mombasa was much lower, with no major differences between sites (2.1% in Bamburi and 0.3% in Kisauni). Since most solid waste in Kenya is not sorted, it is highly likely that it is mixed with human excreta thereby raising concerns about the appropriateness and safety of using such compost or water for agriculture.

Respondents were asked to grade the perceived level of contamination of water in their community on a scale of one to three. Overall, 44% of respondents in Nairobi indicated that their water was somehow or extremely contaminated, with the proportion reporting such concerns being highest in Saika (46%) and Korogocho (45%) and lowest in Makadara (29%; Table 4.2). In Mombasa, the proportion was higher in Kisauni (56%) than in Bamburi (41%).

4.2 Experiences of Health Issues Related to Poor SWM in the Past 12 Months

Respondents were asked to report, for each household member, whether they experienced any health issue related to poor SWM in the past 12 months preceding the interview.

Figure 4.3: Proportion who experienced health issues due to poor SWM in the past 12 months

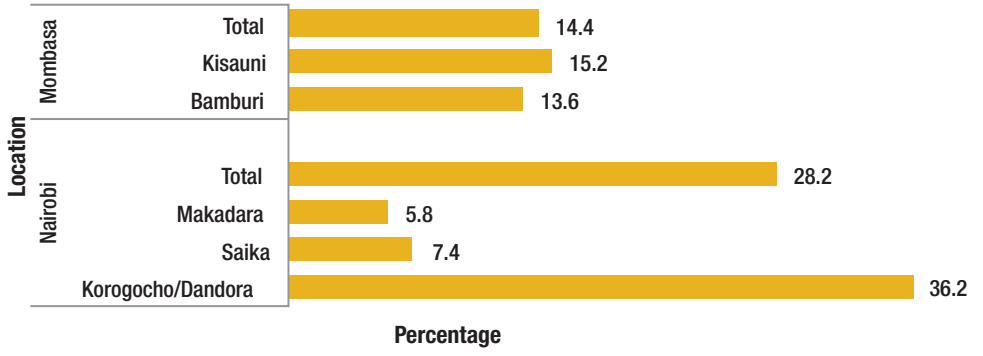


Figure 4.3 shows that in Nairobi, the proportion that reported a health issue related to poor solid waste management was highest in Korogocho/Dandora site (36%) and lowest in Makadara (6%) while in Mombasa, there was no major difference between sites (15% in Kisauni and 14% in Bamburi).

4.3 Self-Reported Health Conditions Associated with Poor Solid Waste Management and Care Sought

Table 4.3 shows results of reported illnesses associated with poor solid waste management, the source of information, and health care seeking practices for the conditions. In all sites, diarrheal diseases were the most commonly reported illnesses associated with poor solid waste management. Respiratory conditions, malaria and allergies were the other important conditions related to poor solid waste management. Respiratory conditions were prominently mentioned in Korogocho/Dandora compared to other sites. This is likely due to proximity to the dumpsite where pungent fumes from the burning waste emanate and affect the population living in the neighbourhood.

Table 4.3: Individual-related health issues associated with poor SWM

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Health issues experienced by household members							
Diarrheal diseases	45.3	35.4	25.4	44.4	49.5	41.6	45.3
Respiratory problems	26.0	2.9	18.1	24.9	11.8	10.3	11.0
Allergies	2.9	8.1	13.3	3.4	2.1	1.0	1.5
Skin problems	1.6	2.4	0.0	1.6	5.5	6.2	5.9
Asthma	0.8	0.0	2.8	0.9	1.9	2.8	2.4
Blood disorders/heart problems	0.0	0.0	0.0	0.0	0.6	0.3	0.5
Injuries (e.g.cuts, burns)	0.8	0.0	5.6	0.9	1.7	2.0	1.8
Malaria	14.1	12.1	31.0	14.4	23.3	34.5	29.3
Other	8.5	39.1	3.7	9.6	3.6	1.2	2.3
N	**1,022**	**39**	**32**	**1,093**	**270**	**316**	**586**
Source of information on the health issue							
Health facility	54.9	71.0	61.0	55.7	59.9	60.6	60.3
Pharmacy	2.3	0.0	0.0	2.1	8.2	5.5	6.8
Community health worker	0.9	0.0	0.0	0.8	0.5	1.0	0.8
Self-evaluation	41.5	24.3	39.0	40.8	30.9	31.8	31.4
Other	0.5	4.7	0.0	0.6	0.6	1.0	0.8
N	**1,022**	**39**	**32**	**1,093**	**270**	**316**	**586**
Actions taken to address the health problem							
Sought medical care	77.7	90.2	85.4	78.3	81.6	82.3	82.0
Bought medicine	19.7	9.8	10.8	19.1	15.3	14.7	15.0
Sought prayers	0.0	0.0	0.0	0.0	0.0	0.4	0.2
Nothing done	1.4	0.0	3.7	1.4	2.2	1.8	1.9
Other	1.2	0.0	0.0	1.2	0.9	0.8	0.9
N	**1,022**	**39**	**32**	**1,093**	**270**	**316**	**586**

In all sites, information on the nature of illness was mostly obtained from a health facility followed by personal judgement (Table 4.3). Most respondents sought care from a provider for specific health conditions (78% in Nairobi and 82% in Mombasa) although self-medication was also common (20% in Nairobi and 15% in Mombasa). Site differences were noted especially among respondents reporting self-medication. In Nairobi, the highest proportion was reported in Korogocho/Dandora (19.7%) while the lowest was in Saika (9.8%). In Mombasa, there was a small difference in the proportions for the two sites.

4.4 Community Actions to Reduce Risks

Table 4.4 shows results of community actions in response to solid waste challenges. In Nairobi, the proportion of respondents who reported that communities are in a position to address the risks associated with solid waste was lowest in Korogocho/Dandora (23%) and highest in Makadara (47%) while in Mombasa, it was lower in Kisauni (28%) than in Bamburi (41%).

Table 4.4: Community actions to address poor SWM

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Communities able to address risks due to poor SWM							
Yes	23.3	39.2	47.2	28.8	41.1	27.8	33.6
No	76.7	60.8	52.8	71.2	58.9	72.2	66.4
N	**765**	**174**	**148**	**1,087**	**490**	**681**	**1,171**
Actions taken by the community to address health risks*							
Public health education	3.9	0.9	5.2	3.5	5.5	5.3	5.4
Organised regular clean-ups	21.0	10.9	24.7	19.7	25.8	20.3	22.7
Petitioned the local representatives	5.4	0.0	11.1	5.2	6.5	2.4	4.2
Nothing done	61.0	77.9	50.2	62.7	56.0	63.4	60.1
Other	15.8	10.3	26.9	16.1	10.0	11.6	10.9
N	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**
Are actions taken by the community adequate for addressing the risks?							
Yes	17.3	39.4	35.7	22.5	34.1	26.3	30.1
No	82.7	60.6	64.3	77.5	65.9	73.7	69.9
N	**313**	**40**	**78**	**431**	**223**	**262**	**485**
Reasons for community's inability to addressrisks*							
Poverty	47.7	30.5	14.5	42.0	43.5	36.9	39.9
Lack of Government support	35.8	24.1	58.9	37.9	44.0	58.8	52.1
Lack of unity & coordination	55.2	21.7	67.9	54.2	40.1	54.3	47.8
Lack of land tenure / Illegal occupancy	2.6	4.8	0.0	2.4	14.6	25.5	20.6
Ignorance	46.5	26.3	35.6	43.5	62.4	43.3	52.0
Other	15.3	17.8	23.8	16.7	8.8	6.5	7.5
N	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**

** Multiple responses*

Over 60% of respondents in Nairobi and Mombasa reported that there was no action to address poor solid waste management issues. A small fraction reported that there were sensitization events in the community (4% in Nairobi and 5% in Mombasa), while 20% and 23% in Nairobi and Mombasa, respectively, reported that they had organized clean-up events. In both cities, at least 70% of respondents indicated that the actions taken so far were inadequate to effectively address solid waste challenges. This was more so in Korogocho/Dandora where 83% of respondents indicated that the actions undertaken were not sufficient. The perceived inadequacy of the actions are mainly attributed to four key issues including poverty, lack of government support, lack of coordination, and ignorance among members of the public. Poverty ranked high in Korogocho/Dandora (48%); lack of government support featured prominently in Kisauni and Makadara (59% in each site); lack of coordination was important in Makadara (68%); while ignorance featured prominently in Bamburi (62%).

4.5 Challenges

The effects of poor solid waste management on health vary. They may also be overt or occult; and short term or long term. Individuals' appreciation of the potential dangers solid waste has on health is a good starting point for addressing the solid waste challenge. This is important because there are actions that can be carried out at individual and household levels to contribute to improvements in solid waste management. In addition, public awareness and interest in improving solid waste management to protect health can galvanize demand on the leadership to address the issues around solid waste management, including adequate resource allocation. The challenges discussed in this section are categorized into three: short-term and long-term effects on health; individual and community responses; and the role of leadership and governance.

Based on findings in this report, it is evident that many respondents associate certain health issues such as diarrhoea, skin and respiratory diseases with exposure to solid waste. Indeed, a higher proportion of respondents residing closer to dumpsites expressed health concerns associated with solid waste compared with those living in settlements far off, a possible indication of some form of dose-response. Whether the observed health problems can directly be attributable to solid waste was beyond the scope of the study. However, individuals' ability to appreciate the potential dangers associated with solid waste provides a basis for either taking action or avoiding potential exposure to solid waste. From the literature, some of the health conditions reported here have been empirically shown to affect health. The biggest, yet unseen health challenges, are those of occult and long term effects (Nduka et al., 2006; Nduka, Orisakwe, Ezenweke et al., 2008; Song & Li, 2015). With increasing complexity and composition of the solid waste content, it is expected that many effects unfold several years after exposure. These effects are likely to be chronic diseases such as cancers and chronic obstructive pulmonary diseases. Without proper surveillance, attributing such effects to solid waste might not be possible and this is likely to delay efforts to address the problems.

The solid waste problem can be looked at and responded to as a challenge and opportunity rather than a mere problem (Oguntoyinbo, 2012). The biggest question is how to enable residents to collectively take part in improving solid waste management at the various levels. The challenge of poor solid waste management starts at the point of generation where, if sorted, it is easier to transport and dispose of the less hazardous (Cimpan, et al., 2015). This suggests the need for sensitizing individuals and households to engage in solid waste sorting. Related to solid waste sorting is recycling. Recycling not only reduces the bulk of waste to be disposed of but also saves on exploitation and use of natural resources, and in various ways contributes to slowing down of global warming and climate change. Sorted organic solid waste is also easier to compost for agricultural use and biogas production. Mixed waste is cumbersome to handle and less appealing to would-be investors in composting and biogas production as the investments are higher with low net returns.

One of the major challenges in solid waste management is leadership and governance. Leadership has a central role in designing policies, guidelines and bylaws besides overseeing their implementation. However, formulation of policies, guidelines and bylaws is often detached from implementation and, as a result, no tangible outcomes are realized (Haregu, et al., 2016; Hoornweg & Bhada-Tata, 2012). Leadership can also play a key role in community sensitization and behavioural change, advocacy for resource allocation, setting up of better systems and ensuring their implementation. In the Kenyan context, the devolved system of governance that came into effect in 2010 provides a great opportunity for leadership to work closely with the general public to address some of the very important challenges communities face regarding solid waste management (Government of Kenya, 2010). It is also critical for governments to make a commitment for more environmental and health-friendly solid waste disposal approaches as opposed to the existing practices of open site dumping and poorly operated incinerators (Njagi, et al., 2012; Kimani, 2007). This, however, requires a paradigm shift in thinking among those in leadership and substantial investments (Hoornweg & Bhada-Tata, 2012). Continuing with the existing practice amidst growing urban population and increasing solid waste per capita is not sustainable for health and the environment. Human activities, which are bound to increase with the growing urban population, are now recognized as the single most important cause of environmental and climatic change (Whitmee et al., 2015).

References

Abd El-Wahab, E. W.; Eassa, S. M.; Lotfi, S. E.; El Masry, S. A.; Shatat, H. Z;. and Kotkat, A. M. (2014). Adverse Health Problems among Municipality Workers in Alexandria (Egypt). *International Journal of Preventive Medicine, 5*(5), 545-556.

Boadi, K. O. and Kuitunen, M. (2005). Environmental and Health Impacts of Household Solid Waste Handling and Disposal Practices in Third World Cities: The Case of the Accra Metropolitan Area, Ghana. *Journal of Environtal Health, 68*(4), 32-36.

Carpenter, C. J. (2010). A Meta-Analysis of the Effectiveness of Health Belief Model Variables in Predicting Behavior. *Health Communication, 25*(8), 661-669. doi: 10.1080/10410236.2010.521906

Cimpan, C.; Maul, A.; Jansen, M.; Pretz, T.; and Wenzel, H. (2015). Central Sorting and Recovery of MSW Recyclable Materials: A Review of Technological State-of-the-Art, Cases, Practice and Implications for Materials Recycling. *Journal of Environtal Health, 156,* 181-199. doi: 10.1016/j.jenvman.2015.03.025

Government of Kenya. (2010). The Constitution of Kenya *Kenya Law Reports.* Nairobi, Kenya: National Council for Law Reporting with the Authority of the Attorney General.

Grant, K.; Goldizen, F. C.; Sly, P. D.; Brune, M. N.; Neira, M.; van den Berg, M.; and Norman, R. E. (2013). Health Consequences of Exposure to E-Waste: A Systematic Review. *Lancet Global Health,* 1(6), e350-361. doi: 10.1016/S2214-109X(13)70101-3

Haregu, T.N.; Mberu, B.; and Ziraba, A.K. (2016). Evolution of Solid Waste Management Policy Landscape in Kenya: Analysis of Evolvement of Policy Priorities and Strategies. Nairobi: African Population and Health Research Center.

Hoornweg, D. and Bhada-Tata, P. (2012). What a Waste: A Global Review of Solid Waste Management. *Urban Development Series, Knowledge Papers.* Washington, DC: World Bank.

Janz, N. K. and Becker, M. H. (1984). The Health Belief Model: A Decade Later. *Health Education Quarterly, 11*(1), 1-47.

Kimani, N. G. (2007). Environmental Pollution and Impacts on Public Health: *Implications of the Dandora Municipal Dumping Site in Nairobi, Kenya.* Nairobi: UNEP.

Nduka, J. K.; Orisakwe, O. E.; Ezenweke, L. O.; Abiakam, C. A.; Nwanguma, C. K.; and Maduabuchi, U. J. (2006). Metal Contamination and Infiltration into the Soil at Refuse Dump Sites in Awka, Nigeria. *Archives of Environmental & Occupational Health,* 61(5), 197-204. doi: 10.3200/AEOH.61.5.197-204

Nduka, J. K.; Orisakwe, O. E.; Ezenweke, L. O.; Chendo, M. N. ; and Ezenwa, T. E. (2008). Heavy Metal Contamination of Foods by Refuse Dump Sites in Awka, Southeastern Nigeria. *Scientific World Journal, 8,* 941-948. doi: 10.1100/tsw.2008.129

Njagi, N. A.; Oloo, M. A.; Kithinji, J.; & Kithinji, M. J. (2012). Health-Care Waste Incineration and Related Dangers to Public Health: Case Study of the Two Teaching and Referral Hospitals in Kenya. *Journal of Community Health, 37*(6), 1168-1171. doi: 10.1007/s10900-012-9578-4

Oguntoyinbo, O. O. (2012). Informal Waste Management System in Nigeria and Barriers to an Inclusive Modern Waste Management System: A Review. *Public Health, 126*(5), 441-447. doi: 10.1016/j.puhe.2012.01.030

Rosenstock, I. M. (1966). Why People Use Health Services. *Milbank Memorial Fund Quarterly, 44*(3), Suppl:94-127.

Rushton, L. (2003). Health Hazards and Waste Management. *British Medical Bulettin, 68,* 183-197.

Ryu, J. Y.; Sunwoo, Y. E.; Lee, S. Y.; Lee, C. K.; Kim, J. H.; Lee, J. T.; & Kim, D. H. (2015). Chronic Obstructive Pulmonary Disease (COPD) and Vapors, Gases, Dusts, or Fumes (VGDF): A Meta-analysis. COPD, 12(4), 374-380. doi: 10.3109/15412555.2014.949000

Song, Q., & Li, J. (2015). A Review on Human Health Consequences of Metals Exposure to E-Waste in China. *Environmental Pollution, 196,* 450-461. doi: 10.1016/j.envpol.2014.11.004

Whitmee, S.; Haines, A.; Beyrer, C.; Boltz, F.; Capon, A. G.; de Souza Dias, B. F; Yach, D. (2015). Safeguarding Human Health in the Anthropocene Epoch: Report of the Rockefeller Foundation-Lancet Commission on Planetary Health. *Lancet.* doi: 10.1016/S0140-6736(15)60901-1

Chapter 5

VIOLENCE AND CRIME IN SOLID WASTE MANAGEMENT

Dickson Amugsi Kanyiva Muindi

5.1 Background

This chapter examines community perceptions of violence and crime in solid waste management (SWM) in Nairobi and Mombasa. Violence and crime are common features associated with solid waste management across countries (D'Amato et al., 2015; D'Amato & Zoli, 2012). This is mostly as a result of competition among service providers and workers at dumpsites for ownership (Gumbihi, 2013). Violence in this context refers to both physical and non-physical actions such as coercion and/or control, while crime refers to acts considered illegal under the laws of a country and may not necessarily involve violence (Davis, 2012). There is a paucity of evidence on the relationship between violence/crime and SWM especially in the developing country context. However, few studies mostly in developed countries have documented the relationship between violence and crime and SWM (D'Amato et al., 2015; D'Amato & Zoli, 2012). For example, in Italy, the mafia are known to collude with local institutions to control waste markets (D'Amato et al., 2015). Consequently, legal forms of waste disposal and socially preferable management options are often undermined (D'Amato et al., 2015). In the analysis of the role of the mafia in the waste cycle, D'Amato & Zoli (2012) conclude that under certain circumstances, a criminal organization operating in the waste management cycle and extracting rents through socially harmful extortion might lead to higher levels of production and lower levels of enforcement. Thus, the role of organized crime within local municipalities is a strong obstacle to achieving better waste management.

The discussion in the preceding paragraph can also be applied to Kenya, where the evolution of violence and crime in SWM in Nairobi can be traced to the inability of the city government to effectively manage the waste produced and limited capacity of medium-to-large private collectors to significantly contribute to SW collection (Allison & von Blottnitz, 2010; Mazzanti & Montini, 2014; Peters, 1998). This has resulted in the emergence of small private collectors and entities that operate in an environment of unregulated open competition, with rivalry among these collectors being the order of the day (Kantai, 2000). The competition for clientele and control of the SWM business has created a situation where service providers arm cartels to protect their interests (Gumbihi, 2013). The situation creates a fertile ground for violent clashes among cartels and also other interested groups, especially at the Nairobi's official dumpsite (Dandora Dumpsite), which sometimes results in deaths (Kantai, 2000; Leigh, 2012). The dumpsite also provides a safe haven for gun-toting criminals who operate from the site, using it as a hiding place and strategizing point for crime (Leigh, 2012). This chapter presents findings on community perceptions of violence and crime as they relate to SWM.

5.2 Community Perceptions of Crime and Conflict in SWM

Table 5.1 presents results of community perceptions of violence and crime/conflict as they relate to SWM. The results showed that the proportion of study participants in Nairobi that had heard about cartels was higher in Korogocho/Dandora (52%) than Saika (17%) or Makadara (48%). The results for Korogocho/Dandora are not unexpected because these locations border the Dandora dumpsite where the cartels operate. However, it would be expected that respondents in Saika, which borders Korogocho/Dandora, would be more aware of the existence of cartels than Makadara. The results for Makadara suggest that, being a formal settlement, it is likely to have more educated people who are familiar with the term through reading newspapers or hearing it in news. In addition, Makadara is located in a region of the city characterised by cartels/gangs and therefore respondents may have had first-hand experiences with these. In Mombasa, only 9% of the respondents in Bamburi and 11% in Kisauni indicated that they had heard of cartels. The finding may suggest that cartelism as it relates to SWM is not a common practice in these settings.

Table 5.1: Community perceptions about crime and conflict in SWM

	Nairobi				Mombasa		
	Korogocho/ Dandora	Saika	Makadara	Total	Bamburi	Kisauni	Total
Heard about cartels in SWM?							
Yes	52.1	16.6	48.0	45.5	9.3	10.5	9.9
No	47.9	83.4	52.0	54.5	90.7	89.5	90.1
N	**805**	**196**	**157**	**1,158**	**518**	**719**	**1,237**
Community experienced crime/conflict							
Yes	61.6	59.6	26.5	57.1	29.0	35.5	32.8
No	38.4	40.4	73.5	42.9	71.0	64.5	67.2
N	**419**	**32**	**78**	**529**	**51**	**76**	**127**
Types of crime/conflict experienced							
Fights	19.1	9.9	14.4	18.1	4.5	7.2	5.7
Disputes	15.4	5.1	27.2	15.2	22.1	8.8	16.0
Rape/defilements	3.2	0.0	5.9	3.1	2.2	0.0	1.2
Killings	3.6	5.1	0.0	3.5	0.0	3.0	1.4
Robbery	50.8	50.3	45.5	50.5	38.8	78.0	56.8
Destruction of property	0.5	0.0	0.0	0.4	0.0	0.0	0.0
Other	7.4	29.6	7.0	9.1	32.4	3.0	18.9
N	**283**	**24**	**22**	**329**	**31**	**27**	**58**
Primary victims of the crime/conflicts							
Community leaders	1.8	0.0	15.0	2.3	0.0	0.0	0.0
County authority staff	0.0	0.0	0.0	0.0	3.8	0.0	2.0
Women	28.6	36.6	5.9	28.0	44.3	38.5	41.5
Children	2.4	4.0	0.0	2.4	4.3	11.1	7.6
Waste pickers	6.4	0.0	0.0	5.5	3.0	0.0	1.6
Other	60.8	59.4	79.1	61.7	44.5	50.4	47.3
N	**283**	**24**	**22**	**329**	**29**	**27**	**56**
Effects of cartels*							
Insecurity	86.9	69.4	76.4	84.5	72.9	89.7	82.8
Illegal dump sites	46.5	7.0	54.1	45.0	43.8	44.2	44.0
Littering	50.5	30.3	59.8	50.4	48.8	32.3	39.0
Better garbage collection	4.7	3.2	4.2	4.6	14.4	7.9	10.6
Other	13.0	3.2	31.0	14.6	1.5	1.2	1.3
N	**806**	**196**	**157**	**1,159**	**518**	**719**	**1,237**

** Multiple responses*

Regarding the experience of crime and conflict in Nairobi, higher proportions of respondents in Korogocho/Dandora (62%) and Saika (60%) than in Makadara (27%) reported that their communities had experienced crime/conflict (Table 5.1). The high prevalence of crime and conflict in Korogocho/Dandora is not surprising given their proximity to the dumpsite. The same applies to Saika, which borders Korogocho/Dandora. In the qualitative interviews, respondents attributed conflict to competition among SWM players. For example, they indicated that in Nairobi, numerous groups are undertaking garbage collection activities as a source of income, which triggers competition among multiple formal and informal actors over the control of waste. This usually degenerates into conflicts and violence as people jostle to fill up the gaps in SWM services. Respondents from cartel groups reported the use of violence to takeover SWM operations:

> *"I won't say crime but rather conflict. This is to say that waste here is like gold; it is the source of income closest to us which helps us not to engage in crime and that's why I say 'conflict' because you will get where there was someone who controlled all the income arising from the waste and now there are other youths who are jobless and see the opportunity which can only be realized by getting rid of the other person. So conflicts have been there especially those to do with boundaries."* ***(IDI, Cartel representative)***

Criminal activities in SWM especially at dumpsites have previously been reported. For example, competition among waste service providers for business at the Dandora dumpsite created a situation where cartels were armed to protect the interest of service providers (Gumbihi , 2013). Unsurprisingly, most reports of crime and violence in relation to SWM in Nairobi are within the Dandora dumpsite. However, in Mombasa, a lower proportion (29%) of respondents in Bamburi (where the official dumpsite is located) than in Kisauni (36%) reported that their community experienced crime/conflict during the period preceding the survey. The high proportion in Kisauni relative to Bamburi suggests that crime/conflict as it relates to SWM in Mombasa is not limited to communities bordering dumpsites. The low prevalence of reported crime may be due to the less attractive location of the Mwakirunge dumpsite that makes waste disposal at the site difficult and is therefore not attractive to cartels. On the other hand, the proximity of the Voice of Kenya (VOK) transfer station to the city center and the presence of regular security officers may act as a deterrent to anyone intending to use this as an operating base.

In relation to type of crime/conflict the community had experienced, armed robbery was the most commonly reported crime across sites in Nairobi although it was highest in Korogocho/Dandora (51%) and Saika (50%) and lowest in Makadara (46%; Table 5.1). This was followed by fights and disputes, with these forms of crime being reported more in Makadara (14% for fights and 27% for disputes) than in other sites in the city. The high prevalence of armed robbery in Korogocho/Dandora and Saika may be attributed to the nature of the settlements (low income), which are fertile ground for breeding of criminals (Kantai, 2000; Leigh, 2012). Another plausible explanation is the proximity of these locations to the Dandora dumpsite, which has

been reported as a site for crime/conflict (Kantai, 2000; Leigh, 2012). In Mombasa, a lower proportion of those in Bamburi (38%) than in Kisauni (78%) reported armed robbery as a type of crime their community experienced. Regarding the perpetrators of armed robberies in the city, representatives of youth waste collectors in the VOK area in Mombasa city reported that the crimes were often committed by other people, but waste pickers were usually the target of security officers.

> *"If you are attacked and robbed, it is not the waste pickers but some other people who may have followed you. And since you are fearing, if there is crime around VOK, policemen would ask you where you have been robbed from and then you say VOK, the waste pickers will be in trouble."* ***(FGD, Youth collectors, Mombasa)***

The above sentiment could be attributed to the generally negative view people have about waste pickers. They are looked down upon by both the community members and government officials. The waste pickers noted that they are often perceived as criminals. These sentiments were expressed by FGD participants at the Mwakirunge dumpsite in Bamburi.

> *"We are being looked down upon that we are waste pickers and maybe we have lost our future life and therefore we are seen as useless. But it's not our wish, it is part of life and once we get some good job we will not stay here."* ***(FGD, waste pickers, Mwakirunge)***

Disputes constituted 22% of forms of crime/conflict reported by communities in Kisauni. High unemployment among the youth was identified as an important factor contributing to crime in the two study sites in Mombasa, with strangers being the usual target of criminals.

> *"We can't tell because most of the time, they say they don't have jobs. Lack of employment is their main excuse. If you happen to meet about ten of them walking, they have knives. Once they spot an unfamiliar person they pounce on him/her even if it is during the day. For example, this madam here, if she happens to go round the town, they will notice her. But, for example, a person like me who is well known to them can't be robbed, such a stupid thing."* ***(KII Mombasa)***

Regarding primary victims of crime/conflicts in SWM, higher proportions of respondents in Saika (37%) and Korogocho/Dandora (29%) than in Makadara (6%) mentioned women. In Mombasa, a higher proportion of respondents in Bamburi (44%) than in Kisauni (39%) indicated that women were the primary victims of crime/conflicts. This is consistent with evidence of vulnerability of women to crime in SWM in other settings (Jerie, 2011).

Participants reported three negative effects of cartel activities on SWM: insecurity, creation of illegal dumpsites and littering of the environment. In Nairobi, the proportion reporting that insecurity was a major effect of cartelism was highest in Korogocho/Dandora (87%) and lowest in Saika (69%). Creation of illegal dumpsites was also identified as an effect of cartel activities, although this was more commonly reported in Makadara (54%) than in Korogocho/Dandora (47%) or in Saika (7%). Respondents also associated cartel activities with littering of the environment, again with the phenomenon being more commonly reported in Makadara

(60%) than in Korogocho/Dandora (51%) or in Saika (30%). Qualitative interviews (FGDs) showed that residents of Korogocho/Dandora and Makadara viewed waste pickers as key actors in SWM. The same positive sentiments were expressed by key informants from institutions engaged with waste pickers. However, a contrary view was held by a government official who considered waste pickers not so important actors in SWM. Similar negative views were held by FGD participants from formal settlements in Nairobi.

In Mombasa, a lower proportion of respondents in Bamburi (73%) than in Kisauni (90%) reported insecurity as an effect of cartel activities (Table 5.1). The proportion reporting creation of illegal dumpsites in Bamburi was similar to that of Kisauni (44% in each case). Similar sentiments were expressed by participants in the qualitative interviews.

> *"Yes, waste pickers, are the biggest problem! Instead of keeping the place clean, the waste pickers even make it worse because they remove the stuff from there; they create another dumpsite of their own."* ***(KII Mombasa)***

The proportion of respondents that reported littering of the environment as a negative effect of cartel activities was higher in Bamburi (49%) than in Kisauni (32%; Table 5.1). However, some respondents identified positive effects of cartel activities in the city. For example, 14% of respondents in Bamburi and 8% of those in Kisauni indicated that the activities of cartels resulted in better garbage collection.

5.2 Summary

This chapter examined community perceptions of crime and conflict in relation to SWM. The results showed that in Nairobi, respondents who were aware of cartel activities were mostly from the communities bordering the Dandora dumpsite. However, in Mombasa, very few participants indicated that they had heard of the term cartel. Majority of the respondents in Nairobi who reported that their community experienced crime and conflict were from Korogocho/Dandora and Saika communities, which are located near the dumpsite. In contrast, in Mombasa, the community located in the environs of the official dumpsite reported lower levels of crime and conflict compared with that located farther away from it. Armed robbery was the mostly commonly reported form of crime in Korogocho/Dandora and Saika communities. In Mombasa, more than three quarters of respondents in Kisauni indicated that armed robbery was a major problem in their community. In both cities, women were identified as the primary victims of crime and conflict. In addition, insecurity was reported as a major effect of cartel activities in both cities and across all locations.

References

Allison K. and von Blottnitz, H., *Solid Waste Management in Nairobi: A Situation Analysis.* 2010, Environmental & Process Systems Engineering Group University of Cape Town: Cape Town.

D'Amato A and Zoli M, *Illegal Waste Disposal in the Time of The Mafia: A Tale of Enforcement and Social Well Being. Journal of Environmental Planning and Management.* , 2012. 55: p. 637–655.

D'Amato A, Mazzanti M, and Nicolli F, *Waste and Organized Crime in Regional Environments How Waste Tariffs and the Mafia Affect Waste Management and Disposal.* Resource and Energy Economics 2015. 41: p. 185–201.

Davis D. E, *Urban Resilience in Situations of Chronic Violence.* 2012, MIT Center for InternationalStudies: Massachusetts.

Gumbihi H. *Lords of the Flies: Unmasking Dandora's Trashlords* 2013; Available from: www.standardmedia.co.ke/entertainment/thenairobian/article/2598/unmasking-the-trashlords-of-dandora.

Jerie S. *Gender and Solid Waste Management in the Informal Sector of Bulawayo, Zimbabwe* 2011; Available from: http://ir.msu.ac.zw:8080/jspui/bitstream/11408/383/1/jerie.pdf.

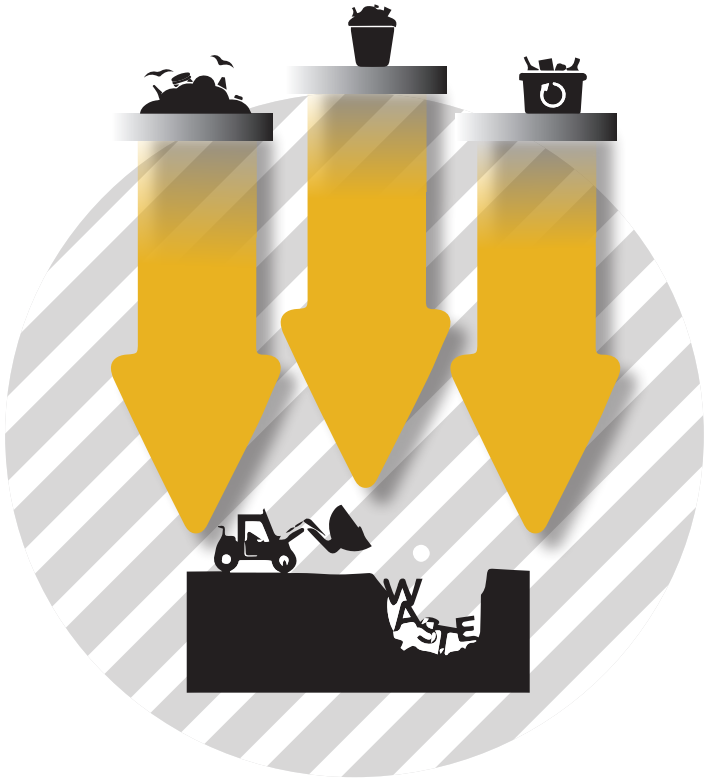
Kantai P. The Treasure Buried in Nairobi's Dumps. Nairobi: *The East African* 2000[cited 2016 08.08]; Available from: http://www.hartford-hwp.com/archives/36/145.html

Leigh E. *Kenya's Chronically Overflowing Dandora Dump September 24*2012[cited 2016 08.08]; Available from: http://recyclenation.com/2012/09/kenya-chronically-overflowing-dandora-dump#sthash.Ue9vrmA6.dpuf

Mazzanti M and Montini A, Waste Management Beyond the Italian North–South Divide: Spatial Analyses of Geographical Economic and Institutional Dimensions. In: Kinnaman, T., Takeuchi, K. (Eds.), *Handbook on Waste Management. Edward Elgar.* 2014.

Peters K. *Community-Based Waste Mangement for Environmental Management and Income Generation in Low-Income Areas: A Case Study of Nairobi, Kenya.* 1998[cited 2016 08.08]; Available from: http://www.cityfarmer.org/NairobiCompost.html.

Chapter 6



STAKEHOLDER VOICES ON IMPROVING SOLID WASTE MANAGEMENT IN KENYA

Kanyiva Muindi

Dickson Amugsi

6.1 Background

Solid waste management especially in Nairobi and Mombasa and in other major urban centres in Kenya has received attention due to the deplorable condition of dumpsites in these cities and the attendant environmental and human health effects (Kimani, 2007). The country has always relied on open dumps as waste disposal sites and in many of the urban centres, these dumpsites have become eye-sores and indeed pose risks to people living in close proximity to them. This chapter assesses stakeholder voices on what needs to be done to improve the state of SWM in the study cities. The data are from qualitative work conducted in the cities among community members, waste pickers, waste collectors and transporters, bilateral agencies, NGOs, CSO/CBOs and among local authority officials. The results are presented by source of information.

6.2 Views of Community Members, Waste Pickers, Collectors and Transporters

The results from the qualitative enquiry indicate a convergence of views regarding some of the steps that need to be taken to improve the state of SWM in the two cities.

Awareness/education

It was evident from the data that lack of awareness among residents of the two cities was a main cause of poor SWM. For instance, people seemed unaware of the need to keep the environment free of litter and instead, there was indiscriminate dumping within residential areas. Thus, community members, waste collection groups, waste pickers as well as other stakeholders felt that residents needed to be educated on the effects of waste on health, their roles in proper SWM including waste reduction, reuse and recycling of materials with the latter seen to not only address issues of poor waste management but also increase incomes especially among waste pickers.

> *"We need civic education and call people from different sectors and create awareness among people on the benefits of proper waste management."**[KII, Community leader, Mombasa]***

> *"…youth engaging in proper waste management and recycling, giving them the proper tools… and linking them to the proper markets and the other areas… Then I believe it can help improve the status of waste [management] in especially our community and our urban areas…" **[IDI, NGO officer, Nairobi].***

Equipment and protective clothing for informal collectors

Among informal collection groups, there was an expressed need to have better equipment to improve their service delivery to the households they serve, as well as to transport the waste to the designated dumpsites. Besides equipment, there was also the need for protective gear to avert adverse effects of solid waste on their health. They also called for support from county governments who should view their roles as complementary rather than a hindrance to the achievement of better solid waste management. Given the important gap that informal waste collectors bridge (Gunsilius, 2010) especially in the informal settlements, their concerns should be given due consideration by concerned officials. In addition, there was a call for county authorities to invest in equipment needed for efficient waste collection.

> *This is because Mombasa County is aware of the population of the county. And within their yearly budget, what needs to be in place is already in their budget. So for them, saying that they don't have equipment is not enough excuse since we are paying taxes! Where does it go to? Yes, where does it go to?* ***[FGD, Informal Recycler, Mombasa]***

Improving access to dumpsites

Being the repositories of waste from cities, dumpsites are important facilities with far-reaching public health implications. Their siting and accessibility are therefore important considerations that need to be taken into account as they could make or break a city's solid waste management system. Study participants viewed the municipal dumpsites in both Nairobi and Mombasa as inaccessible especially during the rainy season. This is because in Nairobi, the Dandora dumpsite is full and vehicles delivering waste do not venture into the interior of the site due to unstable waste that poses the risk of vehicles sinking. Waste transporters therefore resort to dumping garbage on the access roads, making it hard for vehicles to access the dumpsite. Participants expressed need for the access roads to be cleared of garbage that has been dumped there to avoid the proliferation of illegal dumpsites all over the city. In Mombasa, the official dumpsite is located far away from the city centre with unpaved roads that are unusable in the rainy season. Participants therefore suggested that the roads be paved, or alternatively, the dumpsites be decentralized to ensure that each division has one instead of relying on one central dumpsite that was hardly used due to difficulties with access.

> *"… So issues of planning plus the road to Mwakirunge is impassable when it rains and other trucks just dump on the road..."* ***[KII, NGO representative, Mombasa]***

Embracing partnerships

There were suggestions, especially from civil society organizations (CSOs) and non-governmental organizations (NGOs) working in informal areas of Nairobi, for stronger

partnerships between the county government and these groups as well as with community-based organizations (CBOs) providing waste collection services to residents in under-served areas.

> *"So what we're saying is that partnership is key in all these things and the county government really needs to embrace that particular aspect and not necessarily be averse to it because the sense I get is that much as there are a few good things happening maybe in the county government but they've still not been able to be at a point where they see the value of partnership and how that can actually compliment their work. When you go for partnership they think that you have come to snoop around and see what the problem is. Instead of looking at you as somebody who can assist or compliment their work, they think that you've come to cause trouble, we've come to pick information which then you'll use against them. So we need to address that aspect of partnership…" **[IDI, CSO Officer, Nairobi]***

6.3 Views of Informants from Local Authorities and Bilateral Agencies

Interviews with representatives from the county governments in the two cities were conducted to elicit their views on various issues of SWM. In addition, interviews were conducted with officers from a bilateral agency that has keen interest in proper waste management in the country. Key among the issues explored was the way forward for the two cities to implement a proper solid waste management system.

City Planning

The findings indicated that policy considerations needed to be given priority, especially with regard to land use and city planning to ensure proper siting of landfills/dumpsites.

> *"… in the future in order, in terms of ... planning in land-use.... before land-use, we have to think about like...development control policy, so, we have to have proper project; proper land-use and proper urban planning" **[KII, Bilateral Agency]***

Plastic bag ban

Participants were of the opinion that there is need for an immediate ban on plastic bags that have contributed to much misery in both cities due to clogging of drains, leading to floods.

> *"…but if the government is being played, played by the guys who are running the plastics factories and they keep on supplying them to supermarkets we will be having the same problems. So we must.... the government must come out and eliminate the use of plastics, we will survive, you know? For a sustainable development we will survive but if we cannot do that one, we are just uttering words, nothing happens." **[KII, County official, Nairobi]***

Harmonize agency roles and rework existing policies

There were views that the county government and the National Environment Management Agency (NEMA) had roles that needed to be harmonized/synchronized. For example, the licensing of solid waste collectors was apparently in the hands of both NEMA and the county government. This has the potential to negatively impact solid waste management as licensees may find it tedious and expensive. Also there were out-of-sync roles such as approval by some county departments that happened before the environmental impact assessments (EIA); yet the EIA should ideally accompany any application for approval of projects in the city. In addition, it was felt that there was need to look at the policies that exist and address the gaps therein. For example, participants were of the view that the Public Health Act needed to be customized to serve the devolved system of government; move away from an enforcement outlook; address missing gaps such as public education; and mandate relevant officers with duties that fit their expertise. Participants reported that addressing these gaps would lead to better policy whose implementation would contribute to better health for all.

Resources at dumpsite

There were concerns about resources available at the Nairobi dumpsite to ensure better management of the site. The resources include equipment for handling garbage, and human resources to manage the site. It emerged that the dumpsite lacked adequate human resources to ensure efficient day-to-day running of the site.

> *"…so we walked all the way but there are issues in that dumpsite that needed to be addressed. One, the capacity in terms of human resource that is there to deal with the day to day business of the dumpsite is dying."* ***[KII, County official, Nairobi]***

The declining number of waste handling vehicles that the two cities own and operate was cited as a major issue that is affecting the way waste is handled.

> *"At least we need, I can talk of the collection trucks. The least the county can have we can talk of 85 trucks so that we can talk of every ward having at least a garbage truck; that can be our starting point, just to make sure every ward has a garbage collection truck…but now we have only 43 trucks."* ***[KII, County official, Nairobi]***

Following up on agreements made with private providers of SWM services

One other factor that participants felt required some re-thinking is the privatization of waste collection services in Nairobi, which they attributed to the poor waste management. This was associated with the private providers' inability to offer optimal services as was previously the case when the county was in charge of the services. Others felt that the county needed to strictly follow the guidelines they have set for engaging private providers so that they can

provide services as expected. It was noted that the county's failure to be strict with the minimum requirements of a service provider — for example, the kind of trucks that collect and transport waste — was contributing to poor SWM as providers did not have the requisite number and type of trucks.

Waste separation at source

There was concern over the continued dumping of mixed waste streams with no attempt to separate at source. Although this was not a popular option among waste pickers who were concerned that waste separation would rob them of their incomes, local authority officials and bilateral agency officers felt this was a necessary step towards improving the solid waste management situation in the country. It emerged that there was a pilot study on the feasibility of waste separation at the household level, an approach that was reported to be welcomed by many but that has not been rolled out to the entire city.

> *"…And before even we go and tell them to separate, we need to go and sort our house; you are not separating and taking them to Dandora dumpsite. You are separating and taking them to an organized disposal site, isn't it? So I think the county needs to put its house in order first and teach Nairobians, I think Nairobians are tired, they are ready, and they want to move. Nairobians now want to move to the next level, they don't want to just dispose. People are ready, I mean, you only need to start with the middle income who are the majority, and they will be able to separate the plastics, the papers and the e-waste. But they cannot do that if we're all picking the three of them [separated waste] and dumping them in Dandora."* ***[KII, County officer, Nairobi]***

Dealing with cartels

Participants reported that cartels in different aspects of SWM were hindering proper waste management in Nairobi. There emerged two types of cartels operating in the SWM sector: the 'white collar' cartels that operate at the county office charged with awarding tenders to private operators to collect, transport and dispose solid waste. These are said to wield influence on who is given these contracts regardless of their meeting the minimum requirements for providers. The second type of cartels identified are the 'blue collar' cartels that mainly operate at the dumpsite, where they have gained control over disposal of waste. Officials felt that the county needed to be strict on the contracting process so that only qualified service providers were awarded contracts. In addition, the county needed to gain control over the areas where the 'blue collar' cartels have infiltrated (such as the Dandora dumpsite), leading to poor SWM.

> *"These guys [cartels] are a problem to us, because for sure even at the final disposal site [Dandora] in fact we are where we are because the county does not own that place. It's being owned by other guys."* ***[KII, County officer, Nairobi]***

Informants pointed out that the county government was in the process of ensuring they gain control over the dumpsite by fencing it, ostensibly to keep the cartels out, and it remains to be seen how this step will ensure the activities of these groups are controlled.

Adoption of technology for proper SWM

Participants felt that there was need for the Nairobi County government to invest in the latest technologies to safely handle waste and move away from open dumpsites. It emerged that staff from the relevant unit had been trained on some of the safe approaches to waste disposal being used in other countries. What was remaining on the part of the county was to adopt the approaches by allocating the necessary resources for implementation, including identifying an appropriate site.

> *"… when you embrace technology, when you embrace safe measures, when you move forward like cities in Japan... you live with it, you know everything is used other than of course the e-waste. The ones that cannot be converted are the only ones they destroy. Plastic is the one that makes tires, whatever, it's the one that makes clothes that they wear. It can be applied in Kenya, but I think we need to do a lot of community mobilization, citizen knowledge, citizens need a lot of knowledge."* ***[KII County officer, Nairobi]***

There were overlaps in the opinions of informants from the local authority and those of community members, waste collectors, waste pickers and representative NGOs/CBOs working in low-income settings. For example, local authority officials pointed out the need to create awareness to avoid littering and dumping of waste in illegal dumps besides rehabilitating roads leading to the dumpsites.

Summary

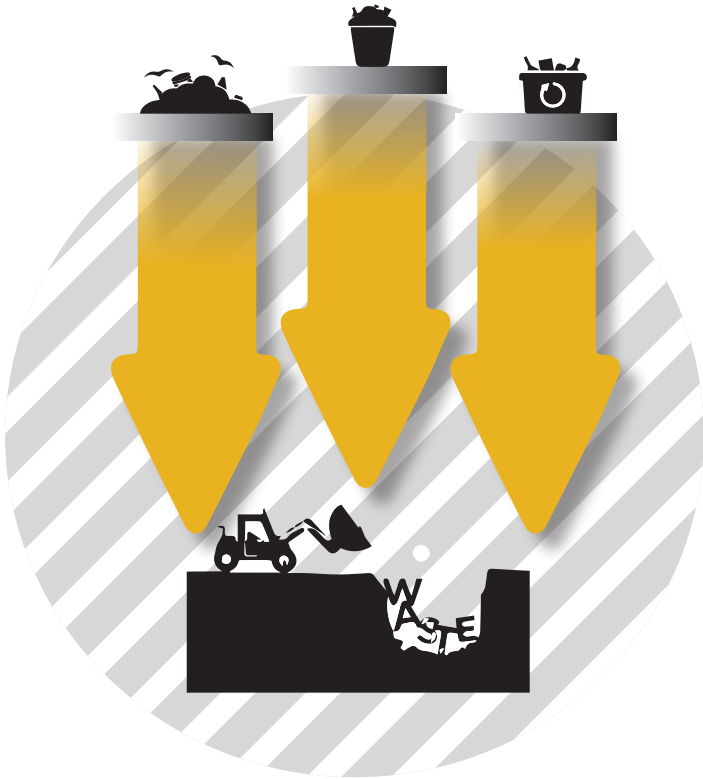
This chapter presented the opinions of various stakeholders in the SWM sector on what needs to be done to ensure proper waste management in the two cities. The stakeholders raised various issues that the two counties need to address if they are to improve the state of SWM in the cities. For example, creation of awareness on proper waste management practices, investing in proper infrastructure such as access roads to the dumpsites, adoption of technology to safely manage waste as well as dealing with cartels that hinder proper SWM, were some of the actions that were suggested.

References

Kimani, N.G. 2007 *Environmental Pollution and Impact to Public Health: Implication of the Dandora Municipal Dumping Site in Nairobi, Kenya.* , UNEP: Nairobi.

Gunsilius, E. (2010). Role of informal sector in solid waste management and enabling conditions for its integration. Experiences from GTZ. Paper presented at Transwaste workshop on the Informal Sector, Geneva, 2010. http://www.transwaste.eu/file/001441.pdf.

Chapter 7



SUMMARY OF FINDINGS AND RECOMMENDATIONS

Kanyiva Muindi Blessing Mberu Dickson Amugsi

This report presented findings from a study that assessed solid waste management practices in Nairobi and Mombasa as well as the perceptions of health-related risks associated with such practices. In addition, the study explored the perceptions of various stakeholders regarding the existing practices around solid waste management and what needs to be done to improve the situation. This chapter provides a summary of the study's findings and the recommendations for policy and programmatic actions.

Majority of the households surveyed were male-headed, with about a third of household members being aged below 15 years except in Makadara, Nairobi where there were more older people compared with other sites. Only 9% of households primarily exposed to the Dandora dumpsite in Nairobi (those living in Korogocho/Dandora settlements) owned or co-owned their dwellings, while it was much higher in Makadara (33%). In Mombasa, 37% of households in Bamburi and 23% of those in Kisauni owned or co-owned their dwelling units. Public water taps and water vendors were the most common sources of water in the study communities. Informal employment was the dominant source of income in the two cities, while involvement in waste collection and scavenging accounted for less than 1% of the income-generating activities.

There were city-level differences in waste storage, collection and disposal practices, with more households in Nairobi using plastic bags for storage compared to those in Mombasa. Common collection points within residential areas were reported more in Mombasa than in Nairobi. Household waste collection services were not reaching all households, with 24% and 46% of households in Nairobi and Mombasa, respectively, reporting not getting any services at all. SWM service provision was dominated by private providers which comprised private companies and community-based organizations, while county government providers only accounted for less than 1%. Even among those receiving collection services, it emerged that they at times resorted to other alternatives such as burning of waste or illegal dumping. Disposal of toxic and electronic waste remains a challenge in both cities as these waste streams are mixed with household waste. Majority of households reported having taken no measures to reduce waste. Moreover, although majority of respondents had heard about recycling and composting as ways of reducing waste, very few households were involved in recycling and composting. Most respondents expressed willingness to separate household waste, which presents an opportunity for county authorities to implement waste separation programmes at source. The strategy was, however, not readily acceptable among waste pickers, who believed that it could jeopardise their source of livelihood. Participants felt that the existing SWM system was inefficient, with disposal in open dumpsites being one of the major challenges.

A higher proportion of respondents in Mombasa compared with Nairobi felt that there was no risk to health or environment associated with poor SWM. However, those acknowledging the existence of such risks mentioned a range of consequences including fires, air and water pollution, dirty environment as well as flooding. Majority of these respondents felt their health

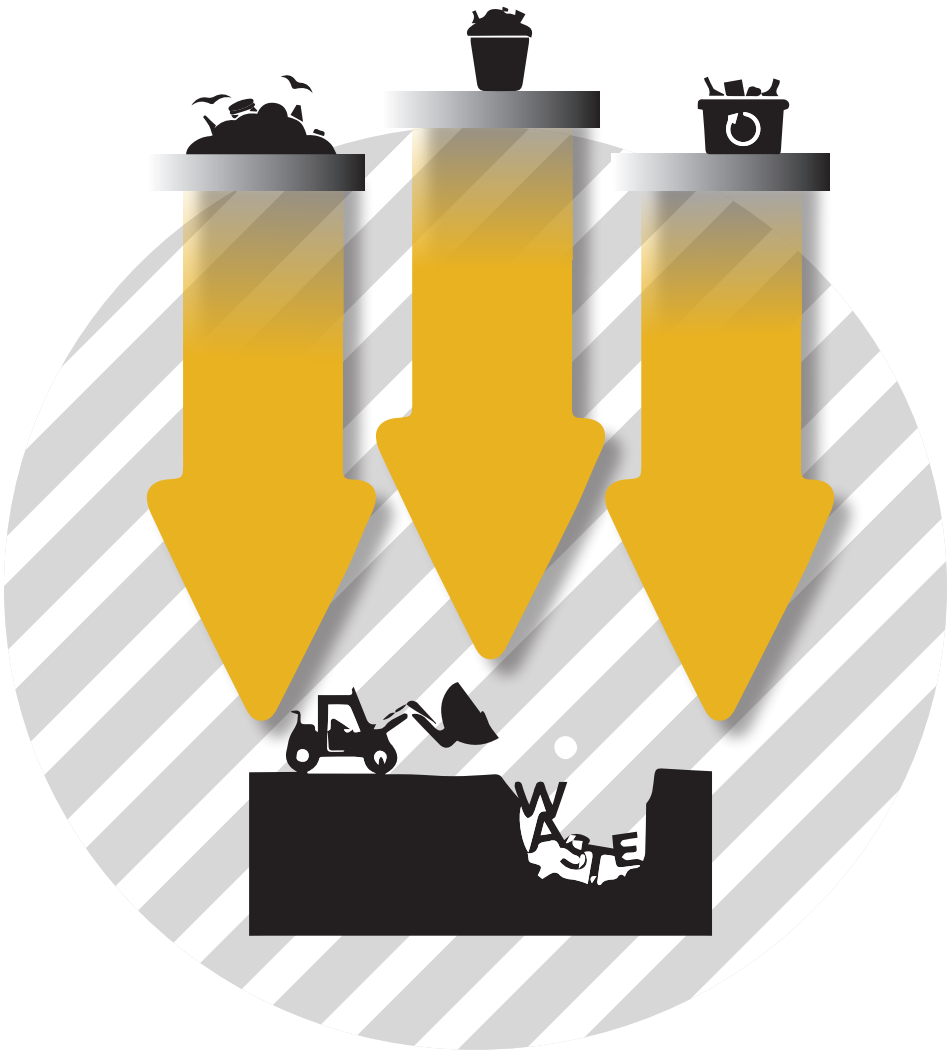
was at moderate to high risk due to exposure to poor SWM, with the majority mentioning that children were the most affected. Participants identified several pathways through which poor SWM affected health/environment including unpleasant smell, contamination of water and smoke. In both cities, a small proportion of respondents indicated they had experienced a health issue related to SWM in the past 12 months, with the proportion being highest in Korogocho/Dandora, which is located near the municipal dumpsite in Nairobi. At the individual level, diarrheal diseases were the most reported illnesses associated with poor SWM followed by malaria and respiratory illnesses. In spite of the prevailing risks associated with poor SWM, most participants reported that their communities were unable to adress the risks (71.2% and 66.4% in Nairobi and Mombasa, respectively). The most commonly mentioned reasons for inability to address the risks were ignorance, poverty, lack of government support, and lack of unity and coordination within the communities.

The presence of crime and conflict across the SWM chain can have negative impacts on service delivery and public health. The presence of cartels was reported in Nairobi, and this was viewed as contributing to the poor state of SMW in the city. Residents of areas near the Dandora dumpsite were more likely to report having heard about cartels in the SWM sector and experiencing crime/conflict than those from other sites. Robbery was the most common criminal act experienced in the communities. In contrast, only a small proportion of respondents in Mombasa reported having heard about cartels. Qualitative data indicate that there are both 'white' and 'blue' collar cartels in the sector, with the most visible being those at the dumpsite who are often associated with violence and criminal acts. Participants suggested a range of actions to safely contain and dispose of waste, including creation of awareness among Kenyans, addressing the issue of cartels that continue to hinder service delivery, waste separation at source, taking advantage of communities' willingess to separate waste, and adoption of technology to better manage waste.

Several recommendations arise from these findings. First, there is need to increase service provision in the cities to reach those not getting any waste collection services. This could be an opportunity for county governments to provide collection services, since these unreached households are likely unable to afford the fees levied by private collectors. In relation to waste reduction, there is an opportunity for governments in the counties to sensitize the populace on what can be done and to encourage them to fully take part in programmes aimed at reducing waste such as recycling, re-use and composting, which should be easier if communities are encouraged to embrace waste separation at source, something they expressed willingness to do.

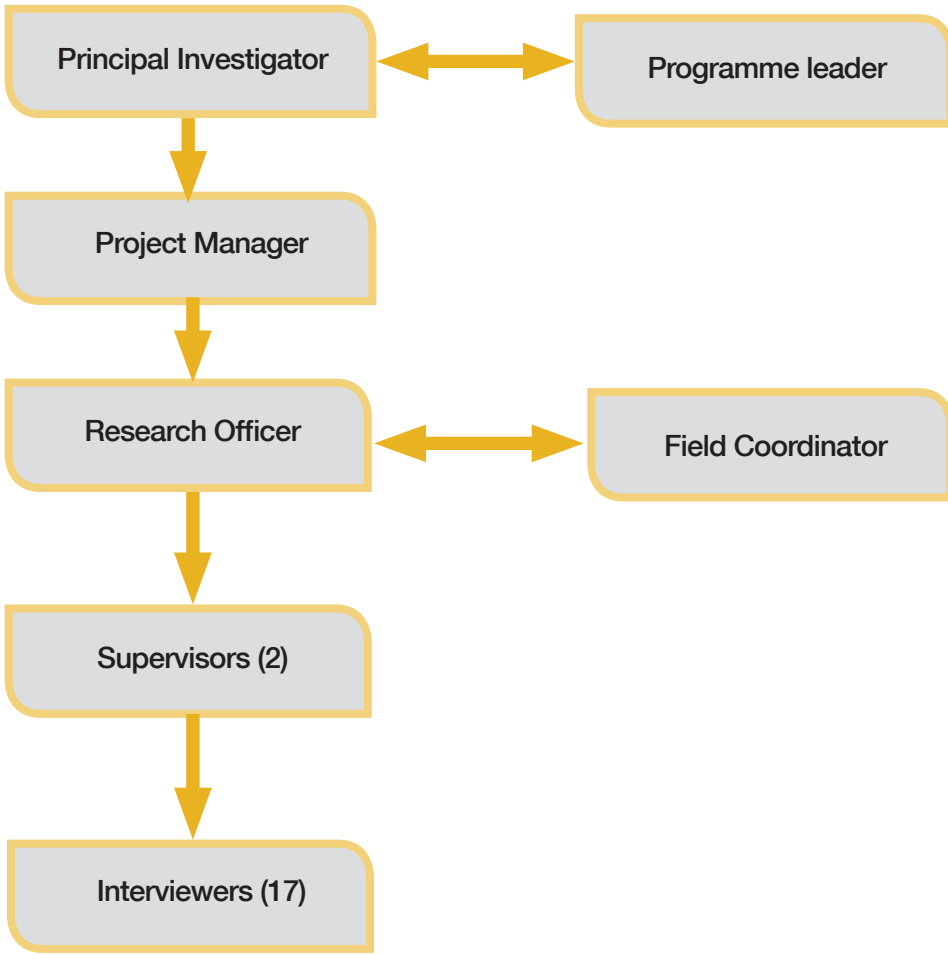
Third, there is need for concerned authorities to improve the state of SWM in the cities to offset the negative impacts on health, which should be done in collaboration with communities who are important stakeholders in the SWM chain. Fourth, the shift from open dumpsites to better alternatives is warranted given the dangers and inefficiencies associated with such sites. There is also a need to address the issue of cartels within the SWM service chain as

they were identified among the drivers of poor SWM. This should go hand in hand with further investigation into the crime and conflict and SWM nexus and how the various group interests come to play. This would provide valuable information in search of pathways to addressing the challenge this poses to SWM.



APPENDICES

Team structure



Study tools

Quantitative Questionnaire

AFRICAN POPULATION AND HEALTH RESEARCH CENTER

URBAN RISK AFRICA PROJECT

HOUSEHOLD SURVEY ON SOLID WASTE MANAGEMENT

1.0 BACKGROUND

1.1 CITY NAME AND CODE **(NRB=01; MSA=02 DKR=03)** ☐☐

1.2 LOCATION NAME AND CODE ☐☐

1.3 SUB-LOCATION NAME AND CODE ☐☐

1.4 EA NAME AND CODE ☐☐☐☐

1.5 HOUSEHOLD NUMBER ☐☐☐

1.6 HOUSEHOLD ID ☐☐☐☐☐☐☐☐☐☐☐☐

1.7 HOUSEHOLD HEAD NAME _____

1.8 START TIME ☐☐☐☐

1.9 FIELD WORKER'S CODE ☐☐☐☐

1.10 DATE OF INTERVIEW ☐☐☐☐☐☐☐☐

INTRODUCTION AND CONSENT

Hello, my name is _____ and I work with the African Population and Health Research Centre.

We are conducting a survey in the city of Nairobi/Mombasa to understand the state of solid waste management in different communities.We shall be speaking to households, community leaders and players in waste management to understand the risks that arise from the current waste management practices within the city, how people living in various communities address the risks they face and what challenges they face in the process. The information will be useful for city planners and community members who can use it to inform decisions regarding the handling of solid waste from households, industries and other institutions.

Your participation in this study is voluntary and if at any point you decide to discontinue your participation, you are free to do so. You or members of your household will not be penalized in any way if you choose not to participate. The information you give will be kept secret and none of your names shall be used in any reports. There are no direct financial benefits to you or members of your household, however the information you provide will be useful in informing policy and practice on solid waste management. This interview is not expected to cause you any harm and if you feel uncomfortable with certain questions, you can choose not to answer. However, we hope that you will participate in this survey since your views are important. This interview will take 45 minutes of your time.

1.11 Do you accept to participate in the study? **[1=YES; 2=NO; IF YES SKIP TO 1.13]** ☐

1.12 IF THE RESPONDENT DOES NOT ACCEPT TO BE INTERVIEWED: Why don't you want to participate in in this interview? ☐

1=Too busy/Do not have time; 2= Tired of Research; 3= Research not beneficial;
4= Not interested; 6=Other (specify) _____

Thank you for your time. **[GO TO Q8.1]**

1.13 IF THE RESPONDENT ACCEPTS TO BE INTERVIEWED: Thank you for agreeing to participate in this study.

I would like to ask you about people who live with you in your household in this community. These are people you share common cooking arrangements with and who acknowledge a common head of household. I will ask about their educational attainment, income generating activity and other general questions. I will list the names beginning with the head of the household.

	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19	1.20	1.21
Line No.	Name	What is (NAME'S) relationship to (NAME OF HH HEAD)?	What is (NAME'S) sex?	On what day, month and year was (NAME) born? (DD/MM/YYYY)	What is (NAME'S) ethnic group?	[IF AGED 5 YEARS AND ABOVE] Has (NAME) ever attended school? [IF NO SKIP TO Q1.18]	What is the highest level that (NAME) attained? And what is the highest class completed at that level?	[IF AGED 24 YEARS AND BELOW] Is (NAME) currently in school?	[IF AGED 15 AND ABOVE] What is (NAME'S) current marital status? Is (NAME):	[IF AGED 6 AND ABOVE] Were you/was (NAME) involved in income generating activities last month?	[IF AGED 6 AND ABOVE] Is (NAME) currently involved in an income generating activity?	What is the MAIN income generating activity that (NAME) is/has been involved in?
01												
02												
03												
04												
05												
06												
07												

CODES

q1.11

AUN= Aunt; SIS=Sister;
BIL=Brother-in-law; SOL= Son-in-law;
BRO= Brother; STC=Step child;
CHD = Child; STP=Step parent;
COU=Cousin; UNC=Uncle;
CWF = Co-wife; UNK = Unknown relation;
DIL = Daughter-in-law; WIF = Wife;
GCH = Grand child; OTH = Other (specify_____)
GDP = Grand parent;
HHH=Household head;
HUS = Husband;
NEP= Nephew;
NIE=Niece;
NRL = Not related;
PAR = Parent;
PIL = Parent-in-Law;
SIL=Sister-in-law;

q1.16

Level

0=None
1=Incomplete primary
2= Complete primary
3=Secondary
4=College/University

q1.14

KIK=Kikuyu; SOM=Somali;
LUH=Luhya; TAI=Taita;
LUO=Luo; TAV=Taveta;
KAM=Kamba; MAS=Masai;
MER=Meru; KAL=Kalenjin;
EMB=Embu; OTH=Other (spec)_____)
KIS=Kisii;
MIJ=Mijikenda;
SWA=Swahili;

q1.18

1=Never Married
2=Married/cohabiting
3=Divorced
4=Widowed
5=Separated

q1.21

01=Formal employment
02=Informal employment
03=Own established business
04=Own unestablished business
05=Waste collector
06=Waste scavenger
07=Urban agriculture
08=Rural agriculture
96=Other (Specify)_____)

2.0 HOUSEHOLD CHARACTERISTICS

We are now going to discuss about where you get your drinking water, the nature of house you live in, and the durable goods you have within your house. This information will help us in understanding the socio-economic state of each household interviewed.

	QUESTIONS & FILTERS	CODING CATEGORIES	SKIP
2.1	For how long has your household lived in this community? (ask about the duration for the household member who has lived there the longest)	YEARS ☐☐ MONTHS ☐☐ **[IF LESS THAN 12 MONTHS ENTER IN MONTHS]**	
2.2	What is the **main** source of your household's drinking water?	Water sellers/vendors ..... 10 PIPED WATER Piped into dwelling ..... 11 Piped into compound/plot ..... 12 Public tap/standpipe ..... 13 WELL WATER Well on residence/plot ..... 21 Public well ..... 22 SURFACE WATER River/stream ..... 31 Pond/lake ..... 32 Rain water ..... 41 Bottled water ..... 51 Other _____ 96 (Specify)	
2.3	What kind of toilet facility do members of your household usually use?	FLUSH OR POUR FLUSH TOILET ..... 11 TRADITIONAL PIT LATRINE ..... 21 VENTILATED IMPROVED LATRINE ..... 22 FLUSH TRENCH TOILET ..... 31 BUCKET TOILET ..... 41 NO FACILITY/BUSH/FIELD ..... 51 FLYING TOILET ..... 61 OTHER _____ 96 (Specify)	
2.4	Do you share this toilet facility with other households?	Yes ..... 1 No 2	

2.5 [1= YES, 2= NO AND 8= DON'T KNOW]

[CIRCLE THE APPROPRIATE RESPONSES]

[IF 2 or 8 SKIP TO THE NEXT ITEM]

	Does your household own any of the following items? Y	N	D
A wall clock?	1	2	8
A radio/cassette player?	1	2	8
A television?	1	2	8
A mobile telephone?	1	2	8
A refrigerator?	1	2	8
An electric/gas stove?	1	2	8
A car?	1	2	8
A motorcycle?	1	2	8
A bicycle?	1	2	8
Sofa set?	1	2	8
Table?	1	2	8
A flash light (with working batteries)?	1	2	8
Kerosene lamp with glass/lantern?	1	2	8
Kerosene stove?	1	2	8
An electric iron	1	2	8
A charcoal iron	1	2	8

	QUESTIONS & FILTERS	CODING CATEGORIES		SKIP
2.6	What type of fuel does your household mainly use for cooking?	ELECTRICITY	01	
		LPG/NATURAL GAS	02	
		BIOGAS	03	
		KEROSENE	04	
		COAL, LIGNITE	05	
		CHARCOAL	06	
		WOOD	07	
		STRAW/SHRUBS/GRASS	08	
		AGRICULTURAL CROP	09	
		ANIMAL DUNG	10	
		NO MEAL COOKED IN HOUSEHOLD	11	→ 2.8
		OTHER _____ (Specify)	96	
2.7	Where does your/this household do most of its cooking?	Open air/outside or small shed outside	01	
		Separate kitchen (distinct room)	02	
		Room also used for sleeping	03	
		Room used for other purposes	04	
		Other _____ (Specify)	96	
2.8	MAIN MATERIAL OF THE FLOOR RECORD OBSERVATION.	NATURAL FLOOR		
		EARTH/SAND	11	
		DUNG	12	
		RUDIMENTARY FLOOR		
		WOOD PLANKS	21	
		PALM/BAMBOO	22	
		FINISHED FLOOR		
		PARQUET OR POLISHED WOOD	31	
		VINYL OR ASPHALT STRIPS	32	
		CERAMIC TILES	33	
		CEMENT	34	
		CARPET	35	
		OTHER _____ (Specify)	96	
2.9	MAIN MATERIAL OF THE ROOF RECORD OBSERVATION	GRASS/THATCH	01	
		PLASTIC SHEETS	02	
		CARDBOARD SHEETS	03	
		WOOD/TIMBER	04	
		METAL SHEETS/TIN	05	
		IRON SHEET (CORRUGATED)	06	
		TILES	07	
		OTHER _____ (Specify)	96	
2.10	MAIN MATERIAL OF THE WALLS RECORD OBSERVATION	MUD	01	
		WOOD/TIMBER	02	
		IRON SHEETS(MABATI)	03	
		BURNT BRICKS	04	
		STONE/QUARRY STONES	05	
		CONCRETE BLOCKS	06	
		CARDBOARD SHEETS	07	
		CEMENTED MUD	08	
		CARTON/PLASTIC	09	
		TIN/METAL SHEETS	10	
		OTHER _____ (Specify)	96	

	QUESTIONS & FILTERS	CODING CATEGORIES	SKIP
2.11	DOES HOUSE HAVE VENTILATION	Yes / No WINDOWS ..... 1 2 DOORS ..... 1 2 EAVES 1 2	
2.12	Does your household own this structure (house, flat, shack), do you rent it, or do you live here without pay?	OWNS ..... 1 PAYS RENT/LEASE ..... 2 NO RENT,WITH CONSENT OF OWNER ..... 3 NO RENT, SQUATTING ..... 4 OTHER _____ 6 (Specify)	
2.13	Does your household own the land on which the structure (house, flat, shack) sits?	OWNS ..... 1 PAYS RENT/LEASE ..... 2 NO RENT,WITH CONSENT OF OWNEI ..... 3 NO RENT, SQUATTING ..... 4 OTHER _____ 6 (Specify)	
3.0	**SOLID WASTE STORAGE COLLECTION AND DISPOSAL**		
	Now we are going to discuss about solid waste from your household and how it is handled from the time it is produced to the time it is taken to the final disposal site.		
3.1	How does your household store the garbage generated in the house?	Closed Container ..... 01 Open Container ..... 02 Plastic bags ..... 03 Pile in the yard ..... 04 Common collection point outside plot ..... 05 Other _____ 96 (Specify) Don't Know 98	
3.2	Does your household receive any garbage collection services?	Yes ..... 1 No ..... 2 →	3.11
3.2a	What type of garbage collection services does your household receive?	Door to door ..... 1 Take to private pit/collection point ..... 2 Take to public pit/collection point ..... 3 Other (Spec) _____ 6	
3.3	Who are the providers of these services?	City Council ..... 1 Private companies ..... 2 CBOs ..... 3 Other _____ 6 (Specify)	
3.4	How many times in a month does the collection of garbage by the providers take place?	Number of times ☐☐	
3.5	What is the payment schedule for the garbage collection services?	Per collection ..... 1 Weekly ..... 2 Monthly ..... 3 Don't pay ..... 5 →	3.7
		Other _____ 6 (Specify)	
3.6	How much do you pay for these services?	AMOUNT ..... ☐☐☐☐ →	3.10
		DON'T KNOW 998	
3.7	What are the reasons why you don't pay?	Poor service ..... 1 Can't afford fees charged ..... 2 Free service ..... 3 Other _____ 8 (Specify)	

	QUESTIONS & FILTERS	CODING CATEGORIES		SKIP
3.8	How willing would you be to pay for the pick up of waste from your house?	Very unwilling Somewhat unwilling Willing Very willing	1 2 3 4	→ 3.11
3.9	How much would you be willing to pay per month?	Amount		
3.10	Are there times your household has been forced to use other garbage disposal avenues?	Yes No Don't Know	1 2 8	→ 3.12
3.11	Where does your household **mostly** dispose garbage? /What other avenue does your household **mostly** resort to?	Garbage dump In the river On the road/rail In drainage/trench In private pits In public pits Vacant/abandoned house/plot Burning No designated place/all over Other _____ (Specify)	01 02 03 04 05 06 08 09 10 96	
3.12	What measures, if any, do you take to reduce the amount of solid waste your household produces?		Yes / No	
		Re-use items like bottles etc. Use long life shopping baskets Compost organic waste Other _____ (Specify) No measure taken	1 / 2 1 / 2 1 / 2 1 / 2	
3.13	How do you **mainly** dispose of toxic substances such as radio/torch batteries, paint and chemicals?	Together with other trash Throw into pit latrines Dump in the river Throw on road/rail Other _____ (Specify) Don't Know	01 02 03 04 06 98	
3.14	How do you **mainly** dispose of electronic equipment such as broken mobile phones, radios, computers?	Together with other trash Throw into pit latrines Dump in the river Throw on road/rail Sell to scavengers Give away Other _____ (Specify) Don't Know	01 02 03 04 05 06 96 98	
3.15	Does your household routinely burn some of the household waste?	Yes No	1 2	
3.16	Would you say the following are problems faced by people living in this community as concerns waste? [READ OUT OPTIONS]		Yes / No	
		Burning of trash at dumpsite Disposing toxic waste e.g. chemicals Illegal dumping of trash Littering the community People dumping trash in others' plots Consuming food grown near dump Other _____ (Specify)	1 / 2 1 / 2 1 / 2 1 / 2 1 / 2 1 / 2 1 / 2	

	QUESTIONS & FILTERS	CODING CATEGORIES			SKIP
3.17	Whose responsibility is it to keep the streets in your community clean?		Yes	No	
		Individual volunteers	1	2	
		Organised cleaning groups	1	2	
		City Council	1	2	
		No one in particular	1	2	
		Self	1	2	
		Other _____ (Specify)			
		Don't Know	1	2	
3.18	What happens to trash collected from the streets in your community?		Yes	No	
		Taken to dump site	1	2	
		Burned	1	2	
		Gathered & piled on the streets	1	2	
		Sold to scavengers	1	2	
		Nothing	1	2	
		Don't know	1	2	
		Other (Spec) _____			
3.19	Do you notice any indiscriminate dumping in your neighborhood?	Yes, frequently	1		
		Yes, once in a while	2		
		No	3		
3.20	Is there a dumpsite (legal or not) in/near your community?	Yes	1		
		No	2		→ 3.21
3.20a	Can the dumpsite be seen from your house? (If living in flats; ask if dumpsite can be seen from the ground floor of the flat)	Yes	1		
		No	2		
3.21	Thinking about your neighborhood, how clean would you say it is?	Very dirty	1		
		Dirty	2		
		Average	3		
		Clean	4		
		Very clean	5		
3.22	Have you ever heard about recycling?	Yes	1		
		No	2		→ 3.25
3.23	Does any member of your household take part in recycling of waste produced in your community?	Yes	1		
		No	2		→ 3.25
			Yes	No	
3.24	Which particular waste do you take for recycling?	Paper	1	2	
		Plastics	1	2	
		Glass	1	2	
		Tin/metal	1	2	
		Other _____ (Specify)			
3.25	**[FW: CHECK Q3.12 IF COMPOSTING =2, ASK:]** Have you ever heard about composting? **[ELSE SKIP TO Q3.27]**	Yes	1		
		No	2		→ 3.27
3.26	Do you or any member of your household compost any organic waste from your house?	Yes	1		
		No	2		
3.27	In general, how willing would you be to separate waste from the rest of your household's trash, if there was a program to compost/recycle it?	Somewhat unwilling	1		
		Very unwilling	2		
		Willing	3		
		Very willing	4		

	QUESTIONS & FILTERS	CODING CATEGORIES			SKIP
3.28	In your opinion, is there proper solid waste management in (NAME OF STUDY SITE)?	Yes		1	
		No		2	
		Don't Know		8	
			Yes	No	
3.29	What are the challenges you see in the way the city's waste is managed?	Inefficient collection	1	2	
		Lack of waste sorting	1	2	
		No control over illegal dumps	1	2	
		No recycling options	1	2	
		Lack of public education on waste mgt.	1	2	
		Lack of waste treatment	1	2	
		Unsafe disposal in open dumps	1	2	
		Other (Specify) _____			
4.0	**HEALTH CONCERNS RELATED TO SOLID WASTE**				
	We are now going to talk about the health risks arising from exposure to poor solid waste management. We shall also touch on experiences you or members of your household have gone through in the last 12 months.				
4.1	In your opinion, are there risks that people face from poor state of waste management? **[IF NO OR REFUSED ANSWER Q4.3-4.5 THEN SKIP TO 5.1]**	Yes		1	
		No		2	
			Yes	No	
4.2	What are the daily risks that you think people in this community face from poor solid waste management?	Health risks	1	2	
		Fire risks	1	2	
		Dirty environment	1	2	
		Flooding	1	2	
		Vermin	1	2	
		Pollution of rivers/water	1	2	
		Air pollution	1	2	
		Other _____ (Specify)	1	2	
4.3	Do people in this community grow food using compost made from waste at a dumpsite?	Yes		1	
		No		2	
		Don't Know		8	
4.4	Do people in the community water food crops using water downstream of the dumpsite?	Yes		1	
		No		2	
		Don't Know		8	
4.5	In your opinion, to what degree would you say that the water used in this community is contaminated by solid waste?	Not contaminated at all		1	
		Somewhat contaminated		2	
		Very contaminated		3	
		Unsure/Don't Know		8	
4.6	On a scale of 1 to 5 with 1 being no risk at all and 5 being very high risk, how would you rate your household's health risk arising from solid waste?	No risk at all		1	→ 4.8
		Little risk		2	
		Moderate risk		3	
		High risk		4	
		Very high risk		5	
4.7	In what way do you think your household is exposed to these risks?		Yes	No	
		Smell	1	2	
		Smoke	1	2	
		Contaminated Water	1	2	
		Contaminated Food	1	2	
		Other _____ (Specify)			
4.8	Who in your community do you think is affected most by poor solid waste management?	Children		1	
		Older persons		2	
		Adult Women		3	
		Adult Men		4	

	QUESTIONS & FILTERS	CODING CATEGORIES			SKIP
4.9	What health issues do people in this community get due to poor solid waste management? CIRCLE ALL THAT APPLY		Yes	No	
		01 Cholera/Diarrhea	1	2	
		02 Chest problems	1	2	
		03 Allergies	1	2	
		04 Skin problems	1	2	
		05 Asthma	1	2	
		06 Heart problems	1	2	
		07 Injuries (e.g.cuts, burns)	1	2	
		08 Blood disorders	1	2	
		96 Other _____ (Specify)	1	2	

Now I would like us to discuss about health issues you or members of your household have experienced as a result to poor solid waste management

Line No.	Name	4.10 Have you/has (NAME) experienced a health issue that is related to poor waste management in the last 12 months? (1=Yes; 2=No; 8=DK)	4.11 What health issue did you/(NAME) experience? (PICK CODE FROM q4.7) [PICK MOST RECENT ISSUE IF HAD MORE THAN ONE IN 12 MONTHS].	4.12 How did you find out the health issue was related to poor solid waste management?	4.13 What did you do when you/(NAME) had the issue?
01					
02					
03					
04					
05					
06					

CODES

q4.12
01=Health facility
02=Pharmacy
03=Community health worker
04=Media
05=Neighbour
96=Other (specify)_____)

q4.13
01=Sought medical care
02=Bought medicine
03=Sought prayers
04=Petitioned leader
05=Nothing
96=Other (specify)_____)

4.14	In your opinion are you as a community able to address the risks posed by poor solid waste management?	Yes No Don't Know	1 2 8		
			Yes	No	
4.15	What has the community done/been doing to reduce/avoid these risks?	Public health education/awareness	1	2	
		Organised regular clean-ups	1	2	
		Petitioned the local representatives	1	2	
		Nothing done	1	2	
		Other _____ (Specify)	1	2	
4.16	Do you think the actions taken by the community are adequate in addressing the risks?	Yes No	1 2		→ 5.1

	QUESTIONS & FILTERS	CODING CATEGORIES			SKIP
4.17	What do you think are the causes of this community's inability to address these risks?		Yes	No	
		Poverty	1	2	
		Lack of Government support	1	2	
		Lack of land tenure	1	2	
		Ignorance	1	2	
		Other _____ (Specify)	1	2	
5.0	**CRIME AND CONFLICT IN SWM**				
	We are about to complete the interview. We will now discuss crime and conflict within the waste management sector in this city. We shall discuss the experiences of community members of this crime/conflict.				
5.1	Have you heard about involvement of cartels in the city's solid waste sector?	Yes		1	
		No		2	→ 5.6
5.2	Has this community experienced any crime/conflict arising from solid waste management?	Yes		1	
		No		2	
5.3	What tpye of crime/conflict has your community experienced?	Fights		01	
		Disputes		02	
		Rape/defilements		03	
		Killings		04	
		Robbery		05	
		Destruction of property		06	
		Other (Spec) _____		96	
5.4	Who are the primary victims of these crimes?	Community Leaders		01	
		City Council staff		02	
		Women		03	
		Children		04	
		Scavengers		05	
		Other (Spec) _____		96	
5.5	What do you think are the effects of having cartels involved in this sector?		Yes	No	
		Insecurity	1	2	
		Illegal dump sites	1	2	
		Littering	1	2	
		Better garbage collection	1	2	
		Other _____ (Specify)			
5.6	GEO COORDINATES OF THE HOUSE	LAT: ☐ — ☐☐☐ — ☐☐☐☐☐			
		LONG: E — ☐☐☐ — ☐☐☐☐☐			
6.0	**RESPONDENT'S PARTICULARS AND OTHER INTERVIEW DETAILS**				
6.1	FW: IS RESPONDENT REFERENCE PERSON NAMED IN 1.4? **1=YES; 2=NO, IF 1 GO TO 8.1**			☐	
6.2	What is your name? _____				
7.0	**OFFICE/FIELD CHECKER'S DETAILS**				
7.1	FIELD SUPERVISOR/TEAM LEADER'S CODE			☐☐	
8.0.	**END OF INTERVIEW**				
8.1.	I would like to thank you for taking your time to answer the questions that I asked you. As I said at the beginning, the information you have given me will help a lot in understanding the state of solid waste management in your community. Now we have come to the end of our discussions. Do you have any questions for me? 1=YES; 2= NO; **[IF 2 SKIP TO Q8.3]**			☐	
8.2.	FW: RECORD QUESTIONS AND COMMENTS RAISED BY RESPONDENT				
8.3.	FW: RECORD COMMENTS ABOUT THE INTERVIEW _____				
8.4.	RESULT OF INTERVIEW (CODESHEET A[7])			☐	
8.5.	**END TIME (24 HRS)**			☐☐☐☐	

Qualitative Tools

A Guide for FGDs with community members on Solid Waste Management

Target: Community members aged 18 years and above, disaggregated by sex.

Vulnerability

1. Which group are you representing and what is your role in the group? (Probe for youth, women etc.).
2. What does the term proper waste management mean/imply?
   a) Who are the players?
   b) What are their roles?
   c) How do we perceive the role of informal players such as scavengers?
3. Solid waste state in community:
   a) At the household level: how is waste stored, collected and disposed? (Discuss on who does the collection and disposal; where disposal is done etc.)
   b) Are we satisfied with the services of waste management offered to households?
   c) Who is responsible for general community cleanliness?
   d) What would we say are people's attitudes towards waste? (Probe for evolution of waste management/practices in the city over the last say 3 decades. Has the role of council changed? what has changed)

Capacity

4. What are the challenges we have as a community in managing solid waste?
   a) Probe: what has contributed to these challenges?
   b) How are we as a community addressing these challenges?
   c) Do we think our response to these challenges are sufficient?
   d) What more needs to be done to manage waste?
5. Waste reduction- what does this mean to us? Discuss further on the following:
   a) Recycling and re-use
   b) Composting
   c) Do we think households would be willing to separate household waste to enable recycling and composting?
6. Overall, what is our opinion on waste management in the city as a whole?
   a) Probe on indiscriminate dumping in different parts of the city.
   b) Siting of dumpsites where is the ideal site? How about relocating current dumpsites given their views on consequences of poor waste management? Probe for location of formal and informal dumpsites)
   c) People's dependence on dumpsite for livelihood- how can this be changed given the dangers of working on the dumpsite?

Loss

7. What do we think are the consequences of having poor waste management?
   a) (Group should discuss in detail each mentioned item. Probe as necessary)
   b) How have these consequences manifested in our community?
   c) Who would you say bears the greatest burden of these consequences (by age, sex)?
8. Any further suggestions regarding solid waste management?

A Guide for FGDs with scavengers/waste collectors

Introductions

Vulnerability

1. Which group are you representing and what is your role in the group (by sex, life-course)
2. What does the term proper waste management mean/imply?
   a) Who are the players in waste management? (Probe both community and city) How do you perceive yourselves? How does the community perceive you?
3. How important is your role in the waste sector? Why do you think your role is important? Do you interact with government and county officials and in what ways (probe for approval/acceptance of their work, probe for work with provincial/police/enforcement officials' involvement).
4. What are the challenges we have as a city in managing solid waste?
   a) Probe: what do we think has contributed to these challenges?
   b) How can we tackle these challenges?
5. Discuss about dumpsites:
   a) The state of dumpsites in the city including illegal dumpsites
   b) Siting of dumpsites- where is the ideal site? How about relocating current dumpsites?
   c) People's dependence on dumpsites for livelihood- how can this be changed given the dangers of working on the dumpsite? What else can you be engaged in? Are there success stories among your colleagues? Discuss ways to formalize your work.
   d) What are your experiences of crime and conflict arising from cartels?

Capacity

6. Waste reduction- what does this mean to us? Discuss further on the following:
   a) Recycling and re-use
   b) Composting
   c) Burning
   d) Do you think Nairobians would be willing to separate household waste to enable recycling and composting?

Loss

7. How has working in the waste sector affected your health?
   a) What health issues have arisen from this work? Discuss in detail major issues (injuries, blood disorders, respiratory illnesses, heart problems, poisoning). (Probe for the age sex burden of these illnesses)
   b) Has the health of other members of your household/community been affected too (especially young children who might accompany mothers to dumpsite and members of scavengers' households due to recovered items stored in compound)? In what way?
   c) How can the situation be improved? By whom?
   d) Probe for issues like protective clothing; access to appropriate health care (on site first aid, health facilities)
8. Any further suggestions on proper waste management?

A Guide for KIIs with Cartel members

Vulnerability

1. Which group are you representing and what is your role in the group?(probe for youth, women etc)
   a) What specific activities of solid waste management are you involved in?
   b) Do you interact with government and county officials and in what ways (probe for approval, probe for work with provincial/police/enforcement officials involvement)
2. Comment on the state of solid waste management in this city. Probe on people's attitudes towards waste.
   a) Who are the players in the waste management sector in this city?
   b) What are the roles of each of these players?
3. The things that we do can have both positive and negative impacts.
   a) What are some of the positive impacts your work has on the solid waste management sector? Probe on what gap(s) these cartels bridge in waste management?
   b) What are some of the negative effects your role has on the city's waste management?
   c) Probe on the cartel's links to crime and violence at the dumpsite, (who is usually involved, what triggers this, who are the targets)?

Capacity

4. Overall, what is your opinion on waste management in the city as a whole?
   a) Probe on physical location of dumpsites including illegal ones within the settlements- how can we control their establishment?
   b) Siting of dumpsites- where is the ideal site? How about relocating current dumpsite given views on consequences of poor waste management?

c) People's dependence on dumpsite for livelihoods- how can this be changed given the dangers of working on the dumpsite? What is your role in this change? What else can you be engaged in? Can your business remain profitable if these changes are implemented?
d) Current zoning in waste management- how do you fit in this new system?

Loss

5. Discuss the health consequences of poor waste management
   a) How has working on the dumpsite impacted your health and the health of your colleagues?
   b) What have you done to avoid/reduce these effects?
   c) How have other players such as scavengers, waste collectors, transporters and communities nearby been affected? - discuss in-depth each mentioned, probing on age-sex differences.
   d) How can these effects be reduced/eliminated?
6. Any further suggestions regarding the way forward in proper waste management in Nairobi and the country as a whole?

A Guide for KIIs with community leaders

Vulnerability& Capacity

1. Please comment on the state of solid waste management in this community.
   a) Probe on people's attitudes towards waste.
   b) Who are the players in your community's waste management? (probe both at community and city level)
   c) What are their roles?
2. What challenges does your community face in managing solid waste?
   e) Probe: what has contributed to these challenges?
   f) How are we as a community addressing these challenges? (probe for good case studies)
   g) Do we think our responses to these challenges are sufficient?
   h) What more needs to be done to manage waste?
3. Overall, what is your opinion on waste management in the city as a whole?
   a) Probe on physical location of dumpsites including illegal ones within the settlement- how can we control illegal dumpsite establishment? As a leader can you enforce some form of punishment to those involved in indiscriminate dumping?
   b) Siting of dumpsites- where is the ideal site? How about relocating current dumpsite given the effect on health?
   c) People's dependence on dumpsite for livelihoods- how can this be changed given the dangers of working on the dumpsite? What is the role of local leadership in this change?

d) Probe on cartels and the crime and conflict associated with this?
e) Probe for evolution of waste management/practices in the city over the last say 3 decades. Has the role of council changed? has the state deteriorated

4. Waste reduction- what does this mean to this community? Discuss further on the following:
   a) Recycling and re-use in the community
   b) Composting in the community
   c) How do you see local leaders like yourself contributing towards the zero waste goal of the county?
5. Recently, the county government introduced a zoned system of waste collection. How does this help or limit waste management in your community?

Loss

6. What are the health consequences of poor waste management?
   a) How has this manifested in this community? Discuss in detail about each mentioned consequence and any existing age-sex differences.
   b) What is the community doing to address this?
   c) Who beyond the community should be involved in addressing this and how should they get involved?

A Guide for KIIs with County Officials

1. What is your role in the County government in the SWM sector?
2. Who are the players in the waste management sector in the county?
   a) What are the roles of each of these players? How do we see the role of scavengers in this sector?
   b) Probe for evolution of solid waste management/practices in the city over the last say 3 decades. Has the role of council changed?
   c) Comment on collection rates of waste in the last few years? (probe for decline in collection rates of waste)
   d) Discuss the current zoned waste collection system- the strengths and weaknesses?
3. Please comment on existing SWM and health policies.
   a) What are the strengths in the existing policies?
   b) What are the weaknesses you see in these policies?
   c) What is the progress we are making in re-shaping these policies?
4. What are the challenges we have as a county in managing solid waste?
   a) Probe: what has contributed to these challenges?
   b) How are we as a department addressing these challenges?
   c) Do we think our current and planned responses to these challenges are sufficient?
   d) What more needs to be done to properly manage the city's waste?

5. What initiatives/programmes have been initiated at the City level between the County and other bilateral partners in the last few years in relation to safe waste disposal technologies?
6. What has constrained the county in adopting safe waste disposal technologies despite bilateral partners willing to support the county?
    a) What is the status of such initiatives (probe for who was involved challenges/progress)
    b) Are there specific constraints?
    c) How is the county government addressing these constraints?
    d) Does the department have requisite skills mix to address these constraints and adopt and maintain the new technologies?
    e) Probe on resources – financial, mechanical, skills etc.
7. Various reports have highlighted the health consequences of open dumpsites like Dandora/Mwakirunge. Could you comment on this?
    a) Could you comment on the illegal dumpsites in this city? How do the illegal dumpsites evolve? What plans if any have been made to do away with these sites?
    b) How are we fighting the establishment of these sites?
    c) Siting of dumpsites- where is the ideal site? Are there any proposals and what is the status?
8. How is the county planning to achieve zero waste as envisioned in its waste management strategy?
    a) Discuss about waste separation at source and how this will be enforced.
    b) Probe on recycling, re-use and composting in the county in terms of current scale and where this will be in the next 5 years.
    c) Role of public, engagement of public
    d) How about toxic and hazardous waste disposal (probe separately for industrial, e-waste, agricultural and medical waste- what are the plans for the future?
9. A lot has been written about cartels running the waste sector in the city. Please comment on how this has happened?
    a) What are the strengths if any and downsides of having cartels controlling such an important public health service?
    b) What plans, if any, does the county have in reinstating control to the right department?
10. Finally please speak about institutional challenges such as duplication of roles e.g. NEMA vs CCN; experience with policy; stakeholder engagement, city growth etc.

A Guide for KIIs with NEMA Officials

1. What is your role in NEMA in the SWM sector? (probe both individual/organizational role)
2. As an enforcing agency, what are challenges do you face working with the County in solid waste management?
    e) Probe: what has contributed to these challenges?
    f) How are we as an agency addressing these challenges?
    g) Do we think our current and planned responses to these challenges are sufficient?

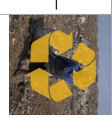
h) What more needs to be done to properly manage the city's waste?
i) What has constrained the County in adopting cleaner and safer disposal technology?

3. Please comment on existing SWM and health policies.
   a) What are the strengths in the existing policies?
   b) What are the weaknesses you see in these policies?
   c) What is the progress we are making in re-shaping these policies?
4. Who are the players in the waste management sector in the county?
   a) Discuss the current zoned waste collection system especially in view of environmental protection- the strengths and weaknesses?
5. Various reports have highlighted the health consequences of open dumpsites like Dandora/Mwakirunge. Could you comment on the illegal dumpsites in this city?
   a) What steps has NEMA taken to facilitate closure of these illegal dumpsites?
   b) How are we fighting the establishment of these sites?
   c) Siting of dumpsites- where the ideal site should be?
   d) How about toxic waste disposal (probe separately for industrial, e-waste, agricultural and medical waste- what are the plans for the future?
6. Please comment on your role in addressing environmental issues arising from solid waste?
7. Finally please speak about institutional challenges such as duplication of roles e.g. NEMA vs CCN; experience with policy makers; skills; powers to prosecute offenders etc.
   a) How are we addressing these challenges?

Sampled EAs

Nairobi EAs

COUNTY	DISTRICT	DIVISION	LOCATION	SUB LOCATION	EA CODE	EA NAME	Male	Female	Total	Households	Selection Number
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	GITATHURU	103020501009	GROGAN 'A	130	122	252	81	1
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	GITATHURU	103020501022	GITATHURU CENTRAL 'B'	83	82	165	60	2
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	GITATHURU	103020501035	GROGAN 'B	154	161	315	123	3
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	GITATHURU	103020501043	NGOMONGO 'A'	177	153	330	99	4
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	GITATHURU	103020501052	NGOMONGO 'B'	97	107	204	59	5
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	GITATHURU	103020501063	NGOMONGO 'B'	154	132	286	82	6
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	GITATHURU	103020501073	NGOMONGO 'B'	202	185	387	93	7
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	KOROGOCHO	103020502008	KOROGOCHO B 1	179	166	345	117	8
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	KOROGOCHO	103020502018	HIGHRIDGE 'A'	159	152	311	66	9
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	KOROGOCHO	103020502029	HIGHRIDGE 'B'	197	181	378	136	10
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	NYAYO	103020503003	NYAYO	162	134	296	111	11
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	NYAYO	103020503012	KISUMU NDOGO 'A'	120	112	232	68	12
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	NYAYO	103020503022	KISUMU NDOGO 'B'	185	146	331	112	13
NAIROBI	NAIROBI NORTH	KASARANI	KOROGOCHO	NYAYO	103020503034	KOROGOCHO 'A' 2	128	127	255	97	14
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'A'	102010101015	WAMWARES	103	112	215	74	1
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'A'	102010101036	DANDORA HDD	88	88	176	65	2
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'A'	102010101058	CANAAN	150	130	280	103	3
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'A'	102010101078	DANDORA PCEA	100	110	210	77	4
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'A'	102010101102	DUNIA	209	218	427	159	5
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'A'	102010101122	MUTHARAKWA	160	198	358	67	6
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'A'	102010101146	SHELL/MUTITU	74	68	142	57	7
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'A'	102010101169	JAMES GICHURU	122	93	215	91	8
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'A'	102010101190	BLOCK 'G'	107	118	225	79	9



COUNTY	DISTRICT	DIVISION	LOCATION	SUB LOCATION	EA CODE	EA NAME	Male	Female	Total	Households	Selection Number
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'A'	102010101216	JUNCTION	148	142	290	105	10
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'A'	102010101241	JESTAN	99	93	192	83	11
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102005	GITARUMARIGU 'A'	155	144	299	89	12
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102025	GITARI MARIGU 'C'	358	350	708	207	13
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102045	DANDORA PHASE IV 'B'3	170	155	325	99	14
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102064	DANDORA PHASE IV 'B'3	192	168	360	113	15
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102081	DANDORA PHASE IV 'B'1	156	151	307	105	16
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102099	DANDORA PHASE IV 'A'1	174	185	359	96	17
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102118	DANDORA PHASE IV 'A'2	119	130	249	94	18
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102136	DANDORA PHASE IV 'C'	167	153	320	97	19
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102158	SHARP CORNER	167	179	346	94	20
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102177	NYUMBA MOJA	175	183	358	106	21
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102197	DANDORA V 'A'	162	157	319	99	22
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102219	KAMBI CHAFU/EXMUOROTO	157	163	320	102	23
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102240	BLOCK 'G'	132	125	257	83	24
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102259	DANDORA PHASE III '3'	101	106	207	80	25
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102279	DANDORA PHASE III '4'	95	103	198	68	26
NAIROBI	NAIROBI EAST	EMBAKASI	DANDORA	DANDORA 'B'	102010102301	DANDORA PHASE III '1'	139	131	270	104	27
NAIROBI	NAIROBI EAST	MAKADARA	MAKADARA	HARAMBEE	102020102003	BURUBURU PHASE 2 'A'	102	136	238	79	1
NAIROBI	NAIROBI EAST	MAKADARA	MAKADARA	HARAMBEE	102020102010	BURUBURU PHASE 2 'D'	125	216	341	78	2
NAIROBI	NAIROBI EAST	MAKADARA	MAKADARA	HARAMBEE	102020102018	BURUBURU PHASE 4 'D'	158	237	395	82	3
NAIROBI	NAIROBI EAST	MAKADARA	MAKADARA	HARAMBEE	102020102025	BURUBURU PHASE 3 'D'	214	231	445	108	4
NAIROBI	NAIROBI EAST	MAKADARA	MAKADARA	HARAMBEE	102020102030	BURUBURU PHASE 3 'B'	141	179	320	78	5
NAIROBI	NAIROBI EAST	MAKADARA	MAKADARA	HARAMBEE	102020102039	BURUBURU PHASE 2 'F'	94	129	223	60	6
NAIROBI	NAIROBI EAST	MAKADARA	MAKADARA	HARAMBEE	102020102047	BURUBURU CITY COUNCIL	157	184	341	91	7
NAIROBI	NAIROBI EAST	MAKADARA	MAKADARA	HARAMBEE	102020102058	HARAMBEE 'C'	223	330	553	171	8
NAIROBI	NAIROBI EAST	MAKADARA	MAKADARA	HARAMBEE	102020102063	OFAFA JERICHO 'A'	164	163	327	90	9

COUNTY	DISTRICT	DIVISION	LOCATION	SUB LOCATION	EA CODE	EA NAME	Male	Female	Total	Households	Selection Number
NAIROBI	NAIROBI EAST	MAKADARA	MAKADARA	HARAMBEE	102020102068	JERICHO MARKET	248	292	540	119	10
NAIROBI	NAIROBI EAST	EMBAKASI	NJIRU	SAIKA	102010602008	OBAMA	171	193	364	111	1
NAIROBI	NAIROBI EAST	EMBAKASI	NJIRU	SAIKA	102010602019	MWENGENYE 'B'	152	102	254	83	2
NAIROBI	NAIROBI EAST	EMBAKASI	NJIRU	SAIKA	102010602028	KAYOLE JUNCTION	185	166	351	100	3
NAIROBI	NAIROBI EAST	EMBAKASI	NJIRU	SAIKA	102010602037	MALI MUNGU	166	174	340	88	4
NAIROBI	NAIROBI EAST	EMBAKASI	NJIRU	SAIKA	102010602043	SAIKA ESTATE	243	284	527	109	5
NAIROBI	NAIROBI EAST	EMBAKASI	NJIRU	SAIKA	102010602051	OGOPA	137	137	274	92	6
NAIROBI	NAIROBI EAST	EMBAKASI	NJIRU	SAIKA	102010602060	MAILI SABA CENTRAL	114	94	208	90	7
NAIROBI	NAIROBI EAST	EMBAKASI	NJIRU	SAIKA	102010602067	BIAFRA	179	149	328	130	8
NAIROBI	NAIROBI EAST	EMBAKASI	NJIRU	SAIKA	102010602076	JEHOVA JIREY	105	116	221	68	9
NAIROBI	NAIROBI EAST	EMBAKASI	NJIRU	SAIKA	102010602086	SHIRANGA CENTRAL 'A'	118	110	228	69	10
NAIROBI	NAIROBI EAST	EMBAKASI	NJIRU	SAIKA	102010602097	SHIRANGA RIVERSIDE	158	128	286	88	11

Mombasa Sampled EAs

COUNTY	DISTRICT	DIVISION	LOCATION	SUB LOCATION	EA CODE	EA NAME	Male	Female	Total	Households	Selection Number
COAST	MOMBASA	BAMBURI	BAMBURI	BAMBURI	301010101007	MAJAONI PHASE I	122	135	257	56	1
COAST	MOMBASA	BAMBURI	BAMBURI	BAMBURI	301010101015	MAJI MACHAFU	197	250	447	91	2
COAST	MOMBASA	BAMBURI	BAMBURI	BAMBURI	301010101021	KIDARAJANI I	237	281	518	120	3
COAST	MOMBASA	BAMBURI	BAMBURI	BAMBURI	301010101026	GREEN II	1012	1044	2056	367	4
COAST	MOMBASA	BAMBURI	BAMBURI	BAMBURI	301010101031	RED ESTATE	225	196	421	108	5
COAST	MOMBASA	BAMBURI	BAMBURI	BAMBURI	301010101038	MOGADISHU	266	274	540	132	6
COAST	MOMBASA	BAMBURI	BAMBURI	BAMBURI	301010101044	MOGADISHU	212	240	452	148	7
COAST	MOMBASA	BAMBURI	BAMBURI	BAMBURI	301010101052	KASHANI	312	285	597	112	8
COAST	MOMBASA	BAMBURI	BAMBURI	MWAKIRUNGE	301010103003	GANDINI	410	407	817	127	9
COAST	MOMBASA	BAMBURI	BAMBURI	MWAKIRUNGE	301010103011	NDENGEREKENI	344	365	709	140	10
COAST	MOMBASA	BAMBURI	BAMBURI	MWEMBE LEGEZA	301010104004	MWEMBE LEGEZA II	211	232	443	119	11
COAST	MOMBASA	BAMBURI	BAMBURI	MWEMBE LEGEZA	301010104011	GOROFANI	109	129	238	71	12
COAST	MOMBASA	BAMBURI	BAMBURI	MWEMBE LEGEZA	301010104021	SHALOM	119	90	209	75	13
COAST	MOMBASA	BAMBURI	BAMBURI	MWEMBE LEGEZA	301010104030	MBUYU KIWETE	169	163	332	90	14
COAST	MOMBASA	BAMBURI	BAMBURI	MWEMBE LEGEZA	301010104039	UTANGE MAWENI I	116	109	225	58	15
COAST	MOMBASA	BAMBURI	BAMBURI	MWEMBE LEGEZA	301010104048	UTANGE MAWENI II	205	195	400	84	16
COAST	MOMBASA	BAMBURI	BAMBURI	MWEMBE LEGEZA	301010104057	MIKOROSHONI II	179	163	342	98	17
COAST	MOMBASA	BAMBURI	BAMBURI	MWEMBE LEGEZA	301010104067	MIKOROSHONI I	108	114	222	56	18
COAST	MOMBASA	BAMBURI	BAMBURI	MWEMBE LEGEZA	301010104075	MIKOROSHONI	183	152	335	105	19
COAST	MOMBASA	BAMBURI	BAMBURI	MWEMBE LEGEZA	301010104083	MIKOROSHONI	89	94	183	68	20
COAST	MOMBASA	BAMBURI	BAMBURI	MWEMBE LEGEZA	301010104091	MIKOROSHONI	124	105	229	75	21
COAST	MOMBASA	BAMBURI	BAMBURI	MWEMBE LEGEZA	301010104099	SHANZU WAYANI	120	96	216	71	22

COAST	MOMBASA	BAMBURI	BAMBURI	MWEMBE LEGEZA	301010104108	SHANZU WAYANI	122	129	251	82	23
COAST	MOMBASA	BAMBURI	BAMBURI	SHANZU	301010105005	SHANZU 'B'	109	100	209	94	24
COAST	MOMBASA	BAMBURI	BAMBURI	SHANZU	301010105014	SHANZU 'E'	139	146	285	100	25
COAST	MOMBASA	BAMBURI	BAMBURI	SHANZU	301010105025	SAGA TOLE	107	126	233	63	26
COAST	MOMBASA	KISAUNI	KISAUNI	JUNDA	301030101009	CALVARY	129	107	236	78	1
COAST	MOMBASA	KISAUNI	KISAUNI	JUNDA	301030101019	MAKUMBA	183	166	349	109	2
COAST	MOMBASA	KISAUNI	KISAUNI	JUNDA	301030101027	KARANJA	145	136	281	90	3
COAST	MOMBASA	KISAUNI	KISAUNI	JUNDA	301030101036	BENGALA	188	174	362	92	4
COAST	MOMBASA	KISAUNI	KISAUNI	JUNDA	301030101046	MISHOROMONI D	170	196	366	120	5
COAST	MOMBASA	KISAUNI	KISAUNI	JUNDA	301030101055	MISHOROMONI A&B	164	129	293	93	6
COAST	MOMBASA	KISAUNI	KISAUNI	JUNDA	301030101064	MISHOROMONI C	142	116	258	89	7
COAST	MOMBASA	KISAUNI	KISAUNI	JUNDA	301030101074	MACHAFUKO 'A'	289	251	540	157	8
COAST	MOMBASA	KISAUNI	KISAUNI	JUNDA	301030101082	MACHAFUKO 'B'	132	146	278	100	9
COAST	MOMBASA	KISAUNI	KISAUNI	JUNDA	301030101091	MANYANI B	203	171	374	121	10
COAST	MOMBASA	KISAUNI	KISAUNI	JUNDA	301030101099	SIMBA WA JUNDA	151	101	252	82	11
COAST	MOMBASA	KISAUNI	KISAUNI	JUNDA	301030101110	KASARANI KUMBWA	174	150	324	95	12
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102005	BAMBURI MADUKANI	173	168	341	114	13
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102015	VESCON	172	192	364	91	14
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102027	MUOROTO	128	100	228	72	15
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102037	BOMBOLULU	127	122	249	72	16
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102047	MKWANJUNI	146	167	313	107	17
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102056	FRERE TOWN/BENKAY	223	198	421	110	18
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102066	FRERE TOWN/BENKAY	158	166	324	107	19
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102076	SWALIHMA	186	152	338	112	20

COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102087	MAJENGO MAPYA	152	138	290	93	21
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102097	KISAUNI MSIKITINI	132	142	274	92	22
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102109	BARSHEBA	161	161	322	78	23
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102120	QADIRIA	97	130	227	75	24
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102132	KATISHA	167	192	359	100	25
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102142	KATISHA	167	136	303	100	26
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102152	BAKARANI	202	208	410	126	27
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102164	BAKARANI	176	195	371	114	28
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102175	MTOPANGA	118	134	252	79	29
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102186	KADZANDANI	173	166	339	97	30
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102196	KADZANDANI	143	144	287	98	31
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102207	MBUNGONI'B'	219	199	418	87	32
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102218	MBUNGONI	137	143	280	83	33
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102227	MATOPENI	202	141	343	119	34
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102238	MIGOMBANI	154	178	332	85	35
COAST	MOMBASA	KISAUNI	KISAUNI	KISAUNI	301030102250	MAFISINI	219	179	398	125	36

African Population and
Health Research Center

Urban
Africa
Risk
Knowledge

APHRC Campus, Kitisuru
P.O Box 10787 - 00100, Nairobi
Kenya +254 20 400 1000
Email: info@aphrc.org
www.aphrc.org
@aphrc