Solid Waste Management and Risks to Health in Urban Africa

A Study of Dakar City, Senegal

African Population and Health Research Center

Urban Africa Risk Knowledge

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Abbreviations

3Rs	Reuse, Reduce, and Recycle
AGETIP	Agence d'Exécution des Travaux d'Intérêt Public
APHRC	African Population and Health Research Center
ARI	Acute Respiratory Infection
ARK	African Risk Knowledge
CUD	Communauté Urbaine de Dakar
DFID	Department for International Development
DHS	Demographic and Health Surveys
EA	Enumeration Area
EOL	End-of-their Life
EPR	Extended Producer Responsibility
ESRC	Economic and Social Research Council
FGD	Focus Group Discussion
ICT	Information and Communication Technology
IDI	In-depth Interview
IGA	Income Generating Activity
KII	Key Informant Interview
MSW	Municipal Solid Waste
PCA	Principal Component Analysis
PPS	Probability Proportional to Size
SIAS	Société Industrielle et d'Aménagement du Sénégal
SOADIP	Société Africaine de Distribution et de Promotion
SWM	Solid Waste Management
TEOM	Taxe d'Enlèvement des Ordures Ménagères
UCG	Unité de Coordination et de Gestion des Déchets
UN	United Nations
WTP	Willingness to Pay

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Executive Summary

Introduction

There is growing concern worldwide regarding municipal solid waste generation. An estimated 11.2 billion tons of solid waste is collected worldwide every year. The increasing volume and complexity of waste associated with the modern economy and rapid urbanization pose a serious risk to ecosystems and human health. In Africa, the key drivers of solid waste generation are urbanization and sustained urban population growth. Although currently ranked as the least urbanized region of the world, Africa is the most rapidly urbanizing continent globally. It is projected that in the next few decades, the continent will have more than half of its population living in urban settings. Urbanization comes with several challenges, including high production of solid waste. The management of the waste that is generated in urban areas and the risks associated with its handling are a major problem confronting many cities in sub-Saharan Africa (SSA), including Dakar, the focus of the present study.

The solid waste management chain—including generation, collection, treatment, recycling and disposal—is complex and poses serious financial constraints to municipalities, especially in developing countries, thereby creating a wide range of risks including the stagnation of economic development, proliferation of diseases, and degradation of the environment. Existing evidence in developing countries points to disproportionate generation of waste vis-à-vis collection and disposal, possibly due to limited administrative capability and lack of public funding for municipalities. Consequently, less than 70% of generated waste is collected and more than 50% of the collected waste is disposed of through uncontrolled landfills, while 15% is processed through unsafe and informal recycling.

There is debate globally regarding the implications of rapid urbanization for economic development and poverty reduction in developing countries. Certainly, rapid urbanization poses challenges to the environment and increases risks that threaten the well-being and prospects of poor people living in cities. Among these threats are the primary man-made hazards associated with poor solid waste management and secondary hazards such as flooding in the context of climate change.

Project Overview

There is increasing debate regarding the sustainability and resilience of cities around the world. Governments, development agencies and civil society organizations in sub-Saharan Africa (SSA) and around the world increasingly recognize that the current urbanization trajectories are part of the problem and the solution to sustainable and resilient future of urban settings.

A better understanding of urban processes, improved data collection, and support for cities and neighbourhoods are therefore prerequisites for addressing the tension between risks and development. It is within this context that the DFID/ESRC-funded Urban Africa: Risk Knowledge (Urban ARK) project was designed to respond to the urban resilience agenda by providing a focal point for knowledge generation, policy analysis and capacity building of city officials responsible for environmental issues in developing countries, especially SSA countries. The overarching goal of the project was to generate evidence on the nature and distribution of urban risks, best practices in urban planning and governance, climate change adaptation for environmental and public health, as well as programmes at local government levels required to reduce the risks and build resilience to multiple hazards in urban African contexts.

The Urban ARK project has several components and is implemented in six African cities: Mombasa and Nairobi (Kenya), Dakar (Senegal), Ibadan (Nigeria), Karonga (Malawi) and Niamey (Niger). This report addresses the component of Solid Waste Management (SWM) implemented in Dakar (Senegal), led by a team of experts from the African Population and Health Research Center (APHRC) based in Nairobi (Kenya). It focuses on man-made hazards of poor Solid Waste Management, consequent loss to health and associated secondary hazards. Ideally, an effective SWM system: (i) protects population health, especially for the poor; (ii) promotes environmental quality and sustainability; and (iii) supports economic productivity and the creation of jobs.

Specifically, the study aimed to:

a. Identify the existing practices and interests shaping the state of solid waste collection, disposal and recycling;

b. Examine the relative exposure of residents of slum settlements and less deprived city areas to poor SWM and associated health outcomes;

c. Explore knowledge, attitudes and practices of stakeholders in relation to environmental and health risks due to poor SWM at individual, household and community levels;

d. Explore disparities in vulnerability, capacity and loss to health across different age-groups and gender.

The report is organised in five chapters. Chapter One presents an overview of the project and data collection tools. Chapter Two presents socioeconomic characteristics of households and respondents. Chapter Three describes the waste management chain including storage of waste within households, collection, transportation, and disposal. Chapter Four addresses the health and environmental risks associated with poor solid waste management. Chapter Five presents stakeholders' views and opinions regarding SWM in study communities in Dakar.

The study was conducted in three sites in Dakar identified in consultation with stakeholders (Chapter 1). Study sites were (a) Keur Massar and Malika communities, located close to the

city's main dumpsite (Mbeubuss); (b) Thiaroye Djiddah Kao, selected as the "secondary exposed site" affected by frequent flooding linked to poor SWM; and (c) Medina and Patte d'Oie were the non-slum comparison sites. For the quantitative component, 424 households were targeted for inclusion in Keur Massar/Malika, 424 in Thiaroye Djiddah Kao, and 442 in Medina/Patte d'Oie. Participants for the qualitative component were purposively selected from a list of stakeholders who are involved in SWM activities in the study sites as well as government officials in charge of SWM.

The study used a mixed-method approach (quantitative and qualitative). The quantitative arm entailed a cross-sectional, population-based survey to generate representative data on household capacity to respond on vulnerability to poor SWM. The qualitative component included key informant interviews (KIIs), focus group discussions (FGDs) and in-depth interviews (IDIs), conducted with a wide spectrum of SWM stakeholders. The qualitative component aimed to capture in depth the underlying disparities in vulnerabilities and capacity at individual, household and community levels, and to identify gaps in existing SWM policies. The two sources of data were triangulated to provide a comprehensive understanding of the state of SWM in Dakar.

Summary of Findings

In Chapter 2, study findings showed that across the three sites, the majority (66%) of households had lived in their communities for more than 6 years, implying some level of stability of households in the study sites. A higher proportion of households owned their dwelling units in Keur Massar/Malika (62%) compared to the other two sites, Thiaroye Djiddah Kao (43%) or Medina (24%) where more rentals were reported. Most households (99%) had access to clean water and flush toilets (95%) with Thiaroye Djiddah Kao having the lowest proportion (84%) of households with flush toilet. Majority of the households (>80%) across the study sites lived in structures made of improved wall and modern roofing materials including cement, tiles or zinc. Wolof (39%) and Pular (33%) were the dominant ethnic groups, accounting for 72% of the total sampled population. Overall, the proportion of poor households was higher in Thiaroye Djiddah Kao (46%) than in Medina (39%) or Keur Massar/Malika (29%).

SWM practices in the three study communities in Dakar are discussed in Chapter 3. Overall, only 27% of households in the three sites in Dakar were using safe means of waste storage (closed containers). The proportion of households using a closed container for waste storage was highest in Medina/Patte d'Oie (43%), more than twice higher than in Djiddah Thiaroye Kao (16%) or Keur Massar/Malika (12%). Waste storage in open containers was most prevalent close to the dumpsite in Keur Massar/Malika (62%) compared to Djiddah Thiaroye Kao (16%) or Medina/Patte d'Oie (12%). Waste collection across the three sites was mainly provided through free municipal service with close to full coverage and most

frequent collection in Medina/Patte d'Oie (Table 6). Municipal waste collection was lower close to the dumpsite in Keur Massar/Malika (77%) where the largest proportion of informal waste collection such as cart handlers was prevalent (21%). The proportion of households willing to pay for collection services was two times higher among the households not adequately served by the municipality in Keur Massar/Malika (62%) compared to Medina/Patte d'Oie (30%) or Djiddah Thiaroye Kao (32%). Illegal dumping was also more prevalent in the under-served study site in Keur Massar/Malika (31%) compared to under 11% in the other two sites. On waste reduction, re-using items like bottles was practised by majority of the households (93%) with little variability across the study sites. Only a small proportion of the households had knowledge on composting (11%) which was only practised in the city periphery in Keur Massar/Malika (7%). On waste separation, households closer to the Dakar centre were more willing to separate waste (40%) compared to the other two sites (under 10%). Lack of appropriate equipment was reported as the main hindrance to waste separation by majority households in Medina/Patte d'Oie and Djiddah Thiaroye Kaowhile and the lack of options to resell was highlighted in Keur Massar/Malika.

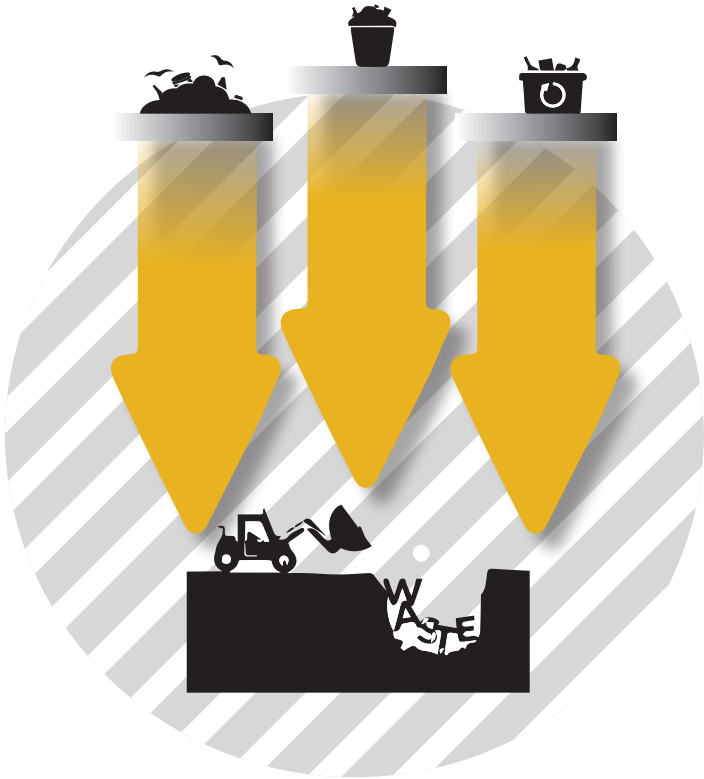
The study findings on health and environmental risks associated with poor solid waste management are discussed in Chapter 4. In summary, only 3.3% of households perceived themselves to be at high risk or very high risk of health and environmental-related hazards associated with poor SWM. The risk perception varied with proximity to the dumpsite, with more concern expressed by respondents in Keur Massar/Malika (21%) compared to respondents in Medina/Patte d'Oie (1.3%) located farther from the dumpsite. Unpleasant smell (27%), children playing with garbage (16%), and smoke from the dumpsite (15%) were the most mentioned threats related to poor SWM. The proportion of residents interviewed who had experienced health problems linked to poor SWM in the 12 months preceding the survey was on average low (1%), with many respondents reporting no one in their communities was either exposed (50%) or affected by poor SWM (60%). Majority of residents (88%) who experienced health problems sought care from health facilities. Participants reported that children were the most vulnerable populations in the communities.

Chapter 5 summarizes stakeholders' views and opinions regarding SWM, with emphasis on potential strategies for an effective and efficient system of SWM in Dakar. The chapter specifically focuses on opinions and views about storage and processing of waste within households, collection and transportation, processing at dumpsites, health and environmental issues, and management and financing.

Conclusion

This report highlights a number of challenges in solid waste management (SWM) in Dakar, the capital city of Senegal. Like many rapidly growing cities in Africa, SWM in Dakar is inadequate and inefficient. The study findings identified challenges in SWM began at the household level spilling over into the neighbourhoods. Households were not equipped to properly store their waste leading to the proliferation of uncontrolled dumping in the streets, yards, abandoned houses or illegal dumpsites. The study also revealed challenges at the government/policy level. Lack of clear delineation between national and municipal responsibilities, ineffective planning as well as constrained financial resources have affected the management of huge quantities of solid waste generated by households in the city. There is a need for deliberate interventions at policy and community levels to address the problem of poor SWM in the city.

Chapter 1



INTRODUCTION

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1.1 Background

Half of the world's population currently lives in urban environments. This proportion will rise further in the next decades reflecting the perceived attractiveness of cities – compared with rural settings – partly because urban settings offer potentially a greater choice of housing, employment opportunities, better education and health services (Royal Tropical Institute, 2013). However, an estimated one-third of the world's urban population (about one billion) live in slums, with no access to decent housing or basic services such as clean water supply and decent sanitation (UN-HABITAT, 2013). As a consequence, numerous diseases and crime are rampant (UN-HABITAT, 2006). These factors impact health and well-being of slum dwellers, as exemplified by the increased burden of infectious diseases (e.g. diarrhoea, typhoid, malaria) and chronic diseases (such as asthma) among these vulnerable populations (Royal Tropical Institute, 2013).

UN-Habitat estimates that 200 million people in sub-Saharan Africa lived in slums in 2010, or 61.7 % of the region's urban population, the highest rate in the world (UN-HABITAT, 2013). Within this context, and as part of broader debates on the implications of rapid urbanization for development and poverty reduction in the developing countries, there is increasing attention to urban environmental risks that threaten the well-being and prospects of poor urban dwellers. Of key importance among these concerns is the primary man-made hazard of poor solid waste management (SWM) and associated secondary hazards such as frequent flooding in the context of climate change, expansion and increasing density 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 -- is an indication of lifestyles and production technology in societies (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, proliferation of disease, environmental degradation, climate change and negative impact on livelihoods. The risks are more pronounced in urban settlements where huge quantities of waste are generated within a very small area. In particular, poor SWM within cities and big municipalities has deleterious impacts on public health, environment and quality of life of citizens (NEMA, 2014).

The estimated quantity of Municipal Solid Waste (MSW) generated worldwide is between 1.7 and 1.9 billion metric tons (UNEP & CCN, 2010). Research has shown that in many cases, developing countries experience poor municipal solid waste management because cities and municipalities are not well equipped to manage waste in a sustainable way (UN-HABITAT, 2013). Less than 70% of waste generated in low-income countries is collected and more than 50% of the collected waste is often disposed of through uncontrolled landfilling while about 15 % is processed through unsafe and informal recycling (Chalmin & Gaillochet,

2009). In sub-Saharan African (SSA) cities, like 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). First, poor areas experience limited or no waste collection. Second, refuse can be removed but improperly disposed of, typically in open dumpsites or landfills, which are often situated in close proximity to the city, particularly 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 contamination of ground water and soil, as well as air pollution resulting from the combustion of untapped gases. In addition, materials that are recovered for recycling – mainly by informal and small-scale operations – are likely contaminated, thus affecting their safety and value for re-use (CalRecovery & UNEP IETC, 2005; Hoornweg & Bhada-Tata, 2012). Existing evidence points to disproportionate expenditure on collection versus disposal of waste, poor municipal administrative abilities and a lack of public funding, staff and equipment as key institutional constraints to appropriate SWM (UN-HABITAT, 2010).

Against the backdrop of the foregoing, cities are placed at the nexus of further threats to the environment through the production of increasing quantity and complexity of waste. Further, 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 (IFRC, 2010; Pelling & Wisner, 2009; World Bank & GFDRR, 2010). However, the impacts of small-scale hazards and disasters are widely under-estimated mainly because they fail to meet the criteria to qualify as disasters in international databases, resulting in a significant share of damage to housing, local infrastructure, livelihoods and low-income households affected by small disasters being overlooked by existing response mechanisms (Pelling & Wisner, 2009; UNISDR, 2009, 2011). Moreover, little is known about the nature and scale of such disasters in urban areas of developing countries due to the longstanding rural bias within policy, aid and research agenda (HPN, 2006). Lack of data at local levels across African cities is also a major hindrance to answering critical questions on health needs of urban poor, understanding the health inequities in urban areas, and effective urban health programming (APHRC, 2014; David, 2014).

The research agenda of this study was designed to address gaps in context-specific knowledge on SWM within urban areas in developing countries to enhance our understanding of local challenges and inform strategies for addressing them. This report presents findings from a study that was conducted in Dakar, Senegal, as part of an initiative aimed at generating evidence on SWM in urban areas of developing countries in order to inform policy and actions to address the associated challenges.

Overview of Dakar City

The study that provided data for this report was conducted in Dakar, the capital city of Senegal, which is spread over 550 square kilometres (0.3% of the national territory) and is home to nearly 25% of the Senegalese population (ANSD, 2014). The rapid population growth in Dakar has led to critical challenges in urban planning, in particular, solid waste management. As the hub of economic and industrial activities, Dakar is the main "solid waste producer" in Senegal with about 2,000 tons of solid waste per day (Diawara, 2009). At the same time, SWM practices are yet to be aligned with the heavy amount of waste generated. A previous study revealed that less than half of households in Dakar have access to a regular system of garbage collection (Centre de Suivi Ecologique, 2010). In addition, most of the garbage collected in Dakar is disposed of at Mbeubeuss dumpsite, located approximately 30 kilometres from the city centre. Declared as the official dumpsite of the city in 1968, the site was initially allocated a land parcel of about 5 hectares, but today covers an area of more than 60 hectares (Diawara, 2009; Journal Officiel de la Republique du Senegal, 2010). Diverse types of solid waste are dumped on the site, comprising stones, metal, organic material (such as food residues, paper, and cardboard), plastics, and biomedical waste from health facilities (Diawara, 2009). This situation exposes the population and SWM service providers to significant health and environmental risks. Recent studies have documented a variety of health risks that are associated with poor SWM such as exposure to contaminated ground water, and heavy metals, including lead and cadmium (Cabral et al., 2012; Cissé, 2012).

1.2 The Urban ARK Project

An important question in urban development is how to make cities in Africa, that are experiencing the fastest rates of growth in the world, leverage that growth to stimulate economic opportunities, reduce poverty and build resilience. Governments, development agencies and civil society organizations in cities across Africa, and globally, recognise that current 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 cities and neighbourhoods to improve their capacity to effectively manage urban growth. 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 of city officials responsible for environmental issues in the study cities. The overarching aim of Urban ARK is to generate evidence 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 African urban contexts (Adelekan et al., 2015).

Different components of the Urban ARK programme are 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 objectives, focuses on man-made hazards of poor solid waste management and consequent negative impacts on health as well as associated secondary hazards. It builds on the primary goal of an effective solid waste management system, which is to protect the health of the population, especially for low-income groups, as well as secondary goals of promoting environmental quality and sustainability, besides supporting economic productivity and employment generation (Schubeler et al., 1996). The project adopted a three-pronged approach: policy reviews, quantitative and qualitative surveys, and biomedical tests of health and environmental outcomes associated with poor SWM. This report presents findings from quantitative and qualitative surveys conducted in Dakar, Senegal.

1.3 Overview of the SWM System and Policies in Dakar

For several decades after independence, solid waste management in Dakar was characterized by chronic institutional instability. Collection and disposal of solid waste fell under the jurisdiction of municipalities, but they faced technical and financial constraints, often struggling to effectively fulfil their mandate. The national government and municipalities tried several options to ensure proper SWM in the city. After a brief experience with the Municipal Waste Management Authority (Régie Municipale de Gestion des Déchets, 1966 - 1971) marked by poor performance related to under-equipped communal technical services, and facing the rapid expansion of the city (Doucouré, 2002), municipalities appealed in 1971 to a monopolistic private company named Société Africaine de Distribution et de Promotion (SOADIP). The company operated until 1984 before going bankrupt partly because municipalities did not comply with their own financial commitments (Sy, 2006). Confronted with limited technical and financial resources, the municipalities initiated inter-communal strategies that allowed pooling of resources to better manage solid waste. Thus, in 1983, the Communauté Urbaine de Dakar (CUD) which included all municipalities of the Dakar region, was set up to manage solid waste in the Senegalese capital city.

SOADIP was replaced in 1985 by the Société Industrielle et d'Aménagement du Sénégal (SIAS), a public sector company which was dissolved in 1991 due to management issues (Cissé, 2007; Diawara, 2009). As a result, the government and municipalities decided to involve community organizations and groups with economic interests in solid waste management in addition to contracting new private enterprises. The challenge for public authorities was to reconcile the issue of waste management with the need to address youth unemployment. The strategy involved the establishment of the Agence d'Exécution des Travaux d'Intérêt Public (AGETIP) that sub-contracted private companies to collect garbage and the launch of cleanliness days, commonly known as "set-setal[1]", led by sports clubs and youth groups. The

[1] Wolof term , literally: make clean; means a community activity to clean a neighborhood

year 2002 saw the entry of foreign companies in solid waste management in Dakar. An Italian company (AMA) was contracted and tasked with an integrated waste management strategy, including garbage collection and disposal, and setting up a suitable solid waste treatment infrastructure. AMA also failed to achieve its objectives and was replaced in 2005 by local private companies which were directly contracted by the municipalities through their inter-communal structure, Entente CADAK-CAR. This structure, which replaced CUD, existed until 2015 when the government decided to transfer the SWM responsibility to the Ministry of Local Government through its coordinating unit named Unité de Coordination et de Gestion des déchets (UCG). Currently, UCG deals directly with private companies (dealers) in charge of collecting and disposing of solid waste at the Mbeubeuss dumpsite.

The legal framework which governs the management of solid waste in Dakar is deficient. Indeed, there are no clear and specific laws that govern solid waste management in Senegal. The Environmental and Public Hygiene Code (Code de l'Environnement et de l'Hygiène Publique) addresses the problem in a piecemeal manner. The single decree about solid waste management in the country dates back to 1974. The fiscal framework is limited to a 1972 decree about household solid waste collection tax (Taxe d'Enlèvement des Ordures Ménagères, TEOM) which requires each developed land parcel in Dakar to pay a contribution of 6% of its annual rental value. The weakness of this source of financial resources and households' non-compliance prompted the government to introduce a specific public-funded SWM programme for the Dakar region in 2002. Nevertheless, there are still doubts about the sustainability of the programme (Dieng, 2012).

In summary, the management of solid waste in Dakar is marked by structural instability which is amplified by a political reductionist vision that has characterised policy decisions since independence. Successive governments did not formulate coherent policies for solid waste management. The institutional framework provides no clear guidance for actors and decisions are not based on evidence.

1.4 Objectives of the Survey

The study that provided the data for this report aimed to contribute to our understanding of different risks associated with exposure of populations to poor SWM practices and the capacity of authorities and communities in developing regions to deal with these risks.

More specifically, the study aimed to:

i. Identify the existing practices and interests shaping the state of solid waste collection, disposal and recycling;

ii. Examine the relative exposure of residents of slum settlements and less deprived city areas to poor SWM and associated health outcomes;

iii. Explore knowledge, attitudes and practices of relevant stakeholders in relation to environmental and health risks resulting from poor SWM at individual, household and community levels;

iv. Explore disparities in vulnerability to risks associated with poor SWM, capacity to manage waste, and loss to health across different age groups and gender.

1.5 Organisation of the Survey

The African Population and Health Research Center (APHRC) collaborated with a local research firm (Agence pour la Promotion des Activités de Population—Sénégal) and an expert in SWM in Dakar to conduct data collection. The local research firm recruited field workers, sensitised community members and stakeholders about the project, worked with APHRC researchers to conduct training, updated the household listings, and undertook data collection activities in the field. APHRC team designed the study protocol and survey tools and provided technical guidance and real-time data quality assurance in the field.

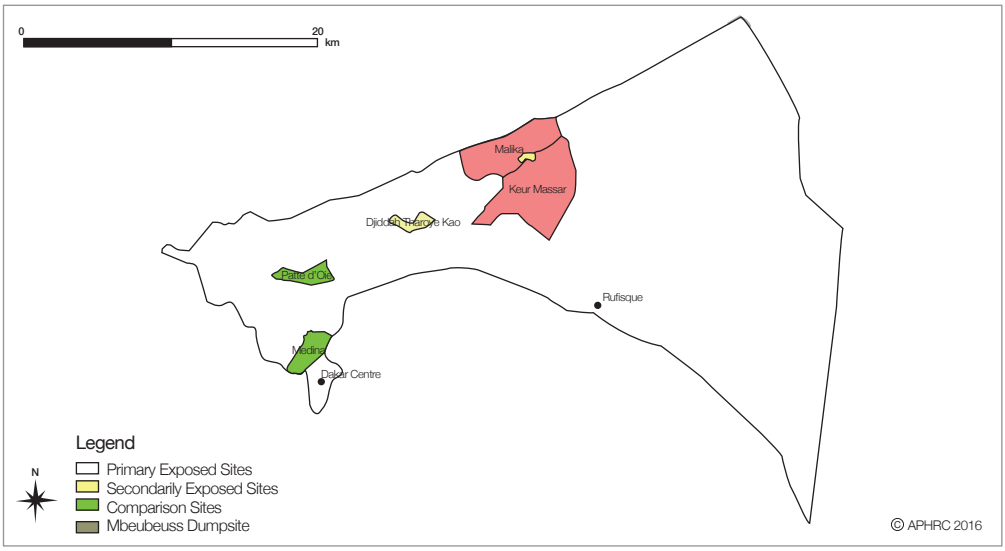
1.6 Survey Design

The study used a mixed-method approach (quantitative and qualitative). The quantitative arm entailed a cross-sectional, population-based survey which aimed to generate representative data on household vulnerability and capacity to respond to poor SWM. The qualitative component included key informant interviews (KIIs), focus group discussions (FGDs) and in-depth interviews (IDIs), conducted with a wide spectrum of SWM stakeholders. The qualitative component aimed to capture in depth the underlying disparities in vulnerabilities and capacity at individual, household and community levels, and to identify gaps in existing SWM policies. The two sources of data were triangulated to provide a thorough understanding of the state of SWM in Dakar. The information is important for informing policies and programmes to address poor SWM and associated health and environmental risks in Dakar and similar cities across Africa.

1.7 Sites and Populations

The study was conducted in three sites in Dakar identified in collaboration with stakeholders. The underlying principle was to include one site that was exposed to the city's main dumpsite (Mbeubeuss); a less exposed site facing secondary hazards such as flooding; and a third non-exposed site as a control. Keur Massar and Malika settlements were included as the "primary exposed sites" since these communities are located close to the dumpsite; Thiaroye Djiddah Kao was selected as the "secondary exposed site" because it is affected by frequent flooding as a result of poor SWM; while Medina and Patte d'Oie were the non-slum comparison sites.

Figure 1: Map of study sites



1.8 Sample Size

The quantitative component of the study used a two-stage sampling approach to select households in each site. At the first stage, enumeration areas (EAs) were selected with Probability Proportional to Size (PPS) based on the 2013 Senegalese Census data. Twenty households were then randomly selected in each EA using a similar approach to that of the demographic and health survey (Aliaga & Ren, 2006; ICF International, 2012). The sample was drawn to be representative at the level of each site and to enable comparison of risk among the three communities. The number of households targeted for inclusion in the study was 424 in Keur Massar/Malika, 424 in Thiaroye Djiddah Kao, and 442 in Medina/Patte d'Oie.

The sample size for each site was calculated using the Cochran's formula [Equation 1] (Cochran, 1977).

$$n_i = \frac{z_{\alpha}^2 p_i(1-p_i)}{d^2} \qquad (1)$$

Where:

- n_i = the number of households to be interviewed in site i

- p_i = the value of the known value of a key outcome in site i. The outcome used to calculate the sample size in this study was the "*percentage of households where solid waste is regularly collected*". Based on previous studies conducted in Dakar, the value of the outcome was: p=0.0 in Keur Massar/Malika and Thiaroye Djiddah Kao; and p=0.50 for Medina and Patte d'Oie (Diawara, 2009).

- Z_a = 1.96 for + 0.05;

- d = 0.05

For the qualitative component, study participants were purposively selected to participate in the KIIs, IDIs and FGDs. Participants were identified from a list of stakeholders who are involved in SWM activities in the study sites as well as government officials in charge of SWM. A total of 4 FGDs, 14 IDIs and 15 KIIs were conducted.

1.9 Survey Tools

For the quantitative component, a structured questionnaire administered to the household head captured information on knowledge, attitudes and practices regarding SWM. In particular, information was collected on the background characteristics of all household members; household assets and amenities; household practices regarding solid waste storage, collection and disposal; and health risks related to household's exposure to solid waste.

FGDs targeted waste-pickers[2], food sellers and community members living around the Mbeubeuss dumpsite to understand their knowledge and perceptions of the risks related to exposure to SWM. The IDIs were conducted with selected stakeholders including health facility managers around the dumpsite, garbage management authorities in the study sites, garbage collectors and dumpster drivers. The KIIs targeted stakeholders and authorities at higher levels including garbage truck owners, representatives of the Garbage Collectors Unions, as well as local government (site level) and national government officials in charge of SWM. The KIIs captured information on policies shaping SWM in Dakar and views regarding better SWM practices in the city.

1.10 Recruitment and Training

Fieldworkers were recruited based on their level of education, prior experience in conducting household surveys, knowledge of the study areas, and fluency in French and local language (Wolof). The recruitment process followed APHRC's guidelines. In total, 15 fieldworkers (12 interviewers and 3 supervisors) were recruited for the quantitative survey and 4 interviewers for the qualitative survey. An intensive training of field teams was conducted for three days to provide fieldworkers with thorough knowledge of the survey procedures and their roles in the data collection process. The training involved use of participatory techniques and practical exercises, including: (i) facilitated sessions on the overall aims of the study and its procedures such as data handling, study tools, and ethical considerations and (ii) mock interviews. At the end of the training, a pilot survey was conducted in a non-sampled neighbourhood in Dakar to test the study tools and data collection procedures.

[2] Person who salvages recyclable materials from streets, public places or disposal sites. They are also called Scavengers scavengers (UN-Habitat, 2010).

1.11 Data Collection

Data collection took place from April 18 to May 8, 2016 concurrently in the three study sites. Information was captured using Android tablets. The field teams worked in synergy under one central management team which comprised three field coordinators and a project manager. In each site, one quantitative team (1 supervisor and 4 interviewers) was in charge of identifying sampled households and conducting the interviews with household heads. The sampled households were identified based on the listings and cluster maps provided to the teams. Interviews were mainly conducted in the local language (Wolof).

The qualitative interviews were conducted by a team of 4 experienced interviewers under the supervision of a field coordinator. They scheduled appointments with respondents, organized field logistics and conducted the interviews, which were audio-recorded with the consent of participants. Prior to data collection, community sensitisation activities were undertaken in study sites to explain the objectives of the survey and seek support and participation of the local communities, stakeholders and authorities.

1.12 Data Processing and Analyses

The quantitative tool was programmed in an online software platform called SurveyCTO. The platform enabled the data to be collected and synchronised on an APHRC server in real time. After running the necessary checks at office level, the data were exported into STATA 14.0 for cleaning and analysis. Analysis entailed generating weighted descriptive statistics (means and percentages) using Svy command in Stata to control for the clustered nature of the data.

The qualitative data were captured using digital recorders, transferred to password-protected computers, and encrypted for security purposes. The audio-records were then transcribed in French for analysis. The French transcripts were also translated into English to enable further analyses by non-francophone researchers at APHRC. The data were coded using NVivo 10, synthesized using thematic analyses, and triangulated with quantitative results to provide a robust picture of participants' knowledge and perceptions of SWM and associated health risks.

1.13 Data Quality Assurance

Quality assurance was undertaken at both field and office levels. Team supervisors and field coordinators conducted spot checks and sit-in interviews in the field in order to ensure data collection procedures were adhered to. In addition, they reviewed all interviews to ensure possible errors were corrected before uploading the data on to the server. At the office level, a data analyst worked with the project manager to conduct real-time checks on the data and provide feedback to field teams. Consistency checks were built in the quantitative data

capture software to ensure that no missing information or implausible values were accepted. For qualitative data collection, sit-ins by field coordinators helped ensure high quality data.

1.14 Number of Interviews and Response Rates

For the quantitative survey, a total of 1,282 households were selected in the three study sites, of which 1,178 were successfully interviewed, yielding a response rate of 91.9% (Table 1). Households that were not interviewed owed that to various reasons including inability to locate the structures, structures being vacant or destroyed, and household members being away for extended periods. Table 2 below presents the number of qualitative interviews by type.

Table 1: Number of quantitative interviews by type and study

Study sites	Urban districts *(Communes)*	Number of EAs selected	Number of households sampled	Number of households interviewed	Response rates
Site 1 (most exposed)	Keur Massar/Malika	21	420	383	91.2%
Site 2 (less exposed)	Thiaroye Djiddah Kao	21	422	393	93.1%
Site 3 (comparison)	Medina/Patte d'Oie	22	440	402	91.4%
TOTAL		**64**	**1282**	**1178**	**91.9%**

**Multiple responses*

Table 2: Number of qualitative interviews by type

Type of interview	Respondents	Number
Focus-Group Discussions	Waste-pickers around the Mbeubeuss dumpsite	1
	Food sellers around the dumpsite	1
	Youth / Women groups living around the Mbeubeuss dumpsite	2
	Total FGDs	**4**
In-depth Interviews	Health facility manager around dumpsite	2
	Garbage management authority in study sites	2
	Garbage collectors / cart-handlers	3
	Garbage collectors in streets	1
	Drivers of dumpsters	2
	Garbage collectors in dumpsters	4
	Total IDIs	**14**

Table 2 (Continued)

Type of interview	Respondents	Number
Key Informant Interviews	Dumpster owners / dealers	5
	Garbage Collectors' National Union	2
	Municipal authorities	4
	Garbage Management Authority (Government)	1
	For Profit Garbage Collection Community Groups	2
	Manager of Mbeubeuss dumpsite	1
	Total KIIs	15

**Multiple responses*

1.15 Ethical Considerations

To minimise any potential stress to participants, interviews were conducted in private settings that were convenient to respondents. The research team was trained to listen and observe without displaying judgmental attitude towards respondents or the information received. They were also 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 them.

Participants were also provided with information about the study before obtaining consent to participate in interviews. They were adequately informed about the purpose of the study and methods to be used; the 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. Participants in the qualitative interviews also provided consent for audio-recording of the conversations.

The tablets were password-protected to ensure data security in the field, and data were automatically removed from the devices and uploaded to a secure server on a daily basis. Ethical clearance to conduct the study was obtained from the Senegalese National Ethics Committee for Health Research (Ref: SEN16/13).

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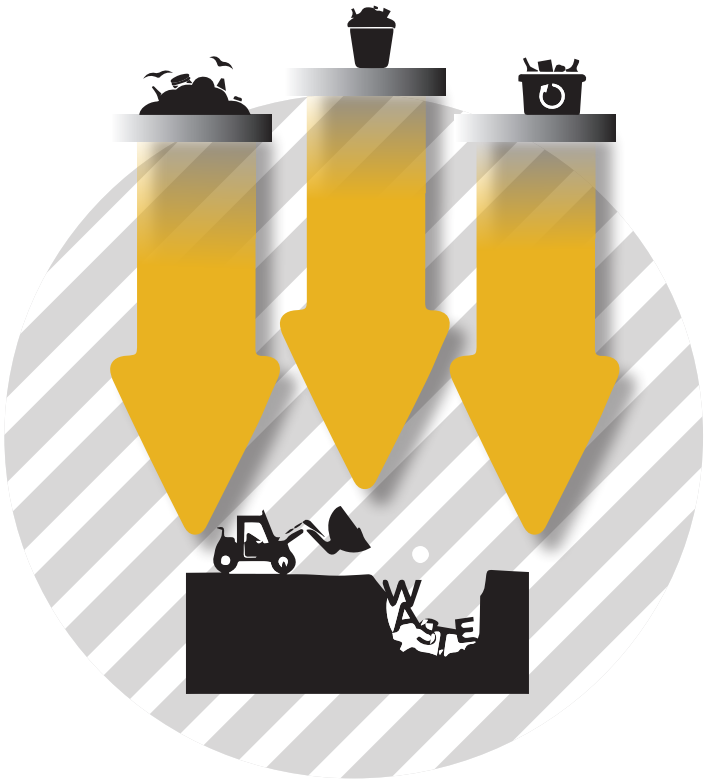
Chapter 2



CHARACTERISTICS OF HOUSEHOLDS AND RESPONDENTS

Cheikh Mbacké Faye Caroline Kabaria

This chapter presents socioeconomic characteristics of sampled households and their members. In the survey, a household was defined as a person or a group of persons, related or not, who live together and share a common source of food. Information was generally collected from the head of household, except for a few households where another member was designated by the head to respond to questions on his/her behalf. For each household, information was obtained on housing status (e.g. duration of stay, ownership of dwelling, family size), household amenities and assets (e.g. electricity, water supply, toilet, type of walls, roofs, durable goods), and socio-demographic characteristics of members such as age, ethnic group, marital status, education and occupation.

2.1 Characteristics of Dwellings

The characteristics of dwellings are important to better understand the conditions of solid waste management within households and possible health and environmental risks faced by household members. The percentage distribution of households by characteristics and study sites is shown in Table 3.

Findings indicate that the majority (66.4%) of households in the three sites had stayed in their communities for more than 6 years. The remainder of households (33.6%) had stayed in the community for less than 5 years while a small fraction (3%) had been in the site for less than a year (Table 3). Similar patterns occurred at the site level, which suggests a certain level of stability of households in the study settings.

One third (33%) of households owned their dwelling units, with the proportion being higher in Keur Massar/Malika (61.8%) than in Djiddah Thiaroye Kao (42.9) and Medina / Patte d'Oie (23.9) This suggests that households in Keur Massar/Malika are more stable compared with those in the other two sites. The rest of households were either rented (63.7%) or were accommodated by an employer (3.4%). The proportion of households renting their dwelling units was highest in Medina (72.8%), which is not surprising because the site is closer to Dakar centre which attracts many temporary residents coming from other cities of Senegal and who are engaged in short-term employment. In contrast, only 33.7% of households in Keur Massar/Malika (which is an outlying municipality) and 53.8% of those in Thiaroye Djiddah Kao rented their dwelling units.

The gender of household head is often associated with the welfare of members. For instance, female-headed households are more likely to be poor compared with male-headed ones (Barros et al., 1997; Buvinić & Gupta, 1997). Nearly seven out of ten households (68.4%) included in the study were headed by men (Table 3). Across the sites, the proportion of female-headed households was lower in Keur Massar/Malika (27.3%) than in the other sites (31.8% in Thiaroye Djiddah Kao, 32.3% in Medina).

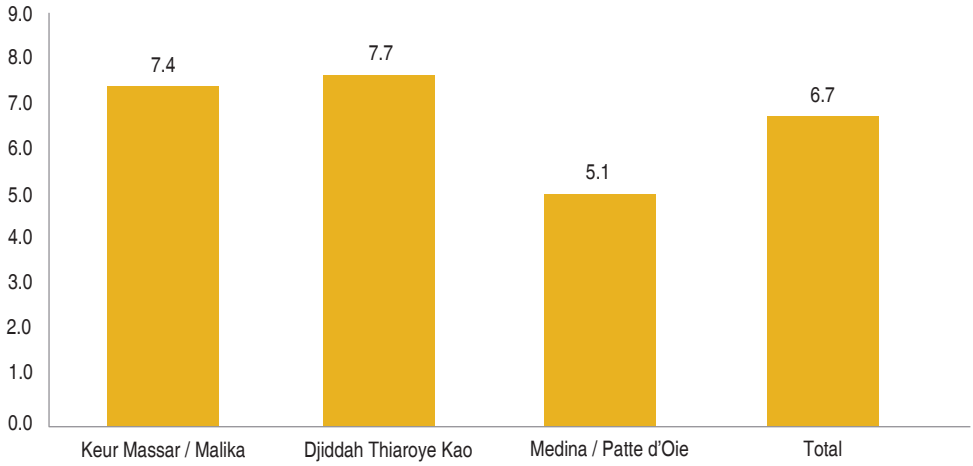
Table 3: Characteristics of households by site

	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Duration of stay in the community				
< 1 year	4.1	3.2	2.7	2.9
1 - 5 years	29.5	29.7	31.2	30.6
6 - 20 years	45.3	28.6	39.3	37.0
> 20 years	21.1	38.6	26.9	29.4
N	**382**	**392**	**402**	**1,176**
Ownership status of dwelling				
Owns or co-owns	61.8	42.9	23.9	32.9
Rent	33.7	53.8	72.8	63.7
Accommodated by employer/parent	4.5	3.2	3.3	3.4
N	**382**	**392**	**402**	**1,176**
Sex of household head				
Male	72.7	68.2	67.8	68.4
Female	27.3	31.8	32.3	31.6
N	**382**	**392**	**402**	**1,176**
Family size				
1 – 2	11.8	14.2	23.1	19.5
3 – 6	35.2	41.9	57.8	51.2
7 - 10	34.3	28.3	14.4	20.1
> 10	18.8	15.6	4.8	9.1
Mean size of households	7.4	7.7	5.1	6.7
N	**383**	**393**	**402**	**1,178**

** Multiple responses*

Figure 2 shows that the average household size was 6.7 persons, with Djiddah Thiaroye Kao having the largest households (7.7 persons), followed by Keur Massar/Malika (7.4 persons), and Medina (5.1 persons) in that order.

Figure 2: Mean size of households by site



2.2 Household Amenities

The main source of drinking water for most households (98.8%) included in the study was taps, with no major variations across sites (Table 4). In addition, majority (94.5%) used flush toilets although the proportion was lower in Djiddah Thiaroye Kao (84.1%) than in Keur Massar/Malika or Medina (98% in each site). Most households in all sites had structures with walls and roofs made of improved materials including cement, tiles or zinc, although the proportion of households owning structures with improved floors (e.g. vinyl, ceramic tiles or cement) was higher in Medina (85.3%) than in Thiaroye Djiddah Kao (73.5%) or Keur Massar/ Malika (76.1%).

Information about household amenities and assets was then used to construct household wealth index estimated using Principal Component Analysis (PCA) (Filmer & Pritchett, 2001). Nearly 4 out of ten households were in the poorest segment of the population, 31.2% were in the middle while 29.2% were in the richest tertile (Table 4). Across sites, the proportion of poor households was higher in Thiaroye Djiddah Kao (45.5%) than in Medina (38.9%) or Keur Massar/Malika (28.5%).

Table 4: Household amenities and selected durable goods by study site

	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Main source of drinking water				
Piped water	95.8	98.9	99.3	98.8
Other sources	4.2	1.1	0.7	1.2
N	**382**	**392**	**402**	**1176**
Types of toilet				
Flushed toilet	98.4	84.1	98.3	94.5
Other types	1.6	15.9	1.7	5.5
N	**382**	**392**	**402**	**1176**
Floors, walls, and roofs of homes*				
Improved floor	76.1	73.5	85.3	81.2
Modern wall	98.9	100.0	95.0	96.8
Modern roof	100.0	100.0	99.4	99.7
N	**382**	**392**	**402**	**1176**
Selected durable goods*				
A radio/cassette player	72.3	66.4	60.5	63.3
A television	88.4	86.9	87.3	87.3
A refrigerator/freezer	33.5	23.6	37.5	33.3
An electric/gas stove	4.7	44.9	25.4	28.6
A car	5.4	3.3	9.3	7.3
Air Conditioning Unit (AC)	0.3	0.0	3.5	2.2
Desktop/Laptop	20.3	10.0	23.2	19.3
Internet in house	5.4	4.7	11.5	9.0
A motorcycle	1.9	2.7	4.5	3.8
Sofa set	45.2	34.0	33.9	35.1
Fan	67.0	62.6	62.8	63.1
N	**380**	**392**	**402**	**1174**
Wealth index				
Poor	28.5	45.5	38.9	39.6
Middle	35.1	33.9	29.4	31.2
Rich	36.4	20.6	31.7	29.2
N	**383**	**393**	**402**	**1178**

** Multiple responses*

2.3 Background Characteristics of Household Members

The background characteristics of household members are presented in Table 5. The distribution of household members by sex shows similar proportions of men and women in the sampled households (Table 5). The age distribution, however, depicts a young population with 52.7% of household members being aged between 15 and 45 years. Children aged 0-10 years represented 22.7% while older people (46 years and above) comprised 15.9% of household members. The proportion of households with children aged 0-10 years was similar across sites (25.5% in Keur Massar/Malika, 25.1% in Thiaroye Djiddah Kao, and 20.5% in Medina).

The dominant ethnic group in all the three sites was Wolof (48.3% in Keur Massar/Malika, 39.3% in Thiaroye Djiddah Kao and 35.8% in Medina), followed by Pulaar (representing more than one-third of household members in Medina and Thiaroye Djiddah Kao and 25.9% of those in Keur Massar/Malika) and Sereer (comprising between 10% and 15% of the population in the three sites). These patterns are consistent with those from national surveys such as 2011 Senegal Demographic and Health Survey (DHS) and 2013 Census. Distribution by marital status shows that slightly more than half (52%) of respondents were married or cohabiting at the time of the survey. The proportion of married household members was higher in Thiaroye Djiddah Kao (55.4%) and Keur Massar/Malika (52.4%) than in Medina (50.0%).

Figure 3 displays the percentage distribution of household members by educational attainment and site. A substantial proportion (34.6%) of household members had no education while 32.0% had secondary level education or higher. The proportion of household members with no education was higher in Thiaroye Djiddah Kao (44.3%) than in Keur Massar/Malika (38.7%) or Medina (27.6%). The proportion of household members with university level education or higher was less than 10% in all the sites combined although the proportion was higher in Medina (10%) than in Keur Massar/Malika (6%) or Thiaroye Djiddah Kao (4%).

Table 5: Background characteristics of household members

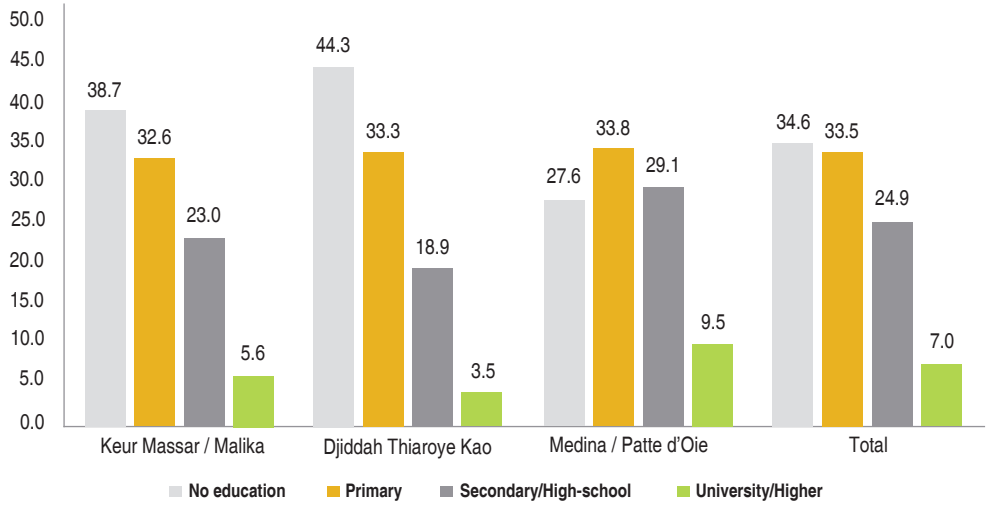
	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Sex				
Male	48.7	48.6	50.9	49.8
Female	51.3	51.4	49.1	50.2
N	**2,830**	**3,007**	**2,026**	**7,863**
Age group				
0-5	12.9	13.7	9.9	11.5
6-10	12.6	11.4	10.6	11.1
11-15	9.9	10.1	7.7	8.8
16-20	12.3	11.6	12.0	11.9
21-25	11.0	9.7	10.5	10.3
26-35	16.4	18.1	18.4	18.0
36-45	9.7	11.2	13.9	12.5
46-55	6.6	7.5	8.5	7.9
>55	8.6	6.8	8.5	7.9
N	**2,830**	**3,007**	**2,026**	**7,863**
Ethnic group				
Wolof	48.3	39.3	35.8	38.7
Pular	25.9	34.9	34.1	33.3
Serer	10.1	12.1	15.1	13.4
Mandingue	2.8	7.1	3.2	4.4
Diola	5.5	1.5	3.0	2.9
Soninke	0.9	0.9	4.8	2.9
Other	6.5	4.1	4.0	4.4
N	**2,830**	**3,007**	**2,026**	**7,863**
Marital status (age>14 years)				
Never married	41.9	37.8	43.4	41.4
Married/cohabiting	52.5	55.4	50.0	52.0
Widowed/divorced/separated	5.7	6.9	6.6	6.6
N	**1,904**	**2,035**	**1,519**	**5,458**
Highest level of education (age>5 years)				
No education	38.7	44.3	27.6	34.6
Primary (including pre-primary)	32.6	33.3	33.8	33.5
Secondary/high-school	23.0	18.9	29.1	24.9
University/higher	5.6	3.5	9.5	7.0
N	**2,529**	**2,678**	**1,854**	**7,061**

Table 5 (Continued)

	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Income generating activity past 12 months (15 years and above)				
Not employed	46.7	57.8	46.2	49.9
Formal employment	17.2	13.9	19.3	17.3
Informal employment	35.6	28.4	34.5	32.7
Waste collector	0.1	0.0	0.0	0.0
Other	0.4	0.0	0.0	0.1
N	**1,905**	**2,035**	**1,519**	**5,459**

** Multiple responses*

Figure 3: Percentage distribution of household members by educational attainment and site



With respect to income generating activities (IGA), close to half of household members aged 15 years and above were not engaged in any IGA in the 30 days preceding the survey while 32.7% were engaged in informal employment and 17.3% in formal IGA (Table 5), with minimal variations across sites. For instance, the proportion of household members engaged in informal employment ranged from 28.4% in Thiaroye Djiddah Kao to 35.6% in Keur Massar/Malika.

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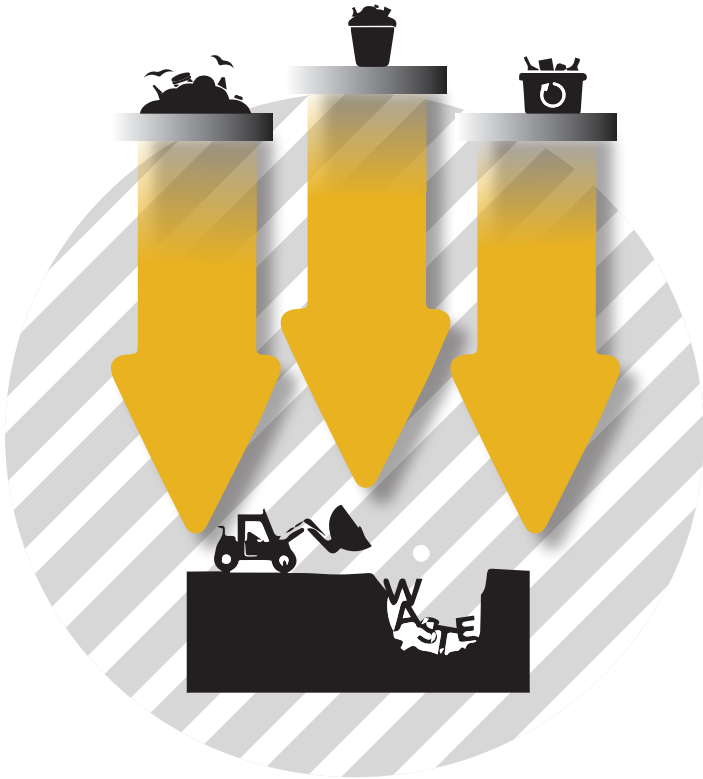
Chapter 3



SOLID WASTE STORAGE, COLLECTION AND DISPOSAL

Zacharie Tsala Dimbuene Dickson Amugusi

Most sub-Saharan African (SSA) countries face rapid population, urban and economic growth. One major consequence of these demographic and socio-economic trajectories is undoubtedly the expansion of cities without adequate planning, which leads to increased waste production and management (Komakech, 2014; Laner et al., 2012). SSA cities including Dakar are experiencing difficulties with solid waste management. These difficulties are exacerbated by population pressures in heavily populated and often poor areas in the cities. Previous research reported that the volume of solid waste generated is associated with the characteristics of households. In a review of solid waste management (SWM) in East African cities, Okot-Okumu observed that poor households generate lower volumes of waste because they buy little and are less wasteful in consumption compared with richer households (Okot-Okumu, 2012; Scheinberg et al., 2011).

A plausible explanation for these variations stems from the types of goods purchased. While rich communities purchase a variety of goods that result in high quantities of waste being generated (e.g., packaging, containers, plastic bottles), poor urban communities mostly purchase goods (often food items) which are consumed and little is disposed of. Although this explanation is relevant for the waste generation chain, it is insufficient when the entire process of waste management (from generation to disposal) is considered (Nzeadibe, 2009). In fact, while poor communities generate lower quantities of waste than rich communities, the former are also less equipped in terms of appropriate means to store and dispose of waste. This chapter addresses the waste collection chain in Dakar, the capital City of Senegal which has 3 million inhabitants (ANSD, 2014). The chapter specifically explores solid waste generation and storage, collection, disposal, recycling and composting within and from households. These processes should ideally adhere to the best principles of public health, which guarantee or protect human health and wellbeing.

3.1 Solid Waste Storage in Households

Best practices in solid waste management (SWM) start in households. Failures at this stage affect the entire system of SWM. Table 6 describes garbage storage and collection practices in selected households in Dakar. Practices around waste storage in the households include use of closed and open containers, plastic bags, and piles in the yard. For those who do not store their waste within households, the alternative is a common collection point outside the household. Overall, households used a closed container (26.9%), an open container (47.1%), or plastic bags (22.3%) to store waste. Other households that did not have a storage system used either a pile in the yard (3.0%) or a common collection point outside the household (0.7%).

Table 6: Garbage storage and collection from households

	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Storage within households				
Closed container	11.7	15.5	34.2	26.9
Open container	62.1	55.3	41.2	47.1
Plastic bags	24.6	17.6	24.0	22.3
Pile in the yard	0.8	9.3	0.6	3.0
Common collection point outside plot	0.8	2.3	0.0	0.7
N	**382**	**392**	**402**	**1,176**
Household receive garbage collection services (%Yes)	79.6	97.8	99.0	96.7
N	**382**	**392**	**402**	**1,176**
Type of garbage collection services received by households				
Public service	77.2	95.3	99.7	96.6
Informal services/cart handlers	21.1	4.7	0.3	3.3
Other	1.7	0.0	0.0	0.1
N	**297**	**384**	**397**	**1,078**
Number of times household receives garbage collection services in a week				
< 2 times	1.4	0.7	0.0	0.3
2 – 5 times	85.3	30.9	6.5	19.7
6 – 7 times	13.8	68.3	93.5	80.0
N	**297**	**384**	**397**	**1,078**
Regularity of garbage collection services				
Very regular	16.4	7.6	44.8	32.3
Regular	45.8	75.7	50.4	57.0
Not regular	37.8	16.8	4.8	10.8
N	**295**	**384**	**397**	**1,076**
Payment schedule				
Per collection	1.7	4.3	0.2	1.4
Monthly	21.9	0.7	0.2	2.1
Free service (government providing services)	76.0	94.9	99.4	96.2
Other	0.3	0.0	0.3	0.2
N	**297**	**384**	**397**	**1,078**
Willingness to pay for garbage collection (% Yes)	**62.0**	**31.8**	**29.5**	**33.7**
N	**335**	**344**	**339**	**1,018**
Amount to pay per month if willing to				
Average amount per month (CFA)	1,992.00	1,446.00	2,721.00	2,219.00
N	**205**	**118**	**87**	**410**

** Multiple responses*

Analysis across sites (Table 6) showed that the proportion of households using open containers was higher in Keur Massar/Malika (62.1%) than in Djiddah Thiaroye Kao (55.3%) and Medina/Patte d'Oie (41.2%). In addition, the proportion of households using a closed container for waste storage was more than two times higher in Medina/Patte d'Oie (34.2%) than in Djiddah Thiaroye Kao (15.5%) and Keur Massar/Malika (11.7%).

3.2 Waste Collection from Households

The next step in the chain following waste storage in households is collection and transportation of waste. This section examines how waste is collected and transported, and whether households are willing to pay (WTP) to improve waste collection services in Dakar.

3.2.1 Garbage Collection Services: Supply and Frequency of Waste Collection

Most households (97%) included in the study received waste collection services with significant variations across sites (Table 6). The proportion of households receiving waste collection services ranged from 77% in Keur Massar/Malika to 99% in Medina/Patte d'Oie. The latter is closer to the center of Dakar and receive better waste collection services than the other sites.

Two main methods of waste collection in Dakar include formal (e.g. public service) and informal services (e.g. cart handlers). Among households receiving waste collection services, the majority (97%) were served by the public sector while only 3% relied on informal services/ cart handlers. This finding is in line with the current waste collection legislation in Dakar which states that "municipalities are responsible for waste collection services". However, the findings indicate that public sector services for waste collection were unequally distributed across the three sites. In particular, while almost all households (99.7%) in Medina/Patte d'Oie have received public waste collection services, the corresponding figures for Djiddah Thiaroye Kao and Keu Massar/Malika were lower (95% and 77%, respectively). In contrast, the proportion of households relying on informal waste collection services was higher in Keu Massar/Malika (21%) than in Djiddah Thiaroye Kao (4.7%) and Medina (0.3%).

Most households (80%) receiving waste collection services were served 6-7 times a week. However, the frequency of waste collection varied significantly across sites, with the proportion of households being served 6-7 times a week being higher in Medina/Patte d'Oie (94%) than in Djiddah Thiaroye Kao (68%) or Keu Massar/Malika (14%). Although the frequency of waste collection in Dakar seems to be high, regularity of the service is another important factor to consider for planning and management of solid waste. Approximately, 90% of households reported that waste collection is very regular or regular. However, similar to supply and frequency of waste collection, there were inequalities in the regularity of the service across sites. In particular, the proportion of households receiving very regular or

regular services was higher in Medina/Patte d'Oie (95%) than in Djiddah Thiaroye Kao (83%) and Keur Massar/Malika (58%).

3.2.2 Payment for Collection Services

The financial costs of efficient solid waste collection remain a challenge for many SSA cities including Dakar due to budget constrains (Henry et al., 2006; Kinobe et al., 2015). Previous research showed that waste collection costs represent over 70% of SWM budget of municipalities in developing countries (Kinobe et al., 2015; Tchobanoglous & Kreith, 2002). This study explored the perceptions and behaviours of households regarding the costs of waste collection. First, most households (96%) benefited from free services offered by municipal providers. Secondly, where public services were less effective as in Keur Massar/ Malika, households relied on informal waste collection services; they were therefore more likely to pay for waste collection services, with 22% of households in the community reporting making monthly payments for waste collection services compared with less than 1% in other sites. Thirdly, willingness to pay (WTP) for waste collection services is associated with the ineffectiveness of public services. Overall, 34% of households were willing to pay for waste collection services, with the proportion being higher in Keur Massar/Malika (62%) where the waste collection services were less efficient than in Djiddah Thiaroye Kao (32%) or Medina/ Patte d'Oie (30%). Medina/Patte d'Oie is closer to the centre of Dakar and receives better services and thus residents were less willing to pay compared with the other sites.

Our results showed that, on average, households were willing to pay 2,219.00 FCFA per month (approximately $US 4.0) for waste collection services. Interestingly, the amount was higher in Medina/Patte d'Oie (2,721.00 FCFA-~-$US 4.9) where households are less willing to pay compared to the sites where households were more willing to pay for the services, that is, an average of 1,992.00 FCFA (~$US 3.6) in Keur Massar/Malika and 1,446.00 FCFA (~ $US 2.6) in Djiddah Thiaroye Kao, respectively.

3.3 Disposal of Household Waste

Poor disposal of waste in SSA cities is also a source of disease in addition to causing environmental damage. In Kenya, for instance, poor disposal of solid waste forced the local government in 2003 to order the relocation of the Dandora dumpsite, the only official landfill in Nairobi, on the grounds that it had become an eyesore, a recipe for diseases and that the large swarms of birds at the dumpsites could cause plane accidents (Henry et al., 2006). In this section, we analysed other forms of disposal practices, and disposal of toxic and electronic waste in Dakar.

3.3.1 Alternative forms of Waste Disposal Practices

Although public and informal waste collection services are provided in the city, households may use alternative ways to dispose of their waste due to irregularity of public services. Results

reported in Table 7 indicate that one-third of households included in the study used alternative forms of solid waste disposal in the absence of waste collection services. However, this practice varied across sites. In particular, the proportion of households using alternative forms of disposal was more than two times higher in Keur Massar/Malika and Djiddah Thiaroye Kao (47% in each site) than in Medina/Patte d'Oie (20%). Alternative waste disposal practices in the study sites mainly include cart handlers (34%) and public garbage containers (23%). In addition, 3% of households routinely burned solid waste, with the proportion being higher in Keur Massar/Malika (9%) than in Djiddah Thiaroye Kao (1%) or Medina/Patte d'Oie (2%).

Use of alternative forms of waste disposal was also related to the availability of public waste collection services. The results showed that 9% of households in Keur Massar/Malika had consistently used the official dumpsite as an alternative waste disposal point when public waste collection services were not available. In Medina/Patte d'Oie where the public waste collection is more efficient, households placed waste on the road/rail (26%) and public containers (23%) for collection. The situation in the other sites (Keur Massar/Malika and Djiddah Thiaroye Kao) was different because public waste collection services are less efficient and less regular. Households in Keur Massar/Malika used unauthorized dumpsites (30%) while those in Djiddah Thiaroye Kao used either informal providers or cart handlers (66%) as alternative forms of waste disposal.

Table 7: Disposal of household solid waste

	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Use of other disposal systems when garbage collection services not provided (% Yes)	46.8	46.5	20.4	30.9
N	**334**	**334**	**337**	**1,005**
Other disposal systems used when garbage collection services not provided				
Unauthorised dumpsite / wild dumpsite	30.5	7.0	11.2	12.7
In the lake/dam	4.7	1.7	0.0	1.5
On the road/rail	0.0	1.0	25.9	11.4
Unoccupied terrain/place	2.4	0.0	3.1	1.7
Vacant/abandoned house/plot	4.7	5.3	0.8	3.3
Burning	6.3	0.7	2.5	2.4
Public garbage containers / trucks	18.5	10.2	38.0	23.4
Burying	13.3	7.9	4.2	7.2
Informal providers/cart handlers	10.4	65.8	12.1	33.7
Mbeubeuss dumpsite	9.2	0.0	0.0	1.5
Other	0.0	0.5	2.2	1.1
N	**203**	**195**	**94**	**492**
Routinely burn household waste (% Yes)	9.0	0.8	2.4	2.6
N	**382**	**392**	**402**	**1,176**

Table 7 (Continued)

	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Measures to reduce household solid waste*				
Re-use items like bottles	94.7	93.2	92.6	93.1
Use long life shopping baskets	96.8	86.3	81.3	85.3
Compost organic waste	7.3	0.0	0.0	1.6
No measure taken	0.0	1.8	1.4	1.1
N	**280**	**62**	**161**	**503**
Disposal of toxic substances such as radio/torch batteries				
Together with other trash	99.4	99.1	94.3	96.1
Give/offer to someone else for re-utilization	0.0	0.5	4.9	3.2
Other	0.5	0.5	0.8	0.7
N	**382**	**392**	**401**	**1,175**
Disposal of electronic equipment such as broken mobile phones				
Together with other trash	75.5	98.0	47.6	64.2
Burying	11.6	0.8	19.9	13.8
Give/offer to someone else for re-utilization	12.6	1.2	31.8	21.5
Other	0.3	0.0	0.7	0.5
N	**380**	**392**	**396**	**1,168**

** Multiple responses*

3.3.2 Disposal of Toxic Waste

Although all countries around the world face challenges of toxic waste management, developing countries are more affected due to ineffective and inefficient systems of solid waste management occasioned by rapid urbanization and poor planning in most cities. Participants were asked how their households usually disposed of toxic waste including paint, batteries, and radio receivers (see Table 7). Unsurprisingly, almost all households (96%) disposed of toxic waste like other unhazardous waste, with no major variations across sites (99% in Keur Massar/Malika and Djiddah Thiaroye Kao, and 94% in Medina/Patte d'Oie). These behaviours can be partially explained by a lack of clear rules and regulations concerning sorting and recycling of waste.

3.3.3 Disposal of Electronic Waste

Electronic waste, also referred to as "e-waste", is generated from the new information and telecommunication technologies (ICT) such as computers, printers, fax machines, mobile phones, tablets and netbooks, personal digital assistant (PDA), radio receivers and television sets (TVs). E-waste is defined as end-of-use or end-life of electronic products, components and peripherals. Recycling e-waste is a more promising way of protecting the environment worldwide, especially in developing countries that lack proper SWM policies regarding disposal of such waste (Nnorom & Osibanjo, 2008a, 2008b; Olowu, 2012; Osibanjo & Nnorom, 2007). The inefficient enforcement of rules and regulations is evident from households' behaviours regarding e-waste disposal in Dakar. Sixty-four percent of households treat and dispose of e-waste like any other waste, with the practice being more prevalent in Djiddah Thiaroye Kao (where 98% of households disposed of e-waste with other trash) compared with Keur Massar/ Malika (76%) and Medina/Patte d'Oie (48%). Like most SSA cities, Dakar lacks clear rules and regulations about e-waste despite the fact that most developed countries have in place legislation mandating manufacturers and importers to take back used electronic devices at the end-of-their life (EoL) based on the principle of extended producer responsibility (EPR) (Nnorom & Osibanjo, 2008b).

3.3.4 Measures to Reduce Solid Waste

In the absence of clear rules and legislation, all initiatives to reduce the volume of waste generated can be ineffective. Many initiatives have been put in place in developed countries and the 3Rs (Reuse, Reduce, Recycle) philosophy seems to be effective in reducing solid waste generated from households. For instance, to reduce the volume of waste in developed countries, the 3Rs involved either selling or not providing plastic bags in supermarkets. Likewise, canned drinks include an extra fee as an incentive to recycle; the extra fee is refundable upon handing back the containers. Findings from this study revealed two main strategies that households use to reduce the volume of waste. These include re-use of items such as bottles (93%) and the use of long life shopping baskets (85%). Re-use of items was almost similar in all sites while that use of long life shopping baskets varied across sites. The proportion of households re-using long life shopping baskets was higher in Keur Massar/ Malika (97%) than in Djiddah Thiaroye Kao (93%) and Medina/Patte d'Oie (81%).

3.4 Solid Waste Recycling and Composting

The study assessed the knowledge of households regarding recycling and composting which are also strategies to reduce the volume of waste. Results are presented in Table 8.

Table 8: Solid waste recycling and composting

	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Ever heard about solid waste recycling (% Yes)	32.7	49.8	27.0	33.8
N	**382**	**392**	**402**	**1,176**
Ever heard about composting (% Yes)	11.7	1.7	7.8	8.0
N	**260**	**62**	**161**	**483**
Willing to sort household solid waste for composting purposes (%Yes)	9.5	7.1	40.1	28.1
N	**379**	**392**	**400**	**1,171**
Conditions for sorting household solid waste for composting purposes				
Availability of appropriate equipment	44.8	73.5	87.0	84.7
Possibility to resell	45.6	6.7	9.3	10.4
Other	9.6	19.8	3.7	5.0
N	**39**	**27**	**160**	**226**

** Multiple responses*

3.4.1 Recycling

Recycling is one of the effective strategies for reducing the volume of waste. Findings indicated that 34% of households had heard of recycling, with the proportion being higher in Djiddah Thiaroye Kao (50%) than in Keur Massar/Malika (33%), and Medina/Patte d'Oie (27%).

A prerequisite for recycling is sorting to separate the components of household waste and manage differently recyclable ones. Approximately one-third of households in the study sites were willing to sort household waste, with substantial variations across sites. The proportion of households willing to sort solid waste was higher in Medina/Patte d'Oie (40%) than in the other sites where it is less than 10%.

3.4.2 Composting

Organic waste is another type of detritus generated by households. In developing countries, organic and biodegradable waste constitute an important share of municipal solid waste flows, which originate from households (Cointreau, 2006). Study participants were asked about composting practices as a strategy to reduce the volume of waste. Findings indicated that 8% of households had heard of composting as a waste reduction strategy (Table 8), with variations from 2% in Djiddah Thiaroye Kao to 12% in Keur Massar/Malika. Most households (85%) also reported willingness to compost waste if appropriate equipment was available although the proportion was lower in Keur Massar/Malika (45%) than in Djiddah Thiaroye Kao (74%) and Medina/Patte d'Oie (87%). The low proportion of households willing to compost

waste in Keur Massar/Malika was because the residents were more interested in composting if there were opportunities for resale (46%). In contrast, a lower proportion of residents of Djiddah Thiaroye Kao and Medina / Patte d'Oie were interested in composting if there were opportunities for resale (7% and 9%, respectively).

3.5 Solid Waste Management in the Communities

Another important factor to consider in SWM in SSA cities is the responsibility of communities in the process. This section explores attitudes and perceptions about SWM to inform community engagement strategies and actions towards SWM.

3.5.1 Stakeholders and Actors Involved in SWM outside of Households

Many actors within the community are involved in cleaning streets to ensure a viable environment for its inhabitants. These include government and municipal authorities, community-based organisations and organized cleaning groups, volunteers[3], and neighbourhood residents. Results revealed that two main actors were involved in cleaning the streets in the study communities: the residents (56%) and the government (38%). Although the legislation in Dakar states that municipalities are responsible for SWM, the findings showed that the involvement of the municipality in cleaning the streets was minimal (reported by 16% of households). The involvement of these main actors in street cleaning also differed across sites. For instance, the residents of Keur Massar/Malika and Djiddah Thiaroye Kao were the main actors involved in the cleaning of the streets (reported by 96% and 76% of households, respectively). In contrast, both the residents and the government were major actors involved in cleaning the streets in Medina/Patte d'Oie (reported by 41% and 58% of households, respectively).

3.5.2 Collection and Disposal of Waste

When household waste is disposed of in the streets, its management becomes more difficult. Household heads were asked about the final destination of waste found in the streets. Most (95%) reported that trucks collected waste from the streets although the proportion varied from 68% in Keur Massar/Malika to 99% in Medina/Patte d'Oie (Table 9). Waste may also be taken to dumpsites (6%) or collected by cart handlers (6%). These also varied by site. For instance, the proportion of households that took waste to a dumpsite was higher in Keur Massar/Malika (26%) than in Djiddah Thiaroye Kao (9%) or Medina/Patte d'Oie (2%). A similar pattern occurred for the proportion of households reporting that waste was collected by cart handlers (Table 9).

[3] Volunteers are mostly young people trained by the government on environmental issues and deployed to help maintain the streets while residents are formal/informal groups organized to clean the streets.

3.5.3 Waste-Related Problems in the Community

Concerns of residents about problems related to poor SWM can be a starting point for present and future actions regarding proper management of waste. Study participants reported various problems related to poor SWM, including: littering (18%), illegal dumping (13%), dumping trash in someone else's plot (12%), and burning of waste (11%). These problems may indicate failure of the formal SWM system in the city. The waste-related problems were more likely to be reported by residents of Keur Massar/Malika than those of other sites, mostly due to its proximity to the official dumpsite (Table 9).

Table 9: Solid waste management in the communities

	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Stakeholders/actors involved in cleaning streets in this community*				
Volunteers	4.2	27.7	17.0	18.6
CBOs / organised cleaning groups	14.5	7.5	9.6	9.5
Government	5.5	4.0	57.5	37.7
Municipal authorities	5.6	1.3	23.2	15.5
Ourselves – residents	95.9	75.9	41.1	56.1
Other	0.3	0.6	0.5	0.5
N	**382**	**392**	**402**	**1176**
Disposal of trash collected from the streets*				
Transferred to garbage trucks	68.2	96.0	98.8	95.0
Taken to dumpsite	25.7	9.3	1.5	6.0
Taken to garbage cart handler	22.2	12.7	0.0	5.7
Burned	8.6	3.4	0.0	1.8
Gathered and piled on the streets	1.9	2.5	0.4	1.1
Other	6.6	2.4	0.8	1.8
N	**381**	**392**	**402**	**1175**
Perceived status of the environment in the neighbourhood				
Very poor	0.8	0.6	0.7	0.7
Poor	22.0	12.8	4.6	8.6
Average	53.0	67.6	43.1	50.8
Good	23.4	18.3	42.9	34.2
Very good	0.8	0.7	8.7	5.7
N	**382**	**392**	**402**	**1176**

Table 9 (Continued)

	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Waste-related problems faced by people in the community*				
Burning of trash at dumpsite	59.7	9.5	3.5	10.8
Disposing toxic waste e.g. chemicals	13.6	2.5	1.9	3.2
Illegal dumping of trash	35.4	19.2	7.1	13.2
Littering the community	38.4	9.2	18.4	17.9
People dumping trash in others' plots	49.0	12.4	6.0	12.1
Consuming food grown near dump	8.2	0.7	0.8	1.5
Other	0.8	0.0	2.5	1.7
N	**382**	**392**	**402**	**1176**
Level of satisfaction with waste management in the community				
Very satisfactory	4.4	2.3	5.8	4.7
Satisfactory	54.8	76.0	79.0	75.8
Somehow satisfactory	25.3	19.5	14.0	16.6
Not satisfactory	15.5	2.2	1.2	2.9
N	**382**	**392**	**402**	**1176**
Challenges with SWM in the community*				
Ineffective collection	75.9	65.7	55.7	63.0
Lack of solid waste sorting	38.0	3.6	37.1	27.2
No control over illegal dumpsites	70.3	33.7	10.9	30.3
No recycling options	21.0	2.7	12.6	11.4
Lack of public education	56.9	52.0	49.9	52.0
Lack of waste treatment	32.5	20.9	19.9	22.9
Unsafe disposal in open dumps	40.9	20.8	2.9	16.3
Other	0.0	0.0	1.1	0.6
N	**159**	**85**	**59**	**303**

** Multiple responses*

The most common waste-related problems in the community included burning (reported by 60% of households), dumping of waste in other people's plots (48% of households), littering (38% of households), illegal dumping of trash (35% of households), and disposal of toxic waste (14% of households).

3.5.4 Community Perceptions about the Current System of SWM

The existing SWM system in Dakar negatively impacts the quality of the environment in the neighbourhood. Respondents were asked to rate the quality of their environment and how satisfied they were with waste management in their communities (Table 9). With regard to cleanliness of the neighbourhood, the findings indicate that 40% of respondents thought that their neighbourhood was good or very good, with the proportion being more than two times higher in Medina/Patte d'Oie (52%) than in Keur Massar/Malika (24%) or Djiddah Thiaroye Kao (19%). Concerning satisfaction with waste management, 80% of respondents were very satisfied or satisfied with SWM operations in their communities although the level of satisfaction was higher in Medina/Patte d'Oie (85%) than in Djiddah Thiaroye Kao (78%) or Keur Massar/Malika (59%).

3.5.5 Stakeholders Perceptions about Existing System of SWM

Findings from in-depth and key informant interviews with various stakeholders were consistent with those from the quantitative survey. In particular, most stakeholders were of the view that the existing SWM in Dakar was poor and ineffective, ranging from storage, collection, transportation, to disposal. To address these challenges, respondents suggested that the municipalities should provide households with appropriate waste bins and bags to store their waste. This will to a large extent facilitate waste collection and consequently reduce the spread of waste in the streets.

Another issue raised by stakeholders was about the working conditions, including wages and equipment used by waste handlers. Most SWM workers were poorly paid and were not adequately equipped to work well in the sector. Workers did not have basic supplies such as gloves, helmets, or safety boots, thereby exposing themselves to health hazards. Financial constraints were also reported as impediments to proper SWM in the city, largely due to lack of financial capacity on the part of the municipalities to handle SWM.

3.5.6 Challenges and Expectations Regarding SWM

The most important challenge regarding SWM in the study communities was inefficient collection of solid waste (Table 9). A little over half of the respondents (52%) also felt that education/communication activities should be undertaken to ensure effective SWM in the city. Low control of illegal dumpsites and the absence of initiatives to sort waste were other challenges identified by 30% and 27% of households, respectively. However, the magnitude of these challenges varied across sites. The three main waste-related problems in Keur Massar/Malika and Djiddah Thiaroye Kao were ineffective and inefficient collection, illegal dumpsites, and lack of public education/communication on SWM. In contrast, the three most important waste-related problems in Medina/Patte d'Oie were ineffective waste collection, lack of public education/communication, and lack of solid waste sorting. The variations suggest that challenges with SWM were similar in settings where public sector services were less effective.

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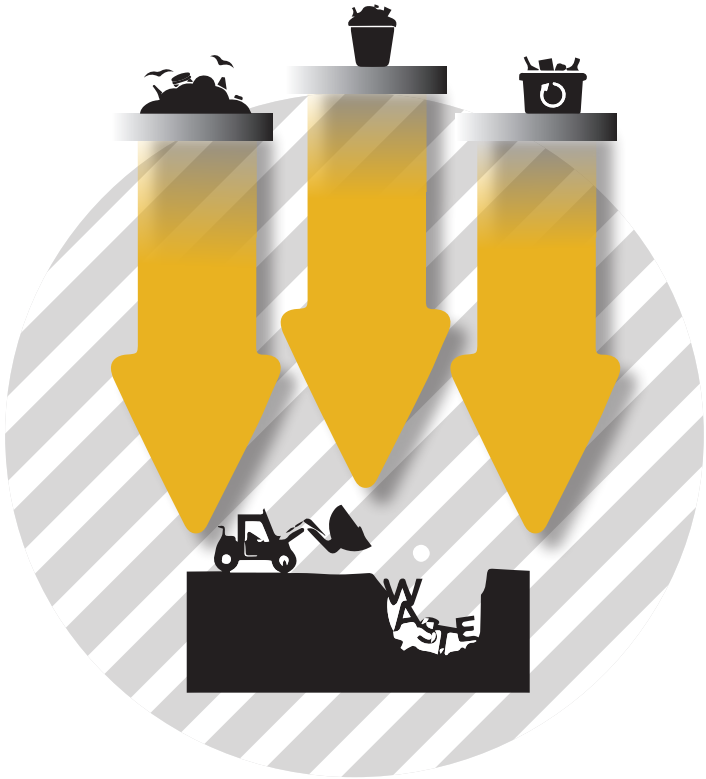
Chapter 4



HEALTH AND ENVIRONMENTAL RISKS RELATED TO POOR SWM

Zacharie Tsala Dimbuene Dickson Amugsi

4.0 Background

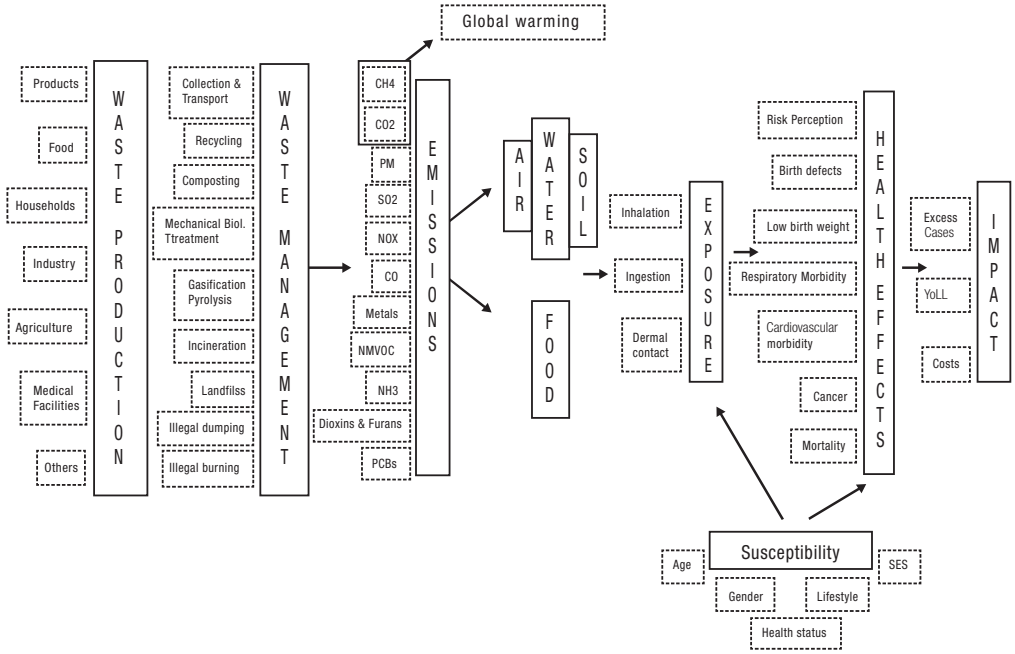
Rapid urbanization in SSA cities has brought many disadvantages due to lack of proper planning, including the growth of slums, and more importantly, land, air, and water pollution resulting from poor solid waste management (Giusti, 2009). Poor SWM can result in serious health hazards and the spread of infectious diseases (Ranzi et al., 2014; Rushton, 2003; Sankoh et al., 2013). When improperly managed, waste lying in the streets, sewage, landfills and dumpsites attract flies, rats, and other vectors which, in turn, spread infectious diseases[4] (Sankoh et al., 2013). Wet waste decomposes and releases bad odours, leading to unhygienic conditions which are linked to health problems. Plastic waste[5] is another cause for ill health, especially in SSA cities where uncontrolled plastic bags have been transformed into flags that welcome visitors and tourists into the cities. A review of waste management practices showed that activities such as landfilling, incineration, sewage treatment and composting, and radioactive waste management affect the health of people exposed to waste directly, for instance, workers in waste management and waste-pickers or indirectly to residents living in proximity to landfills and dumpsites (Giusti, 2009).

Figure 4 presents the full waste chain approach from production to health effects. Previous research has identified many health effects resulting from poor waste management. These include birth defects and low birth weight (Porta et al., 2009), respiratory diseases (Roberts & Chen, 2006), cardiovascular diseases (de Hartog et al., 2003; C. A. Pope et al., 2004), cancer (Dockery et al., 1993; I. C. Pope et al., 2002), morbidity and mortality (Mataloni et al., 2016; Pirastu et al., 2013; C. A. Pope et al., 2004; Rushton, 2003; Vigotti et al., 2014). However, there is debate about the robustness of previous findings regarding the relationships between waste management processes and health effects. Studies showed that the quality of evidence used to establish the relationships between a specific waste management process and health effects is still inadequate or insufficient (Porta et al., 2009). More research is therefore needed to improve our understanding of the associations between waste management processes and health effects. This chapter examines knowledge and perceptions of health and environment-related consequences of poor waste management at individual, household and societal levels.

[4] Certain chemicals (e.g., cyanides, mercury, and polychlorinated biphenyls) are highly toxic and being exposed to them can lead to disease or death. Studies have detected high rates of cancer in people exposed to hazardous wastes.

[5] Unhygienic use and disposal of plastics and its effects on human health has become a matter of concern. Coloured plastics are harmful as their pigment contains heavy metals that are highly toxic. Some of the harmful metals found in plastics are copper, lead, chromium, cobalt, selenium, and cadmium.

Figure 4: The full waste chain approach - from production to health effects



Source: Forastiere et al., 2011

4.1 Exposure, Knowledge and Perceptions of Risks Associated with Poor SWM

Knowledge and perceptions of risks are important for adoption of preventive and protective behaviours.

4.1.1 Exposure, Knowledge and Perceptions of Risks at Household Level

Respondents were asked to rate their households' health risks associated with solid waste management. Only 3.3% of households felt that they were at high or very high risk of poor health outcomes resulting from solid waste (Table 10). However, the proportion of households reporting elevated risks of poor health outcomes associated with solid waste was higher in Keur Massar/Malika (21%) than in Djiddah Thiaroye Kao (2%) or Medina/Patte d'Oie (1%).

Table 10: Health issues at household level related to poor SWM

Indicator	Keur Massar/ Malika	Djiddah Thiaroye Kao	Medina/Patte d'Oie	Total
Perceived household exposure to health risks associated with solid waste				
No risk at all	34.1	48.9	71.7	61.8
Little risk	25.0	29.0	23.3	25.0
Moderate risk	20.0	20.5	3.6	9.9
High risk	14.9	1.4	0.4	2.1
Very high risk	6.1	0.2	0.9	1.2
Forms of health risks associated with poor SWM*				
Unpleasant smell	79.5	23.1	19.5	26.5
Smoke from dumpsite	84.9	13.3	4.6	15.0
Contamination of water used in house	27.8	5.5	0.8	4.8
Skin/eye problems	28.9	15.3	0.4	7.3
Contamination of food in house	17.4	1.9	0.8	2.8
Kids playing with garbage	47.9	23.8	6.9	15.6
Other	0.0	0.0	0.3	0.2
Number of households	**382**	**387**	**400**	**1169**

**Multiple responses*

Respondents were further asked about indications or signs of exposure to health risks associated with poor SWM. The most commonly mentioned forms of health risks related to poor SWM included unpleasant smell (27%), children playing with garbage (16%), and smoke from the dumpsite (15%; Table 10). Variations across sites showed that proximity to a dumpsite was associated with higher likelihood of reporting health risks. For instance, the proportion of households reporting exposure to smoke was more than six times higher in Keur Massar/Malika (85%) than in Djiddah Thiaroye Kao (13%) or Medina/Patte d'Oie (5%). Similar patterns occurred for the proportion of households mentioning unpleasant smell, children playing with garbage, skin/eye problems, and contamination of water used in the household.

4.1.2 Experiences of Health Problems

Poor SWM has health implications for individuals. Table 11 presents the health problems individuals experienced in the past 12 months preceding the survey. The findings showed that a higher proportion of respondents in Keur Massar/Malika (5%) than those in Djiddah Thiaroye Kao (0.6%) and Medina/Patte d'Oie (0.1%) experienced health problems in the 12 months preceding data collection.

Majority of those who reported experiencing health problems in the past 12 months suffered mostly from asthma (30%), skin problems (25%), chest problems (23%), and allergies (11%). There were variations in health problems across sites. In Keur Massar/Malika, most of the reported health problems included asthma (42%), chest problems (29%), allergies (15%), and skin problems (8%). In Djiddah Thiaroye Kao, skin problems (87%) and cholera/diarrhoea (14%) were the most common health problems while in Medina/Patte d'Oie, only two respondents reported experiencing cholera/diarrhoea or chest problems.

4.1.3 Sources of Information on Health Issues and Care-Seeking Behaviours

Respondents were asked about the source of information on health problems. Most (88%) obtained information from health facilities, with variations from 88% in Keur Massar/Malika to 95% in Djiddah Thiaroye Kao (Table 11). With regard to care-seeking for health problems, most (86%) sought medical care although the proportions varied from 54% in Medina/Patte d'Oie to 100% in Djiddah Thiaroye Kao.

Table 11: Experiences of health problems related to poor SWM

	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Individuals experiencing health problems related to poor SWM in the past 12 months (% Yes)	5.1	0.6	0.1	1.0
N	**2,827**	**3,007**	**2,023**	**7,857**
Types of health issues experienced by household members*				
Cholera/diarrhoea	2.1	13.5	-	7.0
Chest problems	28.9	0.0	-	23.2
Allergies	15.1	0.0	-	11.0
Skin problems	8.1	86.5	-	25.2
Asthma	41.5	0.0	-	30.4
Blood disorders	1.5	0.0	-	1.1
Other	2.8	0.0	-	2.1
N	**158**	**11**	**-**	**169**
Source of information on the health issue*				
Health facility	87.8	94.7	-	87.9
Pharmacy	4.1	5.3	-	4.2
Neighbour	4.9	0.0	-	3.6
Other	3.1	0.0	-	4.3
N	**158**	**11**	**-**	**169**

Table 11 (Continued)

	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie **	Total
Actions taken to address the health problem *				
Sought medical care	84.1	100.0	-	86.3
Bought medicine	8.4	0.0	-	8.2
Went to traditional healers	4.3	0.0	-	3.2
Nothing done	3.1	0.0	-	2.3
N	**158**	**11**	**-**	**169**

**Multiple responses*

*** The results for Medina/ Patte d'Oie not reported due to few respondents*

4.1.4 Community Knowledge & Perceptions of Risks Associated with Poor SWM

This section draws on two focus group discussions (FGD) conducted among women and youth living close to the Mbeubeus dumpsite in Dakar. The discussions focused on three themes, namely knowledge and perceptions regarding SWM; potential effects of poor SWM; and the challenges of proper waste management system within the communities.

4.1.4.1. Knowledge and perceptions about solid waste management

Participants in FGDs were asked about SWM in their neighbourhood. Specifically, they were asked to describe the process of SWM chain from households to the dumpsite, including waste collection, the consequences of poor SWM, and responsibilities of households and municipalities in the process. Participants felt that the SWM system in the neighbourhoods and households was very poor. As one participant noted:

> *"Households and solid waste are cohabiting. Within households, bins and trashes are not appropriate, exposing people to bad smell and smoke arising from the dumpsite."* ***(Female participant)***

Participants further reported that people in the neighbourhood used abandoned plots to dump their waste. Another issue impeding SWM in this area was the width of the streets. First, the area is not well served by the municipality waste collection trucks because it is close to the dumpsite. Second, participants stated that streets were narrow and it was almost impossible for trucks to access the area to collect waste.

4.1.4.2. Potential effects of poor solid waste management

Participants were fully aware of the health impacts of SWM; however, they also reported that the dumpsite was a source of income-generating activities. The dumpsite generated jobs and people worked there to earn a living. The idea of relocating the dumpsite was not therefore favoured by participants because many households relied on it for their survival. Despite the economic importance of the dumpsite, people living close to it recognized that it brings a lot of health problems. However, the sentiments of one youth -- "we have no choice" -- seems to suggest that communities living close to the dumpsite had no alternative but to live with it in spite of the dangers associated with exposure to solid waste.

Participants mentioned that poor SWM in the dumpsite was associated with air pollution due to smoke resulting from burning of waste in the dumpsite. This is what one female participant had to say:

> *"When the big smoke starts in the dumpsite I am obliged to go out of my house because I am asthmatic and I cannot stand being in the house with this smoke."* ***(Female participant)***

Another social issue brought about by the dumpsite was school dropouts. Participants reported that the dumpsite was responsible for the high rate of school dropouts in the neighbourhood. Due to income-generating activities at the dumpsite, "a necessary evil," according to a respondent, children and youth devote time to activities to earn money instead of going to school. Children were involved in picking and selling plastic bags, which earned them up to 5,000 FCFA (8.52USD) per day.

Participants also reported that diseases related to poor waste management at the dumpsite were frequent in the area. These included malaria, asthma, diarrhoea, cardiovascular diseases, tuberculosis, and cough. These diseases affect both children and adults. Participants further reported that poor waste management often led to flooding in the neighbourhood.

4.1.4.3. Improving solid waste management in the household

All FGD participants reported that SWM in the neighbourhood close to the Mbeubeuss dumpsite was ineffective and inefficient. They suggested some practical solutions to improve handling of waste. First, female participants suggested that households be equipped with appropriate bins to store waste to prevent disposal in the streets. Secondly, women expressed willingness to pay (WTP) an average of 1,000 FCFA per month (USD 2.00) to improve waste collection and management. Although getting this amount of money may be a challenge, women were of the opinion that their well-being was a priority. Thirdly, although it would seem appropriate to relocate the dumpsite, participants were of the view that such action should be the last resort because the dumpsite was a source of employment and income-generation for many poor households including those not living close to it.

4.1.5 Stakeholders' Knowledge and Perceptions of Risks Associated with Poor SWM

Findings from IDIs and KIIS revealed that stakeholders were generally aware of health and environmental risks such as diseases (e.g., cancer and tuberculosis), safety issues and accidents, wounds due to hazardous waste, smoke and dust associated with the dumpsite. Informants were also aware of the secondary hazards arising from poor SWM such as flooding. Participants reported that their area experienced frequent flooding and in some cases people were forced out of their homes by the floods. Although data on living conditions of people displaced by floods was not collected during the interviews, it is likely that the conditions did not meet the minimum standards to ensure their well-being, leading to diseases such as diarrhoea and other infectious diseases, which could be avoided with effective SWM in the neighbourhood.

4.2 Health and Environmental Risks Associated with Poor SWM at Community Level

Overall, 28% of respondents reported there were risks associated with poor SWM at the community level although the proportion was higher in Keur Massar/Malika (84%) than in other sites (41% in Djiddah Thiaroye Kao and 13% in Medina/Patte d'Oie; Table 12). The four most important risks identified included health risks (77%); parasites, flies, rodents and vermin (50%); dirty environment (47%); and air pollution (44%).

There were variations in knowledge and perceptions of risks faced by communities across sites. For instance, the proportion of households reporting health risks was more than two times higher in Keur Massar/Malika (93%) and Djiddah Thiaroye Kao (95%) than in Medina/Patte d'Oie (35%; Table 12). Similarly, the proportion reporting exposure to air pollution was more than two times higher in Keur Massar/Malika (72%) than in Djiddah Thiaroye Kao and Medina/Patte d'Oie (31% in each site). In contrast, the proportion reporting exposure to flooding was higher in Djiddah Thiaroye Kao (40%) than in Keur Massar/Malika (21%) and Medina/Patte d'Oie (4%).

Table 12: Health and environmental risks related to poor SWM at community level

Indicator	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Perception of risks related to poor waste management (% Yes)	84.0	41.2	12.9	27.7
N	**382**	**391**	**401**	**1,174**
Types of risks related to poor solid waste management*				
Health risks	93.3	95.2	35.3	77.1
Fire risks	4.2	14.2	0.0	7.0
Dirty environment	45.1	59.8	29.8	46.5
Flooding	21.7	40.3	4.3	24.1
Parasites/flies/rodents/vermin	42.8	58.4	45.2	49.8
Blocked sewers	4.0	2.4	47.8	16.1
Pollution of rivers/water	36.9	9.9	0.0	15.3
Air pollution	72.4	30.5	31.1	43.5
Other	0.6	0.6	0.0	0.4
N	**327**	**169**	**48**	**544**
Health problems related to poor solid waste management*				
Cholera/diarrhoea	14.6	41.5	1.0	13.4
Chest problems	53.3	16.1	0.6	10.1
Allergies	25.9	16.5	1.5	8.0
Skin problems	23.0	36.4	0.6	12.6
Asthma	43.8	7.1	0.3	6.6
Heart problems	9.7	0.2	0.0	1.0
Injuries (e.g. cuts, burns)	3.2	13.7	0.6	4.4
Blood disorders	9.1	0.2	0.0	1.0
Other	1.4	2.6	1.5	1.8
N	**382**	**392**	**402**	**1,176**
Persons in the community most exposed to poor solid waste management				
Children	80.3	58.9	35.1	46.1
Women	13.7	3.0	0.2	2.3
House helps	1.3	2.0	1.4	1.5
Other adults	2.3	0.9	0.4	0.7
Nobody	2.4	35.3	63.0	49.3
N	**382**	**392**	**402**	**1,176**

Table 12 (Continued)

Indicator	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Persons in the community most affected by poor solid waste management				
Children	80.8	46.7	19.6	33.1
Women	13.6	13.9	0.2	5.2
House helpers	0.5	4.0	1.1	1.8
Other adults	2.6	0.0	0.0	0.3
Nobody	2.4	35.5	79.1	59.6
N	**382**	**392**	**402**	**1,176**
Food crops grown in the community using water drawn next to a dumpsite (% Yes)	9.9	0.0	0.0	3.1
N	**311**	**166**	**38**	**515**
Food crops grown in the community using compost made from waste at a dumpsite (% Yes)	16.6	0.0	15.4	9.6
N	**327**	**169**	**47**	**543**
Community re-uses or buys objects/products coming from dumpsites (% Yes)	58.8	11.3	18.4	28.7
N	**327**	**166**	**39**	**532**
Types of objects or products coming from dumpsites and re-used by the community*				
Paper	30.2	22.5	0.0	24.3
Plastics /plastic bags	60.5	95.0	90.5	70.9
Glass	83.2	65.0	100.0	82.8
Electric/electronic materials	71.9	27.5	18.9	56.4
Metal (tin, iron, etc.)	65.7	67.5	66.5	66.1
Other	1.1	5.0	0.0	1.6
N	**196**	**20**	**6**	**222**
Perceptions about contamination of water used in the community				
Not contaminated at all	44.0	47.8	71.5	53.7
A bit contaminated	11.8	36.2	21.7	24.2
Somewhat contaminated	19.8	13.6	1.3	11.9
Very contaminated	10.9	1.8	0.0	4.1
Unsure/don't Know	13.5	0.6	5.5	6.1
N	**327**	**158**	**48**	**533**

** Multiple responses*

With regards to health issues in the communities, the major problems included cholera/diarrhoea (13%), skin problems (13%), chest problems (10%), and allergies (8%), with variations across sites (Table 12). The proportions reporting chest problems, allergies, asthma, heart problems, and blood disorders were higher in Keur Massar/Malika than in the other sites. In contrast, the proportions reporting cholera/diarrhoea, skin problems and injuries were higher in Djiddah Thiaroye Kao than in the other sites. The proportion reporting exposure to the various health problems was very low in Medina/Patte d'Oie compared with the other sites.

4.3 Vulnerable Populations

This section examines the perceived vulnerability of the communities in relation to exposure to poor SWM. Nearly half of the participants (46%) reported that children were the most at risk/exposed when solid waste in the communities is not well managed (Table 12). The proportion was, however, higher in Keur Massar/Malika (80%) than in Djiddah Thiaroye Kao (59%) or Medina/Patte d'Oie (35%). Findings further showed that children were perceived to be the most affected by poor SWM, with the proportion being higher in Keur Massar/Malika (81%) than in Djiddah Thiaroye Kao (47%) or Medina/Patte d'Oie (20%). Majority of respondents from Medina/Patte d'Oie felt that nobody in their community was exposed to (63%) or affected by poor solid waste management (79%).

4.4 Strategies to Reduce Risks

This section examines the strategies communities put in place to mitigate the risks associated with poor SWM. Results indicated that 71% of respondents were of the opinion that communities are in a position to address the risks associated with poor SWM (Table 13). The proportion reporting community readiness was, however, higher in Djiddah Thiaroye Kao (80%) than in Medina/Patte d'Oie (71%) and Keur Massar/Malika (47%). Regarding specific actions taken by communities, 68% of respondents mentioned organizing clean-ups to ensure that the neighbourhoods reduce health risks. However, participation in regular clean-ups was reported by a higher proportion of households in Djiddah Thiaroye Kao (83%) than those in Medina/Patte d'Oie (68%) and Keur Massar/Malika (29%). Communities also sent petitions to local representatives (reported by 14% of households) to request them to initiate rules and regulations to improve SWM in the areas although this was more common in Medina/Patte d'Oie (reported by 18% of households) than in Keur Massar/Malika (10% of households) or Djiddah Thiaroye Kao (7% of households). Another action taken to address health risks related to poor SWM was organizing public health education sessions (reported by 12% of households) to increase awareness about health risks associated with poor SWM although this was reported by a higher proportion of households in Djiddah Thiaroye Kao (17%) than in Medina/Patte d'Oie (10%) and Keur Massar/Malika (9%). Overall, 79% of respondents felt that

these strategies were sufficient to adequately address the health risks associated with poor SWM, with variations across sites (more than two times higher in Djiddah Thiaroye Kao and Medina/Patte d'Oie than in Keur Massar/Malika; Table 13).

Table 13: Community actions to address poor SWM

	Keur Massar / Malika	Djiddah Thiaroye Kao	Medina / Patte d'Oie	Total
Community is able to address risks posed by poor solid waste management (% Yes)	46.8	80.1	71.4	71.2
N	**382**	**392**	**402**	**1176**
Actions taken within the community to address health risks related to poor SWM*				
Public health education /increase awareness	9.0	17.4	9.9	11.8
Organize regular clean-ups	29.4	82.5	67.8	67.9
Petitioned the local representatives	9.6	7.2	17.6	14.0
Nothing done	59.0	8.8	14.5	17.4
Other	0.0	0.0	0.6	0.4
N	**382**	**393**	**402**	**1177**
Actions taken by the community are adequate to address risks related to poor SWM (% Yes)	33.0	83.7	80.1	78.8
N	**157**	**362**	**349**	**868**
Reasons for community's inability to address risks related to SWM*				
Poverty	47.8	67.1	48.2	52.0
Lack of government support	72.6	82.8	17.2	46.3
Lack of leadership/community not well organized	55.6	27.3	72.6	58.5
Lack of land tenure /illegal occupancy	2.1	3.0	1.2	1.8
Ignorance	35.2	67.1	67.7	58.5
Other	0.8	1.0	0.0	0.4
N	**320**	**96**	**82**	**498**

**Multiple responses*

4.5 Barriers to Effective Community Actions Regarding SWM

Respondents also identified challenges undermining efficient actions and practices to address health risks associated with poor solid waste management. These challenges were at individual, household, and policy levels. At the individual level, ignorance was reported as an important factor impeding the effectiveness of community action against health risks

associated with poor SWM. Results in Table 13 indicate that 59% of respondents believed that ignorance was a key factor hampering effective community actions against health risks associated with poor SWM although the proportion varied from 35% in Keur Massar/Malika to 68% in Medina/Patte d'Oie.

At the household level, about half of respondents (52%) identified poverty as a barrier to effective community action against health risks, with the proportion being higher in Djiddah Thiaroye Kao (67%) than in Keur Massar/Malika or Medina/Patte d'Oie (48% in each site). At the policy level, lack of government support (reported by 46% of households) and lack of leadership (reported by 59% of households) were the main barriers to effective SWM. The findings suggest that effective community actions to improve SWM require shifts at the policy level.

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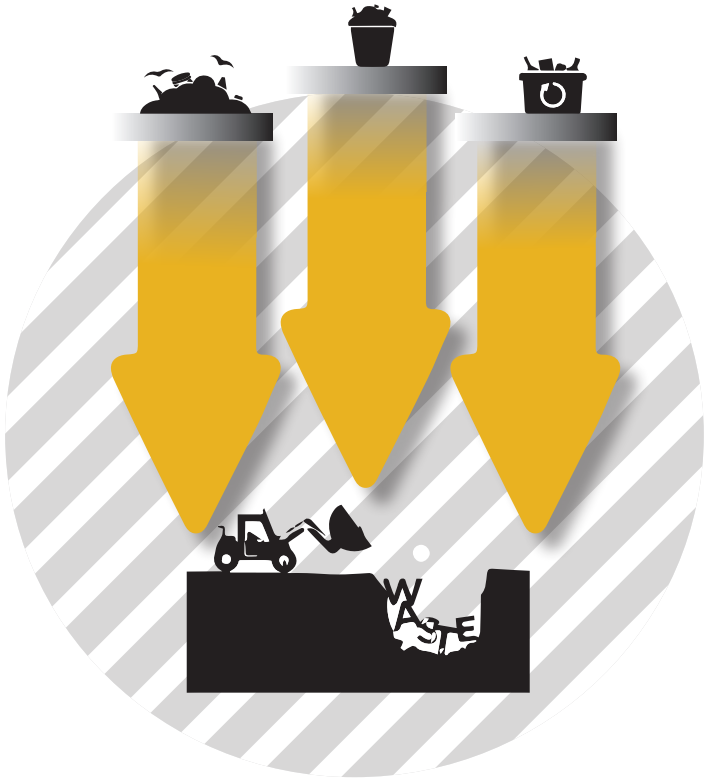
Chapter 5



COMMUNITY VOICES ON IMPROVING SOLID WASTE MANAGEMENT IN URBAN SENEGAL

Cheikh Dieng Cheikh Mbacké Faye Zacharie Tsala Dimbuene Dickson Amugsi

Background

Information was obtained from various stakeholders at different levels of engagement and decision-making, including officials from the national government (e.g. Waste-Management and Coordination Unit--UCG), municipal authorities, dealers responsible for the transportation of solid waste, waste-pickers and people residing close to the Mbeubeuss dumpsite. This chapter summarizes stakeholders' views and opinions (referred to as "voices of stakeholders") regarding SWM, with emphasis on potential strategies for an effective and efficient system of SWM in Dakar. It specifically focuses on opinions and views about storage and processing of waste within households, collection and transportation, processing at dumpsites, health and environmental issues, and management and financing.

5.1 Storage

As mentioned in Chapter 3, storage is an important step in the overall chain for effective and efficient SWM. Best waste storage practices start at the household level. Chapter Three showed that storage practices within the households are deficient. Stakeholders at all levels of responsibilities and engagement blamed households for "lack of discipline", which leads to uncontrolled dumpsites in the city. Likewise, SWM workers hold women responsible for the chaos in the sector. The workers feel that women should wait until the trucks come to collect waste instead of disposing of garbage in the streets, which makes their work difficult as they spend a lot of time gathering the scattered waste.

5.2 Collection and Transport

Besides storage, collection and transportation of waste are equally important in the management chain. Stakeholders interviewed pointed out that lack of access to many neighbourhoods was a key barrier to an effective SWM system. This was occasioned by narrow streets which waste collection trucks could not access easily thereby necessitating the use of carts to collect waste. However, cart handlers were viewed by some stakeholders as being responsible for uncontrolled dumpsites within the neighbourhoods. A potential solution to the problem would be to synchronize the schedules of trucks and carts whenever possible. Cart handlers who missed truck schedules resorted to illegal dumping of waste within the neighbourhoods. Another solution suggested by municipal authorities was the undertaking of frequent clearing of uncontrolled dumpsites in the neighbourhoods, but more importantly, the *"enforcement of laws and regulations"*. As an official from the municipal authority pointed out, *"If the code of environment and code of hygiene are enforced, there will be no issues."* Participants suggested that police officers could sometimes be used to enforce laws to ensure compliance with proper waste disposal. Officials from UCG recognized the contribution of cart handlers towards collection of waste in inaccessible areas. However,

they pointed out that the work of cart handlers should be made an integral part of the SWM system through dialogue and consultations. According to one participant:

> *"Government should recognize the work of cart handlers to improve waste collection in the city. Indeed, should the government recognize their work, they will be able to transport the waste collected to the dumpsite therefore leaving the entire city clean."* ***(UCG official, male)***

According to some suburb officials, houses abandoned because of flooding encouraged illegal dumping as people who do not receive regular waste collection services dump their waste there unseen by the authorities.

Stakeholders generally suggested sensitization and environmental education as key to proper SWM systems in the city. They also suggested greater responsibilities to municipalities and the city residents regarding SWM. Officials from municipalities felt that they were in a better position to handle SWM in the city instead of UCG. Some stakeholders emphasized the importance of enforcing laws and regulations on solid waste disposal to prevent indiscipline among residents. Suburb officials called for restructuring of abandoned houses to improve access to the neighbourhoods.

5.3 Health and Environmental Issues

Findings in Chapters 3 and 4 showed that study participants were well aware of health and environmental risks posed by poor SWM, which include water contamination, smoke from the dumpsites and its consequences on health. UCG officials revealed that as a precautionary measure, all SWM workers have been systematically vaccinated against tuberculosis although truck drivers did not benefit from this prevention strategy. One UCG official noted that *"All environmental issues are in Mbeubeus!"* Almost all stakeholders alluded to the health and environmental risks associated with the Mbeubeus dumpsite. There was, however, divided opinion regarding whether the dumpsite should be closed:

- Health professionals advocated an immediate closure of the dumpsite;
- UCG officials suggested an alternative site acceptable to local populations;
- SWM workers wanted dumpsites closer to Dakar;
- Residents of Mbeubeus were concerned about the economic benefits the site generates although they felt that burning of waste should stop to avoid air pollution.

Some UCG officials felt that the operations at Mbeubeus should continue for the time being, with some improvements including promoting recycling and valorisation of waste. Hazardous waste is another form of threat from the dumpsite that mostly affects children. Stakeholders were of the view that children should be banned from the dumpsite; however, the management team at the dumpsite lacks the capacity to enforce such a regulation because the dumpsite is not fenced and, secondly, they noted that the income generating activities

that children undertake at the dumpsite mitigate poverty in their households. Sensitization campaigns for parents and those responsible for Daaras (Koranic schools) are planned to address this problem.

SWM workers were also aware of risks associated with their frequent exposure to toxic waste, including wounds from sharp objects. One waste collector had this to say:

"Our faces become dark, and we don't know what this is exactly; we know it's a sign of chemicals." ***(Waste collector)***

Another waste collector emphasized the same point:

"There are always wounds on our hands, feet and knees. Sometimes we lift heavy garbage, especially bins in metal." ***(Waste collector)***

The workers were aware of safety equipment required to protect their health; however, most of them acknowledged that they do not wear appropriate equipment. This is what one waste worker had to say:

"This equipment hampers my work; even though I wear gloves, I can't stay [with them] for thirty minutes; I take them off and put them in my pocket. This is just a matter of habit which I admit is not a good habit." ***(Waste collector)***

Other SWM workers reported that the available equipment was not enough and was not replenished regularly.

SWM workers formed a health association funded largely by members' contributions, with a small share from the employer. Truck drivers were enrolled in another health association for transportation of workers. However, SWM workers wanted more regular medical check-ups to ensure that they are in good health:

"The Director promised medical check-ups and we are delighted because this will allow us to know if the personnel are in good health or we are just dead living people working in SWM sector." ***(Waste worker)***

From a social perspective, SWM workers suffer from stigmatisation due to the nature of their work:

"It's a kind of humiliation because people think they are superior when they see you working on SWM." ***(Waste worker)***

SWM workers complained about compensation: "I heard that the budget is about a billion; however, it benefits dealers and not SWM workers collecting waste; we have almost nothing and we are living with God's grace." ***(Waste worker)***

The SWM workers also requested that those people who insult or stigmatize their profession should be prosecuted in the law courts to serve as deterrent to others.

5.4 Management and Financing

The stakeholders interviewed expressed concern regarding the lack of sustainability in funding of SWM. UCG officials pointed to the lack of recovery mechanisms from TEOM whose contribution was marginal; they suggested that the government should put in more efforts in tax collection in the SWM sector. There is on-going discussion on how to improve taxation in the sector, including a more rigorous enforcement of the *"polluter-pays"* principle. Stakeholders revealed that for more than a decade, the contribution of the government to the sector stagnated, and SWM workers felt that this was unjustifiable.

The findings revealed that due to financial constraints, municipalities were unable to allocate enough financial resources to the SWM sector. An official from the municipal authority expressed the condition, thus: *"We do not have a budget for SWM; the government must pay for it."* Municipality action in SWM was limited to purchasing of light equipment and supporting secondary activities such as removing sand from the streets, and organizing casual activities to clean neighbourhoods and uncontrolled dumpsites. According to stakeholders, SWM could be a major source of employment if only the work was valued in the community. However, its contribution is often neglected in all considerations about funding for the sector.

Stakeholders also reported that the government did not allocate sufficient budget to improve the SWM sector. The UCG team is therefore thinking of a project-oriented approach to build appropriate infrastructure for SWM in the city in partnership with others. Likewise, municipalities expect assistance from the government and international agencies to acquire appropriate equipment for an effective and efficient SWM system in the city.

5.5 The Way Forward on SWM

Stakeholders identified the major issues impeding proper SWM in Dakar that include a lack of clear legislation on SWM in the country, poor working conditions of SWM personnel (e.g. wages, safety, regular medical check-up, etc.), and financial constraints at municipal level. They also pointed out that dumpsites remain unsafe sites where criminal activities and rape are rampant. They suggested a number of strategies to improve the sector, including:

- Municipalities should take greater responsibilities as a prerequisite to significantly improve SWM in the city. This includes legislation mandating the central government to make substantial resources available to municipalities to tackle the solid waste menace.
- Concerted efforts to improve waste storage within the households, and to encourage people to sort waste before disposal and recycling as a waste reduction strategy.
- Improvement in the working conditions of SWM personnel including, but not limited to, enforcement of safety regulations, regular medical check-ups, and decent wages;
- Fostering dialogue and communication among various stakeholders in order to mitigate the ineffectiveness of SWM in the city.

Recommendations for Future Actions

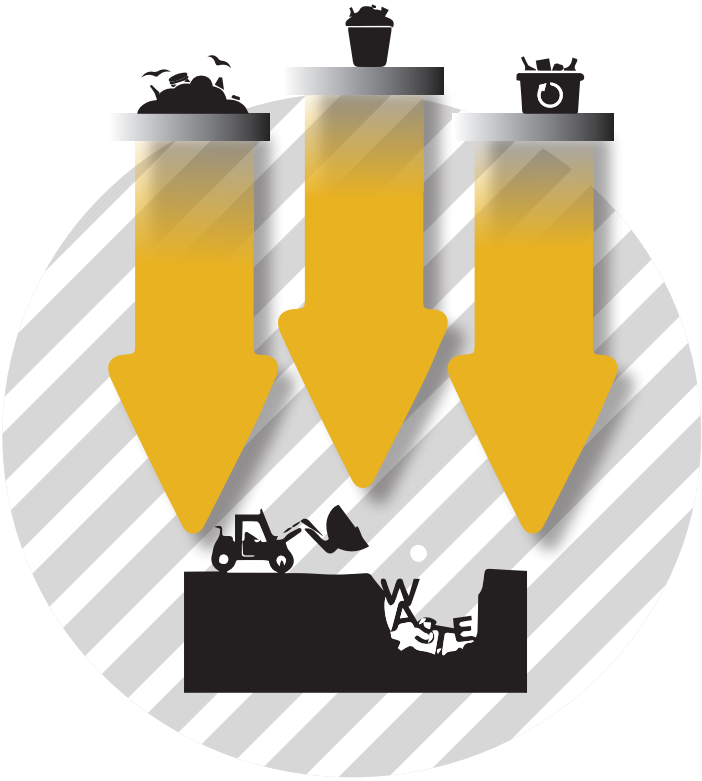
The following are some actions to improve SWM in Dakar. At individual and household levels, lack of knowledge on health risks associated with poor SWM was an impediment to effective community actions. There is therefore a need for sensitization of the communities to promote effective SWM, starting from households' waste collection points by municipal authorities in collaboration with the national government. Municipal authorities should also provide households with closed containers for storing waste for scheduled collection. Further, sensitization on recycling and composting should be carried out to reduce the volumes of waste to be collected and disposed of. In addition, more actions should be taken at local and government levels.

The findings revealed that lack of leadership and government support are big barriers to effective SWM in the city. This is evident from fuzzy legislation regarding SWM since the 1970s. In the short-run, the government should enforce laws and regulations about SWM in the city and the country. In the long-run, findings indicate that accessing the streets to collect waste is a big challenge. Municipalities and the national government should therefore work together to widen the streets to make them accessible to trucks in order to improve waste collection in the city. Stakeholders also mentioned lack of financial resources as a barrier to effective SWM in the city. SWM is financially demanding, and unless the local and national government allocate enough financial resources for equipment and personnel, the challenges will continue to grow.

CONCLUSION

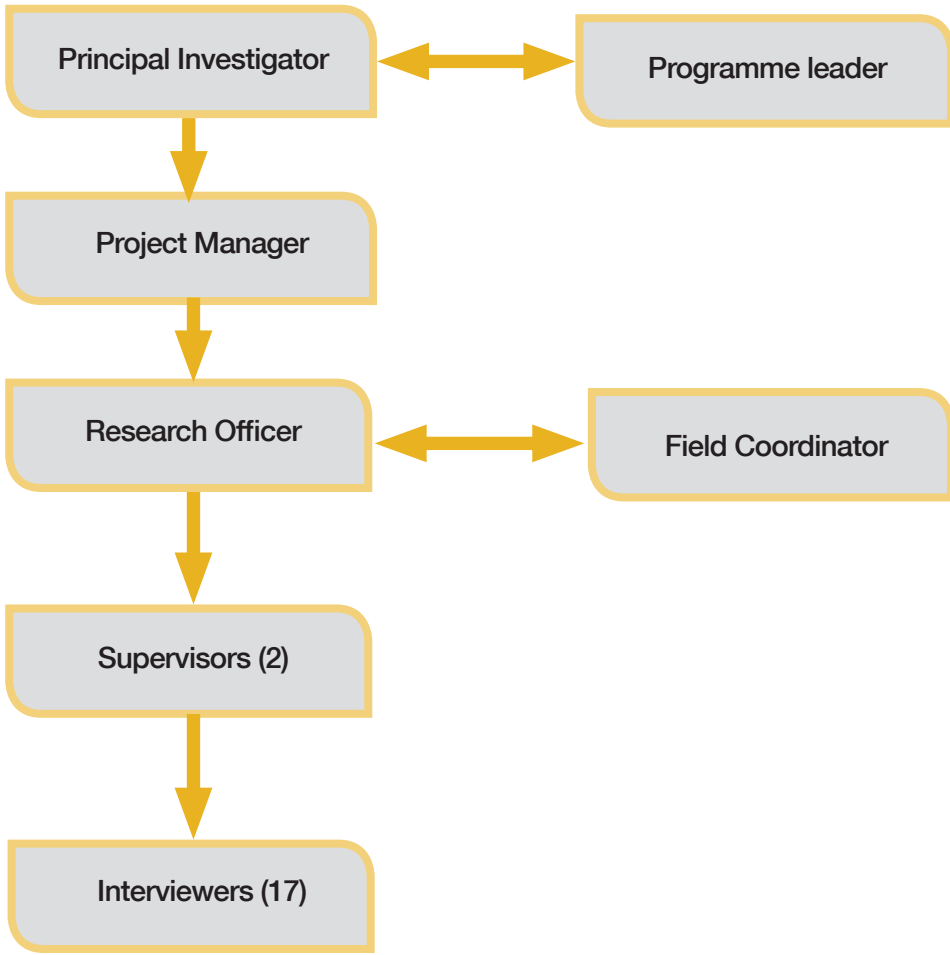
This report presents findings from a study that examined solid waste management (SWM) in Dakar, the capital city of Senegal. The results showed that SWM problems in the city start at the level of households and the neighbourhoods. Households do not have appropriate containers to store their waste collection. They therefore simply dump waste in the streets, yards, abandoned houses or uncontrolled dumpsites.

The findings revealed challenges at the government and policy level. First, laws and regulations on SWM did not evolve in a manner that ensures a clear delineation of responsibilities between the national government and municipalities. Municipalities simply claim that they do not have sufficient funds to ensure a sustainable SWM system in their areas of jurisdiction and that the government should pay for SWM. Over time, responsibilities for SWM have shifted between public and private stakeholders without clear roles for each sector. Second, laws and regulations have never been sufficiently enforced to reduce the indiscriminate disposal of solid waste by households. Yet, poor SWM is associated with numerous negative consequences for humans and the environment. To improve SWM in the country, the two levels of government (municipalities and national government) should put in place incentives to promote sorting, recycling, and composting — these strategies have been proven to be effective in developed countries. In addition, the government should improve the working conditions of SWM personnel who are, in most cases, stigmatized due to the nature of their work. Members of the public should be sensitized about the importance of keeping the environment clean and safe. Ultimately, improved SWM will lead to a reduction in infectious diseases (e.g. diarrhoea, typhoid, malaria) and chronic diseases (such as asthma) in addition to promoting the well-being of vulnerable populations (women and children).



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

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	1	→ 3.11
		Somewhat unwilling	2	
		Willing	3	
		Very willing	4	
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	1	
		No	2	→ 3.12
		Don't Know	8	→ 3.12
3.11	Where does your household **mostly** dispose garbage? /What other avenue does your household **mostly** resort to?	Garbage dump	01	
		In the river	02	
		On the road/rail	03	
		In drainage/trench	04	
		In private pits	05	
		In public pits	06	
		Vacant/abandoned house/plot	08	
		Burning	09	
		No designated place/all over	10	
		Other _____ (Specify)	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.	1 / 2	
		Use long life shopping baskets	1 / 2	
		Compost organic waste	1 / 2	
		Other _____ (Specify)		
		No measure taken	1 / 2	
3.13	How do you **mainly** dispose of toxic substances such as radio/torch batteries, paint and chemicals?	Together with other trash	01	
		Throw into pit latrines	02	
		Dump in the river	03	
		Throw on road/rail	04	
		Other _____ (Specify)	06	
		Don't Know	98	
3.14	How do you **mainly** dispose of electronic equipment such as broken mobile phones, radios, computers?	Together with other trash	01	
		Throw into pit latrines	02	
		Dump in the river	03	
		Throw on road/rail	04	
		Sell to scavengers	05	
		Give away	06	
		Other _____ (Specify)	96	
		Don't Know	98	
3.15	Does your household routinely burn some of the household waste?	Yes	1	
		No	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	1 / 2	
		Disposing toxic waste e.g. chemicals	1 / 2	
		Illegal dumping of trash	1 / 2	
		Littering the community	1 / 2	
		People dumping trash in others' plots	1 / 2	
		Consuming food grown near dump	1 / 2	
		Other _____ (Specify)	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
3.24	Which particular waste do you take for recycling?		Yes	No	
		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	
			Yes	No	
4.7	In what way do you think your household is exposed to these risks?	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)**				☐☐☐☐

African Population and
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