



University of Nairobi

School of Engineering

DEPARTMENT OF GEOSPATIAL ENGINEERING AND SPACE TECHNOLOGY

Mapping the Physical Constraints to Food Safety in Nairobi's Informal Settlements: Case Study of Mathare

BY

Wafula Simiyu Edwin

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Declaration

I, Wafula Simiyu Edwin, hereby declare that this project is my original work. To the best of my knowledge, the work presented here has not been presented for a degree in any other Institution of Higher Learning.

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Name of student

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Date

This project has been submitted for examination with my approval as university supervisor.

.....
Name of supervisor

.....
Date

Abstract

Street vendors are the major providers of food in low-income urban settlements; unfortunately they are often seen as a problem. Their stalls increase congestion in the very limited public spaces of the settlements, often causing obstructions; and inadequate food safety measures, including poor storage facilities and contamination from nearby solid waste disposal points and open sewers, associates them to poor health. Recognising the important role of street vendors and supporting them to improve the safety and quality of their products is a major opportunity for advancing urban food safety.

This project set out to review the food safety situation in Mathare Informal Settlement, identify the physical constraints to food safety within the settlement, develop a spatial database of these physical constraints and apply the spatial database to understand the physical constraints to food safety in the settlement. The work sampled four of the thirteen villages in Mathare Informal Settlement. The project started by reflection sessions at the community level where the food vendors were able to discuss their understanding of the physical constraints and food safety within their settlement spaces. This was then followed by a mental mapping exercise to identify where and why the four villages were selected for data collection. This then led to the development of the data collection tools which included the mapping tools and the Focus Group Discussion questionnaire. The tools then had to be piloted in one of the villages in order to refine them before the actual data collection for the rest of the villages was conducted. The resultant data was then analysed and taken back to the community for verification.

The major physical constraints within the settlement have been found out to be environmental, infrastructure and space whereas the safety issues include contamination, storage, security and food handling. The study found out that there is a very strong correlation between the physical constraints and the food safety in this settlement. For instance lack of space has affected the way food vendors store their food. The study has been useful in advising both the community and the policy makers on how to improve food safety situation in Nairobi's Informal Settlements.

Dedication

This project is dedicated to my family, the Shiners family, Muungano Support Trust and the food vendors within Mathare Informal Settlement.

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Table of Contents

Declaration.....	i
Abstract.....	ii
Acknowledgement	iv
Table of Contents.....	v
List of Figures.....	viii
List of Tables	ix
List of Abbreviations	x
CHAPTER 1: INTRODUCTION.....	1
1.1 Background	1
1.2 Problem Statement	3
1.3 Objectives.....	4
1.3.1 Main Objective.....	4
1.3.2 Specific Objectives	4
1.4 Justification for the Study	4
1.5 Scope of work.....	5
1.6 Organization of the report	6
CHAPTER 2: LITERATURE REVIEW	7
1.1 Introduction	7
2.1 The Concept of Food Security	10
2.2 Food security components.....	15
2.3 Role of regional infrastructure in the Food Supply Chain	17
2.4 Risk-Coping and Risk-Management	20
2.5 Systems-level analysis.....	21
CHAPTER 3: MATERIALS AND METHODS	24
3.1 About the study area.....	24
3.2 Data sources and tools.....	26

3.2.1	Data sources	26
3.2.2	Data tools	30
3.3	Sampling.....	31
3.4	Data collection.....	33
3.4.1	Overview of the data collection	34
3.4.2	Preparation of the data collection tools.....	36
3.4.3	Mapping process	38
3.4.4	Focus Group Discussions.....	40
3.5	Data processing	41
3.6	Validation of the results	42
CHAPTER 4: RESULTS AND DISCUSSIONS		43
4.0	Introduction	43
4.1	Food vending related activities	43
4.2	Spatial distribution of the food vendors	45
4.3	Physical constraints to food safety	47
4.4	Food safety findings.....	51
4.4.1	Food contamination	51
4.4.2	Hygiene of vending surroundings.....	53
4.4.3	Relationship between food vending and infrastructure	56
4.4.4	Food vendors association.....	58
4.5	Food safety map	59
4.6	Discussion of the results.....	60
4.6.1	Opportunities available for improving food safety in Mathare	62
CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS		64
5.0	Introduction	64

5.1	Summary	64
5.2	Conclusions	65
5.3	Recommendations	66
	REFERENCES	68
	APPENDICES	73
	Appendix A: Focus Group Discussion questions.....	73
	Appendix B: Excerpts from the project website data downloaded in csv file format.....	74

List of Figures

Figure 2.1: Food security major components	16
Figure 2.2: Influence zones of food security corridor	20
Figure 3.1: The area of study	24
Figure 3.2: Mathare land tenure map	26
Figure 3.3: Training of the data collection team	27
Figure 3.4: Training the community data team on mapping	29
Figure 3.5: Epicollect application on a Samsung Galaxy Ace mobile phone	34
Figure 3.6: Data collection strategy	35
Figure 3.7: A cognitive mental mapping exercise by residents of Mathare	36
Figure 3.8: The satellite imagery used for the study	37
Figure 3.9: The paper map used for collecting mapping data within Bondeni	39
Figure 4.1: The spatial distribution of the food vendors	45
Figure 4.2: The various food types market share	46
Figure 4.3: Mathare food types map	47
Figure 4.4: Physical constraints to food vending	48
Figure 4.5: Physical constraints to food vending in Mathare	49
Figure 4.6: The sanitation constraints in food vending	50
Figure 4.7: Food open without cover	52
Figure 4.8: Water distribution in Mathare	54
Figure 4.9: Road buffer showing food vending within a given road buffer	57
Figure 4.10: Food safety map and proximity to infrastructure	60

List of Tables

Table 3.1: Secondary data collected	29
Table 3.2: Primary data sources	30
Table 3.3: The mapping symbols used for paper mapping	40
Table 4.1: Main food categories	43
Table 4.2: Sources of raw materials	44
Table 4.3: Density distribution for the food vendor in Mathare	46

List of Abbreviations

AfDB	African Development Bank
CDR	Complex, diverse and risk-prone
CFS	Committee on world Food Security
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FIVIMS	Food Insecurity and Vulnerability Information and Mapping Systems
FVA	Food Vendors Association
GIS	Geographic Information System
GTZ	German Technical Cooperation
ICT	Information Communication Technologies
IFW	Informal Food Web
KFSS SRA	Kenya Food Security Steering Group Short Rains Assessment
MDGs	Millennium Development Goals
MZP	Mathare Zonal Plan
UN	United Nations
USDA	United States Department of Agriculture
WB	World Bank
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

1.1 Background

As a technology, GIS has greatly advanced from its initial use in the 1960s by cartographers who wanted to adopt computer techniques in map-making to the versatile toolkit it is today. The GIS toolkit available today has evolved largely by innovations created in one application of GIS being shared and built upon in subsequent applications. Thus, GIS users, by sharing their innovations and applications formally and informally, were very important to the development of the GIS tools available today. Sharing applications and innovations among users remains an important aspect of GIS both within and across disciplines and business sector (Pierce, 2007).

Food safety is a scientific discipline describing handling, preparation, and storage of food in ways that prevent foodborne illnesses. This includes a number of routines that should be followed to avoid potentially severe health hazards. The tracks within this line of thought are the safety between industry and the market and then between the market and the consumer. For the purposes of this study, in considering industry to market practices, food safety consideration includes origin of food. This therefore includes the markets where they get this food, food hygiene, food preparation e.g. use of additives and chemicals for cooking and preservation, and certification of these informal food vending web. Certification is considered within the context of those who have health certificates after inspections by health officers certifying their food handling environment meet the basic public health policies. In considering market to consumer practices, the usual thought is that food ought to be safe in the market and the concern is safe delivery and preparation of food for the consumer. Food may transit disease from person to person as well as serve as a growth medium for bacteria that can cause food poisoning. The main issue in food poisoning within this study is the availability of adequate safe and clean water. According to WHO¹, the five key principles of food hygiene are:

- a) Prevent contaminating food with pathogens spreading from people, pets, and pests.
- b) Separate raw and cooked foods to prevent contaminating the cooked foods.

¹ "Prevention of foodborne disease: Five keys to safer food". World Health Organization. Retrieved 2014-03-05.

- c) Cook foods for the appropriate length of time and at the appropriate temperature to kill pathogens.
- d) Store food at the proper temperature.
- e) Do use safe water and cooked materials.

The study therefore seeks to understand the hazards associated with the main types of food and the conditions that promotes the growth of bacteria which can cause food poisoning and related foodborne illnesses. This therefore includes understanding issues such as problems and diseases spread by pests; safe food handling which includes food storage, preparation and cooking, transport and delivery; correct cleaning measures such as use of enough water for washing of utensils, vegetables and fruits; personal hygiene, hand washing and protective clothing.

The Mathare Informal Settlement constitutes about 7 percent of the total population in Nairobi County. Ironically, these slums occupy only about 0.2 percent of the total land mass within the County. Mathare Valley is an Informal Settlement constituting 13 villages that provide home to nearly 200,000 people confronting a range of challenges (Muungano, 2013). Mathare is one of the largest slums in Nairobi; a city where over half the approximately 4 million residents live in over 180 different villages of Nairobi's informal settlements. Like many informal settlements in Nairobi, Mathare's 13 villages are characterized by unsafe and overcrowded housing, elevated exposure to environmental hazards, high prevalence of communicable diseases, and a lack of access to essential services, such as sanitation, water and electricity. Residents in Nairobi's slums frequently suffer from tenure insecurity, while widespread poverty and violence further increase their vulnerabilities. Yet residents are also well educated, are entrepreneurial and have resilience strategies that allow them to survive in one of the most difficult urban environments in Africa (Bocquier et.al., 2009).

Constraints refer to the state of being restricted or confined within prescribed bounds. Physical environment on the other hand refers to the area surrounding a person. A physical constraint in this study therefore refers to the surrounding constraining conditions under which the Mathare food vendors have to operate. They include environmental factors, infrastructure limitations, sanitation issues and competing use of public spaces.

1.2 Problem Statement

The World Food Summit 1996, defined food security as: “when all people at all times have physical and economic access to sufficient, safe, and nutritious food for a healthy and active life.” Household food security is, therefore, a combination of availability of safe food and assured possibility for households to meet their dietary needs and food preferences in socially acceptable ways. Food safety is an umbrella term that encompasses many facets of handling, preparation and storage of food to prevent illness and injury. Included under the umbrella are chemical, microphysical and microbiological aspects of food safety. A priority of food chemical quality is control of **allergens** which can be life threatening to some people that are highly sensitive. Other chemical properties of food such as vitamin and mineral content are also important and affect the overall quality of the food but are not as significant in terms of food safety. To prevent injury, the absence of foreign microphysical particles is crucial. Microphysical particles such as glass and metal can be hazardous and cause serious injury to consumers. **Pathogenic** bacteria, viruses and toxins produced by microorganisms are all possible contaminants of food and impact food safety (Hanning et.al., 2012).

Although street food vendors are the major providers of food in low-income urban settlements, they are often seen as a problem. Their stalls increase congestion in the very limited public spaces of the settlements, often causing obstructions; and inadequate food safety measures, including poor storage facilities and contamination from nearby waste dumps and open sewers, associates them to poor health. As a result, street food vendors often suffer removal or forced closure by city authorities during disease outbreaks which not only put their livelihoods at risks but also affect access to food for the poorest residents of low-income settlements, who tend to be most dependent on street vendors.

Recognising the important role of street vendors and supporting them to improve the safety and quality of their products is a major opportunity for increasing urban food safety. A first step is to understand the physical constraints within which the informal food web operates, correlate how these physical constraints dictate food safety issues for the food vendors, and integrate it in community-led infrastructure planning in the settlements.

1.3 Objectives

1.3.1 Main Objective

The main research objective is mapping the physical constraints to food safety in Mathare Informal Settlement with a view of influencing policy change in addressing food safety related issues. This involved the development of a spatial data infrastructure system that would support documentation of how the location of the activities of street vendors contributes to access to food for local residents, but can also result in inadequate food safety measures (and at times limited access to food) because of their exposure to environmental hazards, inadequate infrastructure, poor sanitation and competing uses of public spaces.

1.3.2 Specific Objectives

The specific objectives of this research include:-

- 1) To identify food safety issues in Informal Settlements
- 2) To identify physical constraints to food safety issues in Informal Settlement
- 3) To develop a spatial database of the physical constraints to food safety in Informal Settlement
- 4) To apply the spatial database to understand the physical constraints to food safety in Informal Settlement.

1.4 Justification for the Study

Food Vending and Livestock keeping is an agribusiness sector ideally suited for the application of Geographic Information Systems (GIS) because it is natural resource based and hence exposed to various physical constraints such as the accessibility to sources of raw materials; transportation requirements e.g. movement of food stuffs and livestock from one location to another; distribution channels within the settlements; and dynamics of space utilization considering the large number of competing uses for the same space. Nearly all food safety related data has some form of spatial component, and GIS allows you to visualize information that might otherwise be difficult to interpret. The value of GIS to food safety continually increases as advances in technology accelerate the need and opportunities for the acquisition,

management, and analysis of spatial data on the food and livestock activities and throughout the agriculture value chain.

The food safety situation in Mathare was examined at the settlement and village levels. Food safety indicators falls into three broad categories: demographic indicators (e.g., street rent values, operation hours, food types, and storage facilities), food supply indicators (e.g. distribution of food vendors, seasonal variations, differential exposure to risks and perception), and safety/location indicators (e.g., access to raw materials or transportation within the settlements; disease outbreaks and closeness to the environmental hazards such as open sewers, drains and dust; security issues and infrastructure). These map-based indicators were used to visualize the exposure to risk for the food vendors and food safety overall situation in Mathare valley.

The food crisis in the urban slums is more of one of access related rather than availability of food. Whereas the datasets and findings of the research is particular to the Mathare area, the results of the study can be used for policy design for other areas and can be applied elsewhere in order to address the physical constraints to food safety in Informal Settlements.

1.5 Scope of work

The project is limited to four villages of Mathare Infomal Settlement (Bondeni, Kosovo, Village 3A and Village 4B) which are strategically selected to provide a more representative picture of the entire settlement. A detailed spatial database of these villages with information on access to food and the risks associated to the exposure of street vendors to environmental hazards was then developed. This mapping was then added to the base mapping developed before by other players working in these villages, to provide a rich source of information and knowledge base to the community members and Muungano wa Wanavijiji affiliated Food Vendors Associations to use for further reflections and initiatives. Through a transformational mapping approach, the study was limited to collecting the following data:

- Community-led mapping to get insights about the competing uses of public spaces (i.e. primarily main streets and walkways that can also be shared as children's playgrounds, street vending locations, solid waste dumping sites, storage facilities and open drains) and to map related environmental risks;

- Focus Group Discussions to capture the perception of food retailers in the selected villages on food safety issues, including physical constraints that dictate their opening and closing times, and the types of food they sell; challenges associated with food vending in these public spaces, and preparation facilities – including cooking; seasonality /time of the day that dictates sale of particular foods i.e. the dynamics of locations as the street vendors change locations of their trading places in the morning and evening, and the underlying factors that dictates/influences such dynamic use of public spaces – especially in relation to infrastructure; exposure to risk of sewage/waste overflow, flooding; Livestock keeping practices, types, quantity and location as well as how livestock keeping activities contributes to food safety/security within the settlement.

Since most of the data that is useful to the project is of the mapping and qualitative nature, the Community led mapping and Focus Group Discussion approaches were better suited for the study as compared to administering of the questionnaires to the individual food vendors. The advantage of using the Focus Group Discussion approach in this study was that participants are able to discuss and verify the details given out within the same forum. The project relies heavily on the use of Computers. The use of computer is useful in the execution of various data related tasks, such as: map design, map compilation, evaluation of spatial and non-spatial data, analysis, visualization and graphic display, and archiving. In this project, all the data and features were converted to a specific software compatible formats such as shape files for all spatial data and database for non-spatial data. Some of the software that will be used includes ArcGIS 10.0, Global mapper 13, Microsoft Excel 2013 and Microsoft Access 2013.

1.6 Organization of the report

The report is organized into five chapters. Chapter one gives the introduction to the Mathare Informal Settlement, the objectives and the scope of the study. Chapter two addresses literature review with reference to the developments in the food safety concept. Chapter three gives an overview of the study area, materials and the methodology used to come up with the results. Chapter four gives the results and analysis from the study. Finally conclusions and recommendations are presented in chapter five.

CHAPTER 2: LITERATURE REVIEW

This chapter focuses on existing literature on concepts and theories that are relevant to the issues that have been raised in the research for assessing the physical constraints to food safety. It includes the concept of food safety, theories on impact of infrastructure on food security and policy impact evaluation.

1.1 Introduction

In March 2009, Oxfam GB, Concern Worldwide and CARE International in Kenya commissioned a technical review of available data on the status of food security, livelihoods, nutrition and public health in the Nairobi's Informal Settlements. The purpose of the technical review was two-fold: 1) begin a process of consolidating key information on the Nairobi slums for assessing current status and future trends and 2) assess whether a food security emergency was currently occurring in the slums.

On beginning a process of consolidating key information on the current situation of the Nairobi slums, this was done in recognition that there is a lack of disaggregated and long term data on the food security, livelihoods, and nutrition and public health situations of residents of these informal settlements, not only in Nairobi but in Kenya as a whole. There is a need for ongoing reliable data collection and synthesis to increase the knowledge base of the current situation in urban slums and ongoing awareness of critical trends.

On assessing whether a food security emergency is occurring, it is clear that there is limited information to fully understand the current situation and the impact of recent shocks, in particular high food prices on the nutrition and health status of the urban poor. For background, on 16 January, 2009, President Kibaki formally declared Kenya's food shortage to be a national emergency, with one out of every three Kenyans (10 million) reported to be threatened by starvation. Subsequently, the Kenya Food Security Steering Group Short Rains Assessment (KFSSG SRA, 2009) stated, "... at least 4.1 million urban dwellers to be extremely food insecure and have difficulty meeting their food needs on a predictable basis."

The declaration of a national food security emergency was based on a number of critical problems. The KFSSG report noted that the combination of the poor 2008 long and short rain

seasons, reduced hectareage planted due to the post-election violence (PEV), high input costs and resulting sub-optimal application of recommended inputs, resulted in a 2008 annual maize production of 2.34 million metric tons (MTs), which was 15% below recent years' averages and around 22% below annual national consumption requirements. Exacerbating the shortfall is an expected 60% reduction in cross border imports from Tanzania and Uganda. At the same time, Kenya's national strategic reserve had fallen inappropriately low. The 2009 KFSSG report stated that the country's reserve for the staple maize was at 72,000 MTs, equivalent to slightly over one week's supply for the national annual consumption of 3 million MTs. As maize is the staple food for around 90% of the Kenyan population, and as other staple grains are equally depleted, it is no surprise that the Kenyan Government announced in early 2009 an emergency food security crisis in the country. The GoK is currently strongly committed to reducing hunger and malnutrition. This includes efforts to build self-reliance to reduce chronic food insecurity, as well as measures to assist those in need when emergencies occur. Linking relief with longer-term development efforts helps mitigate the potential impact of future emergencies.

The Government's declaration that at least 4.1 million urban dwellers are extremely food insecure was not supported by clear data. As noted above, there is limited information on the status of such key indicators as food security, livelihoods, nutrition and health in the urban slums, and especially limited information on trends. This is especially problematic for the urban poor as they typically reside in slums that are marked by extreme chronic poverty within highly dense populated areas. In such settings, it is not a simple task to differentiate extreme chronic poverty from an emerging emergency situation. So a key purpose of this technical brief was to better specify the current humanitarian situation in the urban slums of Kenya at a time of a declared national food security emergency.

The world produces enough food to feed everyone with at least 2,720 kilocalories per day, which is well above the Food and Agriculture Organization of the United Nation's (FAO's) recommended minimum of 2250 (FAO, 2003a). Ironically food insecurity remains globally widespread and stubbornly high (FAO, 2006). In 2003, the FAO estimated that there were 842 million undernourished (defined by FAO, 2003b as a situation of chronic food insecurity) people worldwide: 798 million (95 percent) in the developing world, 10 million in industrialized countries and 34 million in countries in transition. In Sub-Saharan Africa, the number of

undernourished people has been increasing: from 169 million in 1992 to 206 million in 2003, and by 2015, the FAO (2006) estimates that the region will be home to around 30 percent of the undernourished people in the developing world, compared with 20 percent in 1992.

Despite considerable efforts by national governments and the international community to reduce hunger and malnutrition in the context of the Millennium Development Goals (MDGs) and other initiatives, the proportion of undernourished people in developing countries has been largely constant since the mid-1990s (FAO, 2010). While some progress in hunger reduction had been made until 2007, the 2008 global food price crisis and subsequent food price spikes in local markets have pushed or kept millions of people in food insecurity (Brinkman et al. 2010; FAO, 2009a). The main causes of this rise in global and national food insecurity include trade restrictions imposed by major food exporters, biofuels policies, and increased food commodity speculation combined with poor national and local governance to cope with such shocks. Besides, longer-term dynamics such as climate change and mounting food demand through changing dietary patterns and growing populations have strained international food markets and are expected to lead to further rising food prices and increasing price volatility (Nelson et al., 2010; FAO, 2011).

The government policy objective on food safety is to ensure safe, high quality food by creating public awareness on relevant issues, and by setting, promoting and enforcing appropriate guidelines, standards and a regulatory framework. Various government bodies are responsible for food safety and quality, which are governed by no less than 20 legislative acts. Coordination of activities and harmonizing the regulatory and institutional framework is, therefore, essential. While food safety and quality control are national issues, concern about public health is particularly acute in urban and peri-urban areas, which require special efforts to ensure safe production, handling, storage, preparation and sale of food. Guidelines and standards, based on international standards, will be developed, revised and updated. These standards and guidelines will focus not only on food and food products but also service delivery in various sectors. The private sector will be substantial partners to further efforts to improve food product quality, regulations and safety.

2.1 The Concept of Food Security

Various institutions and organizations define food security differently without much change in the basic concepts. The roots of concern about food security can be traced back to the Universal Declaration of Human Rights which recognized that “everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food” (UN, 1948).

Food security as a concept originated in 1970’s and since then it has been a topic of considerable attention. However, the concept has become more complex due to a shift in the level of analysis from global and national to household and individual levels. In the mid-1970s food security was conceived as adequacy of food supply at global and national levels. This view focused merely on food production variables and overlooked the multiple forces that in many ways affected food access and the definitions of food security focused on aggregate food supplies at national and global levels, and analysts advocated production self-sufficiency as a strategy for nations to achieve food security. The 1974 World Food Conference defined food security as: “availability at all times of adequate world supplies of basic food-stuffs” (United Nations, 1975).

Just 12 years after the World Food Conference, the World Bank proposed a definition of food security which remains current today, that broadened the emphasis from food availability to include access to food, and narrowed the focus from the global and national to households and individuals: “access by all people at all times to enough food for an active, healthy life” (WB, 1986). Since the 1980s, it has been recognized that the achievement of food security requires paying attention to both supply-side and demand-side variables and the concept of food security attained wider attention that shifted from global and national level to household and individual levels.

(Maxwell and Frankenberger, 1992) identified many definitions for the concept of food security. However, all definitions emphasis development from macro-level to micro-level concern; from adequate level of supply towards concern to meet the demand; and from short term to a concern of long term (permanent).

Macro-level food self-sufficiency does not assure the achievement of food security at household level. According to FAO there are two levels of food insecurity, macro-level (food supply insecurity) and micro-level (food consumption insecurity) (FAO, 1996). Food supply insecurity is the national aggregate insecurity which arises when a country is unable to supply its aggregate food requirement either through domestic food production, imports or run-down of stocks and reserves. On the other hand, food consumption insecurity exists when certain individuals or groups cannot gain access to adequate food given their nominal incomes and the price and availability of food. Consumption food insecurity may exist within food supply security, i.e. certain groups of people may lack adequate food although a country may possess adequate aggregate food supplies to meet needs. Thus, national aggregate insecurity entails household food insecurity. On the other hand household insecurity can exist regardless of the status of aggregate national or regional food supply.

USDA (1995) defined food security as, “when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life”. This definition encompasses availability, access and utilization. Food availability is achieved when sufficient quantities of food are available to all individuals. Such food can be supplied through household production, other domestic output and commercial imports or food assistance programs (USDA, 1995).

Urban areas have an overall poverty incidence of 49% and chronic food insecurity of 38%. Over two-thirds of Kenya’s non-agricultural workforce, primarily in urban and peri-urban areas, is engaged in the informal sector, which is characterized by lower wages and returns than in the formal sector. Informal enterprises are constrained by high interest rates, limited access to formal credit, lack of skills, high and multiple taxation, and weak business networks. Employment in the formal sector has been constrained by a sharp drop in investment caused by infrastructure deficiencies, high interest rates, administratively burdensome and costly regulations, and a legal and judicial system which does not effectively enforce contracts. The poorest and most vulnerable urban and peri-urban dwellers may not be able to take advantage of employment and income earning opportunities. When their health and nutrition status and overall well-being is at imminent and serious risk, it may be necessary to introduce nutrition and food security monitoring and direct measures of support to ensure their food access.

The World Food Summit 1996, defines food security as: "Food security exists when all people at all times, have physical and economic access to sufficient, safe and nutritious food to meet the dietary needs and food preferences for an active, healthy life" (FAO, 1996). FAO has defined food security not in terms of access to, and availability of food, but also in terms of resource distribution to produce food and purchasing power to buy food, where it is produced.

Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS), similarly, defines food security as a state that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active life. Food insecurity, when people lack this, is seen as due to unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate utilization at household level. It is a complex phenomenon attributable to a range of temporally and spatially varying factors, such as the socio-economic and political environment, the performance of the food economy and the health and sanitation situation (FIVIMS, 2003). Besides, vulnerability is also seen to be key, referring to factors that place people at risk of becoming food insecure or reducing their ability to cope (Hussein, 2004).

The conceptual framework of food security has progressively developed and expanded along with the growing incidence of hunger, famine and malnutrition in developing countries. In the mid-1970s food security was conceived as adequacy of food supply at global and national levels. This view focused merely on food production variables and overlooked the multiple forces that in many ways affected food access. In the 1980s, the concept of food security attained wider attention that shifted from global and national level to household and individual levels.

An understanding of food security also includes the time dimension, which explicitly describes the intensity and characteristics of household's food insecurity. Food insecurity can be "chronic" or "transitory". A constant failure to "access" food is distinguished as chronic, while a temporary decline is considered as transitory food insecurity. Chronic food insecurity is a sign of poverty and shows a long-term structural deficit in food production and lack of purchasing power. Transitory food insecurity, on the other hand, implies a short-term variability in food prices, production and income (Maxwell and Smith, 1992). Transitory food insecurity is a temporal or seasonal shortage of food because of unexpected factors for only a limited period and it is often

triggered by seasonal instability in food supply or availability and fluctuation in prices and incomes (Degefa, 2002). Chronic food insecurity can translate into a higher degree of vulnerability to famine or hunger. Repeated seasonal food insecurity also depletes the assets of the households and exposes them to a higher level of vulnerability.

Food security in general is a concept that integrates a number of important issues the magnitude of which ranges from micro to macro-economics. Its attainment requires an overall consideration in terms of policy and program development in all aspects of the food system. Hence, the success in production and distribution plays an important role in influencing the food security status of an individual, a household or a society at large (Maxwell and Smith, 1992). Food security is dependent on the ability of a population to access food in quantities and qualities that satisfy the dietary needs of individuals and households throughout the year.

Moreover, food insecurity is a complex phenomenon attributable to a range of temporally and spatially varying vulnerability factors such as the socio-economic and political environment, the performance of the food economy, care practice and the health and sanitation situation (FIVIMS, 2003). These are taken as indicators and key vulnerability factors that causes hunger and that should be monitored in assessing food insecurity (CFS, 1999). These are:

Demographic conditions create vulnerability when size of population exceeds the carrying capacity of a particular area, and there is limited opportunity for out-migration or for development of physical, social and economic infrastructure so as to provide more productive alternatives to the dominant livelihood systems in the area. High share of rural population in the total may indicate the presence of this kind of vulnerability, particularly if it occurs together with a low level of economic development in rural areas. A high proportion of dependent persons within a family, community, locality or nation also increases the risk of under-nourishment for these persons.

Environmental conditions can create chronic vulnerability in several ways. People living in areas where the natural resource base is poor or deteriorating often have limited opportunities for earning their livelihood. Their situation is worsened if acts of man lead to pollution and environmental degradation. Variable climatic and geophysical conditions and biological threats create additional risk. Availability of arable land per capita usually declines with economic

development, as more and more land is dedicated to non-agricultural use, and high-technology, high-yielding agricultural practices are introduced on the remainder. However, if availability of arable land per capita is declining solely as a consequence of population growth, without compensating improvements in productivity or in the performance of the national economy, the result is likely to be increasing levels of under-nourishment.

Economic conditions can be monitored and assessed at various levels - national, sectoral, or zonal. The structure and performance of the national economy and its components can affect the food security situation of an entire nation through the performance of food markets. These are in turn affected by factors such as food prices, interest rates, inflation rates, labour market conditions, foreign exchange rates, and trade balances. Economic conditions can also create vulnerability and food insecurity if assets and incomes are distributed inequitably among the population, or if public and private sector investment is inadequate or skewed. The degree to which an economy is or is not diversified will often determine whether or not employment and income-generating opportunities exist that would provide sufficient purchasing power to meet basic food needs to all segments of the population. Also, the level of development and the dynamism of economic activities in rural areas often have a strong influence on the level of under-nourishment nationwide.

Political conditions can affect food security positively or negatively. Political structures that encourage people's participation tend to reduce vulnerability. But, the presence of civil conflict is a vulnerability factor which can restrict employment and market opportunities, and may lead to loss of assets, destruction of social and physical infrastructure, and even displacement from their homes for affected households. Armed conflict and civil strife were major sources of food insecurity in the 1990s and will continue to be this century (FAO, 2000).

Social conditions including both the state of social services and prevailing social attitudes have a very important influence on vulnerability and food insecurity. Where people have access to social infrastructure such as primary education, health care centres and extension services, serious undernourishment is less likely to be found. People's traditional attitudes influence the kinds of food they eat, the way in which available resources and food are distributed, and the kinds of hygiene, food preparation and caring practices that they most commonly follow.

Traditional knowledge offers possibilities for finding innovative solutions to local problems but traditional attitudes may also create a stumbling block in certain circumstances.

Government Policy: Whenever food shortage or famine occurred in a given country, the government is responsible for failing to prevent the crises. Some researchers claim that government policy failures or inappropriate development strategies are responsible for the recurrence of food shortage and famine or for underdevelopment in a broader context (Bird, Booth et al., 2003). For example on the cause of the 1977-1988 Ethiopian famine, Clay et al. (1998) noted the correlation between famine areas and specific government policies: in Tigray, famine prevailed in areas outside government control and under military attack; in Tigray and Wollo, famine occurred in areas of forced resettlement; in northern Bale, Hararghe and Shoa, famine occurred as a result of the government villagisation programme and local production disrupted (Downing, 1996). Research evidence indicates that inappropriate government policies have become a major barrier to increased food security and economic development in many sub-Saharan African countries (Gebremedhin, 1997). The poor farmers, who bear the greatest burden of misguided government policy measures in many African countries, have responded rationally to damaging agricultural policies by turning to private market alternatives. In the 1970s and 1980s, the failures of agricultural policies in Somalia, Ethiopia and the United Republic of Tanzania quickly became apparent in declining output and productivity and a growing inability of these countries to feed their own people (Gebremedhin, 1997).

In a nutshell food insecurity is a multi-disciplinary concept which takes into account of technical, economic, social cultural and political dimensions. Thus, the concept of food security must form part of the broader concept of food strategy, which in itself forms parts of a socio-economic development strategy and poverty reduction policies.

2.2 Food security components

Food security is multi-dimensional having interrelationships with vulnerability indicators; it cannot be captured by any single or specific indicator. It would therefore be important to understand the essential dimensions of food security – Access to food, Availability of food, and Utilization of food. The interactions and combinations of these dimensions represent food

security together. Currently Stability is also considered as the fourth component of Food security (GTZ, 2006).

Access is referred to access by individuals to adequate resources (entitlements) to acquire appropriate foods for a nutritious diet. Entitlements are defined as the set of all those commodity bundles over which a person can establish command given the legal, political, economic and social arrangements of the community in which he/she lives (including traditional rights - e.g. access to common resources). Securing access to enough food at all times for an active and healthy life is a prime objective of all modern society because of the role played by food in economy, culture, and politics. Food access is largely determined by the ability of households and individuals to obtain food from own production, purchases and other sources, such as gifts, government transfers and food aid.

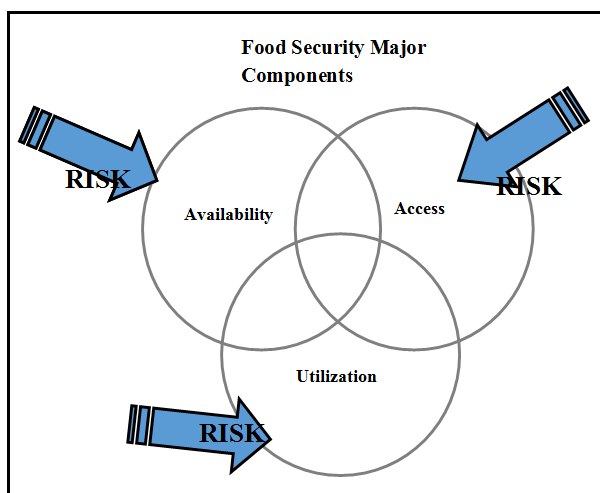


Figure 2.1: Food security major components (GTZ, 2006)

Availability refers to the availability of sufficient quantities of food of appropriate qualities, supplied through domestic production or imports (including food aid). On the supply side, cereal output is the key indicator, as cereals provide about 60% of dietary energy in developing countries. At micro or household level, availability is taken as the capacity of the households to produce the food they need.

Utilization is related to utilization of food through adequate diet, clean water, sanitation, and health care, to reach a state of nutritional well-being for which all physiological needs are met.

This brings out the importance of non-food inputs in food security. It is not enough that someone is getting what appears to be an adequate quantity of food if that person is unable to make use of the food because he or she is often falling sick. The dimension of food utilization underlines the importance of such processes, including marketing, storage, processing, cooking practices, feeding practices and nutrition to the attainment of food security.

Stability is a very important component of the food security indicator. To be food secure a population, household, or individual must have access to adequate food at all times. They should not be at risk of losing access to food as a consequence of a shock (e.g. an economic or climatic crisis), or cyclically (e.g. during a particular period of the year – seasonal food insecurity). The concept of stability can therefore refer to both the availability and access dimensions of food security.

2.3 Role of regional infrastructure in the Food Supply Chain

Infrastructure in terms of adequate energy and water/irrigation supplies, high-speed communications, and seamless transportation systems connecting areas of high production with centers of high consumption, all play a crucial role in safeguarding food security.

Because of the differing locations of activities along the food supply chain, their economic relationship is based on efficient transportation and long distance communication services. These are essential to ensure sustainable access to basic food products. Moreover, the development of regional infrastructure that can contribute to food supply and price stability will have a decisive impact on the overall level of consumption and on food security.

In Africa, agricultural resources are unequally distributed across national and sub-regional territories because of the disparate endowments and potentialities of different countries. The lack of connective infrastructure between deficit and surplus areas for the production, collection, and distribution of food products heightens food insecurity in all sub-regions. This vulnerability is accentuated by a lack of high-tech infrastructure (including refrigerated storage) for national and regional trade of food products – which are, by definition, seasonal and perishable.

Transportation infrastructures are used, in one direction, to distribute agricultural inputs to farmers to improve productivity and, in the other direction, to transport large volumes of produce

from areas of production to those of processing, storage, marketing, distribution, and consumption. For transportation to be cost-effective, it needs to be reliable and delivered at low-cost, which is problematic for a continent with challenging economic geography. Furthermore, as outlined previously, increasing urbanization and migration to cities means that more and more people are relying on rural manpower and increased agricultural productivity to meet their nutritional needs.

Throughout the food supply chain, the regional economic role of the modern infrastructures of transportation, telecommunications, and energy facilitate cheaper long distance product flows as well as enhanced commercialization and trade between complementary regions. The aim of regional trade infrastructure should be to promote cross-country synergies and exploit economies of scale by opening up larger markets, thereby lowering transaction costs.

The question then arises: Which infrastructure framework can best address the food security crisis in Africa? The establishment of food security corridors, as sketched out in Chart 8 below, would offer significant benefits to participating countries. This framework would comprise connected networks of roads, railroads, electricity, ICT (Information, Communication, Technologies), water and logistics that would serve all the locations of food supply chain activities, from agricultural producers, to factories (agro-industries), processing plants, distribution centers, through to consumers in urban centers. This would entail a sustainable process of regional integration of countries that possess comparable levels of food security and infrastructure support for their food economies.

The impact of regional infrastructure on food security depends on its nature and quality. Thus, the construction of food security corridors that accelerate and multiply communication between the poles of high consumption and production areas is one approach to promote food security. The impacts of the individual sectors of regional infrastructure development are summarized below:

- 1) Transportation: The modern infrastructure that supports regional transportation by road, rail, air, and sea can reduce transit times for products and lower procurement costs (inputs, transport and production). By opening up new markets, transportation facilitates diversification of products and expansion, thereby boosting trade and economic growth.

The impact on marketable volumes, producers' incomes, and consumers' purchasing power is reflected in economies of scale and mass consumption.

- 2) ICT: The infrastructure that supports information, communication and technology allows the establishment of freight, transit, and cross-border trade platforms and facilitates the dissemination of regional market data on perishable products for a fair comparison of supply and demand. The impact on the security of formal business operations as well as on the reliability of transactions is reflected in the setting of reasonable prices, thanks to direct competition between regional markets.
- 3) Electricity: The electrification infrastructure (e.g. refrigerated containers) can transform or preserve large volumes of perishable products in a form that is appropriate to population consumption. The impact on the agro-industry as well as on the improvement of health conditions is translated into a better adaptation of processed products for urban and mass consumption.
- 4) Water supply and sanitation infrastructure: This helps to build networks of drinking water supply, irrigation and health environment conducive to food consumption in urban and rural areas. The impact on agricultural intensification is reflected in the diversification of seasonal food crops or consumption of seasonal products and in the strengthening of regional water and food stockpiles.
- 5) Logistics: Other logistical infrastructures support the concentration of marketing areas across national and regional wholesale markets, as well as the connection of these networks to regional highways to establish food security corridors along with corridors of development.

When all these spheres are linked into a complementary inter-sectoral framework of food security corridors, their synergistic benefits are far greater than the sum of the individual sectors. The influence zones of such corridors cover economic areas that promote a balanced distribution of food security support areas. For countries with a network of modern and appropriate infrastructures, the impact of regional infrastructure can be crucial at all stages of activities along the food supply chain.

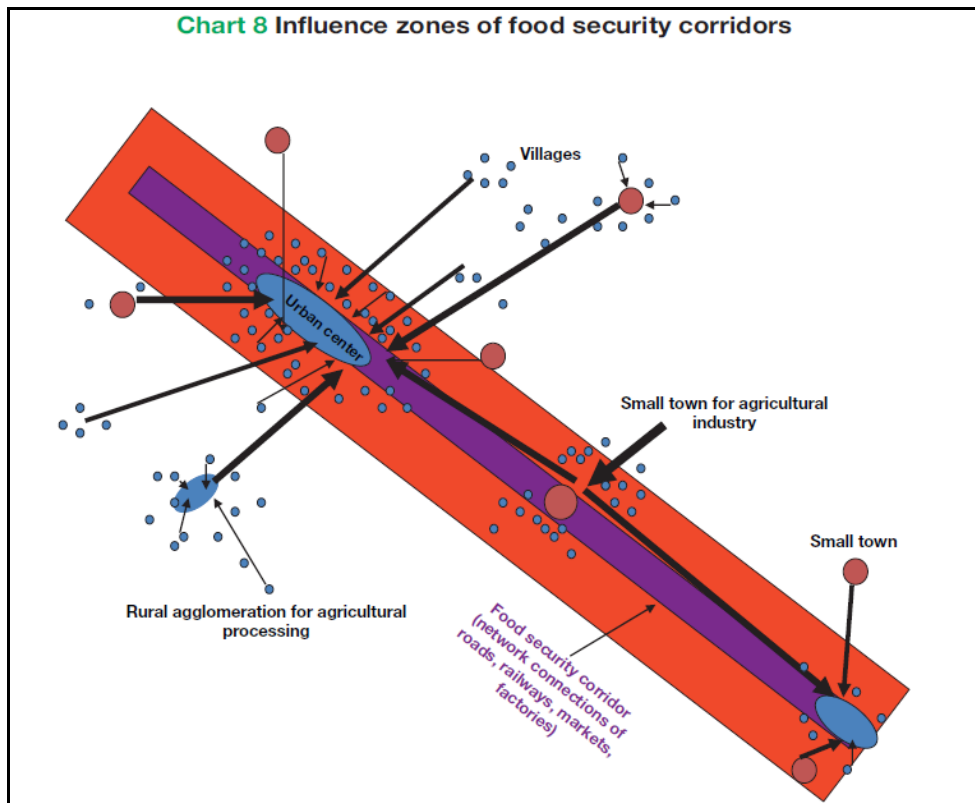


Figure 2.2 Influence zones of food security corridors (African development bank [AfDB, 2012])

Secondary connective infrastructures guarantee cross-border linkages between local economies, their branching to isolated villages, thereby promoting access between economic concentration centers (consumption, processing, import and export) and production, extraction and exploitation areas.

Studies undertaken on the spatial distribution of economic infrastructures point to the need for development corridors and connective networks to be constructed, in order to meet food security requirements on the continent. The origin of food insecurity lies partly in a failure to instigate robust and coherent policies and strategies at a regional level.

2.4 Risk-Coping and Risk-Management

Robert Chambers emphasizes that the poor mostly live in environments which are ‘complex, diverse and risk prone’, the so-called CDR environments, characterised by volatile prices,

incomplete market information, variable rainfall and unexpected socio-economic shocks (Chambers, 1997). The impact of such a CDR environment is captured by the ‘vulnerability context’ of the SLF in the form of short-term shocks, longer-term trends and seasonality. In 1964, Theodore Schultz proposed via his ‘poor but efficient’ hypothesis that farmers responded rationally to their environment, which led them to be efficient in their profit maximising decisions and actions within the constraints of their poverty (Schultz, 1964). This insight fundamentally changed attitudes to semi-subsistence farmers, with economists “beginning to realize that the farmer is no fool. A non-fool, in a static environment, learns to live ‘efficiently’: to optimise, given his values and constraints, and to teach his children to do the same” (Lipton 1968:327). Since then, it has become apparent that even in a ‘non-static’ and risky environment, farmers practice ‘constrained optimisation with bounded rationality’: they respond rationally to changes, given their objectives, constraints, opportunities, and knowledge (of both current and future situations). As a result, agricultural policy has focused on alleviating these constraints, in particular institutional constraints, market imperfections and incomplete knowledge. The field of New Institutional Economics specifically deals with the high transaction costs which result from such incomplete institutional arrangements (Poulton *et al.*, 1998).

2.5 Systems-level analysis

Different disciplines have studied phenomena with a systems-oriented approach – this has been coined ‘complexity’; or “the emerging science at the edge of order and chaos” (Waldrop, 1994). A complex system is composed of interconnected parts that as a whole exhibit one or more so-called ‘emergent’ properties not obvious from the properties of the individual parts (Ziemelis, 2001). The term comes from mathematical modelling, because such systems are, as the name suggests, difficult to model: they are made up of multiple feedback loops, which makes the system adaptable and self-regulating, with buffers absorbing shocks (Rind, 1999). The system is often nested, with subsystems interacting through different feedback loops at different scales (Strogatz, 2001). Any given theory can only explain one subsystem, and cannot predict the behaviour of the whole system. Once buffers are exhausted, the system can ‘tip’ rapidly: non-linearity, change and evolution are typical features of complex systems (Sethna *et al.*, 2001). Despite such apparent ‘chaos’, complex systems are said to have ‘memory’, because change over time is not random, with prior states influencing present states (Goldenfeld and Kadanoff, 1999).

The earliest precursor to modern complexity theory can be found in economics, stating that order in market systems is spontaneous and emergent, and not the execution of any human design (Hayek, 1978). Nobel Prize economist and philosopher Friedrich Hayek dedicated much of his work to the study of complex phenomena in the 20th century. Gregory Bateson played a key role in establishing the connection between anthropology and systems theory in the 1940s, recognizing that the interactive parts of cultures function much like ecosystems. In the 1970s the field of economics integrated the same principles into agent based modelling and ‘fuzzy’ models. In ecology, systems-based thinking gained momentum following a seminal paper on the predator-prey cycles in lake ecosystems (Holling, 1973). Ecological systems theory is discussed in detail in Section 2.3.3. As all complex systems have many interconnected components, network theory plays an important role in the study of complex systems, culminating in the ‘new science of networks’ in the 1990s. The idea of complexity has sparked similar theories in different disciplines, “often brandishing an ominous-sounding C-name: in the 1960s it was cybernetics, in the 1970s it was catastrophe theory. Then came chaos theory in the 1980s and complexity theory in the 1990s” (Strogatz, 2001).

Arguably, a lack of understanding of the complexity of socio-ecological systems has stymied progress on achieving sustainable development because policy makers lacked the tools to help them understand and plan for the complexity of the social, economic and ecological systems in which people live and construct their livelihoods. As pointed out by Robinson (2007:7): “To acknowledge complexity is not merely to accept that things are complicated and difficult to comprehend; it is to recognize that the natural environment, communities, economies, and agriculture are all complex systems, and that livelihoods are created within these complex and intersecting systems. To acknowledge this complexity is to accept, among other things, that no single theory or perspective can encompass or explain the systems in question”. As all the feedbacks working at different scales can never be fully understood, more efforts should be directed towards fostering resilience towards an unpredictable outcome, rather than trying to prevent a specific outcome of ‘poverty’ in the face of unknown future shocks (Jones, 2011). While various disciplines have identified a plethora of indicators to measure vulnerability, this is impractical for guiding policy (Fraser *et al.*, 2005). The use of ‘adaptive co-management’ has been particularly useful for the management of fisheries (Hinke *et al.*, 2004) and wild fires

(Suyanto *et al.*, 2004) – with important implications for understanding natural resource based livelihoods, present as well as past (Janssen and Scheffer, 2004).

The emerging field of ‘ecosystem health’ has adopted a similar systems-based interdisciplinary approach to understanding and promoting health and wellbeing in the context of social and ecological interactions (Waltner-Toews and Kay, 2005). Applying the principles of complex systems to livelihood analysis offers a more incisive diagnostic of livelihood resilience than development economics has delivered to date. Nonetheless, a clearer methodology is still needed to incorporate ‘resilience’ into livelihood analysis (Gallopín, 2006). Some researchers warn that applying ‘adaptive co-management’ to social systems comes with serious equity concerns, if less-vocal groups are not adequately included in the dialogue (Plummer and Armitage, 2007). As mentioned earlier, the SLF already encompasses some of the principles of systems-thinking but lacks an analytical tool for measuring the adaptability of the whole livelihood system. Livelihoods analysis (dominated by the social sciences) has remained remarkably separate from research on ecosystem health (dominated by the natural sciences) despite livelihoods depending on natural assets, and on the risks which underlie them (Adger, 2006).

CHAPTER 3: MATERIALS AND METHODS

The core objective of this study was mapping the physical constraints to food safety in Mathare informal settlement with a view of influencing policy change in addressing food safety related issues. This chapter describes the setting of the research and the data methodology for the identification of these physical constraints and food safety issues in Mathare. The chapter has six sections: about the study area, data sources and tools, sampling, data collection, data processing and verification.

3.1 About the study area

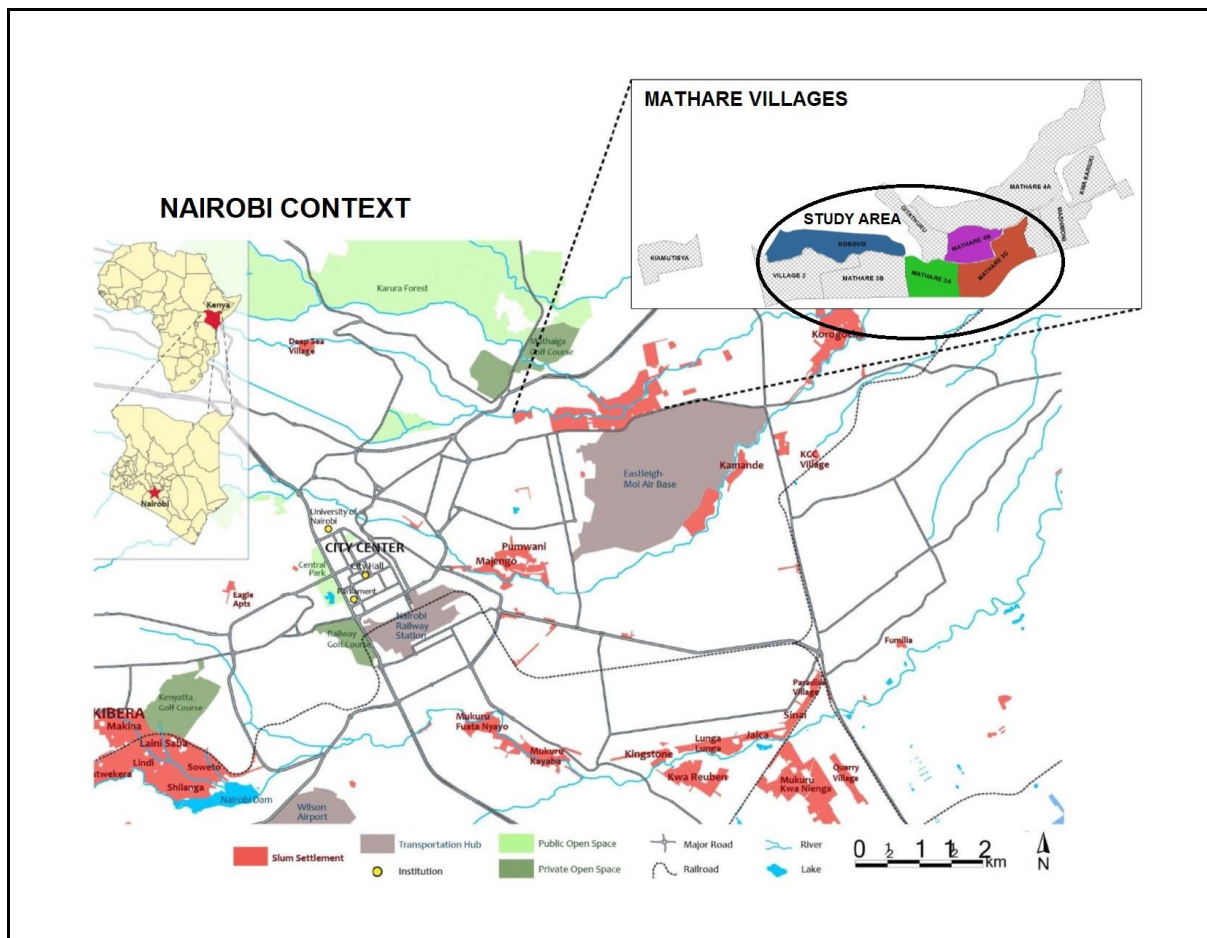


Figure 3.1: The area of study

Mathare Valley lies about 4 kilometers to the NE of current day Nairobi city center. Prior to the 1950's, the Valley was largely settled by an Asian population who utilized it as a stone quarry for building blocks. In the 1950's a demographic shift occurred as it was overtaken by Mau Mau

rebels and used as a location to hide weapons. Up to that point Mathare remained sparsely populated however, that changed following independence in 1963 as Kenya began to experience a rural to urban population shift which has continued almost unabated.

Today, the valley is comprised of 13 villages (Mashimoni, Mabatini, Village No 10, Village 2, Kosovo, village 3A, village 3B, village 3C, village 4A, village 4B, Gitathuru, Kiamutisya, and Kwa Kariuki) which lie stretched along the Mathare and Nairobi Rivers. It is the second largest slum in Nairobi with an estimated population of 188,000 (Muungano, 2011) and sits on just 0.89km² of land. This density trend is mirrored in Nairobi at large where it is estimated that the 2 million slums dwellers (62% of the population) occupy only 5% of the city's residential area. Conditions for slum dwellers continue to deteriorate as the settlements' population increase by 6% annually. In the slums, it is estimated that 92% of all tenants are renters. Most households in the slums live in 10ft by 10ft room with mud or brick walls and corrugated tin roofs. Kenya's annual housing demand is estimated at 150,000 units, yet it currently produces in the range of 20,000-30,000 units, leaving a shortage of 120,000-130,000 units annually. Housing demand is rapidly outpacing supply and the units that do actually get produced are targeted towards the middle and upper class. The result has been ever-increasing informal settlements where poor infrastructure and few basic services create appalling living conditions. To further complicate issues, land ownership is highly contested across the valley. The land was originally and continues to be government owned but over the years property has become highly politicized as powerful and politically connected speculators have built structures for private rent across the valley. These structure owners fail to meet basic building codes and are often constructed lacking any services such as water, electricity or sewage. Their failure to assume responsibility for constructing a healthy environment and choosing to prey on the extremely poor has been detrimental for development and provision of the slums. Large donors have also shied away from tackling the difficult context surrounding Mathare and choose rather to work in areas where issues are more clear-cut and the land less contested. Figure 3.2 summarizes these land tenure patterns. (MZP, 2012²). The 2009 Kenyan Census reported 80,309 residents in the 13 villages.

² Mathare Zonal Plan, a collaborative plan for informal settlement upgrading. A collaboration between Muungano Support Trust, Slum Dwellers International, University of Nairobi (Department of Urban and Regional Planning) and University of California Berkeley, Department of City and Regional Planning. July 2012

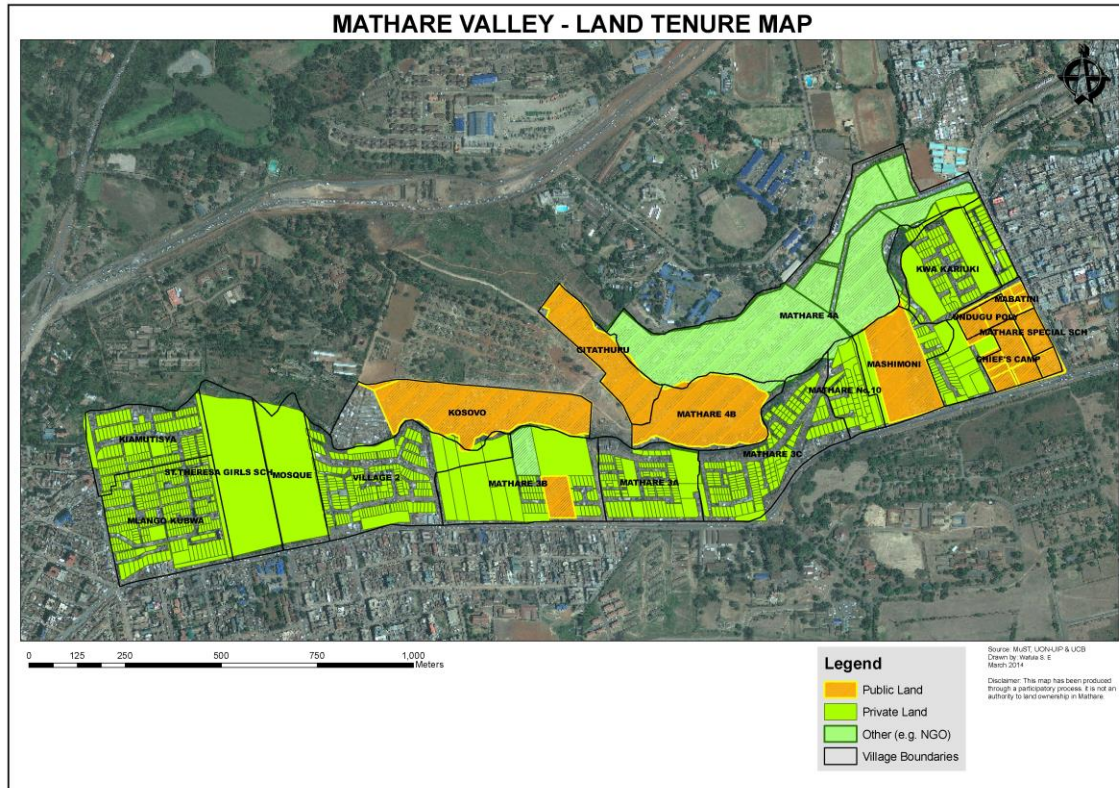


Figure 3.2: Mathare land tenure map (Source: MZP, 2012)

3.2 Data sources and tools

Qualitative data method has been used to capture data pertaining local perception and opinions on the safety of food using Focus Group Discussion questionnaires whereas the mapping data method has been used to capture the food safety status, physical constraints and other basic information relating to infrastructure through paper maps and mobile mapping application.

3.2.1 Data sources

The study is based on both primary and secondary sources of information. Primary data was collected through ground mapping, Focus Group Discussions, and field observations. Secondary data were obtained from existing mapping base information, data published in different books and policy documents about food safety. Most of the data required for the project were collected from primary sources.

a) Primary data

To generate the required data from the primary sources, different methodological approaches such as mapping, Focus Group Discussions, and field observations were employed.

i) Mapping approach

Mapping was the first approach used for generating the primary data for this project. In order to minimize the errors in the data collected by the community mapping teams, training was provided to ensure that the mapping tools were understood.



Figure 3.3: Training of the data collection team

Moreover, pilot data collection was conducted in Bondeni village in order to test the data collection using the mapping tools. This also served as a demonstration to check the teams' understanding of the tools, and how to administer them. The majority of the information that was used in achieving the objectives of the study were then generated using these tools.

The mapping approach was the core of the primary data collection process and it was useful in capturing the location of the food vending and livestock keeping activities, the surrounding environment to the food vending spaces, settlement infrastructure related to food safety, proximity of the food to the settlement infrastructure together with the physical constraints to food safety within the settlement.

ii) Focus Group Discussion

This was the other source of primary data for the study. Focus Group Discussion provided an appropriate forum to bring together food vendors, livestock keepers and customers/consumers to share their experience on food safety and its relationship with the physical constraints. The technique was useful in collecting data pertaining to the dynamic use of space, food types and sources of raw materials for the foods they sell, causes of food contamination, environmental constraints and other surrounding constraints that affect food vending business, challenges faced by food vendors within their vending spaces, and their suggestions on how to improve food safety within the settlement. Just like the mapping approach, a pilot was carried out in Bondeni village to test the contents of the questionnaires. This served as a demonstration to check the interviewers' understanding of the questionnaires, interviewees' understanding of the study, and how the study should be administered. In addition to this, the pilot data collection was intended to test whether the tools developed were good enough to capture the intended issues or some improvements were needed, respondents understanding of the questions and check for omission of questions. After the pilot survey, the questionnaires were revised and things that were unclear during the pilot study were clarified.

iii) Observation

Observations of the food vendors' way of life, their operating spaces, the physical constraints that they have to overcome in their daily struggles and their activities for livelihood provided valuable and supportive information. Having a good look at the physical and socio-economic infrastructures and the different economic activities these vendors are involved in providing valuable contributions to understand the existing real food situations and the overall situation of the food safety. Photos were taken across the villages to capture these observed issues which also form part of the primary data collected.

The approach was complimentary to the other primary data collection approaches used as it can be carried out at any stage of the data collection. For instance, during mapping, a number of environmental issues could be observed and documented. During Focus Group Discussions, observations could be made relating to the behavior of both food vendors, livestock keepers and customers in matters of food safety.



Figure 3.4: Training the community data team on mapping

b) Secondary data

Secondary data was collected to capture the existing literature concerning food safety in informal settlements as well as the existing data about Mathare that could be relevant to the study. These data included the base mapping information, food safety related studies in informal settlements in Kenya, food security studies carried out in Mathare and government interventions in infrastructural and food safety issues. Moreover, the data published in different books, policy documents about food safety and research journals were also important to accomplish the research. The data collected during the field work are shown in **Table 3.1** below.

Table 3.1: Secondary data collected

SN	DATA TYPE	SOURCE AND YEAR
1	Demographic data	KNBS (2009) and Muungano (2011)
2	Food riots and food rights research in Mathare	IDS (2013)
3	Land use/land cover map	Muungano (2012)
4	Cadastral maps	Survey of Kenya (2014)

5	Road infrastructural distribution maps	Muongano (2012)
6	Water, sanitation and electricity data and maps for Mathare	Muongano (2012)
7	Satellite imagery	Oakar Services Limited (2012)

Table 3.2: Primary data sources

METHOD	DATA SOURCES
Focus Group Discussions	<p>Consumers: One FGD (2 male and 3 female consumers)</p> <p>Vendors: Five FGDs (four of these FGDs consisting of 8 vendors each whereas the fifth one consisting of 12 vendors). A total of 44 vendors aged between 18 and 45 years of age distributed into the three categories of cooked food, green groceries/other uncooked food, and mobile vendors. Out of the 44, the number of female vendors was 27 whereas the number of male vendors was 17.</p> <p>Livestock keepers: Five FGDs (with two representative in each of the four FGDs constituting a total of 8 livestock keepers and 4 livestock keepers for the fifth FGD). Out of the 12, the number of male livestock keepers was 7 whereas the number of female livestock keepers was 5</p>
Observations	General observations of a variety of food stalls and shops including butcheries, cereal shops, sanitation facilities and routine
Mapping	A total of 154 food vendors were captured and consisted mainly of cooked food, uncooked food and green groceries

3.2.2 Data tools

The data collection tools used in the project included both hardware and software tools that supported the execution of the project work at different stages.

3.2.2.1 Hardware requirements

The hardware refers to the physical components of a computer system. It also includes the physical medium used in data capture in the field. The purpose of the hardware was to input,

output, process, store data and communicate with the software. The hardware used in the project included;

1. Host computer: Intel (R) Core (TM) i5-2450M CPU, 2.5GHZ, 2.5GHZ, 4.00 GB RAM
2. Storage Media: 500GB Hard Disk
3. Portable storage media: Flash disk of 2GB
4. 15 inch color monitor
5. HP Desktop color printer for scanning and data output in hardcopy form.
6. Optical disc (DVD-RW) as backup storage device
7. Mobile phone: Samsung Galaxy ACE
8. Wireless networking infrastructure
9. Accessories: chargers, cables

3.2.2.2 Software requirements

The software used in the project included;

- ArcGIS 10.0: for digitizing, editing, overlaying, networking, vectorizing, data conversion, analysis, answering the queries and generating layouts.
- Matlab Programming Language Version R2011b used for coordinate transformation purposes for the cadastral maps
- Global Mapper 13 for georeferencing
- Epicollect: a mobile/web application for smartphone data collection
- Adobe Reader V.XI
- Microsoft office 2013 suite
- Google earth 7.1.2.2041

3.3 Sampling

The villages where data collection was to be conducted were arrived at after discussions. Since Mathare informal settlement has 13 villages, it was appropriate to choose the four that can provide a representative picture of the entire valley and can also fit within the project scope. Some of the issues that were used to determine which villages should be sampled included:

- a) The dynamics use of space such as moving from one place to another during the day for the food vendors, why they move and what factors influence such dynamic use of space.
- b) Distribution of food vendors within the settlement i.e. where they are densely distributed or sparsely distributed.
- c) Operational constraints such as times of closure as dictated by such factors as security and other physical constraints that affect food vending.
- d) Issues of livestock keeping within the settlement, where they are majority, the relationship between the livestock keepers and food vendors, and the conflict of space between the livestock keepers and food vendors.
- e) Areas affected most by issues like flooding, dust and open drains to understand the copying mechanisms especially during the rainy season.

Based on the above issues, the four villages were chosen. The four villages were therefore chosen as follows:

- a) **Bondeni** village was chosen since it offers a good mix of both food vendors and livestock keepers. Also it lies along a slope and hence it was interesting to see the physical constraints that these food vendors within the village are exposed to. Bondeni village provides a very representative picture of the entire valley due to its proximity to Juja road as well as the Eastleigh airbase and the number of activities that happen within the settlement. Its proximity to the two notorious villages in terms of security (village 2A and village 3C) could also provide a good picture of the exposures to risks for these food vendors and livestock keepers.
- b) **Kosovo** village was identified as a result of its urban agricultural activities. There is a five acre piece of land that the Mathare mental hospital leased to the Kosovo community to practice agriculture and hence it was interesting to see how these farming activities have influenced the food vending within the village and hopefully within the entire valley. Issues of sources of raw materials and the constraints in terms of transporting them from the markets to the village could be better dealt with in this village. It also lies on a sloppy ground hence better placed to understand the issues of flooding and how it affects the food vending business.
- c) **Village 3C** was chosen as a result of its food vending activities. A mixture of food vending activities is evident within the village. Activities range from cooked food (such

as Githeri), fish vending, large-scale vending of vegetable and fruits, and meat products related vending activities. Some of the activities are also located towards the river and hence it was strategic in comparing the physical constraints that these vendors exposed to as compared to other villages. Being also composed of members from different tribes, it was interesting to see the security issues affecting food vendors within this setup in terms of operation hours and dynamic use of space.

- d) **Village 4B** is strategically located in between the two rivers. The two rivers i.e. Mathare and Nairobi river bound the settlement and meet at the end of the village. It was therefore strategically located in assessing the environmental conditions under which these food vendors operate. Since it was largely composed of members of one community, it was also interesting to understand the dynamics of space utilization and contestation of public space. Some of the villages in Mathare comprise mainly members of one community such as Mashimoni, village 4A and village 4B whereas others are composed of members from different tribes such as Kosovo, Kiamutisya and village 3C. The 3C and 4B scenario would therefore provide a sneak view of the vending environment within these different setups.

The four villages were therefore chosen as appropriate for carrying out this study. The subsequent data collection process was then carried out in these four villages.

3.4 Data collection

Based on the sampling process, the data collection therefore consisted of four mapping case studies for the four villages of Mathare, short interviews conducted through the mobile phone application for a total of 166 food vendors (within Bondeni, Kosovo, Village 3C and Village 4B) and five Focus Group Discussions for the four villages were conducted. The mobile application data covered mainly short surveys for the food vendors using a structured questionnaire developed in the Epicollect web application whereas the Focus Group Discussion also used a structured questionnaire for the food vendors and livestock keepers.

The data collection started with reflection sessions with members of Mathare community to review the food safety situation in their settlement and to capture their perceptions about the physical constraints to food safety in their settlement and also ended with a reflection forum

where members of the community could verify the information collected and identify the gaps in the data that needed to be filled.

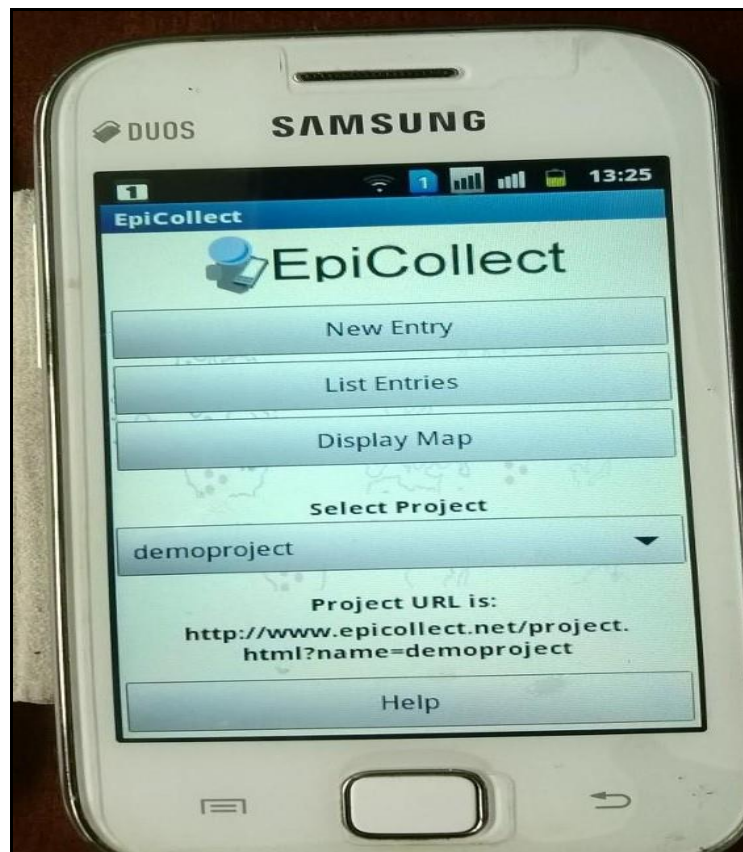


Figure 3.5: Epicollect application on a Samsung Galaxy Ace mobile phone

3.4.1 Overview of the data collection

The Figure 3.6 illustrates in a nutshell the data collection strategy used in this project. The first step of data collection was the mapping of the informal food web in terms of the food vendors, consumers and livestock keepers. The most visible activities within this informal food web are food production (urban agriculture and livestock keeping activities within the settlements), processing (cooking and packaging of food within the settlement by the food vendors for the customers), catering (bringing food closer to the customers) and transport (getting food stuffs from their markets to the food stalls within the settlement and also positioning their stalls in strategic locations where customers can have access to), and retail sale of fresh or prepared products (e.g. the sale of cooked and uncooked food).

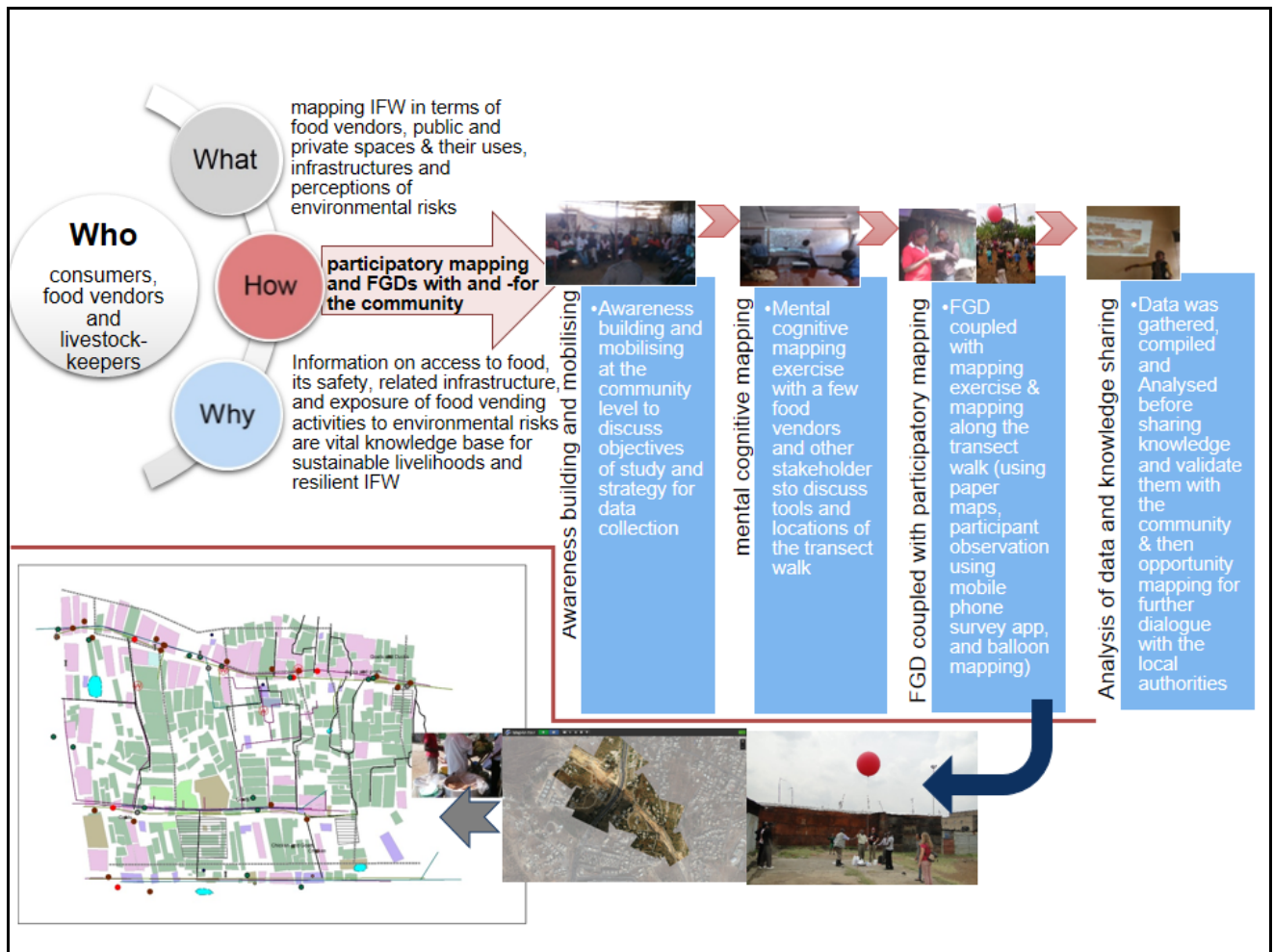


Figure 3.6: The data collection strategy used for the project

Mapping of the IFW (informal food web) was useful in identifying the different categories of food players within the villages and their relationships. These food players include the food vendors, customers and livestock keepers. The food vendors were further categorized into those dealing with cooked food and those dealing with uncooked food, vegetables and fruits. Meetings were held at the village level for the four villages (Bondeni, Kosovo, village 4B and village 3C). The meetings were also meant to familiarize them on the need and importance of the data collection process as well as reflection discussions to get insights on the food vending conditions in each of these villages. The outcome of these meetings was identification and training of the data collection teams on the tools for data collection in order to equip them with the necessary skills to collect data within the 4 villages.



Figure 3.7: A cognitive mental mapping exercise by the residents of Mathare informal settlement

The mapping of the IFW (Informal Food Web) was part of the reflection sessions that were carried out at the beginning of the study. The second stage of these reflection sessions was a mental mapping exercise. In the Mental Mapping process, the community members were tasked to locate themselves and other facilities in their localities from paper and digital maps so as to assist in sampling of the villages for the study as it could provide a sneak view of where street vending is concentrated and dispersed per village. Figure 3.7 highlights the mental mapping exercise that was held with representatives from the Mathare Informal Settlement.

A mental cognitive mapping exercise was undertaken with a few food vendors and other stakeholders to discuss the data collection tools and logistical requirements for the Focus Group Discussions as well as locations of transect walk within the four villages.

3.4.2 Preparation of the data collection tools

The three main tools used that needed to be prepared for use in data collection were paper maps, digital mapping application, and Focus Group Discussions questionnaires.

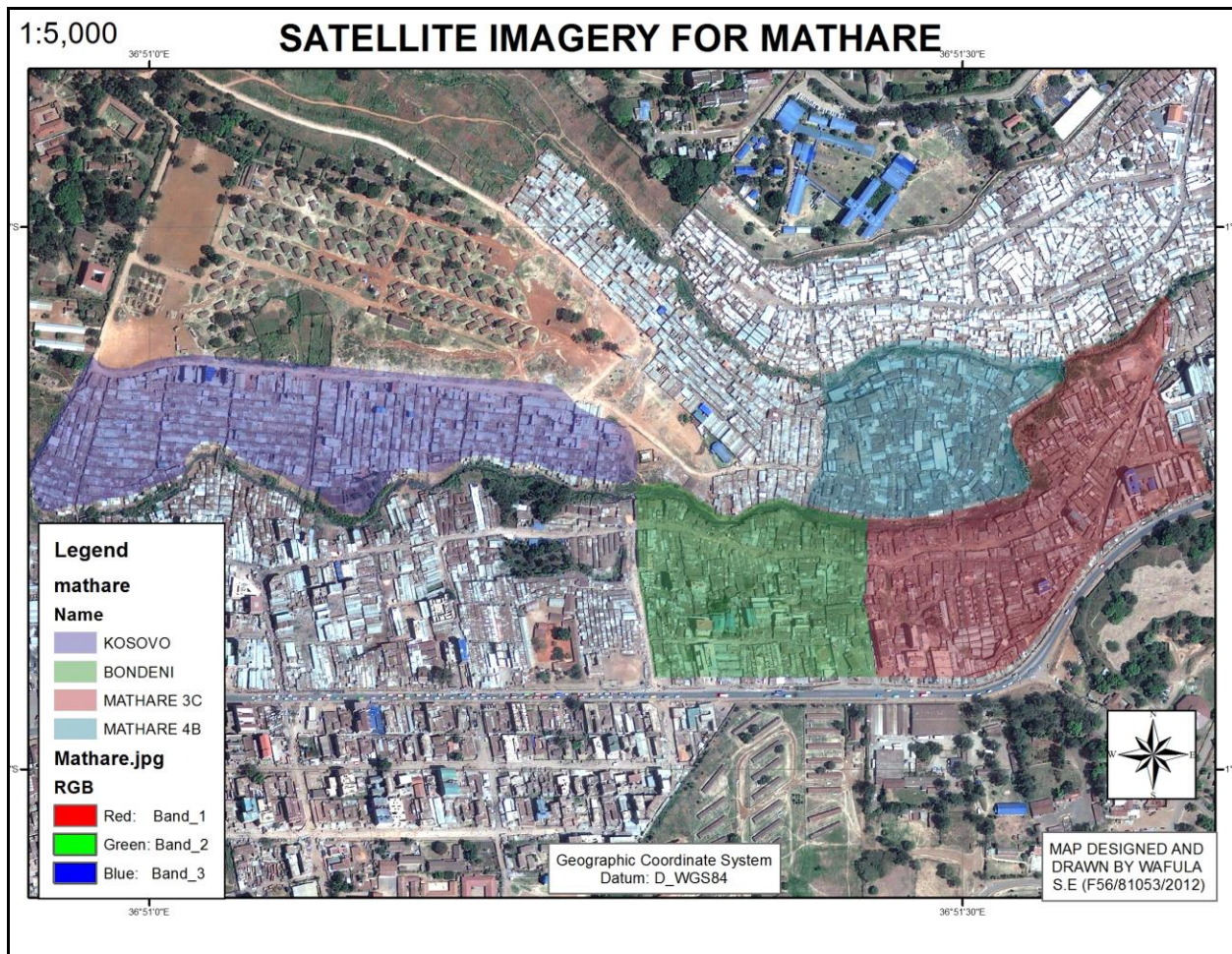


Figure 3.8: The satellite imagery used for the study (Obtained from Oakar Services Limited, 2012)

Preparation and printing of the satellite imagery to be used in the paper mapping was therefore carried out. Figure 3.8 shows archived satellite imagery obtained from Oakar services limited, geo-referenced and printed to be used by the community data collection teams. The imagery assisted the team in collecting the following information: Animal keeping activities within the settlements; Roads and infrastructure e.g. footpaths where food are sold; Environmental hazards within the area e.g. steep slopes, flooding areas, open sewers and drainage, solid waste dumping sites and playgrounds; and Location of storage spaces.

The installation of Epicollect mobile application in the Samsung Galaxy ACE android enabled phones was carried out for digital mapping purposes. The designing of the questionnaire for the use within the mobile phones was carried out using the Epicollect web application. A project website was therefore created on the web application which was then loaded in the mobile

application. Calibration of the mobile phones was also undertaken which involved defining the spatial reference system that will be used in collecting the data as well as definition of the data bundle plan to enable real time sharing of the data as it is collected from the field. The digital mapping tool assisted in locating the food vending locations, locating animal stalls within the settlement and capturing the proximity of the food vending locations to the physical infrastructure within the villages.

Designing of the Focus Group Discussion questions was also undertaken. This involved defining the Focus Group so that to ensure all the categories of people required for the discussion are well represented. A group of ten people was chosen for each of the first four Focus Groups for each of the village. The ten people included three people dealing with cooked food, three people dealing with uncooked food, two people dealing with mobile food vending and two people dealing with livestock. The final Focus Group Discussion involved 20 people where each category had five people cutting across the four villages. The identification of the group members was also sensitive to various categories of people as defined by age, gender and clique.

3.4.3 Mapping process

The mapping process was the core of the data collection process as it was useful in capturing the location of the food vending and livestock keeping activities together with the physical constraints to food safety within the settlement. The two mapping tools developed for this study were:

- a) Paper maps – this consisted of both satellite and hard copy maps prepared and printed for the four villages and having some of the basic facilities within the villages as captured in the previous mapping process by other people such as Muungano Support Trust. The satellite imagery was useful in orienting the community members since they could easily locate themselves within the villages. It was useful for visual interpretation of features within the villages. The hard copy maps composed of key features such as roads, existing sewer lines, manholes and drains, sanitation blocks, water lines and water points, power lines and power points within the villages. It also captured the village boundaries. Figure 3.9 gives an example of this paper map used for Bondeni village.

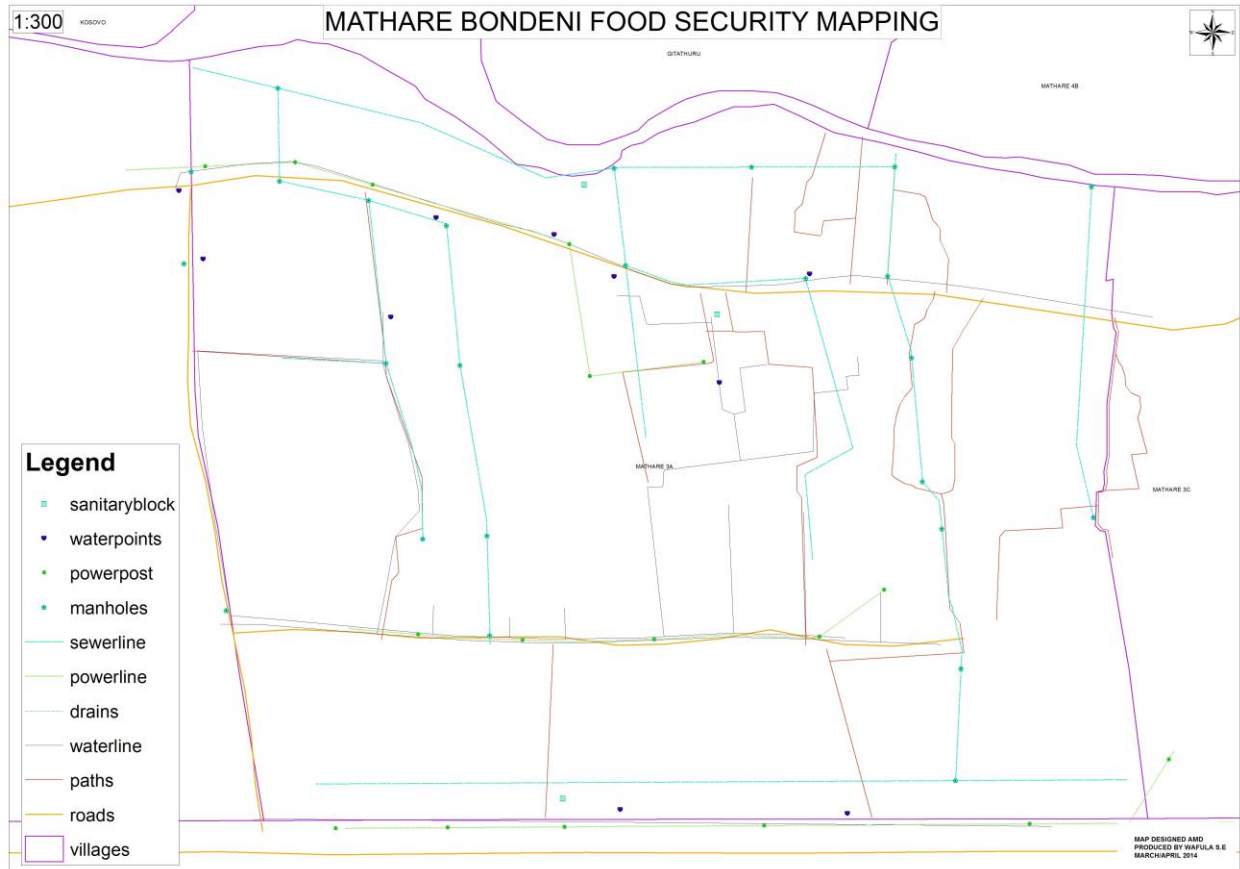









Figure 3.9: The paper map used for collecting mapping data within Bondeni village

- b) Mobile phone application for digital mapping – This application was useful in collecting data related to location of the food vending activities, taking photos of the food vending activities with their surrounding environment and conducting short surveys on the mapped locations. The data is then synchronized with the website. A project website was created i.e. <http://www.epicollect.net/project.html?name=FoodSecurityNairobi>. All the data collected in the field therefore once synchronized is updated automatically on the project website and hence the data is available for downloading in csv file. The data can also be downloaded as a map in kml file. Epicollect is a free and open source mobile/web application developed at the Imperial College London and funded by Wellcome Trust for smartphone data collection purposes. The research assistants from the community side were trained on how to pick these data using the phones.

The paper mapping process was useful in updating the existing map features such as sewer lines, drains, water points, foot paths, dumping sites and mapping street rent values. With the help of

markers and symbols the community members were able to use the maps to collect the information. For rent values, different colors were used for different rent values e.g. pink for values below 1000, green for values between 1000 and 1500, blue for values between 1500 and 2000, yellow for values between 2000 and 2500, and red for values above 2500. This was useful in getting the average rent values per street for the food vendors. The paper maps were also useful in picking the livestock keeping locations within the village. The location were marked using a symbol agreed upon. In this case it was a circle with the letter L inside the circle. Once they had marked the location, they also picked other information like the type of livestock and the quantity. Other information that was picked using the paper maps was the public spaces within the settlement. These spaces were shaded using the pencils and a diagonal pattern as shown in table 3.3. The mobile application mapping on the other side collected information on the proximity of the vending locations to the environmental hazards such as roads, drains, sewer lines and dumping sites. It was also used to capture the safety issues such as selling of food next to a road, selling along the open drains and existing sewer lines, selling in a shaded environment where there is a shed on top of the vending place and exposure of food to dust and dirt e.g. whether the food is covered or left open.

Table 3.3: The mapping symbols used for the paper mapping exercise

Mapping symbol	Description
	Rent value below Kshs. 1000
	Rent value between Kshs. 1000 and 1500
	Rent value between Kshs. 1500 and 2000
	Rent value between Kshs. 2000 and 2500
	Rent value above 2500
	Livestock keeping activity
	Location of open spaces

3.4.4 Focus Group Discussions

Surveys assume that people know how they feel. But sometimes they really don't. Sometimes it takes listening to the opinions of others in a small and safe group setting before they form

thoughts and opinions. Focus groups are well suited for those situations. Focus group discussion was used as a participatory method emphasizing the participation of the different categories of food players within settlement. The three main categories identified in this process were: food vendors dealing with cooked food; food vendors dealing with uncooked food, vegetables and fruits; and livestock keepers. These three categories were useful in capturing the diverse environment under which each of this category operates. A follow up focus group discussion was also carried out bringing together all these food categories in order to check on the findings of the individual group discussions.

These focus groups were structured around a set of carefully predetermined questions – for each of the three categories – but the discussion was free-flowing. Ideally, participant comments were useful in stimulating and influencing the thinking and sharing of others. Some people even found themselves changing their thoughts and opinions during the group. The FGD was useful in capturing the following details

- a) The food safety situation e.g. cases of contaminated food and the effects of contaminated food within the settlement
- b) Operating hours for the food vendors e.g. the opening and closing hours
- c) Types of food sold within these settlements
- d) Seasonality i.e. time of day that dictates sale of particular food types.
- e) Challenges faced by the food vendors in their day to day operation
- f) Effects of floods on food vending among other environmental constraints
- g) Effects of dust, open drains, storage and other physical constraints on the safety of food

During the discussions, recording was done using the data phones so as to cross check the information captured using the notebooks.

3.5 Data processing

Once the data has been collected, it was then entered into the database (both spatial and non-spatial), the databases are then cleaned before analysis of the same takes place.

The mapped information was then transferred back into the GIS database through ArcGIS 10 software. The original map which had been printed to facilitate data collection was edited to

capture the changes in base information as well as the new data that had been picked on the ground. This stage also included spatial database creation, features symbolization, generation of thematic layers as well as linking of spatial and non-spatial databases.

Therefore the following procedure has been used in processing the findings of the study.

- Generating summaries of the FGD's to facilitate the capturing of those thoughts expressed during the discussions.
- Map editing to capture the details collected in the field using the satellite images as well as the paper maps.
- Uploading of the mobile application data on the project website and downloading of the data in a csv file format to be used in ArcGIS 10. The downloaded csv file is added in the ArcGIS window where the XY data is then displayed using the longitudes and latitude values where the longitudes represent the X data whereas the latitudes represent the Y data. Once the data has been displayed, it is then exported into a shapefile
- Overlaying of the spatial datasets with the satellite imagery and other base information for spatial analysis of the results.
- Joining of the spatial and non-spatial datasets for comprehensive analysis of the food safety situation in Mathare slums.
- Preparation of the preliminary report.

Once the results has been obtained, presentation of these findings at the community level takes place as a way of giving feedback to the community members who participated in this study.

3.6 Validation of the results

The resultant maps and findings were then printed and taken back to the community. A forum was organized where the community members who participated in the data collection process as well as the key persons within the community come to see the study results. It is at this stage that a review of the data was carried out to see if all the aspects of food safety had been captured correctly during the data collection stage. Any improvements on the mapping results and Focus Group findings were carried out during this stage and also the findings were interrogated to ensure they reflected the actual situation in the villages. It was at this stage that additional information were collected and included in the maps and the Focus Group Discussion findings.

CHAPTER 4: RESULTS AND DISCUSSIONS

4.0 Introduction

This chapter focusses on the results obtained during the study. The chapter has been divided into six sections: Food vending activities, spatial distribution of food vendors, physical constraints to food safety, food safety findings, challenges of food vending in public spaces, and opportunities for improving food safety. The first section focusses on food vending related activities with emphasis on the types of food sold by the food vendors. The second section further focuses on the spatial distribution of the food vendors as captured during the mapping process. The third section focusses mainly on physical constraints to food safety within Mathare Informal Settlement. The fourth section focusses on the food safety findings whereas the fifth section looks at the challenges of food vending in public spaces. The last section focusses on the opportunities available for improving food safety in Mathare Informal Settlement with major focus on the Food Vendors Association as a way of addressing settlement-wide food related issues such as infrastructure, water and sanitation.

4.1 Food vending related activities

The study was conducted in four villages which include: Bondeni, Kosovo, Village 4B, and Village 3C. The villages revealed the food safety conditions in the whole of Mathare Informal Settlement which varied sparingly from village to village. However the issues arising from the whole village in general were similar.

Table 4.1: Main food categories

Food categories	Main food types sold
Cooked food	Githeri (mixture of maize and beans), Ugali, Rice, Roasted Meat and other cooked meat products (such as “Mutuura”, “Sambusa”, “Mushugi” and cooked chicken parts), Beans, Chips (French Fries), “Chapati”, “Mandazi” and Hot Beverages (Coffee, Porridge, and Tea)
Cereals	Maize, Beans, Rice, Green grams and “Njahi”
Meat	Raw meat and Fish products (Fish, Omena)
Vegetable and Fruits	Vegetables: “Sukuma Wiki”, Cabbages, Carrots, Tomatoes, Onions,

	<p>“Kunde” (Cowpeas leaves), and other traditional vegetables {such as Amaranth (“Terere”), Spider plant (“Saget”), Pumpkin leaves (“Malenge”), and African nightshade (“Managu”)</p> <p>Fruits: Oranges, Water melon, Mangoes, Bananas, Pawpaw and Avocado</p>
Other Uncooked	Sweet potatoes, Arrow roots, Irish potatoes and Bananas

Table 4.2: Sources of raw materials (Markets)

Food types	Sources of food (markets)
Green Groceries	Nairobi market (“Marikiti”), Gikomba, Korogocho and Muthurwa
Meat	Kiamaiko, Njiru, Bama, Gikomba and Dagoretti
Cereals	Gikomba, Korogocho, Nyamakima

Food vendors undertake the food venture business for different reasons. They include: as a source of income, as a way of combating unemployment and for self and/or family sustainability. Since most of these activities are on a small scale, it also requires little capital to start and hence becomes a source of livelihood for many of the vendors living in these informal settlements.

The food vendors mainly operate between 5am and 10pm; however, these timelines change from village to village depending on the security, street lighting, available stock and customer flows. Kosovo and Village 4B are the safest and the vendors operate their businesses up to late night hours, approximately 11 P.M. Location of a food vendor also matters since those who are along major streets are safer and have higher customer flows than those who are located in the inner narrow streets. Village 4B is safe for the food vendors since it is composed mainly of one tribe and hence the youth groups operating within the area are acquainted with these vendors and will provide security against any external aggression. People entering village 4B from outside however will be victims of these youth groups and their safety beyond 9 P.M. is not guaranteed. Kosovo enjoys a good reticulation of electricity and street lights hence providing a safe environment for food vendors to operate even way beyond 11 P.M.

4.2 Spatial distribution of the food vendors

Figure 4.1 gives the visualization for the four villages highlighting the spatial distribution of the food vendors mapped during the study.

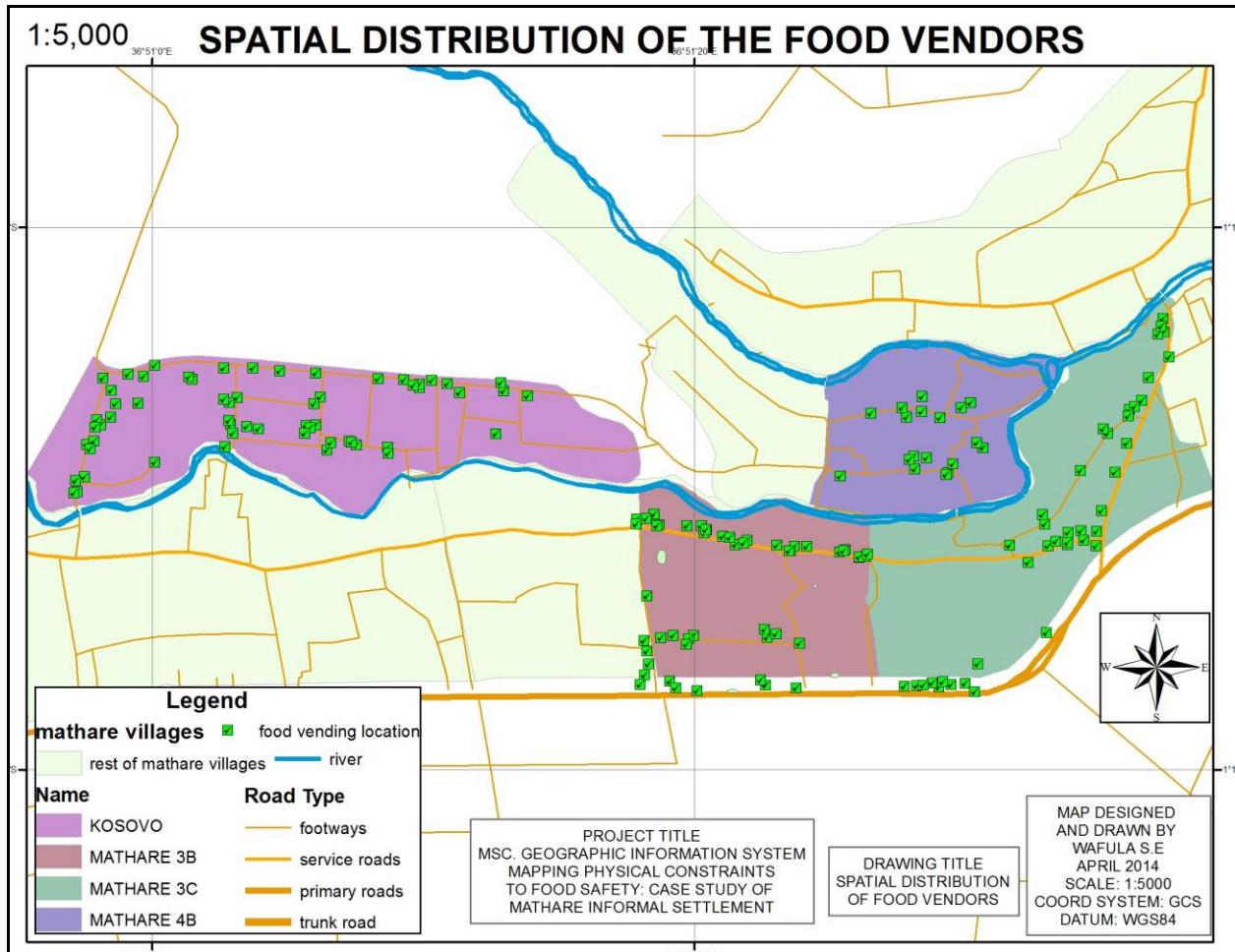


Figure 4.1: The spatial distribution of the food vendors in Mathare

A total of 166 food vendors were captured for the four villages with Kosovo having the largest number of 59 food vendors. This was then followed by Bondeni with a total of 49 food vendors then Village 3C with a total of 40 food vendors. Village 4B had the least number of food vendors as it had only 18 of them. In terms of density, Bondeni village is the densest with an average of 953 food vendors per square kilometer. It is followed by Kosovo at an average of 741 per square kilometer, and then Village 3C at 529 vendors per square kilometer and Village 4B has the least density of 422 food vendors per square kilometer. The density has been obtained by dividing the total number of food vendors in each of the village with their respective surface areas in square

kilometers. These results are shown in table 4.1 and as it can be seen the average for the four villages gives a density of 661 food vendors per square kilometer.

Table 4.3: Density distribution for the food vendors in Mathare

Village	No. of vendors (per village)	Total area (in sq.km)	Density of food vendors (vendors per sq.km)
Kosovo	59	0.079644	740.7965446
Bondeni	49	0.051396	953.3815861
Village 4B	18	0.042645	422.0893422
Village 3C	40	0.075643	528.7997568
Totals/Average	166	0.249328	661.2668074

Another aspect that was captured using the mobile application was that of the different food types sold within these vending locations.

Figure 4.2 shows the market share for the food categories for the study which include meat, cooked food, uncooked food and green groceries.

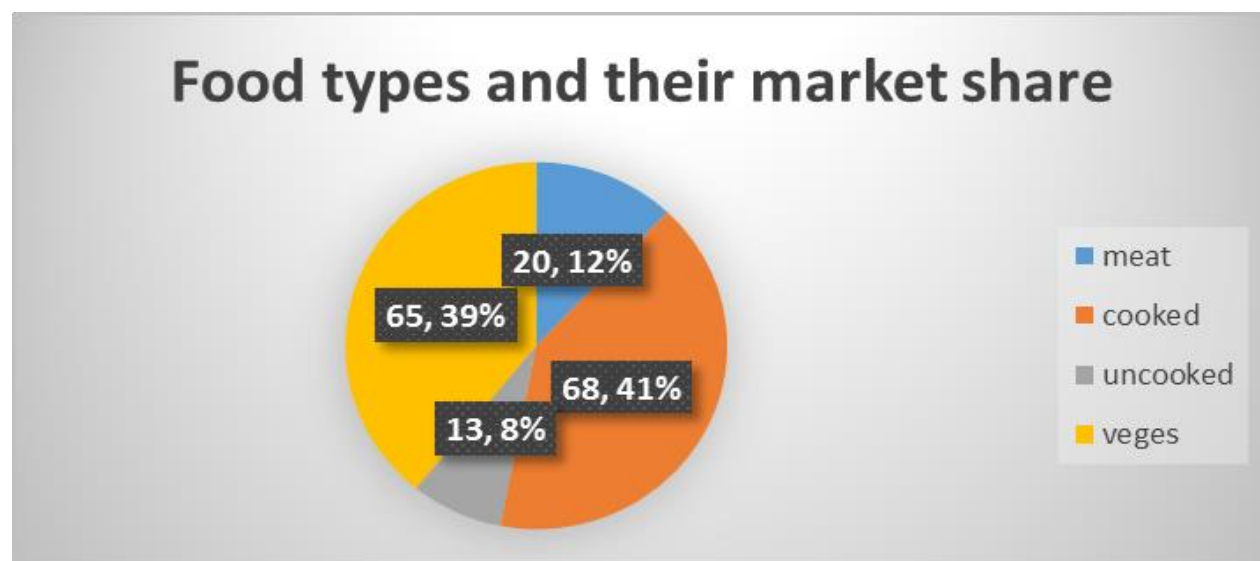


Figure 4.2: The various food types market share

Figure 4.3 shows these food types distributed spatially and the foods have been divided into four main categories i.e. Meat products, cooked food, Uncooked food, and Vegetable and Fruits. Meat products in this case include raw meat, cooked meat and roasted meat products sold in the

settlement. Cooked food refers to such foods as Githeri, Chips, Beans, Rice, Chapati and Mandazi whereas the uncooked food refers to such foods as Sweet Potatoes (“Ngwaci”), Arrow roots (“Nduma”) and cereals.

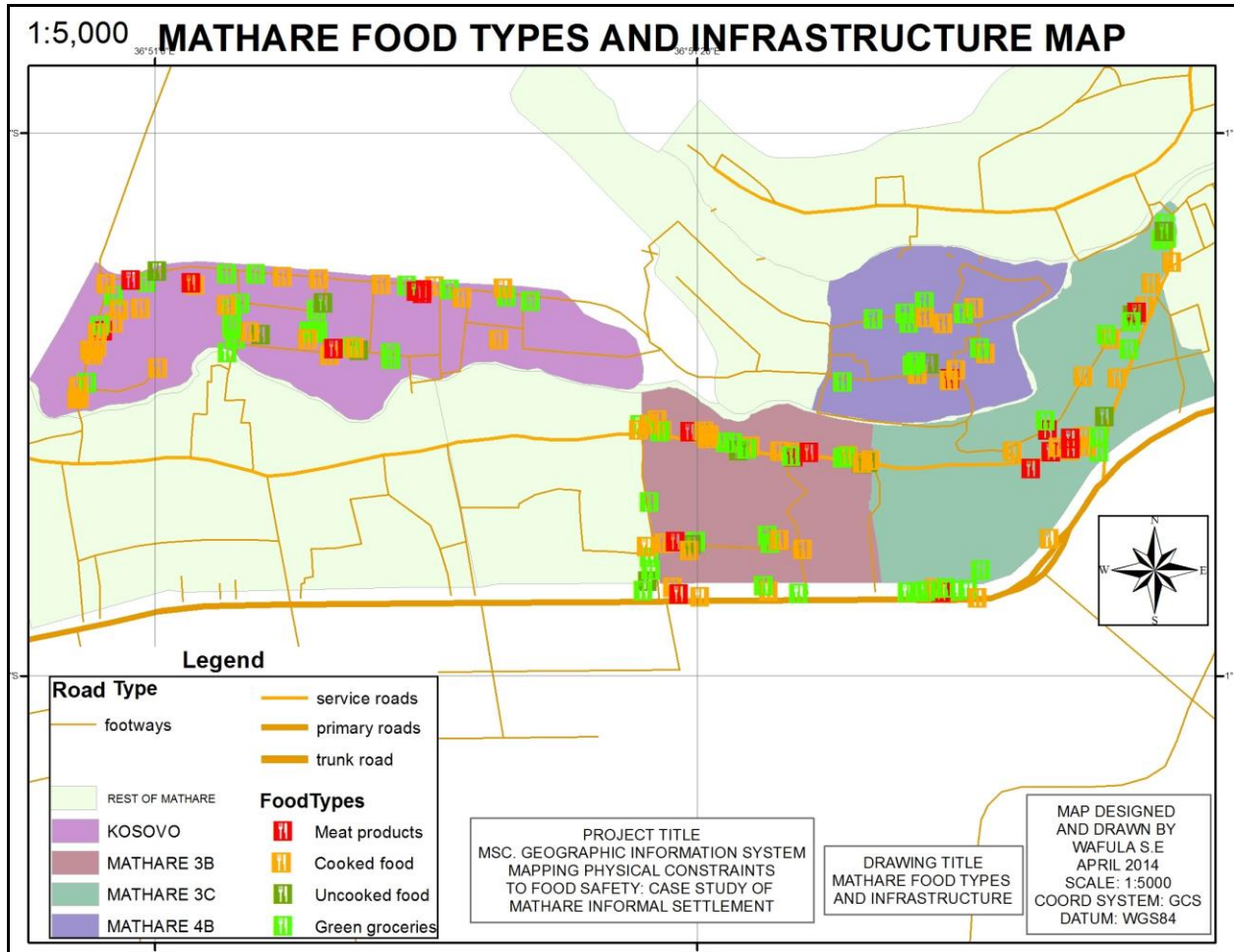


Figure 4.3: Mathare Food types map

From the food types map, it can be clearly seen that majority of the food sold in the settlement is cooked food. Out of the 166 food vending locations, 68 of these were found to sell cooked food. This represents about 41 percent of the total food sold.

4.3 Physical constraints to food safety

Figure 4.4 shows that majority of the food vendors are located in environments characterized by open drains, open sewers, heaps of garbage and along dusty roads. The open drains are chaotic in that solid wastes are also disposed in them causing them to be blocked and produce stench odour.

The blocked and smelly drains attract insects such as flies which are vectors; thus possibility of spreading diseases. They are also a nuisance to the customers due to the bad smells. The major drains along major roads especially along Juja road is large; all types of waste are disposed which results in flooding when it rains. The open drains also act as breeding sites for mosquitoes which could result in malaria outbreaks which may not relate directly to food safety, but may affect the food handling practices. Open sewers are also smelly and attract insects which may cause food contamination. The heaps of garbage are another nuisance which attracts insects and rodents such as rats. Insects such as flies and Rats are disease carrying vectors which cause food contamination.

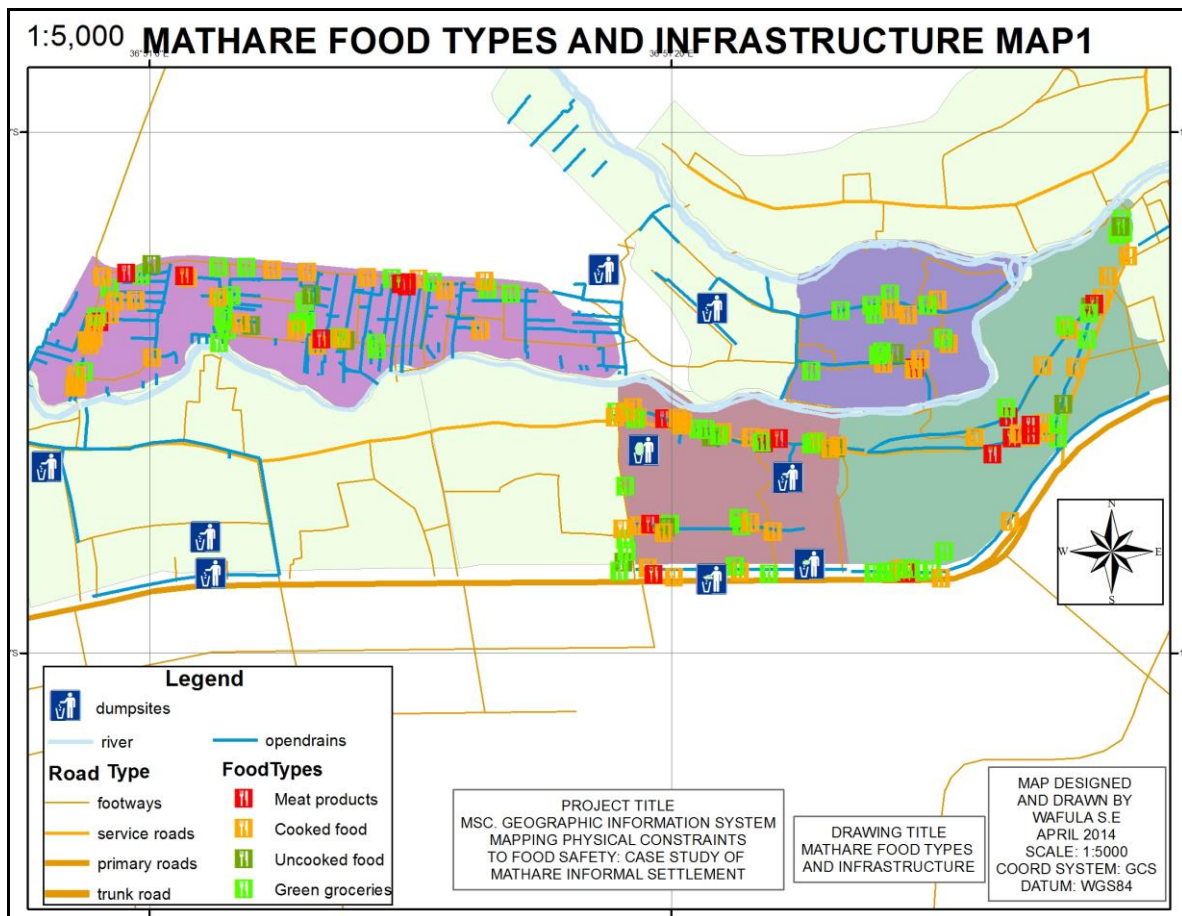


Figure 4.4: Physical constraints to food vending



Figure 4.5: Physical constraints to food vending in Mathare

Water is relatively expensive in the settlement which forces food vendors to use water sparingly. This could compromise the cleanliness of the food they sell especially if they are not cleaned well and also the utensils in which are used. The sources of water are water kiosks and water vendors; the water is relatively expensive when purchased from water vendors. Majority of the food vendors have to walk for quite long distances to acquire water. Others opt to buy water from water vendors which reduce the profit margin. Figure 4.6 shows the distribution of water points within the mapped villages. As it can be seen Bondeni village is the worst hit by water shortages and hence has to access water at a higher cost as compared to Village 3C where a number of food vendors are located to a nearby water point. Village 4B also has a challenge of water as only three water points are located along the boundary of the village. Most food vendors are operating inside the settlement and hence have to send somebody to supply water for them at a higher cost than the retail price.

Toilet distribution also shows where these people can access the toilets during the time of food vending. Bondeni village has only one toilet and hence the food vendors will have challenges of accessing it especially during peak hours of their businesses as this will mean leaving their business unattended. Most of these vendors therefore have to look for alternative means of using the toilet service and hence compromising the safety of their food.

The spaces for food vending are competitive, food vendors prefer to sell mainly along the main roads where every food vendor would like to sell their wares due to volumes of people using the roads; thus more customers. There is therefore space conflict among the food vendors and between food vendors and owners of formal shops, the conflict arises in situations where they sell in front of the formal shops. The food vendors selling in front of other shops have to pay a certain monthly fee. In case of a hotel and a food vendor selling cooked food; it means competition which is really bad since customers prefer food from food vendors which is deemed fresh and hot. The spaces used for vending are also at times polluted by solid waste or human waste disposal especially at night. Most of the food vendors along the access roads have to clean their spaces before opening their businesses every morning. This is due to poor sanitation; there are inadequate toilets and designated spaces for disposing solid waste in the settlement.

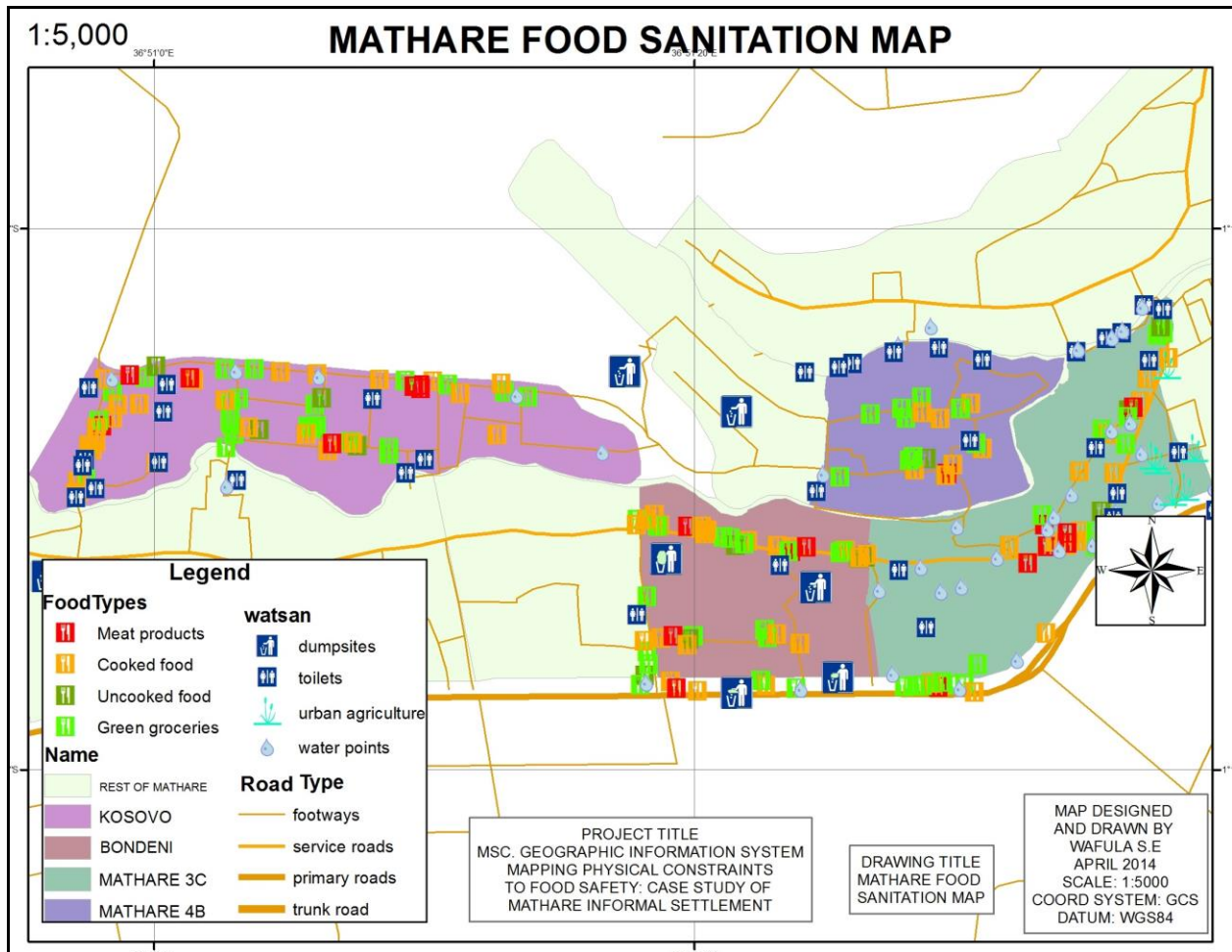


Figure 4.6: The sanitation constraints in food vending

The food vendors lack appropriate storage facilities for their items which causes spoilage especially if the food stays overnight. They reported various coping mechanisms which also depend on the food under consideration. Githeri is boiled and dried; others add pepper to it; when it is contaminated some of the vendors take advantage of those who are ignorant by selling to them (such as selling to the drunkards). In other cases, food vendors give left over's to the livestock keepers. Those dealing with vegetables have to store them up in crates at night. Fish and meat vendors buy just a few to ensure that they do not remain in case they remain for several days then it's a loss to them. Others complained of rodents; especially rats eat the food when it's stored in the houses due to poor storage facilities. Others reported adding preservatives to food especially Githeri and beans to extend their expiry duration and also quicken their cooking period.

4.4 Food safety findings

The Focus Group Discussions focused on elaborating consumers' perceptions of street food safety, how they choose a vendor, what they perceive as safe or hygienic street foods and the physical challenges in accessing safe foods. The recordings and notes taken during the Focus Group Discussions were compiled for each of the four villages. All texts were analyzed using content analysis by organizing data by overall thematic trends. Themes were further developed in sub analyses relating to food contamination, hygiene, environmental hazards and physical infrastructure. Findings are therefore presented according to these themes and are summarized in the sections 4.1.1 to 4.1.4

4.4.1 Food contamination

There are cases of food contamination on the consumers of food sold by the vendors. The major outcomes upon eating this contaminated food included diarrhea, stomachaches, vomiting, dizziness, cholera, amoeba and typhoid. The causes of these cases of food contamination were said to be dirty selling environments, location near dusty roads, inadequate water, poor hygiene by food vendors and lack of storage facilities thus addition of preservatives. Discussions revealed that the overall hygiene practices of vendors were insufficient to ensure bio medically safe foods. Unsafe practices were especially related to inadequate storage and reheating of food before sale,

insufficient hand washing, inappropriate cleaning of cooking utensils, and inadequate rinsing of vegetables.

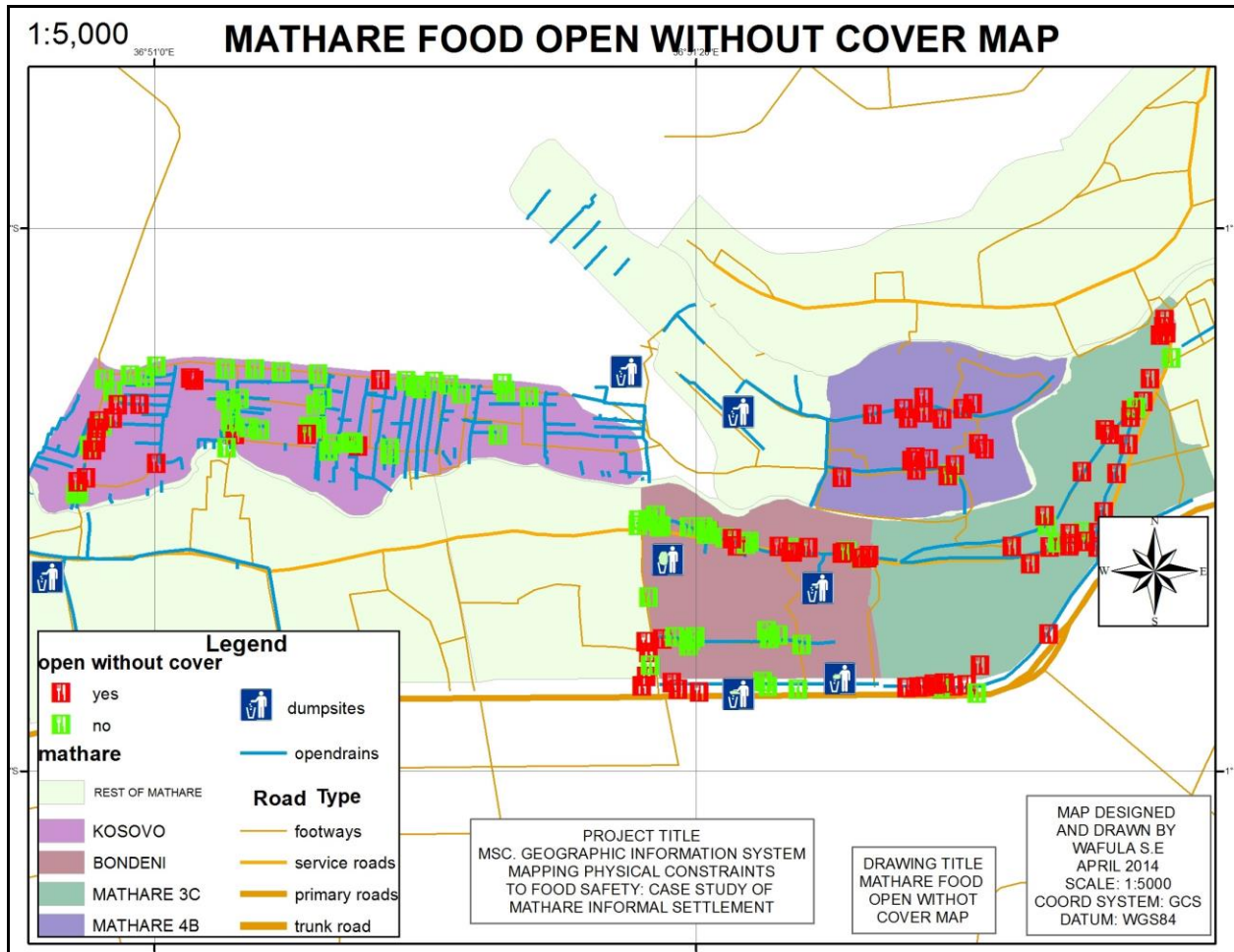


Figure 4.7: Food open without cover

During the mapping exercise using the mobile application, food covering was captured to show whether it was covered or not. With the aid of other mapping information captured during the paper mapping, it was possible to analyze the physical causes of food contamination as shown in figure 4.7. From figure 4.7; the red symbol is used to capture all the foods that are open and hence exposed to other external factors. For instance these foods are being sold next to open drains and hence being exposed to direct contact with storm/dirty water. Since the food vending is happening within the public spaces, there are other competing users of the same space such as livestock and children. This exposure therefore is not food secure as any of these users is likely to disturb the flow of this dirty water and hence end up in the food which will ultimately be consumed. This therefore increases the chances of food spoiling very fast as micro-organisms

will be breeding in the exposed food due to a conducive environment as compared to the covered food. Village 3C, Village 4B and Kosovo cluster A are the most affected sections of the study area with these open foodstuffs being sold next to the open drains. In some cases, the open food is being sold next to a dumping site. This also exposes food to flies and other germs emanating from the garbage and interacting freely with the food. These are some of the factors that cause or act as a catalyst to food contamination within the settlement.

From the Focus Group Discussions, majority of vendors and consumers demonstrated concerns about the conditions of food preparations. One consumer said: “We don’t know where they prepare the food... You don’t even know whether it is leftover food or not... You won’t know...” and vendors often expressed similar concerns about other vendors’ food preparation standards. One respondent said “I think one of the most significant battles for food vendors in Mathare to fight is the right for consumers to know what’s in their food, and how it is prepared”. Most vendors and consumers also expressed basic biomedical knowledge and awareness of disease transmission by describing the presence of dirt at the vending site that pose health risks: a vendor from Bondeni said “She (the vendor) has to remove anything associated with dirt from the selling place before she serves. This will ensure that you will not get any illness and that customers will be attracted to buy her food.” A consumer from Kosovo also observes, “First I will observe the immediate surroundings and appearance before deciding where to buy food.” A female vendor from village 4B contributes to the discussion by saying that “Food is very delicate since it could be the cause of a lot of diseases if not well handled.”

Knowledge of severe food-borne diseases such as typhoid and cholera and their ways of transmission were also mentioned by all vendors and many customers, who thereby demonstrated basic knowledge on disease transmission via food and water. “Retaining customers of cooked food in the settlement takes a high standard of a vendor’s personal hygiene, well cleaned vending spaces and properly cultivated vendor customer relations.” —Respondent, focus group discussion (cooked food vendor)

4.4.2 Hygiene of vending surroundings

The analysis of data from all discussions shows that four overall criteria seem to guide both vendors and customers when describing food safety and choosing food: (1) All customers and vendors mentioned their choice of a stand was influenced by its physical appearance and

presentation, which they verbalized as “neatness;” (2) they also stressed the need for a vendor himself or herself to appear “neat” and “orderly”, meaning being a tidy person; (3) most consumers also expressed that trust in the vendor was important when choosing a safe place to eat—this trust was built on previous positive experiences or social/family relationships and not on food safety assessments; and (4) all consumers mentioned that street food should be cheap and easily accessible.

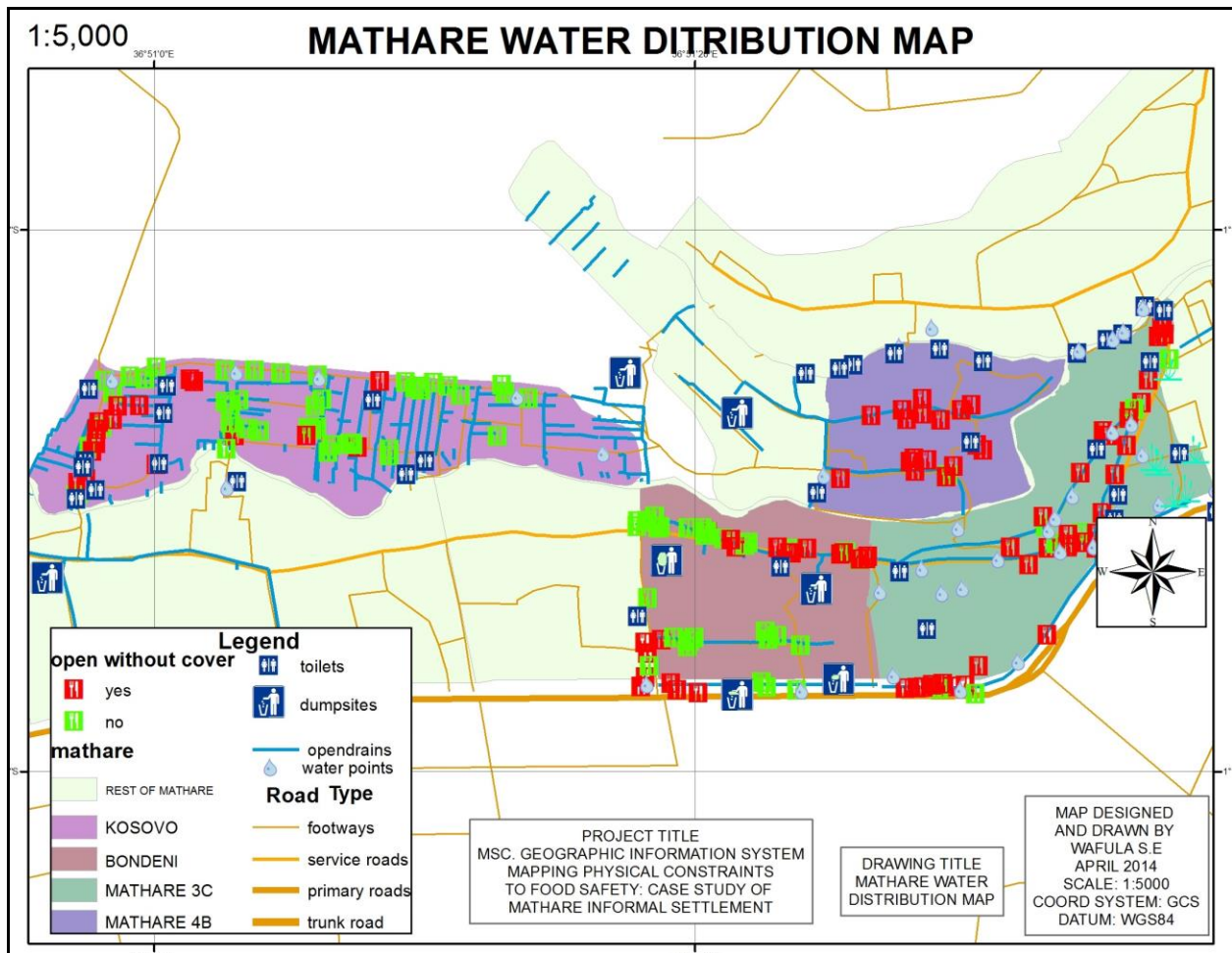


Figure 4.8: Water distribution within Mathare

Figure 4.8 highlights the water distribution within the mapped villages. From the map, we can see that some of the villages are poorly served with water such as Bodeni and Village 4B. The end effect of this is that many vendors in these villages have to buy water at a faraway kiosk and hence at a higher cost due to additional costs such as transport costs. A normal 20 liter Jerican full of water costs about Kshs. 2 to Kshs. 5. The carrying costs are from Kshs. 20 per Jerican. A food vendor operating further away from the water points will therefore spend up to Kshs. 25 per

Jerican to get water. Most food vendors dealing with vegetable and fruits utilize about 2 to 3 Jericans per day. Therefore for most of these vendors, they will be forced to recycle water and use less water in a day in order to cut down the water expenses. This in itself compromises the hygiene of the food sold as some customers will buy already cut vegetables which may not have been properly washed. The water used for washing vegetables may still be used to wash fruits hence exposing those fruits to unhygienic conditions. For those vendors dealing with cooked food, the washing of utensils may also be compromised as the water may have been recycled.

To cope with the uncertainty of food safety, several risk avoidance strategies were expressed. A few customers expressed more fatalistic attitudes toward the potential dangers of consuming street foods: “Yes, I am afraid of getting sick from food but I can do nothing about it. I have to eat because I have no time to cook” (female consumer in FGD). “The way we eat in informal settlements has changed over time; this is because we lack adequate cooking spaces in our shanties and more so we are prone to fire outbreaks. This is why we prefer ready cooked food.” — Respondent, focus group discussion. “If you can’t see it, it does not hurt you” was also frequently heard from customers describing their reaction to being unable to monitor cooking premises and identifying sources of contamination. Most of the consumers mentioned the importance of assessing the hygiene and visible appearance of the vendor and the surroundings of the vending sites: “Some (vendors) cook the food somewhere else and bring it to the stand. What we do then is to look at the vendor. If she is neat ... the food will also be neat” (FGD, female consumer). Despite basic knowledge of risks of food-borne diseases, observations showed that consumers do not request for more hygienic behaviors from vendors. Consumers were never heard inquiring about hand washing or whether the vegetables had been washed sufficiently. Similarly, in FGDs, consumers emphasized that they did not wish to influence the practices of vendors even though they were highly concerned about food safety: “In fact you can’t tell the owner of the place if the vendor or the place is not neat. You will feel too shy to stand in her face and tell her” (FGD, male consumer).

Both observations and discussions with vendors and consumers made it clear that there is a strong focus on the personal neatness and appearance of the vendor. Vendors are conscious of changing stained clothes to clean ones, putting on colorful dresses before presenting themselves to customers at their vending sites. One consumer said: “You will have to be careful by being selective i.e. how the person looks. Her appearance is important to me” (FGD, female

consumers). Consumers and vendors referred to hygiene as personal pureness and positive personal qualities such as neat manners, being friendly, and polite. Also, 'cleanliness' seemed to have a moral connotation and was associated with having a good moral attitude. Thus, neatness is comprised of normative values of aesthetic, social, and moral pureness. Furthermore, it was clear from the participant observations that while many efforts were made to keep the vending premises neat and the appearance of the vendors neat, the food preparation sites were often disorganized and dirty. Local perceptions of food safety and hygiene thus seem to be highly influenced by values of neatness and appearance among both vendors and consumers.

4.4.3 Relationship between food vending and infrastructure

Lack of adequate infrastructure perpetuates poverty, because it denies possibilities such as access to food especially for residents living deep in the settlement. Hunger, is one of the most obvious symptoms of poverty, is often less the result of lack of food than a distance from food. When people live far away from food sources, food safety depends on infrastructure that ensures food can be transported in an efficient and cost effective way.

Figure 4.9 shows food kiosks within the road buffer. Three road buffers have been created based on the size of the road. The first buffer is along Juja road which is a 15 meter buffer since Juja road is approximately 25 meter wide and hence food kiosks falling within 30 meters lie within the road reserve. The second buffer is 10 meters and this is mainly along Mau Mau road which is a major road cutting across Mathare Informal Settlement. The width size of the road is about 15 meters and hence food kiosks lying within 20 meters of Mau Mau road also fall within the road reserve by default. The last buffer is 5 meters and is covering majority of the non-motorable foot access roads within the settlement which are less than 10 meters in width. From the three buffers, a total of 105 food vending locations out of the 166 mapped locations are selected to be falling within the buffer zones. This means that at least 63 percent of the total food vendors in Mathare Informal Settlement sell directly on the road or within 5 meters from the road. This contributes greatly towards safety of food as most of these roads are non-motor able and dusty. The food is exposed to dusty environments and other users of the road hence compromising its safety.

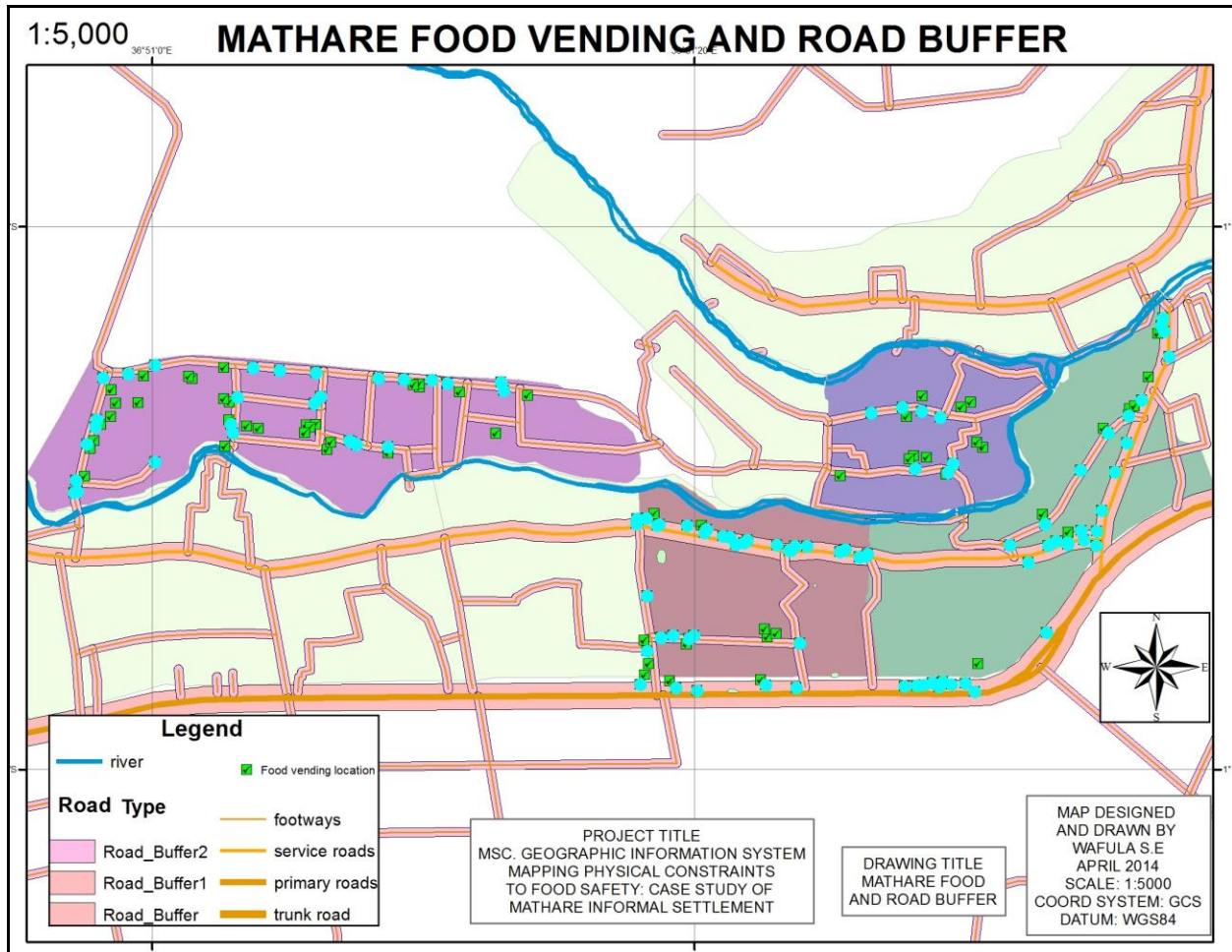


Figure 4.9: Road buffer showing the food vending locations within the road buffer

The food vending business lacks adequate infrastructure that could enhance food safety situation. Supply of water was inadequate and hence costly especially in times of water shortage. Inefficient and unreliable waste disposal system; inconvenient and unhygienic eating-places were some of the major infrastructural problems brought out during the discussions. Poor drainage systems within the villages pose a danger to their children, both in terms of health and possible accidents. During the FGD held in 3C, one of the respondent said “Designating waste disposal sites in the settlement without a proper road network to enhance regular collections will not solve waste issues in Mathare.” A consumer also in a Focus Group Discussion notes that, “Never before in my wildest thoughts have I ever considered that food is directly impacted by the status of sanitation infrastructure, but now I know.” There is therefore a very strong relationship between infrastructure and food safety. In order to achieve safe food operating environment, then the water, road, sanitation and electricity infrastructure needs to be addressed.

4.4.4 Food vendors association

An area of improvement in the street food vending activity is the formation of an umbrella association by the street food vendors. Through this association, training in personal hygiene, safe food handling, preparation and clean environment is impacted to the street food vendors. The association also offers a forum for the food vendors to share ideas and discuss issues of common concern. It offers an opportunity for credit facilities and other benevolent activities. This enhances improvement and ensures food safety.

The Food Vendors' Association began in late 2013, formed by the Kenyan Federation of Slum Dwellers, Muungano wa Wanavijiji. The association members come from three informal Nairobi settlements: Mathare, Huruma and Kibera. It champions food security issues in the informal settlements and infrastructure needs. Its membership has grown very quickly — to almost 400

Box 1. Community views

1. "I think one of the most significant battles for food vendors in Mathare to fight is the right for consumers to know what's in their food, and how it is prepared" — respondent, focus group
2. "The way we eat in informal settlements has changed over time; this is because we lack adequate cooking spaces in our shanties and more so we are prone to fire outbreaks. This is why we prefer ready-cooked food" — respondent, focus group discussion
3. "Food Vendors Association is not all about lobbying for the interests of food vendors but a strategic platform to champion issues of sanitation and improved basic infrastructure in the settlements which have direct impacts on food safety" — Julia Wacera, mobiliser
4. "My security and that of the settlement is a factor that dictates my vending hours" — respondent, focus group discussion
5. "In Mathare we've become a community of technicians! We would rather focus on the know-how, and not rubber stamp studies that did not involve the community" — Willy, community mapper
6. "Open spaces are social meeting points for many slum residents, often managed on the basis of collective informal governance" — respondent, focus group discussion
7. "Never before in my wildest thoughts have I ever considered that food is directly impacted by the status of sanitation infrastructure, but now I know" — consumer, focus group discussion

individual vendors and producers in just a few months, suggesting there is great interest in this issue. The members include women who sell vegetables and cooked food, persons operating butcheries, kiosks owners selling food and cereals and livestock keepers. Members are organised in local groups who jointly buy maize flour and soap and develop a saving scheme from

which they can get loans to expand their businesses (up to three times the value of their savings).

The FVA sees itself as a change agent taking a strategic initiative and championing issues of sanitation and other infrastructure in the settlements. It can integrate and scale up individual and personal actions, drawing on the deep social networks that exist in the informal settlements. FVA proposes several opportunities that food vendors and livestock keepers can embrace to enhance food safety in Mathare. These include: monthly trainings on food security and sanitation to create awareness of the importance of hygiene and how to enhance cleanliness at food vending spaces, and team clean up exercises to create collective responsibility among food vendors, livestock keepers and residents for keeping the settlement clean. As Julia Wacera puts it, “Food Vendors Association is not all about lobbying for the interests of food vendors but a strategic platform to champion issues of sanitation and improved basic infrastructure in the settlements which have direct impacts on food safety.”

4.5 Food safety map

Figure 4.10 shows the food safety map for Mathare Informal Settlement integrating hygienic and infrastructure with the food vending as the core of the analysis. The layout has two maps where the map on the left hand side identifies the food vending locations that are under a shed and those that are not with relationship to the road infrastructure. A buffer of 15 meters, 10 meters and 5 meters has been created respectively around the primary, secondary and tertiary roads to identify the possible food vending locations affected most by such factors as dust and livestock/human conflicts. The main road cutting across the Mathare valley (i.e. Mau Mau road) where food vending activities are many is about 8 meters wide. It is therefore assumed that vendors operating within 5 meters from the road are likely to be affected by the conditions of the road. This therefore is the criteria used in this study to choose the 10 meter buffer for this road. The map on the right hand side on the other hand identifies those food vendors whose food is open without a covering on top. The food left in open is more likely to be affected by such factors as flies, drains and livestock. Due to conflict of space, somebody can step in the drains and the effects of the water coming from the drains are likely to affect the uncovered food around. Livestock can also pass by and if the food vendor is busy working on other things, they may eat the food and by the time he/she chases them away the damage is already done. A buffer of 10

meters is also done to identify those food that are not covered and lying within 5 meters from the open drains using Mau Mau road as the main street of focus.

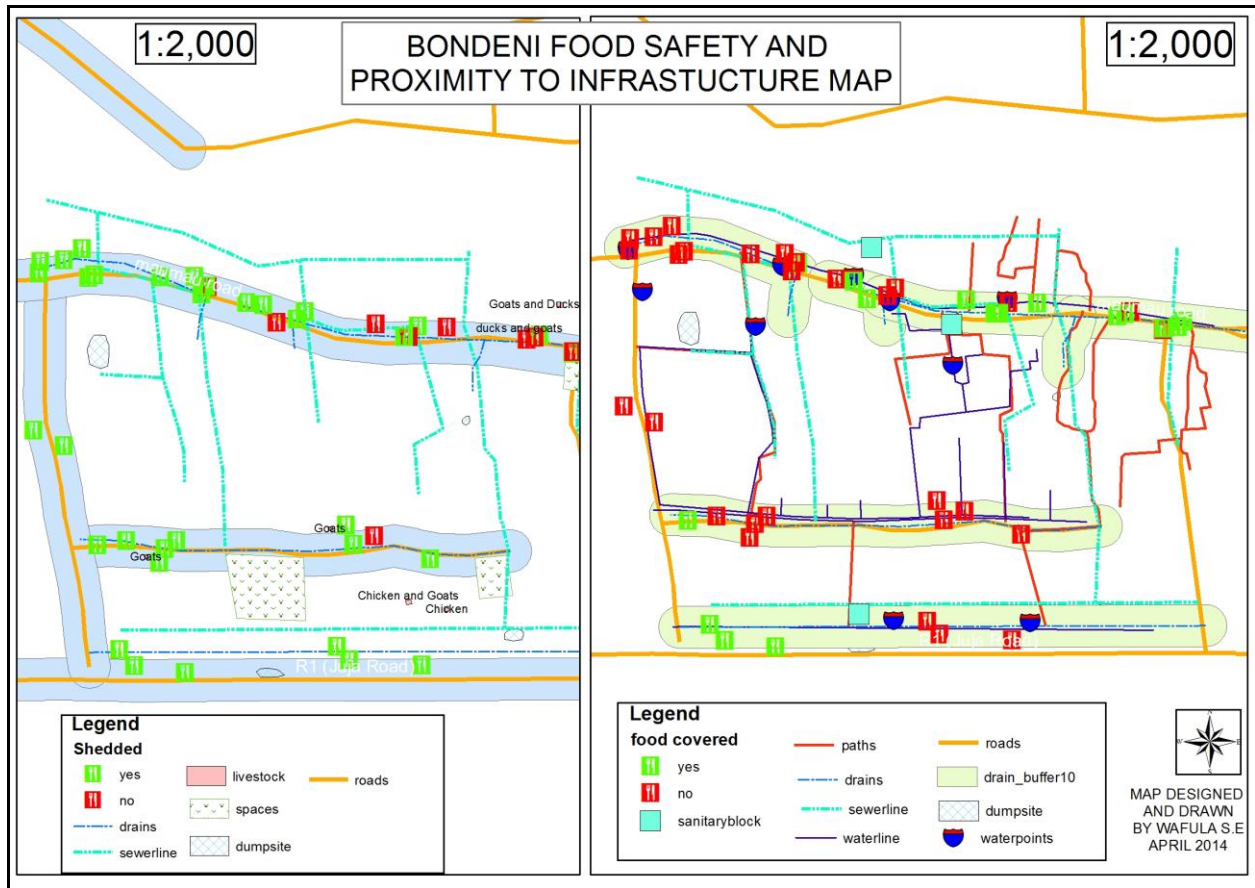


Figure 4.10: Food safety map and proximity to infrastructure

4.6 Discussion of the results

Despite their important role, Mathare’s street vendors are often seen as a problem. The public spaces where they work are often contested, and poor facilities pose further difficulties. The mapping and survey work identified many challenges facing Mathare’s informal food web. These challenges include

- Vendors compete for spaces along major streets and those operating in front of other businesses may have to pay formal businesses for using their frontages. This increases their operation costs and hence limits their profits.
- Social and commercial exchanges in public spaces can cause obstructions to the competing users of these spaces.

- Vendors generally lack shelter and proper storage facilities, while high humidity and temperatures increase food spoilage. Some vendors add preservatives such as magadi soda to their food, which could be harmful to the customers in the long run.
- Pests including rats and rodents pose many problems for vendors and customers alike. For instance storage of the tomatoes in their houses overnight causes great losses as these rats eat them or even poke holes and destroy majority of them.
- Working in public spaces means competing for the same space with livestock. The end effect is that livestock feces can contaminate food, and livestock may themselves eat food and hence contaminate these foods.
- Sanitation infrastructure is often in disrepair or non-existent, and water may be expensive or unavailable and hence limiting the level of cleanliness that these vendors can achieve.
- Food being sold very close to uncovered surface drains hence exposing them to risks of poor health considering some of these foods is not covered. These uncovered drains also contribute to flooding of the vending spaces especially during the rainy season. The food vendors have to work very hard to open up these drains so that water can flow and be able to continue with their businesses.
- Inadequate solid waste collection fosters food contamination
- Floods can damage food transport and stop vendors from working
- Power cuts and black outs reduce physical security for both street vendors and their customers. When power cuts force vendors to close, their own earning potential is curtailed, as is their customers' access to cheap cooked food
- Food for urban livestock must be sourced from shops, markets/food vendors, neighbours or acquaintances. But contrary to popular perception, this need for animal food means street food vendors produce very little waste — peelings etc go to livestock food.
- Livestock are slaughtered in the settlement where waste removal is inadequate. So slaughter waste or whole dead animals may be left in the river or along the streets hence contributing to the unhygienic food vending locations.
- Street vendors often suffer evictions or forced closure by city authorities during disease outbreaks. This puts their livelihoods at risk and reduces access to food for the poorest residents of low-income settlements, who tend to be most dependent on street vendors.

Mapping also revealed how the spaces near environmental hazards are positively attractive to food vendors and consumers, because competition and costs there are low. Customers in Mathare on the other hand opt for lower prices over higher quality when purchasing food.

4.6.1 Opportunities available for improving food safety in Mathare

The food safety study conducted in Mathare revealed the situation of food related activities. The main food typologies sold by the food vendors were cooked food (including hot beverages), green groceries and cooked/uncooked meat (and meat products). The food vendors operate between 5am and 10pm in which various food categories have different peak hours. Hot beverages and their accompaniments are prepared as early as 5am and the cooked food is mainly available during meal times that is 11am to 3pm and 6pm to 10pm. The main food sources are within Mathare neighborhood and other parts of Nairobi.

One of the major observations made is that majority of food vendors sell in dirty and unhygienic environments characterized by nearness to open drainages/sewers and heaps of garbage. The spaces near the environmental hazards such as open drains have no competition therefore the food is sold cheaply and more customers are therefore attracted. The food vendors are also faced by the problem of water which is relatively expensive and in limited supplies. Thirdly is the issue of competition of space especially along major streets where they at times have to pay a fee to the owners of formal business premises whose frontages they use. The prices of raw materials are relatively high causing them to buy low quality goods. The other concerns were insects and rodents getting into food which are ignored thus a health hazard or causes the food vendor losses if they dispose the food. There are also incidences of insecurity reported which hinders some vendors from working late. The customers do not also leave the house past particular times of the night. The food vendors also reported lack of cooling facilities; they therefore have improvised cooling methods or the food just goes bad. Another problem was there being few toilets the residents dispose human waste at the spaces used by the food vendors at night or early in the morning. The food vendors have no option other than cleanup the spaces and continue with business as usual.

From the analyses carried out so far, the safety issues within the settlement range from selling in dirty environments, selling near open drains, unhygienic handling of food by the food vendors,

food vending locations near dirty roads, inadequate water for washing of food and utensils and addition of preservatives and chemicals to food which poses health hazards. From the mapping data, we can also find out that most of the food vendors are operating along the roads of passage within the villages. Some of the physical constraints within these operating spaces are exposure to open drains, limited water supply points within the village, lack of storage facilities for the food vendors and limited toilets within the settlement whose cost of accessing is beyond the reach of an average food vendor. There is therefore a very strong link between the poor infrastructure network within the settlement and the food safety situation.

From the discussions with the residents, the opportunities that therefore come out in the order of preference to address the food safety situation are:

1. Creation of food safety awareness
2. Clean up exercises
3. Provision of designated dumping sites
4. Lobbying for water provision
5. Lobbying for covering of open drains and sewers by the County government
6. Provision of communal storage/cooling facilities
7. Engagement with the public health sector to lobby for free issuance of health certificates and licenses.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter focusses on summary, conclusion and recommendations

5.1 Summary

From the study, it can be seen that residents of Mathare Informal Settlement have demonstrated a strong ability to provide for their own needs and survive in difficult economic circumstances. The communities in Mathare Informal Settlement struggle with issues including inadequate housing, water and sewerage networks, inaccessible and unsafe sanitation services, unaffordable electricity and muddy roads. Many residents rely on street vendors for their cooked food and often for water, clothes and so forth. All street sellers rely on a locally functioning community structures, and this two-way reliance is manifested in strongly ingrained community solidarity, for example not selling milk with preservatives to families with children or by providing social support such as buying food from family members and neighbours. Even strains such as theft, loans between customers and vendors that turn sour, or conflict between livestock owners and food vendors fail to dent the strong social network within the settlement.

The food safety study conducted in Mathare has revealed the situation of food related activities. The main food typologies sold by the food vendors were cooked food including hot beverages and green groceries as well as cooked and uncooked meat and meat products. The food vendors operate between 5am and 10pm in which various food categories have different peak hours. Hot beverages and their accompaniments are prepared as early as 5am and the cooked food is mainly available during meal times that is 11am to 3pm and 6pm to 10pm. The main food sources are within Mathare neighborhoods and other parts of Nairobi.

One of the major observations made is that majority of food vendors sell in dirty environments characterized by nearness to open drainages/sewers and heaps of garbage. The spaces near the environmental hazards such as open drains have no competition therefore the food is sold cheaply and more customers are therefore, attracted. The food vendors are also faced by the problem of water which is relatively expensive and in limited supplies. Thirdly is the issue of competition of space especially along major streets where they at times have to pay a fee to the owners of formal business premises whose frontages they use. The prices of raw materials are

relatively high causing them to buy low quality goods. The other concerns were insects and rodents getting into food which are ignored thus a health hazard or causes the food vendor losses if they dispose the food. There are also incidences of insecurity reported which hinders some vendors from working late. The customers do not also leave the house past particular times of the night. The food vendors also reported lack of cooling facilities; they therefore have improvised cooling methods or the food just goes bad. Another problem was there being few toilets the residents dispose human waste at the spaces used by the food vendors at night or early in the morning. The food vendors have no otherwise other than clean the spaces and continue with business as usual.

Food vendors therefore play a significant role in informal settlements such as Mathare, and Food Vendor Associations and their initiatives on infrastructure can complement formal planning policies. In Nairobi and other cities there are opportunities for vendors' associations to collaborate with initiatives such as the Kenya Slum Upgrading Program and the Kenya Informal Settlement Improvement Project. Participatory mapping is a way to build this relationship.

Mapping has also revealed how local communities use public spaces innovatively, managing these on the basis of informal governance. Policies on community lands should entrust communities with settlement led development solutions for such open public spaces (community markets, designated waste disposal points, and toilet and water blocks).

However, good food safety practices depend on a foundation of proper inhabitable and affordable housing and on basic infrastructure in low- income settlements. Without sound policy on housing, land tenure and infrastructure, rapid urbanisation will ensure poverty, food insecurity and poor health standards continue to coalesce in urban slums.

5.2 Conclusions

In conclusion the project was designated to map the physical constraints to food safety in Nairobi's Informal Settlements. From the study, it has been found out that the major physical constraints in these settlements are poor road infrastructure, inadequate water reticulation, poor sewerage system which is non-existent or in disrepair, lack of storage facilities and congested public space. On the other hand the safety issues have been found out to include food contamination, hygiene and poor food handling. The study has been able to show how these physical constraints contribute to food safety within the settlement. this has been made possible

through the GIS database where the physical constraints were captured spatially and then the analyzed together with the findings of the Focus Group Discussions and observation made during the transect walks within the settlement.

The specific objectives highlighted in section 1.3.2 have been achieved since

- a) The physical constraints to food safety issues in informal settlements have been identified as environmental, infrastructure and space. Food safety issues have also been identified to include contamination, storage, security, hygiene and food handling.
- b) A spatial database of the mapped food locations can be visualized on the project website <http://epicollectserver.appspot.com/project.html?name=FoodSecurityNairobi>. A spatial database of the physical constraints has been further created in the ArcGIS 10.0 software.
- c) The resultant database has been analyzed to understand how these physical constraints contribute to the food safety issues in the settlement. Figure 4.10 is a result of this analysis.

5.3 Recommendations

Mapping is a tool for communities to engage with public authorities. In Nairobi, the FVA (Food Vendors Association) can embrace balloon mapping as both a knowledge creation and a mobilization tool. Such interactive and participatory mapping tool will offer the community leverage when advocating better access to water and improved sanitation. They can also showcase community-led infrastructure improvement and better social, health and environmental practices that have started to raise food safety in informal settlements. Following the findings of this study in Mathare, food safety mapping can be extended to other places such as Mukuru and Kibera, two other large informal settlements in Nairobi.

The FVA can be seen as a change agent taking strategic initiatives and championing issues of sanitation and other infrastructure in the settlements. It can integrate and scale up individual and personal actions, drawing on the deep social networks that exist in the informal settlements. In discussion with these FVAs, there have been some proposals on several opportunities that food vendors and livestock keepers can embrace to enhance food safety in Mathare. These include: organized trainings on food safety and sanitation to create awareness of the importance of hygiene and how to enhance cleanliness at food vending spaces, and team clean up exercises to

create collective responsibility among food vendors, livestock keepers and residents for keeping the settlement clean. Another major opportunity is solid waste management. Recently the County government of Nairobi implemented an ambitious program to manage solid waste within the county. This launch involves the garbage collection tracks which have been sent to the various parts of the county. The residents of Mathare can be mobilized through the Food Vendors Association towards collecting their solid waste at designated garbage collection points and through the partnership with the County government ensure that these waste is collected at a given day of the week. This step will contribute greatly towards ensuring food vendors operate in clean environment and minimize the effects of food contamination and overall hygiene of the vending locations.

Finally the food vendors can also improve the storage of their food stuffs through a collaborative effort such as acquisition of a communal refrigerator. In this concept, the food vendors through their daily savings can acquire a refrigerating facility as a project and place it at a strategic location within the settlement and then the vendors are able to store their food in this facility at a small and affordable cost.

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APPENDICES

Appendix A: Focus Group Discussion questions

1. What are the main food types?
2. Do you know your customers? If yes who are they? (neighbours, family, other villages)
3. Where do you source your materials for sale?
4. How many days per week and hours in a day do you operate your businesses?
5. Which types of food sell mostly in the morning, mid-morning and evening hours?
6. What effect does the surrounding environment (open drains, solid waste heaps, open sewers, roads) have on the activity you are undertaking? (measures taken to lessen the negative impacts on your food)
7. Are there people who move from one location to another during the day? If yes; What factors lead to continued change of location of food vending e.g. selling at one point in the morning and another point in the evening?
8. Are you located at one area at all seasons of the year? If no what are the main constraints (slopes, flood, hot sun, dust)
9. Is the area considered secure?
10. Where do you store your food?
11. Do you consider your food safe for consumption at all times?
12. Are there foods you have sold in the past that you do not sell anymore?
13. Have you heard cases of food contamination from your customers
14. In your opinion what measures can be taken to enhance food safety in your settlement?

Appendix B: Excerpts from the project website data downloaded in csv file format

Appendix B1: Excerpt 1

key	dateCreat	latitude	longitude	altitude	deviceId	entryId	lastEdited	timeUploz	projectNa
ahZzfmVw	02:20.1	-1.26538	36.85664	1631.7	3.57E+14	356779057	02:20.1	15:35.2	FoodSecu
ahZzfmVw	13:25.8	-1.2653	36.85555	1634.5	3.57E+14	356779057	13:25.8	05:01.6	FoodSecu
ahZzfmVw	04:26.8	-1.26405	36.85515	1617.5	3.57E+14	356779057	04:26.8	55:23.0	FoodSecu
ahZzfmVw	27:37.3	-1.26421	36.85568	1621.5	3.57E+14	356779057	27:37.3	38:54.5	FoodSecu
ahZzfmVw	35:42.2	-1.26532	36.85521	1635.4	3.57E+14	356779057	35:42.2	08:48.9	FoodSecu
ahZzfmVw	33:50.6	0	0	1627.3	3.57E+14	356779057	33:50.6	08:19.4	FoodSecu
ahZzfmVw	36:31.4	-1.26586	36.85559	1633.3	3.57E+14	356779057	36:31.4	06:10.4	FoodSecu
ahZzfmVw	18:11.0	-1.26533	36.8555	1625.2	3.57E+14	356779057	18:11.0	06:13.5	FoodSecu
ahZzfmVw	56:00.7	-1.2641	36.85497	1615.9	3.57E+14	356779057	56:00.7	54:36.7	FoodSecu
ahZzfmVw	52:23.0	-1.26416	36.85496	1614.5	3.57E+14	356779057	52:23.0	54:21.3	FoodSecu
ahZzfmVw	17:27.4	-1.26417	36.85548	1621.7	3.57E+14	356779057	17:27.4	52:27.3	FoodSecu
ahZzfmVw	51:56.1	-1.26583	36.8566	1623.3	3.57E+14	356779057	51:56.1	15:01.3	FoodSecu
ahZzfmVw	24:26.6	-1.26417	36.85563	1623.4	3.57E+14	356779057	24:26.6	52:52.5	FoodSecu
ahZzfmVw	04:59.8	-1.26532	36.85631	1632.5	3.57E+14	356779057	04:59.8	16:13.3	FoodSecu
ahZzfmVw	51:16.6	-1.26483	36.85494	1625	3.57E+14	356779057	51:16.6	10:01.5	FoodSecu
ahZzfmVw	42:42.1	-1.26581	36.85629	1621.8	3.57E+14	356779057	42:42.1	06:31.8	FoodSecu
ahZzfmVw	23:57.8	-1.2653	36.85534	1635.4	3.57E+14	356779057	23:57.8	07:40.9	FoodSecu
ahZzfmVw	08:28.5	-1.26523	36.85628	1637.8	3.57E+14	356779057	08:28.5	55:36.7	FoodSecu
ahZzfmVw	23:07.7	-1.26577	36.85531	1624.8	3.57E+14	356779057	23:07.7	57:18.7	FoodSecu
ahZzfmVw	48:51.7	-1.26575	36.85624	1623.2	3.57E+14	356779057	48:51.7	07:07.6	FoodSecu
ahZzfmVw	15:14.6	-1.26416	36.8552	1624.5	3.57E+14	356779057	15:14.6	52:05.5	FoodSecu
ahZzfmVw	21:08.6	-1.26539	36.85548	1621.5	3.57E+14	356779057	21:08.6	06:52.3	FoodSecu

Appendix B2: Excerpt 2

timeUploz	projectNa	photo	FoodVenc	FoodType	Sex	Age	Shedded	OpenWith	mainRoad	DumpingS	SewerDra	Access2wa
15:35.2	FoodSecu	http://epi	7	OtherCoo	Female	36to45	Shed1	open2	road2	dump1	drain1	waterKios
05:01.6	FoodSecu	http://epi	11	Vegetable	Female	36to45	Shed1	open2	road2	dump2	drain2	waterKios
55:23.0	FoodSecu	http://epi	104	OtherCoo	Female	46to55	Shed1	open2	road1	dump2	drain1	waterKios
38:54.5	FoodSecu	http://epi	109	OtherCoo	Female	26to35	Shed2	open1	road1	dump2	drain1	comTap
08:48.9	FoodSecu	http://epi	17	OtherCoo	Female	26to35	Shed1	open1	road2	dump2	drain2	waterKios
08:19.4	FoodSecu	http://epi	16	OtherCoo	Male	46to55	Shed1	open1	road2	dump2	drain1	waterKios
06:10.4	FoodSecu	http://epi	3	OtherCoo	Male	36to45	Shed1	open1	road1	dump2	drain1	waterKios
06:13.5	FoodSecu	http://epi	12	Others	Female	36to45	Shed1	open2	road2	dump1	drain1	waterKios
54:36.7	FoodSecu	http://epi	102	Vegetable	Male	36to45	Shed1	open2	road1	dump1	drain1	waterKios
54:21.3	FoodSecu	http://epi	101	OtherCoo	Female	46to55	Shed1	open2	road1	dump2	drain1	waterKios
52:27.3	FoodSecu	http://epi	107	Meat	Male	26to35	Shed1	open2	road1	dump2	drain1	waterKios
15:01.3	FoodSecu	http://epi	6	Vegetable	Female	36to45	Shed1	open2	road1	dump1	drain1	waterKios
52:52.5	FoodSecu	http://epi	108	OtherCoo	Male	26to35	Shed1	open2	road1	dump2	drain1	waterKios
16:13.3	FoodSecu	http://epi	8	Vegetable	Female	36to45	Shed1	open2	road2	dump1	drain1	waterKios
10:01.5	FoodSecu	http://epi	20	Vegetable	Female	26to35	Shed1	open2	road2	dump2	drain1	waterKios
06:31.8	FoodSecu	http://epi	4	OtherCoo	Male	26to35	Shed1	open2	road1	dump1	drain1	waterKios
07:40.9	FoodSecu	http://epi	15	Meat	Male	36to45	Shed1	open2	road1	dump2	drain2	waterKios
55:36.7	FoodSecu	http://epi	9	Vegetable	Female	36to45	Shed1	open2	road2	dump1	drain1	waterKios
57:18.7	FoodSecu	http://epi	1	OtherCoo	Female	16to25	Shed1	open1	road1	dump2	drain1	waterKios
07:07.6	FoodSecu	http://epi	5	Vegetable	Female	46to55	Shed1	open2	road1	dump1	drain1	waterKios
52:05.5	FoodSecu	http://epi	106	OtherCoo	Female	46to55	Shed1	open2	road1	dump2	drain1	waterKios
06:52.3	FoodSecu	http://epi	13	OtherCoo	Female	36to45	Shed1	open2	road2	dump1	drain2	waterKios