PUBLIC HEALTH RISKS OF URBAN LIVESTOCK KEEPING: A CASE STUDY OF MAKADARA SUB-COUNTY IN NAIROBI

BY

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DECLARATION

I declare that this research project is my original work and has not been presented for a degree in any other university

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(I56/71304/2014)

This research project has been submitted for examination with our approval as University Supervisors

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DEDICATION

I would like to dedicate this project to my parents who supported me both financially and emotionally despite all the challenges; to my husband Peter Musau and brother Peter Githinji who were always there during the entire period of this study; and to the FOODMETRES Project team: Dr. Samuel Owuor, Dr. Romborah Simiyu, Dr. Teresa Mbatia, Dr. Jacqueline Walubwa and Ms Bancy Kinuthia.

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ABSTRACT

Livestock keeping is one type of farming that is gradually gaining popularity in urban areas. More often than not, it is a way of supplementing food or income for, especially the urban poor living in informal settlements. However, livestock keeping, whether in the rural or urban areas, is associated with a number of public health risks. The aim of this study is to assess the public health risks of urban livestock keeping – using Makadara sub-County in Nairobi as a case study. The objectives of the study are to (1) examine the nature and extent of urban livestock keeping in Makadara sub-County; (2) assess the livestock keeping practices that result in public health risks; and (3) determine innovative livestock keeping practices. Both primary and secondary data were used to achieve these objectives. Primary data was collected through questionnaires, in-depth interviews, key informants interviews and direct field observations. The study results are largely based on data generated from a sample of 30 livestock keepers in three administrative wards of Makadara sub-County, namely Viwandani, Makongeni and Hamza. Majority of the urban livestock keepers were male who ventured into the practice as an income generating activity. It is not surprising that many of the livestock keepers preferred small animals (poultry, rabbits) because of their fast maturity, fast selling products and less demand for space. The main public health implications observed were related to handling and disposal of livestock wastes. Disease management was also a concern. This is because none of the farmers reported withdrawal from consumption of livestock or livestock products during and after administration of drugs. However, some of the public health risks have resulted in innovations – as a way of dealing with the situation. Livestock waste being a nuisance to urban livestock keepers has, as well become a resource. Livestock keepers utilize the waste in crop cultivation and levelling of animal sheds to deal with the dumpy and wet status of the sheds during the rainy season. The researcher observes that urban livestock keeping is important for the livelihoods of the households practicing it, and especially for the urban poor. The public health could be addressed through proper education and land use planning that incorporates urban farming.

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CHAPTER 1: INTRODUCTION

1.1 Statement of the Research Problem

Urban agriculture has been in existence since the Aztec and Mayan civilizations and prehistoric Jericho (FAO, 2000). It has been banned in some cities but has grown in others; growing in scope and importance (Hans Schiere & Rein Van Der, 2001). Livestock keeping on the other hand has been associated with particular problems but also opportunities (Smit, 2001). It has been regarded as a sign of poverty but it is now being appreciated for the positive roles it plays in urban areas (Bakker et al., 2000). Agricultural development initiatives have for long focused on rural areas whose surplus supply the expanding urban population (Guendel, 2002). However, the increase in urban population has led to many citizens fall back to urban crop cultivation and livestock keeping as an alternative source of food and income (Boqvist et al., 2014; Gerber, 2010).

There has been little attention from city authorities, research and also development initiatives on urban livestock keeping despite its growing in scale (FAO, 1995). Urban livestock keeping has been forbidden in most cities due to perceived negative health risks. As such, there have been no policies and spatial plans in support of urban livestock keeping (Waters-Bayer, 1995). Urban livestock keeping is clearly beneficial in cities despite the many limitations, but also prone to limited space.

Research in Bamako revealed that 20,000 households keep livestock in town where they receive inputs and market services (Thys, 2006). In Harare more than one third of the households keep livestock especially chicken but also rabbits, pigeons, ducks and turkeys (Shackleton et al., 2009; Dale et al., 2012). Dar es Salaam on the other hand has urban agriculture as the second largest employer after petty trade and labour yet 74% of the farming households keep livestock (Kristjanson et al., 2004). Nairobi has 20% of the

households involved in urban farming and 40% would starve if urban agriculture was stopped (Smith, 2010).

Urban livestock keeping is a reliable source of income, source of food, can help reduce the volume of organic waste and can contribute to social cohesion (Lock & Veenhuizen, 2001). Some studies have highlighted health risks associated with urban agriculture in general whereas others are specific for urban livestock keeping (Birley & Lock, 1999). Urban livestock keeping can cause bad smell, public nuisance, risk of disease, pollution of waterways or quarrels between neighbours when livestock invade and damage gardens (FAO, 2000; Smit, 2001). In Nairobi's informal settlements, many cases of human diarrhea are associated with zoonotic pathogens and/or food sourced from animals, largely as a result of poor livestock keeping practices (ILRI, 2012). This study intends to contribute to the debate of the potential public health risks of livestock keeping in urban areas – using Makadara sub-County in Nairobi as a case study.

1.2 Research Questions

1. What is the nature and extent of urban livestock keeping in Makadara sub-County?
2. Which are the livestock keeping practices that lead to public health risks in Makadara sub-County?
3. What are the innovative urban livestock keeping practices in Makadara sub-County?

1.3 Research Objectives

The overall objective of this study is to assess the public health risks associated with urban livestock keeping. The specific objectives that emanate from this broad objective are to:

1. Examine the nature and extent of livestock keeping in Makadara sub-County.
2. Assess the livestock keeping practices that pose public health risks in Makadara sub-County.
3. Determine innovative urban livestock keeping practices in Makadara sub-County.

1.4 Justification of the Study

Livestock keeping is crucial in any urban and rural setting as it is a source of food and income for the households practicing it. Urban livestock keeping is increasing in importance not only in Kenya but in the world at large due to the increasing urban population. Most urban areas, including Kenya, are however characterized by high dense settlements, which present unfavourable setting for livestock keeping. Research has shown that livestock-human contact and/or closeness exposes human beings to zoonotic diseases. In recognition of the challenges in urban livestock keeping, livestock keepers have come up with several innovative ways to continue with the practice. These innovations could be to cope with space, food and disease, among others. This study is an investigation of the public health risks associated with livestock keeping in Makadara sub-County in Nairobi County. Makadara sub-County, with a number of urban farmers, is densely populated and houses middle-lower and lower income households with a diversity of livelihood sources.

1.5 Scope of the Study

This study focuses on the public health risks associated with urban livestock keeping practices in Makadara sub-County in Nairobi County. The study is part of a broader project; Food Planning and Innovation for Sustainable Metropolitan Regions (FOOD METERS), whose focus was broader encompassing both livestock keeping and crop cultivation. The study does not include laboratory tests in the analysis of public health risks but makes references and inferences from other research findings. In addition, the innovations in this study are those practices which have been documented as innovations in other areas.

1.6 Literature Review

This section provides a review of the relevant literature that has informed most aspects of this study. It is divided in eight sub-sections that gives an overview on urbanization, poverty

and food insecurity; urban farming in sub-Saharan Africa; urban farming in Nairobi; livestock keeping in Makadara sub-County; importance of livestock keeping; urban livestock keeping and public health risks; innovations in urban livestock keeping; and research gaps.

1.6.1 Urbanization, Poverty and Food Security

For the first time the year 2008 is the year when the worlds urban population was rated as higher compared to that in rural areas. The urban population of the world has been projected to reach 6.4 billion by 2050. It is also expected that 60% of the population of the world by 2030 will be living in cities (UNFPA, 2007). Rapid urbanization is taking place while the non-farm jobs are few in many developing countries (UNCTAD, 2006; Veenhuizen, 2002; Waters-Bayer, 1995). Therefore, urbanization process is occurring together with what is known as the "urbanization of poverty". Migration from rural to urban accompanied by limited job opportunities has led to a shift from rural poverty to urban poverty. The numbers of the poor living in cities is expected by 2035 to rise to 50% if "proper guard rails" are not put in place (UNCHS, 2011).

Increasing urban poverty is inseparable from the rise in malnutrition and food insecurity in the urban areas. The World Food Summit of 1996 defined food security as a situation that exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preference for an active and healthy life (World Food Summit, 1996). This definition comprises four dimensions of food security: availability, stability, safety and access (FAO, 2006). Urban food insecurity is in some instances overlooked since at generally, socio-economic status of urban dwellers are better than those of rural dwellers (World Bank, 2000). Urban food insecurity is characterized by lack of financial ability by the poor urban dwellers which limits their access to adequate quantities nutritious food (Mutobodzo, 2009).

Urban food production is, therefore, a response to inadequate and unreliable food access and financial incapability. Urban farming avails fresh food, saves on money spent on food and create employment (Veenhuizen, 2002). However (Mougeot, 2000) indicates that urban farming has always been a significant part of the urban food system and not as a result of economic or food crises which could be the case in future.

1.6.2 Urban Farming in sub-Saharan Africa

Urban farming is the growing of plants and the raising of animals in and around cities (Dubbeling, 2010). Urban farming may take place in locations inside the cities (referred to as intra-urban) or in the peri-urban areas. The activity may take place inside the homestead (on-plot) or on land away from the residence (off-plot); on private (owned, leased) or on public land (parks, conservation areas, along roads, streams and railways); and on semi-public land (schoolyards, grounds of schools and hospitals) (Mougeot, 2000; Smit, 2001).

Location is not the major factor distinguishing rural and urban farming; but the fact that urban farming interacts with the urban ecosystem (Ritcher et al., 1995). Such linkages include the use of urban residents as labourers; use of urban resources (like organic waste as compost and urban wastewater for irrigation); direct links with consumers; direct impacts on urban ecology (positive and negative); being part of the urban food system; competing for land with other urban functions; and being influenced by urban policies and plans (RUAF, 2014).

Urban farming in sub-Saharan Africa is viewed as a way of reducing poverty and food insecurity and also contribute environmental conservation and preservation. Urban agriculture improves the quality and intake of food (Argenti, 2000). In Harare, 60% of the food consumed by low-income groups was self-produced (Bowyer-Bower et al., 1996), while in Kampala children in urban-farming households aged five years and below were found to have better nutrition status than those from households that were not practising farming (Maxwell et al., 1998).

Urban farming also contributes to local economic development, poverty alleviation and social inclusion of the urban poor and women in particular, as well as to the greening of the city and the productive reuse of urban wastes. Growing own food saves household expenditures on food, while the sale of farm products supplements the household's income. In addition, urban agriculture stimulates the development of related micro-enterprises: the production of necessary agricultural inputs and the processing, packaging and marketing of outputs (Gerber, 2010).

1.6.3 Urban Farming in Nairobi

According to Foeken & Mwangi (1992), there are three typologies of urban farming in Nairobi. These are on-plot, off-plot and peri-urban farming (see Table 1.1). On plot farming is practiced in the same plot as a farmer dwells. It is mainly small scale in nature and characterized by kitchen gardens and backyard or front yard farming. Off plot farming is practiced away from the dwelling houses, i.e. along the roads, in riparian zones, in way leaves and other open spaces. Peri-urban farming is practiced in areas away from the city and away from the major activities. They are the transition zones between rural and urban areas.

Table 1.1: Typology of Urban Farming in Nairobi

Feature	On-plot	Off-plot	Peri-urban
Location	High or low density areas	Open spaces, road sides, river sides	Outside the city boundary
Plot ownership	Self/family, private landlord and public land	Private landlord and public land	Self/family, private landlord and public land
Consumption mode	Subsistence	Subsistence and commercial	Subsistence and commercial
Crops produced	Vegetables	Beans, maize, vegetables, fruits	
Livestock kept	Poultry, goats, rabbits	Pigs	Cows, goats, sheep
Plot size	50 square metres maximum	50-100 square metres to 1 acre	Over 100-200 square metres to 3 acres
Access/ modes of transport	On foot	Public transport, walking, bicycle	Public transport, walking

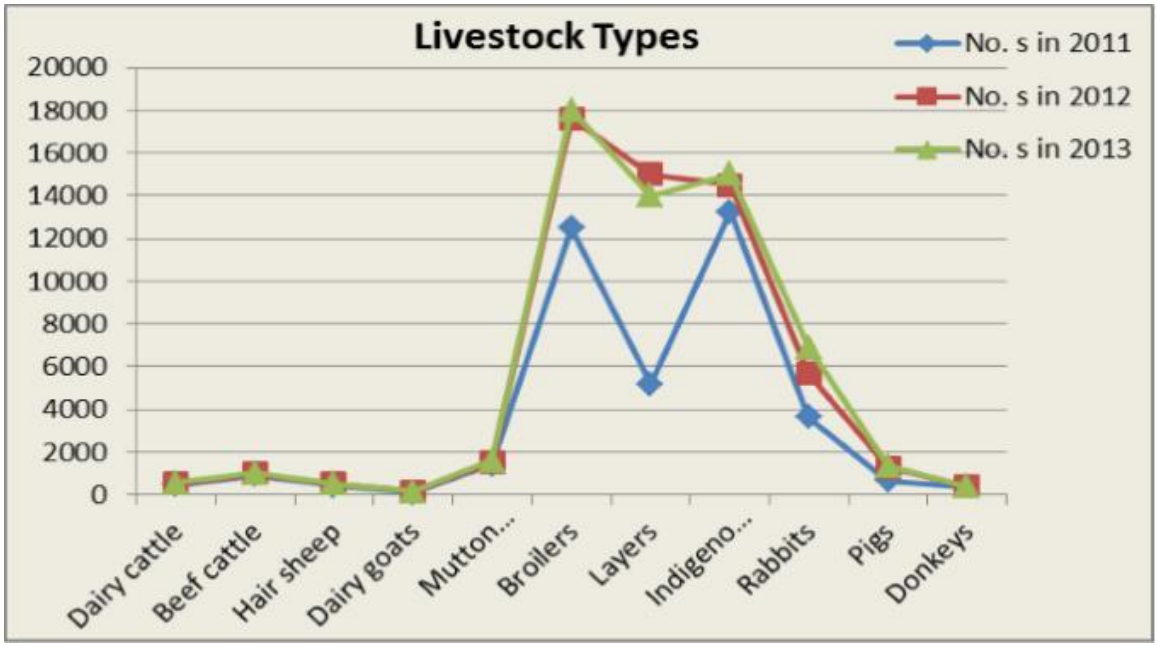
Source: Foeken & Mwangi (1992)

1.6.4 Livestock Keeping in Makadara sub-County

Despite the ban on keeping livestock in Nairobi, Makadara sub-County has a wide-range of livestock whose numbers have been increasing over the years (see Figure 1.1). Poultry is the most favourite for the livestock keepers followed by rabbits. This is due to the increasing demand for poultry products (eggs) and in recent times, white meat from rabbits. Dairy cattle and pigs are common in slum areas of Viwandani Ward because of the large open spaces available for grazing and growing of cattle feed, especially along the riparian reserves of Ngong' River.

In general, Livestock keeping in Makadara Sub-County has been increasing over the years for all types of livestock except donkeys (Figure 1.1). The greatest increase seems to have been between 2011 and 2012. Significant increase between 2011 and 2013 is seen in rabbits, pigs, layers and broilers. The number of dairy and mutton goats has a small increase whereas that of donkeys is relatively constant. Donkeys have relatively little economic value as it is not generally accepted for consumption but for transportation. Poultry and rabbits require less space thus the almost double increase and their products have relatively high demand.

Figure 1.1: Trends in Livestock Keeping in Makadara sub-County



Source: GOK (2013)

On the other hand, Makadara sub-County has a variety of livestock products which include milk, beef, mutton, chevron, pork, poultry meat and eggs. These products' production levels increased between 2011-2013 apart from beef and mutton (see Table 1.2). Notably, the quantity of eggs increased tremendously over the three indicating reliance on eggs from poultry than meat. Milk production also increased over the three years indicating livestock keepers concentrated on dairy livestock than meat.

Table 1.2: Livestock Production Trends in Makadara sub-County

Livestock product	Quantity in 2011	Quantity in 2012	Quantity in 2013
Milk (kg)	654,376	700,433	817,400
Beef (MT)	39	38	-
Mutton (MT)	5		
Chevron (MT)	8	9	10
Pork (MT)	186	190	200
Poultry (MT)	24	26.64	36
Eggs (Nos)	3,571,250	4,222,500	4,914,000

Source: GOK (2013)

1.6.5 Importance of Livestock Keeping

Generally, the main reasons for keeping livestock are income generation, consumption and in some cases for leisure and as a tradition. The livestock sector is a major provider of livelihoods and a key determinant of human health and provides a component of diets

for the larger part of the world's poor (FAO, 2006). (Steinfield et al., 2006) states that almost 30% of human protein consumption is from livestock products. The growing urbanization in developing countries is growing proportionately with the demand for animal products especially meat and milk (Gerber & Steinfeld, 2008; Johnson, 2009; Boqvist, 2014). Livestock keeping also raises the social status of the farmers and enhances gender balance; children also have the opportunity to own livestock, especially small stock (Waters-Bayer & Letty, 2010).

In areas where the environment is harsh, livestock keeping provides a means of reducing the risks associated with crop failure. In addition, livestock keeping contributes to sustainability in resource use through nutrient and energy cycling. For instance, animal manure increases soil fertility, soil structure and water-holding capacity (Herrero et al., 2010; Stroebel et al., 2010). Livestock keeping also enable saving, provide security, allow resource-poor households to accumulate assets and serve as

1.6.6 Urban Livestock Keeping and Public Health Risks

Livestock production and consumption can lead to four main types of human health risks: diseases transmitted from livestock to humans; environmental pollution; food borne diseases and risks; and diet- related chronic diseases (see Table 1.3).

Table 1.3: Human Health Risks of Livestock Keeping

Livestock Keeping Practices	**Human Health Risk**
Pollution: zero-grazing animals effluent, dust from poultry houses and poor disposal of animal waste	Disease-causing organisms causing diarrhea and respiratory problems
Living in closely with animals especially poultry and pigs	Internal parasites: tapeworms and ectoparasites, fleas and jiggers
Handling sick animals and contaminated animal products consumption	Zoonotic diseases: e.g. brucellosis, tuberculosis, skin and diarrheal diseases Diarrheal diseases for consumers of animal products Drug resistance
Stray animals	Emotional stress Physical injury

Source: Boischio (2006)

It is also important to note that many aspects of animal production are at risk from biological, chemical and physical agents which may enter food-producing animals or animal products through exposure points in the food chain, with consequent potential risks of transferring to consumers (see Table 1.4).

Table 1.4: Possible Biological, Chemical and Physical Hazards of Livestock Keeping

Biological Hazards	**Control points**
Transmission of pathogens and contaminants	Animal housing and population density; Disease diagnosis (horizontal and vertical transmission); Health and hygiene of visitors and personnel; Vehicles, clothing, instruments and equipment; Infected and contaminated carcasses, tissues or secretions; Bedding management; and Insect or pest vectors
Airborne infections and contaminations	Animal housing and ventilation; Population density; and Farm location
Feed borne infections and contaminations	Feed production, transport and storage; Feed quality; Feed equipment; and Record keeping
Carrier animals shedding pathogens	Animal management; Diagnosis; and Population density
Waterborne infections and infestations	Water quality; Effluent management; and Watering equipment
Chemical hazards	**Control points**
Chemical contamination of environment, feed and water	Farm location; Animal movement; Use of agricultural chemicals; Feed and water quality; Equipment and building materials; and Hygiene practices
Toxins of biological origin (plants, fungi, algae)	Feed, pasture and water quality; Farm location; Animal movements; and Feed production, storage and transport
Physical hazards	**Control points**
Ingestion of dangerous/harmful objects	Farm location; Source of feeds and water; Record keeping; Construction and equipment; and Infrastructure

Source: Smit (2001)

Animal waste if left untreated can result in negative human health impacts either gastrointenstinal diseases or respiratory compilcations (Catelo, 2006). Consumption of ill prepared livestock products results in xposur to deadly bacteria namely: Campylobacter, Salmonella, E.coli and Enterococcus.

Zoonotic diseases from urban livestock keeping can be spread in various ways as: animal waste in public places, intake of meat that could be contaminated, intake of dairy products that are untreated; direct contact with sick animals, direct contact with infected animal waste, animal feed that is contaminated, waste scavenging animals spreading pathogens, animal waste discharge into water systems and leaching of nitrates and phosphorus from animal waste into water supplies (Catelo, 2006).

Roaming livestock can spread a disease in the environment thus spreading the threat. Poor livestock keeping practices as uncontrolled roaming of livestock in public spaces gives flies and bacteria an opportunity to thrive in animal waste on these public spaces. Keeping buffalo and cattle in cities exposes the urban farmers and consumers to the risk of bovine tuberculosis, especially if milk is consumed untreated (Vijayakumar & Phillott, 2013).

The people who are mainly exposed to the zoonotic disease are livestock keepers, workers at the slaughter houses and livestock factories, animal products consumers, residenets in places with large numbers of livestock, and residents in places where animal waste is disposed. According to Flyn (1999) and Guendel (2002) the most vulnerable groups are women, children and the urban poor. This is due to the fact that women are producers, as well as as family health care providers their important role. Likewise, the division of labour in farming activities exposes men to risks which women may not encounter.

Children are exposed since the roaming animals excrete their waste in public spaces where children play. Children may ingest the animal waste since they touch the animal waste and eat in unwashed hands (RUAF, 2000). Children are in most cases the ones involved in cleaning livestock shelters and disposing animal waste, this exposes the children to diseases. The children lack knowledge on possible contamination which leaves them prone to diseases when no mechanisms are put into action while handling animal waste and livestock shelter (Guendel, 2002).

The social status in every society determine the burden of disease; the poor bearing the highest. The urban poor have more exposure to livestock-related diseases due to the fact that they are more often in close contact with livestock. They are also likely to consume contaminated livestock products (Guendel, 2002); pork which has cysts can be sold off cheaply to the poor since it cannot be marketed; milk which is unpasteurized is sold to the urban poor; and meat from dying animals and others which is untreated is all bought by the poorest consumers. The bigger problem is that when the poor get sick theye cannot afford the best treatment but also that they may spend most of their income in treating the disease (WHO, 2006).

1.6.7 Innovations in Urban Livestock Keeping

Most urban livestock keepers in sub-Saharan cities have developed their own innovative ways to, largely deal with some of the challenges they face such as lack of animal feed, scarcity of water, management of diseases, utilization of space, management of animal waste and value addition. The challenge of space is critical for urban livestock keepers and therefore most livestock keepers in the urban areas prefer small animals that require less space, feed and management. Some farmers also control the number of animals they keep.

Innovations can be lead user, technological and institutional or policy innovations (Von Hippel, 2005). In urban farming, more than in rural farming, innovation takes place in the form of micro-enterprise development due to proximity of consumers to the urban producers (Holmer, 2001).

Milk for example is either marketed raw or converted by such technologies as boiling, natural fermentation, souring, mechanical separation and heating. In many cities around the world, milk is purchased almost directly from the cow and is consumed locally, often in small quantities, within an hour of purchase.

In many temperate countries, a major reason for pasteurizing milk was to reduce infection of tuberculosis. In many tropical countries, fresh milk is not consumed, milk is always boiled and there are so many other sources of infection that pasteurization is seen as an unnecessarily expensive step; instead it denies access to a valuable food resource to the people (especially children) who would benefit most from it (FAO, 2000).

In Ethiopia, farmers feed their livestock with residues for making a local beer. These residues have high water content to curb the water problem they experience. Alternative animal feeds used are wastes from vegetable markets, flour mill dust and grain residues. Innovations in the management of diseases have mainly been done through the application of traditional knowledge (Araya et al., 2007).

In Tunisia, a 70 year old Mrs Mbirika Chokri incubates her chicken eggs in dry cattle dung. She puts the eggs with some straw in plastic bags to preserve some humidity. Each bag contains 16-20 eggs. She puts the bags in small holes dug in the manure, covers them with a piece of cardboard to protect them against damage and covers the cardboard with a thin layer of manure. Each day, she opens the bags to check the temperature of the eggs and to turn and aerate them. From day 20 the eggs start to hatch. She puts the chicks into a box to protect them from the cold and feeds them couscous, vegetables and bread.

Mbirika began experimenting in 1995 when one of her chickens, whose eggs were about to hatch, suddenly died. She decided to put the eggs into a pile of dried cattle dung. After some days the eggs hatched, to her delight. She decided to use manure again in the same way to hatch eggs. Mbirika has now mastered this technique and produces numerous chicks (Reij, 2014).

1.6.8 Research Gaps from Literature Review

Research on urban farming has always focused on the nature and extent of urban crop cultivation. Little emphasis has been given to urban livestock keeping, largely because urban crop cultivation is widely practiced. Furthermore, available research on urban livestock keeping has placed less emphasis on the public health risks of raising animals in the city. Major emphasis has also been on innovations in crop cultivation with little documentation on innovations in livestock keeping. The main innovations of interest in this case are those the community are comfortably practicing with very little technicality.

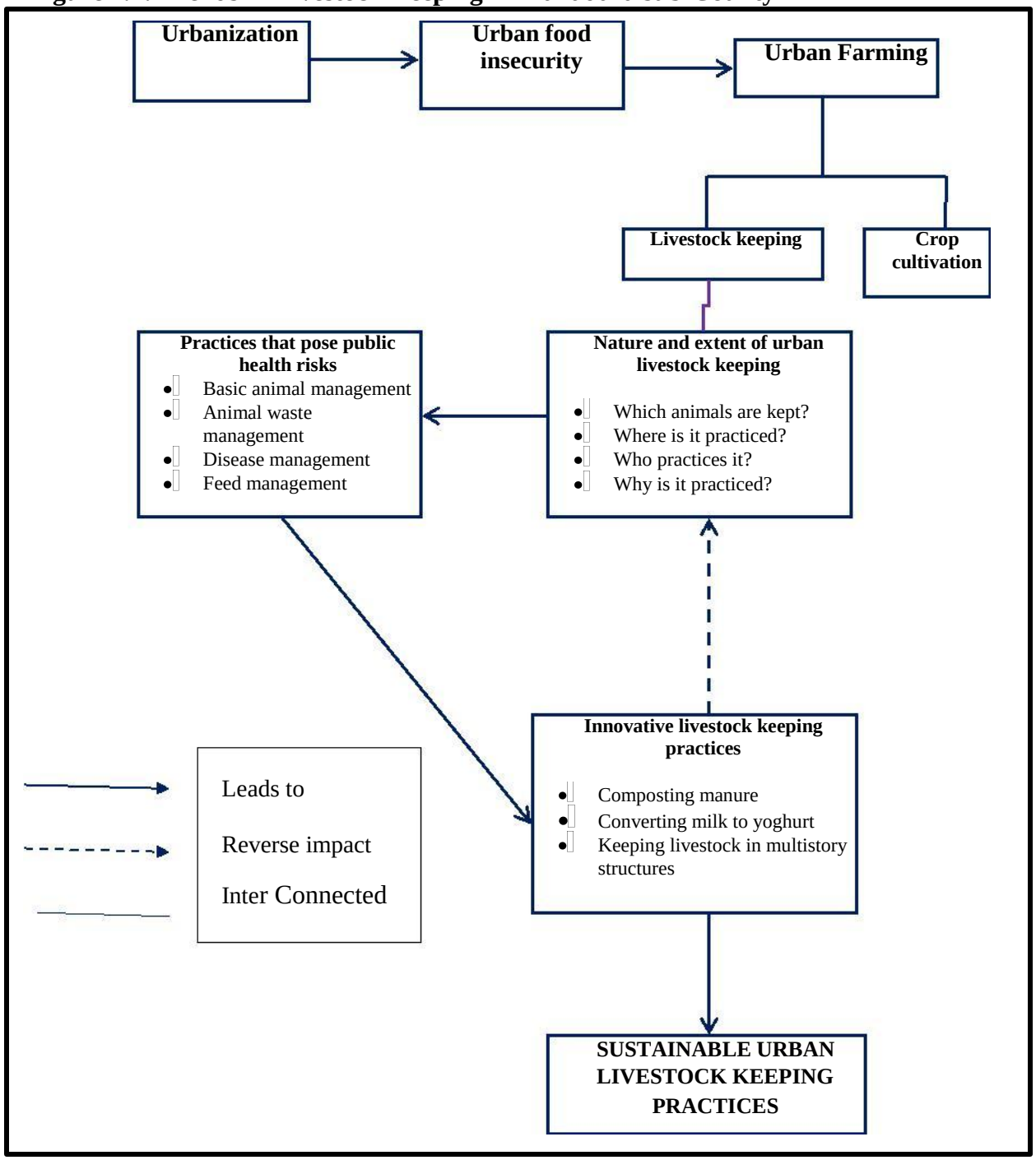
1.7 Conceptual Framework

Figure 1.2 presents the conceptual framework of this study. In the recent past, urbanization rates in urban areas have been relatively high. This has led to increased food demand and consumption in urban areas which may not be fully met by rural agriculture. As such, urbanization results in urban food insecurity, triggering urban farming as a coping strategy. Urban farming is categorized into urban livestock keeping and urban crop cultivation. This study concentrates on urban livestock keeping. It provides an overview of the nature and extent of urban livestock keeping in Makadara sub-County in Nairobi.

The nature and extent of urban livestock keeping outlines the animals kept, where the practice occurs, people involved and the benefits. The practice of urban livestock keeping results in public health risks which impacts on human beings, either the livestock keepers or the general community at large. The health hazards occur because urban livestock keeping is practiced in congested areas and locations not fit for the practice. The potential health risks are in form of diseases which affects vulnerable people such as children, women and the urban poor.

In response to the various challenges in urban livestock keeping, including health risks, urban livestock keepers have come up with a number of innovations. These innovations are at times developed not necessarily to curb public health risks but to solve other challenges. These innovations in the long run become a normal practice thus contribute to sustainable urban livestock keeping practices.

Figure 1.2: Trends in Livestock Keeping in Makadara sub-County



Source: Adopted from UNCHS (2011) and UNCTAD (2007)

1.8 Operational Definitions and Concepts

Urban farming: This is practicing crop cultivation and livestock keeping in areas within urban areas.

Urban livestock keeping: This is the keeping of animals namely: poultry, cattle, goats, sheep, pigs and others which are of economic value to the famer in urban areas.

Public health risks: These are the possible health implications on human beings as a result of keeping livestock.

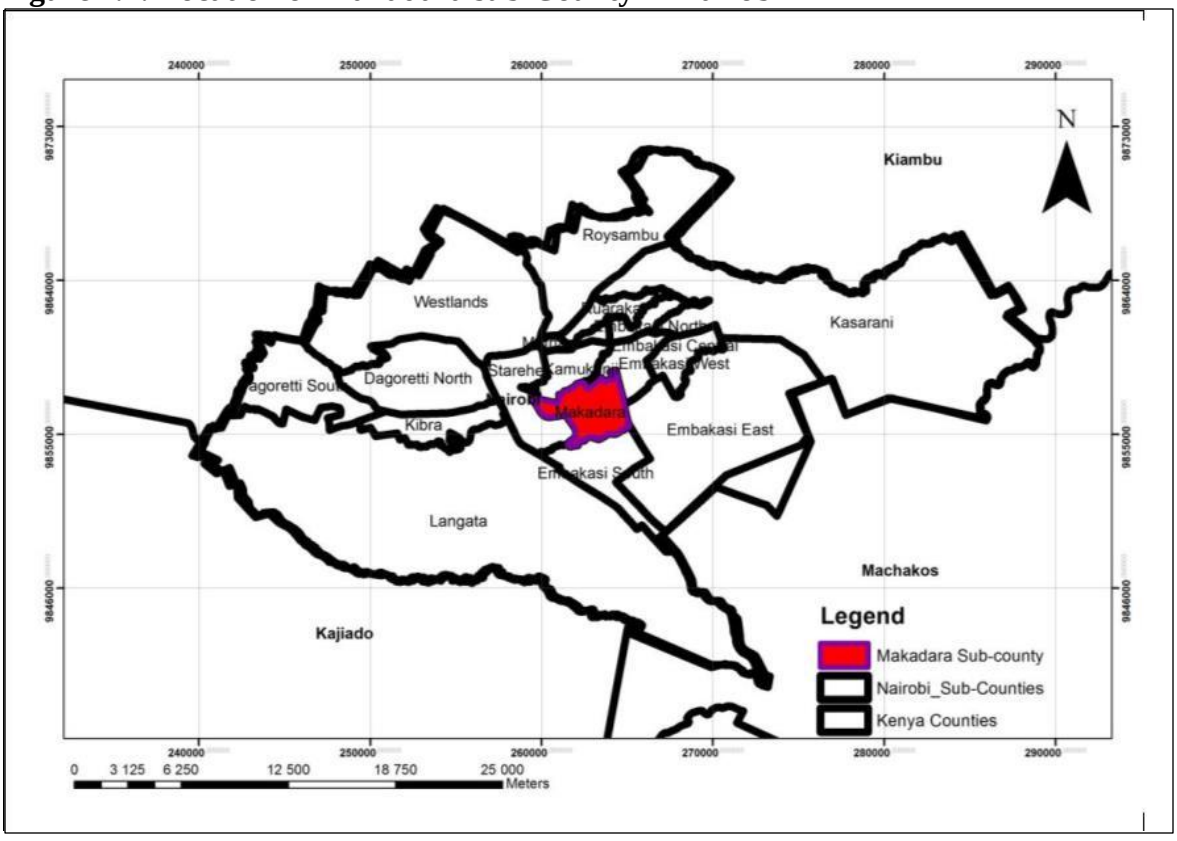
Sustainable livestock keeping practices: These entails livestock keeping practices that do not pose negative environmental and health implications to the community.

CHAPTER 2: THE STUDY AREA

2.1 Location of the Study Area

Makadara is one of the sub-counties in Nairobi (Figure 2.1) covering an area of approximately 20.1 square kilometers. Nairobi is located at the south-eastern end of Kenya's agricultural, at approximately 1° 9'S, 1° 28'S and 36° 4'E, 37° 10'E. Nairobi's altitude varies between 1,600 and 1,850 metres above sea level (UNEP, 2007). The western part of Nairobi lies on a high ground (approximately 1700-1800 metres above sea level) with rugged topography, while the eastern side, where Makadara sub-County is located, lies on a generally low ground (approximately 1600 metres above sea level) with a flat topography.

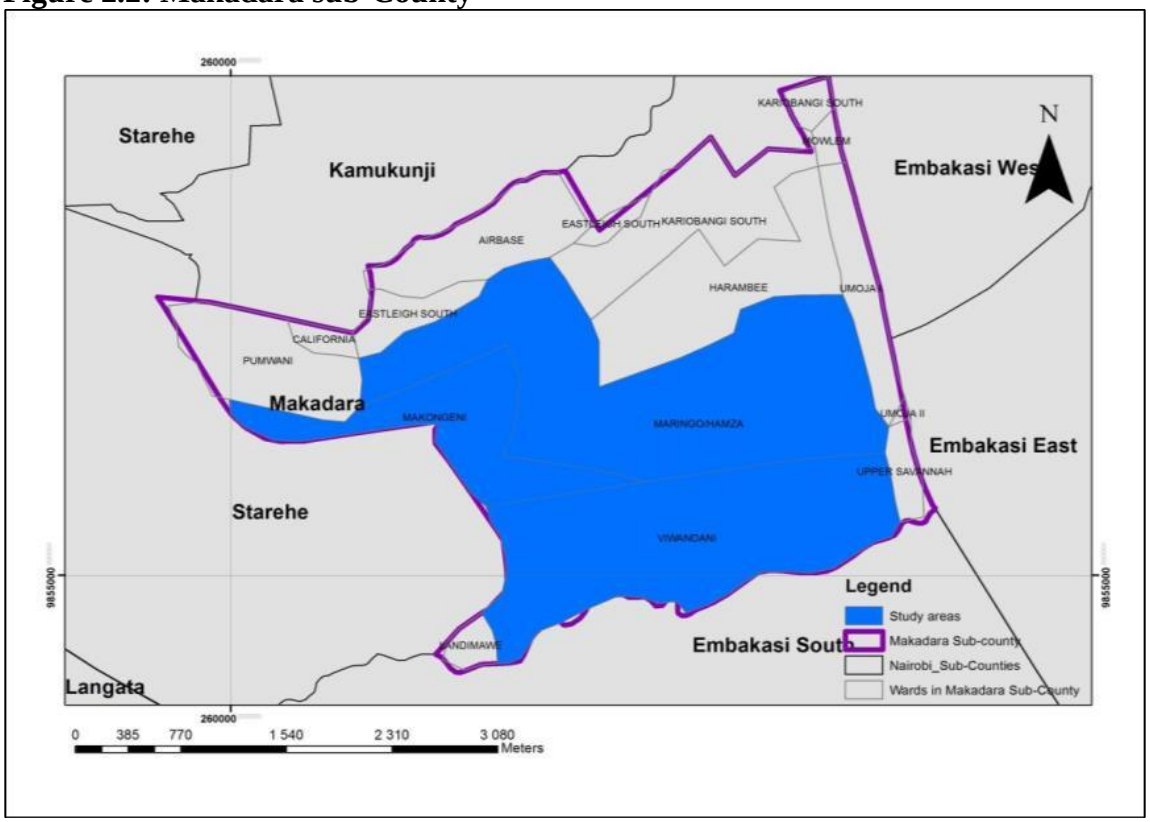
Figure 2.1: Location of Makadara sub-County in Nairobi



Source: Adopted from Kenya GIS Data, 2015

Makadara sub-County has three administrative wards namely: Makadara, Bahati and Viwandani (Figure 2.2). Makadara and Bahati are located along Jogoo road, while Viwandani is located along Lungalunga road, bordering Mukuru slums.

Figure 2.2: Makadara sub-County



Source: Adopted from Kenya GIS Data, 2015

2.2 Climatic Characteristics

Nairobi East District, where Makadara sub-County is located, has a temperate tropical climate with two rainy seasons. Highest rainfall is received between March and April and the short rainy season is between November and December. The mean annual rainfall ranges between 850 and 1,050 mm. The mean daily temperature ranges between 12 and 26°C. It is usually dry and cold between July and August, but hot and dry in January and February. The mean daily sunshine hours varies between 4 and 9.5 hours (Kenya Meteorological Department, 2014).

2.3 Hydrology

Nairobi is generally a county served by several rivers, dams and wetlands which are mainly part of the larger Nairobi River. The rivers that traverse through the various parts of the city include rivers Ruiru, Gatharaini, Rui Ruaka, Karura, Gitathuru, Mathare, Kirichwa, Motoine-Ngong and Nairobi River. River Motoine-Ngong passes through Makadara sub-County and may have several names at different locations. It is a source of water to livestock, especially in Viwandani ward. The river has however been heavily polluted by the industries in the industrial area along which it passes. It is also known to flood during the rainy seasons causing great damage on livestock keeping along the river.

2.4 Physical and Topographic Features

The terrain in the eastern side of Nairobi where Makadara sub-County is located, is gently rolling but divided by steep valleys towards the city boundaries. To the north, there is the Karura forest which is characterized by steep sided valleys. The Karen-Langata area is characterized by plains surrounded by Nairobi National Park to the east and Ngong Forest to the south. Several streams with steep-sided valleys covered with vegetation are a dominant landscape feature in Nairobi. The main types of soils are the black cotton and red soils that form patches in different parts of the city. Red volcanic soils being in most parts of the city make urban farming favorable (Onyancha et al., 2011).

2.5 Population Characteristics

During the 2009 Kenya Population and Housing Census, Nairobi East District, where Makadara sub-County is located, had a population of 1,114,416 people (582,554 males and 561,862 females). A projection of this population with a growth rate of 3.8 per cent indicates that the current population should be 2 million people. Makadara sub-County has a population of 218,641 people (KNBS, 2015) with a population density

is 9,464 persons per square kilometers, which is relatively higher than Nairobi County (4,509 persons per square kilometers).

2.6 Land Use

The land uses in Nairobi County lie in 8 categories (Table 2.1) namely: residential, industrial, commercial, infrastructure, recreation, water bodies, open lands, protected areas and urban agriculture areas. The distribution of farming households by mean agricultural parcels and land holding sizes by poverty status in Nairobi County shows that the poor have a mean agricultural parcel of 1.2 acres and holding size of 0.9 acres while the non-poor have a mean agricultural parcel of 1.4 acres and mean holding size of 1.3 acres (Nairobi County Integrated Development Plan, 2015).

Table 2.1: Land Use Distribution in Nairobi County

Land Use	Acreage	Percentage
Residential areas	175.6	25.22
Industrial/commercial/ service centres	31.8	4.57
Infrastructure	15.9	2.28
Recreation	12.0	1.72
Water bodies and riverine areas	11.8	1.69
Urban farming	96.8	13.9
Open lands	198.8	28.55
Others (including protected areas)	153.6	22.06
Total	696.3	

Source: Nairobi County Integrated Development Plan (2015)

The proportion of households that have title deeds in Nairobi County is low, a higher proportion of the non-poor compared to the poor own title deeds. The numbers of parcels held by the poor stands at 1,565 while those of the non-poor stands at 6,944. It is worth noting that all the 1,565 parcels operated by the poor have no title deeds. This situation is also shared by 33.4% of the non-poor operating about 2,389 parcels (Nairobi County Integrated Development Plan, 2015). Makadara sub-County is characterized by mainly residential, average commercial, few pieces of land for urban farming and pockets of open lands.

CHAPTER 3: METHODOLOGY

3.1 The Study Set Up

The study is part of a broader project – Food Planning and Innovation for Sustainable Metropolitan Regions (FOODMETERS) – whose main objective was to assess the environmental and socio-economic impacts of food chains with regard to spatial, logistical and resource dimension of growing food as well as food planning and governance. FOODMETRES uses food-chain characteristics (such as environmental and performance indicators) to assess the "land footprint" of urban food consumptions in terms of the socio-economic and environmental impacts. To achieve its objective, part of the broader project was to assess the nature the nature and extent of urban farming in Nairobi, using Makadara sub-County as a case study. This study focused on urban livestock keepers in the sub-County.

3.2 The Target Population

The target population was all the urban farmers registered with the Ministry of Agriculture, Livestock and Fisheries in Makadara sub-County. The farmers gave their first-hand information on all aspects covered by this study in regard to the practice of urban livestock keeping – based on a pre-designed questionnaire. On the other hand, the government officers in the same Ministry gave oversight information on the trends and patterns of urban livestock keeping in the sub-County, as well as their opinion on the public health risks associated with the practice – based on a predesigned interview schedule.

3.3 Data Needs and Requirements

The first objective on the nature and extent of urban livestock keeping was intended to answer the "who", "what", "where" and "how" questions in relation to the practice of

urban livestock keeping in the sub-County (see Table 3.1). The second objective looked at the livestock keeping practices that result in public health risks. The major data need in this respect was a detailed understanding of the practice of urban livestock keeping and their related health risks. The third objective was based on in-depth case studies to understand the innovative livestock keeping practices.

Table 3.1: Data Needs and Sources

Objective	Data needs	Data sources
Nature and extent of livestock keeping	"What", "where", "who" and "how" questions in regard to the practice of urban livestock keeping	Household questionnaires; observation; and photography
Livestock keeping practices that lead to public health risks	The practice of urban livestock keeping	Household questionnaire; key informants; and secondary data
Innovative urban livestock keeping practices	Innovations in various aspects of urban livestock keeping	In-depth case studies; observations; and key informants

Source: Researcher (2015)

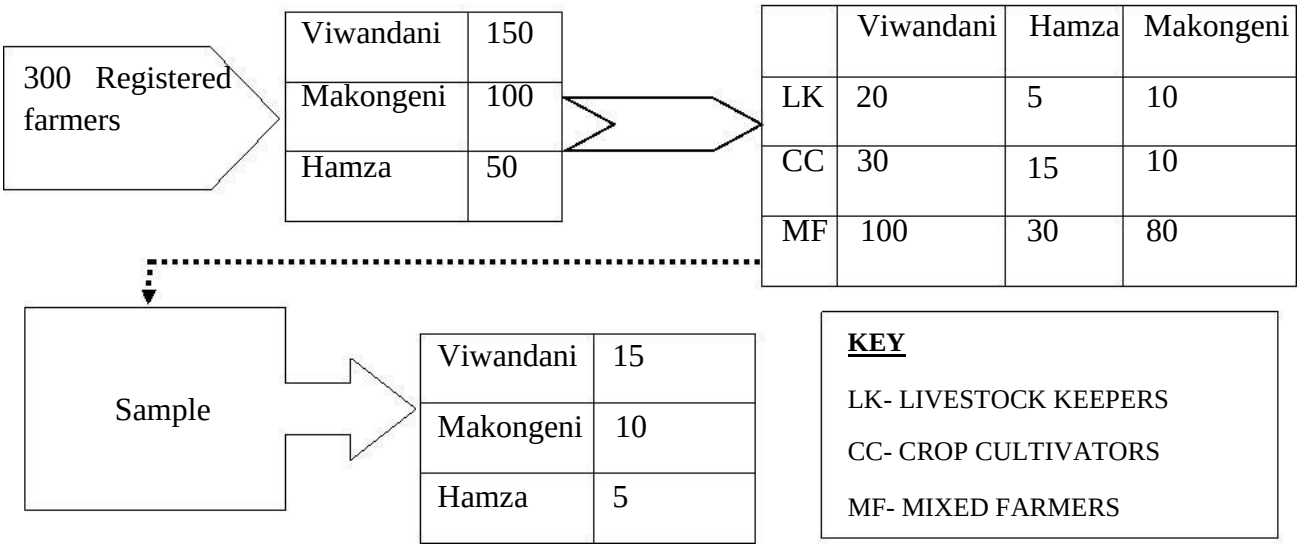
3.4 Sampling Procedure

There are 300 registered farmers at the Ministry of Agriculture, Livestock and Fisheries (Makadara sub-County office) of which some are exclusively livestock keepers or crop cultivators, while others practice both livestock keeping and crop cultivation. From this list, multistage sampling was applied to select the 30 farmers for this survey. All the registered farmers were first divided into the three administrative wards: Makongeni, Viwandani and Hamza. Viwandani had 150 farmers, Makongeni had 100 farmers and Hamza had 50 farmers (see Figure 3.1).

In each of the three administrative wards, the number of livestock keepers, crop cultivators and mixed farmers were determined. This gave a total figure of 245 livestock keepers (livestock keepers plus mixed farmers) in Makadara sub-County: 120 in Viwandani, 35 in Hamza and 90 in Makongeni. The 30 farmers included in this study were thereafter determined proportionately to the sub-population of livestock keepers in

each administrative ward. In the end, the survey included 15 livestock keepers in Viwandani, 10 in Makongeni and 5 in Hamza.

Figure 3.1: Steps in Sampling



Source: Researcher (2015)

The sample size of 30 was derived using the following formulae:

$$S = \frac{X^2 NP(1-P)}{d^2(N-1) + X^2 P(1-P)}$$

Where: S=required sample size
X=Z value (e.g. 1.96 for 95% confidence level)
N=population size
P= population proportion, expressed as decimal- 50%
d= degree of accuracy (5%)

This gave a sample size of 32~30

3.5 Methods of Data Collection and Analysis

Both primary and secondary data were used to achieve the objectives of this study. Primary data was collected through pre-coded questionnaires, in-depth interviews, and key informant interviews. The pre-coded questionnaires were administered to all the sampled livestock keepers, while in-depth interviews were accorded based on innovations

some of the livestock keepers had exposed during the questionnaire-based interviews. The quantitative data was coded and entered in Statistical Package for Social Sciences (SPSS) software. This was later used to generate frequency distributions (descriptive statistics) and cross-tabulations that were later used in the data analysis.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Characteristics of Urban Livestock Keepers

4.1.1 Socio-Economic Characteristics

There were as many male urban livestock keepers in Makadara sub-County as female: 53 and 47 percent, respectively (Table 4.1). Urban livestock keeping is thus becoming a famous economic activity among both males and females. However, men are mainly keen to keep large livestock for sale such as cattle, goats and pigs, while women concentrate on small livestock such as poultry for sale and food. About three fifths (63%) of the respondents were married.

Table 4.1: Socio-Economic Characteristics of Livestock Keepers

Gender	**(N)**	**(%)**
Male	16	53
Female	14	47
Marital status		
Never married	7	23.3
Married	19	63.3
Widowed	3	10
Level of education		
Primary	5	17
Secondary school	14	46
Postsecondary/college/tertiary University (Bachelors)	11	37
Employment status		
Employed	12	40
Unemployed	14	47
Retired	4	13

Source: Fieldwork (2015)

While majority of the livestock keepers have both primary and secondary levels of education (63%), it is important to note that 37% percent of the livestock keepers had attained university and post-secondary school education. Sixty percent of the livestock

keepers were either unemployed (47%) or retired (13%) indicating that livestock keeping is their major income generating activity.

4.1.2 Plot Characteristics

There are no spaces provided specifically for livestock keeping in Makadara sub-County. More than three quarters of the farmers (83%) therefore, practice urban livestock keeping within their own compounds (Table 4.2). These pieces of land are mainly owned by the farmer (47%) or by the government (40%). Government land category is largely on the open spaces located in Nairobi City County houses. The plot sizes are relatively small and only less than five households have about half an acre. These households are mostly in Viwandani ward along the river (riparian reserve).

Table 4.2: Plot Characteristics

Location of plot		**(N)**	**(%)**
	On plot (own compound)	25	83
	Off plot	5	17
Ownership of plot			
	Own land	14	47
	Landlord	3	10
	Government	12	40
Plot size (in square metres)			
	Below 1000	10	33
	1000-2000	3	10
	Above 2000	5	17

Source: Fieldwork (2015)

4.1.3 Motivation, Experience and Knowledge in Livestock Keeping

The farmers had different reasons that motivated them to start practicing urban livestock keeping. Largely, income and food were what motivated most of them to start keeping livestock in Makadara sub-County: 63.3% and 23%, respectively (Table 4.3). Apart from economic reasons four farmers reported social and personal fulfillment as being their motivation. More than half (64%) of the farmers have practiced urban livestock keeping for up to 15 years. About one-quarter have more than 20 years in the practice, which is an indication of the passion to the practice. Half of the livestock keepers acquired

knowledge of the practice from family and friends, while another 5 farmers attended a training course.

Table 4.3: Motivation, Experience and Knowledge in Livestock Keeping

		(N)	(%)
Motivation to start livestock keeping			
	Source of Income	12	40
	Source of food	7	23.3
	Social reasons	4	13.3
	As a source of employment	7	23.3
Numbers of years practicing			
	Less than 5years	5	17
	5-10years	8	27
	11-15years	6	20
	16-20years	4	13
	Over 20years	7	23
How the farmer learnt livestock keeping			
	Personal observation	9	30
	From family members and friends	16	53
	Attending a training course	5	17

Source: Fieldwork (2015)

4.2 Nature and Extent of Livestock Keeping

4.2.1 Livestock Kept

Chicken and rabbits were the livestock kept in large numbers: 597 and 572, respectively (Table 4.4). This is due to the increasing demand for eggs and rabbit meat. Though the number of rabbit keepers is small, one of the farmers had 500 rabbits. The less popular livestock were ducks and the guinea pigs, with few farmers keeping them. However, some farmers kept more than one type of livestock. Despite occupying a lot of space, 8 farmers kept a total of 50 cattle, largely for milk production.

The type of livestock kept depends on three main factors: availability of space, food requirements of the livestock, and the demand for livestock and/or livestock products. For example, small livestock (chicken and rabbits) are favourite to many farmers because of the high demand of their products, as well as requiring less space and less feed. However, this perception depends on individual farmers and their access to land and resources.

Table 4.4: Type and Numbers of Livestock Kept

Types of livestock kept	Number of livestock kept	Number of livestock keepers
Cattle	50	8
Pigs	185	5
Chicken	597	19
Rabbits	572	5
Goat	40	4
Ducks	10	3
Guinea Pig	23	1

Source: Fieldwork (2015)

4.2.2 Rearing System

The majority of the farmers (88%) practice zero grazing within their compounds while the rest practice free range (see Plate 4.1). Those who practice free range do it not far from their structures or homes. This is mainly for security reasons; to avoid conflicts with neighbours and city by-laws; to avoid incidences of diseases; and also for lack of designated grazing fields. However, in Viwandani livestock is left to roam about freely on open spaces. Zero-grazing is preferred due to space limitations, security from theft and to abide by the city by-laws that prohibit roaming of livestock. The livestock that are left to roam about are chicken, ducks and goats. Cattle are reared indoors.

Imani is a group of 15 young men who keep 60 pigs in an open space near Donholm. The open space is located along Jogoo Road. The pigs are confined to their "sty" to avoid them roaming or straying to nearby industries and to the busy Jogoo Road. The space is well utilized such that they have separate structures spread over for storing food, for the piglets, for the mature pigs and for the mating pigs. The youth indicated that customers come to buy pigs from them and therefore they do not have to go the market. The profit is shared among them but they fear of being evicted from this open space by the County government.

Plate 4.1: Livestock Rearing Systems

Source: Fieldwork (2015)

4.2.3 Purpose and Importance Livestock Keeping

Livestock is kept for consumption and/or for selling. However, selling of livestock and livestock products is prevalent in Makadara sub-County. The farmers attributed this to availability of market and demand for livestock products. However, chicken and rabbits are also kept for consumption purposes. The maximum income from livestock keeping was Kshs 76,800 a month while the minimum was reported to be Kshs 1,200 a month, indicating a great potential for livestock keeping as a source of income.

All the farmers noted that livestock keeping is a source of livelihood to their households. It is a major source of income to 40% of the farmers and an additional source of income to another 33% (Table 4.5). It is also an additional source of food to 7 households and a

major source of food in one household. This implies that livestock keeping is practiced as a source of income.

Table 4.5: Importance of Livestock Keeping

	(N)	(%)
Major source of food	1	3.33%
Major source of income	12	40%
Additional source of food	7	23.3%
Additional source of income	10	33.3%

Source: Fieldwork (2015)

4.2.4 Livestock Inputs

There is no doubt that livestock keeping requires much attention for it to be successful, at least for the farmers who practice it for commercial purposes. Three of the sampled farmers spend more than six hours in a day on their farms; 10 farmers spend between 4 to 6 hours a day, while the rest spend less than 4 hours a day (see Table 4.6). These hours are spent on feeding, spraying and daily general care.

Table 4.6: Inputs for Livestock Keeping

		(N)	(%)
Hours spent on livestock keeping (hours/per day)			
	1-2	4	13
	2-3	13	43
	4-6	10	33
	Above 6	3	10
Source of labour			
	Self	14	47
	Family members	6	20
	Friends	2	6
	Hired labour	8	27
Source of water			
	Rain water	2	6.7
	Tap water	25	83.3
	Borehole/well	3	10
Source of technical knowledge			
	Extension Officers	16	53.3
	Media	2	6.7
	Family members and neighbours	4	13.3

Source: Fieldwork (2015)

The source of labour is mostly from the farmer himself or herself and the family members. Eight farmers used hired labour. According to the farmers, hired farm labour in an urban area is very expensive or unavailable. The only source of water available for the farmers is tap water, adding another cost to the practice. Half of the farmers seek and get technical assistance from extension officers. This illustrates the value these farmers have put into the practice as this assistance is obtained at a cost.

4.3 Urban Livestock Keeping and Public Health Risks

4.3.1 General Challenges Faced by Livestock Keepers

Livestock keepers in Makadara sub-County noted that they face a number of challenges such as lack of labour, lack of land, diseases, pests, theft, lack of water, lack of access to credit facilities and lack of space (Table 4.7). Livestock diseases and pests is a challenge faced by more than half of the farmers. Some of these diseases can pose a public health risk if not properly diagnosed and treated.

Table 4.7: Challenges Faced by Livestock Keepers

	Number of livestock keepers who faced the difficulty	% of livestock keepers
Lack of labour	1	3.3
Lack of land	7	23.3
Diseases	21	70
Pests	16	53.3
Theft	3	10
Lack of water	5	16.6
Access to credit	3	10
Lack of space	10	33.3

Source: Fieldwork (2015)

The farmers have put in place a number of measures to prevent the spread of diseases. These are wearing protective clothing, washing hands, avoiding ingestion in livestock sheds, covering wounds, reporting illness, and regular removal of animal waste (Table 4.8). Almost half of the livestock keepers reported protecting themselves from contact with livestock contaminants by wearing protective garments and washing hands before

and after handling livestock products. Only four farmers ensured that they removed livestock waste on a regular basis. Animal waste if not removed results in bad odours as well as attracting disease causing vectors.

Table 4.8: Measures to Control Livestock Diseases

	(N)	(%)
Wear protective clothing	8	27
Washing hands	6	20
No eating in the livestock sheds	3	10
Covering wounds	3	10
Reporting illness	6	20
Regular removal of animal waste	4	13

Source: Fieldwork (2015)

The other mechanisms were covering wounds (only three farmers reported this) to prevent disease causing microorganisms to get into the body through the wound. Others in their discussions indicated that apart from covering own wound they also covered the wounds of the livestock to enhance fast healing and also ensure that they do not get ill through the open wound. Another practice reported by 20% of the farmers that is considerably important is reporting illness of livestock immediately to minimize spread and also alert the veterinary officers to take the necessary precautions.

Prohibition of eating or drinking in the livestock shed was another strategy by three farmers. They claimed that some disease causing microorganisms from the livestock would get into the human body by first getting into the food. From informal discussions with the farmers some only practiced these protective practices as a routine and not as a result of being conscious of the possible consequences. These hygienic measures are important in helping curb the transferring of disease from the livestock to human beings.

4.3.2 Managing Livestock Diseases, Waste and Products

Livestock keepers have adopted various ways to prevent livestock diseases. Even then, five farmers do not take any action to prevent livestock diseases (Table 4.9) – and therefore a public health risk. More than half of the livestock keepers (63.3%) practice

vaccination; nine livestock keepers maintain cleanliness of the sheds; five livestock keepers maintain regular check-ups from veterinary officers; while four livestock keepers maintain cleanliness of the livestock feeds.

Table 4.9: Prevention of Livestock Diseases

	(N)	(%)
Nothing	5	16.7
Vaccination	19	63.3
Regular checkups by a veterinary officer	5	16.7
Maintaining cleanliness of the livestock sheds	9	30
Cleanliness of livestock feeds	4	13.3

Source: Fieldwork (2015)

When there is any disease outbreak, most of the farmers seek the services of a veterinary officer, while others seek the neighbours' assistance and use local methods (Table 4.10). Private veterinary services are very expensive but the farmers depend on services from the Ministry of Agriculture, Livestock and Fisheries at Makadara sub-County office. Two farmers reported that they did nothing even after a disease outbreak and in such cases causing a public health risk. Such diseases could be transferred to human beings through consumption of such products.

Table 4.10: Action Taken During Disease Outbreak

	(N)	(%)
Nothing	5	16.7%
Vaccination	19	63.3%
Regular checkups by a veterinary officer	5	16.7%
Maintaining cleanliness of the livestock sheds	9	30%
Cleanliness of livestock feeds	4	13.3%

Source: Fieldwork (2015)

According to one of the livestock keepers:

"In cases of disease outbreaks, I seek assistance from the Ministry of Agriculture, Livestock and Fisheries. However, in cases where only one or two are sick; it is not viable to seek help since a rabbit costs approximately Kshs 800 and a veterinary officer consulting fee is Kshs 1500. I cannot therefore use more money on veterinary services than the value of the rabbit itself. I would rather lose one rabbit and save money."

The livestock waste is normally used for crop cultivation (Table 4.11). This is because most of these farmers are mixed farmers – practicing both livestock keeping and crop cultivation. Five farmers dump the livestock waste on the street posing a public health risk.

Table 4.11: Action Taken During Disease Outbreak

	(N)	(%)
Use it in crop cultivation	23	70
Selling	4	12
Dump it on the street	5	15
Use it in levelling of the cattle shed	2	3

Source: Fieldwork (2015)

Ten farmers reported that they sell meat products. However, two of these livestock keepers do not subject the meat products to inspection – thus posing a public health risk. Generally, customers and consumers come to the farm to purchase animals and/or the animal products. Commercialization of urban livestock keeping is thus assumed to be more profitable since majority of the livestock keepers do not require transportation or rent fees to make income from the practice. A few livestock keepers sell their products to neighbours, while eight farmers sell their products to supermarkets, shops and kiosks (Table 4.12).

Table 4.12: Market of Livestock and Livestock Products

Source of Market	Livestock	Livestock Products
People come to buy from the household	30 (79%)	23 (59%)
Neighbours	7 (18%)	8 (20.5%)
Supplies to supermarkets and shops/kiosks	1 (3%)	8 (20.5%)

Source: Fieldwork (2015)

According to Boischio (2006), livestock keeping practices that result in public health risks include poor disposal of animal waste; dust from poultry houses; living with livestock in the same house; handling of sick animals; consumption of contaminated animal products; stray animals; poor housing and congestion; unhygienic conditions; poor ventilation; feed quality and quantity; and poor disease management. The public

health risks include disease causing organisms; diarrhea and respiratory problems; infestation with internal parasites such as tapeworms; zoonotic problems; and transmission of pathogens.

4.4 Innovative Urban Livestock Keeping Practices

4.4.1 Value Addition to Animal Products

Fifteen livestock keepers reported that they add value to their products. This is done through conversion to another product (three livestock keepers) and through packaging (12 livestock keepers). Francis Wachira, a known urban farmer practicing both crop cultivation and livestock keeping, converts his goat milk to yoghurt. He started converting milk to yoghurt as a preservation mechanism but with time the yoghurt became popular. He explained that once the milk lasts for a day before it is sold, he boils the milk. He then allows the milk to cool before separating the cream and the milk. He uses the cream on bread or for cooking chapatti. He adds additives and flavor to the milk and leaves it to form yoghurt. He has undergone several trainings to improve on this value addition.

Ondiek Nyakona keeps seven cows in Viwandani. He ferments his milk and the fermented milk has attracted many customers. This process is done at his home. He allows the milk to stay for three days in a gourd. At times he adds charcoal into the milk to enhance the fermentation process. Once the milk is fermented he adds sugar and sells this as the final product to his customers. He observes that it is a good way to preserve milk such that even when fresh milk is in surplus, he does not incur any loss. He makes Kshs 1500 every morning from such sale and has been able to raise his children through livestock keeping. Paul Mwangi is a member of Fuata Nyayo group of 10 farmers in Viwandani. They keep rabbits, among other livestock. They slaughter the rabbits and use the rabbit meat to make samosas.

4.4.2 Composting Animal Waste

Animal waste disposal is a major challenge to all urban livestock keepers. As such livestock keepers like Francis Wachira have devised ways on how to deal with such a challenge. He has approximately 40 dairy goats and 500 rabbits. He composts his animal waste, which he uses for crop cultivation and sells the rest to other crop cultivators. He explains that lack of space in an urban centre makes composting of animal waste more challenging. However, he segregates a small space of approximately 10 by 10 feet and digs to a depth that is manageable. The hole is then used for animal waste, kitchen waste and crop residue collection and composting. Water is added to the animal waste to ensure it is not dry. It is then covered with a polythene bag and is left and occasionally turned for approximately two weeks to compost (Plate 4.2).

Plate 4.2: Composting of Animal Waste

Source: Fieldwork (2015)

The farmers practicing composting acknowledge that livestock waste should not be used in its raw state due to possible contamination of the crops. It should therefore be allowed to decompose and be probably mixed with other wastes. They insisted that livestock waste was very precious to them indicating that they used it for farming and could never use inorganic fertilizers.

4.4.3 Using Pig Waste to Generate Worms for Poultry Feed

John Kamau, a member of Bidii group of farmers, decided to generate worms from pig waste. The worms are used as poultry feed. The pig waste is collected in one corner of the farm. The heap of pig waste is then covered using polythene bags, sacks and mosquito nets. The covered pig waste is then left for some time to decompose until worms develop. This is done to a specific duration, wetness and temperature for the worms to develop. According to John, the polythene bags retain a lot of heat which is favourable for the worms to develop. The worms are then used to feed the poultry. The worms are very nutritious and contain many supplements as bought chicken feed. This reduces their expenses on poultry feeds and also drugs since the nutrients boosts the immunity of the poultry to diseases. The group is actually planning to intensify the decomposition and start packaging and selling the worms to other poultry farmers which is an innovative business venture (Plate 4.3).

Plate 4.3: Generating Worms from Pig Waste

Source: Fieldwork (2015)

An agricultural extension officer at Makadara sub-County noted that there was a specific cattle keeper in Viwandani ward who does not remove animal waste completely and when it rains it is really bad. According to the officer, this is a health risk not only to the cow but also to the farmer and the environment.

4.4.4 Using Kitchen Waste for Poultry Feed

Agnes Kariuki is a poultry farmer in Bahati. She keeps broiler chicken. She noted that she does not have to wholly use purchased feeds for her poultry. She compliments purchased feed with crop residues and kitchen waste. She explains that this is done by first drying the crop residues and kitchen wastes. The fully dried waste is then crushed into smaller pieces using a hand-driven machine. According to Agnes, the home-made chicken feed increases the immunity of the poultry and therefore she does not need to immunize the poultry. This food protects the poultry farmer from frequent veterinary services which were said to be relatively expensive.

4.4.5 Coping with Diseases

Having a disinfectant at the entrance at the entrance of the chicken shed is practices by all the poultry farmers. According to the farmers, disease causing microorganisms can be carried by the feet of human beings. To protect the poultry from such diseases the farmers ensure that a disinfectant is placed at the entrance of the chicken shed or at the gate of the farm. One of the farmers had soaked the disinfectant on a mattress material, others had it on a basin where one dips their feet, while another poultry keeper had built a structure for that purpose (Plate 4.4).

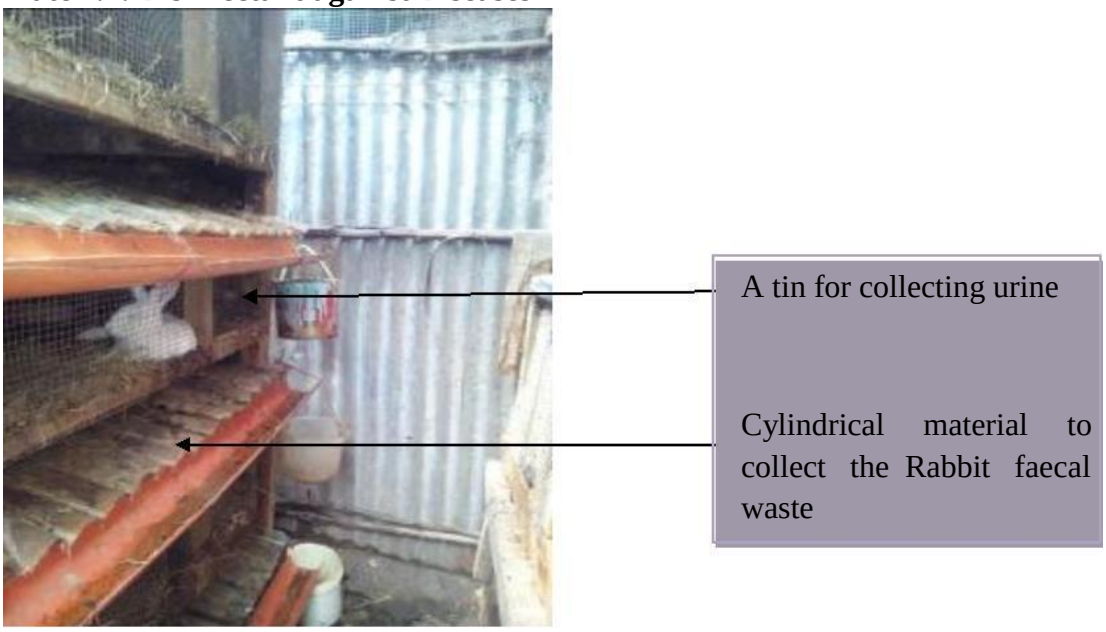
Plate 4.4: Disinfectant against Diseases

Source: Fieldwork (2015)

4.4.6 Coping with Limited Space and Animal Waste

Paul Mwangi, a member of Fuata Nyayo farmers group, rears rabbits, guinea pigs as well as practicing crop cultivation. Paul reported that their "innovative" structures are aimed at ensuring that the rabbit waste does not bring dump conditions that enhance diseases. They developed the structure after they were faced by loss of many rabbits and guinea pigs. They have constructed the structure in such a way that the livestock waste is disposed immediately. Nothing goes to waste for the rabbits as they utilize both the urine and animal waste. The urine is used as a pesticide and waste as manure in crop cultivation.

Plate 4.4: Disinfectant against Diseases



Source: Fieldwork (2015)

CHAPTER 5: SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

1) Nature and Extent of Livestock Keeping

- The main types of livestock kept in Makadara sub-county are cattle, goats (dairy and mutton), poultry, rabbits, guinea pigs, geese and ducks.
- Majority of the livestock keepers practice zero grazing, especially in Makadara and Bahati.
- Urban livestock keeping is largely practiced for commercial purposes. Very little is left, kept or used for household consumption.
- The choice of livestock kept depends on a number of factors such as availability of space, access to livestock feed and the demand for livestock products.
- The farmers have received information on how to conduct livestock keeping from their neighbours, friends and others learnt from their rural homes. However, the Ministry of Agriculture, Livestock and Fisheries has been offering technical advice to farmers from time to time.

2) Livestock Keeping Practices and Public Health Risks

- The main challenges for livestock keepers are livestock diseases and pests which can lead to public health risks.
- Poor management of livestock diseases, poor disposal of livestock wastes and poor handling of livestock may lead to public health risks.
- Poor handling of livestock products, contamination of livestock products, non-inspection of livestock products before sale and unhygienic conditions may lead to public health risks.

3) Livestock keeping Innovations

- Livestock keepers in Makadara sub-County have come-up with innovative ways to largely deal with space, livestock waste and livestock diseases, besides value addition.
- The innovations include value addition to the livestock products, re-using of animal waste and turning waste into products.

5.2 Conclusion

There is no doubt that urban livestock keeping is likely to lead to public health risks if not managed well. Urban areas are generally congested which is a major challenge to urban livestock keepers. The main health risks associated with urban livestock keeping can be through human diseases transferred from diseases vectors attracted by the activity; transmission of diseases from domestic animals to people (zoonosis) during animal husbandry, processing or meat consumption; human diseases associated with unsanitary conditions; and occupational health risks for the workers involved. However, the positive impacts of livestock keeping cannot be ignored as it is a source of income and food to the farmers and households practicing it. Livestock waste can be reused in an environment friendly manner to make the practice of livestock keeping sustainable in urban areas. Urban farmers practicing both livestock keeping and crop cultivation have been able to use the livestock waste in crop cultivation.

5.3 Recommendations

To Policy Makers

1. There is need to formulate and implement urban farming-friendly by-laws to regulated the practice. Attempts have been made so far but little has been achieved. Furthermore, urban farming should be integrated into the city planning and development policies and strategies.

2. Policies and by-laws governing urban farming should aim at guiding and regulating the practice by reducing risks and maximizing opportunities offered by urban farming.
3. There is need for Nairobi City County to work together with NGOs and CBOs who are supporting urban farming. Communities are better placed to regulate themselves and apply any by-laws that may be formulated by the county government to regulate urban farming.
4. The Ministry of Agriculture, Livestock and Fisheries (Makadara sub-County) has been supporting urban farmers through skills and trainings. However, there is need to reach more farmers so that they can all embrace sustainable urban farming practices.

To Future Researchers

1. This study focused on the practice of livestock keeping. However, it did not do laboratory analysis to clearly understand the public health risks associated with urban livestock keeping.
2. There is also need for a systematic study on the innovative practices of urban livestock keeping, as well as the role of NGOs, CBOs and the County government towards the development of these innovations.

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Appendices

Appendix 1: Livestock Keepers Questionnaire

NAME OF RESPONDENT

FARM CHARACTERISTICS

Q1. Where is your farm located?
[1] On-plot (own compound)
[2] Off-plot (somewhere else on private land)
[3] Off-plot (somewhere else on public land)
[4] Off-plot (on railways, road sides and other open spaces)
[5] Other (specify):

Q2. Who owns the land where you practice livestock keeping?
[1] Own land [2] Family land [3] Landlord
[4] Government [5] Don't know [6] Other

Q3. Name of estate or locality where farm is located

Q4. How do you get to your farm?
[1[On foot [3] Bicycle [5] Other (specify):
[2] Public transport [4] Personal car [7] Not applicable (on-plot cultivation)

Q5. Do you have a contract with the owner of the plot to use this plot?
[1] Yes [2] No [3] Not applicable

Q6. Do you pay rent or any other fees in order to use this plot?
[1] Yes, I pay a rent of Kshs [2] Yes, I pay some fees of Kshs [3] No
…….. Per ……. …… per ……

Q7. What is the approximate total size of your plot?

Q8. What is the approximate size of the area under livestock keeping?

ABOUT THE FARMER AND HIS/HER HOUSEHOLD

Q9. How many are you in this household?
[1] Enter the number of adults: _____ [2] children: _____ [3] Total: _____

Q10. Approximately how much do you spend on food in your household?
Specify the amount per **day, week or month**:

Q11. What is your average monthly income per month?

Q12. Gender of respondent: [1] Male [2] Female

Q13. Age of the respondent: In completed years:

Q14. Which county do you come from? [OPTIONAL]

Q15. What is your highest level of education?
[0] None
[1] Primary School [2] Secondary School
[3] Post-secondary school tertiary/college [4] University (Bachelors)
[5] University (Masters) [6] University (PhD)

Q16. What is your working/employment status?
[1] Employed / self-employed full time [2] Employed / self-employed part time
[3] Unemployed [4] Retired
[5] In education/training [6] Stay at home parent
[7] Long term sick or disabled [8] Doing unpaid or voluntary work
[9] Carer [10] Other, please specify

Please explain the type of occupation

Q17. Do you own or rent your dwelling unit: [1] Own house [2] Rental unit

Q18. Marital status of the respondent
[1] Never married [2] Married [3] Divorce [4] Widowed [5] Separated

Q19. For how long have you been a resident of this area?
[1] Less than 5 years [2] 5-10 years [3] 11-15 years [4] 16-20 years [5] over 20 years

LIVESTOCK KEPT

Q20. Livestock kept, their current numbers, rearing system and purpose of rearing

Type of livestock kept [Probe for various types of livestock = Cattle, Sheep, Goats, Pigs, Chicken, Ducks, Rabbits, etc]	**Livestock product**	**Current numbers kept**	**Rearing system** [1] Within own compound [2] Zero grazing [3] Free range	**Purpose of keeping livestock….check q37** [1] Own consumption only [2] Consumption and selling [3] For selling only
1				
2				
3				

Q21. What reason do you keep the specific type (s) of livestock

[1] They are small requiring less space [2] They consume less food
[3] High demand for them or their products [4] My neighbours keep them
[5] Others, specify

Q21. If you sell any of your <u>livestock</u>, who buys?

[1] People come to buy from here [2] I sell it to households and neighbours around
[3] I sell it to shops/kiosks around [4] I supply the supermarkets
[5] Others, specify

Q22. Approximately how much do you earn from selling your livestock?

Kindly specify if it is per month or year _____

Q23. If you sell any of your <u>livestock products</u>, who buys?

[1] People come to buy from here [2] I sell it to households and neighbours around
[3] I sell it to shops/kiosks around [4] I supply the supermarkets
[5] Others, specify

Q24. Approximately how much do you earn from selling your livestock products?

Kindly specify if it is per day, week or month

Q25. What ways do you change your livestock products before sale?

[1] Adding preservatives [2] Converting to another product
[3] Packaging [4] Nothing [5] Others, specify

<u>LIVESTOCK KEEPING METHODS</u>

Q25. Do you keep livestock as a:

[1] Individual [2] Corporative society [3] Youth group
[4] Women group [5] CBO [6] Self-help group

Q26. Roughly how many hours per week do you spend on livestock keeping?

[1] 0-2 hours [2] 2-4 hours [3] 4-6 hours [4] 10+ hours

Q27. Do you practice livestock keeping by yourself or does anyone help you with this?

[1] I do it by myself [2] Other members of the household help me
[3] Other relatives help me [4] My friends help me
[5] I hire labour [6] Other, please specify:

Q28. Do you normally use any of the following inputs?

a) Improved breeds/AI [1] Yes [2] No b) Veterinary drugs [1] Yes [2] No
c) Feed supplements [1] Yes [2] No d) Urban waste as feed[1] Yes [2] No
e) Crop residues [1] Yes [2] No

Q29. Where do you get water for your livestock keeping activities?

a) Collecting rainwater [1] Yes [2] No
b) Use the tap water from my home [1] Yes [2] No
c) Other, specify:

Q30. What do you do with the animal waste?

[1] Use all of it for own crop cultivation [2] Use part of it and sell the rest
[3] Sell all of it [4] Dump it on the street
[5] Give it out to neighbours/friends/relatives

Q31. Are you faced with any of the following difficulties in livestock keeping? If so, how do you solve or manage them?

a) Pests [1] Yes [2] No If yes, specify solution:
b) Diseases [1] Yes [2] No If yes, specify solution:
c) Livestock theft [1] Yes [2] No If yes, specify solution:
d) Water [1] Yes [2] No If yes, specify solution:
e) Land insecurity [1] Yes [2] No If yes, specify solution:
f) Access to credit [1] Yes [2] No If yes, specify solution:
g) Space [1] Yes [2] No If yes, specify solution:
h) Market [1] Yes [2] No If yes, specify solution:
i) Any other problems, please specify:
If yes, specify solution:

SKILLS AND KNOWLEDGE

Q32. How did you learn livestock keeping?

a) Personal observation [1] Yes [2] No
b) In school [1] Yes [2] No
c) Learning from family members and relatives [1] Yes [2] No
d) Learning from friends and neighbours [1] Yes [2] No
e) Learning from other farmers [1] Yes [2] No
f) Attending a training course [1] Yes [2] No
g) Learning from books and magazines [1] Yes [2] No
h) Learning from Radio and TV programs [1] Yes [2] No
i) Other, specify:

Q33. Do you receive any technical assistance for your livestock keeping?

[1] Yes [2] No

Q34. If yes, from whom?

[1] Extension officer [2] Programme [3] Neighbour/friend [4] Relative

MOTIVATION FOR LIVESTOCK KEEPING

Q35. How long have you been practicing livestock keeping? Specify (in years):

Q36. What inspired you to start keeping livestock?

[1] Needed income or diversify income [2] Needed to use livestock products for food
[3] It is a family tradition/custom/hobby [4] I had access to land
[5] I had no job [6] Other, please specify:

Q37. How important is livestock keeping to your household?

[1] Cannot survive without it [2] Major source of food
[3] Major source of income [4] Additional source of food
[5] Additional source of income [6] Could do without it

CONTRIBUTION OF LIVESTOCK KEEPING TO FOOD SUPPLY

Q38 Please estimate what proportion of your household food needs is covered by the products you get from livestock keeping?

[1] All of it (90-100%)
[2] Most of the food (80-90%) [3] About half of the food (50-60%)
[4] Less than half of the food (30-40%) [5] Only a small portion (20%)
[6] Negligible (10%) [7] None at all

PUBLIC HEALTH CONCERNS OF LIVESTOCK KEEPING

Q39. What are the actions you take towards prevention of diseases of your livestock

[1] Vaccination [2] Regular check ups by a veterinary officer
[3] Maintaining cleanliness of the livestock house
[4] Ensuring cleanliness of livestock feeds [5] Others, specify:

Q40. What are the actions taken upon an outbreak of diseases?

[1] Nothing [2] Call the Veterinary officer
[3] Use local methods [4] Seek neighbours' assistance
[5] Others, specify:

Q41. Do you sell your meat products?

Q42. Are animals inspected before slaughter or sale? [1] Yes [2] No

Q42. How often do you remove waste (feaces) from the livestock pen?

[1] Regularly: (x/week) [2] When necessary [3] Other specify:

Q43. Which measures do you take regarding personal hygiene?

[1] Workers, visitors and subcontractors are wearing protective clothing
[2] Hands are washed prior to handling livestock products and after visiting the toilet
[3] No drinking and eating in the livestock shed
[4] Wounds are covered
[5] Employees/person responsible for handling livestock report illnesses

Appendix 2: In-depth Interview Guide

1. Name of the Livestock Keeper
2. Types of livestock kept
3. Practice considered an innovation
4. When they started the practice
5. What influenced the practice
6. How it is done
7. Benefits of the practice
8. Challenges of the practice

Appendix 3: Key Informant Interview Guide

1. Name of the officer (Optional)
2. Position of the officer
3. What are the ways in which you are supporting livestock keeper as regards the practice, disease prevention and innovations?
4. What are the challenges you have noted the farmers face in livestock keeping
5. What are the challenges you have observed livestock keeping may cause in Makadara Sub-county?
6. What could be done to make livestock keeping conducive in the city, to eradicate the existing challenges?