Urban-Based Agriculture and Poultry Production

The Case of Kisumu and Thika in Kenya

Omondi, Samuel

Urban-Based Agriculture and Poultry Production

The Case of Kisumu and Thika in Kenya

SAMUEL ONYANGO OMONDI
DEPART. OF HUMAN GEOGRAPHY | FACULTY OF SOCIAL SCIENCES | LUND UNIVERSITY

Rapid population growth, urbanisation, dietary shift, urban poverty, and food insecurity are some of the forces driving some urban dwellers to engage in agricultural activities in urban areas, rural areas or both. This thesis looks at the participation rates in agriculture by urban households and its importance to their livelihood. It further examines the urban poultry value chain to determine the upgrading mechanisms of the value chain actors. Results indicate that agricultural production by urban households is an important livelihood activity, contributing directly to food security through consumption of own produced food or indirectly through earning income from sale of the produces. Other actors not directly involved in agricultural production, such as input and output traders also benefit from urban agriculture.

SAMUEL ONYANGO OMONDI has a background in Agricultural Education and Extension (BSc) and Agricultural and Applied Economics (MSc). *Urban-Based Agriculture and Poultry Production: The Case of Kisumu and Thika in Kenya* is his doctoral thesis.

Printed by Media-Tryck, Lund 2018 NORDIC SWAN ECOLABEL 3041 0903

LUND UNIVERSITY

Faculty of Social Sciences
Department of Human Geography

ISBN 978-91-7753-872-1

Urban-Based Agriculture and Poultry Production

The Case of Kisumu and Thika in Kenya

Samuel Onyango Omondi

LUND UNIVERSITY

DOCTORAL DISSERTATION
by due permission of the Faculty of Social Sciences, Lund University, Sweden.
To be defended at Världen. Geocentrum I, Sölvegatan 12,
Lund on 6th December, 2018 at 11:00am.

Faculty opponent
Karl M. Rich
International Livestock Research Institute,
East and Southeast Asia Regional office, Vietnam

Organization LUND UNIVERSITY	Document name Doctoral Dissertation
	Date of issue
Author(s) Samuel Onyango Omondi	Sponsoring organization

Title and subtitle: Urban-based Agriculture and Poultry Production: The Case of Kisumu and Thika in Kenya

Abstract

Kenya's population is rapidly growing and urbanising. Poverty and problems of food insecurity are equally urbanising at an unprecedented rate. Formal employment has not kept pace with the job demand of the growing population. As a result, urban residents seek employment (livelihood) from an array of informal economic activities, including own food production. The growing urban population and urbanisation creates a demand for food, some of which are grown in urban areas. Despite its importance, there has been no recent studies to document and analyse own food production in the medium-sized cities of Kenya, which have the largest share of population, are the majority, and still have relatively more available land than the bigger cities.

Thus, the purpose of this study is to contribute to our understanding of the development of urban agriculture in medium-sized cities in Kenya by analysing the role of own food production on households' food security. This was achieved through three specific objectives; to provide a theoretical framework of why urbanites engage in farming; to analyse the operation of the urban poultry value chain; and to investigate the profitability of indigenous chicken production in urban areas of Thika and Kisumu, Kenya. Using data from these two cities, and a mixed-methods approach of combining quantitative and qualitative methods, the aforementioned objectives were addressed in three journal articles.

Findings indicate that more than half of urban households in the two cities studied engage in some form of agriculture in urban or rural areas. One out of four households practises urban agriculture while 37 per cent practise agriculture in rural areas. For households engaged in urban agriculture, 36 per cent of their income derives from agriculture. Households practising agriculture in rural areas derive 39 per cent of their income from agriculture. Findings from this study also demonstrate that urban agriculture contributes to household food security through two pathways; through direct consumption of produces and indirectly through income. Own production of food items such as vegetables and eggs provide nutritious food to the farming households. Additionally, income derived from sale of own produced agricultural commodities could be used to purchase other food items not produced by the household.

Three fifths of the urban farmers practise poultry production. Poultry production in the two cities is dominated by indigenous chicken production, with a significant share of households producing broiler, layer, and ducks. Indigenous chicken provides both food and income to the households. Broiler and layer production are predominantly for income generation. The poultry value chain is characterised by spot market exchanges, with many buyers and uncoordinated activities. Poultry theft, especially in informal settlements, slaughtering of chicken without inspection by meat inspectors, non-adherence to drugs withdrawal period, and manufacturing and sale of substandard poultry feed are some of the illegalities in the urban poultry value chain. Indigenous chicken production is a profitable venture with a gross margin of Ksh. 756 per bird (1USD was equivalent to Ksh. 100 at the time of survey). Access to high value markets, market information, production system, and a farm's location within a cluster of related industries are important determinants of profitability.

The study identifies several potential points of entry for county governments and authorities to support urban poultry farmers. For example through encouraging and assisting farmers to form producer groups that would improve their accessibility to high value markets. Another entry point for the county governments is enhancing farmers' knowledge on poultry production and disease management as an avenue of improving their position and upgrading in the value chain. Furthermore, to reduce potential health risks, County governments could enforce the meat control act's regulation to ensure that all poultry meat intended for sale is inspected by county meat inspectors. The Kenya Bureau of Standards should ensure that only certified companies produce livestock feed to ensure quality of feed.

Key words: Urban agriculture, urban-based rural agriculture, poultry production, poultry value chain, food security, Kenya

Classification system and/or index terms (if any)

Supplementary bibliographical information		Language English
ISSN and key title 978-91-7753-873-8		ISBN 978-91-7753-872-1
Recipient's notes	Number of pages	Price
	Security classification	

Signature: Sammy Date: 10th October, 2018

Urban-Based Agriculture and Poultry Production

The Case of Kisumu and Thika in Kenya

Samuel Onyango Omondi

LUND
UNIVERSITY

Cover photo by Samuel Onyango Omondi

Faculty of Social Sciences
Department of Human Geography

ISBN 978-91-7753-872-1 (print)
ISSN 978-91-7753-873-8 (pdf)

Printed in Sweden by Media-Tryck, Lund University
Lund 2018

MADE IN SWEDEN

To my mother, Benta Atieno Omondi

Light up the darkness (Bob Marley)

Table of Contents

Acknowledgement.....v
List of articles..... vi
List of abbreviations..... vii
List of figures ix
List of tables..... ix
List of appendices ix

CHAPTER ONE: INTRODUCTION 1
1.1 Background information 1
1.2 Problem statement.....2
1.3 Purpose and objectives.....4
1.4 Justification 5
1.5 Structure of the thesis.....5

CHAPTER TWO: LITERATURE REVIEW.....7
2.0 Introduction.....7
2.1 Population growth and urbanisation trends.....7
2.2 Urban livelihoods and own food production.....8
2.3 Types of urban agriculture 14
2.4 Health hazards and ecological sustainability of urban agriculture.....15
2.5 Urban livestock production 16
2.6 Poultry production systems in Kenya.....17
2.7 Illegalities in agricultural and food value chains.....19
2.8 Urban agriculture policies, regulatory framework, and institutions.....19
2.9 Summary; research gaps.....21

CHAPTER THREE: THEORETICAL PERSPECTIVES 23
3.0 Introduction.....23

3.1 Theoretical perspectives of food security in relation to own food production 23
3.1.1 Food security metrics and measurement 27
3.1.2 Food security metrics adopted 27
3.2 Value chain approach: theoretical underpinning 28
3.3 Cluster theory and geographical clustering of firms 31
3.4 Bridging the theoretical gap: Combining value chain and cluster theory 32
3.5 Profitability; Conceptual framework 32
3.6 Summary of theoretical approaches used in the thesis 33
CHAPTER FOUR: METHODOLOGY 37
4.0 Study country and cities 37
4.1 Kenya 37
4.2 Justification for selecting the two cities 39
4.2.1 Kisumu 40
4.2.2 Thika 40
4.2.3 Types of urban agriculture based on location in Kisumu and Thika, Kenya 41
4.3 Sampling procedure 41
4.4 Data description, survey instruments, and data collection 43
4.5 Data analysis 45
4.6 Data validity and reliability 45
4.7 Problems encountered during field work 47
4.8 Study limitations and strengths 47
CHAPTER FIVE: SUMMARY OF RESEARCH ARTICLES 49
5.1 Summary of articles 49
5.2 How do medium-sized cities' findings compare to larger cities 52
CHAPTER SIX: DISCUSSION AND CONCLUSION 55
6.0 Introduction 55
6.1 Discussion; relating results to theory 56
6.2 Conclusion 58
6.4 Recommendations for policy 60
6.5 What does the future hold for urban agriculture and urban poultry production? 61
6.6 Future research gaps 62
6.7 Reflections by author 62

References 65
Appendix 1: Poultry farming survey instrument, 2016 77
Appendix 2: Guiding questions for FGDs and other key stakeholders in the poultry value chain 97
Appendix 3: List of participants in qualitative interviews, 2016.....101

Acknowledgement

Although PhD is mainly an individual achievement, conducting a research for a span of more than three years means that many people help in achieving the goal. It delights me to give thanks to colleagues, friends, and family for all the help they have accorded me during my studies. First and foremost, I thank God for enabling me to soldier on in this journey. My sincere gratitude goes to my principal supervisor, Prof. Magnus Jirström (Lund University), for his able and professional supervision from the inception of the research to its completion. His keen eyes on my academics shaped me into what I am today. His words that, 'PhD is like a driving licence' and that I should always take control of the study, has to a great deal helped shape the direction of my research. Thank you very much.

Many thanks to Dr. Yahia Mahmoud (Lund University), my co-supervisor who critically read my manuscripts and gave very insightful comments. I will never forget the afternoon meetings in his office, with the cool music playing in the background. He always insisted that I look for patterns in the data. I am glad to say that the patterns have yielded this thesis. I would also like to thank Prof. Willis Oluoch-Kosura (University of Nairobi), my co-supervisor for all the valuable comments that enabled me to cut a research niche. Many thanks to Dr. David Jakinda (University of Nairobi) for his valuable comments during proposal development. I would also like to thank Martin Prowse, Markus Grillitsch, and Carl-Johan Lagerkvist for their valuable and insightful comments as they acted as opponents for my first, midterm, and final seminars, respectively and Teis Hansen as the 'final' reader at the department of Human Geography, Lund University. Their comments helped in improving the quality and organisation of the study. Many thanks to Mikael Hammarskjöld for his invaluable comments and sharp editing skills for all my manuscripts and the kappa. Many thanks to Judy Kawira for developing the maps used in the kappa and journal articles.

My gratitude also goes to my enumerators whose contribution to data collection was immense, all the urban farmers, and key stakeholders who participated in the survey and interviews. Heartfelt gratitude goes, in no particular order, to colleagues at the department of Human Geography, Lund University; Hayford Ayerakwa, Ibrahim Wahab, Illia Farahani, Katherine Burlingame, Maria Archila, Sara Alobo, and Süheyla Türk as well as Heather Mackay (Umeå University). I would also like to thank all the staff at the Department of Lund University. Thanks to Linda Stihl and Arvin Khoshnood for the administrative support and Henrik Steen for taking care of finances. Finally, thanks go to my family for all the encouragement, patience, and love they accorded me. Your prayers have finally been answered.

List of articles

Article 1:

Omondi, S.O., Oluoch-Kosura, W. and Jirström, M. (2017). The role of urban-based agriculture on food security: Kenyan case studies. *Geographical Research*, 55(2): 231–241.doi:10.1111/1745-5871.12234

Article 2:

Omondi, S.O. (*to be submitted*). Poultry value chain in two medium-sized cities in Kenya; insights from cluster theory

Article 3:

Omondi, S.O. (*accepted*). Economic analysis of small-scale poultry production in Kenyan medium-sized cities of Kisumu and Thika. *Journal of Agribusiness in Developing and Emerging Economies*

List of abbreviations

AFSUN	African Food Security Urban Network
ARVs	Anti-Retroviral drugs
ASALs	Arid and Semi-arid Lands
CBOs	Community Based Organizations
CGIAR	Consultative Group on International Agricultural Research
DOCs	Day Old Chicks
EPZ	Export Processing Zone Authority
FAO	Food and Agriculture Organization of the United Nations
FGDs	Focus Group Discussions
GDP	Gross Domestic Product
GPS	Global Positioning System
HFIAP	Household Food Insecurity Access Prevalence
HFIAS	Household Food Insecurity Access Scale
HVMs	High Value Markets
IDRC	International Development Research Centre
KEBS	Kenya Bureau of Standards
KIIs	Key Informant Interviews
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KNBS	Kenya National Bureau of Statistics
NGO	Non-Government Organization
NIE	New Institutional Economics
ODK	Open Data Kit
RUAF	Resource Centres on Urban Agriculture and Food Security
SPSS	Statistical Packages for Social Sciences
UH	Urban Harvest
UN	United Nations
UNDP	United Nations Development Program

UN-HABITAT United Nations Human Settlements Programme

UNIDO United Nations Industrial Development Organization

List of figures

Figure 1: A sack garden outside a residential house in Nyalenda, Kisumu, 2016. At the bottom left corner is a pile of chicken manure to be used for vegetable production 12

Figure 2: Urban agriculture food security pathways from an entitlement perspective 26

Figure 3: Conceptualisation of the connection between studies presented in the three articles 34

Figure 4: Map of Kenya, Kisumu and Thika 38

Figure 5: Location of urban agriculture in Kisumu and Thika, 2013 41

List of tables

Table 1: Sample sizes in Kisumu and Thika 42

List of appendices

Appendix 1: Poultry farming survey instrument, 2016

Appendix 2: Guiding questions for FGDs and other key stakeholders in the poultry value chain

Appendix 3: List of participants in qualitative interviews, 2016

CHAPTER ONE: INTRODUCTION

1.1 Background information

Urban and peri-urban agriculture, which entails rearing of livestock and cultivation of crops within urban areas or at their peripheries, has been a continuing activity since time in memorial (Mougeot, 2000; van Veenhuizen, 2006; Lee-Smith and Cole, 2008; Gallaher, *et al*., 2013). As pointed out by Mougeot (2000), the distinction of whether agriculture is practised in urban areas or in peri-urban areas is not as important as the fact that it is an integral part of the urban system. It utilises urban resources, its products are marketed in urban areas, and the practise is affected by urban policies.

In developing countries, urban agriculture is practised by households of all income groups and is a vital part of the urban community in which it acts as a basic livelihood strategy among some poor urban households (Deelstra and Girardet, 2000; Foeken and Owuor, 2008). Factors such as rising demand for food by rapidly urbanising population and close proximity to inputs and output markets attract urban dwellers with access to land to urban agriculture (van Veenhuizen, 2006; Lagerkvist, 2014). Wide spread poverty, unemployment, and food insecurity on the other hand, act as push factors for households to engage in urban agriculture (Foeken and Owuor, 2008; Orsini *et al*., 2013).

Yet, in spite of the scepticism and opposition from urban planners, environmental and public health agencies, urban agriculture is not a negligible activity in Sub-Saharan Africa (SSA), where between 20 and 84 per cent of urban dwellers practise urban agriculture (Zezza and Tasciotti, 2010; Smart *et al.*, 2015; Ayerakwa, 2017a). The prevalence and importance of urban agriculture is however highly contextual. Whereas in some African countries a significantly high number of urban households derive their livelihood from urban agriculture, the engagement rate and agricultural income shares are considerably low in some countries (Zezza and Tasciotti, 2010; Frayne *et al*., 2014; Smart *et al.*, 2015; Ayerakwa, 2017a). The high prevalence rates of urban agriculture and its significant contribution to incomes of urban households have had momentous effects in gaining the attention of researchers, development agencies, and recently (local) governments on the potential role of urban agriculture

in improving households' welfare (Dongmo *et al*., 2010; Lee-Smith, 2010, 2013; Mougeot, 2011; Stewart *et al*., 2013; Warren *et al*., 2015).

Urban-based rural agriculture, that is, the practise of agriculture in rural spaces by urban households has not been widely researched, except for a few cases (Memon and Lee-Smith, 1993; Foeken and Owuor, 2008; Jayne *et al*., 2015; Ayerakwa, 2017a). It has been found that urban households still hold ties with rural areas, through practising agriculture in rural areas and food transfers between urban and rural areas (Foeken and Owuor, 2008; Jayne *et al*., 2015; Ayerakwa, 2017b). This presents another livelihood opportunity to urban households who own or rent land in rural areas, through direct consumption of food produced on such land or through income derived from sale of agricultural commodities produced in rural areas. These activities are important in enhancing food security and income generation (Ayerakwa, 2017a).

1.2 Problem statement

To better understand the role of urban agriculture as a livelihood activity and its potential to improve households' food security and income in developing countries, it is important to understand the functioning of the urban agricultural and food systems (Ambrose-Oji, 2009). Except for a few African countries such as Tanzania, Uganda, and Ghana which have urban agriculture policies and farmers receive some support from the government, urban agriculture has generally received negative criticisms. Kenya's urban agriculture policy is still in the draft stage since 2010, yet the practise is still continuing. Urban agriculture has been associated with food safety and health risks through consumption of crops irrigated with untreated sewage water, poor disposal of livestock wastes, inconveniences caused by urban livestock production, and risks of zoonoses (Republic of Kenya, 2010a). The scepticism has further been amplified by a lack of or inconsistent empirical data on scale, type and nature of urban agricultural practises to support its economic and food provision roles (Stewart *et al.*, 2013).

A lack of solid empirical data on the level of importance of urban agriculture has further compounded the scepticism and hampered recognition of urban agriculture in policies (Zezza and Tasciotti, 2010). The literature on urban is still sporadic, unsystematic, and anecdotal with no causal relationships (Zezza and Tasciotti, 2010) and advocacy driven (Ellis and Sumberg, 1998; Webb, 2011). Infrastructural development and land sub-division which have shrunk urban farmlands have also raised doubts about the capacity of urban agriculture to enhance food security (Vagneron, 2007; Paül and McKenzie, 2013). Furthermore, as noted by Zezza and Tasciotti (2010), economic importance based on the analysis of profitability and

food provision roles of urban agriculture require more empirical research. These sentiments are echoed by Andersson Djurfeldt (2014) who notes that there is a dearth of empirical studies on the contribution of urban agriculture on household income.

In recent times, there has been an increased interest in urban agriculture as a livelihood activity by researchers and development agencies (Lee-Smith 2013; Stewart *et al*., 2013; Hardman and Larkham, 2014). However, the focus has mainly been on crop production, specifically horticulture and dairy production (Amoah *et al*., 2007; Kang'ethe *et al*., 2010; Orsini *et al*., 2013; Henseler and Amoah, 2014; Eigenbrod and Gruda, 2015). The role of small livestock reared at the backyards for food security and income generation are rarely studied, partly because they are usually not readily visible to researchers (Waters-Bayer, 1996). For instance, even though poultry production is a popular enterprise among urban farmers, its welfare role is rarely studied. Furthermore, information on the scale, potential and problems associated with urban livestock production is limited (Amadou *et al*., 2012).

The literature on urban agriculture split the theorising of urban agriculture into two broad categories as it tries to explain why people farm in the city. Firstly, urban agriculture has been theorised to be a response to market opportunities, where practitioners engage to provide food to the ready market (Dongmo, *et al*., 2010; Kang'ethe *et al*., 2010; Nyapendi, *et al*. 2010; Lee-Smith, 2013). On the other hand, it has been hypothesised to be responding to market failures, in which the poor engage in it as a survival strategy (Maxwell, 1995; Gallaher *et al*., 2013). While these positions could be true to some contexts, are they applicable in Kenyan medium-sized cities? This thesis attempts to theorise why Kenyans farm in these cities.

Agricultural value chains analysis and cluster theory offer useful insights on how the competitiveness of an industry can be improved. However, the two theories focus at different loci regarding the source of competitiveness. Value chain analyses concentrate on the importance of coordination between buyers and local suppliers (Gereffi *et al*., 2005) while cluster theory gives more attention to local relationships as sources of competitiveness (Porter, 1990; Humphrey and Schmitz, 2002). This study contextualises value chains in two medium-sized cities in Kenya using a combination of value chain and cluster theory approaches with an effort to build on their synergies.

This research is timely in addressing some of the knowledge gaps highlighted. It provides new empirical evidence on own food production by urban households and attempts to theorise why people farm in the city. In addition, it characterises a specific urban livestock production activity (poultry), its scale, importance, and profitability. It focuses on the local linkages, relationships, and institutions from cluster theory perspective and at the same time looking at the industry from a broad

value chain perspective. Considering that there are several types of poultry species, the analysis of profitability is for indigenous chicken only, for which sufficient sample enabled comparisons across categories and regression analyses. Such information is important in designing effective urban food and urban agriculture policies. The study also departs from metro cites and crop agriculture bias (Obudho and Foeken, 1999), by studying the phenomenon of urban poultry farming in two medium-sized cities, in Kenya.

1.3 Purpose and objectives

The purpose of this thesis is to contribute to our understanding of development of urban agriculture in medium-sized sized cities in Kenya by analysing the role of own food production on households' food security and specifically focusing on the economic benefits of urban poultry farming and the operation of the urban poultry value chain.

The specific objectives of the study and respective research questions are:

1) To provide a theoretical framework of why urbanites engage in farming
    - What is the level of engagement in agriculture among urban households?
    - How are 'own-produced' agricultural commodities utilised, and what is their income contribution?
    - What role does engagement in agriculture play in enhancing food security of farming households?
2) To analyse the operation of the urban poultry value chain.
    - How does the contextualisation of the poultry value chain in medium-sized towns enhance our understanding of how it operates?
    - What is the governance structure and institutional framework of the urban poultry value chain?
    - How does application of cluster theory to value chain improve our understanding of the urban poultry value chain?
3) To investigate the profitability of urban indigenous chicken production.
    - What is the profitability of urban indigenous chicken production?
    - What factors determine the profitability of urban indigenous chicken production?

1.4 Justification

Even though a significant share of urban households in Kenya practises agriculture, very little is known about its nature, scale, and benefits. This study provides insights to some of these issues.

Food insecurity is a major concern in Kenya. The maize shortage in Kenya in 2017 led to price increases that were unaffordable to most households. The government intervened by subsidising maize. However, the sustainability of such a subsidy programme is yet to be evaluated. Perhaps it is time to focus more attention to own food production, for households who have access to land. This study evaluates the food security roles of own food production by urban households. It further explores the operation of urban poultry value chain and profitability of indigenous chicken production. Findings from such a study present a feasible income generating opportunity to urban residents, which could be up scaled to provide employment opportunities.

1.5 Structure of the thesis

The compilation thesis format has been adopted in this thesis. It is composed of three journal articles, which form the core of the thesis. The different journal articles are stand alone and could be read independently. The journal articles are preceded by the introductory chapters (in Swedish *Kappa*) which introduce the study, present the research problem, objectives, research questions, justification of the study, and organisation of the thesis. The introductory chapters also present literature review, theoretical perspectives, methodology, summary of the articles, and the conclusion. Afterwards, the three articles that address the specific objectives of the study are presented.

It is important to note that the *kappa,* paper 1 and paper 2 have adopted British English while paper 3 uses American English. The choice of language, particularly in the papers was informed by journal requirements.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter presents literature on population growth and urbanisation trends, followed by urban livelihoods and own food production. Urban agriculture is discussed in detail in this sub-section, including its benefits, risks, and main actors. A characterisation of urban livestock production has also been discussed. An overview of the Kenyan poultry sub-sector and a brief discussion on illegalities in agricultural food value chains are also provided. Finally, the chapter presents urban agriculture's regulatory framework and concludes with a summary highlighting research gaps. Therefore, this chapter generally provides a discussion on the drivers of urbanisation and reasons for engagement in urban agriculture. It discusses urban livestock production and specifically poultry production to provide context for the study. The chapter also presents some anecdotal evidence on illegal activities in the poultry value chain which occurs alongside the legal.

2.1 Population growth and urbanisation trends

The world's population estimated at 7.6 billion in 2017 is expected to grow to 9.8 billion by 2050 and 11.2 billion by 2100 (United Nations, 2017). While Africa's population is expected to grow rapidly and double to about 2.5 billion people by 2050, Europe's population is aging and a six per cent decline in population is expected during the same period (Losch *et al*., 2012; United Nations, 2017). By 2020 and 2035, half of Asia's and Africa's populations, respectively, will be urban (United Nations, 2012). The projections indicate that population growth will be concentrated in the urban areas of less developed countries, which will grow from 2.7 billion in 2011 to 5.1 billion in 2050 (United Nations, 2013).

Urbanisation is mostly driven by economic factors, such as employment opportunities, which lead to migration from rural to urban centres (United Nations, 2012). Better access to social services such as ample schools, hospitals, and medical

services also attract people to towns (Satterthwaite, 2007). This notwithstanding, births within towns and cities have also contributed to the rapid urbanisation (Andersson Djurfeldt and Jirström, 2013; United Nations, 2013).

The first comprehensive census in Kenya was conducted in 1969 and reported a population of 10.9 million people. The country recorded a population growth of 4.4 million between 1969 and 1979. Population has since then continued to grow and the most recent census in 2009 reported a population of 38 million and later estimated to be 47 million in 2015 (Republic of Kenya, 2010b; KIPPRA, 2016).

With a rapid annual population growth rate of 2.9 per cent (KIPPRA, 2017), Kenya's urbanisation level will be already 63 per cent by 2030, much earlier than the average for Africa (Republic of Kenya, 2007). In addition to the number of Kenya's urban areas increasing, their populations are also constantly rising because of births within the towns and rural-urban migration. This makes urban planning that supports urban food system a critical policy issue (Republic of Kenya, 2012a).

As is the case in many developing countries, urbanisation in Kenya has not been accompanied by equivalent economic growth, resulting to widespread poverty and food insecurity among the urban poor (Republic of Kenya, 2010b). Infrastructural development, service provision, and housing have also not kept pace with the rapid urbanisation (Matuschke, 2009).

2.2 Urban livelihoods and own food production

The urban poor highly depend on purchased food and face high accommodation and transport costs (Armar-Klemesu, 2000). Their situation becomes even more debilitating with the food and fuel price increases (Cohen and Garrett, 2010). This is because the urban poor spend between 60 and 80 per cent of their income on food (de Zeeuw and Dubbeling, 2009). Global food spikes have left many poor urban households vulnerable to food insecurity (de Zeeuw and Dubbeling, 2009; Crush and Frayne, 2010).

At the same time, as poverty and food insecurity are increasingly becoming major problems in urban areas, formal employment in developing countries has not matched employment needs of the rising population and rapid urbanisation (Republic of Kenya, 2012a; KIPPRA, 2016). In addition to formal employment, urban households adopt several livelihood strategies including informal employment such as petty trades, casual works, and informal food businesses among others (Floro and Swain, 2013; Ayerakwa, 2017a). Among the informal employment opportunities available to urban residents is urban-based farming,

comprising of urban agriculture and urban-based rural agriculture (Mwangi, 1995; Foeken and Owuor, 2008; Ayerakwa, 2017a).

Urban agriculture is defined as *"the growing of plants and the raising of animals for food and other uses within and around cities and towns, and related activities such as the production and delivery of inputs, and the processing and marketing of products"* (van Veenhuizen, 2006, p. 2). Urban-based rural agriculture on the other hand is the practise of farming in rural areas by urban residents (Omondi et al., 2017).

This introduces the concept of multi-local livelihoods, which describes a household that derives livelihood from multiple localities, for example deriving income or food from farming in both urban and rural areas and food transfers from urban or rural areas (Foeken and Owuor, 2001). Although, there are several multi-local livelihoods options which have become particularly important for enhancing food security in developing countries, the scope in this review is limited to own food production.

It is widely cited that global participation in urban agriculture in 1996 stood at 800 million urban farmers, with one quarter of the producers being market oriented and that the practice provided full-time employment to some 150 million people (Smit *et al.,* 1996 as cited in Armar-Klemesu, 2000). Therefore, it is not surprising that urban agriculture has captured the attention of researchers, development partners, (local) governments, and advocacy groups (Lee-Smith, 2013; Stewart *et al*., 2013). However, the estimated number of 800 million urban farmers has been criticised to be exaggerated and advocacy driven (Zezza and Tasciotti, 2010).

Urban agriculture could be perceived to be divergent in its contribution to welfare, between the Global North and Global South perspectives. While in most Global South countries urban agriculture is perceived as a tool for combating food insecurity and a source of income, in the Global North, its main role is seen in the greening of cities (beautification), connecting the community to nature, as a form of exercise, and improving social interaction (Ernwein, 2014; Stewart *et al*., 2013). The Global North's need for urban agriculture for food security is rather unwarranted, given the availability of generally affordable food (Badami and Ramankutty, 2015).

Collective farming in the North through community gardens and allotment gardens act as avenues for promoting cultural integration in cities. Urban farming often involves community participation in the management of urban land, which facilitates community members' social interaction, thereby improving their social capital (Colding and Barthel, 2013). Furthermore, the urban green spaces in the Global North conserve biodiversity, mitigate climate change, and provide ecosystem services (La Rosa *et al.,* 2014). The core of this thesis is on own food production-income-food security nexus. Therefore, the discussion on urban

agriculture is restricted to the Global South context where urban agriculture's role on food security is relatively important.

Although the literature on urban agriculture is fairly recent, the practice has been in existence since ancient times in most SSA cities (Gallaher *et al*., 2013). Farming in and around cities is as old as the cities themselves (Lee-Smith and Cole, 2008). However, in several African countries, colonial governments discouraged and often outlawed urban agriculture on the basis that it's an archaic activity that should not feature in modern cities. The illegality of urban agriculture was further carried forward by post-colonial governments. As a result, the activity received little or no attention at all (Gallaher *et al*., 2013).

Owing to multi-local livelihoods, there is an unprecedented shift in agricultural land owning, control, and use in Africa, in which urban households continue to practise farming in rural areas (Jayne *et al.,* 2015). Urban-based agriculture continues to be an important livelihood strategy in Asia and SSA (Zezza and Tasciotti, 2010; Jayne *et al*., 2015; Ayerakwa, 2017a). Urban agriculture is practised by households in the entire income spectrum. The marginalised members of the community participate in urban agriculture as an adaptive strategy, part-time income activity, or as the main income source (Maxwell, 1995).

However, it should be noted that the prevalence and importance of urban agriculture varies from country to country and even within cities. This implies that its extent of importance on food security and as a livelihood strategy is highly contextual (Zezza and Tasciotti, 2010). In Vietnam and Nepal, urban agriculture participation rates surpass 50 per cent, while in Nicaragua it is 68 per cent. In Nigeria and Madagascar, one out of every three urban households participates in urban agriculture (Zezza and Tasciotti, 2010). In the cities of Tamale and Techiman in Ghana, some 43 per cent of households practise some form of agriculture and the prevalence is much higher in Copper Belt province of Zambia at 84 per cent (Ayerakwa, 2017a; Smart *et al*., 2015). In Mbale and Mbarara in Uganda, more than half of urban households engage in agriculture in urban or rural areas, or both (Mackay *et al*., 2018).

Although the income shares from urban agriculture are smaller than participation rates, in some cases, the incomes shares from agriculture are significant. In Madagascar and Nigeria, urban agriculture income shares are 21 and 27 per cent, respectively (Zezza and Tasciotti, 2010). Just as participation rates and income shares from urban agriculture vary from country to country and even within a country, so is its contribution to food security. Zezza and Tasciotti (2010) in their study of urban agriculture in developing countries report that indeed urban agriculture improves dietary diversity and calorie intake in some selected countries in Latin America, Eastern Europe and SSA. In the informal settlements in Nairobi, Kenya, urban farming was not only found to contribute to households' food security

and nutrition, but also reduced expenses on food thereby increasing fungible income (Mwangi, 1995; Gallaher *et al*., 2013).

However, in a systematic review of 13 papers from 12 different studies on the role of urban agriculture in developing countries, Warren *et al*. (2015), find no strong evidence on the association between engagement in urban agriculture and food security. This emanated mostly from a lack of empirical research that employed rigorous multivariate analyses that relate urban agriculture and food security indicators. In a study of 11 Southern African cities, Frayne *et al.* (2014) conclude that urban agriculture is not an effective tool for improving households' food security. The political economy, economic, and social factors play a critical role in the potential of urban agriculture to improve welfare. In contrast, Poulsen *et al*. (2015), using a similar method as Warren *et al*. (2015), but with a review of 35 articles, conclude that urban farmers consider the activity beneficial and some earn a small share of income from agriculture. They recommend a policy support for urban agriculture.

Another strand of literature on urban agriculture focuses on land requirements and questions its impact on food security. These studies attempt to gauge the feasibility and importance of urban agriculture as a tool for combating food insecurity based on land constraint. Through estimation of land required to produce daily vegetable intake in cities, Badami and Ramankutty (2015) are sceptical about the potential role of urban agriculture. They find that promotion of urban agriculture can only make positive impacts in high income countries, while in the low-income countries where food security is a major concern, its potential role is highly constrained. Population densities are high in low income countries thus constraining land to be devoted to urban agriculture.

In a similar study to Badami and Ramankutty (2015), though evaluating the potential role of urban agriculture on poor urban households' food security, Martellozzo *et al.* (2014) finds that low income countries have an acute urban land constraint to effectively produce vegetables for the poor. However, given the land constraints of urban areas with high population densities, urban agriculture could make significant contributions to food security in the less densely populated urban areas which still have adequate land and some parts of the cities still have relatively lower land value.

An important conclusion from the study by Martellozzo *et al.* (2014) is that urban agriculture discourse should shift from the mega cities, to the small urban clusters, which constitute close to two thirds of urban areas. Although these two studies provide evidence on land constraints of urban agriculture, they fail to contextualise their findings. Because of heterogeneity in the scale, prevalence, and importance of urban agriculture, generalisations on importance and food security are erroneous. Local environment and economic situation of the city must be put into consideration

for appropriate recommendation and policy response (Poulsen *et al.,* 2015). Furthermore, the studies assumed horizontal vegetable gardening, yet some more innovative and space efficient forms of urban agriculture, such as sack gardening exist (Figure 1) (Gallaher *et al.,* 2013). In addition, focusing on vegetables production only as a driver for enhancing food security tends to narrow the scope and nature of urban agriculture.

Figure 1: A sack garden outside a residential house in Nyalenda, Kisumu, 2016. Source: Samuel Omondi

Although there are considerable disagreements on the potential role of urban agriculture on food security, most researchers in this field agree that a lack of credible empirical evidence on urban agriculture is the cause of its limited recognition (Zezza and Tasciotti, 2010; Poulsen *et al.,* 2015; Warren *et al*., 2015). Furthermore, most of the studies are considered to be driven by advocacy groups, hence a likelihood of exaggerating the prevalence and contribution of urban agriculture to household welfare (Ellis and Sumberg, 1998; Zezza and Tasciotti, 2010). Specifically, most urban agriculture studies consider urban farmers alone, lacking comparison groups of non-farmers (Poulsen *et al.,* 2015). Another critical aspect that motivates urban farmers has not been researched on i.e. the profitability of urban agriculture enterprises. The commercially oriented urban farmers have a business mind and are profit motivated. However, most of urban agriculture studies do not analyse the costs of inputs versus returns.

In most African cities, urban agriculture is practised despite its illegality (Gallaher *et al.,* 2013). As already mentioned, urban agriculture serves multifaceted role of food provision, income generation, provision of ecological services, and as a form of leisure activity. These multiple roles, of which some are difficult to economically value and do not conform to official data collection systems, further reinforces informality of the activity (Padgham *et al.,* 2015). The informality of urban agriculture is reflected in the lack of reliable data to support its contributions to the economy and environment (Padgham *et al.,* 2015).

Supportive evidence on scale, type, social, economic, and ecological roles of urban agriculture is often out-dated, fragmented, and anecdotal (Padgham *et al.,* 2015). While early urban agriculture studies such as Memon and Lee-Smith (1993) and Foeken and Owuor (2008) documented the prevalence of own food production by urban households, Kenya's urban landscape has changed considerably, owing to increased urbanisation, population growth, economic changes, and rapid urbanisation of poverty (Gallaher *et al*., 2013). More recent urban agriculture studies explore the broader contributions of urban agriculture to food security, wastes recycling, and importance of sack gardening (Ritho, 2005; Foeken, 2006; Foeken and Owuor, 2008; Karanja *et al*., 2010; Njenga *et al*., 2010; Gallaher *et al*., 2013).

Robust empirical evidence is necessary to inform appropriate functional urban agriculture policies that are supportive to urban farmers (Padgham *et al.,* 2015). Therefore, specialised studies focusing on specific forms of urban agriculture are relevant, for example the impact of sack gardening on food security (Gallaher *et al*., 2013). Although different types of urban agriculture exist in a continuum, there is a need to distinguish between subsistence and commercial agriculture because they have different implications on food security. These ramifications accrue from the indirect impact of commercial urban agriculture through income (Zezza and Tasciotti, 2010).

Urban agriculture has not been incorporated in development theories of developing countries (Lee-Smith and Memon, 1993). Yet, the persistence of urban agriculture and its potential importance requires a theoretical framing for it to be included in development policies (Zezza and Tasciotti, 2010). Urban agriculture has broadly been theorised using two divergent paradigms (Mackay, 2013). On one hand, urban is perceived as a response to market failure, where the poor engage in it as a survival strategy (Ellis and Sumberg, 1998; McClintock, 2010; Smart *et al.,* 2015). Engagement in urban agriculture is described as a response to lack of employment and poverty among urban households and practitioners mainly produce food staples for home consumption (Maxwell, 1995).

Another strand perceives urban agriculture as a response to market opportunities, where people engage in urban agriculture as a result of proximity to market for both

outputs and inputs (Hovorka, 2004). Theorising on urban agriculture and the reasons why people engage in it and its perseverance despite criticisms and lack of support by authorities is important for informing policy. Therefore, in the case of Kenya, time is ripe to understand the role of own food production, to inform the respective County governments on policy formulation.

2.3 Types of urban agriculture

Urban agriculture can be characterised based on several factors; reason for engagement, type of crops or livestock, and location of activity (David, *et al*., 2010). Land availability is a cardinal factor of production in engagement in urban agriculture, even for the most intensive forms of production like vertical gardening (Maxwell, 1995; Foeken and Owuor, 2008). In contemporary African cities, urban agriculture follows discernible patterns of land access, water availability, food needs, and income generation. On the basis of reasons for engagement in urban agriculture, two main types emerge; subsistence and commercial production. Subsistence urban agriculture entails the production of cereal staples such as maize and beans, and small scale vegetable production (Maxwell, 1995). In some cases, livestock products like indigenous chicken, eggs, and milk are produced for own consumption. Urban agriculture for own consumption is often linked to land constraints, especially in high density areas (Gallaher *et al*., 2013). Subsistence urban agriculture is mostly practised by the urban poor and middle class (Cabannes, 2012). Subsistence urban agriculture often overlaps to commercial farming, when there are surpluses for marketing (de Zeeuw and Dubbeling, 2009; Stewart *et al*., 2013).

Commercial urban agriculture involves production of horticultural products, milk, eggs, and chicken for marketing (David, *et al*., 2010; Dongmo, *et al*., 2010; Kang'ethe *et al*., 2010; Nyapendi, *et al*. 2010; Lee-Smith, 2013). Production of these products within towns has the cost advantage of reduced transportation and storage costs, given that they are perishable commodities (Ellis and Sumberg, 1998). Urban agriculture can also be categorised as crops or livestock production. Large livestock farming such as cattle farming appears to be ejected out of urban areas because of increasing urbanisation and rapid population growth. However, other urban agriculture enterprises are innovatively transformed to efficiently utilise the small spaces available, for example production of vegetables in sack gardens, aquaculture, and poultry production (Gallaher *et al*., 2013; Pribadi and Pauleit, 2015). Small scale crop-livestock farming is a characteristic of most African cities (Lee-Smith, 2013).

On the basis of location, urban agriculture is practised on privately owned land, public land, on institutional land, and on private but not own land. Farming on

privately owned land features productions such as backyard crops and livestock farming. Farming on public land is normally conducted along roads and railways, under power lines, and in wetlands. Using public land for agricultural purposes is often illegal with no tenure of security or informal tenure (Mwangi, 1995; Ellis and Sumberg, 1998). It is also common to observe urban agricultural activities on several types of institutional land including hospitals, schools, prisons, and around government housing units (Mackay, 2018).

Some urban residents also cultivate other people's private lands that are idle (Karanja *et al.,* 2010). A majority of those farming other peoples' land illegally are the urban poor with no other means of survival but farming (Maxwell, 1995; Foeken and Owuor, 2008). In addition, free-range livestock production is common in urban areas, particularly among farmers with limited or no land for grazing (Republic of Kenya, 2010a). Within urban boundaries, vegetable producers and livestock keepers face increasing pressure from rapid urbanisation and shrinking agricultural land. However, urban farmers are resilient and adopt new approaches that are space efficient and feasible in highly crowded urban areas (Padgham *et al.,* 2015).

2.4 Health hazards and ecological sustainability of urban agriculture

The practice of urban agriculture is often associated with some health and environmental risks (Catelo, 2006; Dongmo *et al*., 2010). Land pollution emanating from poor disposal of livestock waste and crop residues on the roadsides (as a result of lack of space) by some farmers has been a reason for opposing urban agriculture (Upton, 2004; Republic of Kenya, 2010a). Poor manure disposal and crop production have also been linked to the upsurge of insect vectors of public health concern such as mosquitoes (Republic of Kenya, 2010a).

Additionally, the use of untreated sewage water for crops production, chiefly in vegetable production, has raised concerns about human health risks (de Zeeuw and Dubbeling, 2009). Crops and livestock production along busy roads and on industrial lands have raised concerns over food safety through food contamination with heavy metals. Air pollution arising from urban livestock farming, noise, and free-ranging livestock that cause nuisance to other urban dwellers, for example by causing traffic congestion and conflict among neighbours, are some of the criticisms of urban livestock production (Dongmo *et al*., 2010).

Moreover, urban livestock farming usually occur in close proximity to residential areas, posing risks of zoonoses, that is, transmission of livestock diseases to humans (de Zeeuw and Dubbeling, 2009). It should, however, be noted that these negative

externalities often arise from poor urban planning or lack of planning (Republic of Kenya, 2010a). Although urban agriculture has been criticised for environmental pollution from poor disposal of livestock manure, crop-livestock integration recycles nutrients, helping in ecological sustainability of cities (Lee-Smith, 2013). Utilisation and use of manure from urban farms is further discussed in section 2.5.

2.5 Urban livestock production

Although not as prevalent as crops production, urban livestock production features in the cities and towns of most developing countries. Most urban farmers practise mixed farming, involving both keeping of livestock and crop cultivation (Kang'ethe *et al*., 2010; Karanja *et al*., 2010). In West Africa, in the cities of Kano, Bobo Dioulasso, and Sikasso, in Nigeria, Burkina Faso, and Mali, respectively, urban livestock farmers benefit through gaining income and sourcing food from livestock production. Most urban livestock producers keep more than one type of livestock as a diversification strategy which spreads risks in production (Amadou *et al.,* 2012).

Unlike production of food staples in towns, urban livestock production is mostly market oriented (Dongmo *et al*., 2010; Amadou *et al.,* 2012). For instance, among the various livestock reared in Kampala, Uganda, and Yaoundé, Cameroon, poultry, dairy, and pigs are mostly for income generation (Dongmo *et al*., 2010; Nyapendi, *et al*., 2010). There seems to be a clear gender dimension involved in these activities, for instance large livestock are usually male dominated activities, while small livestock are mainly reared by women. In Yaounde, poultry production is mainly practised by women whereas pig farming is mainly men dominated (Dongmo *et al*., 2010).

For the large ruminants, livestock keepers often allow their livestock to scavenge for food in cities in addition to providing supplemental feeding (Amadou *et al.,* 2012). Urban dairy production is mostly practised under intensive or semi-intensive production systems (Nasinyama *et al*., 2010; Nyapendi, *et al*., 2010). In Nakuru, Kenya, the well-off urban livestock farmers also graze their livestock on public land with pasture (Karanja *et al.,* 2010). Additionally, a significant share of urban dairy farmers source feed from their urban or rural farms (Karanja *et al.,* 2010). Urban poultry farmers in West African cities prefer self-formulated feed, except for commercial egg and broiler production which depend mostly on purchased feed. A majority of these farmers administer vaccination or treatment to their livestock (Amadou *et al.,* 2012).

As already mentioned, livestock waste from urban farms is mostly recycled as organic fertilizer for crop production (Karanja *et al*., 2010; Amadou *et al.,* 2012). A majority of the better-off urban livestock farmers recycle their livestock manure for crop production compared with the less well-off farmers (Karanja *et al*., 2010).

Manure disposal by small livestock producers in densely populated informal settlements has been reported to be a problem because of lack of space (Foeken, 2006; Carron *et al.,* 2017). Therefore, manure from the small urban livestock farms is often dumped along the roads, contributing to environmental degradation. At the same time, a great share of household waste among urban livestock keepers is recycled as livestock feed (Karanja *et al.,* 2010; Prain and Lee-Smith, 2010).

Urban poultry production not only benefit the households producing them, but also those not rearing poultry as they easily access poultry meat and eggs as well as accessing manure for crop cultivation (Nasinyama *et al*., 2010). In Kampala, chicken production accounts for 38 per cent of household income share of producing households (Nasinyama *et al*., 2010). In Yaoundé, commercial urban poultry farms produce large quantities of manure that is used on urban farms and sold to other parts of the country (Dongmo *et al*., 2010). Poultry manure could also be used as dairy feed after sieving (Carron *et al*., 2017). Other than these benefits, urban poultry production could also cause conflicts among neighbours because of bad odour emanating from poultry shelters and destruction of crops by free-ranging poultry (Nasinyama *et al*., 2010).

2.6 Poultry production systems in Kenya

Rapid population growth and urbanisation and improved welfare have led to dietary transformation. The dietary shift has been towards consumption of diets with more meat, dairy products, fruits, and vegetables (Popkin 2003; Pingali, 2006). The growing demand for animal products presents an opportunity for the growth of meat industry (Delgado, 2003; Bergevoet and van Engelen, 2014). Poultry consumption constitutes 30 and 36 per cent of the total meat consumption in the world and SSA, respectively (FAO, 2010; OECD/FAO, 2016). In Kenya, poultry and pork constitute 19 per cent of total meat consumed (EPZ, 2005).

However, it is expected that total meat consumption in Kenya will double between 2000 and 2030, with poultry and pork consumption tripling within the same period (Bergevoet and van Engelen, 2014). Poultry meat consumption in Kenya is expected to increase to about 165 thousand metric tonnes by 2030 compared to only about 55 thousand metric tonnes in 2000 (Robinson and Pozzi, 2011). This will be attributed to rapid urbanisation, increasing population, improvement in welfare and viability of poultry production systems (FAO, 2011). Consequently, poultry production is expected to grow from about 57 metric tonnes in 2000 to about 1666 metric tonnes by 2030 (Nyaga, 2008). In 2016, domestic supply of poultry meat and eggs stood at 64 and 84 thousand metric tonnes, respectively, most of which was consumed

domestically. The domestic supply of poultry meat and eggs during the same year represented annual per capita supply of 1.4 and 1.5 kg, respectively (KNBS, 2017).

The 2009 Kenyan population and housing census reported that the country had 31.8 million birds. The largest share, 81 per cent, constituted indigenous chicken, with broilers and layers sharing most of the remaining proportion (Republic of Kenya, 2010b; KIPPRA, 2016). Poultry production in Kenya performs several livelihood roles. It provides food directly through consumption of poultry meat and eggs. It also acts as an income generating activity for the commercially oriented producers (FAO, 2009; Kingori *et al*., 2010; Bett *et al*., 2012).

FAO classifies poultry production systems into four sectors. The classification is based on biosecurity level, types of products and market, location of the farms, and intensity of input use (Nyaga, 2008). Sector one is highly industrialised and integrated, highly dependent on purchased inputs, and birds are always sheltered. The sector has a high biosecurity level and outputs are targeted for export and urban markets (Nyaga, 2008). Companies in this sector operate modern facilities under international standards, and process chicken to ready-to-cook or ready-to-eat forms. Some have their own retail outlets and they often sell to supermarkets (Keskin *et al*., 2008).

Sector two is also a commercial sector with moderate to high level of biosecurity. Outputs from this sector are often sold in urban and rural markets. It also depends on purchased inputs and birds are kept indoors. Farms in sector one and two are usually located in major urban centres. Although commercially oriented, sector three has low to moderate biosecurity levels and birds are often sold alive in urban and rural markets. It depends on purchased inputs but birds are sheltered part-time. Sector four, also referred to as backyard or village chicken production system, is characterised by minimal biosecurity and birds are marketed in rural and urban areas. There is low dependence on purchased inputs and birds are usually left outdoors to scavenge for food (Nyaga, 2008).

Commercial poultry production in Kenya takes mainly two forms, contract and non-contract production. Contracted poultry farmers are usually part of an out-grower scheme in an integrated scheme for broiler production (Carron *et al.,* 2017). The contracting firm provide inputs (Day Old chicks-DOCs, feed, and veterinary services) while the farmer provides housing and management for the birds under clear biosecurity standards (Okello *et al.,* 2010). This facilitates control of products through traceability of products to farms. At maturity, birds are collected from the farms and transported to contractor's slaughterhouse for processing and packaging (Keskin *et al*., 2008; Bergevoet and van Engelen, 2014; Carron *et al.,* 2017). The major contracting firms are Kenchic Ltd and Kims Poultry Care Center (Okello *et al.,* 2010; Wainaina *et al*., 2012). Non-contracted farmers on the other hand finance all production costs and market their produce independently or through producer groups (Okello *et al.,* 2010).

2.7 Illegalities in agricultural and food value chains

Anecdotal evidence, especially on Kenyan media indicates that cases of illegalities in agricultural and food value chains are rampant. For instance, the use of Anti-Retroviral drugs (ARVs) among pig and poultry farmers and poultry theft have been reported (Otieno, 2015; Awuor, 2016; Obwogo, 2017). Farmers utilise ARVs in a bid to fatten their livestock and in prevention of opportunistic diseases in their flocks (Obonyo, 2013; Awuor, 2016).

The media has also reported on-farm or in-hotel slaughtering of livestock, especially poultry intended for sale. This is despite existence of the meat control act that prohibits slaughtering of livestock without inspection (Republic of Kenya, 2012b). For instance, in Kisumu, a farmer claimed that he slaughters poultry to sell to hotels (Ojina, 2015). In another incidence, food kiosks in Nairobi established illegal slaughterhouses behind their kiosks, which posed health risks (Wekesa, 2015). This thesis provides empirical evidence of these illegalities and provides recommendations on how to combat them.

2.8 Urban agriculture policies, regulatory framework, and institutions

Urban agriculture has met varying responses regarding its acceptance and support. Some countries have developed urban agriculture policies, while in others, it persists as an illegal activity without either policy or government support. Urban farmers have received considerable government support in Cuba, Brazil, and Argentina, resulting from their 'Zero Hunger Campaigns' (van Veenhuizen, 2006, p. 5). There has been an increase in declarations made by (local) governments and political leaders in support of urban agriculture for achieving food self-sufficiency and alleviating poverty and hunger (Mougeot, 2000; van Veenhuizen, 2006). Additionally, the increasing role of food charters involving collaborations between the community, local authority, private sector, and other key actors to pursue food security agenda in North America and the United Kingdom have helped in promoting urban agriculture activities (Hardman and Larkham, 2014).

Support for urban agriculture has further been influenced by the increasing research interest on urban agriculture by Consultative Group on International Agricultural Research (CGIAR), International Development Research Centre (IDRC), Resource Centres on Urban Agriculture and Food Security (RUAF), and Urban Harvest (UH), capturing the attention of international organisations such as Food and Agriculture Organization of the United Nations (FAO), United Nations Development Program

(UNDP), and International Summits (van Veenhuizen, 2006; Mougeot, *et al.,* 2010). The pressure to support urban agriculture has also been originating from local lobby groups, urban farmers, and Non-governmental Organisations (NGOs) (Mougeot, 2000; van Veenhuizen, 2006; Gallaher *et al.,* 2013).

In Kampala, Uganda, the City Council has a department of agriculture which offers extension services to urban farmers and has developed a typology of urban agriculture (Lee-Smith, 2013). The city embarked on listing urban farmers and food handlers (David *et al*., 2010). The city of Accra in Ghana has an Advisory Working Group on urban and peri-urban agriculture with membership from research institutions, public sector, universities, the media, farmer organisations, and agriculture worker unions. The city has also changed its by-laws by issuing permits to livestock producers, for growing and marketing of crops, and management of slaughterhouses and markets (Lee-Smith, 2013). The by-laws also require those interested in practising urban agriculture to obtain permits from the public health unit (Ayerakwa, 2017b). However, despite these by-laws on urban agriculture, for example in Ghana, they are rarely implemented, resulting in uncoordinated and unregulated urban agriculture and marketing. The relevant authorities established to support urban agriculture have been financially starved, leading to urban agriculture policy failure (Ayerakwa, 2017b).

Kenya's national policy on urban and peri-urban agriculture and livestock is still in the first draft stage. The overall objective of the policy is to promote and regulate urban agriculture in a sustainable manner that improves welfare through enhancing food security, improving income, creating employment, and reducing poverty. The draft policy focuses on land use, public health, and environmental management to achieve the desired welfare effects (Republic of Kenya, 2010a). It identifies the need for collaboration between the key actors in the development of urban agriculture, strengthening capacity building of relevant institutions, promotion of appropriate technologies, linking producers to markets, and proper waste management. It is important to note that in Nakuru, Kenya, urban agriculture is legal, following a workshop which created awareness among the then municipal council officials on the extent and importance of urban agriculture (Foeken and Owuor, 2008; Lee-Smith, 2013). The council officials responded to research findings by formulating by-laws that support urban agriculture (Lee-Smith, 2013).

However, there is no specific national policy on urban agriculture in Kenya, despite its importance among some urban households. Nonetheless, there are some policies that affect urban agriculture; Local Government Act (Cap. 265), Public Health Act, and Land Control Act (Republic of Kenya, 2010a). The Local Government Act confers the power of leasing, transferring, and allocation of land for temporary use to local authorities. As such, most local authorities enact by-laws that prohibit cultivation of crops on public land and restricting livestock farming that is deemed

to be a nuisance (Republic of Kenya, 2010a). According to the Public Health Act, the minister for health has the power of prohibiting crops cultivation and irrigation within urban areas (Republic of Kenya, 2010a; FAO, 2012).

NGOs have been active in the promotion of urban agriculture in Kenya, notably *Mazingira Institute* and *Solidarités.* The former has been involved in urban agriculture research, conducting the first urban agriculture survey in Kenya and facilitating forums that bring together urban farmers, public, and private institutions (Memon and Lee-Smith, 1993; Lee-Smith, 2013). *Solidarités* has been active in Nairobi, where it provides urban farmers in slums with seeds and sacks for vertical gardening (Gallaher *et al*., 2013). It has provided about 22,000 households with sacks in addition to promotion of greenhouse farming and poultry production (Achieng' *et al*. 2011). These NGOs advocate for urban agriculture based on its essential livelihood contribution to the urban poor and, if properly promoted, supported, and controlled, could greatly contribute to economic development (FAO, 2012).

2.9 Summary; research gaps

The literature review presented above indicates that there is a lack of solid empirical evidence on the scale and type of urban agriculture as well as the social, economic and ecological roles of various types of urban agriculture. The scepticism about urban agriculture has been compounded by a lack of robust evidence on the importance of urban agriculture. Additionally, most evidence on urban agriculture is based on studies in which data have been gathered only from urban farm households, with no comparison groups. In this study, the access to data also from the majority of household, those not engaged in urban agriculture, allows for comparisons. The literature review has shown that urban agriculture is highly contextual. Therefore, there is a need for specific studies that focus on specialised forms of urban agriculture that highlight its potential benefits and risks. There is also a need for theorising on why people engage in urban agriculture in order to provide insights for policy.

Concerning urban livestock value chain, anecdotal evidence indicate that there are a number of illegal activities within the chain which could pose serious health risks to consumers of such products. This calls for a need for empirical evidence on the illegalities in the livestock value chains. There is also a dearth in knowledge on commercial urban agriculture and estimation of benefits based on comparison of costs and benefits.

CHAPTER THREE: THEORETICAL PERSPECTIVES

3.0 Introduction

This chapter starts by presenting some theoretical underpinnings of the concept of food security and relating it to own food production. This is achieved by a review of literature on food security and a discussion of food security pathways of own food production, including urban agriculture and urban-based rural agriculture. Different measures of food security are also discussed. Subsequently, the chapter presents the theoretical framework of value chain analysis and cluster theory. Lastly, the chapter outlines the conceptual framework of profitability of indigenous chicken production.

3.1 Theoretical perspectives of food security in relation to own food production

Previously, food insecurity was conceptualised through the Food Availability Decline (FAD) approach which perceived food insecurity to occur as a result of a decline in the amount food available in a country. However, applying the entitlement framework to the analysis of three famines; Bengal (1943), Wollo (1973), and Bangladesh (1974), the Nobel prize-winning economist Amartya Sen argued that famine and starvation occurred in absence of a decline in food quantities. In fact, in some cases, some regions experienced boom harvests, yet famine occurred in such areas. Individuals/households acquire food through the entitlement set they control. They acquire food through conversion of their bundle of endowments, which include production-based, employment-based, trade-based, and transfer-based entitlements. He argued that food insecurity is as a result of entitlement failures, that is, the inability of the bundle of endowment to enable a household to acquire enough food (Sen, 1981).

As a result, the definition of food security has evolved over the years, from focusing on global and national food availability, to incorporating other important

components like in the widely adopted definition used in the 1996 World Food Summit Plan of Action (Coates, 2013). Food security[1] is achieved 'when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life' (FAO, 2010, p.8).

In addition to being multifaceted, the concept of food security is composed of complex relationships between three components; food availability, access, and utilisation, often referred to as pillars of food security (Coates, 2013; Ruysenaar, 2013). Stability as the fourth pillar of food security emerges from the phrase 'at all times' in the food security definition. This pillar is, however, less recognised compared to the first three (Jones *et al*., 2013).

Food availability is the physical presence of food, while access is the 'physical and economic access to food' (Jones *et al*., 2013, p. 490). It is the ability of a household to acquire food of sufficient quantity and quality to satisfy the nutritional needs of household members. The food sources are own production, purchases, stocks, food transfers, and gathering (Bilinsky and Swindale, 2010). The food access pillar has several dimensions. For an individual to be food secure, he/she must have food of sufficient quantity, adequate nutritional quality, food that is safe, culturally acceptable, certain, and have a stable source of food (Coates, 2013, p. 191).

Food utilisation is a reflection of intra-household food allocation, nutritional quality, and variability in the degree of absorption and metabolism of nutrients by individuals (Coates *et al*., 2007; Jones *et al*., 2013). Food utilisation is contingent on the good use of food available to individuals and households. Aspects of nutritional quality and value, food safety, and capacity of body to absorb the nutrients are also related to food utilisation. Individuals' bodies have to be in good health to adequately utilise the food available to them (Barrett, 2010). The food system is affected by economic, social, political, and environmental factors in addition to a set of activities involved from food production to consumption (Ericksen *et al*., 2009; Ingram, 2011).

The components of food security are hierarchical in nature. While food availability is a necessary condition for food access, it does not necessarily ensure access to food of sufficient quantity that is safe and nutritious. Additionally, while food access is a necessary condition for utilisation, it is not automatic that the body will utilise it sufficiently (Maunder and Wiggins, 2006; Barrett, 2010).

[1] [1]Although food insecurity and nutrition insecurity are sometimes used interchangeably, the latter is broader than the former. Nutritional security is affected by health, hygiene, care and food security (Jones *et al*., 2013).

Maxwell (1996) describes the shifts in conceptualisation of food security from global and national perspectives to household and individual level, food first to livelihood resilience perspective, and in measurement from objective metrics to subjective perceptions of food security as taking a postmodern perspective. He recommends a post-modern approach to food security policy formulation which recognises diversity in the causes of food insecurity and different strategies that are suited to local conditions. These policies should provide individuals with choices and programme alternatives such as food for work and subsidised credit.

The absolute number of undernourished people has increase from 777 million people in 2015 to 815 million in 2016, a majority living in developing countries (FAO *et al.,* 2017). Quick fixes to food insecurity such as social safety nets without complementing them with long term food security approaches are unlikely to achieve stable food security (von Braun *et al*., 1992). Safety nets such as food vouchers and food packs should be embedded in the broader objectives aimed at avoiding or eliminating future food insecurity (Devereux, 2012).

Own food production promotion by local governments, private institutions, and NGOs resonate with the aims of progressive safety nets. For instance, the promotions of vertical gardens in Kibera, Nairobi, by an NGO or promotion of community gardens, not only provide food to urban farmers, but also income (Gallaher *et al*., 2013; Ruysenaar, 2013). Therefore, programmes such as vertical gardens and community gardening ensure that food is locally available and accessible to the households, and to some extend to the community (Stewart *et al.,* 2013). Additionally, the cardinal aspect of food security i.e. access, is achieved by direct consumption of own produced agricultural produces.

The locally produced food often involves less market actors, with short transport and cold storage. Indeed, own production of vegetables, milk, eggs, and meat from small livestock could provide between 20 and 60 per cent of households' food requirement (de Zeeuw and Dubbeling, 2009). However, to ensure sustainable urban food security, urban agriculture should be placed on wider food security approaches such as establishing efficient urban food systems that make food affordable (Stewart *et al*., 2013) and increasing employment opportunities to urban farmers.

Figure 2 summarises the food security pathways from own-food production. Engagement in urban agriculture or urban-based rural agriculture makes food available to the producing households. These food items often include food staples such as maize and beans, vegetables, milk, eggs, and meat from small livestock such as poultry. Own production of these food items enhances access component of food security. This conceptualisation is parallel to Amartya Sen's entitlement framework which marked a paradigm shift to focus on access as a core component of food security (Sen, 1981).

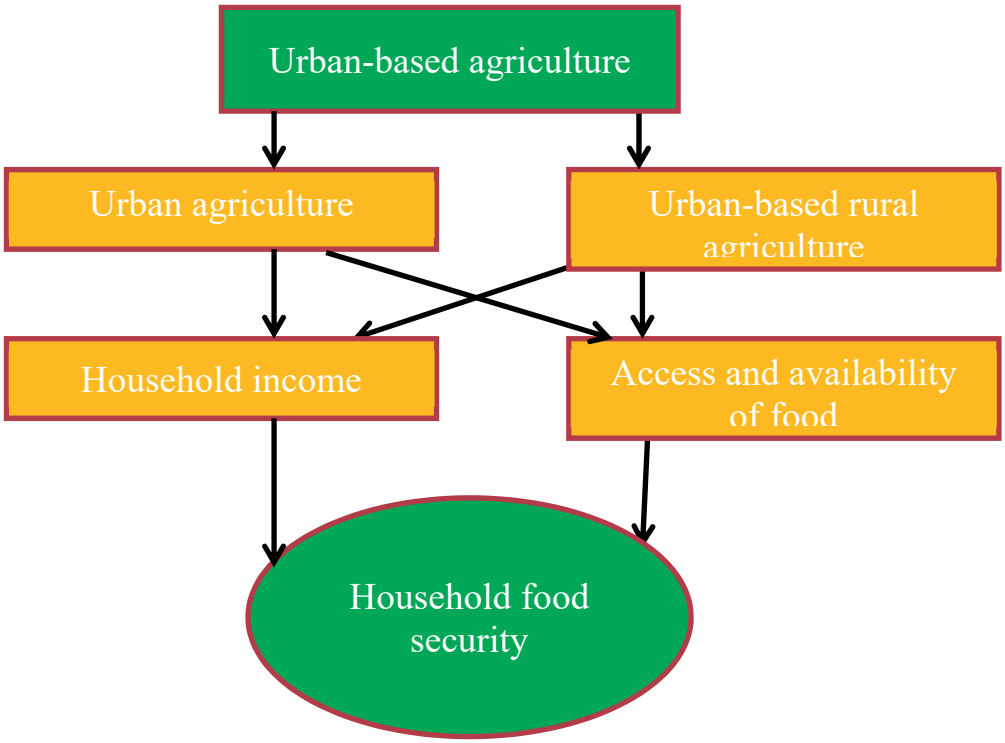

Figure 2: Urban agriculture food security pathways from an entitlement perspective. Source: Author's conceptualisation

This study conceptualised own food production to provide households with at least three entitlements to food elaborated by Sen (1981). Engagement in both urban agriculture and urban-based rural agriculture is considered as production-based entitlement. Urban households engaged in agriculture acquire food directly from their own production. From the employment-based perspective, urban agriculture provides income to the households because surpluses from own production are often sold for income generation. As Chege *et al*. (2015) notes, income from sale of agricultural commodities further improves households' food security through purchasing other food items that are not own produced, thus constituting trade-based entitlement. Additionally, own food production reduces expenditures on these items, thereby increasing fungible income (Stewart *et al*., 2013). The entitlement approach focuses on the ability to command food through legal means such as through own production, trade, entitlements, and the state through social security and safety nets. Thus, viewed from the prism of entitlement, the goals of urban agriculture to enhance food security or provide income are not competitive, but rather complementary.

3.1.1 Food security metrics and measurement

Measuring food security is as elusive as the concept itself (Barrett, 2010). Food security metrics often focus on food availability, access, utilisation, food stability, or a combination of the different dimensions. The measures may use global, regional, national, household or individual level data (Jones *et al*., 2013). Usually, proxies for different dimensions of food security are used for measurement, depending on the objectives and budgetary constraints of the research (Barrett, 2010). The metrics vary from simple and easily collected indicators to comprehensive and expensive survey tools (Jones *et al*., 2013). The difficulty also emanates from high data requirements for some measures and the consequent high cost of collecting the data, particularly on calorie intake, household income, and expenditures (Coates *et al*., 2007).

Generally, food availability is measured using data aggregated at global, regional, or national level. These measures include prevalence of undernourishment, global hunger index, and global food security index (Jones *et al*., 2013). Food access is better measured by data collected at household and individual levels (Jones *et al*., 2013). Access is often measured by household consumption and expenditure, dietary diversity, coping strategies index, household food insecurity access scale (HFIAS), household food insecurity access prevalence (HFIAP), and months of adequate household food provisioning (Swindale and Bilinsky, 2006; Coates *et al*., 2007; Bilinsky and Swindale, 2010; Coates, 2013; Jones *et al.,* 2013).

Food utilisation is measured by anthropometric measures such as weight, height, skin fold measurement, and mid-upper circumference, relating them to age and sex and comparing them to a population's standards (Maxwell *et al*., 2000; Barrett, 2010; Bilinsky and Swindale, 2010). However, apart from food intake, anthropometric measures are often affected by other factors such as health status, hygiene, environment, and level of care giving (Maxwell *et al*., 2000). Put differently, food insecurity is only one among several factors affecting an individual's nutritional status (Coates, 2013). Therefore, depending on anthropometric measures solely as measures of food utilisation, without complimenting them with individual dietary intake, could lead to misrepresentation of food utilisation status (Jones *et al*., 2013).

3.1.2 Food security metrics adopted

Because of high data requirements for collecting data for anthropometric measures of food utilisation, the scope of this study is limited to relating own food production to food availability and access pillars of food security. As already mentioned, the choice of food security indicator depends on the objective of the study and costs. Objective measures of food security such as income and expenditure estimates and

caloric adequacy often omit qualitative aspects of food security. Additionally, estimation of nutritional requirements of groups in a population is often difficult and such estimates are value judgements. This then raises the question, whose judgement is important? Is it the food insecure individuals or the researcher? This gives preference to subjective measures of food security over objective measures (Maxwell, 1996).

HFIAS, which measures economic access to food, food quantity, and food preferences proved to be the best indicator to use. HFIAS is used in the assessment of food security at regional, national, or household level. It is appropriate when monitoring and evaluating impact of interventions as well as targeting certain populations for food security interventions (Jones *et al*., 2013). HFIAS has a series of nine questions asking on perceptions and behaviours about food insecurity. The answers to these questions are on frequency of occurrence of each of the perception or behaviour (rarely, sometimes, or often). These responses are summed, yielding a scale of food insecurity, ranging from zero to 27. A household with a value of zero is considered to be food secure while that with a value of 27 is considered to be severely food insecure (Coates *et al*., 2007).

To further group different household categories based on household food security status, HFIAP, a derivative of HFIAS was used as a complementing indicator. HFIAP groups households into food secure, mildly food insecure, moderately food insecure, and severely food insecure categories, which is appropriate for targeting of populations (Coates *et al*., 2007). In addition to these commonly used indicators of food security, I also assessed perceptions on importance of own food production, coping strategies, and dependence on food from various sources to examine the role of own food production on food security. Furthermore, I computed a household consumption index to estimate the proportion of chicken and eggs consumed by the households. The next section discusses the theoretical framework of value chain analysis.

3.2 Value chain approach: theoretical underpinning

van Veenhuizen's (2006, p. 2) definition of urban agriculture incorporates urban agriculture production as well as all the other related activities before and after production. The definition mirrors the forward and backward linkages of a commodity value chain. It includes transportation of inputs to the farm and outputs to the market, value addition or processing, and marketing of the final commodity. The second article of this thesis, takes this approach in the study the urban poultry value chain with insights from cluster theory. This calls for a review of value chain approach and its theoretical underpinning.

A commodity value chain is a series of activities firms or producers perform in the designing, production, delivering the finished product to consumers, and final disposal (Porter, 1985; Kaplinsky and Morris, 2002). Although the definition appears to describe a linear connection of activities and firms, value chains can be complex with several forward and backward linkages. The value chain is divided into several components or actors for better understanding of its structure and functioning (UNIDO, 2009; Rota and Sperandini, 2010). This enables identification of inefficiencies along the chain and the upgrading mechanisms available to inefficient actors (Webber and Labaste, 2007). Global Value Chains elaborated by Gereffi (1994; 1995) and Gereffi *et al.* (2005) transcends beyond the national borders. It should be noted that this study focuses on the poultry value chain at the city level.

The main theoretical concepts in a value chain analysis are the governance structure, power, and institutional framework of the value chain. Value chain governance is the coordination of value chain activities, which establishes relationships between actors (Gereffi *et al*., 2001, p. 4). Governance is expressed in one firm's ability to influence the activities undertaken by another trading partner in the value chain. Governance could, for example, be defining and regulating the type of product to be produced by a supplier through setting standards and monitoring (Gereffi *et al*., 2001). Value chain governance establishes value chain actors' powers and institutional arrangements. Market power is expressed in various forms. An example of power is the ability to force some actors to undertake certain activities like assembling commodities and not processing (Kaplinsky and Morris, 2002, p. 66). For example, a lead firm in a poultry value chain could exercise power by restricting poultry producers to production only and not processing.

Generally, there are five forms of value chain governance. They include markets, modular forms of governance, relational governance, captive value chains, and hierarchies (Gereffi *et al*., 2005, p. 86). Markets are the simplest forms of value chain governance. They are characterised by simple transactions with low asset specificity, which imply low costs of switching to other trading partners (Gereffi *et al*., 2005). This often characterises spot market exchanges with arms-length transactions involving many buyers and suppliers, with possibilities of repeat transactions. However, there is limited information exchange, technical assistance, and limited interactions (Webber and Labaste, 2007). Examples are marketing of poultry to brokers or at the farm gate. In modular value chains, commodities supplied are customised to customers' specifications (Gereffi *et al*., 2005).

Mutual dependence between buyers and sellers, caused by their complex interactions and high degree of asset specificity is a key feature of relational value chains. Spatial proximity between partners, trust, and reputation reinforce existence of relational governance. Captive relationships occur when small suppliers highly

depend on large buyers, who invest in high levels of monitoring and control. The small suppliers face high switching costs and are therefore held captive by the lead buying firms. The hierarchy form of governance is a form of vertical integration, in which a firm performs all the value chain activities which would otherwise have been outsourced (Gereffi *et al*., 2005, p. 86). For example, a poultry firm that produces DOCs, grows them to maturity, slaughters, process them into finished products, and market them exhibits a hierarchy form of governance because all the value chain activities have been internalised within the firm.

It should, however, be noted that these forms of governance occur in a continuum with some overlaps, with markets and hierarchies at far ends of the spectrum (Vega and Keenan, 2014). Adoption of governance structure by a firm is driven by two main reasons. First, the more tailored or customised a product is required by the consumer, the more likely a firm will coordinate production activities by their suppliers. The second factor results from the level of risk in transaction. The more risks are faced by firms as a result of their suppliers' failures, the higher the chances of coordination and monitoring the supply chain (Gereffi *et al*., 2001). In a food value chain, lead firms would tend to move away from spot market exchanges towards relational and hierarchies forms of governance, where they contract specific farms to supply produces, in order to reduce food safety risks.

In absence of governance, transactions and interactions are random. Governance therefore maintains order and organisation in a value chain (Webber and Labaste, 2007). Additionally, the complexity of governance or level of coordination increases with asset specificity. Therefore, suppliers' capabilities, asset specificity, and information codification are the main factors influencing which value chain governance form will be adopted (Gereffi *et al*., 2005).

A major critique of the value chain approach is its preoccupation with external factors, such as global lead firms that exert coordination mechanisms to local producers, with little attention given to the role of local level relationships within clusters (Humphrey and Schmitz, 2002). Another major challenge in value chain analysis is the measurement of value accrued by value chain actors. Although profits, value added, and price mark-ups have been used as measures of value, these metrics have their own shortcomings. Profits do not give an indication of productivity and data for firms is usually not publicly available, not disaggregated at various stages of the value chain or location. Use of price mark-ups alone without relating them to volume of transactions and activities occasioning increment in price gives erroneous results. Value chain analyses also lack strong well defined theoretical framework that would enable a generalisation of results (Gereffi *et al*., 2001).

3.3 Cluster theory and geographical clustering of firms

Porter (2000) defines clusters as 'geographic concentrations of interconnected companies, specialized suppliers and service providers, firms in related industries, and associated institutions (e.g. universities, standards agencies, and trade associations) in particular fields that compete but also cooperate' (p. 253). The firms often co-locate in an area because of their commonalities and complementarities. The size of a cluster could be as small as a city to as large as a region of several neighbouring countries.

Firms agglomerate for an array of reasons, dating back to Marshall's cost advantages accruing from input-output linkages, knowledge spill overs, and pooling of the labour market (1920). Literature on industrial clusters have further incorporated other drivers of clustering, including local demand, factor conditions, supporting specialised institutions, and firms' structure, strategy, and rivalry (Porter, 1990).

Location within a cluster improves a firm's competitive advantage by increasing its productivity by easily accessing low-cost inputs at low transaction cost (Porter, 2000). Emergence of new businesses and industries is also correlated with strong industrial clusters (Delgado *et al.*, 2014). In addition, joint marketing through referrals is made possible and easy when firms are located in close proximity to each other (Porter, 2000). Concentration of supporting industries and services, such as research institutions improves on research and development thereby improving innovation capacity (Baptista and Swann, 1998; Porter, 2000). Knowledge spill overs across firms in a cluster also ease information flow (Delgado *et al.*, 2014).

Apart from the benefits of firms' clustering mentioned above, firms within a cluster constantly face intense competition and pressure to improve performance and competitiveness (Humphrey and Schmitz, 2002). They manage to survive the intense competition through upgrading by penetrating niche markets and producing better quality products. Humphrey and Schmitz (2002) identify four types of upgrading in value chains; process, product, functional, and intersectoral upgrading. Process upgrading occurs when firms improve their production activities through efficient use of inputs and production of outputs. Product upgrading occurs when firms upgrade to advanced products, while functional upgrading occurs when there is a shift in the functions a firm perform, for example, by acquiring new functions in the value chain or abandoning existing ones. Intersectoral upgrading involves shifting to new productive activities, such as using knowledge acquired in one sector to produce goods in a different sector.

It should be noted that literature on industrial clusters emphasises the role of local linkages for enhancing competitive advantage. This is despite the fact that factors beyond the cluster have a direct impact on the performance and competitiveness of

firms in a cluster (Humphrey and Schmitz, 2002). This is particularly true for urban poultry production and trade cluster in Kenya which depends on imported grandparent stocks.

3.4 Bridging the theoretical gap: Combining value chain and cluster theory

While both the value chain approach and cluster theory recognise the importance of governance, institutions, and upgrading on the competitiveness of an industry, they focus at different levels. Value chains are more focused on how lead firms exercise their coordination power to local supplying firms, giving little attention to local level factors. Although governance and upgrading are emphasised in cluster theory, they are only restricted to emerge from interaction among firms within a cluster and local institutions (Humphrey and Schmitz, 2002). In this thesis, I propose a hybrid approach that inserts cluster theory in value chain analysis. I look at the urban poultry value chain from a cluster theory perspective, that is, how does local level governance and institutions affect the relationship of chain actors?

It should be noted that the study was designed to use the value chain approach to analyse the urban poultry value chain. However, during the analysis and identification of important patterns that indicated the influence of clusters in value chain operations, cluster theory was incorporated to shed more insights and explain the reasons for those patterns. Therefore, the analysis from cluster perspective is restricted to only the data that was collected for purposes of value chain analysis.

3.5 Profitability; Conceptual framework

Rapid urbanisation, urban population growth, infrastructural developments, and conversion of urban agricultural land to housing units have several impacts on urban agriculture. Those agricultural activities that require large pieces of land like crop production and large livestock farming have been pushed to the urban peripheries or completely out of urban vicinity (Pribadi and Pauleit, 2015). Others are converted into novel practices that utilise efficiently the limited land left, for example sack gardening (Gallaher *et al*., 2013). Poultry farming is one of the few urban livestock farming that still thrives under increasing land scarcity. Poultry enterprises require relatively smaller space requirement than staple crops farming and large livestock farming (for example dairy farming). Returns on investment in poultry farming are also faster than in other livestock (Dongmo *et al*., 2010). Furthermore, urbanisation

and improved welfare have seen the number of poultry rising as a reaction to demand and preferences for white meat (KIPPRA, 2016).

Although urban farmers have varying objectives for farming, horticulture, poultry, and dairy production in most cases are market-oriented (Ellis and Sumberg, 1998; Dongmo *et al*., 2010). A sub-sample of poultry farmers that were considered to be rearing poultry as a business enterprise was used to estimate farm profits and factors that affect profitability of poultry enterprises. The selection criteria were to include farmers with more than 20 indigenous chickens and who are market oriented. Starting with the original sample of 312 poultry farmers, only data for 151 indigenous chicken producers met the criteria and were used in the final analysis. Owing to the difficulty of measuring household utility, farm profit is often used as proxy for welfare (Barrett *et al*., 2012). I used gross margin per bird as a measure of profit.

Gross margin was specified as $GM = TR - TVC$ where GM is the gross margin per bird in Ksh. and TR is the total revenue in Ksh. The revenue from chicken production is derived mainly from sales of chicken and eggs. Manure is occasionally sold to crop farmers or to dairy farmers as feed. The variable costs used were; cost of DOCs, feed, drugs, and heating costs in Ksh. Family labour was the most common type of labour used in indigenous chicken production. As such, labour was excluded from calculation of gross margins.

Multivariate linear regressions were estimated to assess the effects of explanatory variables on profitability. The explanatory variables included in the regression models include access to market information, marketing channel, household location, land ownership, poultry production system, and gender of poultry enterprise owner.

The gross margins computed are not necessarily maximum gross margins that would qualify to be maximum profits, because the effects of technical or allocative efficiencies on profit were not tested (Kumbhakar, 2001). The profit efficiency levels for different indigenous chicken producers were thus not estimated and therefore, I cannot purport that these are maximum profits.

3.6 Summary of theoretical approaches used in the thesis

The conceptualisation of the whole study, connecting the different yet connected studies in the three articles is presented in Figure 3. The first article on the role of urban-based agriculture on food security presents the general agricultural activities practised by urban households in urban and rural areas. It highlights the types of agricultural commodities produced in urban and rural zones, utilisation patterns of

own food produced, focusing on income shares from agriculture, and the impact of farming on food security. In doing this, the paper attempts to theorise reasons for engagement in urban agriculture. In addition, it utilises the entitlement framework to analyse the contribution of own food production on households' food security.

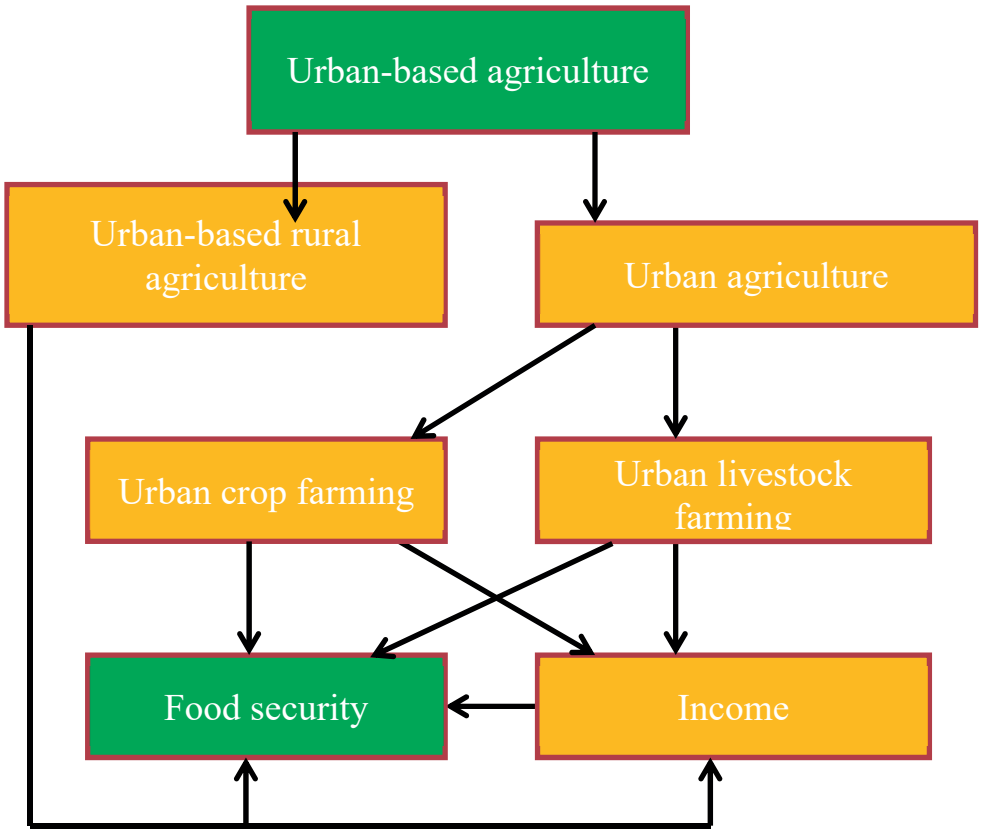

Figure 3: Conceptualisation of the connection between studies presented in the three articles. Source: Author's conceptualisation

The second article narrows down to urban agriculture, focusing on poultry farming and the poultry value chain. It analyses the urban poultry value chain using both the value chain approach and cluster theory. This paper identifies the main actors in the urban poultry value chain and analyses its governance, institutional framework, and competition among actors through the prism of cluster theory. It provides insights on the prevalence and scale of different poultry enterprises in the two cities, which justifies the relevance of the last article. Additionally, it analyses how local factors

shape competition and cooperation among value chain actors as well as local level relationships between value chain actors.

The third article, therefore, narrows down to indigenous chicken farming because this enterprise was found to be the most prevalent in the two cities. This paper estimates the profitability of the enterprise, measured by gross margin and factors influencing profitability. The paper tests empirically whether a firm's location within clusters of related firms influences the profitability of urban poultry production.

These three papers are stand-alone papers that could be read independently. However, for the purposes of understanding the thesis, they should be sequenced as they are presented here.

CHAPTER FOUR: METHODOLOGY

4.0 Study country and cities

4.1 Kenya

Kenya is an East African country with a population of 47 million people (KIPPRA, 2016). In 2015/16, the country had poverty headcount and food poverty of 36 and 32 per cent, respectively, varying widely across different counties (KNBS, 2018). It borders Somalia to the East, Uganda to the West, Ethiopia to the North, South Sudan to the North West, and Tanzania to the South West. The South Eastern part extends to the Indian Ocean. It also has the second largest fresh water lake in the world, Lake Victoria (Figure 4). Arid and Semi-arid Lands (ASALs) constitute the largest share of land cover, covering four fifths of the total land area (Republic of Kenya, 2012c; Republic of Kenya, 2013) and supports about 70 per cent of all livestock produced in the country (Republic of Kenya, 2012c; KIPPRA, 2016).

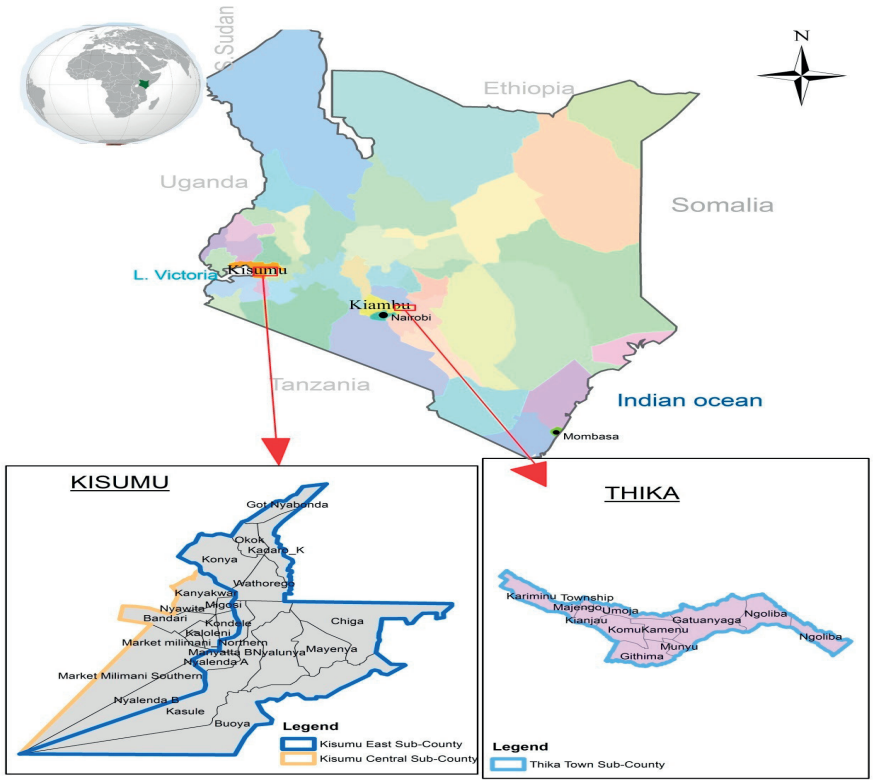

Figure 4: Map of Kenya, Kisumu and Thika

Agriculture is the main contributor to the economy, providing one quarter to the Gross Domestic Product (GDP) and employs three quarters of the population (Republic of Kenya, 2012a). Therefore, Kenya's vision 2030, the country's development blue print, identifies agriculture, as one of the six sectors with the potential of achieving an annual 10 per cent economic growth (Republic of Kenya, 2007). This is not surprising considering that in 2016, agriculture, forestry, and fisheries recorded the highest GDP growth of 16 per cent, followed by real estate (12%) and transport and storage (10%) (KIPPRA, 2017).

Economic growth and development in the country is highly dependent on natural resources for crops and livestock production. As such, crops and livestock production have adversely been affected by climate change, which has resulted in prolonged drought and scarcity of fodder and water for livestock (Republic of

Kenya, 2016). In the strategic plan of 2013-2017, the ministry of agriculture, livestock, and fisheries' identifies the negative impacts of rapid urbanisation and increasing population on the agricultural sector, through conversion of agricultural land to infrastructural and development projects. As a mitigation measure, the ministry aims at promoting urban and peri-urban agriculture (Republic of Kenya, 2015).

The National Agribusiness Strategy identifies five strategic priorities for transforming agriculture to be commercially oriented to steer economic growth. Two of these priorities are relevant to the current study; linking agricultural producers to markets and promoting producer organisations which can benefit from economies of scale (Republic of Kenya, 2012a). The enactment of the 2010 constitution provided for devolution of agricultural services to the 47 county governments. Therefore, it is the role of the county governments to ensure that agriculture drives the double digit economic growth envisioned in the Vision 2030 (KIPPRA, 2016).

4.2 Justification for selecting the two cities

This study is part of an interdisciplinary research on African urban agriculture[2].The study was conducted in Kisumu and Thika (Figure 4). The aim of the broader urban agriculture research project in which this study is embedded was to characterise urban agriculture in medium-sized cities that are rapidly urbanising and with population between 100, 000 and 500,000. Through purposive sampling, Thika and Kisumu were selected. Coincidentally, Thika provides an excellent context of studying how clustering[3] of agricultural production and related industries and proximity to a wide market for agricultural produces (Nairobi) influence the competitiveness of poultry production and trade. Kisumu on the other hand, is less centrally located, though with a substantial market for its urban agriculture

[2]The broad study focused on environmental, social and economic challenges, and prospects under changing global and demographic realities. The research was conducted in collaboration between on one hand two Swedish universities; Lund University and the Swedish University of Agricultural Sciences and, on the other hand, University of Nairobi (Kenya), Makerere University (Uganda), and University of Ghana. Two medium-sized cities that are rapidly urbanising were chosen in each country. Approximately 1,000 households were sampled from each city in which the African Food Security Urban Network (AFSUN) questionnaire was adopted. The selected other cities are Mbale and Mbarara in Uganda and Techiman and Tamale in Ghana.

[3] It should be noted that studying geographical clustering of firms was not an objective of the broader urban agriculture study in the three countries.

produces. These distinct cities' features provided cases for comparisons of competitiveness of poultry production and trade in the two cities.

4.2.1 Kisumu

Kisumu is the third largest city in Kenya, after Nairobi and Mombasa. It is located in the Lake Victoria basin, in the Western part of the country (Figure 4). It is a major business and transportation hub in Lake Victoria basin and covers two sub-counties; Kisumu Central and Kisumu East. It has a total area of 417 km^2, divided into 260 and 157 km^2 of land and water, respectively (UN-HABITAT, 2005). Kisumu had a population of about 383 thousand inhabitants in 2009 and close to 42 per cent employment rate, out of which 61 per cent are employed in the informal sector (Republic of Kenya, 2012d). About half of those employed earn less than US$ 1.60 per day (FAO, 2012). In 2015/16, Kisumu County had a head count poverty of 34 per cent (KNBS, 2018).

The city has several slum settlements that have grown in number as erstwhile rural areas have been zoned into urban areas. Subsequently, about 47 per cent of people in Kisumu live in informal settlements (Republic of Kenya, 2012e). The bulk of the population residing in the informal settlements, are employed in the informal sector (UN-HABITAT, 2005). Even though urban agriculture has a potential to improve livelihoods in Kisumu, it was previously neglected by the local authority. Therefore, over the years, Kisumu has continued to import food from neighbouring Counties (UN-HABITAT, 2005). The unregulated urban agriculture along the shores of Lake Victoria has resulted in siltation of the lake and deforestation (UNIDO, 2008). If used in an environmentally conscious manner, Lake Victoria could sustainably be used for irrigation in urban farming (UN-HABITAT, 2005).

4.2.2 Thika

Thika town is one of the 12 sub-counties in Kiambu County, which had a head county poverty of only 23 per cent compared to 36 per cent at the national level (KNBS, 2018). It is located in the Central parts of Kenya, only about 50 km North of Nairobi, a major market for agricultural commodities. It is a highly industrialised town with 151 thousand inhabitants in 2009 and 51 per cent employment rate (Republic of Kenya, 2012d). Close to half of the employed population is employed in the informal sector. Compared to Kisumu, a bulk of the population (89%) in Thika resides in formal settlements (Republic of Kenya, 2012e).

4.2.3 Types of urban agriculture based on location in Kisumu and Thika, Kenya

The classification of urban agriculture based on location in medium-sized cities of Kisumu and Thika (Figure 5) reveals that three fifths of urban agriculture is practised on own plots. This is congruent with other studies reporting that a majority of the urban farmers are the middle class and wealthy households (Foeken and Owuor, 2008). Another one quarter of the respondents cultivate crops within residential areas but not on their own plots[4]. These are households that illegally utilise other people's land or lease land for agriculture. Those that reported cultivating on the riverbeds and roadsides are only four and three per cent, respectively.

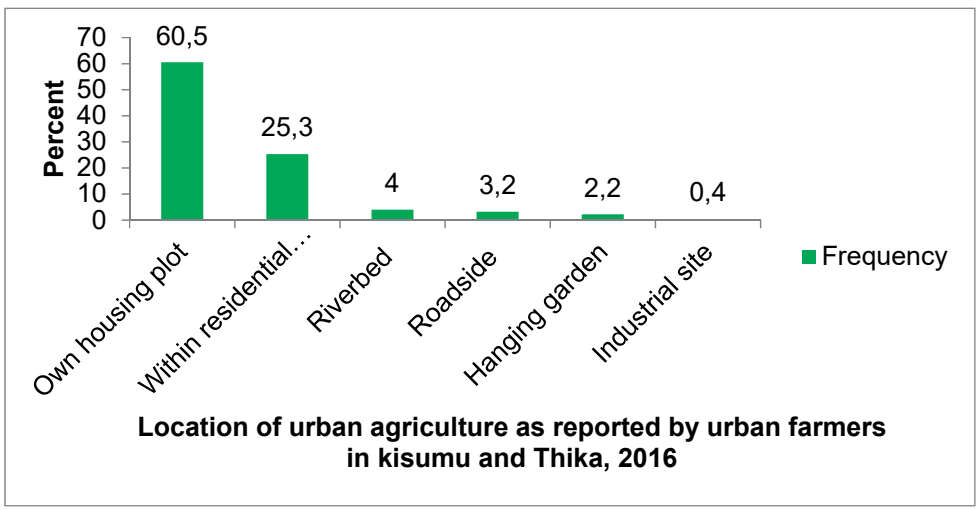

Figure 5: Location of urban agriculture in Kisumu and Thika, 2013. Note: Multiple responses allowed. Source: Urban agriculture baseline survey, 2013

4.3 Sampling procedure

The 2013 baseline survey employed a mix of sampling techniques to select the study cities and the final respondents. Purposive sampling was used to select Kisumu and Thika. The aim was to select rapidly urbanising cities, with population between 100, 000 and 500,000. Local urban experts helped in identifying the urban boundaries

[4]There are cases where a household practises urban agriculture in more than one location. Therefore multiple responses on location of agricultural activities are allowed and the proportions may overlap.

and communities that are considered urban within the cities. Each city was then divided into four quadrants which were proportionately stratified based on their population sizes. Therefore, communities with large populations ended up with a higher sample than small communities. Smaller yet proximal communities were combined into one survey area. Enumerators were then placed at different and spaced locations within the communities, in which they applied systematic sampling, interviewing approximately every third household. The final sample was 1,004 and 1,005 in Kisumu and Thika, respectively (Table 1).

Table 1: Sample sizes in Kisumu and Thika

	Kisumu	**Thika**	**Total**
Baseline survey (2013)	1004	1005	2009
Poultry farmers survey (2016)	177	135	312

Cochran (1977, p. 75) sample size determination formula was used in selecting poultry farmers in the 2016 survey. The formula is specified as follows;

$$n = \frac{pqz^2}{\varepsilon^2}$$

Where n is the sample size; p is population proportion with the variable of interest (households rearing poultry); q=1-p; z is the confidence level (α=0.05); and ε is the allowable error. From the baseline survey of 2013, about 24 per cent and 17 per cent of households in Kisumu and Thika, respectively, reared poultry. Taking p_{Thika}=0.17, p_{Kisumu}=0.24, z=1.96, and ε=0.0635 and applying these proportions to the Cochran formula yields;

$$n_{Thika} = \frac{0.17*0.83*1.96^2}{0.0635^2} = 134\ poultry\ farmers$$

$$n_{Kisumu} = \frac{0.24*0.76*1.96^2}{0.0635^2} = 173\ poultry\ farmers$$

The sampling frame used was the list of all farmers who reported that they reared poultry in the 2013 baseline survey. The MS Excel random number generator was used to proportionately sample 134 and 173 poultry farmers in Thika and Kisumu, respectively. The intention was to interview the same households that were interviewed in 2013. However, because of difficulties in locating most farmers, I was only able to re-interview 45 farmers. Those farmers that were missed were replaced with their nearest neighbours who reared poultry. The final usable sample was 177 and 135 poultry farmers in Kisumu and Thika, respectively (Table 1). This data set consisted of households engaged in various poultry enterprises, highlighted in section 4.4.

4.4 Data description, survey instruments, and data collection

The current study employed a mixed methods approach, utilising both quantitative and qualitative methods. Quantitative approach applied in the baseline survey[5] was exploratory in nature to highlight important issues and patterns about own food production. This allowed for a second round of quantitative data collection which delved deeper into a specific type of urban agriculture (poultry production). Later on, qualitative interviews were used to explain and confirm results obtained from quantitative interviews, particularly those relating to poultry production and marketing, and contextualisation of the study.

The application of mixed methods approach in data collection and analysis helped transcending limitations of each of the individual methods, while at the same time, building synergies by combining the advantages of both methods, thereby providing rigour and in-depth understanding of the issue at hand. This was achieved by triangulation and cross validation of results, thus providing a more complete picture of urban agriculture than any one of the methods. Quantitative data constituted of two sets of data; baseline survey of 2013 and poultry farmers survey of 2016.

The total sample of 2,009 households consisted of households engaged in agriculture and those not practising agriculture. In the baseline survey, respondents were asked about their household and demographic information, employment, food security, and engagement in agriculture in either urban or rural areas. The interviews were administered to household heads, but in their absence, a knowledgeable adult (18 years or older) household member was interviewed.

[5] The questonnaire used during the baseline survey was adopted from the AFSUN questionnaire. For more information about the adopted questionnare contact Magnus Jirström, Department of Human Geography, Lund University, Sweden

The 2016 poultry farmers' survey specifically targeted households that reared poultry in the two urban areas. Interviews were conducted with household heads or knowledgeable adult household members who had poultry. Therefore, the selected sample consisted of households that reared indigenous chicken, layers, broilers, ducks, guinea fowls, turkeys, and pigeons or a combination of these enterprises. However, only information on the three most important types of poultry enterprises for each household were collected. Importance was based on whether farmers depended on specific enterprises for income or as a source of food. Questions included in the questionnaire were on household and demographic characteristics, types of poultry enterprises, input use and prices, outputs, marketing, animal husbandry practices, and animal welfare.

Although the 2013 baseline survey forms part of my primary data source, I neither participated in the questionnaire design nor data collection. However, the sampling procedure described in section 4.3 and the large sample size improved on data quality and reliability. For purposes of the 2016 poultry farmers' survey, I recruited two MSc students from the department of agricultural economics at the University of Nairobi to assist with data collection. The enumerators were thoroughly trained for two days on how to use tablets for data collection and picking Global Positioning System (GPS) coordinates of households interviewed. They were all made to understand the survey questions and how to ask them in Kiswahili.

The survey instrument (appendix 1) was pre-tested and the difficulties that were encountered were rectified in the final questionnaire. Using some of the contact information that was collected during the 2013 baseline survey, I scheduled interviews with farmers whom I could reach. Those that I could reach via the phone or home/farm visits were contacted to set appointments for interview dates. Before starting the interviews, the enumerators (including me) introduced themselves and the project, and explained that respondent's confidentiality was guaranteed. A consent clause written on the questionnaire was read aloud to the respondent, and the interview continued only if the respondent agreed to participate.

Qualitative data included four Focus Group Discussions (FGDS) with poultry farmers, two in each city, Key Informant Interviews (KIIs) with county officers for veterinary services, agriculture and livestock services, and public health as well as with hotel procurement managers and poultry and poultry product traders. Issues discussed during the KIIs and FGDs revolved around urban agriculture, urban livestock production, marketing, challenges, profitability, poultry value chain governance, power, and institutions and support in terms of extension services (see appendix 2). Additionally, participant observations and tours of poultry farms and markets constituted part of the qualitative data.

The entry points for qualitative interviews were the counties' livestock and agricultural offices and some of the key informants I encountered during

quantitative data collection. I scheduled appointments with Kisumu County and Thika sub-county livestock and agricultural officers whom provided me with contact lists of key informants in the poultry value chain. Appointments were made with the key informants and consents for interviews and recording were sought first before commencement of the interviews. I personally conducted all the qualitative interviews, totalling to 40 interviews, as shown in appendix 3. The names of the respondents have been made anonymous, to maintain respondents' confidentiality.

4.5 Data analysis

As already mentioned, this thesis has made use of both quantitative and qualitative data. Quantitative data analysis involved computation of frequencies, means, comparison of means, and econometric analyses. Article one used the quantitative dataset, in which descriptive statistics were used. Frequencies, means, and tests for equality of means between various household groups and the two cities were conducted. Additionally, graphs were also generated to highlight differences and similarities between groups. Participant observations were only applied in explaining the results from quantitative analysis.

Similarly, frequencies, means, and comparison of means were used for article two. These analyses were conducted in SPSS version 20. However, in article two a considerable amount of qualitative data was also used. The qualitative interviews that had previously been recorded were transcribed and grouped into themes around the study objectives and research questions. Afterwards, differences, similarities, and emerging issues were taken as results for the article.

The third and final article focusing on profitability of urban poultry enterprises applied descriptive statistics and econometric analysis, to related profitability to explanatory factors, making use of quantitative data. All the analyses for this paper were done using STATA version 11.0.

4.6 Data validity and reliability

The questionnaire was transformed to be digitally compatible with the ODK (Open Data collection Kit) collect application. The use of tablets rather than paper questionnaire reduced the error margin of data collection because of the logics and sequencing of questions, which allowed only questions relevant for a particular household to be asked. In addition, it was efficient and fast because of the skip questions. GPS locations of the households were also collected for future use if need arises.

Enumerators were educated on the objectives of the study, contents of the questionnaire, and how to record respondents' responses in the tablets. In addition, enumerators were trained on etiquette. For example, upon entering a sampled or replacement household, enumerators were required to greet household members, explain the reason for the visit, and seek consent for interview. The training of enumerators was smooth because the enumerators had experience in conducting surveys and data collection, both of them having spearheaded data collection for their MSc theses and participating in other agricultural related data collection exercises. Recruiting only two enumerators aided in reducing data collection errors and supervision difficulties, thereby improving data validity.

A pilot study was conducted in Ruiru sub-county, which neighbours Thika and whose residents produce poultry. The pilot study was conducted in Ruiru instead of Thika because of the potential risk of interviewing a sampled household in Thika during the pilot study. The pilot study facilitated testing of the survey instrument, particularly on clarity of questions, content, and estimating the time required to administer the questionnaire. It further helped in gauging enumerators' capabilities in approaching households, seeking permission to interview a household member, interaction with the respondents, and recording responses. One question that was particularly difficult for the respondents to answer during the pilot study relates to household income. Most of the respondents were hesitant of giving the specific average monthly income. I therefore resorted to using income ranges as opposed to asking a specific amount of income. The interviews were conducted face to face with the respondents. The enumerators had to inform the respondents that the exercise was an academic research and that they should answer truthfully.

During the fieldwork, enumerators conducted themselves professionally and demonstrated a clear understanding of the survey questions and recording the responses. At the end of each day during the fieldwork, I met the enumerators to review progress, and keeping inventory of the filled questionnaires. I personally counter-checked all the questionnaires to ensure that they were entered correctly. In case of errors and inconsistencies, they were corrected after discussion with the specific enumerator. The questionnaires were then uploaded to the server. Each evening, for the entire period of the survey, I informed the enumerators of the strategy for the following day.

The use of mix methods improved the validity and reliability of the data because of triangulation of results. This also helped in the interpretation of research findings.

4.7 Problems encountered during field work

A major difficulty of conducting surveys in urban areas as opposed to rural areas is that there are high odds of missing respondents because of their busy schedules. Additionally, people in towns often move from one residential area to another or even between towns. For example, some of the households sampled from the baseline survey (2013) had moved from the study cities or were no longer producing poultry in 2016. Some telephone numbers that were recorded during the baseline survey were either not working or belonged to other people who were not interviewed in 2013. In some cases, particularly Thika, despite agreeing to be interviewed when scheduling appointments through the phone, some respondents refused to open the gates. In other cases, only house helps were at home, despite the respondent assuring us that they will be available. To overcome some of these challenges, if the respondent agreed to be interviewed at his/her place of work, the interview was conducted there.

Despite adequate introduction and elaborating the objectives of the study to some respondents, a few were still suspicious of the research team, mainly in Thika[6]. Another difficulty emanated from a lack of clear labelling of streets. Labels for many streets in Kisumu and Thika simply do not exist or have been vandalised, which made it hard to locate some households.

4.8 Study limitations and strengths

The standard questionnaire adopted for the 2013 baseline survey provided a wide range of information on household food security and own food production. However, the quantities of own food produced, consumed, marketed or transferred were not recorded. It would have been more useful to quantify the amount of own food produced and how they are appropriated to various utilisations. Additionally, food security trickles down to the individual. Collecting food security data at individual level would have shed more insights on intra-household food security.

The practice of urban agriculture changes depending on the season and availability of land. Using a cross-sectional data set only captures information at one point in time. Similarly, food security status of a household varies depending on the available livelihood options, such as employment, availability of land to farm, and

[6]They later informed us that the County government of Kiambu was in the processing of acquiring back their houses and they suspected that we were working for the County government

the season among other factors. Although expensive in terms of funds and time, panel data helps in ironing out these divergences.

Furthermore, urban-based agriculture is not the only food source for urban farmers, they also sometimes depend on the food market system. Therefore, to better understand the urban food system and the food security status of the surveyed households, urban agriculture should be embedded into the broader food system including transportation, value addition, marketing, and consumption. This would provide relevant and more robust information for addressing food insecurity in urban areas (Battersby, 2013).

Although the third article attempts to quantify the value of indigenous chicken production, computation of the income share of poultry production to the total household income would have shed more light on the relative importance of the enterprise. The intention was to collect this information in the 2016 survey. However, during questionnaire pretesting, most respondents had difficulties in giving household income information. While some respondents refused to answer the question, others appeared to under-estimate their incomes. I resorted to use a categorical income variable, which aggregated household incomes into ranges. This made it impossible to compute income shares of poultry production. Nonetheless, gross margin values for each bird still provided a good indication of the monetary value of poultry farming.

Despite the limitations, this study has several strengths. It is the second comprehensive study on urban agriculture comparing farmers and non-farmers, after Memon and Lee-Smith's study conducted in 1985, that assessed urban households own food production (1993). This study also utilised mixed methods approach, combining quantitative and qualitative methods, enabling triangulation of findings, making results more robust. Furthermore, the use of two quantitative datasets comprehensively explores the general role of own food production on household welfare and further narrows down to a specific type of urban farming that is common among urban farmers. This provided a broad picture of own food production by urban households and at the same time, delving deeper into a specific type of urban agriculture.

The thesis also contextualises own food production in two medium-sized cities in Kenya. This departs from the metro bias in urban agriculture studies. Additionally, it contextualises poultry value chain in the two medium-sized cities, departing from rural focus of most agricultural and food value chain studies. It also inserts insights from cluster theory in the urban poultry value chain.

CHAPTER FIVE: SUMMARY OF RESEARCH ARTICLES

5.1 Summary of articles

Article 1: The role of urban-based agriculture on food security: Kenyan case studies (published)

A prominent concern for this paper is contextualisation of food security in relation to own food production in medium-sized cities. Except for a few studies such as Ayerakwa (2017a), Foeken and Owuor (2008), and Memon and Lee-Smith (1993), most studies on urban agriculture focus only on the role of own food production within urban spaces for household food security. The perspective taken by the above studies shed more light on several available options households have to improve their food security situation. The multi-local livelihood perspective highlights that apart from dependence on purchased food, some households produce their own food in urban and/or rural areas as well as receiving and giving out food transfers. As noted by Ayerakwa (2017b), focusing on food produced in urban areas alone as a livelihood strategy for these households leaves a gap on other available alternatives. Therefore, apart from examining own food production in urban areas alone, this study expands the debate to agricultural activities in rural areas by urban households.

The overarching objective of the study is to investigate the role of own food production on household food security. To achieve this end, three research questions were posed; What is the level of engagement in agriculture among households? How are 'own-produced' agricultural commodities utilised, and what is their income contribution? and what role does engagement in agriculture play in enhancing food security? The sample is disaggregated into four household categories, those that practice; urban agriculture, urban-based rural agriculture, both urban agriculture and urban-based rural agriculture, and households that do not engage in any form of agriculture. Therefore, it identifies two types of agricultural production based on location of the activity; urban agriculture and urban-based rural agriculture. The

study applies two food security indicators, as well as perceptions about importance of own food production, utilisation patterns of own production, and agricultural income shares to gauge the importance of urban-based agriculture. Comparative perspectives are used to analyse the differences between various categories of households and across the two cities.

Surprisingly, more than half of the households in Kisumu and Thika engage in some form of agricultural production as a source of food and or income, in urban or rural areas. One out of four households practise urban agriculture while slightly more than one third are engaged in urban-based rural agriculture. Most respondents reported that they either consume or sell part of their agricultural produces from urban and rural farms. Those households that practise both urban agriculture and urban-based rural agriculture tend to have better food security status compared to the other three categories. However, both urban agriculture and urban-based rural agriculture contribute significantly to household incomes.

The study concludes that own food production is an important livelihood strategy for the practitioners. Therefore, urban agriculture should be included in the food and urban planning policies and that urban farmers should receive support from their respective county governments. Policy support could be in the form of provision of extension services to urban farmers, especially on the risks of using sewer water for irrigation.

Article 2: Poultry value chain in two medium-sized cities in Kenya; insights from cluster theory (manuscript)

Article 1 is a generalisation of various forms of own food production. As already mentioned, lack of empirical research on specific kinds of urban agriculture and their specific roles on household welfare have hampered policy formulation that supports urban agriculture. A dearth of such information also contributes to the scepticism and criticism of urban agriculture as an option for improving food security and combating poverty. Therefore, article two takes over from where article 1 concluded and narrows down to a specific yet common form of urban farming; poultry production. The general objective is to analyse the poultry value chain in medium-sized cities of Kisumu and Thika, Kenya. It contextualises poultry value chain in the two cities by using insights from cluster theory. It uses quantitative data from 312 poultry farmers and qualitative data from the main actors in the value chain.

Combining value chain analysis and cluster theory enriched the insights of how the urban poultry value chain operates. The broad view of the industry including the governance and institutional framework from a value chain perspective is

complemented by analysing local factors and relations from cluster theory and how they affect competition, innovation, and upgrading.

The most common poultry enterprises in the two cities are indigenous chicken, layer, broiler, and duck farming. Indigenous chicken serves a dual role of food provision and income generation while layer and broiler farming are entirely commercial. The governance structure of the poultry value chain is mainly a spot market. It involves numerous small volumes transactions involving more than one buyer. Traders tend to exploit farmers by buying their produce at low prices, selling them later to high value markets. Farmers' participation in high value markets is limited and constrained by low produce volumes and stringent food quality requirements. One approach of curbing this problem is formation of producer groups that reduce transaction and transportation costs.

The competitive forces within the urban poultry value chain enhance innovation and upgrading in marketing and production of poultry. Producers often cooperate and market their produce through referrals. Some producers upgrade through advertising their produces while some sell through the social media. Traders often collude in setting prices. Poultry theft and on-farm slaughtering of poultry intended for marketing or slaughtering in hotels without inspection are common illegalities in the poultry value chain, with the latter posing serious health risks. In addition, poultry producers complained of poor quality adulterated feed. Some farmers also do not adhere to drugs withdrawal periods before selling their produces.

The county governments should enforce laws that require hotels to slaughter their poultry in slaughterhouses or under inspection with county meat inspectors. Only certified individuals and companies should manufacture poultry feed to reduce cases of poor quality feed.

Article 3: Small-scale poultry enterprises in Kenyan medium-sized cities (accepted for publication)

The bulk of literature on urban agriculture revolves around the role of urban agriculture on households' food security alone. In addition to relating urban poultry farming to household food security, this study goes a step further to assess profitability of urban poultry enterprises. Through the economic (profitability) lens, the study contributes to the discourse of urban agriculture by analysing economic returns of indigenous chicken production and factors that affect its profitability. As urbanisation continues, some agricultural enterprises are ejected out of the urban centres to the peripheries, while others continue to thrive under shrinking land sizes. Poultry farming provides a good example of such an enterprise, which continues to be feasible under small land sizes and yet more profitable because the rising urban population provides market for the outputs.

Indigenous chicken produced within urban realms serves a dual role of food provision and income generation. It is mainly practised as a part-time activity, which supplement household income from other sources. Feed constitute the highest share of costs in poultry production. Generally, indigenous chicken farming is profitable, with each bird generating an average of Ksh. 756. However, indigenous chicken profitability in Thika (Ksh. 1,185) is more than double that in Kisumu (Ksh. 533).

Regression analyses results indicate that selling to high value markets, access to market information, and farms' location within clusters significantly increase profits in indigenous chicken farming. The study recommends a policy support to link poultry farmers to high value markets. Such approaches include facilitation for formation of producer groups to increase their marketable volumes and reduce transaction costs, provision of high yielding and fast maturing poultry breeds, and training farmers on affordable feed production, given that feed constitute the largest share of production costs. Additionally, farmers should be trained on poultry management, especially on poultry diseases control and treatment.

5.2 How do medium-sized cities' findings compare to larger cities

While it would be interesting to compare the nature and scale of urban agriculture and the operation of poultry value chain between the large and the medium-sized cities, similar recent studies are lacking for large cities in Kenya (Nairobi and Mombasa). Several urban agriculture studies have been conducted in Nairobi, though the scopes of these studies are usually narrow. For instance, most focus only on informal settlements and on a specific type of urban agriculture (Ritho, 2005; Gallaher *et al.,* 2013; Carron *et al.,* 2017). Furthermore, these studies lack the control group of the non-farmers. However, the results from the present study are compared with those from an urban agriculture study in 1985, in six urban areas, including Nairobi, Mombasa, and Kisumu (Memon and Lee-Smith, 1993). Additionally, the results are also compared with several studies in Nakuru, a medium-sized city in Kenya and a study on broiler value chain in Nairobi.

Urban agriculture is more prevalent in the medium-sized cities compared to the large cities. Findings from this study demonstrate that about one quarter of residents in Kisumu and Thika engage in some form of urban agriculture. In Kisumu, this study found out that 24 per cent of urban households farmed in towns, though this has marginally declined from 30 per cent in 1985 (Memon and Lee-Smith, 1993). At that time, only 20 and 29 per cent of urban households were farming in Nairobi and Mombasa, respectively (Memon and Lee-Smith, 1993). Urban livestock production also features predominantly in the smaller towns compared to the larger cities. In

1985, while 30 per cent of urban households were producing livestock in Kisumu, only 7 and 22 per cent were raising livestock in Nairobi and Mombasa, respectively (Memon and Lee-Smith, 1993). By 2013, 26 and 19 per cent of households in Kisumu and Thika, respectively, were active in urban livestock production. These findings augur well with findings from the medium-sized city of Nakuru, where 27 and 20 per cent of households were active in urban crops and livestock production (Foeken and Owuor, 2008).

In 1985, 35 per cent of Kisumu's households had access to urban agricultural land, compared to only 22 and 29 per cent in Nairobi and Mombasa, respectively (Memon and Lee-Smith, 1993). This implies that most households in medium-sized cities have better access to agricultural land compared to households in mega cities. Consequently, most of the urban farming in the two medium-sized cites is in own residential areas, unlike in Nairobi, where it is mainly done on public land, roadside, wetlands, or illegally on other peoples' undeveloped private land (Ritho, 2005). This is an indication that the smaller and medium-sized cities still have larger parcels of land for urban agriculture than the large cities. This could be because of stiff competition for urban land for other uses such as formal and informal businesses and real estate development in large cities compared to smaller cities.

While the overall participation rates in urban agriculture, access to agricultural land, and location of urban agriculture vary significantly between the large and medium-sized cities, there are congruencies in poultry production and marketing. In Nairobi's Dagoretti and Kibera areas, urban farmers own broiler flocks of above 300 and under 100 birds, respectively (Carron *et al.,* 2017). This compares favourably with results from the present study, showing that a vast majority of broiler producers in Thika and Kisumu are small and medium-scale producers with flock sizes ranging between one and 500 birds. Similarly, most producers in the two study cities and Nairobi slaughter their chicken on-farm (Carron *et al.,* 2017).

In Nairobi, hatcheries were found to be the dominant actors in broiler value chain, who provided technical assistance on production as a marketing strategy for the purchase of DOCs or engagement in contract farming (Carron *et al.,* 2017). Similar to Thika and Kisumu, brokers and *agrovets* were also mentioned as dominant groups. Additionally, most producers either marketed their broilers to brokers or directly to retailers or consumers. Most of the farmers are also not organised in producer groups because of mistrust and lack of communication among producers (Carron *et al.,* 2017).

However, it should be noted that the characteristics of urban agriculture between the large and medium-sized cities could be affected by other factors such as proximity to rural areas, cities' population sizes, climatic factors (Mackay, 2018), and level of support by the (county) government.

CHAPTER SIX: DISCUSSION AND CONCLUSION

6.0 Introduction

The increasing global population exerts pressure on rural farms to produce enough food (Eigenbrod and Gruda, 2015). As laid out by Badami and Ramankutty (2015), the pressing concern of increasing urban poverty and food insecurity requires a multi-pronged approach, encompassing utilisation of locally available resources, such as urban agriculture, to produce food and generate incomes as well as increasing livelihood opportunities for urban dwellers. This would increase their purchasing power to buy food. One option is for the respective authorities to focus on urban agriculture and vacant plots within the relatively sparsely populated small and medium-sized urban centres that have adequate agricultural land (Eigenbrod and Gruda, 2015).

There has been a never ending debate on the capacity of urban agriculture to improve welfare, specifically in enhancing food security (Lee-Smith, 2010). This is despite the main reason for the scepticism being known, the lack of solid and consistent empirical data! That said, the discourse on urban agriculture should shift to characterisation of urban agriculture in order to improve rigour of analysis to better inform policy (Lee-Smith, 2010). Studies in Kampala show that the prevalence of urban agriculture has been increasing despite rapid urbanisation and population growth (David *et al.,* 2010; Lee-Smith, 2013). In Kenya, although the prevalence of urban farmers in Kisumu has marginally reduced from 30 per cent in 1985 to 24 per cent in 2013, the absolute numbers have increased (Memon and Lee-Smith, 1993; Omondi *et al*., 2017).

However, recent urban agriculture studies present a doubtful picture on the role of urban agriculture on food security. These studies critique urban agriculture based on land availability (Martellozzo *et al.,* 2014; Badami and Ramankutty, 2015). Urban encroachment will continue to exert pressure on urban farming in the densely populated areas of the cities (Padgham *et al.,* 2015). While it is indeed true that mega cities have already constrained their land such that urban agriculture may not be feasible, the small and medium-sized cities still have relatively larger land parcels (Martellozzo *et al.,* 2014). At the same time, the mentioned studies base their

analysis on horizontal production, yet other forms of urban farming such as sack gardening, soilless farming, and roof top gardening have been reported to be highly productive and space efficient (Gallaher, *et al*., 2013; Eigenbrod and Gruda, 2015). The use of vertical chicken houses as a response to land constraint also shows the capacity of farmers to efficiently and effectively adapt to changes.

6.1 Discussion; relating results to theory

More than half of households in Thika and Kisumu undertake some form of agriculture, in rural or urban areas. About two out of five (17%) urban households in Kisumu and Thika practise urban agriculture, one third (29%) produce food in rural areas while eight per cent practise both urban and rural agriculture. This implies that 25 per cent and 37 per cent of urban households engage in urban agriculture and urban-based rural agriculture, respectively. Similar findings have been reported in Sub-Saharan Africa (SSA) where urban households engage in agriculture in urban and rural areas (Memon and Lee-Smith, 1993; Jayne *et al*., 2015; Ayerakwa, 2017a).

Urban agriculture has broadly been theorised using two divergent paradigms. On one hand, urban is perceived as a response to market failure, where the poor engage in it as a survival strategy (Ellis and Sumberg, 1998; McClintock, 2010; Smart *et al.,* 2015). Engagement in urban agriculture is described as a response to lack of employment and poverty among urban households. Another strand perceives urban agriculture as a response to market opportunities, where people engage in urban agriculture as a result of proximity to market for both outputs and inputs (Hovorka, 2004).

However, I argue that the divergence in the perceptions of urban agriculture should be viewed as synergies rather isolated reasons. This study has shown that nearly all households engaged in urban agriculture consume part of the food they produce while slightly more than a third derive some income from sale of urban agriculture produces, constituting slightly more than one third of the total household cash income. About 32 and 37 per cent of eggs and indigenous chickens, respectively, are consumed by the producing households. This finding is congruent with findings from Nakuru, Kenya, where residents practise urban agriculture for food security and income generation (Foeken and Owuor, 2008).

Thus, from these two examples, urban agriculture partly responds to market failure by providing households with income and food. Secondly, as a response to market opportunities, the results of this study show that most urban farmers produce vegetables, a highly demanded commodity by the urbanising community. Additionally, other profitable enterprises such as poultry production respond to the

high demand of animal proteins accruing to urbanisation and favourable dietary shifts. The existence of a ready market for urban agriculture produces therefore, attract urbanites to engage in farming.

The clear theoretical framing of own food production and specifically urban agriculture in the two medium-sized cities of Kisumu and Thika is both a reaction to market opportunities and market failure. However, the type of urban agriculture enterprise and context matters in explaining the main reason for engagement in agriculture.

This study has also analysed food (in)security of urban households using food security indicators and conceptualised it in the broad entitlement framing of food (in)security (Sen, 1981). Through the entitlement prisms, urban households have an array of entitlement bundles, including production-based, employment-based, and trade-based entitlements in urban or rural areas or both. Engagement in agriculture either in urban or rural areas provides households with production-based entitlement, which enable them to acquire and access food. They directly acquire food such as vegetables, maize, beans, milk, eggs, and meat from their own production. When these own produced food items are sold, then the households could be considered to have trade-based entitlements. They sell the food in exchange for money which can be used to purchase other food items not produced by the households. At the same time, for those households that depend entirely on urban-based agriculture, this activity provides them with employment entitlement.

Own food production at least satisfy the first two components of food security; availability and access. The access component is achieved through direct consumption of urban agricultural products or buying them cheaply. However, the dimension of food safety that is closely tied to access requires policy support, through regulation and provision of extension services. Therefore, an understanding of the urban residents livelihood strategies including own food production, through the different entitlements available to them helps in understanding food security situation in urban settings

Responding to calls for context specific and enterprise based analyses of importance of urban agriculture to livelihood (Zezza and Tasciotti, 2010; Padgham *et al.,* 2015), this study delves deeper into urban poultry production and value chain analysis. The value chain approach is enriched with insights from cluster theory. The urban poultry value chain in the surveyed cities is dominated by a spot market form of governance, where producers mostly market their chickens and eggs individually (Gereffi *et al*., 2005). This is as a result of the urgent need to sell poultry once they have attained the market weight to reduce further expenditures on feed (Begum *et al*., 2013). Additionally, the commodities are highly perishable, hence the need to sell the products immediately. The contextualisation of poultry value chain in the medium-sized cities shows that the chains are relatively shorter compared to rural

agricultural value chains and that the farms are relatively smaller than rural farms (Okello *et al*., 2010).

Cluster theory enriched the value chain analysis by showing how local level factors and interactions between value chain actors shape competition and cooperation (Porter, 1990). The competition among poultry producers and traders has facilitated their upgrading in the value chain through innovative marketing techniques and specialisation in specific business (e.g. traders mostly deal with roast chicken while hotels sell fried chicken and chicken stew) (Humphrey and Schmitz, 2002. The roadside traders also sell chicken in parts which are affordable to most consumers. However, these competitive forces also cause some producers and traders to engage in illegal activities that pose health risks to consumers. For instance most producers and hotels slaughter chicken on-farm to reduce expenses in engaging meat inspectors. Additionally, some producers use Anti-Retroviral drugs to fatten their chicken while some do not observe drug withdrawal periods. Others engage in poultry theft while some poultry feed manufacturers produce and sell adulterated substandard poultry feed.

The theoretical argument that poultry producers in Thika who benefit from being located in clusters of related industries and are thus more competitive than those in Kisumu is further empirically tested in paper three. Results show that poultry production in Thika, holding other factors constant, positively influences profitability of poultry production. Clustering of feed millers in Thika or nearby Nairobi accrues some cost advantages to producers in Thika (Omiti and Okuthe, 2009). Most poultry feed are cheaper in Thika than Kisumu. The lower cost could be attributed to lower transportation and transaction costs (Porter, 2000). Output prices are also generally higher in Thika than Kisumu, because of the close nearby demand in Nairobi (Nyaga, 2008; Omiti and Okuthe, 2009; Okello *et al.,* 2010; Carron *et al.,* 2017). This large market for Thika producers presents a unique demand for poultry products which improves the competitiveness of the business (Porter, 1990).

6.2 Conclusion

The objectives of this study were to provide a theoretical framework of the reasons why people farm in the cities while contextualising it in two medium-sized cities of Kenya. It also sought to understand how the contextualisation of poultry production and value chain improves our understanding of the operation of the value chain. Against this backdrop, urban crops and livestock production provides households with food and income, responding to market opportunities and market failure.

The poultry value chain in the studied cities is dominated by spot market form of governance. Competition and local level factors enhance actors upgrading through innovative marketing and product packaging (selling chicken parts as opposed to whole chicken). Some poultry producers and traders reduce production costs by engaging in illegal slaughtering, non-adherence to drugs withdrawal periods, and sale of adulterated feed.

Generally, urban poultry production is a profitable venture. Poultry farms' location within clusters, access to high value markets and market information, and the type of poultry production system are important factors that affect profitability of indigenous chicken production. Only a small share of indigenous chicken producers in the present study had sold their produces to HVMs. The exclusion of these farmers from HVMs could be attributed to the low produce volumes, stringent food quality requirements, and high transaction costs of accessing such markets (Andersson *et al*., 2015; Ochieng *et al.*, 2017). However, these impediments could be reduced through formation of producer groups. Producer groups have been found to increase farmers' bargaining power, reduce transaction and transportation costs through collective buying of inputs and marketing (Neven *et al.,* 2009; Jordaan *et al.,* 2014; Ochieng *et al.*, 2017).

In addition, supporting farmers to access improved farming technologies, such as high yielding poultry breeds that are fast maturing, would improve their marketable surpluses. Cost of feed constitutes the largest share of poultry production. Training farmers on low cost feed formulation could greatly increase their profit margins. A large proportion of commercial poultry farmers reported slaughtering chicken on-farm without veterinary inspection which poses serious health risks. However, this could be avoided through provision of affordable veterinary inspection services or construction of certified cost-effective abattoirs.

As shown in this study, urban poultry farming requires relatively smaller land size for production compared to crops and large livestock production. In addition, there is an adequate market, created by the rapid urbanisation and subsequent dietary shifts towards meat and milk products, which favour urban poultry enterprises (Republic of Kenya, 2010c). Therefore, it would be erroneous to dismiss the potential contribution of urban agriculture on income and food security based on nationally available land and population data alone. It is rather more helpful to consider the scale, extent of various agricultural activities, objectives for farming, and availability of improved production technologies. Additionally, urban agriculture is context specific, and this should be considered when evaluating the potential role of urban agriculture.

6.4 Recommendations for policy

It should be noted that it is not always self-evident that own food production would be economical compared to purchasing food from the market (Stewart *et al*., 2013). For instance, in cases where the opportunity cost of farming outweighs cost of purchasing food or when agricultural markets are efficient with affordable food prices, the food market system might be the better option than own food production. However, findings from this study show that urban agriculture is beneficial for food provision and income generation. Therefore, one approach of promoting urban agriculture could be to motivate urban households with access to agricultural land to cultivate food crops as well as engage in small livestock farming. Incentives would be required to stimulate urban residents with vacant land to start farming and also for the establishment of local food businesses (Grewal and Grewal, 2012). Another alternative is the zoning of idle land which could be developed for urban agriculture.

These approaches would require collaboration between community leaders, County governments, city planners, and researchers. This promotion of urban agriculture would require identification and realignment of the relevant resources, such as idle land and inputs for production, as well as those needed for processing and marketing the final products. This means that the starting point would be mapping out the land use patterns within cities, hence identifying all vacant lots appropriate for agriculture. The zoning of cities to allow for urban agriculture would have to be spearheaded by the County governments (Grewal and Grewal, 2012).

Locally available resources will then have to be realigned, for example, collection of organic wastes from markets and urban farms for production of organic manure, to be recycled in the urban farms. An entry point for organic manure production could be the up-scaling and support of already existing Community Based Organisations (CBOs) involved in compost production (Njenga *et al*., 2010). Additionally, rain water harvesting from surface runoff and roof tops could be used for urban farming rather than constraining the already scarce potable water needed for other household needs (Grewal and Grewal, 2012). Even though such recommendations may be optimistic for a country such as Kenya, which is striving to be a middle-income economy and struggling with high unemployment and poverty rates, it is the responsibility of County governments to promote agriculture.

The challenge of high cost of feed could be reduced through training farmers on formulation of cost effective feed. This could be achieved through training farmers organised in producer groups. The respective County governments should also offer extension services by advising farmers on poultry production and disease management. Above all, these initiatives should be clearly framed in a policy that regulates and support urban agriculture. Regulation is of utmost importance,

considering that urban agriculture has potential food safety and environmental risks, emanating from poor use of untreated sewage water for irrigation and poor manure disposal. Concerning urban poultry production, the county governments should ensure that all hotels sell poultry meat that has been inspected. This could be achieved by enforcing the meat control act, allowing only slaughtering of poultry in recommended slaughterhouses where meat is inspected, or if done in-house, the hotels should only slaughter poultry under inspection by county meat inspectors.

Farmers should also be educated on importance of adhering to drugs withdrawal periods and use of recommended drugs at appropriate doses to reduce risks of antibiotic resistance in humans. The illegality of manufacturing and sale of substandard poultry feed could be reduced by KEBS ensuring that only registered and certified companies engage in animal feed production. Strong producer organisations could assist in pressuring KEBS to adequately regulate feed manufacture to ensure quality standards. The livestock feed firms organised in groups could also set private standards for members to protect the quality of feed.

6.5 What does the future hold for urban agriculture and urban poultry production?

Availability of agricultural land in towns, increasing population, and rising demand for food would make urban agriculture persist in African cites, especially in the small and medium-sized cities. The future African cities will develop in ways that integrate urban agriculture. Rooftop farms, use of hydroponics, and vertical gardens already exist in cities, both in the global North and South (Grewal and Grewal, 2012; Gallaher *et al*., 2013). Agricultural activities in towns will develop into innovative practices that efficiently utilise the limited space.

The increasing demand for livestock products will likely transform urban livestock production to an intensive and modernised sector (Amadou *et al.,* 2012). The large livestock will likely be pushed to the peripheries of cities, paving way for space efficient agricultural activities like horticulture, aquaculture, poultry farming, and production of other small livestock like rabbits and guinea pigs (Pribadi and Pauleit, 2015).

The future projection of poultry consumption, particularly in Kenya is promising for urban poultry producers. With the expectation of demand for poultry and poultry products tripling between 2000 and 2030 (Robinson and Pozzi, 2011), urban poultry producers would be among the beneficiaries. The rising middle class and increasing health consciousness would further drive up consumption of white meat (Delgado *et al*., 1999; Republic of Kenya, 2010c).

6.6 Future research gaps

Even though the current study has estimated profitability of urban poultry enterprises, most farmers often practise mixed farming. Therefore, for some group of urban farmers, poultry farming is only one among several agricultural enterprises. Resources are often recycled in the enterprises as wastes from one enterprise can be used as inputs in other enterprises. For example the use of livestock manure for crop cultivation. Additionally, poultry manure is often sifted and used as dairy feed. Evaluating optimal enterprise mix among urban farmers would shed light on the whole urban agriculture system and complementarities of enterprises.

Urban crops cultivation and poultry production are season dependent. Crops cultivation follow rainfall patterns while the scale of poultry production and marketing are affected by festivities and holidays. There is often an upsurge of urban crops production during the rainy season. Likewise, some poultry farmers plan their production to coincide with festivities and holidays in which poultry prices are high. The use of panel data, that is, collecting data at several points during the year would iron out biases that arise from cross-sectional data.

This study has only considered food crops and livestock produced in urban spaces. The scope did not cover some types of urban agriculture like tree and flower nursery production. Additionally, aquaculture, practised by some urban households did not feature in this study. Future urban agriculture studies should aim at closing these gaps.

The poor quality feed reported by poultry producers significantly affects livestock production and profitability. There is a need to have a census of all animal feed producers, especially in Thika and Nairobi, where a majority are clustered. The census should collect data on the feed manufacturing procedures, formulas, and quality standards followed by the firms. This would help in identifying the firms producing low quality feed.

6.7 Reflections by author

In the 1990s, as a small boy, I remember helping my late father irrigate his vegetables (kales) in Nakuru. We were residing in an institutional house where residents within the estate were allowed to cultivate the vacant plots around the houses. My father had demarcated his ‘allocated’ land for vegetables and maize. Immediately outside the house, he had constructed a chicken house where at any given time he had close to 20 birds. My eldest brother also had some rabbits in the backyard. These crops and livestock provided us with food and income. After my

father retired from work and went back to the village, that land was probably ‘allocated’ to another person for cultivation purposes.

This practise was replicated across most of my neighbours. To me, farming within towns was a normal activity. At that time and even after going through primary, secondary and university education, I had no idea that what my late dad undertook had a name, urban agriculture. It was not until when the PhD position to undertake research on urban agriculture was announced that I became cognizant of the practice. Despite having lived the experience of urban farming, this research has been entirely empirical and evidence based. When I interviewed staff of Kisumu and Kiambu county governments, they indicated that they had no objection to residents practising urban agriculture, unless it causes nuisance to other people. The reality in Kenyan context is that urban agriculture is an important activity for food provision and income generation, especially for the small and medium-sized towns. Efforts should therefore be made to support famers through policies aiming at regulating the practice to ensure safety of products and providing support to farmers, especially through extension services.

References

Achieng', R., Mbusya, W.M. and Ng'ang'a, M.N., 2011. Stakeholder Forum: The Future of Urban Agriculture in Kenya. Solidarités International, Workshop proceedings, Nairobi 3rd-4th August 2011 *Food Security Program*

Amadou, H., Dossa, L. H., Lompo, D. J. P., Abdulkadir, A. and Schlecht, E., 2012. A comparison between urban livestock production strategies in Burkina Faso, Mali and Nigeria in West Africa. Tropical Animal Health and Production, 44(7), 1631-1642.

Ambrose-Oji, B., 2009. Urban Food Systems and African Indigenous Vegetables: Defining the Spaces and Places for African Indigenous Vegetables in Urban and Peri-Urban Agriculture. In: Shackleton, C. M., Pasquini, M., and Drescher, A. W., (Eds.). *African indigenous vegetables in urban agriculture*. Earthscan, London, pp. 1-7.

Amoah, P., Drechsel, P., Abaidoo, R.C. and Henseler, M., 2007. Irrigated urban vegetable production in Ghana: microbiological contamination in farms and markets and associated consumer risk groups. Journal of Water and Health, 5(3), 455–466.

Andersson Djurfeldt, A. and Jirström, M., 2013. Urbanization and changes in farm size in sub-Saharan Africa and Asia from a geographical perspective: a review of the literature. Accessed on 23rd January 2016, available at: lup.lub.lu.se/record/4694048/file/4862245.pdf.

Andersson Djurfeldt, A., 2014. African urbanisation trends and implications for urban agriculture. In: Magnusson, U., Bergman, K.F., (Eds). Urban and Peri-urban Agriculture for Food Security in Low-income Countries – Challenges and Knowledge Gaps, pp. 6-9.

Andersson, C.I.M., Chege, C.G.K., Rao, E.J.O. and Qaim, M. (2015), Following up on Smallholder Farmers and Supermarkets in Kenya. American Journal of Agricultural Economics, 97(4), 1247–1266. doi.org/10.1093/ajae/aav006.

Armar-Klemesu, M., 2000. Urban agriculture and food security, nutrition and health. In: Bakker, N., Dubbeling, M., Guendel, S., Sabel-Koschella, U., de Zeeuw, H., (Eds). *Growing Cities, Growing Food: Urban Agriculture on the Policy Agenda*. DSE, Feldafing. pp. 99–117.

Awuor, T., 2016. Why Butula farmers are giving livestock ARVs. Accessed on 3rd April 2018, available at https://citizentv.co.ke/news/why-butula-farmers-are-giving-livestock-arvs-136037/.

Ayerakwa, H.M., 2017a. Urban households' engagement in agriculture: implications for household food security in Ghana's medium sized cities. Geographical Research, 55(2), 217–230 doi:10.1111/1745-5871.12205.

Ayerakwa, H.M., 2017b. Planting to feed the city? Agricultural production, food security and multi-spatial livelihoods among urban households in Ghana. Published PhD thesis, Lund University.

Badami, M.G. and Ramankutty, N., 2015. Urban agriculture and food security: A critique based on an assessment of urban land constraints. Glob. Food Sec. 4, 8–15. doi:10.1016/j.gfs.2014.10.003.

Baptista, R., and Swann, P. 1988. Do firms in clusters innovate more? Research Policy, 27, 525–540.

Barrett, C. B., Bachke, M. E., Bellemare, M. F., Michelson, H. C., Narayanan, S., and Walker, T. F., Bank, T. and Walker, T.F., 2012. Smallholder Participation in Contract Farming : Comparative Evidence from Five Countries. World Development, 40(4), 715–730. doi.org/10.1016/j.worlddev.2011.09.006.

Barrett, C.B., 2010. Measuring food insecurity. Science, 32 (5967), 825–828.

Battersby, J., 2013. Hungry cities: a critical review of urban food security research in sub-Saharan African cities. Geogr. Compass, 7 (7), 452–463.

Begum, I.A., Alam, M.J., Rahman, S., and van Huylenbroeck, G., 2013. An assessment of the contract farming system in improving market access for smallholder poultry farmers in Bangladesh. In: da Silva, C.A. and Rankin, M. (Eds), Contract farming for inclusive market access. Food and Agriculture Organization of the United Nations, Rome.

Bergevoet, R. and van Engelen, A., 2014. The Kenyan meat sector Opportunities for Dutch agribusiness. LEI Wageningen UR (University & Research centre), LEI Report 2014-032, Wageningen.

Bett H. K., Bett R. C., Peters K. J., Kahi A. K. and Bokelmann W., 2012. Linking Utilisation and Conservation of Indigenous Chicken Genetic Resources to Value Chains. J Anim Prod Adv, 2(1), 33-51.

Bilinsky, P. and Swindale, A., 2010. Months of Adequate Household Food Provisioning (MAHFP) for Measurement of Household Food Access: Indicator Guide (v.4). FHI 360/FANTA, Washington, DC.

Cabannes, Y., 2012. Pro-poor Legal and Institutional Frameworks for Urban and Peri-Urban Agriculture. Food and Agriculture Organization of the United Nations, Rome.

Carron, M., Alarcon, P., Karani, M., Muinde, P., Akoko, J., Onono, J., Fèvre, E.M., Häsler, B. and Rushton, J., 2017. The broiler meat system in Nairobi, Kenya: Using a value chain framework to understand animal and product flows, governance and sanitary risks. Preventive Veterinary Medicine, 147, 90–99.

Catelo, M.A.O., 2006. Understanding the Links between Agriculture and Health. Focus 13, Brief 9, International Food Policy Research Institute, Washington, DC.

Chege, C.G.K., Andersson, C.I.M. and Qaim, M., 2015. Impacts of Supermarkets on Farm Household Nutrition in Kenya. World Development, 72, 394–407. doi.org/10.1016/j.worlddev.2015.03.016.

Coates, J., 2013. Build it back better: deconstructing food security for improved measurement and action. Global Food Security, 2(3), 188–194.

Coates, J., Swindale, A. and Bilinsky, P., 2007. Household Food Insecurity Access Scale (HFIAS) for Measurement of Household Food Access: Indicator Guide (v. 3). FHI 360/FANTA, Washington, DC.

Cochran, W.G, 1977. *Sampling Techniques*-3rd Edition. John Wiley & Sons, Inc., New York.

Cohen, M.J. and Garrett, J.L., 2010. The food price crisis and urban food (in)security. Environ. Urban. 22, 467–482.

Colding, J. and Barthel, S., 2013. The potential of 'Urban Green Commons' in the resilience building of cities. Ecological Economics 86, 156–166.

Crush, J. and Frayne, B., 2010. The invisible crisis: urban food security in southern Africa. Urban Food Security Series No. 1. Kingston and Cape Town: Queen's University and AFSUN.

David, S., Lee-Smith, D., Kyaligonza, J., Mangeni, W., Kimeze, S., Aliguma, L., Lubowa, A., and Nasinyama, G.W., 2010. Changing Trends in Urban Agriculture in Kampala. In: Prain, G., Karanja, N. and Lee-Smith, D., (Eds). *African Urban Harvest Agriculture in the Cities of Cameroon, Kenya and Uganda.* Springer, New York, Dordrecht, Heidelberg, London, pp. 97-122.

de Zeeuw, H. and Dubbeling, M., 2009. Cities, Food and Agriculture: Challenges and the Way Forward. Working Paper No. 3, RUAF Foundation, Leusden.

Deelstra, T., Girardet, H. 2000. Urban agriculture and sustainable cities. In: Bakker, N., Dubbeling, M., Guendel, S., Sabel-Koschella, U. and de Zeeuw, H., (Eds). *Growing Cities, Growing Food: Urban Agriculture on the Policy Agenda*. DSE, Feldafing, pp. 43–65.

Delgado, C. L., 2003. Rising Consumption of Meat and Milk in Developing Countries Has Created a New Food Revolution. The Journal of Nutrition, 3907S-3910S.doi.0022-3166/03.

Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S. and Courbois, C., 1999. *Livestock to 2020-The Next Food Revolution*., Agriculture, and the Environment Discussion Paper 28, International Food Policy Research Institute, Food, Washington, DC.

Delgado, M., Porter, M.E. and Stern, S., 2014. Clusters, convergence, and economic performance. Research Policy, 43, 1785–1799.

Devereux, S., 2012.Social Protection for Enhanced Food Security in Sub-Saharan Africa. Working paper 2012-010, United Nations Development Programme.

Dongmo, T., Meffeja, F., Fotso, J.M. and Nolte, C., 2010. Crop–Livestock Integration in the Urban Farming Systems of Yaoundé. In: Prain, G., Karanja, N., Lee-Smith, D., (Eds). *African Urban Harvest Agriculture in the Cities of Cameroon, Kenya and Uganda.* Springer, New York Dordrecht, Heidelberg, London, pp. 61-70.

Eigenbrod, C. and Gruda, N., 2015. Urban vegetable for food security in cities .A review. Agron. Sustain. Dev 35, 483–498. doi:10.1007/s13593-014-0273-y

Ellis, F.S. and Sumberg, J., 1998. Food production, urban areas and policy responses. World Development, 26(2), 213–225.

EPZ, 2005. Meat Production in Kenya 2005. Export Processing Zones Authority, Nairobi.

Ericksen, P. J., Ingram, J. S. I. and Liverman, D. M., 2009. Food security and global environmental change: emerging challenges. Environmental Science & Policy, 12(4), 373–377.

Ernwein, M., 2014. Framing urban gardening and agriculture : On space, scale and the public. Geoforum 56, 77–86. doi:10.1016/j.geoforum.2014.06.016

FAO, 2009. Rural Livelihood and Biosecurity of Smallholder Poultry Producers and Poultry Value Chain-Gender and Socio-Economic Impacts of Highly Pathogenic Avian Influenza (HPAI) and its Control in Siem Reap Province, Cambodia. Food and Agriculture Organization of the United Nations, Rome.

FAO, 2010. *The State of Food Insecurity in the World 2010*. Food and Agriculture Organization of the United Nations, Rome.

FAO, 2011. *The State of Food and Agriculture 2010-11*. Food and Agriculture Organization of the United Nations, Rome.

FAO, IFAD, UNICEF, WFP and WHO, 2017. *The State of Food Security and Nutrition in the World* 2017. *Building resilience for peace and food security*. Food and Agriculture Organization of the United Nations, Rome.

FAO. 2012. *Growing greener cities in Africa: first status report on urban and peri-urban horticulture in Africa*. Food and Agriculture Organization of the United Nations, Rome

Floro, M.S. and Swain, R.B., 2013. Food Security, Gender, and Occupational Choice among Urban Low-Income Households. World Dev. 42, 89–99. doi:10.1016/j.worlddev.2012.08.005

Foeken D.W.J. and Owuor S.O., 2008. Farming as a Livelihood Source for the Urban Poor of Nakuru, Kenya. Geoforum 39, 1978–1990. doi.org/10.1016/j.geoforum.2008.07.011.

Foeken, D. and Owuor, S. O., 2001. Multi-spatial livelihoods in sub-Saharan Africa: Rural farming by urban households-The case of Nakuru, Town, Kenya. Mobile Africa: Changing patterns of movement in Africa and beyond, 125-140.

Foeken, D., 2006. "*To subsidise my income" urban farming in an East-African Town*. Brill: Leiden.

Frayne, B., McCordic, C. and Shilomboleni, H., 2014. Growing Out of Poverty: Does Urban Agriculture Contribute to Household Food Security in Southern African Cities? Urban Forum, 25(2), 177-189.

Gallaher, C.M., Kerr, J.M., Njenga, M., Karanja, N.K. and Winklerprins, A.M.G.A., 2013. Urban agriculture, social capital, and food security in the Kibera slums of Nairobi, Kenya. Agric Hum Values, 30, 389–404. doi:10.1007/s10460-013-9425-y

Gereffi, G., 1994. The Organization of Buyer-Driven Global Commodity Chains: How U.S. Retailers Shape Overseas Production Networks. In: Gereffi, G., Korzeniewicz, M., (Eds). *Commodity Chains and Global Capitalism*. Westport, CT, Praeger, pp. 95–122.

Gereffi, G., 1995. Global change, regional response-The new international context of development. In: Stallings, B., (Ed). *Global Production systems and third world development*. Cambridge University Press, Cambridge, pp. 100-142.

Gereffi, G., Humphrey, J., Kaplinsky, R. and Sturgeon, T. J., 2001. Introduction: Globalisation, Value Chains and Development. IDS Bulletin, 32(3), 1-12. doi:10.1111/j.1759-5436.2001.mp32003001.x.

Gereffi, G., Humphrey, J., Sturgeon, T., Gereffi, G. and Sturgeon, T., 2005. The governance of global value chains. Review of International Political Economy, 12(1), 78-104 doi.org/10.1080/09692290500049805.

Grewal, S.S. and Grewal, P.S., 2012. Can cities become self-reliant in food ? Cities, 29, 1–11. doi:10.1016/j.cities.2011.06.003

Hardman, M. and Larkham, P.J., 2014. Informal Urban Agriculture-The Secret Lives of Guerrilla Gardeners. Springer International Publishing, Switzerland, 208 pp. doi.10.1007/978-3-319-09534-9_1.

Henseler, M. and Amoah, P. 2014. Marketing channels for irrigated exotic vegetables. In: Drechsel, P. and Keraita, B., (Eds). *Irrigated urban vegetable production in Ghana-characteristics, benefits and risk mitigation*, 2nd edition. IWMI, Colombo, pp. 51-61.

Hovorka, A.J., 2004. Entrepreneurial opportunities in Botswana: (re)shaping urban agriculture discourse, Journal of Contemporary African Studies, 22:3, 367-388, DOI: 10.1080/0258900042000283511.

Humphrey, J. and Schmitz, H., 2002. How Does Insertion in Global Value Chains Affect Upgrading in Industrial Clusters? Regional Studies, 36(9), 1017-1027.

Ingram, J., 2011. A food systems approach to researching food security and its interactions with global environmental change. Food Security, 3, 417–431.

Jayne, T.S., Chamberlin, J., Traub, L., Sitko, N., Muyanga, M., Yeboah, F.K., Nkonde, C., Anseeuw, W., Chapoto, A. and Kachule, R. 2015. Africa's Changing Farmland Ownership: The Rise of the Emergent Investor Farmer. Plenary paper presented at the 29th Triennial International Conference of Agricultural Economists, August 13, 2015, Milan, Italy.

Jones, A., Ngure, F.M., Pelto, G. and Young, S.L., 2013. What Are We Assessing When We Measure Food Security ? A Compendium and Review. Adv. Nutr, 4, 481–505. doi:10.3945/an.113.004119.disciplines

Jordaan, H., Grové, B. and Backeberg, G. R., 2014. Conceptual framework for value chain analysis for poverty alleviation among smallholder farmers. Agrekon, 53(1), 1–25. doi.org/10.1080/03031853.2014.887903.

Kang'ethe, E.K., Njehu, A., Karanja, N., Njenga, M., Gathuru, K. and Karanja, A., 2010. Benefits and Selected Health Risks of Urban Dairy Production in Nakuru, Kenya. In: Prain, G., Karanja, N., Lee-Smith, D., (Eds). *African Urban Harvest Agriculture in the Cities of Cameroon, Kenya and Uganda*. Springer, New York, Dordrecht, Heidelberg, London, pp. 229-247.

Kaplinsky, R. and Morris, M., 2002. *A Handbook for Value Chain Research*. IDRC, Ottawa.

Karanja, N., Njenga, M., Gathuru, K., Karanja, A. and Munyao, P.M., 2010. Crop–Livestock–Waste Interactions in Nakuru's Urban Agriculture. In: Prain, G., Karanja, N., and Lee-Smith, D., (Eds). *African Urban Harvest Agriculture in the Cities of Cameroon, Kenya and Uganda.* Springer, New York, Dordrecht, Heidelberg, London, pp. 213-228.

Keskin, E., Steglich, M., Dijkman, J. and Hall, A., 2008. Private Capacity and Public Failure: Contours of Livestock Innovation Response Capacity in Kenya. UNU-MERIT Working Paper Series number 2008-068, Maastricht.

Kingori, A.M., Wachira, A.M. and Tuitoek, J.K., 2010. Indigenous Chicken Production in Kenya: A Review. International Journal of Poultry Science, 9 (4), 309-316. 10.3923/pjbs.2008.2525.2531.

KIPPRA, 2016. Kenya Economic Report 2016. Kenya Institute for Public Policy Research and Analysis, Nairobi.

KIPPRA, 2016. Kenya Economic Report 2016. Kenya Institute for Public Policy Research and Analysis, Nairobi.

KIPPRA, 2017. Kenya Economic Report 2017. Kenya Institute for Public Policy Research and Analysis, Nairobi.

KNBS, 2017. Kenya Economic Survey 2017. Kenya National Bureau of Statistics, Nairobi

KNBS, 2018, Basic Report on Well-being in Kenya. Kenya National Bureau of Statistics, Nairobi.

Kumbhakar, S.C. 2001. Estimation of Profit Functions When Profit Is Not Maximum. American Journal of Agricultural Economics, 83(1), 1-19.

La Rosa, D. La, Barbarossa, L., Privitera, R. and Martinico, F., 2014. Land Use Policy Agriculture and the city : A method for sustainable planning of new forms of agriculture in urban contexts. Land use policy 41, 290–303. doi:10.1016/j.landusepol.2014.06.014

Lagerkvist, C.J., 2014. Economic drivers for urban and peri-urban agriculture. In: Magnusson, U. and Bergman, K.F., (Eds). *Urban and Peri-urban Agriculture for Food Security in Low-income Countries-Challenges and Knowledge Gaps*. SLU-Global Report 2014:4, pp. 11-14.

Lee-Smith, D. and Cole, D.C., 2008. Can the city produce safe food? In: Lee-Smith, D., Cole, D.C. and Nasinyama, G., (Eds). *Healthy city harvests: Generating evidence to guide policy on urban agriculture.* International Potato Center (CIP) and Makerere University Press, Lima, pp. 3-13.

Lee-Smith, D. And Memon, P.A., 1994. Urban Agriculture in Kenya. In: Egziabher, A.G., Lee-Smith, D., Maxwell, D.G., Memon, P.A., Mougeot, L.J.A., and Sawio, C.J., (Eds). *Cities Feeding People: An Examination of Urban Agriculture in East Africa.* IDRC, Ottawa.

Lee-Smith, D., 2010. Cities feeding people: an update on urban agriculture in equatorial Africa. Environ. Urban, 22, 483–499.

Lee-Smith, D., 2013. Which way for UPA in Africa? City, 17, 69–84. doi:http://dx.doi.org/10.1080/13604813.2012.754177.

Lee-Smith, D., 2013. Which way for UPA in Africa? City, 17, 69–84. doi:http://dx.doi.org/10.1080/13604813.2012.754177.

Losch, B., Fréguin-Gresh, S. and White, E.T., 2012. Structural Transformation and Rural Change Revisited: Challenges for Late Developing Countries in a Globalizing World. African Development Forum series, World Bank, Washington DC.

Mackay, N.H., 2013. Mapping and Theorising the Spatiality, Scale and Functionality of Urban Agriculture in Ghana. Published MSc thesis, Umeå University.

Mackay, H., 2018. Mapping and characterising the urban agricultural landscape of two intermediate-sized Ghanaian cities. Land Use Policy, 70, 182–197.

Mackay, H., Mugagga, F., Kakooza, L. and Chiwona-Karltun, L., 2018. Doing things their way? Food, farming and health in two Ugandan cities. Cities & Health, DOI: 10.1080/23748834.2017.1414425

Marshall, A., 1920. *Principles of Economics*. Macmillan, London.

Martellozzo, F., Landry, J-S., Plouffe, D., Seufert, V., Rowhani, P. and Ramankutty, N., 2014. Urban agriculture: a global analysis of the space constraint to meet urban vegetable demand. *Environmental Research Letters*, 9, 1-8.

Matuschke, I., 2009. Rapid Urbanization and Food Security: Using Food Density Maps to identify Future Food Security Hotspots. Food and Agriculture Organization of the United Nations, Rome.

Maunder, N. and Wiggins, S., 2006. Food security in Southern Africa: changing the trend? Review of lessons learnt on recent responses to chronic and transitory hunger and vulnerability. Final Report, November 2006, Oxfam-GB, World Vision International, CARE, RHVP and OCHA.

Maxwell, D., Ldvin, C., Armar-Klemesu, M., Ruel, M., Morris, S.A and Ahiadeke, C., 2000. Urban livelihoods and food and nutrition security in Greater Accra, Ghana. Research Report 112. International Food Policy Research Institute, Washington, D.C.

Maxwell, D.G., 1995. Alternative Food Security Strategy : A Household Analysis of Urban Agriculture in Kampala. World Development, 23, 1669–1681.

Maxwell, S. 1996. Food security: a post-modern perspective. Food Policy, 21(2), 155-170.

McClintock, N., 2010. Why farm the city? Theorizing urban agriculture through a lens of metabolic rift. Cambridge Journal of Regions, Economy, and Society, 3(2), 191–207.

Memon, P.A. and Lee-Smith, D. 1993. Urban agriculture in Kenya. Canadian Journal of African Studies, 27(1), 25–42.

Mougeot, L.J.A., 2000. Urban Agriculture: Definition, Presence and Potentials and Risks. In: Bakker, N., Dubbeling, M., Guendel, S., Sabel-Koschella, U. and de Zeeuw, H., (Eds). *Growing Cities, Growing Food: Urban Agriculture on the Policy Agenda.* DSE, Feldafing, pp. 1–43.

Mougeot, L.J.A., 2011. International Support to Research and Policy on Urban Agriculture (1996–2010): achievements and challenges. Urban Agriculture magazine, number 25, September 2011.

Mougeot, L.J.A., Gasengayire, F., Lee-Smith, D., Prain, G. and de Zeeuw, H., 2010. IDRC and its Partners in Sub-Saharan Africa 2000–2008. In: Prain, G., Karanja, N. and Lee-Smith, D., (Eds). *African Urban Harvest Agriculture in the Cities of Cameroon, Kenya and Uganda.* Springer, New York, Dordrecht, Heidelberg, London, pp. 267-286.

Mwangi, A.M., 1995. The role of urban agriculture for food security in low income areas in Nairobi. FNSP Report No. 54, Food and Nutrition Studies Programme, African Studies Centre, Leiden.

Nasinyama, G.W., Cole, D.C. and Lee-Smith, D., 2010. Health Impact Assessment of Urban Agriculture in Kampala. In: Prain, G., Karanja, N. and Lee-Smith, D., (Eds). *African Urban Harvest Agriculture in the Cities of Cameroon, Kenya and Uganda.* Springer, New York Dordrecht, Heidelberg, London, pp. 167-190.

Neven, D., Odera, M. M., Reardon, T. and Wang, H., 2009. Kenyan Supermarkets, Emerging Middle-Class Horticultural Farmers, and Employment Impacts on the Rural Poor. World Development, 37(11), 1802–1811. doi.org/10.1016/j.worlddev.2008.08.026.

Njenga, M., Romney, D., Karanja, N., Gathuru, K., Kimani, S., Carsan, S. and Frost, W. 2010. Recycling Nutrients from Organic Wastes in Kenya's Capital City. In: Prain, G., Karanja, N. and Lee-Smith, D., (Eds). *African Urban Harvest Agriculture in the Cities of Cameroon, Kenya and Uganda.* Springer, New York, Dordrecht, Heidelberg, London, pp. 193-212.

Nyaga, P., 2008. Poultry sector country review-Kenya. Animal Production and Health Division, Food and Agriculture Organization of the United Nations, Rome.

Nyapendi, R., Best, R., Ferris, S. and Jagwe, J. 2010. Identifying Market Opportunities for Urban and Peri-Urban Farmers in Kampala. In: Prain, G., Karanja, N. and Lee-Smith, D., (Eds). *African Urban Harvest Agriculture in the Cities of Cameroon, Kenya and Uganda.* Springer, New York, Dordrecht, Heidelberg, London, pp. 139-166.

Obonyo, O. 2013. Shock of farmers using Anti-Retroviral (ARV) drugs, to 'fatten' chicken. Accessed on 3rd April 2018, available at https://www.standardmedia.co.ke/lifestyle/article/2000096749/shock-of-farmers-using-arvs-to-fatten-chicken.

Obudho, R.A. and Foeken, D.W.J., 1999. Urban *Agriculture in Africa: a Bibliographical Survey*. African Studies Centre and Centre for Urban Research, Leiden.

Obwogo, S. 2017. Diary of a Poultry Farmer: Why I'm tempted to use antibiotics. Accessed on 3rd April 2018, available at https://www.nation.co.ke/business/seedsofgold/Why-I-m-tempted-to-use-antibiotics/2301238-4117600-827e7gz/index.html.

Ochieng, D. O., Veettil, P. C. and Qaim, M., 2017. Farmers' preferences for supermarket contracts in Kenya. Food Policy, 68, 100–111. doi.org/10.1016/j.foodpol.2017.01.008.

OECD/FAO, 2016. OECD-FAO Agricultural Outlook 2016-2025. OECD Publishing, Paris, http://dx.doi.org/10.1787/agr_outlook-2016-en.

Ojina, E. 2015. How we squeeze more profit from broilers. Accessed on 3rd April 2018, available at https://www.nation.co.ke/business/seedsofgold/How-we-squeeze-more-profit-from-broilers/2301238-2885344-2ir29wz/index.html.

Okello, J.J., Gitonga, Z., Mutune, J., Okello, R.M., Afande, M. and Rich, K.M., 2010. Value Chain Analysis of the Kenyan Poultry Industry: The case of Kiambu, Kilifi, Vihiga, and Nakuru Districts. Africa/Indonesia Team Working Paper 24, Pro-Poor HPAI Risk Reduction.

Omiti, J.M. and Okuthe, S.O., 2009. An Overview of the Poultry Sector and Status of Highly Pathogenic Avian Influenza (HPAI) in Kenya-Background Paper. Africa/Indonesia Region Report No. 4.

Omondi, S. O., Oluoch-Kosura, W. and Jirström, M., 2017. The role of urban-based agriculture on food security in Kenya's medium-sized towns. Geographical Research, 55(2), 231–241. doi.10.1111/1745-5871.12234.

Orsini, F., Kahane, R., Nono-Womdim, R. and Gianquinto, G., 2013. Urban agriculture in the developing world : a review. Agron. Sustain. Dev., 33, 695–720. doi:10.1007/s13593-013-0143-z.

Otieno, J., 2015. What did the chicken on your plate eat? Beware, it could be fatal. Accessed on 3rd April 2018, available at http://www.theeastafrican.co.ke/news/Chicken-antibiotics-human-health-risk/2558-2708898-rtmmdo/index.html.

Padgham, J., Jabbour, J. and Dietrich, K., 2015. Managing change and building resilience : A multi-stressor analysis of urban and peri-urban agriculture in Africa and Asia. Urban Climate, 12, 183–204. doi:10.1016/j.uclim.2015.04.003.

Paül, V. and McKenzie, F.H., 2013. Peri-urban farmland conservation and development of alternative food networks: insight from a case-study area in metropolitan Barcelona

Pingali, P., 2006. Westernization of Asian diets and the transformation of food systems: Implications for research and policy. Food Policy, 32, 281–298. doi:10.1016/j.foodpol.2006.08.001.

Popkin, B.M., 2003. The Nutrition Transition in the Developing World. Development Policy Review, 21(5-6), 581-597. doi.10.1111/j.1467-8659.2003.00225.x.

Porter, M. E. 1985. *Competitive Advantage-Creating and Sustaining Superior Performance*. The Free Press, New York.

Porter, M.E., 1990. The Competitive Advantage of Nations. Harvard Business Review, 73-91.

Porter, M.E., 2000. Locations, Clusters, and Company Strategy. In: Clark, G.L., Feldman, M.P. and Gertler, M.S., (Eds). *The Oxford Handbook of Economic Geography.* Oxford University Press, Oxford, pp. 253-274

Poulsen, M.N., Mcnab, P.R., Clayton, M.L. and Neff, R.A., 2015. A systematic review of urban agriculture and food security impacts in low-income countries. Food Policy, 55, 131–146. doi:10.1016/j.foodpol.2015.07.002

Prain, G. and Lee-Smith, D., 2010, Urban Agriculture in Africa: What Has Been Learned? In: Prain, G., Karanja, N.K. and Lee-Smith, D., (Eds). *African Urban Harvest: Agriculture in the Cities of Cameroon, Kenya and Uganda*, Springer, New York, and IDRC, Ottawa, pp. 13-35.

Pribadi, D.O. and Pauleit, S., 2015. The dynamics of peri-urban agriculture during rapid urbanization of Jabodetabek Metropolitan Area. Land Use Policy, 48, 13–24. doi:10.1016/j.landusepol.2015.05.009.

Republic of Kenya, 2007. Kenya Vision 2030-A Globally Competitive and Prosperous Kenya. Government Printers, Nairobi.

Republic of Kenya, 2010a. Draft National Urban and Peri-Urban Agriculture and Livestock Policy-First Draft. Ministry of Agriculture, Nairobi.

Republic of Kenya, 2010b. The 2009 Kenya Population and Housing Census Volume 2-Population and Household distribution by Socio-economic Characteristics. Kenya National Bureau of Statistics, Nairobi.

Republic of Kenya, 2010c. Ministry of Livestock Development Strategic Plan 2008-2012. Ministry of Livestock Development, Nairobi.

Republic of Kenya, 2012a. National Agribusiness Strategy-Making Kenya's agribusiness sector a competitive driver of growth. Agricultural Sector Coordination Unit (ASCU), Nairobi.

Republic of Kenya, 2012b. Meat Control Act-Revised Edition 2012 (1977). National Council for Law Reporting, Nairobi.

Republic of Kenya, 2012c. Sessional Paper No. 8 of 2012 on National Policy for the Sustainable Development of Northern Kenya and other Arid Lands. Ministry of State for Development of Northern Kenya and Other Arid Lands, Nairobi.

Republic of Kenya, 2012d. 2009 Kenya Population and Housing Census-Analytical Report on Urbanization, Volume VIII. Kenya National Bureau of Statistics, Nairobi.

Republic of Kenya, 2012e. 2009 Kenya Population and Housing Census Analytical Report on Population Dynamics, Volume III. Kenya National Bureau of Statistics, Nairobi.

Republic of Kenya, 2013. Second Medium Term Plan 2013-2017-Sector Plan for Drought Risk Management and Ending Drought Emergencies.

Republic of Kenya, 2015. Strategic Plan [2013 - 2017]. Ministry of Agriculture, Livestock and Fisheries, Nairobi.

Republic of Kenya, 2016. Sessional Paper No. 3 of 2016 on National Climate Change Framework Policy. Ministry of Environment and Natural Resources, Nairobi.

Ritho, C.N.M. 2005. Economic Analysis of Urban Farming by Households from Low Income Areas of Nairobi, Kenya. Unpublished PhD thesis, University of Nairobi.

Robinson, T., Pozzi, F., 2011. Mapping Supply and Demand for Animal-Source Foods to 2030. Working Paper No. 2, Food and Agriculture Organization of the United Nations, Rome.

Rota, A. and Sperandini, S., 2010.Value Chains-Linking Producers to the Markets. Livestock Thematic Papers- Tools for project design, International Fund for Agricultural Development, Rome.

Ruysenaar, S., 2013. Reconsidering the "Letsema Principle" and the Role of Community Gardens in Food Security : Evidence from Gauteng, South Africa. Urban Forum. 24, 219–249. doi:10.1007/s12132-012-9158-9.

Satterthwaite, D., 2007. The Transition to a Predominantly Urban World and its Underpinnings. Human Settlements Discussion Paper Series. International Institute of Environment and Development, London.

Sen, A., 1981. Ingredients of Famine Analysis: Availability and Entitlements. The Quarterly Journal of Economics, 96(3), 433-464.

Smart, J., Nel, E. and Binns, T., 2015. Economic crisis and food security in Africa : Exploring the significance of urban agriculture in Zambia's Copper Belt province. Geoforum, 65, 37–45. doi:10.1016/j.geoforum.2015.07.009.

Smit, J., Ratta, A., Nasr, J., 1996. Urban agriculture: food, jobs and sustainable cities. Publication Series for Habitat II, Vol. I. United Nations Development Programme, New York.

Stewart, R., Korth, M., Langer, L., Rafferty, S., Da Silva, N. and van Rooyen, C., 2013. What are the impacts of urban agriculture programs on food security in low and middle-income countries? Environmental Evidence, 2(7), 1-13. doi.10.1186/2047-2382-2-7.

Swindale, A. and Bilinsky, P., 2006. Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide Version 2. Academy for Educational Development, Food and Nutrition Technical Assistance Project, Washington, D.C. doi:10.1017/CBO9781107415324.004.

UN-HABITAT, 2005. Situation Analysis of Informal Settlements in Kisumu-Cities Without Slums Sub-Regional Programme for Eastern and Southern Africa Kenya. United Nations Human Settlements Programme, Nairobi.

UNIDO, 2008. Millennium Cities Initiative-Investment Opportunities for Development. United Nations Industrial Development Organization, Vienna.

UNIDO, 2009. Agro-Value Chain Analysis and Development-The UNIDO Approach. Working paper, United Nations Industrial Development Organization, Vienna.

United Nations, 2012. World Population Prospects: The 2012 Revision, Key Findings and Advance Tables. Population Division Working Paper No. ESA/P/WP. 227. Department of Economic and Social Affairs, United Nation, New York.

United Nations, 2013. World Urbanization Prospects: The 2011 Revision. Working Paper No.ESA/P/WP/224. Department of Economic and Social Affairs/Population Division, United Nations, New York.

United Nations, 2017. World Population Prospects-The 2017 Revision. United Nations, New York.

Upton, M., 2004. The Role of Livestock in Economic Development and Poverty Reduction. Pro- Poor Livestock Policy Initiative. Working Paper 10, Food and Agriculture Organization of the United Nations, Rome.

Vagneron, I., 2007. Economic appraisal profitability and sustainability of peri-urban agriculture in Bangkok. Ecol. Econ. 61, 516–529.

van Veenhuizen, R., 2006. Cities Farming for the Future. In: van Veenhuizen, R., (Ed). *Cities Farming for the Future-Urban Agriculture for Green and Productive Cities*. RUAF Foundation, IDRC and IIRR: Ottawa, pp. 1-18.

Vega, D.C. and Keenan, R. J., 2014. Transaction cost theory of the firm and community forestry enterprises. Forest Policy and Economics, 42, 1–7. https://doi.org/10.1016/j.forpol.2014.01.006.

von Braun, J., Bouis, H., Kumar, S. and Pandya-Lorch, R., 1992. Improving food security of the poor: concept, policy, and programs. International Food Policy Research Institute, Washington, DC.

Wainaina, P.W., Okello, J.J. and Nzuma, J. 2012. Impact of Contract Farming on Smallholder Poultry Farmers' Income in Kenya. Selected Paper prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August, 2012.

Warren, E., Hawkesworth, S. and Knai, C., 2015. Investigating the association between urban agriculture and food security, dietary diversity, and nutritional status : A systematic literature review. Food Policy, 53, 54–66. doi:10.1016/j.foodpol.2015.03.004

Waters-Bayer, A., 1996. Animal Farming in African Cities. African Urban Quarterly, 11 (2 and 3), 218—226.

Webb, N., 2011. When is enough, enough? Advocacy, evidence and criticism in the field of urban agriculture in South Africa. Development Southern Africa, 28(2), 195–208.

Webber, M. and Labaste, P., 2007. Using Value Chain Approaches in Agribusiness and Agriculture in Sub-Saharan Africa: Tools that Make Value Chains Work: Discussion and Cases. World Bank, Washington, DC.

Wekesa, C., 2015. Crackdown on illegal abattoirs in Nairobi. Accessed on 3rd April 2018, available at https://www.the-star.co.ke/news/2015/05/08/crackdown-on-illegal-abattoirs-in-nairobi_c1132026

Zezza, A. and Tasciotti, L. 2010. Urban agriculture, poverty, and food security: empirical evidence from a sample of developing countries. Food Policy, 35(4), 265–273.

Appendix 1: Poultry farming survey instrument, 2016

URBAN AGRICULTURE HOUSEHOLD SURVEY

Project Description

Urban agriculture is an emerging area of development concern and academic enquiry, and which is fundamentally different to questions rural agriculture. Thus, in order to carry out informed and effective training and capacity building activities, the first step is to build the knowledge base concerning urban agriculture. This is a follow-up of the Urban Agriculture Baseline Household Survey that was conducted in 2013.

This project is an African Swedish collaborative project funded by the Swedish Agency for International Development (SIDA) and The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS), and is jointly implemented by The University of Nairobi, The University of Ghana at Legon, The University of Lund and the Swedish University for Agricultural Sciences. The project is a response to the mounting levels of poverty and food insecurity in urban areas of Africa and an increased interest in urban agriculture and urban food safety concerns in these areas. The program aims to address these issues through a focused and sustained program of training and capacity building. The project collaborates with the ***African Food Security Urban Network*** (AFSUN)-network, which covers issues of urban food security and poverty in 11 cities in the SADC-region.

Household definition

We will be asking questions about your household and members of your household. What we mean by the household are people who are staying and eating together in this dwelling unit. We do not include members who are away working in other places or relatives who are staying in the rural areas.

Consent

READ OUT ALOUD

I am working as a Researcher for the [University of Nairobi, Kenya and Lund University, Sweden]. We are talking to urban poultry farmers in [INSERT CITY NAME] on management practices, input use and marketing of poultry and poultry products among other issues. Your household has been selected following your consent in 2013 that you would participate in a follow-up survey. We would like to discuss these issues with yourself, or an adult member of your household.

Your opinions will help us to get a better idea about the practice of urban poultry production in [INSERT CITY NAME]. There are no right or wrong answers. The interview will take about 45 minutes. Your answers will be confidential. They will be put together with over 800 other people we are talking to in [INSERT CITY NAME] to get an overall picture. We will be recording the general location of this interview but we will not be recording your name or address, without your permission, and it will be impossible to pick you out from what you say, so please feel free to tell us what you think.

Are you willing to participate? (CIRCLE THE ANSWER GIVEN)

Yes……..1 No……2

IF NO: READ OUT: Thank you for your time. Goodbye.

IF YES: IF WILLING TO PARTICIPATE, READ OUT THE FOLLOWING: should be on top

Thank you for agreeing to participate in this study. Just to emphasize, any answers you provide will be kept absolutely confidential, and there is no way anyone will be able to identify you by what you have said in this interview. We are not recording either your address or your name, so you will remain anonymous. The data we collect from these interviews will always be kept in a secure location. You have the right to terminate this interview at any time, and you have the right to refuse to answer any questions you might not want to respond to.

Are there any questions you wish to ask before we begin?

Specify: ……..

Enumerator's name	**Enumerator's name**
City	**Thika 1**
	Kisumu 2
Household Identification number (HHID)	

SECTION 1: HOUSEHOLD HEAD INFORMATION AND CHARACTERISTICS

1.11 Name of the household head

1.12 Are you still keeping poultry? (*If yes, skip to question 1.14)* 1. Yes 2. No

1.13 If no to question 1.12, why did you stop keeping poultry? (After answering question 1.13, thank the respondent and terminate the interview)

1. Lack of market
2. Poultry death due to diseases
3. Poultry death due to pests
4. Theft
5. Lack of capital
6. Lack of space
7. High cost of feed
8. Other (specify)-*text*

1.14 Gender of the household head

1. Male
0. Female

1.15 Age of the household head (years) (*minimum 18 years*)

1.16 Marital status of the household head

1. Married and living with spouse
2. Married but not living with spouse
3. Widow/widower
4. Single
5. Other (specify)-*text*

1.17 Years of formal education of the household head (*years*)

1.18 What is the average monthly household income level?

1. Less than 5,000
2. 5,001-10,000
3. 10,001-15,000
4. 15,001-20,000
5. 20,001-25,000
6. 25,001-30,000
7. 30,001-35,000
8. 35,001-40,000
9. 40,001-45,000
10. Above 45,001

1.19 What is your household size? (*Number*)

1.20 Distance to the nearest market (*km*)

1.21 Distance to the nearest extension service provider (*km*)

1.22 Distance to the nearest veterinary doctor (*km*)

SECTION 2: POULTRY INFORMATION

2.10 For how many years have you reared poultry? (*Years*)

2.11 Is the household head a member of a poultry producer group?

1. Yes
2. No

2.12 If yes, to question 2.11 above, what structure is the group?

1. Formal
0. Informal

2.13 If yes, to question 2.11 above, what roles does the poultry producer group play? (*Multiple response accepted)*

1. Marketing of produce
2. Input acquisition
3. Offers credi
4. Other (specify)-*text*

2.14 If yes, to question 2.11 above, do you agree that the poultry farmer group achieves its objectives?

1. Highly disagree
2. Disagree
3. Neutral
4. Highly agree

2.15 If yes, to question 2.11 above, how often do you meet as a group?

1. Weekly
2. Every fortnight
3. Monthly
4. Other (specify)-*text*

2.16 Do you share market information as poultry farmers?

1. Yes
0. No

2.17 Are you keeping poultry under any contractual agreement?

1. Yes
0. No

2.18 If yes to question 2.17 above, who is the main contractor? (*Only one response accepted)*

1. Kenchick
2. Trader
3. Hotel/restaurant
4. Schools
5. Hospitals
6. Other (specify)-*text*

2.19 If yes to question 2.17 above, who are the other contractors*? (Multiple response accepted)*

1. Kenchick
2. Trader
3. Hotel/restaurant
4. Schools
5. Hospitals
6. Other (specify)-*text*

2.20 If yes to question 2.17, what type of arrangements do you have with the main contractor?

1. Formal
0. Informal

2.20 If yes to question 2.17, what role does the main contractor play? (*Multiple response accepted)*

1. Inputs provision
2. Purchases the produce
3. Provision of veterinary services
4. Provision of credit
5. Other (specify)-*text*

2.21 Did you receive any training on poultry husbandry in the last one year?

1. Yes
2. No

2.22 If yes to question 2.21, how many times were you trained? (*Number*)

2.23 If yes to question 2.21, who trained you on poultry husbandry? (*Multiple response accepted)*

1. Livestock extension officer
2. Input supplier
3. Mass media
4. Agricultural trade fairs/shows/exhibitions
5. Contractor
6. Other (specify)-*text*

2.24 Over the last one year, did you have access to poultry production credit?

1. Yes
2. No

2.25 If yes to 2.24, did you use the credit in poultry production?

1. Yes
2. No

2.26 If yes to question 2.24 in what form was the credit?

1. Cash
2. Inputs

2.27 If yes to question 2.24 how much was the credit? (*Ksh*.)

2.28 If yes to question 2.24, what were the sources of credit? (*Multiple response accepted)*

1. Contractor
2. AFC
3. Commercial bank
4. Merry go round
5. Microfinance
6. Other (specify)-*text*

2.29 If no to question 2.24, what are the reasons for not getting credit? (*Multiple response accepted)*

1. Lack of collateral
2. Did not need a loan
3. Lack of credit source
4. High interest rate
5. Other (specify)-*text*

2.30 Which constraints do you face as a poultry farmer? (*Multiple response accepted)*

1. Lack of market
2. Low prices
3. Diseases
4. Pests
5. High cost of inputs
6. Lack of veterinary services
7. Other (specify)-*text*

2.31 Who provides most of the labour in poultry enterprises?

1. Family labour
2. Paid labourer

2.32 If paid labourer, how many people do you employ? (*Number*)

2.33 If paid labourer, under what arrangement?

1. Permanent basis
2. Casual basis
3. Both permanent and casual

2.34 Who does the poultry belong to?

1. Husband
2. Wife
3. Both husband and wife
4. Other (specify)-*text*

2.35 Which type of poultry production system do you use?

1. Free range
2. Caged system
3. Both free range and caged system
4. Other (specify)-*text*

2.36 Do you purchase poultry feed?

1. Yes
2. No

SECTION 3: FARM ENTERPRISE MIX

3.10 How many acres of land do you own? (*Acres*)

3.11 How many acres of land have you rented in? (*Acres*)

3.12 Do you have title for the land in which you practise poultry production?

1. Yes
0. No

3.13 How do you use your land for agricultural purposes? Please fill in the table below the allocation of land to various enterprises.

Enterprise	**Size of land (acres)**

3.14 Which poultry type do you currently keep?

Poultry type	**Number**	**Breed (*text*)**	**Importance in terms of income**	**Importance in terms of food security**	**Importance in terms of social/cultural aspects**
Layers					
Broilers					
Indigenous chicken					
Turkeys					
Ducks					
Quails					
Guinea fowls					
Importance code:1=not important, 2=important, 3=very important					

SECTION 4: INPUT USE

4.10 Layers (information for the last 1 year)

	Unit.	Unit price	Month 1		Month 2		Month 3		Month 4		Month 5		Month 6	
Initial costs			**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**
Day old chicks (No.)														
House construction (No.)														
Lamps (No.)														
Feed/watering troughs (No.)														
Others (specify)														
Output														
Eggs (Paper trays)														
Spent birds (No.)														
Manure (Kg)														
Variable costs														
Chick mash (70 kg bag)														
Growers mash(70 kg bag)														
Layers mash (70 kg bag)														
Other feeds (specify)														
Deworming (litre/kg)														
Vaccinations(litre/kg)														
Antibiotics(litre/kg)														
Paraffin (litre)														
Vet. Services (No.)														
Labour (man-days)														

	Unit.	Unit price	Month 7		Month 8		Month 9		Month 10		Month 11		Month 12	
Initial costs			**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**
Day old chicks (No.)														
House construction (No.)														
Lamps (No.)														
Feed/watering troughs (No.)														
Others (specify)														
Output														
Eggs (Paper trays)														
Spent birds (No.)														
Manure (Kg)														
Variable costs														
Chick mash (70 kg bag)														
Growers mash(70 kg bag)														
Layers mash (70 kg bag)														
Other feeds (specify)														
Deworming (litre/kg)														
Vaccinations(litre/kg)														
Antibiotics(litre/kg)														
Paraffin (litre)														
Vet. Services (No.)														
Labour (man-days)														

4.11 Broilers (information for the last 3 batches)

	Unit	Unit price	Month 1		Month 2		Month 3		Month 4		Month 5		Month 6	
Initial costs			**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**
Day old chicks (No.)														
House construction (No.)														
Lamps (No.)														
Feed/watering troughs (No.)														
Others (specify)														
Output														
Chicken meat (kg)														
Manure (Kg)														
Variable costs														
Broilers mash (70 kg bag)														
Finishers mash(70 kg bag)														
Other feeds (specify)														
Deworming (litre/kg)														
Vaccinations(litre/kg)														
Antibiotics(litre/kg)														
Paraffin (litre)														
Vet. Services (No.)														
Labour (man-days)														

4.12 Other poultry types (3rd important)

	Unit	Unit price	Month 1		Month 2		Month 3		Month 4		Month 5		Month 6	
Initial costs			**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**
Day old chicks (No.)														
House construction (No.)														
Lamps (No.)														
Feed/watering troughs (No.)														
Others (specify)														
Output														
Eggs (Paper trays)														
Spent birds (No.)														
Manure (Kg)														
Variable costs														
Feeds(kg)														
Other feeds (specify)														
Deworming (litre/kg)														
Vaccinations(litre/kg)														
Antibiotics(litre/kg)														
Paraffin (litre)														
Vet. Services (No.)														
Labour (man-days)														

	Unit.	Unit price	Month 7		Month 8		Month 9		Month 10		Month 11		Month 12	
Initial costs			**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**
Day old chicks (No.)														
House construction (No.)														
Lamps (No.)														
Feed/watering troughs (No.)														
Others (specify)														
Output														
Eggs (Paper trays)														
Spent birds (No.)														
Manure (Kg)														
Variable costs														
Feeds (kg)														
Other feeds (specify)														
Deworming (litre/kg)														
Vaccinations(litre/kg)														
Antibiotics(litre/kg)														
Paraffin (litre)														
Vet. Services (No.)														
Labour (man-days)														

5.10 SECTION 5: OUTPUT MARKETING

Output	Quantity consumed	Quantity sold	Price per unit (Ksh)	Quantity given out as gifts	Quantity given out as payment in kind	To whom did you sell to? (Code)
Broilers (numbers)						
Eggs (paper trays-30 eggs)						
Spent layers (numbers)						
Indigenous chicken (numbers)						
Quails (numbers)						
Ducks (numbers)						
Guinea fowl (numbers)						
Turkey (numbers)						
Pigeons (numbers)						
To whom did you sell to? Code: 1=Broker, 2=Retailer, 3=Wholesaler, 4=Supermarket, 5=Hotel/restaurant, 6=Producer group, 7=Processor, 8=Direct sales, 9=Contractor						

5.11 Did you have access to market information during the previous season?

1. Yes
0. No

5.12 If yes to question 5.11, from which source? (*Multiple response accepted)*

1. Traders
2. Contractors
3. Radio/TV
4. Fellow farmers
5. Other (specify)-*text*

5.13 Who mainly decides on price of produce?

1. Me
2. We as farmers
3. The buyer 4. We negotiate
5. Other (specify) *–text*

5.14 How do you dispose/use the poultry waste?

Waste type	**Method of disposal/use (code)**
Broilers manure	
Layers manure	
Other poultry types' wastes	
Offal	
Method of disposal/use Code: 1=Use as dairy feed, 2=Use as manure, 3=Dispose in sewage, 4=Dispose on roadside, 5=sell as dairy feed, 6=sell as manure, 7=sell as human food, 8=sell as dog/cat food, 9=other specify	

5.15 If poultry waste is used as manure, in what form is it applied to the farm?

1. Freshly applied
2. Dried first
3. Applied as slurry
4. Other (specify) *–text*

5.16 Do you store some of the poultry manure?

1. Yes
0. No

5.17 If yes to question 5.16, how do you store it?

1. In piles/heap
2. In bags Spread
3. On the farm
4. Other (specify) *–text*

5.18 How do you process (slaughter) your poultry?

1. Home processing
2. Slaughterhouse
3. Sell without processing
4. Other (specify)

5.19 Have you ever had cases of contracting diseases from poultry (zoonotic) diseases?

1. Yes
0. No

5.20 Have you ever been attacked by poultry parasites?

1. Yes
0. No

5.21 Do you use antibiotics in poultry production?

1. Yes
0. No

5.22 If yes to question 5.21, when do you apply antibiotics to your poultry?

1. When they are sick
2. For disease prevention purposes
3. I follow vaccination regime
4. Other (specify) *–text*

5.23 What is the frequency of antibiotics application?

1. Daily
2. Weekly
3. Every fortnight
4. Monthly
5. After two months
6. Other (specify) *–text*

5.24 Why do you keep poultry? (*Multiple response accepted)*

1. Source of income

2. Food security

3. Leisure

4. Other (specify) *–text*

5.254 Among the various meat types, which one do you prefer most? (*Only one response accepted)*

1. Chicken meat

2. Beef

3. Pork

4. Goat meat

5. Mutton

6. Fish

7. Other (specify) *–text*

5.26 What county agricultural laws are you aware of? (*Text, allow utmost three*)

5.27 Have you ever been prevented to keep poultry in urban areas?

1. Yes

2. No

5.28 Who prevented you from keeping poultry?

1. My neighbours

2. Livestock officers

3. Health officers

4. Other (specify) *–text*

5.29 Have your neighbours ever complained about you keeping poultry?

1. Yes

2. No

5.30. If yes to question 5.29, why did they complain? Bad smell from poultry house Noise Fear of contracting diseases Chicken defecating on their properties

5.31 Are you aware of animal welfare?

1. Yes

0. No

5.32 If yes, what do you know about animal welfare? (*text*)

5.33 Other competing enterprises-crop enterprises

Crop enterprises	Importance in terms of income	Importance in terms of food security
Maize		
Beans		
Horticulture		
Others (specify)		
Importance codes: 1=not important, 2=important, 3=very important		

5.34 Telephone number (*optional*)

5.35 GPS coordinates of the household

Appendix 2:
Guiding questions for FGDs and other key stakeholders in the poultry value chain

Focus Group Discussion guiding questions

1. What is your opinion on urban livestock production? What advantages does it have over rural farming?
2. How important is poultry production to your livelihood?
3. Who are the key value chain actors? What roles do they play?
4. Where do you source your inputs from?
5. Which poultry services are provided, and who provide them?
6. How do you time your poultry production cycle?
7. How do you house your poultry?
8. Do you have knowledge on poultry diseases?
9. Have you ever contracted diseases from poultry? Have you ever been attacked by poultry parasites?
10. How do you market your poultry products? How is the market organized?
11. How do you manage poultry waste?
12. Do you get harassed for practicing urban poultry farming?
13. What constraints do you face as poultry farmers?

Traders (Brokers, assemblers, retailers, wholesalers, shops/supermarkets, input suppliers)

1. Which category of trader?
2. Where do you get your poultry/poultry products from?
3. What is the buying/selling price of the poultry/poultry product that you are dealing with?
4. What is the size of your stock?
5. How much cost do you incur?
6. How many days do you sell at the local market in a week?
7. How much is the council charge per day?
8. What are consumers' preferences?
9. Which constraints do you face?
10. How does the market operate?

County livestock officers

1. What's your perception on livestock production in urban areas?
2. How would you characterize urban poultry production?
3. How important is urban poultry production?
4. Do you offer extension services to poultry producers in urban areas?
5. What are the major challenges of poultry production, and especially for urban farmers?
6. Should urban livestock production be incorporated into urban planning?
7. What are the health risks of poultry production in urban areas?

Public health officers

1. What's your opinion of urban agriculture, especially livestock production?
2. Which role do you play in the poultry value chain?
3. What are the health risks of poultry production in urban areas?
4. How do you assist farmers in managing the associated poultry production risks?

5. Do you have any rules on urban agriculture?
6. How do you implement the rules?
7. How can urban poultry production be incorporated in urban planning with reduced human health risks?

Producers' group

1. When was this producer group formed?
2. What are the conditions to be a member?
3. What is your role in the poultry value chain?
4. How do you manage collecting poultry/poultry products from your members?
5. How do you market your outputs and source the inputs?
6. What is your capacity?
7. To whom do you sell your poultry/poultry products?
8. Which costs do you incur?
9. How do you manage poultry wastes?
10. Which challenges do you face as a poultry producer group?

Appendix 3:
List of participants in qualitative interviews, 2016

Participant	Designation	Organisation	Date of interview
Participant 1	Sustainable Agriculture Community Development Programme (SACDEP-Kenya)	NGO	September 26, 2016
Participant 2	Poultry trader at Jamhuri market-Thika		September 28, 2016
Participant 3	Roadside trader-Thika		September 29, 2016
Participant 4	Thika sub-county livestock office		September 29, 2016
Participant 5	Thika sub-county veterinary office		September 30, 2016
Participant 6	WEM Integrated Health Services (WEMIHS)-Project field assistant	NGO	October 4, 2016
Participant 7	ASDSP Focal Development Area chairman		October 4, 2016
Participant 8	Mokuneke farmers group-Thika		October 6, 2016
Participant 9	Imara group		October 6, 2016
Participant 10	Kyini Kya Mithini		October 6, 2016
Participant 11	Bethsaida Gatwanyaga		October 6, 2016
Participant 12	Athi Gravity CBO		October 6, 2016
Participant 13	Simmars restaurant		October 7, 2016
Participant 14	Chania S. Agrovet		October 7, 2016
Participant 15	Roadside trader along Kenyatta highway-Thika		October 7, 2016
Participant 16	Karanja hotel stage view, Kondele-Kisumu		October 11, 2016
Participant 17	Jubilee market trader-Kisumu		October 11, 2016
Participant 18	Poultry broker-Jubilee market		October 11, 2016
Participant 19	Jubilee market-farmer and trader		October 11, 2016
Participant 20	Jubilee kuku dealers CBO		October 11, 2016
Participant 21	Roadside offal trader, Nyalenda		October 11, 2016
Participant 22	Roadside roast chicken trader		October 11, 2016
Participant 23	Kisumu East Animal Production office		October 12, 2016
Participant 24	Acting director, veterinary, Kisumu County		October 12, 2016
Participant 25	Small scale farmer-owns hatcheries		October 12, 2016
Participant 26	KENBRID-HY, Kondele, Kisumu		October 13, 2016
Participant 27	Public health officer, Kisumu county		October 13, 2016

Participant 28	Suburb café, Kisumu		October 13, 2016
Participant 29	Poultry butchery-Arina Shauri Moyo, Kisumu		October 14, 2016
Participant 30	Victoria Eco farm, Kisumu		October 17, 2016
Participant 31	Eggs trader, Nyalenda, Kisumu		October 17, 2016
Participant 32	Boiled egg trader, Kisumu		October 17, 2016
Participant 33	Vuka sasa youth group, Kisumu		October 18, 2016
Participant 34	Hera Kende support group		October 17, 2016
Participant 35	Kasui B3 youth group		October 18, 2016
Participant 36	Acacia Premier-hotel		October 18, 2016
Participant 37	Kenchick depot, Kisumu		October 18, 2016
Participant 38	Kisumu county livestock office		October 18, 2016
Participant 39	Directorate of livestock		October 18, 2016
Participant 40	Mamboleo slaughterhouse Kisumu		October 19, 2016