ANALYSIS OF URBAN AGRICULTURE AS A TOOL FOR INCREASING FOOD SECURITY WITHIN ELDORET TOWN, UASIN GISHU COUNTY, KENYA

BY

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DECLARATION

Declaration by the student

This thesis is my original work and has not been presented for the award of a degree or any other award or purpose in any other University. No part of this thesis can be reproduced without the prior permission of the author and/or Moi University.

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Declaration by the supervisors

This thesis has been presented for examination with our approval as the University supervisors.

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DEDICATION

This thesis is dedicated to all those who are dear to me: my parents Mr. and Mrs. J. Yego, my wife, Ann and our children (Grace and Precious).

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ABSTRACT

There have been increased trend of rural-urban migration that has created food security issues and necessitated growth of urban agriculture. Recognizing the limited information on the urban agriculture in Kenya, this study analyzed urban agriculture as a tool of increasing food security within Eldoret Town. Despite growing awareness about urban agriculture as a strategy of food security and poverty alleviation in urban areas, it remains an informal undertaking and is not integrated to urban and agricultural policies in Kenya, making it vulnerable and its sustainability is jeopardized. The study objectives were: To determine the extent to which urban households practice agriculture in Eldoret Town, evaluate the contribution of urban agriculture to food production and income in Eldoret and, to identify technological innovations used in urban agriculture in Eldoret town. The study relied on sustainable livelihood approach propounded by Carney (2003), which focuses on the link between poverty and food production for the poor urban farmers. From a target population of 3550, only 188 were purposely sampled (those who practiced agriculture) and 10 key informants were used. The study was based on mixed research design using interviews, questionnaires and content analysis. Both quantitative and qualitative data analysis was utilised. Results indicate that most farmers practiced mixed farming for subsistence consumption and for sale in small sized farmlands. Maize was grown by highest number of respondents (54.3%) followed by vegetables (46.2%) while wheat (33.2%), fruits (24.8%), beans (15.4%), and cowpeas (4.1%) were also grown. At the same time, majority of the farmers owned poultry (75.5%), dairy cattle (59.3%), and goats (31.5%). Urban agriculture was practiced for food (68.2%), or to increase household income (49.6%). Individual farmers produced 315.2 ± 37.2 kgs of maize, 110.4 ± 25.4 kgs of vegetables, and 20.1 ± 2.7 kgs of cowpeas. But in terms of overall production among all households, the production of maize was 105,943 ± 14,239 kg, followed by vegetables (28,641 ± 4,477 kgs) whiles the harvest of wheat, cowpeas (2,531 ± 189.2 kgs) and beans (5,088 ± 477 kgs) were low. Beef production was estimated at 25 tonnes followed by eggs, milk and chicken (range 6 tonnes to 10 tonnes). In terms of individual household income, vegetable yielded the highest income (Kshs 3.02 ± 0.32 million) followed by fruits (Kshs 2.41 ± 0.21) and then maize (Kshs 2.01 ± 0.11) whiles income from wheat, bean and cowpeas were low (Kshs 540,000 to 130,000). Beef contributed Kshs 9500 ± 120 to income, followed by chicken (Kshs 7000 ± 870) and income from milk was Kshs 6020 ± 860. In terms of overall income from the all the farmers, the highest contribution was from chicken and beef estimated at Kshs 1.2 million followed by milk (Kshs 1.02 million) while income from eggs, honey and bacon were low (estimated at below Kshs 300,000). The innovations among the urban farmers were in the areas of improved crop varieties/breeds, agrochemicals/veterinary drugs, machinery, water, feed, housing, land preparation, supermarket, grocery point, credit management, urban market and ICT (mobile phone). The study concludes that Urban Agriculture is an important engagement among the urban dwellers because it provides food, employment and income. However government's support, farming skills and modern farm inputs are totally lacking and, generally unsupportive towns' bylaws. The recommends that; the county authority to come up with supportive bylaws to urban agriculture, integrate urban agriculture to Eldoret development plan in the future and encourage livestock and animal diversification among urban farmers' while maintaining aesthetics of the town. Further research on the effect of urban policies on urban agriculture is also recommended by the study.

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LIST OF ACRONYMS/ABBREVIATIONS

ASTI	Agricultural Science Technology and Innovation
CBD	Central Business District
DfID	Department for International Development
EPA	Environmental Protection Agency
FASDEP	Food and Agriculture Sector Development Policy
FBO	Farmer Based Organization
GDP	Gross Domestic Product
GEA	Government Extension Agent
GoK	Government of Kenya
HH	Household head
IDRC	International Development Research Centre
IDRC	International Development Research Centre
IDRC	International Development Research Centre
IWMI	International Water Management Institute
KNBS	Kenya National Bureau of Statistics
RUAF	Resource Centres for Urban Agriculture and Food Security
SIDA	Swedish International Development Agency
SL	Sustainable Livelihoods
SLA	Sustainable Livelihood Approach
SRID	Statistical Research and Information Directorate
SSA	Sub Saharan Africa
STEPRI	Science Technology Policy and Research Institute
UA	Urban Agriculture
UNDESA	United Nations, Department of Economic and Social Affairs
UNDP	United Nations Development Programme

OPERATIONAL DEFINITION OF TERMS

Agricultural Input: Any items used with a sole aim of enhancing agricultural production e.g. material, money and labour

By-law: Rules and regulations governing the operation of an area

Food insecurity: A situation arising from uncertainty in food provision

Food security: A situation where majority has enough foods to eat

Household: A household includes all the persons who occupy a housing unit. A housing unit is a house, an apartment, a mobile home, a group of rooms, or a single room that is occupied (or if vacant, is intended for occupancy) as separate living quarters..

Urbanization: The conventional definition for urbanization used in this thesis entails a shift in settlement patterns from dispersed to more dense settlement.

Urban Agriculture: The practice of growing crops and keeping livestock, poultry and bees within an urban area

Small Scale farmers: Are the farmers whose production systems are extensive/semi-intensive utility-oriented

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the study

The world's population is becoming increasingly urban. In the last five decades, growth of the urban population, in particular caused by rural-urban migration and natural population growth has been dramatic (Kyle *et al*., 2016). In the year 2000, 33.4% of the world's the population was living in urban areas which increased to 54% by 2015 (Desa, 2015). Projections show that urbanization combined with the natural growth of the world's population could increase the proportion of people living in urban areas to 66% by 2050 adding about 2.5 billion people to urban populations (Siyuan, 2014; Cohen, 2016). Close to 90% of the increasing urban population is concentrated in Asia and Africa (Foeken, 2012; Ravallion *et al*., 2017). The speed and the scale of this growth, especially in developing countries, pose enormous challenges to individual countries as well as to the world community creating high rate of unemployment, increasing poverty levels, increasing food insecurity and malnutrition as well as deterioration of the environmental conditions (Bellows, 2011; Birley and Lock, 2012; Hardoy *et al*. 2013; Maxwell, 2015).

The problem of urban food security in Africa has been a fact of life for many low-income urban dwellers for decades (Lee-Smith and Cole, 2008). It is not that there is no food; it's that poor urban consumers cannot afford it since most of the urban poor in Africa receive incomes that are too low to purchase what they need for long-term food security (Egziabher *et al*., 2014). This is the stark but simple truth that has contributed to many of the urban poor within and around African urban centers seeking alternative food production sources to sustain their livelihoods (Ellis and

Sumberg, 2015). As a result, the contribution of food production within the urban areas in solving the problems of food security among the poor households in African urban areas has been largely recognized (Gutman, 2013; Atkinson, 2014; Sanyal, 2016).

Urban agriculture flourish within or on the fringe of a town, city or metropolis, in which a diverse range of food is grown, processed and distributed using largely human and material resources, products and services found in and around that urban area (Maxwell *et al*., 2013; Maxwell, 2015). Activities like horticulture, floriculture, forestry, aquaculture, apiculture and livestock production as well as related activities like the delivery of inputs, processing and marketing of products fit in the realm of urban agriculture (Companioni *et al*., 2013; Ellis and Sumberg, 2015). Although it is a world-wide phenomenon with an engagement of approximately 800 million people around the world, the scale of urban agriculture varies widely between the developing and developed countries and within each eco-regions (Bouraoui, 2005; Brunori and Orsini, 2010; Bomans *et al*., 2011). Accurate statistics of the scale of urban agriculture in Africa is lacking but was estimated at about 50 million household by the year 2015 (Rogerson, 2016). Nevertheless, urban agriculture is currently increasing at fast rate in African urban centers than in the developed countries (Bishwapriya, 2010; Gündel, 2016).

The significance of urban agriculture to the livelihoods of urban households in Sub-Saharan Africa (SSA) has gained increasing recognition in recent years (Drescher *et al*., 2011; Atukunda, 2013; Bryld, 2013; Prain and Lee-Smith, 2014; Drechsel and Dongus, 2015). As a result there has been an increased proportion of the households

in SSA that are involved in urban food production. For example, the proportion of households practicing urban agriculture is 54% in Addis Ababa, Ethiopia (Yilma, 2003; Tegegne, 2004), 50% in Accra, Ghana (Obuobie *et al*., 2012), 45% in Lusaka, Zambia (Bishwapriya, 2010), and 32.4% in Yaoundé, Cameroon (UNDP, 2006), 27% in Maputo, Mozambique (UNDP, 2006), 28.2-30.2% in Kampala, Uganda (Maxwell, 1994; Nabulo *et al*., 2006) and 38.2% in Dar-es-Saalam (Sawio, 2008). These studies appropriately demonstrate the importance of urban agriculture for food security in urban areas of the SSA.

In Kenya, urban agriculture (UA) has emerged as an important means of improving household food security and nutritional status, a source of complementary income and alternative employment in times of increasing economic hardships, and as a means to social and economic empowerment (Foeken, 2006). Although data on area under urban production for different urban centers in Kenya are scanty, a previous national survey of six urban centres revealed that 29% of all urban households cultivated food crops while 17% kept livestock (Memon and Lee-Smith, 1993). The towns analyzed and households found to practice UA were: Kitui (57%), Kakamega (51%), Isiolo (50%), Kisumu (30%), Mombasa (26%) and Nairobi (20%). Later studies between 2006 and 2010 have also indicated that 29.4% of urban dwellers in Nakuru (Foeken, 2006) and 32.1% in Nairobi (Lee-Smith, 2010) practiced UA. Yet until recently, the Kenyan governments and urban authorities viewed the practiced as unfavourable and hence omitted it from urban land-use planning, restricted, and even criminalized its practice through prohibitive and punitive policies, citing public health and aesthetic concerns (Zarina, 2015). Nevertheless, the contribution of UA in Kenya towards

alleviating food insecurity is now well recognized and in some instances supported, but most often there is lack of policy towards the same (Musonga, 2004).

In Eldoret Town, UA started much earlier than in other urban centres due to the agricultural nature of the town (Korir *et al*., 2015), but due to the rapid expansion of the town, more residential building are constructed often, the practice of UA appear to have declined. For example a survey of urban agriculture in 1990 indicated that upto 64% of the urban dwellers practiced one or another form of UA (Murimi *et al*., 1991) while a later study by Korir *et al*. (2015) suggested that the household practicing urban agriculture have declined to 52%. However, there is currently lack of information on the practice of urban agriculture within the town and how this contributes to food production and household income. Against this background, this study was formulated to determine the contribution of UA to the food security situation within Eldoret Municipality

1.2 Statement of the problem

While there is a growing awareness about the role of urban agriculture in the context of food security and poverty alleviation for the urban populations, urban agriculture still largely remains an informal sector that is not being integrated to agricultural policies or urban planning (Mougeot, 1999) making it vulnerable while jeopardizing its sustainability. A number of studies have suggested that urban agriculture will continue to increasingly play an important livelihood activity in developing countries by contributing significantly to the household livelihood systems and the urban informal economy (e.g. Jonathan *et al*., 2014; DiDomenica, 2015), yet there are very few studies that have attempted to quantify the food production levels and how much

household income is earned from such activities in many parts of Kenya. Also, the development programmes have tried to put UA onto the policy agenda through the development of policy sheets, planning guidelines, in a number of countries. Despite these programmes that promote urban agriculture, there is still no relatively in-depth information and analyses available on who is conducting urban agriculture and the extent to which low income groups within smaller towns use urban agriculture (Memon and Lee-Smith, 1993; Musonga, 2004; Hide and Kimani, 2012). In Eldoret Town, there are few other recent studies available which indicate that the current infrastructure is not conducive for sustainable urban agriculture practices and therefore the contribution of urban agriculture to livelihood and household food security may be low or underestimated (Kadenyeka *et al*., 2013). Simiyu and Foeken (2014) also evaluated urban crop production and poverty alleviation in the town. However, the study by Kadenyeka *et al*. (2013) only involved the horticultural producers while that of Simiyu and Foeken only looked at the gender aspect of urban production and therefore the production from and contribution of urban agriculture to food security, and income in the town still remains scanty and unclear. More importantly, studies on the use of technology in urban agriculture within Eldoret Town have not been done. Existence of in-depth information on urban agricultural practices with regards to the status, contribution to food production and income as well as technological advancement in Eldoret Town is inadequate hence the need for the study.

1.3 Objectives of the study

1.3.1. Main objective

The main objective of this study was to analyze the use of urban agriculture as a tool for increasing food security within Eldoret Town, Kenya.

1.3.2. Specific objectives

The specific objectives were to:

1. Determine the extent of urban agriculture among households in Eldoret Town
2. Evaluate the overall contribution of urban agriculture to food production within Eldoret Town.
3. Estimate the overall contribution of urban agriculture to household income within Eldoret Town
4. Identify the technological innovations used in urban agriculture within Eldoret Town

1.4 Research questions

The following research questions guided this study:

1. What is the extent of urban agriculture among households in Eldoret Town?
2. What is the overall contribution of urban agriculture to food production within Eldoret Town?
3. What is the overall contribution of urban agriculture to household income within Eldoret Town?
4. What are the technological innovations used in urban agriculture within Eldoret Town?

1.5 Significance of the study

The study aims at assessing the contribution of urban agriculture to households' livelihoods in Eldoret Town. It suggests measures and recommendations that can lead to sustainable urban agriculture in Eldoret Town, which can be replicated to other urban areas of which share similar characteristics. The findings of the study are also beneficial to the local residents since it will stimulate Government and other institutions to appreciate how urban agriculture affects households' livelihoods in Eldoret Town and in Nairobi County in general. Documentation of the findings adds to the pool of knowledge which is vital for development and for use by current and future scholars.

Policy makers, planners, environmentalists, agriculturists and other professionals are expected to take advantage of the findings of this study to improve their strategies towards solving the existing challenges facing sustainability of urban agriculture for today's and future generations.

In Kenya, urban agriculture is conducted in several urban centres with very little documentation. In the context of growing advocacy for policy support in favor of urban agriculture, it is necessary to provide an assessment of the contribution of urban agriculture research to poverty alleviation in Kenya. This information is currently lacking in Kenya. By channelling such information to relevant decision makers, there will be adequate support and improved funding for urban agriculture and development geared towards improvement of urban environment.

Previous studies that observed that urban farming plays a critical role towards improved livelihoods of the urban poor in several SSA associated it with few indicators such as improved food security and improved nutritional status (Morgan and Sonnino, 2010; Pothukuchi and Kaufman, 2013; Atkinson, 2014; Romero-Lankao and Dodman, 2015). This study explored the extent to which urban agriculture affect livelihood outcome indicators.

1.6 Scope of the study

The content of the study was limited to the of urban UA in terms of food production, household income and technology involved in the practice of UA in Eldoret Town. The scope of the study was limited geographically to Eldoret Town of Kenya. This study sought to identify production of food in Eldoret Town and its immediate environs as well. In terms of data collection, the study was limited to the use of questionnaires and the duration covered a period of 1 year.

1.7 Limitation of the study

The problem of infrastructural networks was a major issue encountered in the course of the research in Eldoret Town. Accessibility to some remote location using a vehicle was a major drawback experienced during the study. As such many of the households' interviews were mostly done by walking on foot through muddy routes by the researcher and the research assistants.

Prejudice – Suspicions from most of the respondents who wanted to know if we had been sent by the Eldoret Municipal Council. This was because the Council '*askaris*' have been harassing them since the Municipal by laws have not recognized any urban

farming in the town. However our public relations initiatives overcame this as well as interventions by Government officers. This was reversed by assuring them that the study was for academic purpose and that no part of the information was to be disclosed to anyone.

Budgetary constraints – The study involved a lot of travelling and interviewing which involved money. However Government officers on the ground were very helpful especially in identification of respondents and field guides. Sampling minimized movements and hence reduced the overall expenses.

Sometimes the respondents took time to understand the questions. This caused delays in administration of the questionnaires. However, attempts to ask the questions in Kiswahili and in some cases mother tongue ensured the situation was improved during the research

1.9 Assumptions during the study

1. The answers given in the questionnaires were true reflections of the respondents' answers and that utmost honesty guided the answering of the questions.
2. The respondents gave accurate and relevant information as required regarding urban agriculture in the region.
3. All variables not included in the study did not affect the response.

1.10 Study Area

This study was conducted in Eldoret Town (Figures 1.1) situated about 320 km from Nairobi City at latitude 0°30'N to 0°25'S and longitude 35°45'E to 35°50'E. Eldoret Town is the headquarters of Uasin Gishu County within former Rift Valley Province of Kenya. It lies at an average altitude of 2100 meters above sea level in the high altitude area. The Town has grown over time from a small centre to a large urban area with population of 450,000 people (Kenya National Bureau of Statistics, [KNBS], 2010). The population comprises residents from different Kenyan ethnic groups, mainly from Rift Valley, Western and Central Kenya region. There are also few residents of Asian descent. Eldoret Town was chosen for this study because it is one of the fastest growing towns in Kenya (Uasin Gishu Development Plan [UGDP] (2008–2012).

Due to the low cost of housing within certain residential estates of the Town, many low-income earners have been attracted to these residential areas which have now become overpopulated (Kwedho, 2013). Shabby buildings have come up haphazardly within the entire surroundings.

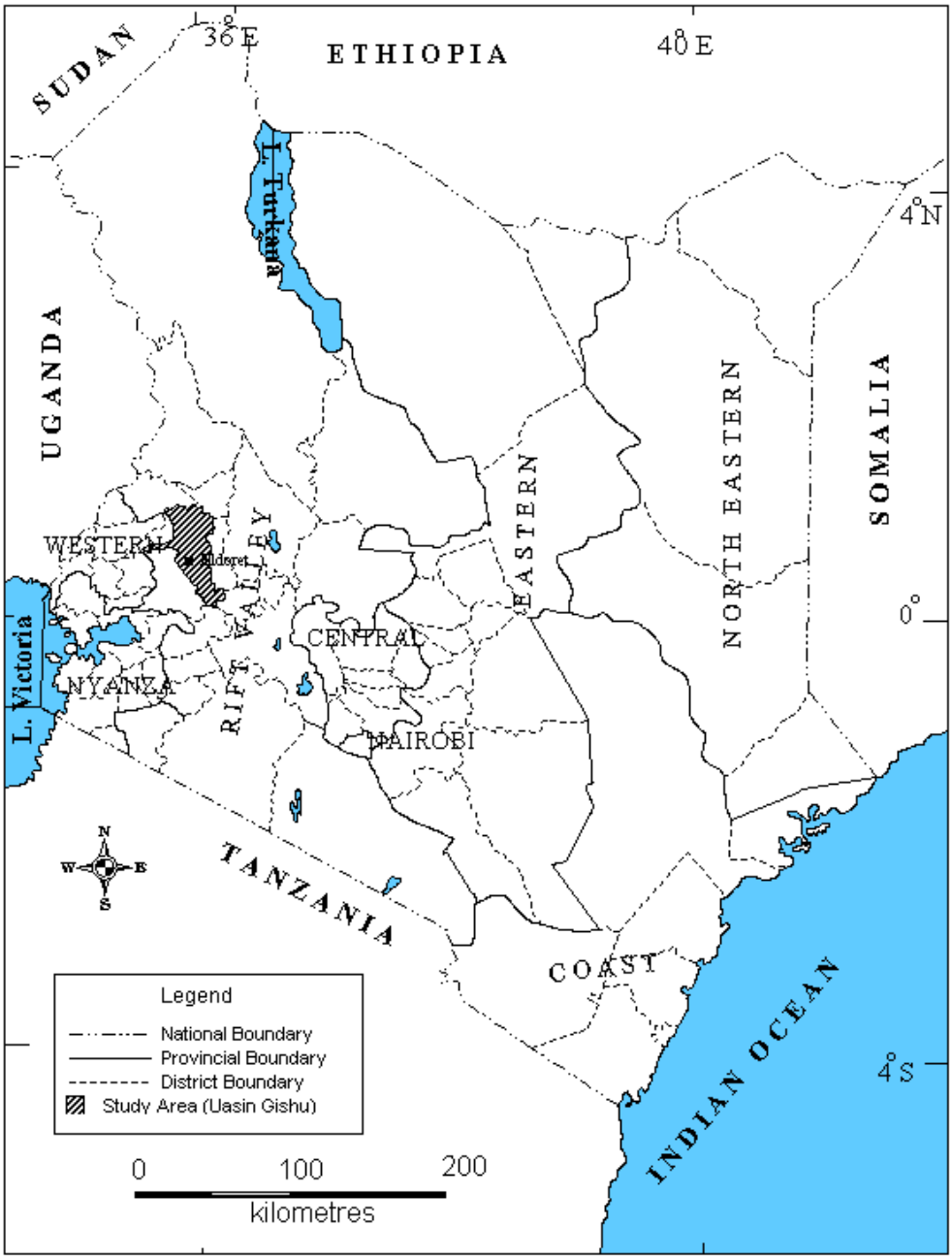


Figure 1.1: Map of Kenya showing location of Uasin Gishu County

Figure 1.2: Map of Eldoret Town Boundaries since 1959 –1988.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature on urban agriculture, from the global, regional and local context. The chapter presents synthesized information related to urban agriculture and its importance; as a source of food, income and employment opportunities. It starts with a review of the concept of urbanisation and development of urban agriculture, and then provides a critical review of the extent of urban agriculture followed by the contribution of urban agriculture to food production and later to household income. The empirical literature is summarized by the technological innovations to urban agriculture. The theoretical and conceptual framework for this study is also highlighted in latter sections of the chapter.

2.2 Urbanisation and development of urban agriculture

The demographic definition of urbanization is the increasing share of a nation's population living in urban areas and leading to a declining share living in rural areas (Satterthwaite, 2007). Urbanizations also encompass urban sprawl; the physical conversion of open, non-built areas for settlement purposes (Hovorka, 2014), as well as socio-cultural transitions of the rural countryside, such as the adoption of urban lifestyles by the rural population or the immigration of urban dwellers (Dittrich and Krueger, 2011). Differences in rural and urban rates of natural population increase may also influence urbanization, although generally these act to reduce urbanization. In effect, the term urbanization is being used to refer to two opposing spatial shifts in settlement patterns, likely to have opposing effects (Satterthwaite, 2007).

An urban population can increase from natural increase (births–deaths), net rural to urban migration and reclassification as a result of urban expansion or extension of boundaries bringing in what was initially termed rural settlement and it becomes urban settlement bringing in population which was previously classified as rural. Nations with rapid economic growth and relatively low rates of natural increase have most of their urban population growth from urbanization; nations with little or no economic growth and high rates of natural increase including many Sub Saharan Africa (SSA) nations during the 1990s have most of their urban population growth from natural increase (Potts, 2009; Foeken and Owuor, 2011). By way of contrast, much of the expansion of urban landuse is the result of a shift from dense to more dispersed settlement (Satterthwaite, 2007).

Over the past few decades, many countries of the world have experienced a rapid process of urbanization beyond former limits. In 1900, there were 6.7 rural dwellers to each urban dweller worldwide, now there is less than one and projections suggest close to three urban dwellers to two rural dwellers by 2025 (Siyuan, 2014; Cohen, 2016; Sanyal, 2016). This has been underpinned by the rapid growth in the world economy and in the proportion of gross world product and of the economically active population working in industry and services (Sebastian *et al*., 2008; Ravallion *et al*., 2017).

Much is made of the fact that in 2008, the world's urban population exceeded its rural population for the first time. Less attention has been given to two other transitions: around 1980, the economically active population employed in industry and services exceeded that employed in the primary sector (agriculture, forestry, mining and

fishing); and around 1940, the economic value generated by industry and services exceeded that generated by the primary sector (Satterthwaite, 2007). UN projections suggest that the world's urban population will grow by more than a billion people between 2010 and 2025, while the rural population will hardly grow at all (United Nations, Department of Economic and Social Affairs, 2014). Two key demographic changes currently under way and likely to continue in the next few decades are the decline in population growth rates and the ageing of the population (Kyle *et al*., 2016). An ageing population in wealthier nations may produce more people that want to and can live in 'rural' areas, but this is best understood not as de-urbanization but as the urbanization of rural areas; most such people will also cluster around urban centres with advanced medical services and other services that they want and value (Satterthwaite, 2007).

Growing poverty, hunger and lack of formal employment opportunities, as well as the special opportunities provided by the urban areas – including the growing demand for food, proximity to markets and availability of cheap resources have stimulated the development of diverse agricultural production systems in and around the developing urban areas (Potts, 2009; Pothukuchi and Kaufman, 2013). These farming activities include the cultivation of mainly food crops, animal husbandry, forestry, horticulture including the production of flowers and garden plants and usually take place along roadsides, in the middle of roundabouts, between railway lines, in open spaces and parks, along rivers and river valleys, under power lines, within backyards of residential plots (Smit *et al*., 2001; Rogerson, 2016; Ravallion *et al*., 2017).

There are numerous instances of the practice of urban agriculture with genesis/origin that date back decades or centuries but have evolved to accommodate contemporary conditions such as the allotment gardens in Europe that were invented in the second half of the 19th century, vegetable patches in African colonial cities with their origin in ancient communal practices, the centuries-old Chinese system of reusing the night soil of cities to fertilize nearby farms, or Mexico City's *chinampas,* which represent a specific farming system predating the arrival of Columbus (Smit *et al*., 2001; Satterthwaite, 2007). In recent decades, urban agriculture was further dissociated from urban locations by well-intentioned and well-funded development experts. Addressing the expansion of urbanization and urban agriculture, the dynamic character of the urban land-use change has been highlighted by early commentators. Sebastian *et al*. (2008) found that many urban lands are capable of producing much food for urban dwellers. Therefore studies on urbanization and the associated urban agriculture will most likely to continue.

2.3 Extent of urban agriculture

Urban agriculture has a long tradition in many cities worldwide, contributing to the lives of many people and providing food to about 15–20% of the world's population (FAO, 2014). Globally, conventional production from urban agriculture has managed to meet food demand from a rapid growth in the proportion of the workforce not producing food and rapid changes in food demands (Simon *et al*., 2006; Rogerson, 2016). However, by existence of perceptions of urban agriculture, it is difficult to estimate its local, regional and global extent. Several reviews have been published on the global extent of urban agriculture in developing and developed countries (Hamilton *et al*., 2014; Mok *et al*., 2014). About 800 million people may have been

previously engaged actively in urban agriculture (Smit *et al*., 2001). However, uncertainty and accuracy of this previous estimate are not well known (Hamilton *et al*., 2014). Currently, transparent estimates of the global extent of urban agriculture have not been published.

In the developed world, agriculture in urban areas was the norm because of the high populations and the need to supply the urban population with food and other necessities such as income (Bomans *et al*., 2011). Most of the cultivation of crops and rearing of livestock was done intensively within and at the edge of cities contributing to the urban livelihood (Smit, 1996). However, the actual extend of the practice remains unknown. In the developing countries, urban agriculture was non existence in the past (Mbiba, 2005) and statistics available indicate that in developing countries, about 266 million households may be engaged in urban crop production, that is, 29 million households in Africa, 182 million in Asia and 39 million in Latin America (Hamilton *et al*., 2014).

Thebo *et al*. (2014) estimated that around the year 2000, the global area of urban cropland was 67.4 Mha (5.9% of all cropland), with 23.6 Mha irrigated (11.0% of global irrigated cropland) and 43.8 Mha rain fed (4.7% of global rain-fed cropland). The per-capita area of urban cropland was more than 300 m^2 per capita in developed countries, Commonwealth of Independent States, and South Asia and less than 100 m^2 per capita in Sub-Saharan Africa. By the turn of the millennium, that percentage had more than doubled (UN-Habitat, 2004). However, the rural urban migration has played a big role in the development of urban agriculture, with more increased trends being observed in recent years (Walter *et al*., 2016). Urban agriculture was based on

this rural-dominated trend by concentrating on local markets, barter trade and currency trade and household as well as community organization (Waddington, 2006) deeply rooted in local concepts of community, and in local societal and cultural practices (Smit *et al*., 2001; Lee-Smith and Cole, 2008).

The major crops in urban croplands are rice (*Oryza* spp.), wheat (*Triticum* spp.), maize (*Zea mays*) and fodder grasses. However, urban agriculture has only a limited potential to contribute to global cereal production as the global annual harvested area for cereals is 10 times larger than the global urban area (Martellozzo *et al*., 2014). This global urban area data set aimed to exclude large urban parks but did include some permeable surfaces (Martellozzo *et al*., 2014). How much urban area may actually be suitable and available for urban agriculture was however not considered. For example, vegetable yields in urban areas may be lower than rural yields because of naturally low soil fertility and soil degradation. On the other hand, vegetable yields in urban agriculture can also be considerably higher than rural yields because of the use of irrigation, relatively high input levels, and the use of best management practices (Morgan and Sonnino, 2010). Most importantly, more science-based information must be generated and distributed among urban farmers to improve the cultivation of plants in urban environments (Wortman and Lovell, 2013). Martellozzo *et al*. (2014) and Thebo *et al*. (2014) also highlighted that small urban areas (<100 km^2) with lower population densities can contribute substantially more to urban agriculture production than large urban areas. Specifically, small and medium urban areas constitute most of the global urban area, and small urban areas can probably devote a higher proportion of their area to urban agriculture because of lower

population densities compared with large areas (Sheriff, 2005; Waddington, 2006; Martellozzo *et al*., 2014).

However, the scale of urban food production may generally be underestimated. There is a very large urban population worldwide with incomes so low that their and nutritional status is at risk from any staple food price rise—as became evident with the rising hunger among urban populations after the food price rises in 2007 and the first half of 2008 (Bebbington, 2009). It is likely that the proportion of the global population not producing food will continue to grow, as will the number of middle and upper income consumers whose dietary choices are more energy intensive (and often more land-intensive) and where such changes in demand also bring major changes in agriculture and in the supply chain.

Urban agriculture in Africa presents a contradiction since it has a relatively long tradition and is widely practiced, yet in most African countries urban agriculture has been undervalued and resisted by generations of public officials (Murimi *et al*., 1991; Bryld, 2013; Hardoy *et al*., 2013; Atkinson, 2014) infact criminalized by city by-laws. This attitude has only recently begun to change as leaders realize the potential of urban agriculture to alleviate the growing hunger, economic, and environmental crisis in the ever-expanding metropolitan areas of Africa (Jonathan *et al*., 2014). There has been only limited continuity of urban agricultural practices in Sub-Saharan Africa from the pre-colonial period to modern times (Smit *et al*., 2001; Foeken and Owuor, 2011; Egziabher *et al*., 2014; Drechsel and Dongus, 2015).

There is general recognition of the importance or urban agriculture in most countries in Eastern African region (Freeman, 1991; Memon and Lee-Smith, 1993; Mbiba, 2005; Mireri *et al*., 2007; Maingi, 2010). Many low income households as well as higher income households are constantly turning to urban agriculture for the production of food for own consumption and at times for extra income. It is argued that the principal reason why people are engaging in urban and agriculture in the region is in response to inadequate, unreliable and irregular access to food supplies from the hinterland. Surveys in Dar-es-Salaam, Tanzania in 1967 and 1991 showed an increase of family agriculture from 18% to 67% (Murimi *et al*., 1991). Reports from Kampala, speak of massive shifts of urban land from open space, and from institutional and transportation use to agricultural production (Nabulo *et al*., 2006).

There are also reports of the extent of urban agriculture in Kenya (Foeken and Owuor, 2011; Foeken, 2012; Hide and Kimani, 2012; Kadenyeka *et al*., 2013; Hamilton *et al*., 2014; Korir *et al*., 2015). Most of these studies in Kenya have found that three of every five families in towns and cities are engaged in urban agriculture. Much of this urban agriculture in Kenya is limited by the problem of access to land in urban area. However, people of all socio-economic classes usually grow food whenever and wherever possible. The significance of urban agriculture as an important and growing sector of the urban space economy in Kenya is also appreciated at individual household, community, and national levels with its widespread practice intensifying in Kenya only in the late 1980s and during the 1990s due to rising food prices and rising unemployment (Hide and Kimani, 2012). Roadsides, portions of streets, electrical utility rights-of-way, golf courses, hospital grounds, and airport land beyond the runway are used to grow food for the poor.

The reviews from the foregoing section makes it clear that the extent to which urban agriculture is practiced is not clearly know in the global context. Many African countries lack data and also the few studies done in Kenya does not clearly demonstrate the extent of urban agriculture. The situation is more acute in Eldoret Town despite the rapid growth it has experienced in population and urbanization in recent years. Therefore studies on the extent of urban agriculture in Eldoret Town are justifiably welcomed in the international literature.

2.4 Contribution of urban agriculture to food production

There is considerable research that has attempted to quantify food produced from urban agriculture including from staple crops like maize, cassava and vegetables, such as local varieties of tomatoes, peppers, leafy vegetables and the more exotic lettuce, cucumbers, cauliflowers and carrots as well as production from livestock such as cattle, goats, poultry and small ruminants (Maxwell *et al*., 2013; Pothukuchi and Kaufman, 2013; Martellozzo *et al*., 2014; Maxwell, 2015). Achievable yields of up to 3–70 tons ha^{-1} $year^{-1}$ have been reported in urban food production (Cohen *et al*., 2012; Egziabher *et al*., 2014; Ellis and Sumberg, 2015), but estimates of yields in urban agriculture are generally not well known and highly variable (DiDomenica, 2015). Although, a little has been directed at quantifying its scale based on data that can be projected to show its contribution to food production, most studies which have done actual measurements of food production from agriculture generally tend to support the hypothesis that urban agriculture does improve food production of vulnerable households. In 1998, it was estimated that by 2020, 50–190 kg m^{-2} $year^{-1}$ million could be realized in urban food production, based on data available at that

time (Smit *et al*., 1996; Morgan and Sonnino, 2010) which relied on the estimates of International Development Research Centre (IDRC) (Egziabher *et al*., 1994).

City case studies indicate a considerable degree of self-sufficiency in fresh vegetable and poultry products as well as other animal byproducts. Using a productivity level of 10.7 tonne per ha per year, London is estimated to produce around 232,000 tonnes of fruit and vegetables (Brunori and Orsini, 2010). Other have estimated the production at about 12 tonnes per ha per year (Ellis and Sumberg, 2015). Dakar produces 60% of its vegetable consumption estimated at 7 tonnes per ha. per year, whilst poultry production amounts to 65–70% of the national demand estimated at 6 tonnes per ha. per year (Foeken, 2012). In Accra, 90% of the city's fresh vegetable consumption is from production within the city estimated to produce 5.5 tonne per ha. per year for the locals (Potts, 2009; Lee-Smith, 2010; Jonathan *et al*., 2014). In Dar es Salaam, more than 90% of leafy vegetables coming to the markets have their origin in the open spaces and home gardens contributing to 6.1 tonne per ha. er year of food (Prain and Lee-Smith, 2014; Rogerson, 2016).

Mwangi (1995) compares farming and non-farming households in low-income neighborhoods in Nairobi and notes that, while mean consumption is well below estimated requirements in all cases, farming households are better off in terms of both energy and protein consumption, and that farmers participating in an organized urban agriculture support program are significantly better off in both categories. The farming households produce 20-25% of their food requirements. Sawio (2008) reports that nearly 50% of Dar es Salaam residents indicated that urban agriculture provided 20-30% or more of their household's food supply. In Kampala, earlier studies indicate

that residents living within a 5 km radius of the city centre produced about 20% of the staple foods consumed within that same area (Maxwell, 1994), later 55% of 150 producers obtained 40% or more and 32% obtained 60% or more of their household food needs from their own urban garden (Maxwell, 2015). In Harare, a disaggregated profile of self-produced food consumption and its variation by income indicated that 60% of food consumed by a quarter of the low-income group was self-produced (Sebastian *et al*., 2008). In terms of meeting household food needs, urban agriculture in Harare is estimated to provide families engaged in the activity with staple food for up to four months in a year (Mbiba 2005).

Clearly, urban agriculture makes a vital contribution to the food self-reliance of many major cities. As reiterated by Mougeot (1999), food self-reliance is not self-sufficiency, but it can go a long way towards reducing the food insecurity of vulnerable groups. Urban agriculture cannot be expected to satisfy the urban demand for food, which can easily be stored and transported with limited losses from rural areas. What must be recognized and appreciated is that urban agriculture, with limited support, already supplies a significant share of food, especially the more easily perishable vegetables and poultry products, to many cities. Being mindful of the fact that food security encompasses quality and not only quantity, local food production is an important component of food security and must be seen as complementary rather than competitive to other urban food supply systems (Sawio, 2008).

To be useful for quantitative projection, surveys need to be based on urban household samples. Many studies only sample urban farmers without situating them in the broader population. The book *Cities Feeding People* provided rich data based on

studies in the four capital cities of Ethiopia (Addis Ababa), Kenya (Nairobi), Tanzania (Dar-es-Salaam) and Uganda (Kampala) in the 1980s and 1990s (Egziabher *et al*., 1994) The Addis Ababa study only sampled vegetable growers, but quoted a 1983 household survey that included questions about vegetable growing. The Kenyan study was based on a national urban sample (Lee-Smith and Memon, 1994) including data specific to Nairobi. The Kampala data were based on random samples of households in several selected neighbourhoods. The study of Dar-es-Salaam only sampled farmers, but luckily a study in the same area a few years later provided comparative data.

These data describe a period in the 1980s and early 1990s when the economic situation in these countries was quite bad and many might be expected to turn to farming for survival. Although not based on a comparative method, the relatively high proportions of farming households meant these data were taken seriously. The Kenyan study used the most systematic sampling techniques and suggested a steady continuum linking urban farming with population size, with a higher proportion of farmers in the smaller urban centres and the lowest proportion (although still high at one-fifth of all households) in the capital (Lee-Smith and Memon, 1994). Maxwell's observation that more than half the land within Kampala's municipal boundaries was being used for agriculture was likewise telling, as was the fact that 70% of poultry products consumed in the city were also produced there (Maxwell, 1994). Despite the fact that these figures needed to be validated and updated as economic conditions changed, reliable surveys were expensive to undertake and were few and far between. The work of Foeken and Owour in Nakuru showed that 35% of Nakuru's population engaged in urban farming in 1998, with 27% of all households growing crops and 2%

keeping livestock in town (Foeken and Owour, 2000). The overall figure for Nakuru placed it in the Kenyan urban continuum, close to Kisumu, which had 30 % of households farming some years earlier (Lee-Smith and Memon, 1994).

In Kampala, the Urban Harvest studies carried out in 2003 provided an indication of the proportion of households engaged in both urban agriculture (David *et al*., 2010) percentages found in the urban zones were not inconsistent with those documented by Maxwell in the early 1990s, averaging 26.5%. However, the figures for the peri-urban zones were much higher, averaging 56%. These figures beg many questions, not least the need for validation, for they suggest an active – mostly peri-urban – household agriculture system that could provide good opportunities for intensification of production close to urban markets (Nyapendi *et al*., 2010). This pattern accords well with observational data from Dar-es-Salaam in Tanzania (Jacobi *et al*., 1999) and historical data from Yaoundé in Cameroon, (Bopda and Awono, 2010) which both show how these patterns move outwards with the growth of a city, suggesting that urban agriculture is a form of "shifting cultivation".

Three important conclusions can be drawn from these studies. First, agriculture is practiced in so many place, even near the centre. Second, there is an urban agriculture gradient with a higher proportion of farmers towards the periphery. Third, the overall proportion of urban farming households could be higher than previously thought because more space is occupied by urban areas due to the concentric spatial pattern of urban centres (David *et al*., 2010). However, this may be a faulty assumption, as urban densities are also lower. A fourth important conclusion to be drawn from this these studies is that the proportion of urban households that are farming have not

diminished with urban growth. Thus, the overall numbers of urban farmers, and by implication the amounts of food they produce, must be adequately addressed.

2.5 Contribution of urban agriculture to household income

For almost all urban farming activities in urban areas, agricultural produce is for eating as well as selling. The growth of urban agriculture has stimulated research into the economics of such production to the households in urban centers and now there is clear evidence that urban agriculture is no longer the single activity that only provide subsistence for the family but generate income as well (Bebbington 2009; Ellis and Sumberg, 2015). In many urban areas of the developing world, the diversity of income from urban agriculture is even more in evidence. It has been clear from several studies that urban agriculture is clearly only a part of diverse livelihoods while still providing a significant contribution to household income (Hovorka, 2014). Formal employment, business, and trade tend to occur in areas where urban agriculture is practiced, where many dwellers can sell food throughout and earn income from such. Few employment alternatives are as lucrative and incomes are estimated to be about 50% above the minimum wage. Likewise, the several studies notes that its findings, of 70% of heads of farming households earning more than US$ 330–6000 per year from urban farming (Wortman and Lovell, 2013).

The spatial pattern in income distribution, with intensive commercial food production in the urban centers is another example of how location within the urban environment affects opportunity and strategy and the types of households involved in household income distribution (Potts, 2009; Lee-Smith, 2010). Urban agriculture has been found to be the major livelihood strategy for producers in the well-endowed urban areas,

where many still depend on rain-fed agriculture to supplements other income sources. Consequently, urban agriculture may play a bigger part both in the deployment of household labour and in generating income than in the built-up urban areas. In many areas, women are the primary household members involved in farming and several studies have established that households in which women are active participants, there is more income obtained from the practice (Hovorka, 2014). This latter variable has been strongly associated positively with lower levels of poverty in many areas (Bopda and Awono, 2010) and underlines the need to look at crop and animal production in the broader context of income and social capital.

Foeken (2012) has noted that even though the rural poor today still out number the urban poor in absolute terms, the latter have been increasing in number at an alarming rate, a phenomenon commonly described as the 'urbanization of poverty'. The increasing urbanization and growing poverty trends in Sub-Saharan Africa has meant that families have to consider alternative means of supplementing their diets and incomes. Kekana (2016) notes that farming in urban environments recently has been found to benefit poor households through direct savings on food purchases and income generation through the sale of produce, which can be used by the household to purchase relevant items for the members of the household including paying school fees. Meanwhile, Reuther and Dewar (2015) recognize that the greatest proportion of urban agriculture is undertaken as a survival strategy by individual households, generally in backyards to augment household real income. Smit *et al*. (2001) maintains that urban agriculture is not a luxury if it can augment incomes in urban areas. Although these income may appear low, sustainable urban systems need to

recognize an approach that will result in improvement of the income of most of the urban households while at the same time tackling them in a holistic manner.

Unfortunately, researchers for a long time have ignored the contribution of urban agriculture to income and the link to reduced urban poverty. This is because for a long time urban areas have been perceived as oases of employment and modernity and less with agricultural activities. This has led to the potential of urban agriculture as a food source and a means of income provision being overlooked. Jonathan *et al*. (2014) and Rogerson (2016) attributes this lack of oversight to three basic reasons: 1. Urban land-use planning strategies for the activity have not been given the due attention that they deserve; 2. There has been lackluster support for the activity by planners, policy makers, politicians, researchers, and other stakeholders. But this is beginning to change due to failure of present poverty alleviation strategies; 3. There has been a glaring lack of an integrated approach to solving income and food shortages in poverty prone regions of urban areas.

An underlying explanation as to why the sector has long been ignored has been the view that urban agriculture has no relevance to modern economics of the family and households like white collar job. For many countries, the official policy has deemed the activity to be illegal, on the basis that it constitutes environmental and health risks and also violates formal town planning and therefore the income obtained from the activity may not mask the underlying problems from the activity (Mbiba, 2005). Foeken (2012) has observed that by-laws in most African cities forbid all agricultural activity within the boundaries of urban centers, as it does not fit in the western perception of what constitutes ‘urban’ (e.g. the city-is-beautiful idea) and because it

supposedly causes all kinds of environmental hazards and thus many do not value the income derived from the activity. But the activity is seen by Reuther and Dewar (2015) as being one of the many diverse livelihood strategies enabling low income households to increase their share of income. Farrington (2002) notes that some governments have been open enough to invite farmers, social organizations and other stakeholders into a planning process in order to achieve some plurality of thinking as a strategy to boost income. This has resulted in the appreciation of urban agriculture as a way of providing employment and boosting income for the urban residents.

Some survey data are available about the level of income earned from urban farming. However, it is risky to generalize because the farming conditions vary enormously from season to season and city to city. Examples are given here primarily as illustrations of the variability of earnings from urban farming. In African countries, it is generally the poor who are cultivating in urban areas, but the Harare survey of 720 households shows that higher-income farmers engage in more gardening and cropping activity, such as maize growing and get more income (Brunori and Orsini, 2010). The highest income earned was the equivalent of 7 months' salary at the industry minimum wage, while the average earnings were equivalent to about two weeks of an industrial salary (US$ 7).

In several African cities, income earned by urban farmers was found to be a significant contributor to household maintenance. Home gardens in Lusaka produced an average of three months' income (120 US $ in 1992), but was extremely seasonal (Von Hippel, 2005). An earlier study found that low-income households in Lusaka obtained one-third of their total food consumption from farming (Sanyal 1986, cited

in Drechsel and Dongus, 2015). Farmers in Accra earned very little cash, but produced 1–8 months' supply of staple food for their families, and used their farm output as a consumption-smoothing and income-diversification strategy. Especially for vegetable growers, income from farming could represent significant amounts and proportions of total income. Estimates from Dar es Salaam indicate that full-time production of certain vegetables or keeping a few dairy cattle and a garden can produce an income of US$ 60 per month – 30% greater than the average salary (Jacobi *et al*., 1999). The same is true for Eldoret families in slum areas, although they sold relatively little and consumed their own output but no actual figure was provided (Kadenyeka *et al*., 2013). These families' standard of living exceeded that of neighbouring non-farming families. Official statistics show 12.6% of total income comes from this source, but this likely excludes a large number of the informally employed in agriculture (Morgan and Sonnino, 2010). Although these are just few statistics available from surveys, there is still lack of comprehensive information on the contribution of urban agriculture to household income in many countries including in Eldoret Town and therefore the need to supplement such information with up date data on the contribution of urban agriculture to household income.

2.6 Technological innovations in urban agriculture

Innovation is defined as the process of creating something new, coming up with better solutions for existing needs or meeting new unspecified requirements (Chesbrough, 2003). Innovations can be technical, involving new improved or adapted products or services or they can be more social or organizational and institutional, entailing new practices or improvements in strategies of entrepreneurship, farmers or organizations. Innovations are to be distinguished from inventions, or novelties which as just new

ideas, devices or methods (Pauli, 2010). Therefore innovations are new ideas that have certain impacts socially or economically and can be translated into practice. The innovation landscape has become much more diverse and dynamic. Traditionally, ideas for new products or methods are generated in a research environment, selected and elaborated in a development environment and commercialized in a marketing environment or disseminated by demonstrations and extensions (Prain and De Zeeuw, 2007). The innovation process ensures that new ideas stay within the knowledge infrastructure. This idea has given way to much more open innovation process, which ideas that are not selected internally spin off outside the boundaries of the firm or knowledge infrastructure to be picked up by other parties that may develop new applications for new markets (Chesbrough, 2003). It is also possible for new ideas to develop from actual practice as is often the case when the users of a certain technology such as urban farmer know that immediate needs, termed leader use innovation (Von Hippel, 2005).

The innovation landscape is diverse and dynamic in urban agriculture, which is practiced by people even without knowledge and practice or even background in agriculture (Walter *et al*., 2016). Novel solutions may be developed, shared through the internet or social media yet may not be recognized by the formal knowledge system. Traditionally, government and market parties have played a leading role in financing agricultural innovations (Morgan and Sonnino, 2010). The increasing popularity of more distributed models of agricultural innovations coincides with the emergence of new actors who are able and willing to take part in financing these innovations. New ideas only gain impact and thus become innovation, if they are properly resourced (Cohen *et al*., 2012).

Because urban agriculture is very diverse activity, innovations have very different expressions. Several typologies have been proposed previously (Bhatt and Kongshaung, 2005; Van Veenhuizen, 2006) which are flexible and are based on such divergent characteristics such as organizational form (e.g. backyard garden, allotment garden, community garden, institutional garden, commercial garden) and spatial forms (micro-garden, low space, scattered in neighborhood, food boulevard, integrated in public green infrastructure). An alternative typology can be created on the basis of spatial considerations (in or around buildings, inner city, suburbs, city fringe, periurban) and agronomic considerations (full control as in closed green house, permanently confined in stables, to some control as in open field crops and livestock ranging in meadows, to hunting and gathering in wild or redeveloped nature) (Cohen *et al*., 2012). This variety within urban agriculture implies a wide range of possible manifestations, and hence innovations, each having its own unique form with the physical and socioeconomic environment. This range of practices encompass inner city initiatives where the food grown is naturally adapted to the microclimates in and around buildings (Pauli, 2010; Dubbeling *et al*., 2013), and different varieties of community and market gardens to peri-urban greenhouses and precision farming, to highly controlled production circumstances such as LED cabinets used in vertical farming (Chesbrough, 2003). Sometimes it is claimed that only high tech initiatives are sufficiently adapted to the urban areas and can solve the issue of urban food provisioning (Cohen *et al*., 2012). However, it has been suggested that low tech solutions may be equally important.

Urban agriculture in itself is an innovation of more conventional models of agriculture, which are situated in rural rather than urban areas, which tend to be based

on linear rather than circular models of nutrient and water resource use (Chesbrough, 2003). In urban context, the need as well as the opportunity for innovation is high leading to a higher intensity of technical innovations, more diversity in farming types and new forms of organization and cooperation (Dubbeling *et al*., 2013). Urban farms may become special micro-units of intensive livestock raising or horticultural production, sometimes without the need of cultivated land (as in rooftops, hydroponic and container production). However, the innovative nature of urban agriculture concern a number of different yet interrelated dimensions: confined landscape, urban metabolism, organizational production and participation in urban designs and planning. Innovations also encompass simple landless farming techniques such as gardening in sacks, hydroponics, and vertical farming (Bhatt and Kongshaung, 2005; Prain and De Zeeuw, 2007). Such methods include hydroponics, use of organic pesticides and composting with organic waste. Hydroponics, for instance, is gaining popularity as a solution to the problem of access to land for urban farming.

Urban agriculture may integrates a wide variety of production systems, ranging from models familiar to a typical rural farmer to techniques that push the limits of the definition of agriculture. This diversity includes both very high-tech approaches, such as nutrient film technology, and low-tech methods, such as planting into soil-filled recycled buckets (Dubbeling *et al*., 2013). Composting of organic waste from harvested produce of farms, markets and urban households to enhance soil fertility is not only gaining popularity but is also being recognized and strongly advocated as a viable alternative to dealing with the problem of municipal waste disposal (Cohen *et al*., 2012).

In Kenya, limited access to productive resources in terms of access to land, availability of water and other inputs are major constraints to local food production, with very little or no documented innovations (Lee-Smith, 2010). The characterization of the various urban agriculture farming systems in Kenya is yet to be done. Consequently, inadequate urban agriculture technologies have been developed limiting crop choices and adaptation of production technologies. However, there is generally insufficient technical capacity to keep abreast with changing trends in technology. Moreover, limited awareness creation of the available urban technologies has also been an impediment to improved productivity.

2.7 Theoretical framework

This study relied on the Sustainable Livelihood Theory (Carney, 2003). One of the more well-known development theories called Sustainable Livelihoods (SL), serve as an umbrella term for thinking and methods regarding livelihood security and associated topics. It became a popular tool of analysis from 1998 onwards, and spread beyond organizations like Oxfam and UNDP around the 1990s, who each adapted this theory to their own views and standards. The SL approach is increasingly helpful in linking macro-level trends to the micro-level groundwork of reality. It therefore contributed a lot the academic transformation of the notion of poverty, veering away from the traditional top-down perspective of applying a band aid to bottom-up differentiating root causes of poverty. People's assets, their vulnerability, the policies and institutions imposed on them and the interaction of these three aspects exemplify the root causes of poverty, instead of the other way around. Thus, the general goal of the SL approach is to alleviate poverty, by getting a good understanding of the forces behind this phenomenon.

Its framework was designed by the Department for International Development (DFID) in 1999, and has been used ever since in academic literature and development policy worldwide. According to Garney (2003) and Benson and Twigg, (2007) its the main elements are:

- **Vulnerability context**: The situational environment in which poor people live and work, which is the source for many elements of their day-to-day struggle;
- **Responsive and participatory**: Poor people themselves are the best actors to identify and addressing the relevant livelihood priorities;
- **Capital**: The assets and capabilities of the poor, which they have access to and use to gain a livelihood (i.e.: seeds);
- **Policies, institutions and processes**: The institutions, organizations, policies and legislation that influence access to assets and choice of livelihood strategies (i.e.: water policy);
- **Livelihood strategies**: The manner in which the poor organize and use their assets and capabilities to safeguard and improve their livelihoods (i.e.: community farming);
- **Livelihood outcomes**: The possible and desired results of livelihood strategies (i.e.: improved food security).

Applying SLA can form a link between research or policy and people's priorities. The analysis can result in either promoting livelihoods, protecting livelihoods or providing livelihoods with essential needs (Benson and Twigg, 2007). At the grass-roots or community level, the SLA guides research in exploring the types of 'capital' (natural, social, human, financial and physical) that exist for the urban poor to earn a livelihood

(Thornton, 2008). As this approach focuses on people and on people's strengths, whilst having its roots in community resource management, SLA serves as an important framework for both household and community development (Brocklesby and Fisher, 2003).

This is why it is a relevant academic theory for the case of urban agriculture. Agricultural practice and interventions are rooted in the capacity and strategies of both households and communities. Before introducing a framework such as urban agriculture in a poor neighborhood, the situational environment needs to be examined, the assets and capabilities of the poor need to be researched, just as the institutions, organizations, policies and legislation that influence these assets, how the poor use these assets and the possible and desired results of this framework introduction. Each individual has his own view on the extent to which he or she is poor, and to which extent other people are living in poverty (Viljoen and Sekhampu, 2013). Gharajedghi (1986) accordingly states that urban poverty does not only have to be inherently economic in perspective, but is actually psychological in nature as well. Thus, he subdivides the term into five different components: powerlessness, incompetence, meaningfulness, exploitation and conflicting values. Also, some individuals or communities may adopt strategies to cope with these barriers, while others won't or simply are not able to (Viljoen and Sekhampu, 2013). In short, urban poverty is a diverse and inherently contextual phenomenon, and needs to be approached accordingly.

The aim is to make this farmer's livelihood sustainable, so that he or she – along with his or her household – can cope with and recover from stress and shocks. Moreover,

the aim is also to uphold or improve its capabilities and assets, and provide sustainable livelihood opportunities for generations to come. Other livelihoods should be able to contribute from these benefits, for example through knowledge transfer, and the whole framework should involve various actors, including local government and relevant organizations and institutions, in decision-making and policy formulation and implementation (Majale, 2002).

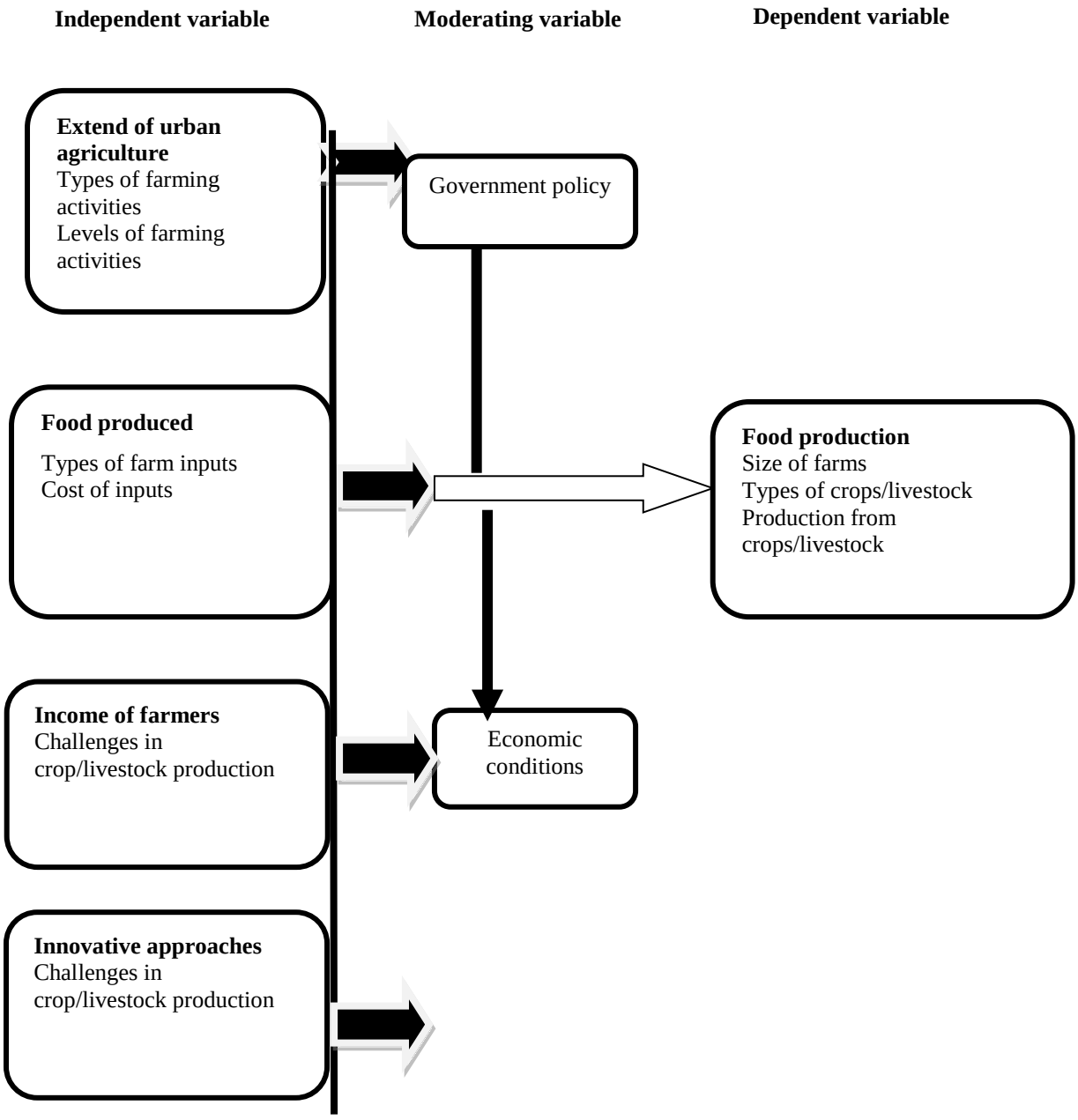
The framework is also subject to some critiques in the context of urban agriculture. For example, the definition of 'natural capital' in the framework largely applies to rural areas, and needs reorientation for it to seamlessly apply to an urban environment, when used here. Also, the emphasis in the model is put on the poor themselves, which introduces the danger of ignoring the importance of policy and governance from the top-down (Carney, 2003). Also, a number of authors have stated that weak local or municipal governments are often unable to address the needs of the urban poor, in some cases even by exclusion or discrimination. The above described link between the government and people's priorities is therefore a vital element of preventing bad urban governance, thereby contributing to safeguarding sustainable livelihoods and improving community development (Farrington, 2002). The farmer's social resources are a vital requisite for this development.

2.8 Conceptual Framework

For the poor urbanites in a cash intensive environment, low incomes, gender disparities, and lack of amenities are likely to propel them into food insecurity and poverty cycle. One way to escape the cycle is for such households to engage in urban

agriculture which has potential adequate access, food availability and utilization as is illustrated in Figure 1.1.

Figure 1.1: Conceptual framework for the study.



Source: Author 2012

Regarding availability, urban agriculture has potential to ensure that supply of food is consistently available to urban households. Urban farming households are able to produce their own food for household consumption and for sale. With income earned from the sale of urban agricultural produce; these households are able to mobilize resources to access appropriate foods for a nutritious diet.

CHAPTER THREE

3.0 RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter describes methods and methodology employed. First, the research design, nature of data, target population and sample size are presented followed by the sampling strategy and research instruments consisting of questionnaires, interviews, observation and content analysis. Pilot survey, validity and reliability of the instruments and data analysis were also undertaken.

3.2. Preparation for the research

Preceding the main study, a pilot study was carried out to standardize data collection methodologies as well as other measurements. More particularly: to test the questionnaires which were used in the study, to get an impression of the urban agriculture conditions in the region and to help identify problems during the study and which may not be seen during the planning stage. The pilot study took a period of one week and relied on a group of twenty people facing similar characteristics in Kitale Town and thereafter adjustments were made on the questionnaires.

Also a research permit was obtained from the county government and to further facilitate the process, an introductory letter from the Head of Department of Geography of Moi University was sought.

3.3 Research Design

This study employed a mixed method design. Mixed method research design is defined as research in which the investigator collects and analyzes data, integrates the

findings, and draws inferences using both qualitative and quantitative approaches and methods in a single study or a program of inquiry to understand a research problem (Creswell and Tashakkori, 2007). The philosophical foundations underpinning a mixed method research design are embedded in pragmatism. Tashakkori and Teddlie, (2010) remarks that pragmatism is the best paradigm for mixed methods research. Pragmatic perspective stems from the fact that inquiry can make a practical difference in the world. A pragmatic perspective draws on employing what works, using diverse approaches, giving primacy to the importance of the research problem and question, and valuing both objective and subjective knowledge.

According to Creswell (2007), mixed method design is appropriate when both quantitative and qualitative data together provide a better understanding of a research problem than either type by itself. Therefore, mixed method investigations may be used to enhance a better understanding of a research problem by converging numeric trends from quantitative data and specific details from qualitative data, identify variables/constructs that may be measured subsequently through the use of existing instruments or the development of new ones and obtain statistical, quantitative data and results from a sample of a population and use them to identify individuals who may expand on the results through qualitative data.

3.4 Nature and sources of data

3.4.1 Nature of data

Two types of data were collected, primary and secondary data. The primary data was collected from the field to give first-hand information about the extent of urban agriculture and food production as well as to determine the income levels in Eldoret

Town. Data on types of farm enterprises, farm sizes, farm inputs and methods of farm waste disposal as well as innovations applied in the field were also collected. Secondary data from documented information was used to review policy and legal framework, and any relevant documents relating to the effects of urban households livelihood and challenges to urban agricultural development in Kenya's urban centre and beyond.

3.4.2 Sources of data

Primary data sources included household surveys, resource persons and focus group discussions. Resource persons included officers (experts) from the county governments in various related disciplines i.e. Environment, Planning, Agriculture and Lands. NGO's and CBO's in the area were also interviewed. Field observations were also done. Secondary data was obtained from various sources which included published books, documented information from relevant line ministries like strategic, annual, quarterly and other reports, relevant publications, Government policy documents and electronic data.

3.5 Target Population

Target population is defined as all the members of a real or hypothetical set of people, events or objects to which a researcher wishes to generalize the results of the research study (Gall *et al*., 2003). The population from which the study sample was drawn was varied. The entire number of households in Eldoret Town and experts in the field of agriculture and urban planning comprised the target population. Within Eldoret Town there is a total of 3,550 households including those in rental houses. Another 30 key

informants comprising of expert government/NGO officials and elders from the region also formed part of the population.

3.6 Sample size

From the population of 3,550 households, the numbers of those practising urban agriculture was established to be 188 after the initial survey. Therefore the sample size for this study was 188 households practising urban agriculture. In addition 30% of the key informants were included in the study, which resulted in the choice of 10 key informants which were picked purposively.

3.7 Sampling strategy

This is the description of the strategy used to select representative respondents from the target population. The researcher used multi-stage sampling technique. In the multi-stage sampling technique, the entire study area was stratified into smaller units using stratified sampling technique. Household practising urban agriculture were sampled from each of the selected strata. Household were sampled using simple random sampling techniques. In simple random sampling every household in the sub-sampling unit had equal chance of being selected.

3.8 Research instruments

The study used four main types of instruments to collect data. These included: questionnaires, interviews, photography and document analysis. The selections of these tools were guided by the objectives of the study, nature of the data collected as well as the time available for the study.

3.8.1 Questionnaires

The questionnaires were justified because they enabled study coverage of a wide area and extensive contents within a short period of time. The questionnaires were distributed to various households' heads and members since distance to some of the local communities' households were quite far. The targeted members were asked to fill the questionnaires before they were collected for analysis and presentation. The questionnaires covered a wide range of issues on food production, types of inputs, type of farming activities and challenges to UA (Appendix 1 and 2). A total of 188 questionnaires were administered to the targeted respondents with an introductory letter. Questionnaires would also avail the opportunity for the respondents to give frank response while maintaining anonymity.

3.8.2 Photography

Data collection by way of direct observation and significant aspect of the study captured using a photograph. Using photographs, the researcher recorded situations as they occurred without having to rely on retrospection or anticipation of the reported situation.

3.8.3 Content Analysis

Content analysis is generally invoked when the research is interested in studying an issue that can be examined, analyzed and documented and entails a research technique for the objectives', objective description of the manifest content. It targeted published and documented data sources such as reports, development plans, research papers, statistical abstracts and other periodicals. These were from libraries, government/NGOs/municipal offices, national archives, documentation and resource

centres etc. With content analysis, the data was in permanent form hence provided chances of re-analyzing the same thus allowed reliability checks and replication. Also non print media was used to beef up this section.

3.8.4 Key informants

This method involved situations where, by chance or training there were persons who would provide the most knowledgeable information possible on any topic of the study. The key informants for this study were 10 local experts who comprised of 5 elders who had lived in the region for a long time in fact over 20 years and other 6 local government experts, member of NGO working in the region. The key informants were chosen simply because they were having in depth understanding of urban agriculture due to their direct involvement in matters of concern to the study. The key informant technique took the form of face-to-face interviews. This method was advantageous in the sense that it provided, expounded and even probed precisely on content of the study.

3.9 Validity and Reliability of the Research Tools

Validity refers to the extent to which a test measures what was actually measured. It is the accuracy and meaningfulness of inferences, which are based on the research results, the degree to which the results obtained from the analysis of the data actually represent the phenomenon under study (Mugenda and Mugenda, 2003). In this research study the focus was on urban agriculture in the Eldoret Town. Thus the validity in this study was tested by providing it to a panel of persons with technical knowledge (experts and key informants) on urban agriculture.

To measure the degree to which the research instruments would yield consistent results or data after repeated trials, the reliability coefficient was computed and if it would have a coefficient of 0.65 or more then it would indicate that the instrument has a high degree of reliability (Kothari, 2008). In this study, the test and re-test method of assessing the reliability was employed to few selected individual local experts and households to capture reliability of the questionnaires. This was so in order to reduce the chance of errors that may have arisen if the instruments were administered to the same respondents during the actual research study. The reliability coefficient was 0.89 which was adjudged to be high.

3.10 Data Analysis

After data collection, qualitative and quantitative methods of data analysis were used. Qualitative analysis employed the use of inferences whereas quantitative analysis involved the derivation of descriptions and interpretation of data by use of descriptive interpretations that rely purely on numerical values. Responses from all the open ended and closed ended questions were examined to facilitate coding, processing and entry into the computer in preparation for the analysis. Data processing exercise commenced with the coding of all the responses obtained to facilitate easy analysis using computer Statistical Package for Social Sciences (SPSS).

Chi-square (χ^2) test of goodness of fit, bivariate Spearman Correlation and descriptive as well as % distribution techniques were used to analyze the data. The % frequencies of respondents were used to show the particular frequency of respondents preferring a particular alternative and to give the face values of implications of the urban agriculture. Chi-square test is a statistical technique used to compare the differences

between categorical frequencies when data is categorical and drawn from a population with uniform distribution in which all alternative responses are equally likely. Chi-square test was suitable here since it enabled the researcher to identify whether there were any significant differences in the frequencies of the alternative responses. Spearman Bivariate Correlations was used to analyze strengths of cross-tabulated significant relationships. Apart from Chi-square test, the researcher also used % rank score as a mean of comparing the responses to variables under study based on the Likert Scale scoring. All data were analyzed at a level of 95% or $\alpha = 0.05$.

CHAPTER FOUR

4.0 DATA ANALYSES, RESULTS AND DISCUSSION

4.1 Overview

In this chapter, the results obtained from the study are discussed. The chapter opens with a discussion of the socioeconomic background of household heads followed by the extent of urban agriculture in Eldoret Town.

4.2 Respondents socio-demographic characteristics

4.2.1 Age Distribution of Respondents

The age distribution of overall household practicing urban agriculture is shown in Table 4.1. Most of the household heads were aged 36–50 years (36.7%) followed by those aged > 50 years (26.1%) while those aged 20–25 years were fewer. This suggests that most household heads are aged 36–50 years, implying that younger farmers are more likely to participate in urban agriculture than older ones. It may also infer that urban agriculture is a recent phenomenon.

Table 4.1: Age distribution of households practicing urban agriculture

Age bracket	Household practicing UA (n = 188)	
	Frequency	% frequency
20-25 years	32	17.0
26-35 years	38	20.2
36-50 years	69	36.7
> 50 years	49	26.1
Total	**188**	**100**

Source: Authors' computation from field data.

4.2.2 Education

Educational levels of the household heads are shown in Table 4.2. The households practicing urban agriculture, majority (40.4%) attained secondary levels of education followed by those with primary level of education (26.1%) with the least being those attaining university education (4.8%). This suggests many household heads and including those practicing urban agriculture are less educated within Eldoret Town.

Table 4.2: Educational background of households practicing urban agriculture

Educational background	Household practice UA (n = 188)	
	Frequency	% frequency
None	16	8.5
Primary	49	26.1
Secondary	76	40.4
Tertiary	38	20.2
University	9	4.8
Total	**188**	**100**

Source: Authors' computation from field data

4.2.3 Gender of the respondents

Gender of the household heads is provided in Table 4.3. Overall household heads were dominated by males who constituted over 93% while female household heads were always less than 7%. These results suggest that most of the household heads are headed with males.

Table 4.3: Gender of the households practicing urban agriculture

Gender	Household practice UA (n = 188)	
	Frequency	% frequency
Male	176	93.6
Female	12	6.4
Total	**188**	**100**

Source: Authors' computation from field data.

4.2.4 Main occupation

Information on the main occupation of the HH during the study is shown in Table 4.4. Among the households, majority of the HH were privately employed, followed by those unemployed while those formally employed were fewer and were often less than 12%. This situation may be attributed to high levels of unemployment in Kenya and therefore most of the farmers were out of formal employment.

Table 4.4: Main occupation of household practicing urban agriculture

Main occupation	Household practice UA (n = 188)	
	Frequency	% frequency
Formal employed	21	11.2
Unemployed	66	35.1
Privately employed	101	53.7
Total	**188**	**100**

Source: Authors' computation from field data.

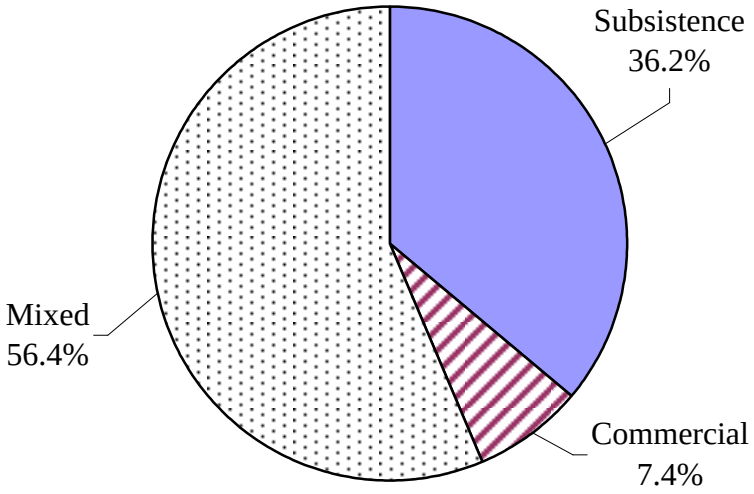
4.3 Extent of urban agriculture among households in Eldoret Town

The first objective was to determine the extent of urban agriculture practiced by the households in Eldoret Town. This was determined by looking at the type of farming activities, agricultural types practiced, proportion of farmers cultivating crops and keeping livestock, reason for practising urban agriculture and farm ownership by sizes.

The type of farming practiced by the urban households in Eldoret Town is shown in Figure 4.1. Most farmers practiced mixed farming for subsistence consumption and for sale. These are similar to the findings by Van Averbeke (2007), which show that home gardens in the urban areas of African are useful sites for the for growing crop.

These are purposely cultivated for personal consumption, although surpluses may be sold.

Figure 4.1: Type of farming activities practiced by farmers in the urban agriculture in Eldoret Town (n = 188)



Source: Authors' computation from field data.

Table 4.5 shows result of the initial household survey on urban farming and it indicate that 26.5% of the respondents practice both crop and livestock production while 29.9% and 44.8% practice only livestock farming or husbandry and crop cultivation respectively. This result indicates that the proportion of farmers undertaking urban farming in the Town is lower than in other towns (Hide and Kimani, 2012; Kadenyeka *et al*., 2013; Simiyu and Foeken, 2014). This could be attributed to lack of statutory laws or by-laws that does not recognize urban agriculture within Eldoret Town.

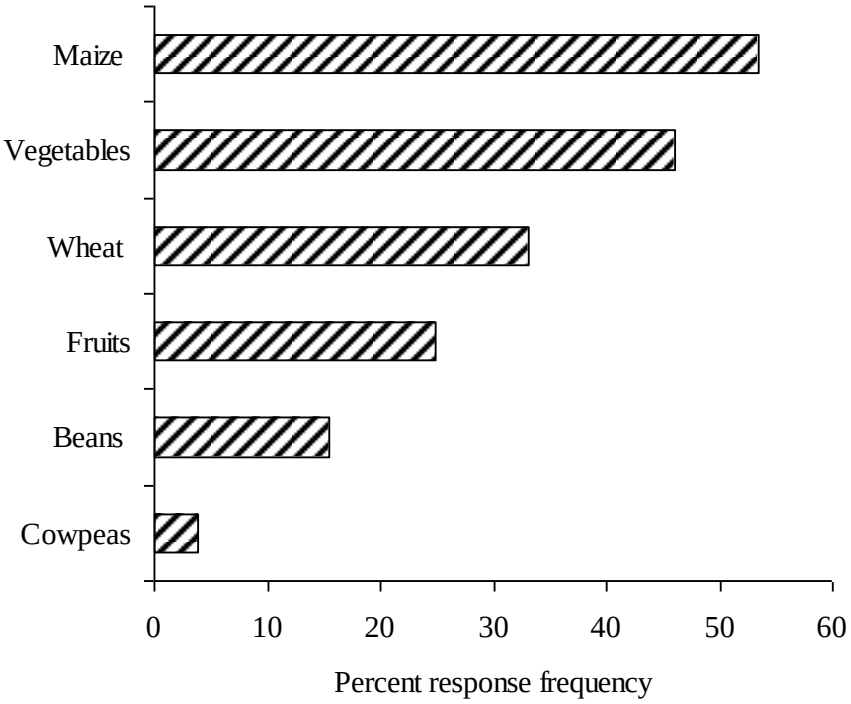
Table 4.5: Agricultural activities practices in the study during the initial survey of households (n = 188)

Agricultural activity	Frequency	Percent
Crop production only	83	44.1
Livestock production only	55	29.3
Crop and livestock production	50	26.6
TOTAL	188	100

The proportion of farmers growing crops in the Town is shown in Figure 4.2. Based on the findings, there were significant differences in proportion of farmers growing various types of crops (χ^2 = 38.44, df = 6, p = 0.002). Maize was grown by highest number of respondents (54.3%) followed by vegetables (46.2%) while other crops grown were wheat (33.2%), fruits (24.8%), beans (15.4%), and cowpeas (4.1%). As it can be observed from the list of crops, all the common crops grown in the study area were food crops which may mean that they were all consumed by the household as has been established in some earlier studies elsewhere (Maxwell *et al*., 2013; Atkinson, 2014; Egziabher *et al*., 2014). In spite of this fact, part of the crops produced by a household were sold. Nugent (2000) asserts that urban agriculture improves both access and food intake of fresh foods, especially among populations suffering from food insecurity, either through their own self provisioning which reduces market expenditure. Urban agriculture is therefore one of the survival strategies poor urban residents adopt to reduce poverty and improve their food security (Van Averbeke, 2007). In Eldoret Town, as in the rest of southern Africa, the importance of maize was much evident, which concurs with a study in Malawi, which epitomizes a Malawian adage that "maize is life" (Egziabher *et al*., 2014). Being the staple food for Eldoret Town, maize is one crop which is associated with food security levels at both the national and household level. This shows that the majority

of households used maize for consumption purposes. No maize was stored for sale or for future use but consumed as they were available.

Figure 4.2: Proportion of farmers cultivating the various types of crops

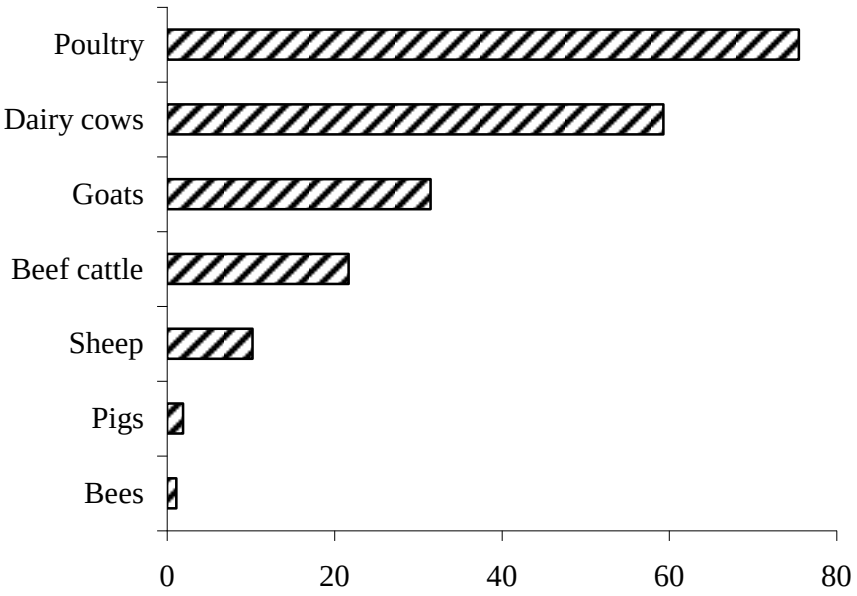


Source: Authors' computation from field data.

Information on the types of livestock kept by the households is shown in Figure 4.3. About 29.6% did not own any form of livestock at all. There were significant differences in the ownership of various types of livestock in Eldoret Town (χ^2 = 54.223, df = 7, $p < 0.0001$). Majority of the farmers owned poultry (75.5%) followed by dairy cattle (59.3%), then goats (31.5%). Livestock owned by least number of farmers in the study area were pigs (1.9%) and bees (1.1%). According to earlier research findings by Mbiba (2005), urban farming included goats, sheep, pigs, rabbits and poultry. This concurs with the present findings. Livestock production is significant among the sampled households. Discussions with the livestock keepers

and key informants revealed that, in most cases, goats were kept for household consumption especially during festivals and social functions while cattle, chicken and pigs were kept for both household consumption and commercial purposes.

Figure 4.3: Ownership of livestock in the household of the farmers respondents from the urban agriculture in Eldoret Town per year



Source: Authors' computation from field data.

When respondents were asked why they had engaged in urban agriculture, the results (Table 4.6) showed that the most important reason for practicing urban farming was improvement of family access to food (44.7%), followed by getting household income (32.4%) or improve the already meager household income (18.6%), and to comply with cultural values (1.6%). They get food supplements such as fresh vegetables, cowpeas and maize (which is a staple food in most families) and also cheap sources of proteins from livestock inform of milk, eggs and meat. This helps them save money which would otherwise been used to buy the food. These savings plus the income earned from sale of surplus farm produce is then used to meet other family expenses.

Food security in urban areas is an important concern to many urban dwellers and policy makers and does not only involve just the amount and type of food available but also the element of food quality and safety. The most commonly expressed primary motivation for urban agriculture was the need to avert hunger by producing staple crops. Other scholars interpret the primary motivation for people's involvement in urban agriculture as the failure of families' monthly per capita incomes to keep pace with rising food prices (Smit *et al*., 2016). It is important to note that there is a close inter-relationship between these two aspects. For example, if people produce their own food, they can spend less income on food and the money earned from the sales of urban agricultural produce is normally used for other household food needs (Mattellozo *et al*., 2014).

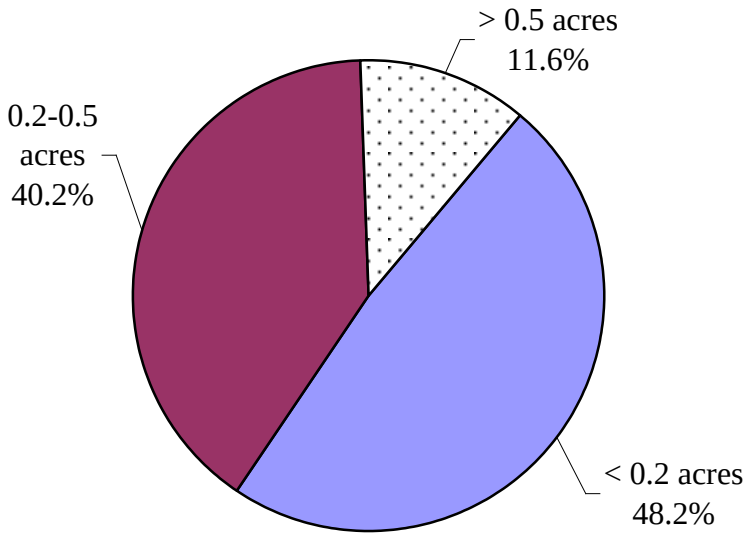
Table 4.6: Reasons for practising urban agriculture

Agricultural activity	Frequency (n = 188)	Percent
To get food	84	44.7
To get income	61	32.4
To diversify income	35	18.6
Hobby	5	2.7
Tradition	3	1.6
TOTAL	**188**	**100**

The study determined the farm sizes in the households within the urban of Eldoret Town (Figure 4.4). 48.2% of the farmers had less than 0.2 acres of land, 40.2% of the farmers had between 0.2-0.5 acres of land, while the rest (11.6%) had over 0.5 acres. The mean farm size in the study area was found to be 0.64 ± 0.28 acres while the mean number of acres under crops was 0.39 ± 0.22, which implies that 60% of the land was under crops. This concurs with other studies elsewhere in Kenya (Place and

Migot-Adholla, 1998; Nugent, 2000; Wayumba, 2004) where land ownership in urban areas are restricted due to the high costs of acquiring land and the high levels of investments that are associated with the land and therefore discourages agricultural production. The non-availability of land as a permanent resource to enhance agricultural production, is a major source of concern to the farmers and therefore likely to jeopardize urban agricultural production. In other studies (e.g. Gallaher *et al*., 2013), most urban dwellers in developing and most will depend on backyard gardens and illegal open spaces. Nevertheless, it was established that farmers were able to utilize their small parcels of land for agricultural production in the urban areas.

Figure 4.4: Proportion of farm sizes by farmers during the survey in Eldoret Town



Source: Authors' computation from field data.

4.4 Overall contribution of urban agriculture food production from Eldoret Town

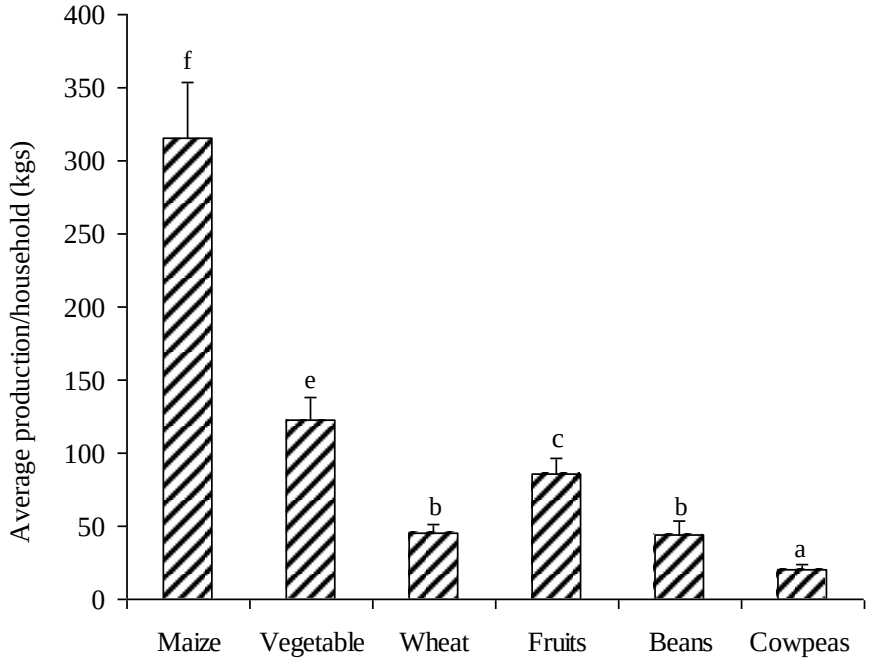
The second objective of the study was to determine the overall food production in Eldoret Town from the urban agriculture practices. This was formulated in terms of

research question stating "*What is the overall food production from urban agriculture in Eldoret Town*?" This section looked at amount of production from crops, livestock per farmer.

Crop production from urban agriculture in Eldoret Town is shown in Figure 4.5. There were significant differences in the overall production from each crop (ANOVA; F = 99.212, df = 6, $P < 0.001$). Maize production (315.2 ± 37.2 kgs/households) was the most common food item produced by the farmers, it was also significantly the favourite than other crop item, followed by vegetables (110.4 ± 25.4 kgs/households) while the least produced food item in the study area by the farmers was cowpeas (20.1 ± 2.7 kgs/households). Average production of wheat (45.3 ± 5.5 kgs/households) and beans (44.1 ± 8.7 kgs/households) were similar ($P > 0.05$). Urban farmers produce food crops as part of their survival strategy and their farming activities are not large-scale. Analysis of food production and consumption was done to determine direct entitlements of harvests from urban farms. The results however show that per capita cereal consumption was 91.2 kg/households. This implies that, on average, households could not support themselves entirely on the maize they produced on urban agricultural plots. Clearly, several livelihoods strategies are being employed to satisfy their food needs.

Figure 4.5: Mean production of various crops by farmers from urban agriculture in Eldoret Town.

Values with different letters differ significantly ($p < 0.05$) against other food crops (one-way ANOVA followed by post-hoc Duncan's Multiple Range Test).



Source: Authors' computation from field data

The study also determined the distribution in the crop produced per household at the household level (Table 4.7). There were significant differences in distribution of each crop per farmer in Eldoret Town. Maize production by most of the farmers' respondents ranged from 45 to 360 kgs/households (59.2%). Vegetable, beans, wheat and cowpeas production by most farmers ranged between 1 to 90 kgs/households. Because urban dwellers must buy most of their food, urban food security depends mostly on whether the household has adequate effective purchasing power given the prevailing prices and incomes (Cohen, 2016). According to Engel's law on the relationship between income and the amount allocated to food (Companioni, 2013), as income increases, the proportion of spending devoted to food decreases. Contrary to this law, the analysis of household monthly income and food expenditure within the

sampled households revealed that food expenditure increased with an increase in household income. In general, the findings from literature show that the urban poor spend between 60-80% of their income on food (Bellows, 2011).

Table 4.7: Distribution in the quantity of farm crop production from the urban agriculture in Eldoret Town during the study period

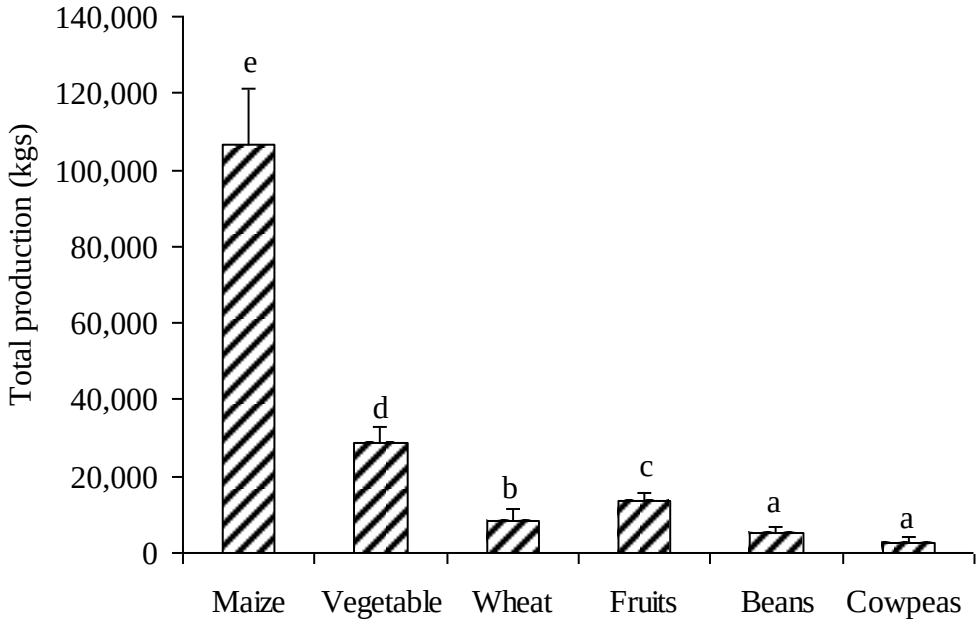
	Levels of production (kgs/household/season)						
	0	1-45	45-90	91-180	181-360	361-1440	> 1440
Maize	10.2	16.3	27.2	18.5	13.5	8.9	5.4
Vegetable	25.0	32.4	29.6	8.3	2.8	1.9	0.0
Wheat	40.7	30.6	16.7	8.3	3.7	0.0	0.0
Fruits	21.3	31.5	26.9	15.7	2.8	1.9	0.0
Beans	42.2	28.4	17.4	9.2	2.8	0.0	0.0
Cowpeas	35.2	29.6	18.5	12.0	3.7	0.9	0.0

Source: Authors' computation from field data.

The estimated crop production in Eldoret Town is shown in Figure 4.6. There were significant differences in the overall food crop production among farmers in Eldoret Town (ANOVA; F = 102.212, df = 6, $P < 0.001$). Maize was the highest harvested crop in the area (105,943 ± 14,239 kg/household) followed by vegetables (28,641 ± 4,477 kgs/household) whiles the harvest of wheat, cowpeas (2,531 ± 189.2 kgs/household) and beans (5,088 ± 477 kgs/household) were overally the lowest food crops harvested from the urban agriculture in Eldoret Town. Kogi-Makau (1998) found that about 20% of the food budget is spent on vegetables and fruits. These results agree with earlier studies by Korir *et al*. (2105). This suggests that any contribution from home production has a direct impact either on the nutrition level of the family or on the budget by reducing expenditures or earning additional income. Savings can be between 5-7% of a low-income household budget.

Figure 4.6: Total crops production from urban agriculture in Eldoret Town (Kgs)

Values with different letters differ significantly ($p < 0.05$) against other food crops (one-way ANOVA followed by post-hoc Duncan's Multiple Range Test).

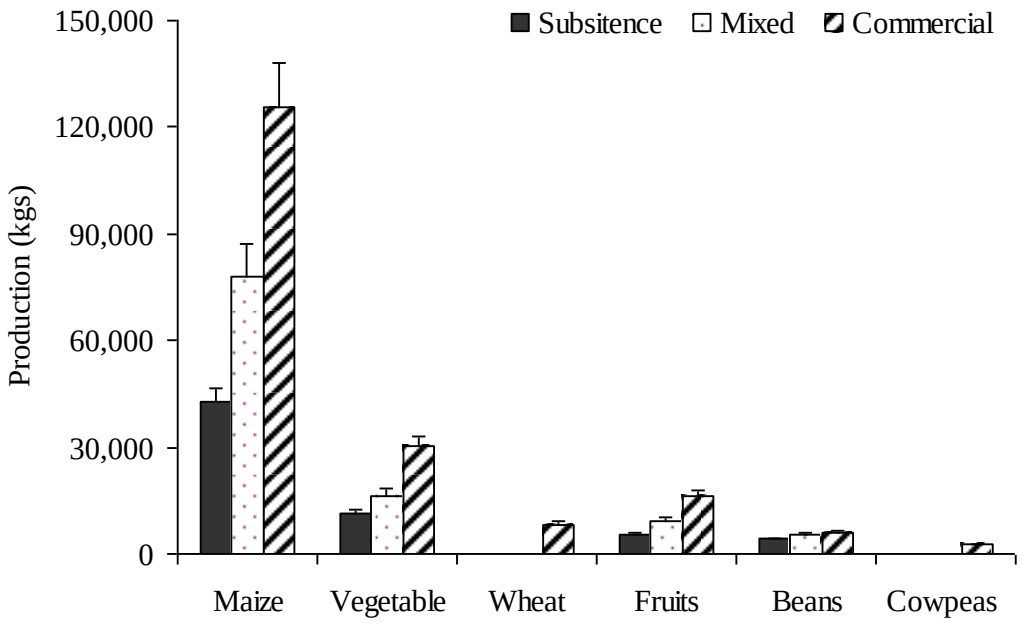


Source: Authors' computation from field data.

Food crop production among different types of farming activities in Eldoret Town was evaluated (Figure 4.7). There were significant differences in the food crop production between subsistence, mixed and commercial farming ($\chi^2 = 144.332$, df = 10 p = 0.00001). Production of all food crops from commercial farming was significantly higher ($p < 0.05$) than mixed farming while production from subsistence farming was the lowest in terms of crop production among the farmers. Previous results have shown the importance of backyard gardens decreases with an increase in household size; larger families tend to be more engaged in open space and urban fringe farming. The popularity of backyard gardens could be attributed to the fact that gardening can be done with virtually no economic resources, using locally available planting materials, green manures, and waste water. It is therefore a production system that can be afforded by the poor city dwellers. This was a government initiative which involved the destruction of illegal vending sites, informal business

premises and homes and other structures not built according to planning laws that guide development in the country (Mwangi, 1995). The characterization of the various urban agriculture farming systems in Kenya is yet to be done. Consequently, inappropriate technologies have been developed limiting crop choices and adaptation of production technologies (Musonga, 2004).

Figure 4.7: Reasons for and total amount of Food crop production (kgs/household) among different types of farming activities in Eldoret Town



Source: Authors' computation from field data.

The production of livestock and livestock products estimated per individual farmer during the study period is provided in Figure 4.8. Poultry was the most important livestock items owned followed by sheep and then pigs while beef cattle was the least. However, in terms of contribution to food items per farmer, beef was the most important livestock (130 ± 24.3 kgs per farmer) followed by eggs (31 ± 12 eggs per farmer) which was statistically similar to milk production (31.4 ± 8.4 kgs/household)

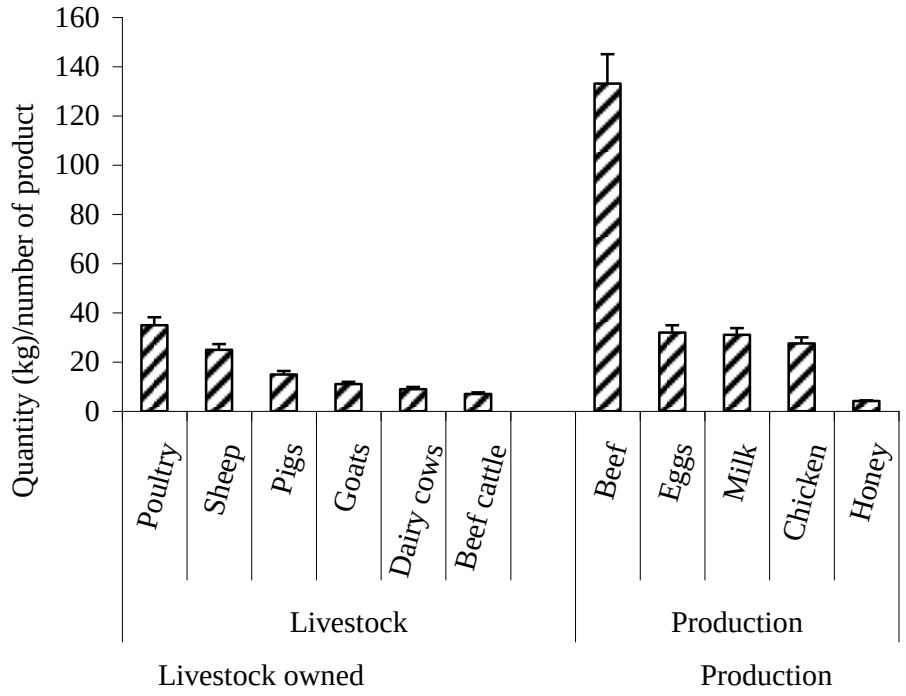
and chicken (28.5 ± 8.2 kg/household). Nevertheless, honey production per farmer was found to be the lowest (5.1 ± 0.9 litres) as was bacon production (4.1 ± 0.8 kgs/household). A survey conducted by IDRC in Kenya (1994) states that poultry was the most common livestock in all towns, though goats, sheep and cattle were fairly numerous in the smaller towns. Very few urban households keep fish, pigs and bees. Nairobi city had an estimated 23000 cattle in the town, although most belonged to medium-high income dairy farmers. Similarly in Dar es Salaam, commercial dairy farming is practiced mainly by middle-high income urban households. Livestock keepers in the other towns usually let their animals roam freely, particularly during the rainy season. This compares well with the study by Mok *et al*. (2014) on low-density home gardens, 65% of the gardeners reported having livestock, 24% had cattle followed by 21% of poultry (broilers/layers) and 19% local fowl. The importance becomes clear by the fact that around 16% of the urban milk consumption originates from urban production (44% urban, 28% imports, 8% Masai herds, 4% others) (Sumberg 1997). The urban system is characterised as one "which is essentially a sideline economic activity; it is characterised by small herds, feed gathered and grazed from public land or purchased from boys who cut roadside grass, and direct marketing to individual consumers" (Thornton, 2008).

The economic situation in Eldoret Town such that there is shortages of basic food commodities on the formal market. However, basic commodities are available on the parallel market but are generally sold at higher prices, which very few people in the country earn. Even the street vendors selling vegetable and re-packaged into smaller quantities of basic food are selling at higher prices. As stated by FEWS NET (2008),

not only are the food crisis urban areas a food availability crisis, it has become an access crisis as well.

Figure 4.8: Livestock and livestock production from urban agriculture in Eldoret Town per year during the year 2007.

Values with different letters differ significantly ($p < 0.05$) against other livestock items (one-way ANOVA followed by post-hoc Duncan's Multiple Range Test).



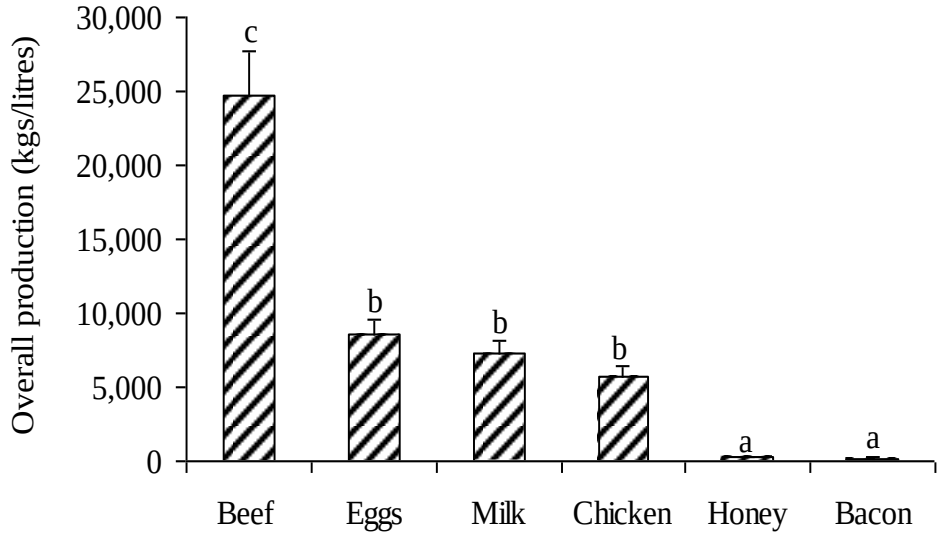
Source: Authors' computation from field data.

The contribution of urban agriculture to the livestock based food supply was determined to establish its contribution to food production (Figure 4.9). In the figure, the items considered were beef, eggs, milk, chicken and honey and the livestock ownership excluded from the analysis as they were not considered food at the ownership stage. Significant differences in the quantity of production from the livestock was discerned ($F = 34.221$, $df = 6$, $p = 0.0042$). The highest contribution from the livestock industry was beef that was estimated at 25 tonnes per year from the

urban agriculture followed by eggs, milk and chicken (range 6 tonnes to 10 tonnes for eggs and chicken and 6000 liters to 10 litres from milk) while the least was honey and bacon (less the 2 tonnes each).

Figure 4.9: Total food production per year in the urban agriculture from the livestock owned by the farmers.

Values with different letters differ significantly ($p < 0.05$) against other livestock items (one-way ANOVA followed by post-hoc Duncan's Multiple Range Test).

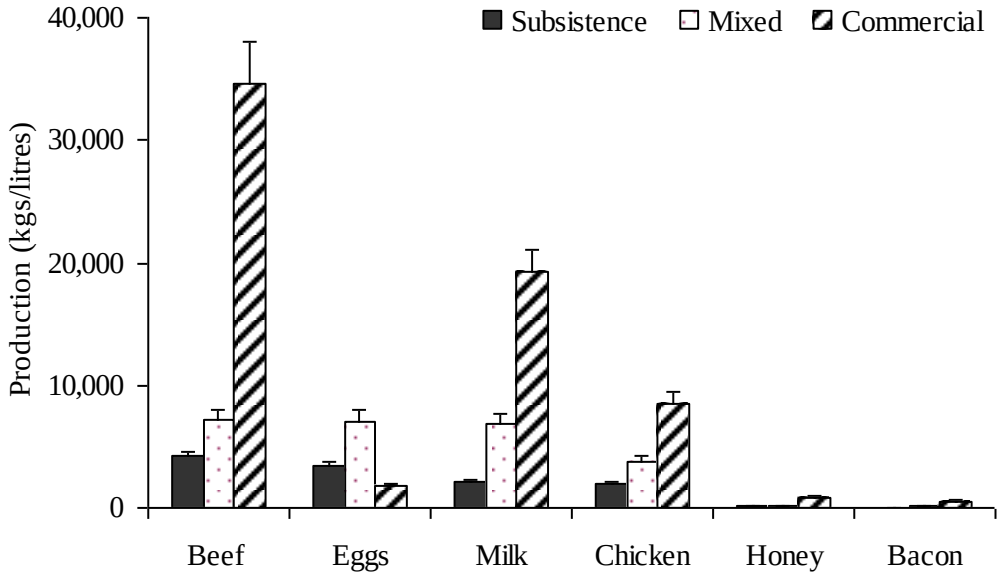


Source: Authors' computation from field data.

Overall production from livestock based on different types of farming was was determined (Figure 4.10). There were significant differences in the livestock production between subsistence, mixed and commercial farming ($\chi^2 = 109.332$, df = 10, p = 0.0006). Production from livestock was significantly the highest among farmers practising farming at the commercial scale. Currently, greenhouse, drip irrigation, organic farming, and to a less extent hydroponics are among the technologies commonly adopted in urban agriculture. However, there is generally insufficient technical capacity to keep abreast with changing trends in technology.

Moreover, limited awareness creation of the available urban technologies has also been an impediment to improved productivity. In the town of Eldoret Town, seven farming systems have been identified by Korir *et al*. (2015). These are seasonal crop farming, customary land rights systems, vegetable growing systems, small ruminants and poultry, commercial livestock farming and backyard gardening.

Figure 4.10: Overall food production from livestock based on different types of farming was related with the in Eldoret Town



Source: Authors' computation from field data.

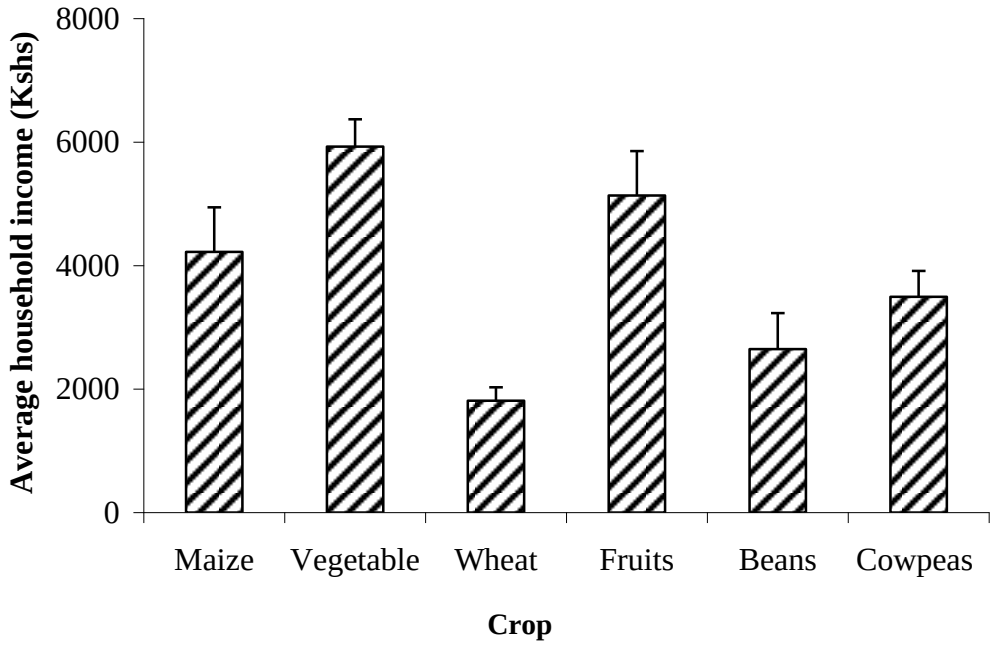
4.5 Overall contribution of urban agriculture to household income in Eldoret Town

Of the 188 respondents, 34.4% reported that UA contributed to both food and income, 30.4% reported that UA contributed to both employment and income while 30% reported it contributed to income only. Average household income from crop in Eldoret Town is shown in Figure 4.11. There were significant differences in income from each crop within the municpality (ANOVA; $F = 20.112$, $df = 5$, $p < 0.001$).

Vegetable production produced the highest individual household income (Kshs 5905 ± 1035), followed by fruits (Kshs 4880 ± 920). Although maize the most crop produced, it was consumed more and therefore its contribution to income was third estimated at Kshs 4200 ± 755. Sales of cowpeas also resulted to improved income of about Kshs 3600 ± 710 while income from wheat was the least at Kshs 1800 ± 420 perhaps due to the low acreage under wheat. It has been reported that farmers in urban areas own small plots of land and therefore produce low quantities of food that more often than not are consumed and only excess amounts sold (Rogerson, 2016) as was the case with maize farming in the area.

Figure 4.11: Average income per household from the sales of crops produced during urban agriculture in Eldoret Town.

Values with different letters differ significantly ($p < 0.05$) against other food crops (one-way ANOVA followed by post-hoc Duncan's Multiple Range Test).

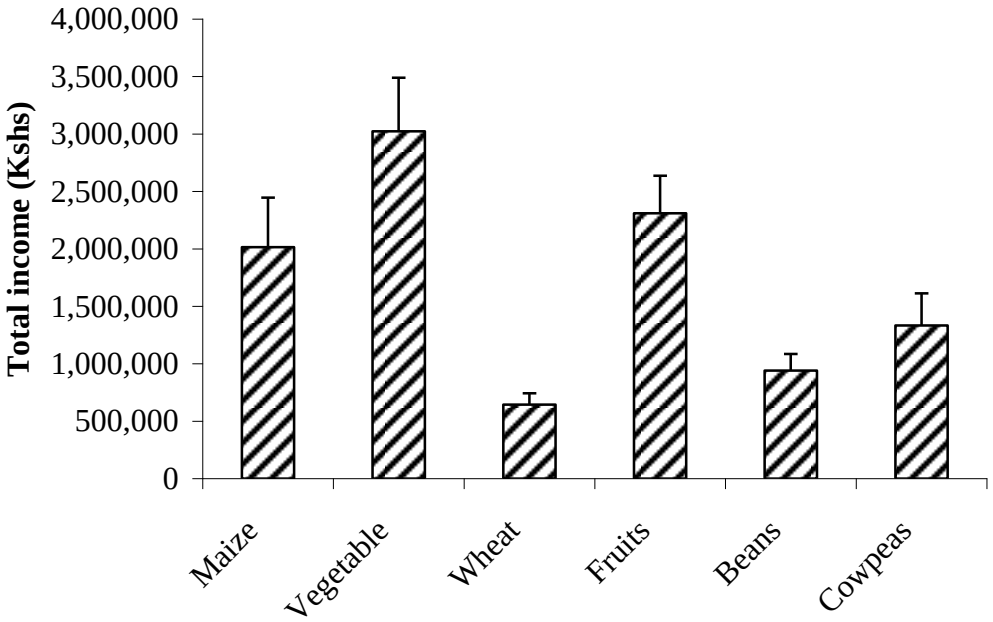


Source: Authors' computation from field data

The estimated overall income from crop production in Eldoret Town is shown in Figure 4.12. There were significant differences in the income from different crops in Eldoret Town (ANOVA; $F = 67.212$, $df = 5$, $p < 0.001$). Vegetable yielded the highest income in the area (Kshs 3.02 ± 0.32 million) followed by fruits (Kshs 2.41 ± 0.21) and then maize (Kshs 2.01 ± 0.11) whiles income from wheat, bean and cowpeas were low (Kshs 540,000 to 130,000). These results agree with earlier studies by Korir *et al*. (2105). This suggests that urban crop farming contribute directly to household income. Savings can be between 5-7% of a low-income household budget.

Figure 4.12: Total income from urban agriculture in Eldoret Town.

Values with different letters differ significantly ($p < 0.05$) against other food crops (one-way ANOVA followed by post-hoc Duncan's Multiple Range Test).

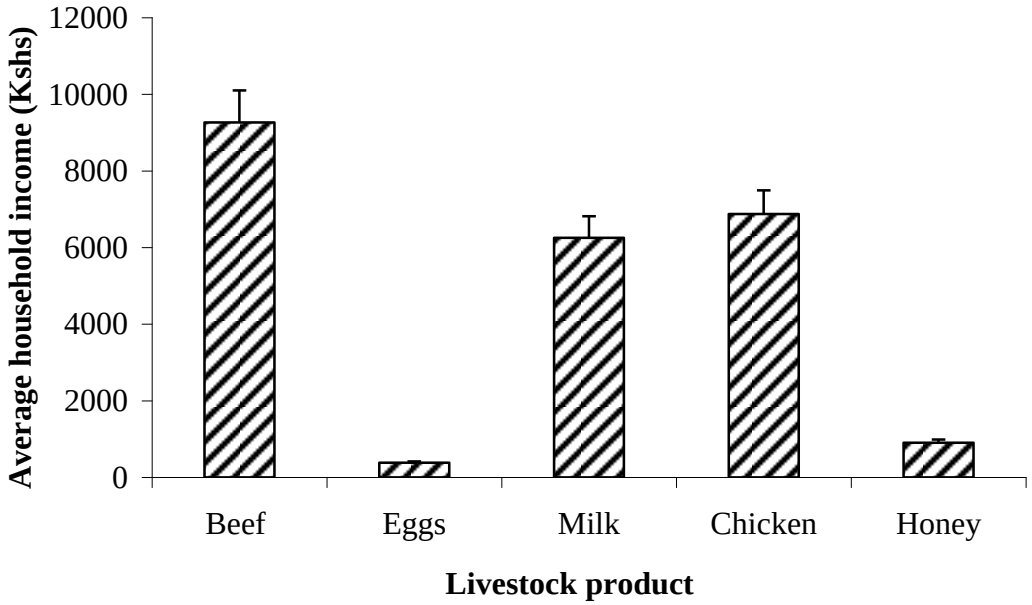


Source: Authors' computation from field data.

The income from livestock products estimated per individual farmer during the study period is provided in Figure 4.13. Beef contributed the highest income to the household estimated at Kshs 9500 ± 120 followed by chicken estimated at Kshs 7000 ± 870, which was followed by income from milk (Kshs 6020 ± 860). However, the

contribution towards household income from eggs, honey was low. A survey conducted by IDRC in Kenya (1994) states that poultry contributed the highest income in all towns, though goats, sheep and cattle were fairly numerous in the smaller towns. The economic situation in Eldoret Town during the time of the survey was such that there were shortages of basic food commodities on the formal market.

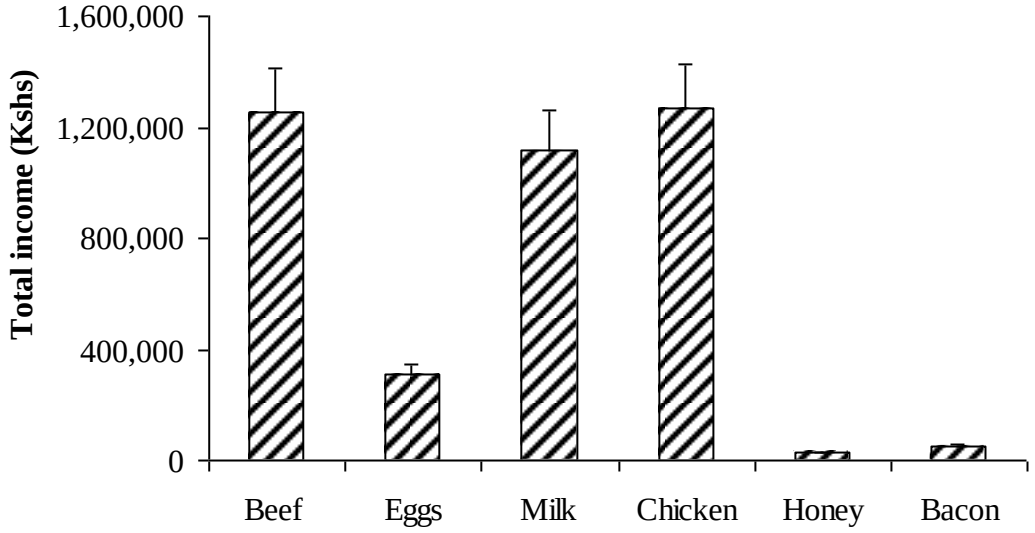
Figure 4.13: Average household income from livestock products obtained from urban agriculture in Eldoret Town per year during the year 2007.



Source: Authors' computation from field data.

The contribution of livestock product to overall household income in Eldoret Town is shown in Figure 4.14. Significant differences in the quantity of production from the livestock was discerned ($F = 34.221$, $df = 5$, $P = 0.0042$). The highest contribution from the livestock industry was chicken and beef that were estimated at Kshs 1.2 million followed by income from milk (Kshs 1.02 million) while income from eggs, honey and bacon were low (estimated at below Kshs 300,000).

Figure 4.14: Total food production per year in the urban agriculture from the livestock owned by the farmers.



Source: Authors' computation from field data.

52% recorded monthly wages of Ksh 5,001-10,000 which is within the basic minimum monthly wage of Ksh 9780.95 whereas 48% recorded monthly wages of Ksh 2000-5000 which is below the recommended rate (Republic of Kenya, 2013). This indicates that UA is an important source of income in Eldoret Town.

4.6 Technological innovations used in urban agriculture within Eldoret Town

Innovations in urban agriculture are propelled by two main things: the urban agricultural practitioner himself/herself and external agents such as NGO's, government extension agents and farmer based organizations. From the studies on the field, about 48% of farmers have ever done something new (innovation) on their own. The remaining 52% have however not introduced any new thing on their own in the last ten years. Some 65% of farmers have also introduced new things (innovations) on their farms as a result of what they learn from other people (external agents). The

other 35% of farmers have not put into practice what other people teach them or what they see their colleagues doing. These findings go to suggest that whereas some farmers experiment on their own to come out with innovations, others need to be 'pushed' by some external force to do so.

However, some farmers have not done or introduced anything new either on their own or as a result of what an external agent has told them in the last ten years. Interactions with the farmers revealed that some farmers think that there is really no need to change their practices or innovate since the old practices seem to be working quite well for them. Additionally, this group of farmers do not see why some external agent should know more about their business than they themselves and therefore do not co-operate with them to bring about innovations.

Table 4.8: Sources of innovation in urban agriculture in Eldoret Town during the study period

	Sources	
	Self (%)	External source (%)
Yes	47.5	65.0
No	52.5	35.0
Total	**100**	**100**

Source: Authors' computation from field data

The innovations among the urban farmers were in the areas of improved crop varieties/breeds, agrochemicals/veterinary drugs, machinery, water, feed, housing, land preparation, supermarket, grocery point, credit management, urban market and ICT (mobile phone). The commonest innovation among farmers within the urban areas was the use of mobile phone as 70% of all farmers make use of this ICT tool to

communicate with their customers/suppliers of inputs and check on market trends even though this is not the only motivation for owning a mobile phone. The introduction of new agrochemicals/veterinary drugs was also prominent among these urban farmers (25%). This can be largely attributed to the fact that pest and disease control is very important if good returns are to be made from the farms. The source of this kind of innovation was from external sources prominent among which was farmer based organizations (associations). Innovations agrochemicals/veterinary drugs is a recent phenomenon among the farmers within urban areas as 14% of those involved introduced them within 2006 and 2007. New drugs/agrochemicals are constantly being introduced onto the market as old ones become less effective as organisms develop resistance over the years.

Feed is very crucial to the urban livestock farmers as animals are not supposed to be left to loiter around the city by law. Sixteen percent (16%) of livestock farmers have between 1997 and 2007 developed/introduced new feeds to their livestock. The farmers have found innovative ways to preserve feeds (especially grass) for the dry season. They have also found ways of enriching the feeds of the livestock with various feed supplements. Majority of the livestock farmers (13% out of 16%) who have innovated in feed did that as a result of what they learnt from farmer based associations. Just as feed is important in urban livestock production, water is an important component of urban crop production. Fifteen percent (15%) of crop farmers have found ways of conserving water and introduced at least an irrigation tool (watering cans) on their farms within the last ten years. Only 4% of farmers innovated in water on their own as the remaining 11% did this as a result of what they saw other farmers do. It was realized that innovations in this area were in dug out wells, shallow

pits and ponds. However, these facilities belonged to groups of farmers in the farming area rather than individuals.

Adequate housing is another important thing to be considered in urban livestock production, but only 7% of livestock farmers have developed improved housing structures for the animals between 2006 and 2007. Four percent (4%) of these farmers did this on their own and the remaining 3% did that as a result of farmer based organizations. Even though marketing of urban agricultural products is not a problem, some farmers have innovated by establishing contacts with supermarkets, grocery points and markets in urban centers. They deliver specified products to these destinations at specified intervals throughout the entire year.

In conclusion, even though the greater percentages of urban farmers within the AMA have held onto their old practices, some try out new things/ideas from various sources. Innovation in improved crop/breed, agrochemicals/veterinary drugs, feed and water are highest among urban livestock/crop farmers and these took place between 1997 and 2007. Farmer based organizations (associations) seemed to be of great influence on innovation development among urban livestock/crop farmers in the AMA. Very few farmers innovated as a result of contact with government extension agents and NGO's. This was because in some places, extension service was either very minimal or absent. Extension agents should intensify their efforts if the needed impact on urban farmers is to be felt. Also, NGO's and other stakeholders in urban agriculture within the AMA should develop innovations together with the farmers themselves as these would be better appreciated and most likely to be implemented by the urban farmers.

Table 4.9: Specific farmer innovation areas, sources and years introduced

INNOVATION TYPE	REPONDENTS (%)	SOURCE OF INNOVATION (%)						YEAR INTRODUCED (%)			
		Self	Farmers	NGO	GE A	FBO	Others	1997-1999	2000-2002	2003-2005	2006-2007
Improved crop/breed	18	11	4	0	1	1	1	2	3	8	6
Agrochemicals/Vet drugs	25	4	5	1	0	15	0	3	1	7	14
Machinery	8	3	2	1	1	1	0	5	0	2	1
Water	15	4	11	0	0	0	0	3	2	3	7
Feed	16	2	1	0	0	13	0	0	0	1	15
Housing	7	4	0	0	0	3	0	0	0	0	7
Land Preparation	1	1	0	0	0	0	0	1	0	0	0
Supermarket	3	3	0	0	0	0	0	1	1	1	0
Grocery point	2	2	0	0	0	0	0	0	0	2	0
Credit Management	2	2	0	0	0	0	0	1	1	0	0
Urban market N=100	1	1	0	0	0	0	0	1	0	0	0

Source: Authors' computation from field data, 2007

The types of farming practice and technology was also determined in urban agriculture in Eldoret Town was also determined (Table 4.10). Based on the responses, majority of the farmers practiced per-urban production followed by home gardening while the least number practiced community based production. Danso *et al* (2000) reduced the farming systems categorization in Eldoret Town to only five types consisting of vegetable farming, backyard gardening, livestock and ruminant farming, seasonal farming and others (commercial pineapple and urban ornamental farming). However, we could simply think of the farming systems in Eldoret Town as classified into crop and non-crop production systems.

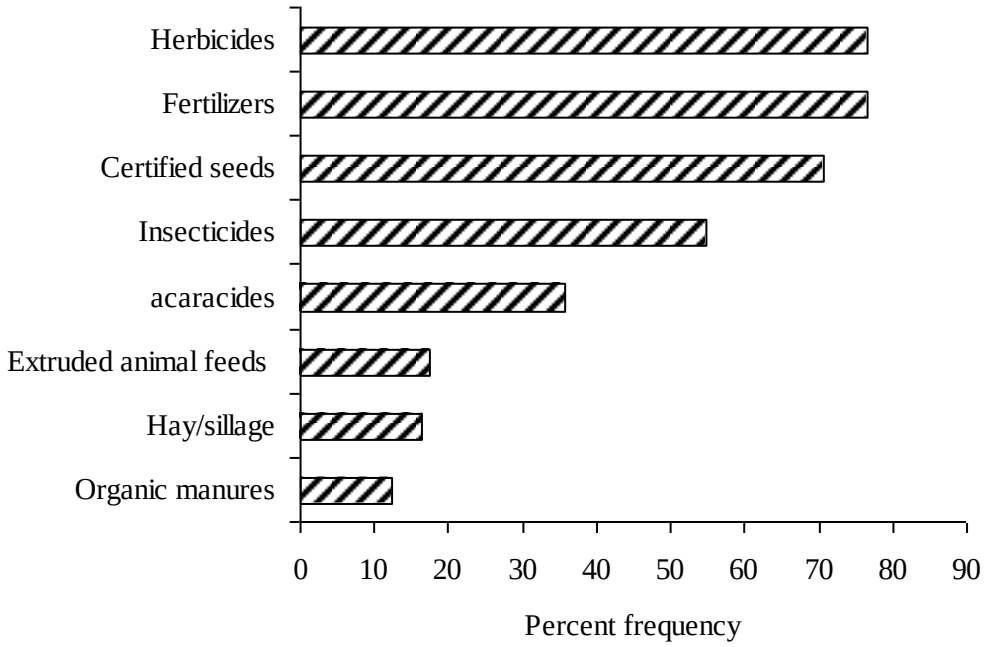
Table 4.10: The types of farming practices in urban agriculture in Eldoret Town

	Frequency	% frequency
Home gardening	72	38.3
Open space production	23	12.2
Urban food production	78	41.5
Community based production	4	2.1
Technology based production	11	5.9
TOTAL	188	100

The types of inputs used during urban in urban agriculture within Eldoret Town were fertilizers, organic manures, certified seeds, herbicides, insecticides, acaracides, manufactured animal feeds and hay/silage. The proportion of farmers using the various inputs is shown in Figure 4.15. Highest of the farmers were using herbicides, fertilizers and insecticides while the lower proportions of the farmers used organic manures, hay/silage and extracted animal feeds. This study thus revealed that most urban farmers farmed on small pieces of land and did not invest much in terms of applying fertilizers to the land and use of certified seeds. This resulted in poor yields, a vicious cycle of low productivity and food poverty. The level of investment in urban farming is very low, and the level of agricultural inputs correspondingly so. For example in Kenya, only 11 % of urban farmers indicated that they used fertilizers, while 30 % use manure. About 50 % of the urban farmers used manure from their own animals, but close to a half obtained it through informal gift or barter from friends or relatives while only 2% bought it. Chicken droppings were used by 16 % of urban crop farmers with 76% of the farmers getting it from their own chickens. Similarly, compost was used by 25% of the urban farmer sample; almost all (96%) said they produced it themselves, except in Nairobi where it was even found in the market and Mombasa where it was acquired by barter. Mulch was employed by 19

per cent, almost all of whom (90%) had their own source, except in Nairobi, where it was exchanged.

Figure 4.15: The proportion of farmers using the various inputs



Source: Authors' computation from field data.

The average cost of inputs used by the farmers was also determined as a way of determining the extent to which farmers are likely to use them during food production. Their prices are as shown in Table 4.11. Based on the price of the items, the most expensive input among the farmers was fertilizers followed by acaricides and insecticides while organic manure was the cheapest for the farmers.

Table 4.11: The average cost of inputs used by the farmers

Inputs	Average price per per acre (Kshs.)
Organic manures	435[a]
Hay/silage	1580
Extruded animal feeds	2565
Acaracides	4500
Insecticides	3200
Certified seeds	4235
Fertilizers	5650
Herbicides	36221

Source: Authors' computation from field data.

It was also determined further that upto 23.2% of the farmers did not use inputs during the production process and they all (100%) attested that the inputs are expensive. Water for irrigation is a limiting factor for development of Urban and Per-urban Agriculture. There are for instance 3,700 farmers in Nairobi that practice irrigation agriculture with 36% of the farmers having limited access to potable water for irrigation (Hide and Kimani, 2000). Comparatively, urban Agriculture is more paying than rural Agriculture. This is attributed to direct marketing by producers due to high demand of produce in urban centres. In addition, urban Agriculture has minimal marketing costs due to less need for packaging, storage and transportation of food.

The study finally determined the food production (both crops and livestock) among farmers using various forms of inputs, which was used to represent innovation (Table 4.12). There were significant association between the use of inputs and crop production ($\chi^2 = 98.223$, df = 25, p = 0.0042). The use of fertilizers and certified seeds

were associated with increased production of most of the crops; however, the highest crop production occurred among farmers using several inputs simultaneously. Similarly the association between inputs and production from livestock was significant (χ^2 = 108.223, df = 20, p = 0.0002). Rearing of animals using extruded feeds produced the highest beef and milk. However, combination of several inputs produced the best outputs in terms of livestock production.

Table 4.12: Food production (both crops and livestock) among farmers using various forms of inputs per year

Inputs	Crop production (kgs)					
	Maize	Vegetable	Wheat	Fruits	Beans	Cowpeas
Organic manures	86,215	46,311	NA	20,225	14,788	ND
Insecticides	81,233	51,222	12,110	28,144	7,112	3,115
Certified seeds	121,221	65,122	19,822	ND	ND	4,500
Fertilizers	155,211	85,422	29,551	35,444	21,555	6,255
Herbicides	128,477	81,335	26,144	30,211	25,411	7,122
Combination	135,450	84,135	30,154	31,251	26,145	8,1245
	Livestock production (kgs/litres)					
	Beef	Eggs	Milk	Chicken	Honey	Bacon
Hay/sillage	34,556	ND	18,655	ND	ND	ND
Extruded animal	45,441	ND	21,524	ND	ND	ND
Acaracides	26,511	9,522	26,744	10,235	ND	ND
Insecticides	24,511	7,522	37,744	8,235	ND	ND
Combination	28,545	8,145	41,125	8,544	ND	ND

Source: Authors' computation from field data.

ND denotes note determined because farmers did not use that particular input for the specific food item. NA denoted not available; no farmer was using the input in their production process for that particular item.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter contains the conclusions and recommendations of the study. The objectives have been linked to the research questions and conclusions and recommendations made.

5.2 Summary

Research in urban agriculture continues to be of interest to many stakeholders around the globe including Kenya. The current study has investigated the following critical issues in urban agriculture in the Eldoret Town: extent of urban agriculture, overall contribution of urban agriculture to food production, overall contribution of urban agriculture to household income and technological innovations used in urban agriculture within Eldoret Town. Primary data was collected from respondents within the urban agricultural sites within the Edoret Town. A largely structured questionnaire sought answers concerning the various issues raised in this study from 188 households practicing urban agriculture. Secondary data included the review of relevant literature to understand the body of knowledge on urban agriculture and methodological issues in systems analysis.

The results of the study suggest that:

1. Most farmers practiced mixed farming for subsistence consumption and for sale. Also 26.5% of the respondents practice both crop and livestock production while 29.9% and 44.8% practice only livestock keeping and crop production respectively. It was also established that maize was grown by highest number of

respondents (54.3%) followed by vegetables (46.2%) while other crops grown were wheat (33.2%), fruits (24.8%), beans (15.4%), and cowpeas (4.1%). As for livestock, majority of the farmers owned poultry (75.5%) followed by ownership of dairy cattle (59.3%), then goats (31.5%). Livestock owned by least number of farmers in the study area were pigs (1.9%) and bees (1.1%). About 50% of the farmers had less than 0.2 acres of land, 40% of the farmers had between 0.2-0.5 acres of land, while the rest (11%) had over 0.5 acres. The mean farm size in the study area was found to be 0.64 ± 0.28 acres

2. Most important reason for practicing urban farming was improvement of family access to food (68.2%), followed by getting household income (49.6%) or improve the already meager household income (28.7%), and to comply with cultural values (2.8%).
3. Maize production per farmer (315.2 ± 37.2 kgs range 45–360 kgs]) was the was the most abundant food item produced by the urban households (59.2%), by vegetables (110.4 ± 25.4 kgs) while the least produced food item was cowpeas (20.1 ± 2.7 kgs). Vegetable, beans, wheat and cowpeas production by most farmers ranged between 1 to 90 kgs.
4. Maize was the highest harvested crop in the area (105,943 ± 14,239 kg) followed by vegetables (28,641 ± 4,477 kgs) whiles the harvest of wheat, cowpeas (2,531 ± 189.2 kgs) and beans (5,088 ± 477 kgs). Kogi-Makau (1998) found that about 20% of the food budget is spent on vegetables and fruits. These results agree with earlier studies by Korir *et al*. (2015). Production of all food crops from commercial farming was significantly higher ($p < 0.05$) than mixed farming while production from subsistence farming was the lowest in terms of crop production among the farmers. Poultry was the most important livestock items owned

followed by sheep and then pigs while beef cattle was the least. However, in terms of contribution to food items per farmer, beef was the most important livestock (130 ± 24.3 kgs per farmer) followed by eggs (31 ± 12 eggs per farmer) which was statistically similar to milk production (31.4 ± 8.4 kgs) and chicken (28.5 ± 8.2 kg).

5. The highest contribution from the livestock industry was beef that was estimated at 25 tonnes from the urban agriculture followed by eggs, milk and chicken (range 6 tonnes to 10 tonnes for eggs and chicken and 6000 liters to 10 litres from milk) while the least was honey and bacon (less the 2 tonnes each). Production from livestock was significantly the highest among farmers practising farming at the commercial scale.
6. 34.4% reported that UA contributed to both food and income, 30.4% reported that UA contributed to both employment and income while 30% reported it contributed to income only. Vegetable production produced the highest individual household income (Kshs 5905 ± 1035), followed by fruits (Kshs 4880 ± 920). Although maize the most crop produced, it was consumed more and therefore its contribution to income was third estimated at Kshs 4200 ± 755. Sales of cowpeas also resulted to improved income of about Kshs 3600 ± 710 while income from wheat was the least at Kshs 1800 ± 420 perhaps due to the low acreage under wheat. Vegetable yielded the highest income in the area (Kshs 3.02 ± 0.32 million) followed by fruits (Kshs 2.41 ± 0.21) and then maize (Kshs 2.01 ± 0.11) whiles income from wheat, bean and cowpeas were low (Kshs 540,000 to 130,000). Beef contributed the highest income to the household estimated at Kshs 9500 ± 120 followed by chicken estimated at Kshs 7000 ± 870, which was followed by income from milk (Kshs 6020 ± 860). However, the contribution

towards household income from eggs, honey was low. The highest contribution from the livestock industry was chicken and beef that were estimated at Kshs 1.2 million followed by income from milk (Kshs 1.02 million) while income from eggs, honey and bacon were low (estimated at below Kshs 300,000).

7. From the field studies, about 48% of farmers have ever done something new (innovation) on their own. The remaining 52% have however not introduced any new thing on their own in the last ten years. Some 65% of farmers have also introduced new things (innovations) on their farms as a result of what they learn from other people (external agents). The other 35% of farmers have not put into practice what other people teach them or what they see their colleagues doing. These findings go to suggest that whereas some farmers experiment on their own to come out with innovations, others need to be 'pushed' by some external force to do so. The innovations among the urban farmers were in the areas of improved crop varieties/breeds, agrochemicals/veterinary drugs, machinery, water, feed, housing, land preparation, supermarket, grocery point, credit management, urban market and ICT (mobile phone). The commonest innovation among farmers was the use of mobile phone as 70% of all farmers make use of this ICT tool to communicate with their customers/suppliers of inputs and check on market trends even though this is not the only motivation for owning a mobile phone. Innovations agrochemicals/veterinary drugs is a recent phenomenon among the farmers as 14% of those involved introduced them within 2006 and 2007. Majority of the farmers practiced per-urban production followed by home gardening while the least number practiced community based production. The types of inputs used during urban in urban agriculture within Eldoret Town were fertilizers, organic manures, certified seeds, herbicides, insecticides, acaracides,

manufactured animal feeds and hay/silage. The use of fertilizers and certified seeds were associated with increased production of most of the crops; however, the highest crop production occurred among farmers using several inputs simultaneously. Rearing of animals using extruded feeds produced the highest beef and milk. However, combination of several inputs produced the best outputs in terms of livestock production.

While specific statistical findings in this study cannot be generalized beyond Eldoret Town, some important points should be considered in other low income urban households. The first is the importance and growing reliance on urban farming for household food consumption and income. The second is the need to just food supply and access to include the environmental context in which the food is obtained. The thesis therefore concludes that although urban agriculture is not a panacea to economic decline or poverty alleviation, it is a positive and appropriate way of improving urban livelihoods. The success and expansion of urban agriculture will therefore depend on the ability of policy makers, administrators and urban farmers to use integrated social, economic and environmental strategies that effectively address food security and urban poverty.

5.3 Conclusion

Farmers owned small sizes of land, but nevertheless practiced urban agriculture on them. The main cultivated crops were maize, fruits, beans, wheat, vegetables and cowpeas. Maize and vegetable production was the most abundant food item produced by the farmers. Farmers also owned several livestock including: poultry dairy cattle, beef cattle, goats, sheep, pigs and bees and produced high quantity of beef, eggs, and

chicken, with low production of honey and bacon. Majority of the farmers practiced mixed farming where they grew crops and kept livestock for subsistence consumption and for sale, yet production of all food crops and livestock from commercial farming was significantly the highest higher ($p < 0.05$) than mixed farming. It was also noted that majority of the farmers practiced per-urban production and home gardening, the highest farm production of all crops occurred when the technology based production was used for crop production.

The types of inputs used during production in urban agriculture within Eldoret Town were fertilizers, organic manures, certified seeds, herbicides, insecticides, acaracides, manufactured animal feeds and hay/silage. Highest usage of the farmers was using herbicides, fertilizers and insecticides. However, the fertilizers followed by acaricides and insecticides were more expensive inputs for most farmers resulting to high %age of farmers not using the inputs. It was also established that the use of fertilizers and certified seeds were associated with increased production of most of the crops. However, the highest crop and livestock production occurred when combination of inputs were used simultaneously.

Despite the fact that urban agriculture has the proven capacity to contribute to food security and income generation, it faces a large number of constraints that impede the achievement of these goals. These constraints included: lack of government support, lack of space, lack of agricultural skills, lack of farm inputs and poor council by-laws.

5.4 Recommendations of the study

The following recommendations are given based on the implications of the results presented.

i. Since urban agriculture is a strategy that has been adopted in response to the availability of favourable resource and policy conditions more efforts are needed to improve upon the situation.

ii. Integrating urban agriculture into Eldoret Town development plans by re-zoning the city and incorporating agro-residential planning in Eldoret development plans. Local authorities should devise policies for community gardens or allotments.

iii. Urban agricultural diversification which promotes production of high-valued speciality foods, which require little space for production but provide good monetary returns should be encouraged. Urban farmers should be capacitated to produce protein rich pulses such as soya beans in their gardens to improve the dietary quality of their households.

iv. Farmers' associations have been found to be a very important source of innovation and platform for diffusion. Farmers are therefore encouraged to join farmers associations in order to stay abreast with new happenings in the industry as well as improve upon advocacy for a favourable policy framework.

v. Since urban agriculture provides a good source of food to farmers and improves livelihoods, modern techniques of production that make use of minimal space and enhances productivity should be promoted. Vegetable production and raising of grass cutter and rabbits are suggested.

5.5 Recommendation for further research

i. Future research would be needed to establish innovation and policy needs of urban farmers which this study did not focus on.

ii. A specific urban agricultural policy that mandates specific areas to be demarcated for food crop production and small animal keeping should be developed by government and implementation facilitated by the key actors. For instance, to sustain good agricultural practices, government extension agents should collaborate and reach out to more urban farmers;

iii. Any agricultural innovations should be designed together with practitioners to make them more acceptable to the practitioners.

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APPENDICES

Appendix 1: Questionnaires for farmers

Part 1: Respondents socio-demographic characteristics

1. What is your age: < 18 years [ ] 18-25 years [ ] 26-35 years [ ]
   36-50 years [ ] > 50 years [ ]
2. Education: None [ ] Primary [ ] Secondary [ ] Tertiary [ ]
   University [ ]
3. Gender: Male [ ] Female [ ]
4. Marital status: Single [ ] Married [ ] Widow [ ] Divorced [ ]
5. Main occupation: Formal employed [ ] Unemployed [ ]
   Privately employed [ ]

Part 2: Overall food production

1. Do you engage in urban agriculture Yes [ ] No [ ]
2. What is your land size: < 2 acres [ ] 2-5 acres [ ] > 5 acres [ ]
3. What are the main types of crops that you cultivate?: Cowpeas [ ] Beans [ ]
   Fruits [ ] Wheat [ ] Vegetables [ ] Maize [ ]
4. Estimate the production (in kg) from the above crops

Crops	Production (in kgs)
Maize	
Vegetable	
Wheat	
Fruits	
Beans	
Cowpeas	

5. What are the types of livestock that you keep? Bees [ ] Pigs [ ]

Sheep [ ] Beef cattle [ ] Goats [ ] Dairy cows [ ]

Poultry [ ]

6. Estimate the number of livestock owned

	Number
Poultry	
Sheep	
Pigs	
Goats	
Dairy cows	
Beef cattle	

7. Estimate the production from the livestock above

Livestock product	Overall production
Beef	
Egg	
Milk	
Chicken	
Honey	
Bacon	

Part 3: Type of farming

1. What is the scale of farming in the area?

Subsistence [ ] Commercial farming [ ] Mixed farming [ ]

2. What is the types of crops do you plant in the various types of farming?

	Subsistence	Commercial farming	Mixed farming
Crops			
Maize			
Vegetable			
Wheat			
Fruits			
Beans			
Cowpeas			

3. What is the production (kg) of the following crops from the following types of farming activities?

	Subsistence	Commercial farming	Mixed farming
Livestock			
Beef			
Eggs			
Milk			
Chicken			
Honey			
Bacon			

4. What is the types of livestock do you have in the various types of farming?

	Subsistence	Commercial farming	Mixed farming
Livestock			
Beef			
Eggs			
Milk			
Chicken			
Honey			
Bacon			

5. What is the production do you obtain from the various types of farming?

	Subsistence	Commercial farming	Mixed farming
Livestock			
Beef			
Eggs			
Milk			
Chicken			
Honey			
Bacon			

6. What is the type of farming production in urban agriculture in Eldoret Town:

Home gardening [ ] Open space production [ ]

Urban production [ ] Community based production [ ]

Technology based production [ ]

7. Please indicate crop production values (kg) from different types of farming in Eldoret Town.

Farming production systems	Crop production (kgs)					
Types of farming	Maize	Vegetable	Wheat	Fruits	Beans	Cowpeas
Home gardening						
Open space production						
Urban production						
Community based production						
Technology based production						

8. Please indicate livestock production values (kg) from different types of farming in Eldoret Town.

	Livestock production (kgs/litres)					
	Beef	Eggs	Milk	Chicken	Honey	Bacon
Home gardening						
Open space production						
Urban production						
Community based production						
Technology based production						

Part 3: Input used in urban farming

1. What type of inputs do you use in production in your farms?

Organic manures [ ] Hay/sillage [ ] Extruded animal feeds [ ]

Acaracides [ ] Insecticides [ ] Certified seeds [ ] Fertilizers [ ]

Herbicides [ ]

2. What is the costs you incur in the above inputs

Inputs	Average price per farmer per acre (Kshs.)
Organic manures	
Hay/silage	
Extruded animal feeds	
Acaracides	
Insecticides	
Certified seeds	
Fertilizers	
Herbicides	

Part 4: Technological innovations in urban agriculture

1. What are some of the challenges do you encounter during urban agriculture

Lack of communication among residents [ ] Lack of space [ ]

Poor farm management [ ] Lack of government support [ ]

Poor physical terrain [ ] Lack of safety [ ] Theft [ ]

Lack of agricultural skills [ ] Lack of farm inputs [ ]

Poor community relations [ ] Low returns of production [ ]

Lack of agricultural infrastructure [ ] Land tenure/cost [ ]

Poor council by-laws [ ]

Appendix 2: Questionnaires for key informants

Part 1: Respondents socio-demographic characteristics

1. What is your age: < 18 years [ ] 18-25 years [ ] 26-35 years [ ]
   36-50 years [ ] > 50 years [ ]
2. Education: None [ ] Primary [ ] Secondary [ ] Tertiary [ ]
   University [ ]
3. Gender: Male [ ] Female [ ]
4. Marital status: Single [ ] Married [ ] Widow [ ] Divorced [ ]
5. Main occupation: Formal employed [ ] Unemployed [ ]
   Privately employed [ ]

Part 2: Overall food production

1. What are the main types of crops that are cultivated?: Cowpeas [ ] Beans [ ]
   Fruits [ ] Wheat [ ] Vegetables [ ] Maize [ ]
2. Please estimate the production (in kg) from the above crops

Crops	Production (in kgs)
Maize	
Vegetable	
Wheat	
Fruits	
Beans	
Cowpeas	

3. What are the types of livestock that are keept? Bees [ ] Pigs [ ]
   Sheep [ ] Beef cattle [ ] Goats [ ] Dairy cows [ ]
   Poultry [ ]
4. Estimate the number of livestock owned in the urban agriculture

	Number
Poultry	
Sheep	
Pigs	
Goats	
Dairy cows	
Beef cattle	

5. Estimate the production from the livestock above in urban production

Livestock product	Overall production
Beef	
Egg	
Milk	
Chicken	
Honey	
Bacon	

Part 3: Type of farming

1. What is the scale of farming in the area?

Subsistence [ ] Commercial farming [ ] Mixed farming [ ]

2. What is the type of crops are planted in the various types of farming?

	Subsistence	Commercial farming	Mixed farming
Crops			
Maize			
Vegetable			
Wheat			
Fruits			
Beans			
Cowpeas			

3. What is the production (kg) of the following crops from the following types of farming activities?

	Subsistence	Commercial farming	Mixed farming
Livestock			
Beef			
Eggs			
Milk			
Chicken			
Honey			
Bacon			

4. What is the types of livestock do you have in the various types of farming?

	Subsistence	Commercial farming	Mixed farming
Livestock			
Beef			
Eggs			
Milk			
Chicken			
Honey			
Bacon			

5. What is the production do you obtain from the various types of farming?

	Subsistence	Commercial farming	Mixed farming
Livestock			
Beef			
Eggs			
Milk			
Chicken			
Honey			
Bacon			

6. What is the type of farming production in urban agriculture in Eldoret Town:

Home gardening [ ] Open space production [ ]

Urban production [ ] Community based production [ ]

Technology based production [ ]

7. Please indicate crop production values (kg) from different types of farming in Eldoret Town.

Farming production systems	Crop production (kgs)					
Types of farming	Maize	Vegetable	Wheat	Fruits	Beans	Cowpeas
Home gardening						
Open space production						
Urban production						
Community based production						
Technology based production						

8. Please indicate livestock production values (kg) from different types of farming in Eldoret Town.

	Livestock production (kgs/litres)					
	Beef	Eggs	Milk	Chicken	Honey	Bacon
Home gardening						
Open space production						
Urban production						
Community based production						
Technology based production						

Part 3: Input used in urban farming

1. What type of inputs do you use in production in your farms?

Organic manures [ ] Hay/sillage [ ] Extruded animal feeds [ ]

Acaracides [ ] Insecticides [ ] Certified seeds [ ] Fertilizers [ ]

Herbicides [ ]

2. What is the costs you incur in the above inputs

Inputs	Average price per farmer per acre (Kshs.)
Organic manures	
Hay/silage	
Extruded animal feeds	
Acaracides	
Insecticides	
Certified seeds	
Fertilizers	
Herbicides	

Part 4: Technological innovations in urban agriculture

1. What are some of the challenges do you encounter during urban agriculture

Lack of communication among residents [ ] Lack of space [ ]

Poor farm management [ ] Lack of government support [ ]

Poor physical terrain [ ] Lack of safety [ ] Theft [ ]

Lack of agricultural skills [ ] Lack of farm inputs [ ]

Poor community relations [ ] Low returns of production [ ]

Lack of agricultural infrastructure [ ] Land tenure/cost [ ]

Poor council by-laws [ ]