DIMINISHING AGRICULTURAL LAND AND FOOD PRODUCTION IN MAKENI, LUSAKA DISTRICT

By

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(2015130851)

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DECLARATION

I Linda Namakando, hereby declare that this dissertation is my own work. Neither the material nor any part of the dissertation has been submitted in the past, or is being, or is to be submitted for a degree in the University of Zambia or any other University. All published work or material from other sources incorporated in this dissertation have been acknowledged and adequate reference thereby given.

I, therefore, present the dissertation for examination for the Degree of Master of Science in Spatial Planning to the University of Zambia.

Linda Namakando

Candidate

December 2024

Date

CERTIFICATE OF APPROVAL

The University of Zambia has approved this dissertation of Linda Namakando as fulfilling the requirements for the award of the Degree of Master of Science in Spatial Planning.

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Examiner 1	Signature	Date
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Examiner 2	Signature	Date
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Examiner 3	Signature	Date

DEDICATION

I would like to dedicate this dissertation to my Husband Arinze, my two daughters Chimamanda and Chiatoka and my entire family for the support they rendered as I worked on my dissertation.

ABSTRACT

Change in land-use, which causes a decrease in agricultural land, has an impact on food production. This situation is a major concern and a subject of many studies around the globe. The objectives of this study were to estimate the proportion of originally zoned agricultural land in Makeni, to determine the proportion of land converted from Agriculture to other land uses between 1990 and 2017 and to determine the implications of land-use change from agriculture to other uses on food production. In-depth Interviews with 5 key informants from different institutions were conducted. Landowners in Makeni were also interviewed. Surveys with traders in the surrounding markets were also conducted. Unsupervised classification in GIS was used to analyze the spatial data collected. The results obtained from interviews and surveys were analyzed using thematic analysis and the quantitative one was analyzed in SPSS. Land in Makeni was originally zoned for agriculture purposes; however, the results obtained show that the proportion of area covered by built-up land is on the increase, whilst there is a decline in land for Agricultural production. Built-up land increased from 5.1 km^2 in 1990 to 7.4 km^2 in 2000 and a sharp increase to 11.9 km^2 in 2017 was recorded. There was a drastic decrease in Agricultural land from 24.2 km^2 in 1990 to 17.8 km^2 in 2000 and in 2017 it reduced drastically to 13.9 km^2. These results also show that 84 percent of the farmers in Makeni experienced reduced Agricultural production. The survey conducted among the traders revealed that 90 percent of the traders witnessed reduced purchase of agricultural produce. Seventy-five percent (75%) of the farmers who maintained agricultural land-use reported a decrease in crop yield, potentially due to factors such as soil degradation or changing climate conditions, while the study indicates that only 16% observed an increase. Approximately 300 properties changed land-use from agriculture to residential in Makeni between 2010 and 2016. The desire for more accommodation as the city expands has influenced the land-use changes, which have led to a drastic reduction in agricultural land in Makeni. This has negatively affected the amount of agricultural production in the study area and has led to increased food prices in Lusaka as most food is sourced from other districts. Therefore, there is need for strict compliance to zoning regulations in the City. There is also a need for farmers in the city to be incentivized to continue engaging in agriculture production as this will help to improve food security in Lusaka.

Key Words: *Diminishing Agricultural land: Land-use change; Food production.*

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LIST OF ABBREVIATIONS

CSO	Central Statistical Office
FAO	Food and Agriculture Organisation
FCC	False Color Composites
FCT	Federal Capital Territory
GDP	Gross Domestic Product
GIS	Geographical Information Systems
JICA	Japan International Cooperation Agency
LCC	Lusaka City Council
LIMS	Lands Information Systems
LPPA	Lusaka Province Planning Authority
PWDRE	Plans, Works, Development and Real Estate
SPSS	Statistical Package for Social Sciences
URPA	Unified Rating of Professional Arm-wrestling

CHAPTER ONE: INTRODUCTION

1.1 Background

The world's population is increasingly becoming urbanised. By 2050, it is estimated that close to 70 per cent of the world's population will be living in urban areas with a world population of over 6.7 billion people (Bocquier 2005; United Nations 2018). In particular, Africa's urban population is growing at a very high rate. The urban population increased from 27 per cent in 1950 to 40 per cent in 2015 and is projected to rise to 66 per cent by 2050 (United Nations 2014). Rural urban migration is one of the major causes of the rapid increase of urbanites in most cities in the Global South (Lall et al. 2006). The population of Zambia increased from 7,759,117 in 1990 to 9,885,591 in 2000, 13,046,508 in 2010 and is now estimated to be over 18 million (Central Statistical Office 2011). Over 44 per cent of the country's population lived in urban areas in 2018 (Plecher 2020). The high rate of urbanisation in cities in the Global South has brought a lot of environmental, cultural, social and economic impacts (Thuo 2013).

Meanwhile, among the most pressing needs of any urban agglomeration is to achieve food security. Urban populations depend on reliable, availability of food products as well as convenient access to them. This means that urban populations need available, affordable and accessible food to in order to be considered food secure (Van Dijk *et al*, 2012). The land-use changes that occur in the periphery of large urban concentrations due to urbanization and industrialization frequently exert pressure on urban land use resulting in losses of prime agricultural lands (Ojeifo, 2005). In the Global South, land use change has adversely affected people's food security due to the fast rate at which agricultural land is diminishing in preference for other land uses such as industrial, commercial and residential uses (Wang et al. 2016).

In sub-Sahara Africa, most cities are losing the balance in their food production due to the loss of agricultural land to built-up expansion. According to Weng Q (2012), defines Built-up area as the proportion of land that is dominated (more than 5% in cover) by non-vegetated, human-constructed elements, such as roads, buildings, runways, and

industrial facilities. A study by the United Cities and Local Government Committee UCLG, 1998 in Dar es Salaam Tanzania illustrated the inadequacies in land use change and control mechanism due to the urbanisation processes which caused a reduction in agricultural land. This saw the marginalisation of urban agriculture despite its relevance in food production, environmental conservation and poverty reduction. It was noted that the reduction in urban agricultural land which occupied 17 per cent of the total surface area in the city in 1993, had visibly reduced to 14 per cent in 1998 and had given rise to reduced food production and poverty in most peri urban areas of the city (UCLG, 1998). The unprecedented rate of urbanization and population increase resulted in the quick disappearance and alteration of agricultural land in urban areas, especially within the Global South. It is estimated that approximately 14 million hectares of agriculture land in the Global South countries were converted into various land uses between 1990 and 2000 (Naab et al. 2013).

Lusaka like many of Africa's capital cities is in the throes of change. Rapid urbanization, globalization and recent economic growth are having a transformative effect on the city spaces. New projects in the form of gated housing complexes, mega malls, international hotels and business parks are changing the urban landscape (JICA, 2009). As such, Lusaka has seen an increase in the land-use changes.

The most common type of land-use change in Lusaka is from agriculture to residential or commercial land uses (JICA, 2009). The number of private housing and commercial developments coming up in the city due to the ever-increasing human population places an increase on the demand for land for housing and commercial developments.

According to Lusaka City Council (2010), between September 2000 and September 2017, approximately 260 properties in Makeni changed land-use from agriculture small holding to other land uses such as light industries, institutions, shopping malls and residential. Therefore, out of all the land-use changed, 206 small holding agriculture lands were converted to residential and commercial uses (LCC, 2010). Not so many studies on diminishing agricultural land and food production have been done in Lusaka. Therefore, this study seeks to analyse the implications that come with diminishing agricultural land due to land-use change on food production in Lusaka.

1.2 Statement of the problem

The rapid growth of Lusaka's population has intensified land-use changes, particularly the conversion of agricultural land to residential and commercial uses. This trend poses a growing threat to urban food security. As urban agriculture declines, the city becomes increasingly dependent on food sourced from distant districts, which raises transportation costs and ultimately leads to higher food prices. The situation is exacerbated by the shrinking availability of land zoned for agricultural use within city limits.

Between 1990 and 2017, Lusaka's population grew from 757,000 to over 2.7 million (CSO, 2018), with projections estimating it will surpass 3 million by 2025. This demographic pressure has driven up demand for housing and infrastructure, particularly in peri-urban areas such as Makeni, Ibex Hill, Lusaka West, and Ngwerere regions historically zoned for urban agriculture. The resulting land-use conversions have not only reduced local food production capacity but also increased the distance between food sources and urban consumers.

This study seeks to assess the implications of diminishing agricultural land on food production in Lusaka, with a focus on Makeni. Understanding this dynamic is critical for informing urban planning strategies that balance development with the need to sustain local food systems.

1.3 Aim of the Study

The aim of the study was to assess the implications of diminishing agricultural land on food production in Makeni, Lusaka.

1.4 Research Objectives

1. To determine the proportion of land converted from Agriculture to other land uses from 1990 to 2017.
2. To explore the major causes of diminishing agriculture land in Makeni.
3. To establish the consequences of land-use change from agriculture to other uses on food production.

1.5 Research Questions

1. What is the size of land that was originally zoned as agricultural in Makeni?
2. How much Agricultural land has been converted to other forms of land-use between 1990 and 2017?
3. What is causing a reduction in land zoned as agriculture?
4. What are the repercussions of reduced agricultural land on food production in Lusaka?

1.6 Significance of the Study

The findings of the study will be of value to relevant planning authorities in Lusaka such as the Lusaka City Council, Lusaka Province Planning Authority, and Ministry of Agriculture in the sense that planners will be able to put in place appropriate measures to protect land which is zoned for urban agriculture around the city to promote increased food production and to safeguard livelihoods of residents in the city. The findings of the study will also contribute to the literature on diminishing agricultural land and food production that may be of use to academicians.

1.7 Structure of the dissertation

This paper is divided into six chapters. Chapter one provides the background to the research, highlights the statement of the problem, aim, objectives and significance of the study. Chapter two presents a literature review while chapter three describes the study area and chapter four outlines the research methodology. Chapter five presents the research findings and discussions and chapter six gives the conclusion and recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature by various authors who provide relevant information on diminishing agricultural land due to land-use change in urban areas around the world and how this has affected food production.

Several studies and publications have been done before from all over the world linking diminishing agricultural land and food production (Azadi, 2010; Dalwai, 2012; Ramakrishnan, 2013 and Govindaprasad & Manikandan, 2014). However, an in-depth analysis of this linkage in the city of Lusaka is missing.

Over the years, agricultural land around major cities has been decreasing rapidly. Because of this, it is feared that productive agricultural land may eventually be depleted and this may have adverse effects on cities' ability to produce their food. Hence, there is a need to understand the concept of diminishing agricultural land and food production.

2.2 Concept of Diminishing Agricultural Land

Land is a basic resource for human society. The rapid pace of economic development along with population growth, urbanization and industrialization exert pressure on this limited natural resource base. Diminishing agricultural land is a process through which there is a rapid pace of economic development along with population growth, urbanization and industrialization exerting pressure on the limited agricultural land around cities (Govindaprasad & Manikandan, 2014). Mostly diminishing agricultural land results from a growing demand for non-agricultural uses and the non-availability of land to meet these demands gradually (Bardhan, 2010). The growing demand for non - agricultural uses and the non-availability of land for meeting these demands gradually results in more and more agricultural land converted to non-agricultural uses.

2.3 Conceptual Framework

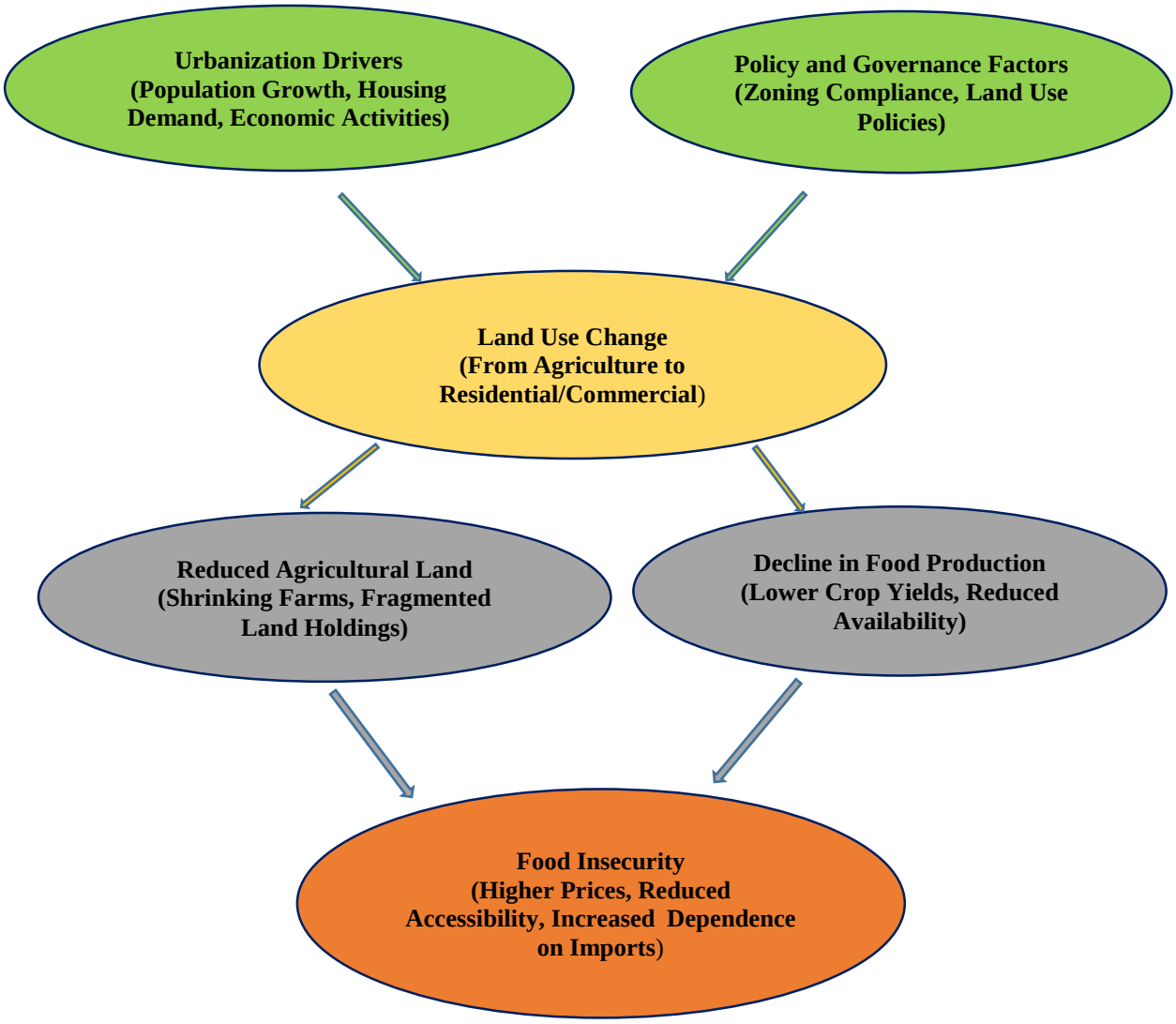


Figure 1: Conceptual Framework

Source: Author, 2024

Independent Variables (Drivers)

Mediating Process (Land Use Change)

Dependent Variables (Outcomes)

Final Outcome (Food Insecurity)

The conceptual framework (Figure 1) illustrates how urbanization, governance challenges, and land-use change interact to reduce agricultural production in Makeni. Population growth and housing demand drive urban sprawl, converting farmland to residential uses, while weak governance fails to enforce zoning, exacerbating land loss. This leads to diminished food production, higher prices, and food insecurity. For example, Makeni's 37.6% agricultural land reduction (1990–2017) directly correlates with increased reliance on external food sources in Lusaka (FAO, 2018).

The conceptual framework demonstrates how urbanization, governance challenges, and land-use changes intertwine to influence agricultural production in Makeni, Lusaka. By connecting the dots between drivers, processes, and outcomes, the framework helps us understand not only the mechanisms behind these challenges but also the pathways to address them effectively. Urbanization is one of the major causes of land use change. Rapid population growth, heightened housing demand, and expanding economic activities are reshaping the landscape, often at the expense of agriculture (Cohen, 2006). For instance, in Makeni, between 1990 and 2017, more than 79 hectares out of 108 hectares of agricultural land were converted into residential and commercial zones due to urban sprawl, leading to a significant reduction in local food production capacity. Similarly, in Jakarta, Indonesia, urban population growth in the 1990s and 2000s converted over 2,000 hectares of rice paddies into residential zones, reducing rice output by 15% and straining governance systems, supporting Cohen's view of urbanization overwhelming developing regions.

Population growth exerts relentless pressure on land resources. As more people move into cities, the demand for residential and commercial spaces grows, pushing urban expansion outward into urban agricultural zoned areas. According to Cohen (2006), this kind of rapid urbanization is a global challenge, especially in developing regions where governance systems struggle to keep up with the rate at which agricultural land is converted into other uses. According to the United Nations (2018), urban populations will account for 70% of the world's total population by 2050. This trend is already playing out in Makeni, where population growth is driving the urban sprawl. A specific example is the rapid expansion of housing estates along Great East Road in the early 2000s, which displaced smallholder farmers and reduced vegetable production, forcing reliance on imports from rural areas. In Lagos, Nigeria, rapid urbanization in the 2000s

saw speculative land sales convert over 1,000 hectares of farmland in peri-urban areas like Ikorodu into housing estates, leading to a 40% reduction in local vegetable production and mirroring Makeni's challenges.

Alongside population growth, the need for housing and the pull of economic expansion often prioritizes short-term gains over long-term sustainability. Angel et al. (2011) argue that unchecked urban sprawl frequently arises from the growing demand for residential and commercial developments. In peri-urban regions, such as Makeni, speculative land sales exacerbate the problem. Landowners and developers find it more lucrative to convert farmland into housing or retail spaces, sidelining agriculture. Ogechi (2014) in Nigeria, where speculative practices accelerate farmland loss, reports a similar trend. In Makeni, for example, speculative land sales in the mid-2010s saw large tracts of farmland near Chainda rezoned for housing, with developers profiting while farmers lost livelihoods and local markets saw vegetable shortages. Likewise, in São Paulo, Brazil, from 2000 to 2010, sprawling housing and commercial developments consumed 1,500 hectares of peri-urban farmland, driven by demand for urban space, aligning with Angel et al.'s theory.

Economic activities, including industrial growth and infrastructure expansion, also play a significant role in land-use changes. Gitau (2018), writing about Kenya, observed how urbanization tends to favour non-agricultural land uses, often leaving farming behind. In Makeni, this pattern is evident in how originally zoned agricultural land has given way to urban development in the form of residential estates and business houses. While economic progress in the form of infrastructure development is essential, it often comes at a cost of reduced agricultural land in peri-urban areas. A notable case is the construction of the Lusaka-Ndola dual carriageway, initiated in 2015, which encroached on farmland in Makeni, reducing maize and vegetable yields and increasing food prices locally. Similarly, in Nairobi's peri-urban zones, such as Kiambu, urban sprawl between 2010 and 2015 consumed over 800 hectares of farmland for residential and industrial use, with maize yields dropping by 30%, reflecting Gitau's observations.

Without clear policies and strong enforcement mechanisms, the balance between urban development and agricultural land preservation becomes skewed. The absence of clear land-use policies or the failure to enforce existing ones creates a vacuum that encourages unregulated land use change from agriculture to other uses. Lambin and

Meyfroidt (2011) reveal that governance gaps allow urban expansion to proceed unchecked, particularly in peri-urban areas where agricultural zones lack formal protection. In the study area in Makeni, more than 79 hectares out of 108 hectares of agricultural land were lost to other uses between 1990 and 2017 due to land use change. This mirrors the findings of van Ginkel (2008), who argues that peri-urban areas are often treated as afterthoughts in national planning. For instance, weak enforcement of zoning laws in the 2000s allowed developers to build shopping complexes on land originally designated for agriculture in Makeni, further shrinking farmland. In Hanoi, Vietnam, weak land-use enforcement in the 2000s allowed 3,000 hectares of agricultural land to be rezoned for industry, reducing vegetable production by 20%, consistent with Lambin and Meyfroidt's argument about governance failures.

Land use change connects urbanization to its socio-economic consequences, as agricultural land is repurposed for non-agricultural uses; in most cases, landowners prioritize profit over sustainable land management (Ginkel, 2008). Similarly in Makeni, such activities have become a major driver of farmland loss, as land intended for agriculture is subdivided and sold for residential purposes. Around the world, urban expansion is encroaching on fertile agricultural land. FAO (2018) warns that this trend poses a significant threat to food systems, particularly in regions where land use change is poorly managed. As cities expand, farmland is often the first casualty, disrupting local food production and economies. In Makeni, the subdivision of farmland near Silverest in the 2010s for housing estates led to a 20% drop in local cabbage production, pushing up prices and affecting food affordability. In Cairo, Egypt, peri-urban farmland shrank by 25% between 1990 and 2010 due to unplanned urban growth, with national planning prioritizing cities over rural zones, reinforcing van Ginkel's point.

In Makeni, land use has become a defining feature of urbanization. Agricultural land is increasingly subdivided and rezoned for housing and commercial purposes. JICA (2009) reported a similar trend in Lusaka, where residential development increased by 15 per cent over nine years, largely replacing farmland. These patterns highlight the urgency of addressing land-use competition between urban and agricultural needs. For example, between 2005 and 2014, the growth of Woodlands Extension in Lusaka consumed over 50 hectares of peri-urban farmland, reducing maize output and increasing dependence on rural suppliers. In Delhi, India, urban expansion from 2000

to 2015 encroached on 12,000 hectares of fertile land, reducing rice and wheat production by 25% and forcing reliance on distant rural supplies, echoing FAO's (2018) concerns.

The outcomes of land use change are far-reaching, particularly for agricultural productivity and food security. Here's how these consequences play out: The most immediate impact of land use change is the shrinking of agricultural land. Appiah et al. (2019) and Abdullahi (2012) show that land use change reduces agricultural efficiency by reducing the available productive land zoned for agriculture and creating small, uneconomical plots and business houses. In Makeni, a 37.6 per cent reduction in agricultural land over 27 years highlights the severity of this issue. A specific case is the conversion of farmland near Roma Township in the 2010s into small residential plots, which fragmented fields and made mechanized farming unfeasible, cutting yields by nearly 30%. In Kumasi, Ghana, between 1995 and 2015, urban growth shrank agricultural land by 35%, fragmenting farms into small plots and reducing crop yields by 20%, aligning with Appiah et al.'s findings.

With less land available for farming, food production inevitably declines, especially in the absence of intensive agriculture (Gitau, 2018). Farmers in Makeni have reported reduced crop yields, particularly for vegetables like cabbages and pumpkin leaves. Gitau (2018)'s study in Kenya observed comparable declines in staple crop yields due to urban encroachment. This trend underscores how urbanization disrupts food systems at the local level. For instance, in Makeni, the loss of farmland near Chamba Valley to housing in 2016 led to a 25% drop in pumpkin leaf harvests, forcing vendors to source from distant regions at higher costs. In Nairobi, Kenya, urban sprawl in Kiambu reduced maize yields by 30% between 2010 and 2015, reflecting Gitau's observations.

It is safe to argue that the most serious consequence of agricultural land use change is reduced agricultural production. As agricultural output falls, reliance on food imports increases, driving up prices and reducing accessibility for low-income households. FAO (2012) stresses that urbanization-induced farmland loss threatens food security globally. Similarly, van Dijk et al. (2012) note that higher transportation costs for imported food disproportionately affect the urban poor. In Makeni, these dynamics are already evident, as residents become increasingly dependent on agricultural produce from outside districts like Chongwe and Chisamba. For example, after farmland near

Ibex Hill was converted to commercial use in 2018, local maize prices rose by 15%, hitting low-income families hardest. In Mexico City, urban expansion from 2005 to 2015 reduced peri-urban farmland by 10,000 hectares, cutting local maize production by 30% and increasing import dependency, validating FAO's (2012) warning about global food system risks.

2.4 Proportion of land converted from agricultural to other land uses

Globally, there has been a massive conversion of prime agricultural land in urban areas into real estate and commercial developments in the past few decades (FAO, 2017) due to the increases in human population and per-capita consumption which are putting enormous pressure on land resources (McConnell & Viña, 2018). According to FAO (2018), about 38 per cent of the Earth's land area is being used for agricultural production with about 12 per cent of the remaining land being under forest cover and the other 50 per cent being less suitable for agricultural production due to edaphic, topographic and climatic factors. The continued growth of and unrenewable nature of land supply creates fierce land-use competition between the agricultural and non-agricultural sectors. Azadi, Ho and Hasfiati, (2011) argue that this gives rise to agricultural land conversion which significantly reduces agricultural land availability and threatens food production. Ironically, the highest rate of agricultural land conversion occurs in developing countries due to high population growth, this is because human population has brought about peri-urban growth, leading to competition for limited land resources (FAO, 2011; Appiah et al., 2019). The process of urbanization has led to the rapid conversion of large prime agricultural lands to urban land-use in the peri-urban areas (Appiah *et al*., 2019). Hence, agricultural activities have come into conflict with alternative economic, residential, and commercial interests.

Busko and Szafranska (2018) noted that changes occurring to agricultural land are advanced and, despite its legal protection in some cases especially in the western world, the land has been continuously subjected to permanent conversion to non-agricultural use year by year. In Poland, Busko and Szafranska (2018) found that as much as 68 per cent of the land converted to non-agricultural use in was earmarked for agricultural use. This case is similar to other parts of the world. Rondhi *et al*., (2018) states that the rate of agricultural land conversion in Indonesia is 187 720 hectares per year, and most of

the land converted from agriculture has been used for housing and industrial site development. Housing development accounted for 48.96 per cent of converted agricultural land, followed by industrial (36.50%) and offices building development (14.55%) (Rondhi *et al*., 2018). The major cause of agricultural land conversion in Indonesia is the high demand for land for non-agricultural uses. (Rondhi *et al*., 2018).

In most parts of Africa, the peri-urban areas have been noted to have a higher growth rate in population as the cities expand outward encroaching into the prime agricultural lands in the peri-urban areas. In Kumasi, Appiah *et al*., (2019), illustrates how high demand for land for residential, industrial, and commercial purposes in Ghana has led to decreased farmlands, resulting in low agricultural productivity and food insecurity in peri-urban areas of that city. In addition to this, Gitau (2018) found that an increase in population in Keumbu Region in Kenya led to the conversion of land from agricultural into human settlements. The researchers discovered that forestland and grassland in Keumbu region were reduced by 38 per cent and human settlements increased by 62 per cent.

Furthermore, a study by Gitau (2018) revealed that agricultural land is reducing at an alarming rate by being converted to built-up areas in Kenya. In Keumbu agricultural land had reduced from 8429.67 hectares in 1995 to 4376.52 hectares in 2018 meaning that 4053.15 hectares of prime agricultural land had been converted into built-up areas within 23 years. In terms of percentage, agricultural land declined by 38.02 per cent within 23 years.

Judging from the above literature, the competition between agricultural and non - agricultural use of land an on-going one and agricultural land have been diminishing due to demand for land for non-agricultural uses.

2.5 Agricultural Land-use Change and food Production in the world

Land-use conversions play a crucial role in determining the amount of food production (Appiah *et al*., 2019). Globally, agricultural land-use conversions into other uses have been of great concern whereby farmlands and other fertile agricultural land parcels are being developed with residential estates (Appiah *et al*., 2019). This has accelerated the negative consequences of reduced agricultural land for agricultural, especially food

production (Appiah *et al*., 2019). It is also important to note that globally, agricultural land is dwindling as years goes by. This has posed a serious food crisis in the long term especially in African countries where increased agricultural production is usually achieved through intensification (use of more land) and not (use of more inputs such as fertilizers) (FAO, 2017). According to Sun (2018) the spatial patterns and configuration of land use, changes in land tenure, and land-use intensification all have profound implications on food security.

Agricultural land conversion has affected agricultural production posing a serious threat to food security in most developing countries (Gitau, 2018). In Kenya, food production has been threatened due to changes in land-use and land cover which has seen a large amount of agricultural land being converted into urban land uses such as residential, commercial and industrial uses (Musa & Odera, 2014; Gitau, 2018). The rate at which agricultural land is being converted to other urban land uses surpasses the ability of the currently available land to provide food to the growing population in most developing countries. The increase in urban population exerts high pressure on available land with agricultural land suffering more as it is converted into built-up areas at an alarming rate (Gitau, 2018). Agricultural land has suffered a great reduction to pave way for residential, commercial, industrial, institutional and recreational use. Conversion of agricultural land has reduced the production capacity of agricultural farms due to a reduction in sizes.

Gitau (2018), further revealed that population increase led to the sub-division of prime agricultural land into small uneconomical units in Kenya. This has greatly reduced agricultural production in most areas originally zoned for agriculture despite efforts to intensify farming. The major constraints leading to the reduction in the production of maize, beans, coffee and tea in Kenya is the diminishing of prime agricultural land for example, some of the farms initially used for growing maize and coffee were replaced by built-up areas through the construction of modern residential units for sale and rental (Gitau, 2018).

FAO (2009), however, argues that Food production growth in recent decades has been impressive. In the developing world, the production of major staples such as rice, maize, and wheat has increased impressively because of the green revolution. In many developed countries, surplus production is being recorded year after year, partly due to

large subsidies. Food production increased by 24 per cent worldwide, and by 39 per cent in developing countries, during the most recent decade (FAO 2009). Particularly large increases were observed in China and the Far East, 54 and 46 per cent, respectively. Even in Africa, where concerns regarding the future food situation are greatest, and food production increased by 33 per cent. However, food production growth is much less impressive when compared to the availability of agricultural land and population growth. More agricultural productive land is converted to built-up area, especially in the developing world (FAO, 2009).

Land-use change is contributing to the diminishing of agricultural land in many cities around the world. Van Dijk *et al*, (2012) note that food production in Vietnam and the rest of the world deteriorates due to a rise in land-use changes. In Vietnam, agricultural land where the traditional paddy rice is cultivated has been reducing steadily since 2000. In 2000, the country had 3.8 million hectares of paddy rice land and was exporting most of its products around the world (Van Dijk *et al*, 2012). However, an analysis shows that by 2005, there was a strong desire for agricultural land conversion to urban development. Hence, reducing paddy rice land into built-up land was required for industrial expansion and urbanisation. This led to a significant reduction in the production of paddy rice affected the staple food production of Vietnam as a nation and reduced its rice exports to different countries around the world. Apart from the decrease in rice production in Vietnam, the world grain stocks were noted to have dwindled to dangerously low levels, highlighting the fragility of food supplies in a world where the population is expected to rise (FAO, 1999).

Other notable studies on diminishing agricultural land and food production have been done in China by Li Jiang et al (2012). According to Li Jiang *et al.* (2012), China's urbanization has resulted in a significant decrease in both agricultural land and agricultural land use. Agricultural land in China has been reducing due to urbanization, however, China has recorded an increase in agriculture production despite decreased agricultural land. The results revealed that a decrease in agricultural land has resulted in an increase in agricultural production due to intensified use of chemicals to increase production hence putting pressures on the country's natural environment (Li Jiang *et al*,. 2012). The findings of this study are contrary to many studies of this nature as most

of studies on diminishing agricultural land and food production usually record a decrease in agricultural produce as agricultural land decreases.

The impact of changes in land use change consequent on food production is a major concern and a subject of many studies recently. For instance, analysis of the conversion of other land cover categories to built-up land was done in Anyigba Nigeria by Ejaro, (2012). The study shows that agricultural land lost a lot of land to built-up area, and this had implications in the long run on food production, food security and maintenance of the biodiversity environment. The development of the State University in Anyigba saw a rise in the demand for land for residential and other developments. Therefore, most agriculture land in this place was taken up and converted to residential houses for the university staff and also those that offered business services to the university required land on which they would build their buildings such as internet cafeterias, restaurants and other office spaces. Within two years, agriculture land visibly reduced in size around the town and this had implications on the food production and food security of the area because a decrease in agricultural land meant a decrease in agricultural produce, thereby resulting in a rise of prices and shortage certain food, especially local farm produce (Ejaro, 2012).

Bernard and Waithaka, 2014 explored land-use changes, food production trends and main drivers behind deteriorating agricultural land and implications on food production and security in Keumbu region Kisii county, Kenya. The findings of this study revealed that Agricultural land fragmentations and urbanization led to a decrease in agricultural land and food production leaving the urban livelihoods food insecure. Forestland and grassland reduced by 58 per cent and 91 per cent while Cropland and settlements increased by 11 per cent and 0.6 per cent respectively. The decrease in Agricultural land shows a negative trend impacting food production with a decrease of 29 per cent over 5 years.

Urbanization threatens food supply drawing from the fact that, as cities grow, they affect agricultural land because they expand into surrounding areas of agriculture and this greatly affects local food production. An immediate consequence of rapid urbanisation is the crowding out of agricultural land, and the reduction of agricultural capacity by most cities in Kenya. Loss of agricultural land through land-use change is

the major factor causing food insecurity by reducing food production and employment opportunity at the same time increasing the price of agricultural products (Njiru, 2016).

Other notable studies on land use change and food production have been done in Choma Southern Zambia by Land Alliance Zambia. The fact that most urban agricultural land is in the hinterlands of the cities means that most of this land is swallowed up in the course of suburbanization (Ejaro, 2012). The study revealed that most Villagers that had farm lands around the town area resorted to selling it for urban development and moved further to settle away from the city in search of new farming areas. Land Alliance Zambia ascertained that Agricultural land in Choma, Zambia has been decreasing steadily over the years. It was stated that most of the changes in agricultural land happened 2010 to 2017. This was mainly attributed to the demand for land for built up area as the population increased (Land Alliance Zambia, 2011). The increase of built-up area at the expense of encroachment of the built-up area on family agricultural land in the town is attributed to the rise in the town's population especially from the time it was declared Southern Province Provincial Headquarters in 2011.

In addition, expansion of the built-up area by the civic leaders has resulted into loss of agricultural land with people being evicted from the land they had been farming on and grazing their animals for decades due to the commercialization of land in the district (Land Alliance Zambia, 2011). This loss of agricultural land has affected food production, especially of the staple food crop (maize) which many families depend on for consumption and for sale.

As noted from the above literature review, many studies around the world have been conducted and are still being conducted on diminishing agricultural land and food production. However, in Zambia specifically Lusaka, not many studies have been done on the implications of diminishing agricultural land and food production.

2.6 Overview of Agricultural Land in Lusaka

Urban agriculture has been an important part of city life in Lusaka. However, the importance of agriculture has reduced over the years as agricultural land gives away to urban development. As Lusaka built-up area expands, particularly in Makeni, more and

more agriculture productive land is taken up for urban purposes leaving little scope for long term practice in the urban agricultural sector (JICA, 2009).

According to JICA (2009), agricultural land is defined as irrigated land and other related areas including mixed patched cultivation area and zoned agricultural land. Agricultural land in the city of Lusaka is mostly in the peri-urban areas to the south, west and east of the city. These areas include Makeni in the south of the city, Ibex hill to the east of the city and many other areas around the city. The total area of agricultural land in Lusaka has decreased from 397 km² in 2000 to 285 km² in 2009. Residential development and some industrial developments have taken over agricultural land (JICA, 2009).

JICA, (2009) indicates that residential areas in Lusaka including formal settlements, informal settlements and rural smallholdings have drastically increased shares from 35 per cent to 50 per cent, out of a total land area of the City. Meanwhile, a large decrease of zoned agricultural lands in urban fringes has decreased from 47 per cent to 14 per cent (JICA, 2009).

Geographical distribution of land-use change is identified in the areas along Kafue Road which indicate incidences of change of use from agricultural to industrial, and urban sprawl of residential areas in the southern and northern part of Lusaka on agricultural land. Built-up area has increased its share from 43.5 per cent to 63.7 per cent, out of the total land area of Lusaka City and most of these developments took place on former agricultural land (JICA, 2009).

2.7 Urban Agriculture and food production in Lusaka

The majority of farmers in Lusaka City are small-scale farmers, presently producing cabbages, tomatoes, green beans, rape, Chinese cabbage, eggplants, peas and tomato as fresh vegetables to city consumers and home consumption, while commercial farmers have settled outside Lusaka City, Chongwe and Chisamba districts, with large capital investment to manufacture domestic and export-oriented products (JICA, 2009).

It is recognised that cities nowadays use too many natural resources (UN Habitat, 2010). The ecological footprints of cities are stamping out the habitat of many species

including agricultural produce due to the loss of agricultural land. The city's impact stretches far beyond its physical boundaries. Cities are confronted with an increasing number of people and, therefore, an increasing number of mouths to feed. Along with other initiatives and activities, urban agriculture, therefore, has an important role in contributing to the urban food production of cities (UN Habitat, 2010).

As noted from the above literature review, many studies around the world have been conducted and are still being conducted on diminishing agricultural land and food production. However, in Zambia specifically Lusaka, not many studies have been done on the implications of diminishing agricultural land and food production.

CHAPTER THREE: DESCRIPTION OF STUDY AREA

3.1 Introduction

This chapter gives a brief description of the study area. Apart from that, it specifically defines where the study was conducted, reasons for choosing the area and the geographical and social-economic features of the study area.

3.2 Location of Study Area

Lusaka is the administrative and capital city of Zambia. It is located between longitudes 22º-34º east and latitude 9º-18º south. The city has a total landmass of 21,896 square kilometres. Lusaka's topography consists of crystalline metamorphic rocks and dolomite which are commonly referred to as Limestone (JICA, 2009). The city experiences a tropical climate which is mainly characterised by long dry season and the wet season and the vegetation characterised by savannah woodlands. Lusaka's topography is generally flat land with escarpments in the north eastern part of the city that falls in to the Luangwa escarpment.

Lusaka is the most populated city in Zambia, the population growth in Lusaka greatly influences the settlement and its development dynamics. The population of Lusaka increased from 796353 in 1990 to 1,084703 in 2000. In 2010, the population increased to 1,747,152 (CSO, 2012). In 2010, Lusaka had an annual average growth rate of 4.9 per cent. The population is currently estimated to be close to three million people. Meanwhile, According to CSO, 2012, Makeni had a population of 216,0800 in 2010. The specific number of housing stocks remains unknown.

The city is a hub to various socio-economic activities including trade and commerce, agriculture, manufacturing, service sector, real estate, construction and tourism. Lusaka city is expanding towards the periphery with most developments occurring on agricultural land. The growing population has put a demand on agricultural land which has caused a decrease in Agricultural land.

Figure 2 shows the location of the study area of Makeni (composed of Farms 50a and 401a) which is one of the peri-urban areas in the South-West of Lusaka originally zoned for urban agriculture (JICA, 2009).

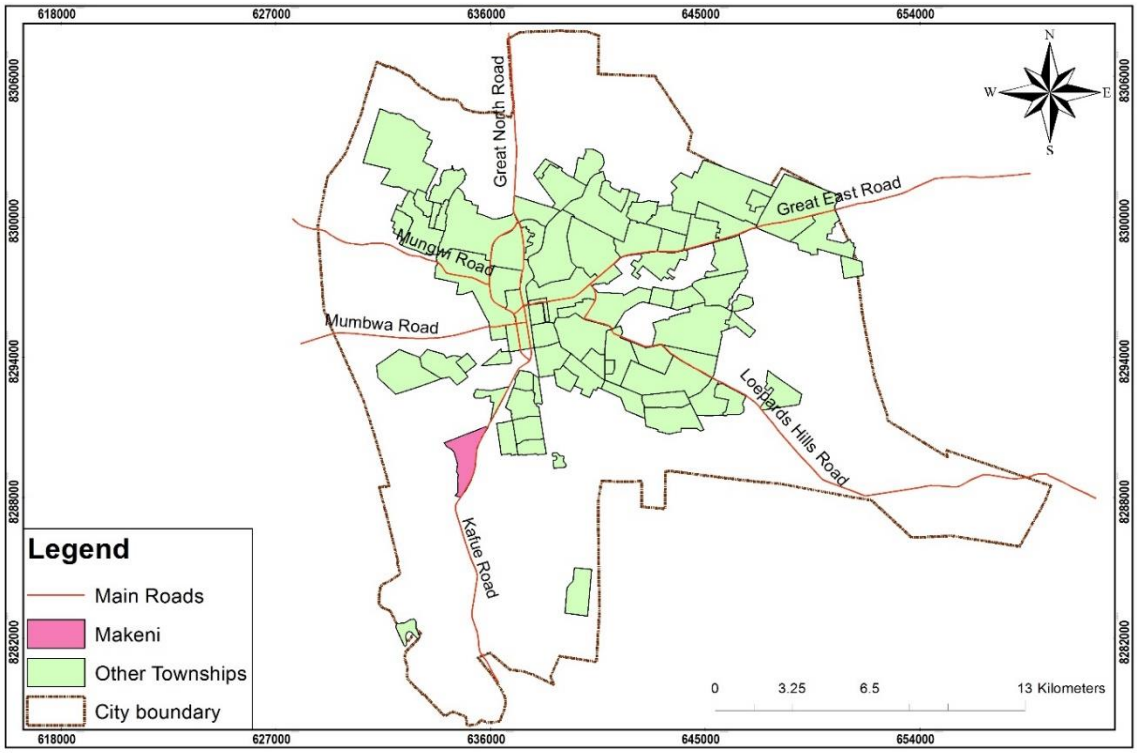


Figure 2: Location of Makeni in Lusaka District

Source: Author, 2017.

3.3 Justification of Study Area

According to Flyvberg, (1999), the selection of a study area is highly dependent on how rich the information is in the study area for a particular subject. The main rationale for the choice of study area is due to the multi-development projects that are going on in Makeni, especially on former agricultural land. Makeni is one of the peri-urban areas that has seen multiple land-use changes from agricultural to other uses. The origins of Makeni are unclear. However, the Livingstone Mail reported that in 1914 Major Boyd Cunningham had a farm called Makeni in Lusaka, which later became subdivided and extended into many small holding agricultural land and commercial farms. Most farmers in the area practice market gardening and supply their produce to the city with little export mostly from commercial farmers (LCC, 2010).

3.4 Soil Type in Makeni

Makeni's designation as an agricultural zone is significantly influenced by its soil characteristics, which are conducive to farming activities. The broader Lusaka region, including Makeni, is underlain by crystalline metamorphic rocks and dolomite, commonly referred to as limestone, as noted in the dissertation (JICA, 2009). These geological formations contribute to the development of fertile soils, particularly loamy and clay-loam types, which are prevalent in Zambia's peri-urban agricultural zones. In Makeni, the soils are likely to be moderately deep and well-drained, with a mix of sandy loam and clay loam textures, enriched by the weathering of dolomite and limestone. Such soils offer good water retention and nutrient availability, making them suitable for a variety of crops grown historically in the area, such as maize, cabbages, rape, and pumpkin leaves.

The presence of limestone parent material suggests a neutral to slightly alkaline pH, which supports the cultivation of vegetables and staple crops commonly produced by small-scale farmers in Makeni before significant land-use changes occurred (JICA, 2009). Makeni was originally zoned for urban agriculture, with both commercial and smallholding farms supplying produce to Lusaka. This agricultural productivity is underpinned by soil fertility, which, while not immune to degradation from urbanization pressures historically provided a strong foundation for farming. Thus, the soil type in Makeni, characterized by its fertility and structure derived from the region's geology, has been a key factor in establishing it as an agricultural zone.

3.5 Vegetation

The natural vegetation of Makeni reinforces its suitability as an agricultural zone, reflecting an environment historically supportive of farming. Lusaka, including its peri-urban areas like Makeni, is characterized by savannah woodlands, a vegetation type typical of Zambia's Central Plateau. Chidumayo (2013) describes this as miombo woodland, dominated by species such as *Brachystegia*, *Julbernardia*, and *Isoberlinia*, interspersed with open grasslands (Chidumayo, 2013). In Makeni, this vegetation likely provided a landscape that was relatively easy to clear and cultivate, a critical factor in its early designation for agriculture. The dissertation notes that Makeni's origins trace

back to a farm established in 1914, later subdivided into smallholding agricultural plots, indicating that the savannah woodland was adaptable for farming.

The miombo ecosystem supports agriculture by contributing organic matter from grasses and leaf litter, enhancing soil fertility when cleared and cultivated (Frost, 1996). This process likely benefited early farmers in Makeni, enabling the production of crops like maize and vegetables. While urbanization has reduced this natural cover, with built-up land increasing from 5.1 km² in 1990 to 11.9 km² in 2017, the historical presence of savannah woodlands provided an ecological foundation for agricultural development. This vegetation, combined with human intervention to maintain cleared fields, underscores Makeni's identity as an agricultural zone prior to significant land-use changes.

3.6 Rainfall Pattern

Rainfall patterns in Makeni play a pivotal role in its classification as an agricultural zone, providing essential water resources for crop production. Lusaka, encompassing Makeni, experiences a tropical climate with distinct wet and dry season. According to Nicholson et al. (2018), Zambia's Central Province, including Lusaka District, receives annual rainfall averaging 800 to 1,000 mm, concentrated between November and April (Nicholson, et al., 2018). In Makeni, this rainfall regime supports a single growing season, ideal for rain-fed crops such as maize, tomatoes, and leafy vegetables like rape and pumpkin leaves, which were predominant before land-use changes intensified.

Hachigonta et al. (2010) confirm that Lusaka's rainfall, averaging around 900 mm annually, ensures sufficient soil moisture during the wet season, critical for market gardening as practiced in Makeni (Hachigonta, S., et al., 2010, "Climate trends and variability in Zambia: Implications for agriculture," *Climate Research*, 43(3), pp. 177-188). The flat topography of Lusaka, including Makeni (Chapter Three, Section 3.2), minimizes runoff and enhances water infiltration, further supporting agricultural viability. However, the dissertation notes potential yield declines possibly linked to changing climate conditions (Abstract), a concern echoed by Hachigonta et al. (2010), who highlight increasing rainfall variability in recent decades. Historically, though, the consistent wet season rainfall has underpinned Makeni's agricultural productivity, enabling it to supply Lusaka with fresh produce before the documented land reduction from 24.2 km² in 1990 to 13.9 km² in 2017 (Abstract). Thus, Makeni's rainfall pattern,

typical of Zambia’s tropical savannah climate, has been instrumental in sustaining its agricultural character

CHAPTER FOUR: RESEARCH METHODOLOGY

4.1 Introduction

This chapter describes how the study was conducted and the methods that were used to collect and analyse data in order to achieve the research objectives. It gives an overview of the methods and techniques that were used in the study.

4.2 Research Design

A case study research design was used in this research applying both qualitative and quantitative research techniques. Face to face interviews with key informants were conducted. The study used snowball sampling to identify households/properties that changed land use. Snowball sampling is a non-probability sampling method that involves asking research participants to identify/recruit other potential subjects or acquaintances for a subject of study (Babbie, 2001). In addition to this, the historical functionality imbedded in Google Earth was used to identify the first property that changed land use.

4.3 Data Types and Sources

Primary data was obtained through face-to-face interviews with respondents from selected households in Makeni. This was done to obtain first-hand information on how change of land-use from agricultural to other uses has affected food production. Key informant interviews were also conducted with various stakeholders which included; the Lusaka City Council (LCC), Lusaka Province Planning Authority, Ministry of Agriculture and Ministry of Lands and Natural Resources.

Due to logistical constraints, interviews with the Ministry of Local Government and Rural Development, which approves land-use changes, were not conducted. To address this gap, a policy analysis of the Town and Country Planning Act (2015) was undertaken, supplemented by media reports (Lusaka Times, 2017). These sources indicate that the Ministry often prioritizes urban development, facilitating land-use conversions in Makeni with limited agricultural preservation measures.

Questionnaire surveys were also conducted with households and respondents from the selected nearby markets. These markets included; Chawama market, Kanyama market and Makeni Simpson market.

Secondary data was obtained mainly through a review of published and unpublished literature, books, documents and journals from the relevant planning institutions. Another source was the use of Landsat satellite images using time series analysis to observe the change process from agricultural land to built-up area in Makeni using three distinctive satellite images of three time periods, 1990, 2000 and 2017.

Unsupervised classification was used to determine built-up areas for the three-time periods. Unsupervised classification is a form of pixel-based classification and is essentially computer automated classification. The user specifies the number of classes and the spectral classes are created solely based on the numerical information in the data (i.e. the pixel values for each of the bands or indices). Clustering algorithms are used to determine the natural, statistical grouping of the data. The pixels are grouped together based on their spectral similarity. The computer uses feature space to analyse and group the data into classes. While the process is basically automated, the user has control over certain inputs. This includes the Number of Classes, the Maximum Iterations, (which is how many times the classification algorithm runs) and the Change threshold percentage, which specifies when to end the classification procedure. After the data has been classified the user has to interpret, label and colour code the classes accordingly (Enderle, and Weih, 2005). Since the results of unsupervised classification use all the pixels as training samples, it is expected to obtain probably more accurate parameters including the mean vectors and the covariance matrix. Unsupervised classification is fairly quick and easy to run. There is no extensive prior knowledge of the area required, but one must be able to identify and label classes after the classification. The classes are created purely based on spectral information; therefore, they are not as subjective as manual visual interpretation (Braiassoulis, 2000).

In order to establish the size of agricultural land converted to built-up area, a times series analysis of three time periods (1990, 2000 and 2017) using Landsat satellite images was a visual image analysis of Google images was also conducted. High-resolution images from Google Earth were also used to visualise the changes in the study site and the images were picked ten years apart and for the same season (See

Table 1). In order to determine the implications of diminishing agricultural land on food production, the size of agricultural produce in the three-time periods were assessed and also a survey among traders on their sources of agricultural produce, how much produce they acquired from Makeni during the three-time periods and where they bought other agricultural products that that cannot be accessed from the study area.

Table 1: Satellite data used in the study

Year	Satellite	Resolution (m)	Path/Row	Observation date
1990	Landsat 5 TM	30	172/071	25th September 1990
2000	Landsat 7 TM	30	172/071	14th October 2000
2017	Landsat 8 OLI/TIRS	30	172/071	30th August 2017

Source: Author, 2017

4.5 Sampling Frame

The sample for this study included, one (1) officer from the Ministry of Agriculture, one (1) officer from Lusaka Province Planning authority, two (2) Officers from Lusaka city council, one (1) executive member of the Zambia Institute of Town Planners were interviewed. Questionnaires were administered to twenty (20) property owners whose property changed land use, and another twenty (20) to property owners who did not change land use in Makeni and 30 marketers from nearby selected markets.

4.6 Sampling Technique

To get relevant and correct information, respondents should be selected using an appropriate technique for their fair representation and for generalization after the study is completed (Baden and Major, 2013). This study used purposive sampling for selecting the study area. The households whose properties had changed land-use were

selected using snowball sampling. Purposive sampling was used for selecting the key informants from the selected institutions because of their expertise on diminishing land in Makeni as well at its implications.

4.7 Data Analysis

The study used thematic analysis to analyse the qualitative data collected from key informants from various institutions concerned with land, land-use change and food production in order to know the roles played by these institutions in land-use change and also to know the original zoned agricultural land in the study area. Descriptive statistics was used to analyse the quantitative data collected from the survey of the traders and was presented through charts, graphs and tables. Descriptive statistics are brief descriptive coefficients that summarize a given data set, which can be either a representation of the entire population or a sample of it (Babbie, 2001).

The Landsat images for 1990 ton 2000 and 2017 obtained from https://earthexplorer.usgs.gov/ underwent Atmospheric correction. They were also geo-referenced to orient the images to WGS 1984 UTM zone 35 South. The mages were classified using an unsupervised classification in Geographic Information Systems (GIS) and used to analyse the rate of land-use change and the rate at which agricultural land is diminishing in the study area.

The clustering algorithm represented by K was used to classify the Landsat satellite images into agriculture and built-up land classes. The K-means classifier executes the land cover land use classification based on the similarity of samples and classes centres are grouped through iteration until the best clustering results are obtained. The unsupervised classification was used because the study area is generally small (419 hectares) and homogenous hence prior knowledge was not required (Phiri and Morgenroth, 2017). The image classification was done over and over to ensure that the accuracy was above 75 per cent.

CHAPTER FIVE: FINDINGS AND DISCUSSIONS

5.1 Introduction

This chapter presents the research findings and discussions on the impact of diminishing agricultural land on food production in Makeni, Lusaka, from 1990 to 2017. Using GIS analysis, interviews, and surveys, the study found that agricultural land decreased from 24.2 km² in 1990 to 13.9 km² in 2017, while built-up areas expanded from 5.1 km² to 11.9 km², driven by population growth and housing demand. Approximately 300 properties shifted from agriculture to residential use between 2010 and 2016. This land-use change reduced agricultural output, with 84% of farmers reporting lower yields and 90% of traders noting decreased local produce availability. Consequently, food prices rose as Lusaka increasingly relied on distant districts like Chongwe and Chisamba, exacerbating food insecurity for the urban poor.

5.1.2 Demographic Profile of Respondents

The study captured the demographic information of the respondents to have an appreciation of the characteristics of the participants in the study. The majority of the respondents in the study area were above 56 years of age. Seventy (70) per cent were male and 30 per cent were female. It is also important to note that 70 per cent of property owners indicated that they had changed land use, this was evidenced by 90 per cent of traders who ascertained that the study area had experienced land-use changes (Table 2)

Table 2: Demographic Profile of Respondents

Factor	Property owners who changed land use		Property owners who did not change land use		Traders	
	f	**%**	**f**	**%**	**f**	**%**
Gender						
Male	7	70	6	60	3	10
Female	3	30	4	40	27	90

Age						
35-45 years	1	10	1	10	7	23.3
46-55 years	3	30	2	20	11	36.7
56-65 years	4	40	4	40	11	36.7
66-75 years	2	20	3	30	1	3.3

Source: Author, 2017.

5.1.3 Proportion of Land Converted from Agriculture to other Land uses in Makeni

Interviews with a key informant from the Provincial Planning Authority reviewed that land-use changes in Makeni were a mix of planned and unplanned processes. Of the 10.3 km² agricultural land lost (1990–2017), 79 hectares were formally approved by the Lusaka Province Planning Authority (LPPA) for residential and commercial uses (Field Data, 2017). However, informal conversions occurred due to weak enforcement, with developers subdividing farmland without approval (Lambin & Meyfroidt, 2011). Public participation was limited, with LPPA interviews indicating minimal community consultations, highlighting a governance gap that facilitated rapid land loss (JICA, 2009).

According to the attribute-based analysis conducted in Arc GIS 10.4 for the study area Farm 50a was originally 108 hectares while Farm 401a was 311 hectares. In 1972, the first subdivision with an area of 19, square meters (100m x 195m) was done. From the 1990s, more and smaller subdivisions were done. The study area now has small plots with an area of 540 square meters having dimensions of 36 x 15m (Figure 3)

Figure 3: Subdivisions done on Farms 50a and Farm 401a

Source: Author, 2017

5.2 Major Causes of Diminishing Agricultural Land

A key informant from LPPA revealed that, "Lusaka has seen a rise in the number of land-use changes mostly from agriculture to residential or commercial. Between 1990 and 2017, LPPA facilitated the change of land use of approximately 178 properties in the study area which translates to 79 hectares of land from agriculture to other uses such as residential and commercial in Makeni".

The findings of this study are similar to those of Bernard and Waithaka (2014) where the average size of agricultural land owned by a family in Keumbu region in Kenya was reduced by at least 0.5 hectares per annum, between 2000 and 2005. This means that families were losing huge pieces of land in the long run and this saw a decrease in food

production. However, built-up area on the other hand was experiencing an increase of 1.0 hectare per annum (Bernard and Waithaka, 2014).

By virtual of being the Capital City of Zambia, Lusaka attracts a lot of Light industries, service industry and the construction industry influence, much of the expansion primarily through casual jobs. The city's population has been increasing due to rural-urban migration, urban to urban migration and natural growth rate (CSO, 2010). According to CSO (2017), Lusaka's total housing stock stands at approximately 300,000 units. Of this, 10 per cent, or 30,000 units, is formal housing i.e., formal dwellings on individual stands, in blocks of flats, or on agricultural holdings accommodating 30 per cent (340,000) of the city's population on about 80 per cent of the residential land. The remaining 90 per cent of the land in Lusaka consists of squatter units, accommodating about 70 per cent of the city's population on less than 20 per cent of its residential land.

Many other cities in Sub-Saharan Africa have also experienced changes in land-use from agriculture to residential. Waithaka (2014) in Keumbu region in Kenya revealed that population growth in Keumbu led to a significant decrease in Agricultural land as the area experienced land-use changes from agricultural to residential due to housing demand. Agricultural land decreased from 61 per cent of the total area to 38 per cent in four years. An increased human population resulted in high demand for housing which in turn exerted pressure on agricultural land and eventually shrinking of the farm sizes.

Similar occurrences were also observed in Bengaluru India, which is an Information Technology and Biotechnology hub of India. The IT and Biotechnology developments spurred a large-scale expansion of housing and infrastructure. The increase in built-up area reduced the agricultural land by 212.49 square kilometres, as employment opportunities grew, so did the population in the city. This required expansive infrastructure particularly a good road network connecting peripheral areas of which agricultural land was the only available land for these developments (Kavitha and Somasheka, 2015).

The growing demand for accommodation due to an increasing population caused substantial expansion of built-up area, accompanied by shrinking agricultural land. Population increase and high demand for accommodation were the most important

demographic factors causing land-use change at timescales accompanied by a shift of land from agriculture to residential, industrial and infrastructure (Kavitha and Somasheka, 2015).

A study conducted by Ogechi (2014) in Olorunda and Osogbo local government areas in Nigeria reveals that housing development on arable farmland has become an issue. Seventy two per cent of interviewed farmers had a fear of losing their farmland to developmental projects as 16.1 per cent of farmers had previously lost between 1 and 2 acres of farmland to such projects. Land modelling change detected that settlement/built-up-areas increased from 978.03 hectares (6.60865%) in 1986 to 2976.39 hectares (20.11178%) in 2014, to the detriment of farmland/vegetative cover. As a result, farmland/vegetative cover reduced from 9277.71 hectares (62.69045%) in 1986 to 7995.33 hectares (54.02527%) in 2014.

Farmland by family members, communities and or land speculators, among other land tenure associated problems. Other ways in which agricultural farmlands were at risk included: 21.2 per cent farmland sold off in exchange for money, 16.6 per cent land lost due to land tenure systems triggered by communal and or familial clashes, 15.7 per cent government acquired land and 14.3 per cent who personally developed part of their farmland for real estate.

5.1.4 Rate of Land-use change in Makeni between 1990 and 2017

Makeni has over the years witnessed a rapid rate of reduction in agricultural land. An assessment of the rate of land-use/land cover change in the study area using time series analysis shows that the land available for cultivation in the study area (455.53 ha) in 1990 was reduced by 7 per cent in 2000. There was a further reduction of 37.6 per cent from 2010 to 2017. The 37.6% reduction in Makeni's agricultural land (24.2 km² to 13.9 km², 1990–2017) was driven by rapid population growth (Lusaka: 757,000 in 1990 to 2,706,000 in 2017) and speculative land sales. High housing demand led to farmland subdivision, particularly near Chainda, where developers rezoned plots for residential estates. Weak zoning enforcement by LPPA allowed informal conversions, with landowners prioritizing lucrative real estate over farming, mirroring trends in peri-urban Africa (Ramakrishnan, 2013).

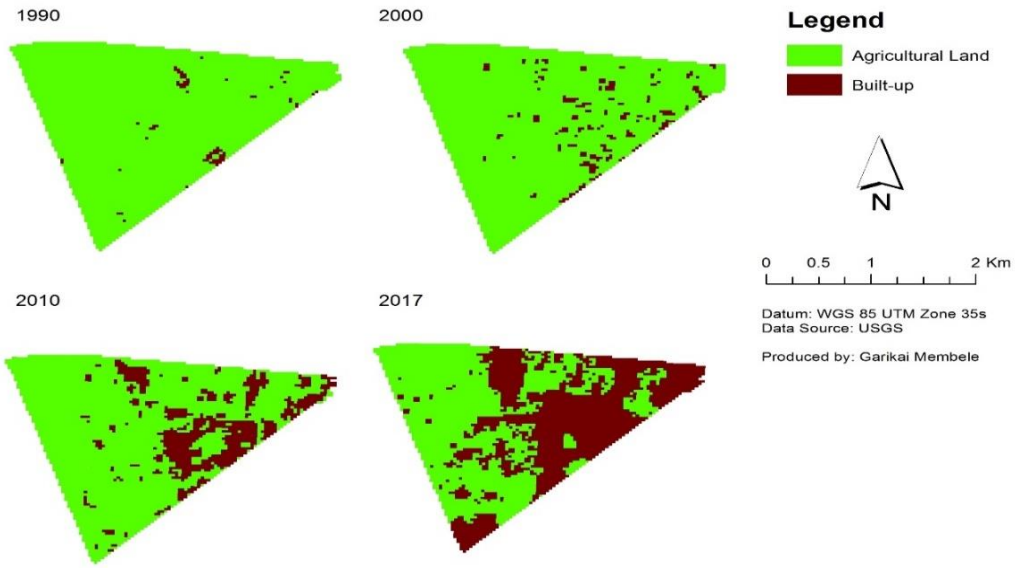
This is due to the rapid increase in hectares of built-up area. When compared to the other years analysed, built-up increased significantly in 2000, from 7 hectares in 1990 to 40 hectares in 2000 (Table 3 and Figure 4).

Table 3: Land-use change dynamics 1990-2017 in hectares

Land cover	1990	2000	%change	2010	%change	2017	%Change
Crop land	455.53	422.02	-7.4	369.41	-12.5	230.67	-37.6
Built-up	6.85	40.37	489.3	92.97	130.3	423.67	355.7

Source: Remote sensing analysis

Figure 4: Multi-temporal reduction of agricultural land use



Source: Author, 2017

Whilst there is a decline in agricultural land, the results obtained show that the proportion of area covered by built-up land was on the increase. The change was more pronounced between 2000 and 2017 due to increased urban developments in the city resulting from population increase and rising demand for accommodation.

These findings relate to the findings of Arome and Ejaro (2012), who conducted studies on Dynamics of Land use/Land Cover changes and their implication on Food Security in Anyigba, North Central, Nigeria. They studied land-use changes for a thirty three year period from 1978 to 2011. They found out that major land-use changes occurred in the first 14 years of their study period. There was an evident decrease in vegetation land and agricultural land. Agricultural land decreased by 29.2 per cent to built-up area during this period. On the other hand, Built-up land increased more than all other land uses/cover categories, it gained 66.7 per cent from agricultural land and open space vegetation.

Arome and Ejaro (2012) further note that there was also a considerable rate of change that took place between 2001 and 2011 which caused a decrease in Agricultural land uses. This was basically a result of an increase in population as built-up land increased by a rate of 53.3%. They noted that between 2001 and 2011, all other land users lost their land in favour of built-up land. Agricultural land was the most affected and this has implications on agricultural productivity output.

A study by Ifatimehin and Ufuah (2008), which involved an analysis of rural-urban land-use change in Umuahia, South Eastern Nigeria, between 1991 and 2007 observed that built-up area increased over the years while agricultural land and vegetation decreased significantly. Similarly, Ejaro, (2008) undertook an analysis of land-use and land cover change in the Federal Capital Territory (FCT), Abuja, Nigeria, using multi-Temporal Satellite Data for the period 1973 to 2006. The results obtained show that the proportion of area covered by built-up land increased while there was an alarming decline in vegetation and agricultural land. The geographical location, political and socio-economic activities and importance of the FCT, which gave impetus to the rapid growth of human population and expansion, are the major reasons which have greatly influenced the changes in land-use and land cover in the FCT, Abuja, especially reducing vegetation and agricultural land. Moreover, Arome and Ejaro (2012) in Anyigba, Nigeria found that agricultural land was continuously decreasing and giving way to built-up. It reduced from 31.0 per cent of the total area in 1978 to 29.2 per cent in 2001 and eventually 19.4 per cent in 2011. This tremendously reduced agricultural production and eventually caused food insecurity as there were shortage and a rise in prices of agricultural produce in the city.

The findings of this study are similar to those of Ejaro in the context above in that the visual interpretation of the Google images of the area under study gave a general idea about the extent and types of land cover changes that took place in the study area over the study period. Many gated residential communities were erected recently, especially on road frontage on former agricultural land (Figure 5).

Figure 5: Residential houses on former agricultural land

Source: Field Data, 2020

Figure 5 shows recent land use changes where residential houses are sitting on former agricultural land in the study area. A noticeable change is detected in areas near road fronts and reclamation is noticeable in the western part of the study area with a high presence of limestone where most farms were converted to residential and commercial land uses.

Figure 6-8 shows the increase of built-up area as presented from the visual image analysis of Google maps series images while figure 5 shows the multi temporal reduction of Agricultural Land use from the analysis of Landsat time series images. A close observation of the time series images of the study area in figure 6-8 reveals how built-up area has been expanding at the expense of agricultural land over the years in the study area visibly showing an increase in built up area from 1990 to 2017.

Figure 6: Makeni 1990

*Source: Google Earth Satellite Image, 1990***.**

Figure 7: Makeni 2000

Source: Google Earth Satellite Image, 2000

Figure 8: Makeni in 2017

Source: Google Earth Satellite

Image, 2017

5.1.5 Type of Land-use Change

A key informant from Lusaka City council revealed that "there have been two distinct types of land-use changes in Makeni from either agriculture to residential or agriculture to commercial and there was no record of the change of land-use from residential or commercial to agricultural". The study findings revealed that there was no record of land-use change from residential or commercial to agricultural at the time of the study. In addition, 80 per cent of the respondents interviewed also stated that they changed land-use from agriculture to residential between 1990 and 2017 (Table 4)

Table 4: Type of Land-use Change

Type of Land-use change	**Frequency**	**Percentage**
Agricultural to Residential	8	80
Agricultural to Commercial	2	20
Total	**10**	**100**

Source: Field data, 2017.

A key informant at LCC revealed that, "land-use change in Makeni has been driven by three major factors: increase in population; a growing demand for housing, and the view by some people to see agricultural land as a lucrative source of income.

A key informant from Lusaka city council revealed that "in Makeni, a rapid decrease in agricultural land was attributed to population growth and increased demand in housing and accommodation around the city". According to LPPA institutional records, there has been an increase in the number of applications for land-use change mainly from agriculture to residential in the city of Lusaka between 2000 and 2017. This has raised a concern on the future spatial development of Lusaka as well as food security in the city. Many people prefer to buy a piece of land and build than to purchase an already built house, as the latter is considered very expensive in most cases. The creation of nearby districts such as

Chilanga has also made accommodation in the study area more desirable because people want to live halfway between Lusaka Town and Chilanga for easy mobility. The existence of housing estates and many other gated communities which sit on former agricultural land in Makeni indicate how the rise in population has brought the need to develop agricultural land into the built-up area.

Similarly, notable studies on the population as a cause of diminishing Agricultural land were conducted in India by Raju & Anil (2006) and Raj &Azzez (2011). These scholars noted that population growth is an important factor causing diminishing agricultural land in India. According to Raju & Anil (2006); Raj &Azzez (2011), high population pressure and the increasing number of nuclear families lead to the distribution of human habitation, this, in turn, increased the demand for agricultural land mainly due to the expansion of settlements which resulted in increasing marginal land consumption, causing conversion of agricultural land for non-agricultural uses.

Key informant from Lusaka city council revealed that "people have found real estate more profitable than farming and have capitalised on the huge demand of housing to build more housing units mainly for rent while others are selling the land in its original form". He adds that "those who do not have the money to change land-use and build would rather subdivide and sale part of their land than to use it for agriculture". The efforts by the Lusaka comprehensive development plan in advocating for urban agriculture have been overrun by the high housing demand due to population increase.

A key informant at LCC revealed that, "land-use change in Makeni has been driven by three major factors: increase in population; a growing demand for housing, and the view by some people to see agricultural land as a lucrative source of income." Similarly, in Vietnam, approximately 1.2 million hectares of agricultural land, including paddy fields, were converted to urban uses between 2000 and 2010, driven by real estate demand due to lower land costs compared to urban zones (Van Dijk et al., 2012). This mirrors Makeni's trend, where economic incentives fuel the shift from agriculture to residential development. The efforts by the Lusaka comprehensive development plan in advocating for urban agriculture have been overrun by the high housing demand due to population increase

Similarly in Vietnam, paddy land has become a desired asset for the capital and cash-rich real estate industry because of its lower price compared to non-paddy land (Raj &Azeez, 2011). Relatedly, a recent study in Dindigul District of Tamil Nadu India revealed that the land area under real estate tripled between 2001(23 hectares) and 2011(70 hectares) while 212 hectares of agricultural land has been left out of cultivation in 2011 as compared to 2001. Due to the influence of the real estate sector demand, the market value of agricultural land has greatly increased. As a result, most of the farmers are selling their land as real estate plots for generating income rather than sticking to non-viable agriculture. In the same district, a study observes that in Sirumalai traditional agricultural land is converted into resorts. Thus, the real estate sector growth leads to land-use change of agricultural land to built-up. (Ramakrishnan, 2013).

Therefore, the shift of population from the urban core to the urban fringes causes increasing demand for residential area. And this unplanned increase in residential area is a major threat to agricultural land in urban fringes. It is reported that pushed by unsettling agricultural conditions and pulled by lucrative real estate deals farmers across the famed and fertile Cauvery delta in Tamil Nadu are selling their lands to real estate developers (Srivathsan, 2011).

High population growth and real estate development are operating at a greater pace. The operations of these factors push up urban sprawl. This phenomenon is significantly greater in urban fringes. Thus, the expansion and growth of those urban centres encroach on productive agricultural land (Srivathsan, 2011). Therefore; the land located near to the city has more demand and higher value than land in an unincorporated township. This is because the cities and secondary centres provide more public services such as police, water, and may also have a better school system, the value of which is capitalized into the land values. Thus, the distance from the land parcel to an access point of an urban centre is expected to reduce land price per acre. Apart from this, urbanization presents many challenges for farmers on the urban fringe, such as destruction of crops and damage to farm equipment and declining benefits such as equipment sharing, land renting, custom work when neighbouring farms are converted to development (Ramakrishnan, 2013). Therefore,

urban sprawl directly and indirectly causes a decrease in area of arable lands as they are diverted to other uses. From early 2000, most farmers took on the trend of land-use change from agriculture to other uses for various reasons such as, subdividing the land mainly for sale.

In Tamil Nadu India, it is reported that more and more small and marginal farmers are selling their land especially to big institutions of higher education and companies since agriculture become an unprofitable venture and they are looking for other works and investments, especially in real estate. The other reasons for land use changes are: uncertainty over water availability, steep rise in input price, and inadequate procurement price for food grains (Ramakrishnan, 2013; Narasimhan, Gireesh, 2012). Therefore, obtaining the best price for their asset typically becomes a high priority. Thus, even a slight increase in cost of production or a decrease in gross value of output makes agriculture economically nonviable. And uncertainty of duration of ripening period may result even in non-use of land (Ramakrishnan, 2013). As such the land is cultivated less intensively or is kept idle for speculative gains. Thus, the low return and profitability from agriculture necessitate increasing supply of agricultural land for non - agricultural uses.

5.2 Consequences of Land-use Change

According to the study findings, 90 per cent of the respondents from Makeni agreed to have been producing vegetables on their farms such as Cabbages, Rape and pumpkin leaves before the year 2000. By 2000 most of the land had started changing use. Only ten percent (10%) of respondents were not productive the year 2000. However, at the time of the study, only about 20 percent of the respondents were still productive on the available pieces of land. According to field data, 50% of the farmers affirmed that there has been a reduction in crop production in Makeni due to a reduction in agricultural land (Table 5).

Table 5: Crop production between 1990 and 2017

Response on crop production	**Frequency**	**%**
There is a reduction in crop production	5	50

There is an increase in crop production	3	30
Indifferent	2	20
Total	**10**	**100**

Source: Filed Data, 2017.

Judging from the higher percentage of farmers who experienced reduced agricultural productivity due to the decreasing size of their farmlands, it can be concluded that despite efforts by some farmers to intensity farming amidst land use changes, most farmers experienced a decrease in agricultural produce in Makeni.

One of the greatest threats to agricultural development and indeed food security as a whole in the developing world is the stiff competition between urban growth and the natural environment (Ejaro, 2008). More parcels of agricultural land are converted to other uses making it difficult for urban areas to meet their agricultural demands. Construction of houses and other non-food uses of agricultural lands have reduced food supply as the area under food crops is reducing. The world grain stocks were noted to have dwindled to dangerously low levels, highlighting the fragility of food supplies in a world where the population is rising and is expected to rise (FAO, 2012). Meeting an ever-increasing demand for food is one of the issues that are attracting the greatest interests among contemporary environmental scientist and policymakers (Mohammed, 2007).

Agriculture is one of the important sectors in Zambia's economy and will remain so in the foreseeable future (CSO,2012). Urban Agriculture provides about 3 percent of the gross domestic product (GDP) and earnings in Zambia (CSO, 2012). Until recently, urban agriculture in Makeni met nearly the vegetable needs of the population in its surrounding location, at least at the subsistence level. Before the year 2000, Makeni was predominantly agricultural with both commercial and small-scale farms mainly producing Maize, Chinese cabbages, rape, pumpkin leaves, egg plants, sweet potatoes leaves and spinach (JICA, 2009).

One of the challenges to food production in Lusaka is the lack of or reduced agricultural land. In Zambia, farming is less intensified hence farmers use more land to produce more food. Land-use change from agricultural to other built-up area such as residential or commercial has to a larger extent affected agricultural food production negatively in Makeni just like in many other parts of the world (Hampwaye et al, 2016). A study conducted in Ilorin Nigeria by Zubair (2006) revealed the amount of farm produce in Ilorin had been reducing from 2001 in relation to the agricultural land kept on reducing due to increasing housing demand.

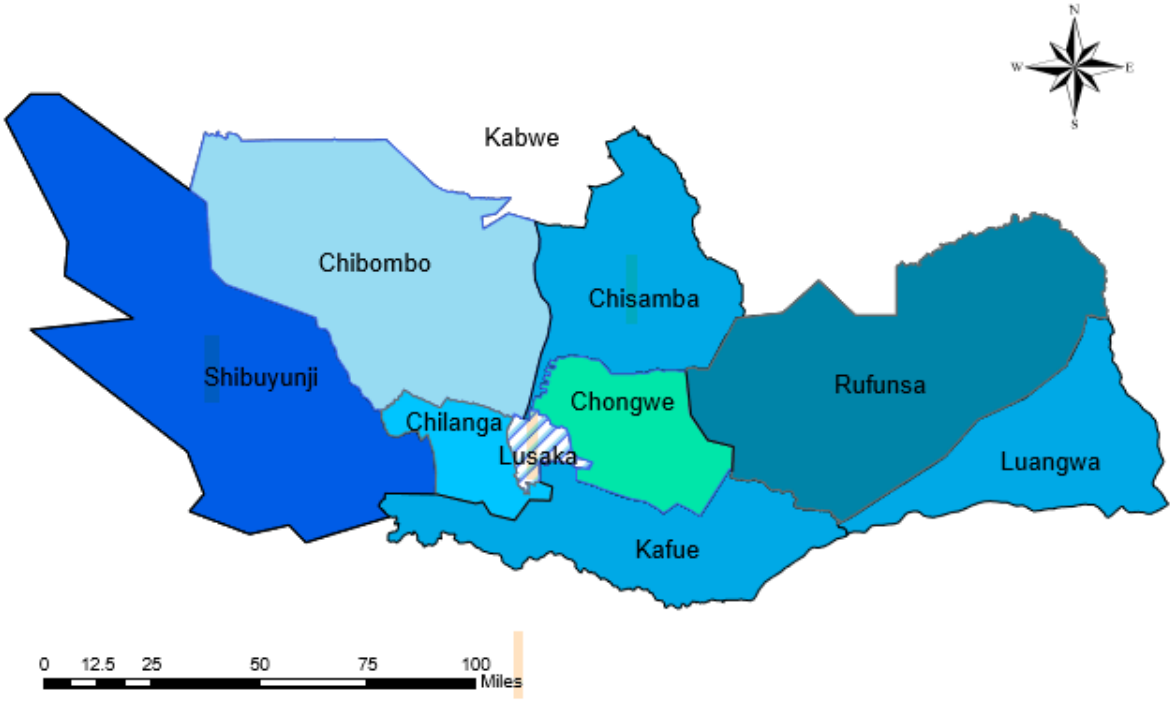
Other similar findings as this study include Owo (2004), Zubair (2006), Mengistu and Ayobami (2007), Ifatimehin and Ufuah (2008). However, this study contradicts the findings of Olowolafe *et al.* (2010), and that of Idowu and Muazu (2010) which showed an increase in agricultural land. Idowu and Muazu (2010) studied Land-use Change detection in Kafur local government of Katsina State, Nigeria and found that agricultural land increased by 2.18 km^2 with percentage change of about 28.17%. He attributed the increase in agricultural land to the adoption of new agricultural practices which made some un-usable land before 2008 usable due to technological advancement like fertilizers supplies and irrigation. With respect to built-up area, this study is in agreement with Olowolafe *et al.,* (2010), Idowu and Muazu (2010), and Muhammed (2007), whose finding indicates an increase in built-up area (Arome and Ejaro, 2012).

5.2.1 Sources of Agricultural Produce outside Lusaka district

As a result of this state of affairs, traders in the surrounding markets can no longer purchase agricultural produce from Makeni like they used to before the area underwent multiple land-use changes from agriculture to other uses. This state of affairs has increased demand among traders in agricultural products that come from outside the city, for example, places like Kabwe, Chibombo, Chisamba, Chongwe and Chilanga are increasingly becoming sources of agricultural products in Lusaka over the years and this means an extra cost of food due high transportation of the agricultural products. Hampwaye et al (2016), also indicate that Chongwe, Chibombo, and Chisamba are perceived to be critical sources of

food for the City of Lusaka followed by Kafue and Chilanga. Figure 9 shows nearby districts where Lusaka sources its agricultural produce. As a result of this, residents of Lusaka can no longer access affordable food. This situation adversely affects food security as the majority of the poor can no longer afford the food.

Figure 9: Sources of Agricultural Produce outside Lusaka district



Source: Author, 2017

This map highlights districts supplying agricultural produce to Lusaka as Makeni's agricultural land decreased from 24.2 km² in 1990 to 13.9 km² in 2017. Key areas like Luangwa provide maize, rape, tomatoes, groundnuts, and sweet potatoes, while Chongwe, Chisamba, Chibombo, Kabwe, and Chilanga contribute similar crops plus beans and soybeans.

The findings of this study affirm the findings of Arome and Ejaro (2012) which revealed that agricultural production reduced as the size of agricultural land decreased. This led to a decrease in agricultural food production as the amount of food produced in the city could not match up with the increasing population, eventually there were food shortages and a rise in prices of agricultural produce.

This reduction in agricultural land in Makeni has affected agricultural production as crop production has decreased as noted from the research findings above. It is acknowledged that other factors such as failure to apply new farming methods such as intensive farming are responsible for reduced crop production as well. Therefore, reduced agricultural land implies that agricultural produce in Makeni can no longer feed the growing population around this area which earlier on depended on agricultural produce from Makeni. This situation adversely affects easy accessibility to agricultural produce in these areas and the City at large.

As a result of decreased agricultural land, there is likely going to be an agglomeration of various socio-economic activities in Makeni in the near future of which if agricultural land is not secured, it may diminish further into urban development completely. This situation may have negative effects in the area such as further loss of agricultural land to residential and commercial use which will result to a further decrease in agricultural activities consequently resulting to a further decrease in food production.

In general, agricultural production in Makeni has reduced significantly as evidenced by the loss of agricultural land. These findings correspond to Ejaro (2008)'s findings which reveal that the establishment of a state university in the city of Anyigba, North Central Nigeria raised the demand for built-up area which in turn saw land-use change from agricultural to residential and other uses to cater for the demand. However, due to this state of affairs, the city experienced a raise in the prices of agricultural produce and eventually a shortage because over 80 percent of the agricultural produce consumed in Anyigba was brought in from the neighbouring towns. Hence, it is noted that there was food insecurity in the city as there were less accessibility, affordability and availability of agricultural produce (Ejaro, 2008). Comparing the study findings with other research work, it largely affirms other

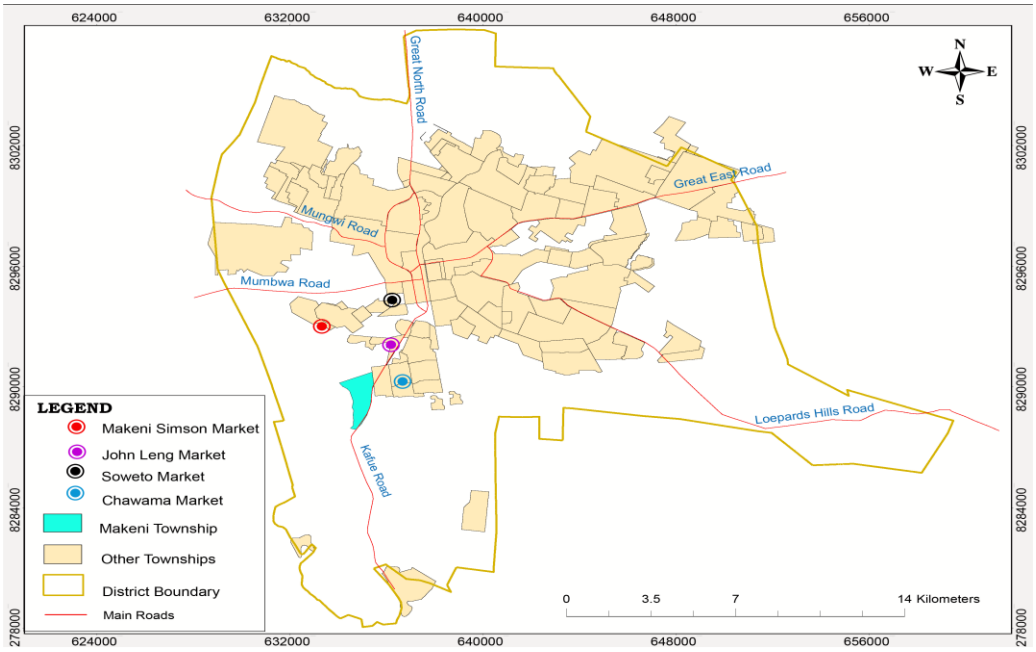
studies with few exceptions. Mohammed, (2007), examined the land-use type of Sharada and Wailari in Kano, northern Nigeria. He found out that from Nigeria's independence to date, there have been drastic changes in the land-use type from a predominantly agricultural uses to residential.

5.2.2 Local Markets for agricultural produce around Makeni

The drastic reduction in agricultural land has resulted in drastic reduction in agricultural produce which has resulted in the study area not being able to sustain the agricultural produce needs of its immediate surrounding such as Chawama, Makeni Simpson and John Lang Markets. Historically, Makeni supplied over 80% of vegetables (e.g., rape, tomatoes) to Chawama, Kanyama, and Makeni Simpson markets in 1990, based on trader recollections (Field Data, 2017). By 2000, this share declined to approximately 50% due to early land conversions, and by 2017, only 20% of produce came from Makeni, with traders sourcing 70% from districts like Chongwe and Chisamba. This shift increased prices due to higher transport costs, impacting affordability (JICA, 2009). The reduction in food production may eventually threaten the food security of the city (accessibility, availability and affordability).

Figure 10 shows the location of the nearby markets which where dependant on Makeni for their agricultural produce.

Figure 10: Local Markets for agricultural produce around Makeni



Source: Author, 2017.

5.2.3 Accessibility of Agricultural Produce

The majority (90%) of traders indicated they were not able to access all agricultural produce for sale from Makeni while 10% per cent said they were able to access all agricultural products from Makeni. This shows that most of the traders can no longer buy all their required agricultural produce from Makeni as was the case earlier. This poses the question of the source of most of the agricultural produce consumed by the surrounding areas. The 90% reduction in trader purchases from Makeni (Field Data, 2017) stems not only from lower production (due to 37.6% land loss) but also competition from external suppliers (e.g., Chongwe, Chisamba), shifting consumer preferences toward imported produce, and market disruptions. Traders noted that cheaper maize and vegetables from Chisamba displaced Makeni's supply, altering market dynamics (Hampwaye et al., 2016).

The research revealed that the prices of commodities have been increasing over the years. In 1990 Over the years, there prices of agricultural produce have gone up around the markets that were dependent on Makeni for agricultural produce. This is due to high transport cost, as products have to be transported for longer distances from the source to the market. Field data revealed that in 2000, a 90 kg bag of rape was between K30000 and K50000. In 2010, a 50kg was going for between 120,000 and 150,000 and in 2017 it was between ZMW 280 and ZMW 300. Likewise, the price of tomatoes has also been increasing as indicated in table 6. It is also important to note that the prices of agricultural produce are also governed by the law of demand and supply.

Table 6: Prices of agricultural produce between 1990 and 2017 in Kwacha

Agricultural Produce	**1990 (Price K)**	**2000 (Price K)**	**2017 (Price ZMW)**
Rape per bag	K30,000-K50,000	K120,000-K150,000	ZMW280-ZMW300
Tomato per box	K90,000-K120,000	K20,0000-K250,000	ZMW K80 –ZMW K350

Source: Field data, 2017.

Eighty four per cent (84%) of traders noted that the increased prices in agricultural produce to transport cost being added to the produce as most agricultural products consumed in Lusaka comes from outside Lusaka.

Food security is an integral part of livelihood in Zambia. Therefore, the consequence of land-use change from agricultural to built-up area will have a far-reaching implication on food production. It has been noted from this study that the reduction in agricultural production has led to higher prices of agricultural produce, which could trigger food crisis and lead to food insecurity.

One of the greatest threats to agricultural development and indeed human security as a whole in the developing world is the stiff competition between urban growth and the natural environment (Ejaro, 2008). More parcels of agricultural land are converted to other uses making it difficult for urban areas to meet their agricultural demands. Construction of houses and other non-food uses of agricultural lands have reduced food supply as the area under food crops is reducing. The world grain stocks were noted to have dwindled to dangerously low levels, highlighting the fragility of food supplies in a world where the population is expected to rise (FAO, 2012). Meeting an ever-increasing demand for food is one of the issues that are attracting the greatest interests among contemporary environmental scientist and policy makers (Mohammed, 2007).

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The change of land-use from agricultural to other built-up area such as residential or commercial has to a larger extent affected agricultural food production negatively in Makeni just like in many other parts of the world. A study conducted in Ilorin Nigeria by Zubair (2006) revealed the amount of farm produce in Ilorin had been reducing from 2001 in relation to the agricultural land that kept reducing due to increasing housing demand, this in return has seen a rise in prices and sometimes shortage of agricultural produce as most of the produce is imported from the neighbouring towns. These findings relate to Makeni whose built-up area has been increasing due to high housing demand.

Findings contrary to this study's findings were revealed by Hamza and Iyela (2012) in Ethiopia. The country which is dominated by smallholder agriculture has been experiencing a drop in the size of agricultural land per household. Landholding is one factor that constrains food production because in most cases food production reduces as

agricultural land reduces. However, the findings of Hamza and Iyela (2012) revealed that there was an increase in crop yield. Increased productivity was achieved by improved technology such as high-yielding fertilizers, and intensive farming which also improved the farmer's livelihood.

Arome and Ejaro (2012)'s findings revealed that agricultural production reduced as the size of agricultural land decreased. This led to a decrease in agricultural food production as the amount of food produced in the city could not match up with the increasing population, eventually there were food shortages and a rise in prices of agricultural produce.

The decrease in the sizes of agricultural land has greatly affected agricultural production in Makeni as the area has been transitioning from agricultural to predominately residential and commercial. Rapid urban growth and urban development has been noted as an important driver of land-use change resulting from population growth, especially in developing countries (Abebe, 2013; Bhatta, 2010; de Jong et al., 2000). This has been associated with several environmental, social and economic consequences, including climate change but more importantly, depletion of agricultural resources (Bhatta, 2010; Dutta, 2012). The development of warehouse and storage facilities and the subsequent siting of shopping malls in Makeni has resulted in an increase of population in that area of the city.

In general, agricultural production in Makeni has reduced significantly as evidenced by the loss of agricultural land. The findings of this study correspond to Ejaro (2008)'s findings which reveal that the establishment of a state university in the city of Anyigba, North Central Nigeria raised the demand for built-up area which in turn saw land-use change from agricultural to residential and other uses in order to cater for the demand. However, due to this situation, the city experienced a raise in the prices of agricultural produce and eventually a shortage because over 80 per cent of the agricultural produce consumed in Anyigba was brought in from the neighbouring towns. Hence, it is noted that there was food insecurity in the city as there was less accessibility, affordability and availability of agricultural produce (Ejaro, 2008).

This reduction in agricultural land in Makeni has had a negative effect on agricultural production as crop production has decreased. It is acknowledged that other factors such as failure to apply new farming methods such as intensive farming are responsible for reduced crop production as well. The use of modern methods of farming is very low among small scale farmers in Makeni. Therefore, the implication of reduced agricultural land is that agricultural produce in Makeni can no longer feed the growing population around this area which earlier on depended on agricultural produce from Makeni.

As a result of decreased agricultural land, there is likely going to be agglomeration of various socio-economic activities in Makeni in the near future of which if agricultural land is not secured, it may diminish further in to urban development completely. This situation may have negative effects in the area such as further loss of agricultural land to residential and commercial use which will result to further decrease in agricultural activities consequently resulting to a further decrease in food production.

Food security is an integral part of livelihood in Zambia. Therefore, the consequence of land-use change from agricultural to built-up area will have a far-reaching implication on food production. It has been noted from this study that the reduction in agricultural production has led to higher prices of agricultural produce, which could trigger food crisis and lead to food insecurity.

Chapter Five outlines the findings of the study, which examined how the transformation of land use in Makeni has affected food production. The research shows that between 1990 and 2017, agricultural land in Makeni declined markedly from 24.2 km² to 13.9 km² while built-up areas more than doubled, rising from 5.1 km² to 11.9 km². This shift is largely attributed to Lusaka's rapid urbanization, population growth, and increased demand for residential space. The findings highlight that over 300 properties were converted from agricultural to residential use within a six-year period (2010–2016), with very little community consultation or regulatory oversight. Interviews with key stakeholders revealed that enforcement of zoning regulations was weak, creating opportunities for informal subdivisions and speculative land sales.

The consequences have been significant: 84% of surveyed farmers reported a decline in crop production, and 90% of market traders indicated reduced availability of local agricultural produce. This has increased Lusaka's dependence on outlying districts such as Chongwe and Chisamba for fresh food, pushing prices up and affecting urban food security. Notably, no cases were recorded of land being converted back from residential or commercial use to agriculture, suggesting a permanent loss of agricultural space unless deliberate interventions are made.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Overview

The previous chapter presented the main findings of the study. This chapter presents the overall conclusion of the findings. It must be emphasized that the aim of this study was to gain a greater understanding of diminishing agricultural land in Makeni, Lusaka and the consequences of this development.

6.2 Conclusion

In conclusion, the study has demonstrated that, indeed, as a result of urban developments, such as industrial growth, expansion of settlements and general urbanisation, land which was originally planned for agriculture in Lusaka, in general, and Makeni, in particular, is under threat. Analyses by GIS techniques and findings from other studies such as those done by JICA (2009) have confirmed that there has been a significant reduction in agricultural land in Lusaka over the years. Resulting from this scenario, there have been negative effects on the food production, and food access by most residents, especially the urban poor. The major food sources for the city are currently in the surrounding districts which entail that food prices have been adjusted upwards due to transport costs as some sources are located farther away from Lusaka. Therefore, many of the low-income residents of the city have challenges in accessing this food. Apart from food insecurity, the traders are also impacted negatively as the customers experience affordability challenges. For the traders, this is their livelihood and any disruption in their business poses a serious hindrance to their source of income. When most of the produce was sourced locally, the prices were relatively low and therefore affordable by most people in the city. It is therefore critical for the planners to consider the importance of food for the city when considering converting agricultural land use to other uses. Further, the planning authority should consider incentives to existing farmers in the city to minimise the rate at which agricultural land is diminishing in preference to other uses. Available farmers in the city should also be

engaged to explore and consider intensive methods of farming to increase food production in the city. Overall, agricultural land conversions in the city of Lusaka have contributed to food insecurity among the low-income residents and deprived traders of the opportunity to grow their businesses. The municipality should encourage urban agriculture in the city as it is an important survival strategy for the urban poor, especially for the women and the youth, instead of considering them as health hazards. Educational campaigns can be conducted to educate households engaged in backyard gardening on better and safer ways of growing crops and rearing livestock in the city (Hampwaye et al. 2007, 2009).

6.3 Recommendations

Based on the study findings the researcher recommends for the following:

- Available farmers in the city should be engaged through workshops, agricultural extension services, and incentive programs to explore and adopt intensive farming methods, such as vertical gardening and high-yield crop varieties, to boost food production on the remaining agricultural land.
- There is a need for the planning authority to consider food production when converting agricultural land by putting restrictions on land-use change over land that is zoned for urban Agricultural purposes.
- It is very important for developers to consider vertical development as against the dominant horizontal development to curtail the increasing land demand and supply that will edge out land for agriculture.
- Lusaka City Council should encourage backyard gardens in the city as they are an important survival strategy for the urban poor, especially for the women and the youths, instead of considering them as health hazards.

6.4 Suggestions for Further Research

Since the study was conducted as academic research on a small scale in Makeni, there is a need for a similar one to be conducted at a city level to understand the implications of diminishing agricultural land on food production in Lusaka city as a whole.

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Appendices

The University of Zambia

Department of Geography & Environmental Studies

Research Interview Guide for Lusaka City council

The answers provided in this interview are purely for academic purpose and meant to help the interviewer write their dissertation for their Master of Science in Spatial Planning. The interviewer is looking at the Implications of Diminishing Agricultural Land on Food Security in Lusaka, particularly in Makeni. Lusaka has seen an increase in the land use changes in the recent past period. The most common type of land use change is from agriculture to residential or commercial. A growing population in the city entails increased demand food demand yet the area zoned for urban urban agriculture is reducing. Therefore, there is need to establish the implications of diminishing agricultural land due to land use changes between 2006 and 2016.

Researcher's Name: Linda Namakando

Institution's Name: University of Zambia

Contact: Mobile – 0961136717, email address: lindanamakando4@gmail.com

Date: …….

Title**: Implications of Diminishing Agricultural Land on Food production in Makeni, Lusaka District**

1. What is the role of the department in dealing with land-use and land-use changes?
   ……..……..
2. What are the implications of land-use change on food production?
   ……..
3. What is the city council doing to encourage preservation of agricultural land?
   ……

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Research Interview Guide for Ministry of Agriculture

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Researcher's Name: Linda Namakando

Institution's Name: University of Zambia

Contact: Mobile – 0961136717, email address: lindaohale02@gmail.com

Date: …….

Title**: Implications of Diminishing Agricultural Land on Food production in Makeni, Lusaka District**

1. What is your position or Title in this department?
   …….
2. How long have you worked in this department in your current capacity?

……..

3. Do you have Agricultural extension officers based in Makeni under this department?
   ……

4. What is their role/responsibility?
   …….

5. As a department, what are your responsibilities/functions in Makeni?
   ……
   …….
   ……

6. What role do you play as a department in crop production, livestock production and poultry in Makeni?
   ……

7. What is the size of originally zoned agricultural land in Makeni?
   ……

8. What was the number of small scale agricultural holdings in Makeni?
   i) In 2006 …….
   ii) In 2016 …….
   ……

9. What was the number of commercial farms in Makeni?
   i) In 2006 …….
   ii) In 2016 …….

10. How much agricultural land was in Makeni in 2006?
    ……

11. How much agricultural land was in Makeni in 2016?
    …..…….....

12. What types of crops were grown in Makeni in 2006?
    ……

13. What types of crops were grown in Makeni in 2016?
    …….

14. Are there any established Agri businesses in Makeni?
    …….

15. How has land conversion from Agriculture to other land uses affected food production?
    ……..

16. What are the implications of the diminishing agricultural land on food security in Lusaka? (Availability, Affordability and Accessibility)

……

17. How has diminishing agricultural land food production in the city?

…….

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Department of Geography & Environmental Studies

Research Interview Guide for Ministry of Lands

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Researcher's Name: Linda Namakando

Institution's Name: University of Zambia

Contact: Mobile – 0961136717, email address: lindaohale02@gmail.com

Date: …….

Title**: Implications of Diminishing Agricultural Land on Food production in Makeni, Lusaka District**

i. What is your position or Title in this department?
……

ii. How long have you worked in this department in your current capacity?
……..

iii. What is their role/responsibility?

…….

iv. How long have you worked in your current capacity in this department?
……

v. Have taken part or witnessed land-usechanges in Makeni before?
……

vi. Describe the procedures of land-usechange?
……..

vii. As a department, what are your responsibilities/functions in Makeni?
……

……

……

viii. What role do you play as a department in land-usechanges in Makeni?
……

ix. What was the size of the originally zoned Agricultural Land in Makeni?

……...

x. What was the size of agriculture land in Makeni in 2006?

……...

xi. What was the size of agricultural land in Makeni in 2016?

……

xii. How much Agricultural land has been converted to other forms of land use?

……

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Research Interview Guide for Lusaka Province Planning Authority

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Researcher's Name: Linda Namakando

Institution's Name: University of Zambia

Contact: Mobile – 0961136717, email address: lindaohale02@gmail.com

Date: …….

Title**: Implications of Diminishing Agricultural Land on Food production in Makeni, Lusaka District**

1. What is your position or Title in this department?
   ……
2. How long have you worked in this department in your current capacity?

……..

3. What is the role of the department in land use, zoning and land-usechanges in Makeni?
   ……..

   …….

4. How long have you worked in your current capacity in this department?
   ……
5. Have taken part or witnessed land-usechanges in Makeni before?
   ……
6. What forms of land-useis Agricultural Land converted to in Makeni?
   ……
7. What are the procedures of land-usechange?
   ……..
8. As a department, what are your responsibilities/functions in land-usechange and zoning in Makeni?
   ……

   ……

   ……
9. What role do you play as a department in land-usechanges in Makeni?
   …….

   …….
10. How much originally zoned agriculture land was available in 2006 in Makeni?
    ……..
11. How much originally zoned agriculture land was available as at 2016 in Makeni?
    ……
12. How much Agricultural land has been converted to other forms of land use?
    ……..
13. How many properties changed land-usefrom Agriculture to other uses in Makeni between 2006 and 2016?
    ……..

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Department of Geography & Environmental Studies

Research Interview Guide for Traders in the surrounding Markets

The answers provided in this interview are purely for academic purpose and meant to help the interviewer write their dissertation for their Master of Science in Spatial Planning. The interviewer is looking at the Implications of Diminishing Agricultural Land on Food Security in Lusaka, particularly in Makeni. Lusaka has seen an increase in the land use changes in the recent past period. The most common type of land use change is from agriculture to residential or commercial. A growing population in the city entails increased demand food demand yet the area zoned for urban urban agriculture is reducing. Therefore, there is need to establish the implications of diminishing agricultural land due to land use changes between 2006 and 2016.

Researcher's Name: Linda Namakando

Institution's Name: University of Zambia

Contact: Mobile – 0961136717, email address: lindaohale02@gmail.com

Date: …….

Title**: Implications of Diminishing Agricultural Land on Food production in Makeni, Lusaka District**

1. Sex F…… M……..
2. Age …….
3. How long have you been trading in this Market?
   …….

4. Where were you buying agricultural produce which you resold (vegetables, poultry, livestock and its products) in 2006?
   ……
5. Where were you ordering agricultural produce which you resold (vegetables, poultry, livestock and its products) in 2016?
   ……
6. Are you able to order every agricultural produce for resale in Makeni? …… If not, where do you get the other agricultural produce?
   ……
7. Do you order the agricultural produce which does not come from Makeni at the same price as that from Makeni?
   .....
8. How much agricultural produce were you getting from Makeni in 2006??
   ……..
9. How much agricultural produce were you getting from Makeni in 2006??
   ……..
10. How do you access agricultural produce from outside Makeni?
    A. Farmers delivery
    B. Follow up produce at point of production
    i) If your answer is (A) to Question 10, how has the delivery of farm produce affected the prices?
       ……
    ii) If your answer is (B) to question 10, how has the transportation of farm produce affected the prices?
       …….
       ……
11. What was the cost of agricultural produce that you sale in 2006 and in 2016 on the market?
    ……
12. Has there been a decrease or an increase in prices of agricultural produce?.....
    i) If there has been a decrease, what do you think is the cause of this reduction?
       …….
       ……
    ii) If there has been an increase, what do you think is the cause of this increase?
       …….
       ……..

13. How long have you been buying agricultural produce from Makeni?
……..

14. Over the years has your agricultural supply from Makeni increased or reduced?
……..

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Research Interview Schedule for properties that changed land-use

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Institution's Name: University of Zambia

Contact: Mobile – 0961136717, email address: lindaohale02@gmail.com

Date: …….

Title**: Implications of Diminishing Agricultural Land on Food production in Makeni, Lusaka District**

1. When was this property acquired?

   ……

2. How was this property acquired?

   ……

3. What was the size of the property when you acquired it?

   ……

4. What was the size of the property in 2006?

   ……

5. What was the size of the property in 2016?

   …….....

6. What use was the land designated for at the time you acquired the property?

   ……...

7. When did you change the land-useof the property from Agricultural to residential or commercial?

   ……

8. Why did you change land-usefrom agriculture to Residential/Commercial?

   ……

9. What agricultural produce (vegetables, poultry and livestock) were you producing before the land-usechange?

   …….

10. Were you still producing any agricultural produce as of 2016?

    ……

11. Where were you selling your agricultural produce at the time you where productive?

    ……..

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Department of Geography & Environmental Studies

Research interview schedule for properties that did not change land use

The answers provided in this interview are purely for academic purpose and meant to help the interviewer write their dissertation for their Master of Science in Spatial Planning. The interviewer is looking at the Implications of Diminishing Agricultural Land on Food Security in Lusaka, particularly in Makeni. Lusaka has seen an increase in the land use changes in the recent past period. The most common type of land use change is from agriculture to residential or commercial. A growing population in the city entails increased demand food demand yet the area zoned for urban urban agriculture is reducing. Therefore, there is need to establish the implications of diminishing agricultural land due to land use changes between 2006 and 2016.

Researcher's Name: Linda Namakando

Institution's Name: University of Zambia

Contact: Mobile – 0961136717, email address: lindaohale02@gmail.com

Date: …….

Title**: Implications of Diminishing Agricultural Land on Food production in Makeni, Lusaka District**

1. When was this property acquired?

   ……

2. How was this property acquired?

   ……

3. What was the size of the property when you acquired it?

   ……

4. What was the size of the property in 2006?

   ……

5. What was the size of the property in 2016?

   …….....

6. What agricultural produce were you producing on your land in 2006?
   ……..
7. What agricultural produce were you producing on your land in 2016?
   ……..
8. How long have you been farming on this piece of land?
   ……
9. How has your agricultural production been between 2006 and 2016?
   ……
10. Why are you involved in food production? Sale/Consumption
    …….
11. If for sale, who do you sale to and where?
    …….
12. Do you deliver your produce to the retailers or they buy from here?
    …….
13. If you deliver, do you add the cost of transport to the cost of production of your produce?
    YES……

    NO……
14. If (Yes) to question 13, how does it affect the cost of your produce?
    …….

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Department of Geography & Environmental Studies

Research Interview Guide for Zambia Institute of Planners

The answers provided in this interview are purely for academic purpose and meant to help the interviewer write their dissertation for their Master of Science in Spatial Planning. The interviewer is looking at the Implications of Diminishing Agricultural Land on Food Security in Lusaka, particularly in Makeni. Lusaka has seen an increase in the land use changes in the recent past period. The most common type of land use change is from agriculture to residential or commercial. A growing population in the city entails increased demand food demand yet the area zoned for urban urban agriculture is reducing. Therefore, there is need to establish the implications of diminishing agricultural land due to land use changes between 2006 and 2016.

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Institution's Name: University of Zambia

Contact: Mobile – 0961136717, email address: lindaohale02@gmail.com

Date: …….

Title**: Implications of Diminishing Agricultural Land on Food production in Makeni, Lusaka District**

1. What is your position in the Institute?
   ……
   ……
2. What role does ZIP play in land-useand land-usechanges?
   ……
   ……
3. Does ZIP regulate plans for Land use?

……
……

4. What is your comment on Diminishing agricultural land and food security?
……
……