Perspectives of the impact of urbanisation on urban agriculture landuse in Johannesburg, South Africa.

Research Report

Ethical Protocol Number: GAES2017-33

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30th October 2018

Declaration of Research

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

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Acknowledgment and Dedication

Firstly, I would like to thank God for giving me the strength to undertake this study and my family for their unending support and encouragement. Secondly, I would like to show my utmost gratitude to my supervisor, Prof. Danny Mulala Simatele for his support during this research. Finally, I would like to express a hearty gratitude to all the study participants who made time to partake in this study and make it a success.

This study is dedicated to my mom Madam Gladys Adwoa Fosua Kumi and my previous mentor Mr. Samuel Nyambi, for his support and encouragement and my family and friends for the patience and confidence in me.

Abstract

Urban expansion and development have caused potential agriculture land to decrease at an alarming rate. Studies conducted around the world exposes the dangers of losing urban agricultural lands to infrastructural development. The conversion of arable lands to infrastructural development causes serious ramifications for long-term agricultural sustainability in urban areas like the City of Johannesburg such as urban food security, especially for the low economic income group. It is in view of this that this study was undertaken to understand the drivers of the City of Johannesburg's urban growth and its impact on urban agriculture land use.

The study builds on a previous research by the Department of Agriculture and Rural Development (DARD) in the Gauteng province which revealed that in addition to high urbanisation rates in the City of Johannesburg (CoJ), it also has high agricultural potential land. To this extent, about 28.7% of the land was conducive for optimum agricultural land use at that time of the study, 2002. However, given the accelerated urbanisation trends in CoJ, several pieces of land are losing their natural functions, including land parcel suitable for food production.

Given the multidimensional nature of the research aim and objectives, this study employed a mixed-method research design. To effectively achieve the set aim and objectives of the study, primary data was collected using structured questionnaires, interviews, and Landsat Satellite images. The aim of the study is positioned within a literature frame of reference and several thematic considerations that reflects on the positive and negative effects of urbanisation and urban growth in the world, South Africa, and the City of Johannesburg in particular.

Keywords: Urbanisation, Urban, urban agriculture, Migration, food security.

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CHAPTER ONE
RATIONALE

1.1 Introduction

According to the United Nations (2009), cities are growing at an alarming rate. This would trigger negative environmental and socio-economic consequences globally, regionally and locally (Cieslewicz, 2002; Houghton, 1994). Studies into the effect of population growth on the environment have revealed that the natural environment is exceeding its natural capacity to provide for those who depend on it (The Nature Conservancy, 2008). The pressure being put on the earth and its resources by humans have changed the land use pattern significantly as well as caused environmental degradation (Cieslewicz, 2002).

Urbanisation is increasing in both the developed and developing countries (United Nations Human Settlements Programme, 2009). Statistics presented by the United Nations, reveal that the number of people living in urban areas globally has increased significantly and would continue to increase with time. The number of urban dwellers has increased from 224 million in the year 1900 to more than 400 million in the year 2000. It is however anticipated that by the year 2030, more than 60% of the world's total population will be living in urban areas, of which 56.2% will occur in developing countries (UN-Habitat, 2010). Recent studies conducted by the United Nations and the African Development Bank (AfDA) predicted that Africa and Asia will experience the highest level of urban growth by the year 2030 (The United Nations, 2015). It is in view of this that urban development must proceed in a strategic manner that will cater for uncontrolled future population growth.

Though there have been many reasons behind Africa's urbanisation rate, the common explanation has been due to a high increase in infrastructural development (Cieslewicz, 2002). The United Nations and other Non-Governmental Organisations' (NGOs), who are advocates of equitable economic growth and human development, perceive this as a positive step towards the attainment of the Sustainable Development Goals (SDGs). It is however, important to understand that urbanisation has both positive and negative consequences, especially when the necessary mechanisms are not effective to meet the demands of urban growth (Cieslewicz, 2002). Among the negative effects of urbanisation are land use changes to

accommodate the demands of the urban areas. Houghton (1994) emphasise the extent to which land use practices for urbanisation purposes have intensified, and as a result, have reduced the capacity of the available land to support other ecosystem functions such as food production, especially in urban areas in many developing nations.

Within the context of South Africa, the Republic has the largest and most industrialised economy in Africa and the 28th largest economy in the world (Turok, 2012). About two-thirds (62%) of its total population of about 50 million live in urban areas, making it one of the most urbanised countries in Africa after Reunion, Gabon and Djibouti (Turok, 2012). The nation's urban population growth has been largely due to internal and external migration. The end of the Apartheid regime made it easier for migration to occur, especially from surrounding countries in search of better living conditions in a more economically stable nation. In addition to external migration, the nation has experienced massive rural to urban migration in pursuit of improved standards of living according to the Theory of Modernisation, the Dependency Theory and the Urban Bias Theory (Lipton, 1977). This is because cities provide services such as better employment opportunities, better housing conditions, educational facilities, quality health services, modern road networks and improved communication facilities among others, required for a better and improved standard of living (Turok, 2012).

Urban growth in South Africa has contributed to the unsustainable utilisation of natural resources within the nation's major cities (Cooperative Governance Traditional Affairs, 2003). This has led to environmental degradation from solid waste accumulation, wetland destruction and natural resource exhaustion (Alberti, 2005). The influx of people, both the South African nationals and foreigners who come into the Republic and make its cities their home, either temporarily or permanently, in pursuit of economic, social and political freedom, has put massive pressure on land resources, specifically on arable agricultural land (Cohen, 2004; 2006). As the population increases and cities grow, pressure is placed on the existing infrastructure and services such as roads, health care facilities, residential facilities and educational facilities (Busko and Szafranska, 2018; Deng et al., 2015; Cieslewicz, 2002). In view of this, there is the need to increase these facilities to ensure the smooth running of the urban system. This leads to the conversion of undeveloped available land, for

instance land demarcated for agricultural purposes into other functions aside from food production.

Despite the current trends and awareness of the processes of urbanisation, there is not enough comprehensive research on the impacts the growing loss of agricultural land to urban development would have on food security in South Africa, especially in the City of Johannesburg. With food security being a fundamental requirement for humans and even animals, it is imperative that effective sustainable measures are put in place to guide urban growth and development in the right direction. This is very necessary because, when development takes over all the potentially arable land in the country, there will be food shortage, famine, disease outbreak and in severe cases death. It is in view of the identified negative consequence of urbanisation on urban agricultural land use that this study is being carried out.

1.2 Thematic Consideration

Gauteng Province is among the rapidly urbanising provinces in South Africa (StatsSA, 2017; Gauteng Provincial Government, 2016). This is because it houses two of South Africa's biggest economic cities, Johannesburg and Pretoria. Aside from the presence of mines, it also has a good number of top universities and other educational facilities, quality and well-equipped hospitals, headquarters of major businesses, hospitality industries and offices of many government departments and industries.

Johannesburg is the business hub of South Africa and over time, has experienced massive urban sprawl / outward growth (Gauteng Provincial Government, 2016). This outward growth has been because of increased urbanisation which has increased the construction of physical structures in terms of housing, industries, hospitals, road networks among others in order to meet the demands of the growing city (Busko and Szafranska, 2018). There has been increased change of land tenure in the city to accommodate urban growth and development.

The process has become a major concern because urban sprawl is changing land covers and hindering the natural capacity of land to perform certain functions like food production (Busko and Szafranska, 2018; Cieslewicz, 2002). Considering the rate at which Johannesburg is growing and infrastructural development is taking place, it is

evident that land use patterns are changing. As a result, the available arable agricultural land in the City of Johannesburg is at risk of being converted into other usage other than food production (Collet, 2013). Though the activities of urbanisation are visible, little is known about the severity of the loss of agricultural land and its impact, especially the likely impact on urban food security.

Though many of the developed nations are equipped with detailed and advanced land cover information, Dewan and Yamaguchi (2009) argues that the current understanding of land cover changes and its impacts are limited due to lack of accurate and timely spatial data in the developing world. To deal with the effects of urban growth, there is the need for reliable and good data to understand the pattern and trends of urban change in order to make projections into the future of the City of Johannesburg. It is in view of the inadequate information on the impacts of urban growth and development that this study is being carried out to investigate the impact of urbanisation on urban agricultural land use in the City of Johannesburg. The study aimed to understand the driving factors of Johannesburg's urban growth and the potential effect of that growth on agricultural land use changes.

1.3 Research Aim and Objectives

In view of the above considerations, the research investigated the impact of urbanisation on urban agriculture land use in Johannesburg. The study aimed at understanding the drivers of the City's growth and its impact on urban agriculture land use change, and possible implication for food security.

In view of the above aim, the objective of the study was as follows:

i. To understand the contemporary drivers of Johannesburg's urban growth.

ii. To identify the extent to which urban development impacts on agricultural land use in Johannesburg.

iii. To identify the likely future impacts urban growth development will have on urban agriculture and food production in Johannesburg.

iv. To contribute to the body of knowledge in the field of urbanisation, urban food security, and sustainable urban planning and development.

1.4 Justification of the study

The purpose of this study was to assess the impact of urbanisation on agricultural land use in Johannesburg. The study was conducted in the City of Johannesburg (CoJ) because it has the highest urban growth rate in South Africa, making it the most urbanised area in the country. In addition to its high urbanisation rate, the city also has high agricultural potential land (The Gauteng Provincial Government, 2016). In the year 2002, the Department of Agriculture and Rural Development (DARD) conducted a research to investigate the presence of agricultural land in the Gauteng province in the hope of protecting them. The study revealed that about 28.7% of the land was conducive for agricultural purposes.

With the rate at which urbanisation is occurring in CoJ, the land may lose its agricultural value, which is for food production just like in China (Zhuang et a*l*., 2017). This makes the study area very important and necessary to investigate because the loss of agricultural land to other functions in urban spaces is an issue of severe concern not only in South Africa but globally. In line with urban expansion and development, potential agricultural land is decreasing at an alarming rate with serious ramifications for long-term agricultural unsustainability. Unfortunately, with the rate at which development is ongoing in CoJ, it appears as if people are ignoring the value of agricultural land (Collet, 2013).

The completion of this study gave a detailed analysis of the drivers of Johannesburg's urban growth and how this has influenced the City’s infrastructural development and its impacts on agricultural land use. The outcomes of the study can guide future urban planning in a sustainable manner as well as make provisions for urban expansion in a manner that does not compromise urban agricultural land.

CHAPTER TWO
THEORETICAL CONSIDERATION AND LITERATURE REVIEW

2.1 Introduction

In order to understand the phenomenon of urbanisation and its impact on urban agricultural land use in the City of Johannesburg, it is necessary to review existing literature on the subject. This chapter is dedicated to the review and analysis of academic journals, articles, books and reports on urbanisation, urban agriculture land use and urban land use changes. The chapter is divided in the following order. Section 2.2 gives an overview of urbanisation. Section 2.3 reveals the drivers and consequences of urbanisation. Section 2.4 reveals the relationship between urbanisation and urban agriculture land use. The final Section 2.5 explores urbanisation in South Africa.

2.2 Overview of urbanisation

According to Cohen (2004), urbanisation is used in a more general context to refer to a more complex urban growth. It involves the physical expansion of urban areas and the changes in socio-economic and political structures as well as the movement of people to urban areas (Ibid). Globally, it is portrayed as a dynamic and complex phenomenon which has led to the integration of a fraction of the population into an urban settlement pattern to create a paradigm which forms the core ecological matrix for social life, expansion and transformation (Sroka et al., 2018; United Nations Human Settlements Programme, 2009).

Sroka and colleagues (2018) reveal that metropolisation is the new global phase of development in urbanisation currently. This has been supported by the United Nations Department for Economic and Social Affairs (UNDESA). Statistical research conducted by UNDESA (2014) revealed that the world's urban population has grown progressively from 746 million in 1950 to 3.9 billion in 2014. This means that cities all over the world are experiencing unprecedented growth rates making the world more and more urbanised. Cohen (2006) however clarifies that, although urbanisation is occurring globally, the rate at which it occurs differs across the world especially in the context of developed and developing countries.

The current patterns of urban growth in developing countries have diverged significantly from historical trends (Cohen, 2006). McDade and Adair (2001), reveal that most developing nations are former colonies, characterised by high levels of poverty and low levels of technological development as compared to the developed nations. For instance, in developed countries like the United States of America and Great Britain, rural to urban movement has been driven by large-scale industrialisation due to high need for labour (Cohen, 2006; McDade and Adair, 2001). However, the majority of developing nations lack the benefits of industrialisation such as job opportunities (Cohen, 2006). Many studies conducted by migration experts and organisations like the United Nations reveal that in developing nations, socio-economic and political conditions are critical factors that causes migration and thus urban growth (Kizos et al., 2017; Krykavskyy and Woronina, 2015; United Nations, 2014).

The concept of urbanisation is highly contested since there is no universally accepted standard for classifying urban environments. Though many explanations have been presented to understand urbanisation, all the definitions seem to point out that the concept revolves around the expansion of urban areas because of increased mobility of people into cities or urban spaces (Deng et al., 2015; United Nations Human Settlements Programme, 2009; Cohen, 2006). This study would therefore adopt the definition of urbanisation as the increase in the size of a population within a specific boundary, which causes the physical transformation of an urban space over time. (Sroka et al., 2018; United Nations Human Settlements Programme, 2009). Based on this, this study therefore intends to understand the drivers of the City of Johannesburg's growth and how the growth of the City has affected its urban agriculture land use.

2.3 The drivers and consequences of urban growth

The process of urban growth can be defined as either a change in an urban area or the rate at which non-urban land is converted to urban uses (Seto and Fragkias, 2005). The question of what drives urban growth has always been one of the most common research questions. As such, several factors have been identified as drivers of urban growth (Krishnakumar and Indumathi, 2014; Arsanjani et al., 2013; Zheng et al., 2012). Urban growth can be explained by the complex interaction of behaviours and structural

factors associated with demand, technological capacity, social relations and the nature of the environment (Arsanjani et al., 2013).

Various studies have revealed urban areas as vital drivers of development and poverty alleviation, because they present many opportunities associated with higher levels of literacy, better health care services, better access to social services, enhanced opportunities and political participation (Rana, 2011; Hammad and Tumeizi, 2010; Cohen, 2006). This explains why, as part of the outcomes of the United Nations Conference on Sustainable Development in Rio in 1992, urbanisation was identified and linked to the three pillars of sustainable development; that is economic development, social development and environmental protection.

The world population has increased drastically, particularly over the last two decades (United Nations Human Settlements Programme, 2009). From a global perspective, globalisation has promoted development, advanced telecommunication and created favourable political climates, allowing for easy movement of people across boundaries (Krykavskyy and Woronina, 2015; United Nations Human Settlements Programme, 2009; Cohen, 2006). Globalisation according to Krykavskyy and Woronina (2015), is the closer integration of people and countries in the world as a result of lower cost in transportation and communication, which previously, were barriers to flows of goods, services, capital, knowledge and people across boundaries. The effects of globalisation have made people more aware of living standards and lifestyles in other parts of the world, for instance through the watching of television, social media platforms and returning expatriates, people have renewed hopes of a better life somewhere aside their current habitat (Krykavskyy and Woronina, 2015). This has been a motivating factor causing people to migrate to cities in order to secure greater income opportunities. The youth especially consider migration in order to escape the drudgery of subsistence living in order to capitalise on the opportunities the big city presents (Krykavskyy and Woronina, 2015).

There is a consensus that the concentration of people in urban areas are driven by economic, social and political developments (Qian et al., 2016; Krätke, 2007; Kok, 2006). Stockdale (2002) is of the view that, though this may be true to an extent, the decision by individuals to migrate are complex and therefore very subjective as they

are influenced by personal aspirations and circumstances, which are dependent on specific geographical locations. Ravenstein (1885), the father of migration research explains the relationship between migration and the factors which drive them based on studying migration patterns in Europe. His law on movement iterates that migration would increase over time because of development in transportation systems and growth of industries and commerce. This he explains would be because of favourable climatic conditions which would stimulate migration processes. Similarly, to Cohen (2006), he emphasised the role economic factors play in the movement of people from rural settings to urban areas which have more commercial services, industries and social opportunities.

Migration is defined as the movement of people which leads to a permanent or semi-permanent change of residence (Krykavskyy and Woronina, 2015). Movements are usually affected by many intervening obstacles and the change in location is dependent on the individual and their unique characteristics (Stockdale, 2002; Lee, 1970). The father of migration studies, Ravenstein (1885) and later Lee (1970), classified the drives that cause individuals to migrate as the 'Pull' and 'Push' factors. The Push and Pull theory are grounded on different conditions in rural and urban settings (Krishnakumar and Indumathi, 2014). The push factor comes into play when there are negative deteriorating conditions in the rural areas and as a result force people to move out in search of better conditions for survival, whilst the pull factors are the positive and favourable conditions that attract people to the cities or urban areas for better opportunities (Krishnakumar and Indumathi, 2014). The push and pull formula reveals that migrants are subjected to "centrifugal" forces at their original location and the "centripetal" forces at the place of destination (Lee, 1970).

McGee (1971), reveals in his study of migration that the push and pull model of western Europe's rural to urban migration is not the same everywhere, especially in the context of developing nations. This was because his study revealed that the main reasons influencing migration were the effects of population growth and the unavailability of job opportunities in rural areas (Ibid). As a result, he replaced urban poverty with rural poverty in the context of studying migration patterns in developing nations. On the other hand, in Eastern Europe, the movement from rural areas has been linked to population pressures, modernisation of agricultural methods, commercial extension

and weak economies to locations of positive things such as employment opportunities with better wages and favourable working conditions (Krishnakumar & Indumathi, 2014; McGee, 1971).

In developing nations, specifically in Africa, Lee's theory of push and pull factors is seen and to an extent has been the driver of migration from not only rural areas to urban areas, but also places of poor economic and social conditions in general (Krishnakumar and Indumathi, 2014; United Nations Human Settlements Programme, 2009; Cohen, 2006). This has risen from the development pattern in third world countries (Cohen, 2006). Lipton's (1977), Urban Bias Theory explains that development associated with better economic opportunities and infrastructure has been centered in urban areas at the expense of rural areas. As a result, the need to access these facilities has pushed and pulled most rural youths into urban areas in search of better living opportunities (Krishnakumar and Indumathi, 2014; Satterthwaite et al., 2010; Mutume, 2006).

A summary of the factors which motivate people to migrate.

i. Economic factors – In most developing nations, there is low agricultural income which has created high agricultural unemployment. These are the basic factors pushing migrants towards urban areas with greater job opportunities. Generally, the non-availability of alternative sources of income in rural areas is a crucial factor for migration (Krishnakumar and Indumathi, 2014; Cohen; 2006).
ii. Demographic factors – It has been revealed that population growth rate of the different regions in countries influence internal migration. Fertility and natural increase in population are generally higher in rural areas, which causes the movement of people towards the cities. In addition to the demographic factors which cause internal migration, marriage has also influenced relocation greatly (Sroka et al., 2018; Barbero-Sierra et al., 2013).
iii. Social and cultural factors - Some of these factors include conflicts within families, and the quest for independence by the younger generation. Cities offer good communication facilities, effective transportation, good network communication facilities, social services such as cinemas, urban oriented education and resultant change in attitudes. All these have played a key role in attracting people to urban areas. Also, in cities there is social inclusion, hence the respect

and protection of social right issues, allowing for freedom of expression and association (Sroka et al., 2018; Krishnakumar and Indumathi, 2014).

iv. Political stability - Many developing nations are experiencing political instability, war and conflict which has created unfavorable living situation for its citizens. This has caused both internal and external movement of people into urban spaces (Sroka et al., 2018; Krishnakumar and Indumathi, 2014; Barbero-Sierra et al., 2013).

v. Miscellaneous Factors – These include factors such as the presence of relatives and friends in urban areas and their projected lifestyles which present urban areas as having solutions to current bad living conditions. Also, most people desire to receive education which is available only in urban areas (Krishnakumar and Indumathi, 2014).

In addition, Metropolisation is becoming the new phase of development in urbanisation (Sroka et al., 2018). It has become one of the most important processes affecting the functionality and the socio-economic change in settlement systems (Kizos et al., 2017; Piorr et al., 2011). The concept of metropolisation leads to a concentration of specialised, unique and rare functions in cities (Sroka et al., 2018). It also occurs as a result of economic transformation, due to the use of land space as well as in society and in culture (Krätke, 2007). Agriculture and agricultural land present in metropolitan areas productive, social, and environmental functions are threatened (Zasada, 2011; Lovell, 2010). One of the most identified negative consequences of the process of metropolisation is the consumption of land, especially taking over high-quality agricultural land (Busko and Szafranska, 2018; Huang et al., 2015; Mazzocchi et al., 2013). The vanishing of arable land is increasing in developing nations as well as in Europe (Deng et al., 2015; Su et al., 2011).

A study conducted in Poland revealed that the contemporary agricultural land in metropolitan areas appears to be reserved for more profitable activities such as the construction of housing facilities, infrastructure for communication activities, recreational facilities and business operational facilities (Sroka et al., 2018; Piorr et al., 2011). The increase in the competition for land, the development of private sector enterprises and growing urbanisation have resulted from conversion of agricultural land to other func-

tions (Sroka, 2015). Individual farm land, particularly those found within the administrative borders of cities have been revealed to receive weak legal protection and therefore converting arable agricultural land to non-agricultural purposes is mainly determined by market mechanisms (Hagedorn, 2004).

Similar studies conducted in other countries, reveal that the manner in which land is used within metropolitan areas is determined by socio-economic reasons as well as urbanisation (Huang et al., 2015; Deng et al., 2015). Some economists are of the view that urban expansion is as a result of market forces and as long as the marginal benefit of land use is greater than that of agricultural land use, urban expansion will occur (Qian and Wu, 2016). The Economic Theory explains land as a special asset which provides space for locating economic activities, infrastructure, housing, amenity services and aesthetic value (Diogo et al., 2015; Veen and Otter, 2001).

Sroka and colleagues (2018) reveal that with urban sprawl, increasing competition for land comes from non-agricultural uses. It is revealed that in many advanced industrialised nations, the main factors which determine agricultural land use in urban areas are linked to urban expansion. Where the factors are in operation, non-agricultural land uses which yield higher rents forces agricultural production beyond cities (Ibid). Similarly, Alonso's bid-rent theory explains the relationship between land prices and land use. He explains that in a competitive land market, land-users aim to gain the most from their land either by selling or renting it to the highest bidder, who is usually the potential land-user (Ibid). This means that land is usually used for the purpose which brings the greatest utility, such as real estate development (Sroka et al., 2018).

According to Runde (2015), though rapid urbanisation brings opportunities, it also comes with serious consequences. The process of urban growth will continue to be a challenging issue influencing human dimensions, especially in the developing nations (Deng et al., 2015). People usually the poor, experience low levels of basic services as well as severe environmental health challenges because of insufficient sewage facilities, clean and safe drinking water, ineffective solid waste removal services among others (United Nations Human Settlements Programme, 2009). This is due to lack of effective mechanisms and recycling policies to deal with the rapid growth of cities (Hove et al., 2013; Cohen, 2006).

Though urban areas occupy just three percent of the earth's land surface, the conversion of land to other uses as a result of urban development is among the most significant anthropogenic land cover changes of which the ecological and environmental impacts are very severe (Wu et al., 2011; Dewan and Yamaguchi, 2009). The process of urban growth has led to significant land cover and landscape pattern changes (Deng et al., 2009). The spatial increase of built-up areas has increased drastically with urbanisation according to the United Nations Human Settlement Programme (2009). Though urbanisation advocates for socio-economic development as well as the improvement of quality of life, urban growth indirectly results in major land cover changes in order to support human needs in urban areas, especially when physical infrastructure development becomes a necessity to meet the needs of the growing population (Alphan, 2003).

Raddad and colleagues (2010) argue that this process of uncontrolled development will continue to have impact on the global carrying capacity of the earth. This is because humans depend on the earth for their basic needs like food production (Rana, 2011). Any change to the functions of the earth's natural ecosystems automatically affects the health of its dependents (Barbero-Sierra, et al., 2013; Raddad et al., 2010; Alberti, 2005). It is in view of this that natural resources such as land need to be utilised judiciously in an equitable manner, so that it does not compromise the ability to support other functions such as food production.

2.4 Urbanisation and agriculture land use change

The act of urbanisation threatens the food supply of an urban area (Busko and Szafranska, 2018). This is based on the assumptions that when cities grow, they change the dynamics of the existing land, and as a result, the processes of urban activities expand into agricultural land (Deng et al., 2015; Salvati and Carlucci, 2014; Cohen, 2006). Generally, urban agriculture is seen as an important issue globally. This is because it has been proven that the presence of urban agriculture has vital roles in cities of the developing world (The United Nations, 2009). Among these are the enhancement of food security, nutrition and health as well as creating employment opportunities and improving wellbeing, especially for the urban poor and vulnerable (Prain et al., 2010; UNDP, 1996).

As of 1993, about 15% to 20% of the world's food was produced in urban areas (Nelson, 1996). Urban agriculture contributes massively to food security of many major cities and forms a major component of the urban food system as well as a means for the vulnerable groups to minimise their food insecurity challenges (Busko and Szafranska, 2018). It is in view of this that Collet (2013) suggest agricultural land be incorporated within all planning activities in order to protect them for their original function through a multi-disciplinary approach.

Agricultural land in cities play a critical role in the sustainability of urban development (Satterthwaite et al*.,* 2010). This is because, in addition to supporting urban food production and food security, it contributes to the urban economy, especially in urban poor areas, where the people's livelihood is dependent on farming (Kanagalakshmi and Nagan, 2013). The process of urbanisation is a major factor which influences changes in agricultural land use in a negative way (Kanagalakshmi and Nagan 2013). This includes the loss of arable agricultural land, reduced food production and agricultural unemployment (Azadi et al., 2011). Certain studies support the argument that the loss of arable land intended for food production in cities could and would lead to food insecurities when the appropriate measures are not taken to preserve them (Collet, 2013).

Agricultural land use change is a phenomenon that is almost impossible to avoid during urban development (Cohen, 2006; Alphan 2003). It has been estimated that by the year 2050, 5.7% agricultural land would be lost globally (Azadi et al*.*, 2011). This projection offers a realistic view of how much new land would be needed for cultivation in order to meet the projected food needs of the world's growing population (Azadi et al., 2011). This scare has caused nations like the United States of America, Japan and China to enact policies to preserve their agricultural land from being converted to other uses (Kanagalakshmi and Nagan 2013). Research conducted on urbanisation and urban agriculture, indicate a positive correlation between urban growth and agricultural land use change (Kanagalakshmi and Nagan, 2013; Hammad and Tumeizi, 2010 ; Cohen 2006). This is because, as the population of people in cities increase there is the need for an expansion of built up areas to provide basic infrastructure and employment opportunities at the cost of arable farm land (Rana 2011; Cohen, 2006).

Issues of food security have been on the international agenda since 1948 after the affirmation of the Universal Declaration of Human Rights which stressed the need for everyone to have access to food. In the urban context, there is a high dependence on market system and commercially processed foods because of inadequate food supplies accompanied by high poverty levels (United Nations, 1991; Armar-Klemesu, 1998). It is claimed by the United Nations Development Program (2015) that the world's resources are adequate to produce food for the entire population for at least the next few decades. Even though food supplies are projected to increase faster than population in higher income developing nations and many lower-income nations, the urban poor will remain vulnerable to food insecurity (United Nations Human Settlements Programme, 2009).

In terms of access to food, the obvious difference between urban and rural areas is the ability of rural dwellers to produce their own food whiles urban dwellers are more dependent on food purchase. Armar-Klemesu (1998) argues that the reason why the urban population, especially the urban poor, are unable to have food security is because of monetary constraints. This is a highly contested issue because many factors drive food production, especially availability of arable land resources to support food growth in the cities. In a context where urban development activities are extending into arable farming land, the city's ability to produce food is reduced.

2.5 Urbanisation in South Africa's perspective

There is a consensus view that the Republic of South Africa has experienced an increase in migration in a form of "cheap labour" right from the 19th century from neighbouring countries (The Gauteng Province, 2016). According to Krishnakumar and Indumathi (2014), the movement of these people has been influenced by the search for better economic opportunities and the freedom to move about. According to a community survey conducted by Statistics South Africa (StatsSA) in 2016, the bulk of migration associated with cheap labour is from the Southern African Development Community (SADC). The countries include Mozambique, Zimbabwe, Malawi, Lesotho and Swaziland.

Several patterns shape and influence the Republic of South Africa's urban growth. Firstly, Alon-Mozes (2011) reveals that the strategic location of the nation on the map, economic power, social, cultural, infrastructure development, natural resource richness and historical richness, makes is very attractive to many migrants. Right from colonisation to Apartheid, urbanisation in South Africa has been influenced by policies to control the movement and settlement of its people, especially the black people (Turok, 2012). Many of these policies around the movement of people were intended to restrict the blacks to their homeland, predominately rural areas which were characterised by limited economic and social opportunities (Nattrass, 1983). Right from the early days of settlement, there have been legal restrictions on black groups from entering towns and cities as well as settling in them. The uprising and advent of unions which saw to the end of Apartheid opened city areas to all citizens and even non-citizens. This allowed for easy movement within the country as well as promoted international migration (Turok, 2012).

The political situation in the country created uneven economic, social and environmental development within the country which did not match the spatial distribution of the African population, making them disadvantaged in all aspects (Cohen, 2006). Development in the republic is centralised and available to the few privileged people during the apartheid era. The new South Africa and its urban areas serve as homes for people in need of economic liberation, political and war refuge (Turok, 2012). After the end of Apartheid, the 1996 census revealed that about 55.1% of the people now lived in urban areas (StatsSA, 2017). This number grew to 57.5% in the year 2000 (Turok, 2012; StatsSA, 2017). This analysis shows the movement of people from rural areas to urban areas in search of the economic, social and cultural opportunities that had been denied them during the apartheid era. This confirms Atkinson's and Marais' (2006) argument that people are naturally attracted to areas of better and quality living.

After the end of the Apartheid regime in 1994, the implementation of the Development Facilitation Act, with the intention of formalising and upgrading informal settlements, led to the movement of many people into cities in South Africa, especially in Johannesburg (Turok, 2012). The people after several years of Apartheid and poor living conditions were in a very precarious state thus the need to rationalise and legalise the movement and housing development phenomenon to accommodate and

make provision for those who were marginalised during the apartheid regime (Turok, 2012; Nattrass, 1983).

Nattrass (1983) just like Lee (1977) revealed that two distinct forces encouraged urbanisation in South Africa after the end of the Apartheid regime. They include the urban pull forces which includes the search for better and improved economic opportunities in urban areas, urban lifestyles and improved access to amenities such as educational services, transport and recreational facilities (Nattrass, 1983). The second factor that drives movement of people to urban areas is classified as the push factors. Many rural areas experience increasing poverty levels, population growth and hardships of rural life and in certain circumstances social obligations which people turned to flee from or find solutions to by moving to major towns and cities in search of economic liberation (Lehohla, 2015). When the combined urban pull and rural push factors become greater than that of the urban push and rural pull factors, urbanisation occurs because people from rural areas are relocating to the major cities like the City of Johannesburg (Lehohla, 2015; Nattrass, 1983; Lee, 1970).

Among all the Provinces, the Gauteng province has the highest urban growth rate (The Gauteng Provincial Government, 2018). The increase in migration to cities or urban areas in the Province reflects similar trends in other developing countries. Johannesburg as the major city provides considerable attractive opportunities to foreigners as well as its nationals (Kok, 2006). Johannesburg is among the fifty (50) urban conglomerations in the world and largest landlocked city in world, with a population of about 10.5 million as of 2016 including its metropolitan areas (StatsSA, 2017; The Gauteng Province Government; 2016). It has a population density of 2,900 people per a square kilometer. The city started growing after the discovery of gold in 1896 on what was previously a farm (World Population Review, 2017). The new discovery attracted many people from all over the world. After the Second World War, the population doubled from 400,000 in 1931 and started declining in the 1990s during the political unrest and the fall of the apartheid regime (World Population Review, 2017).

From the 18th century to date there has been a great change in land use in South Africa's major cities due to the alarming rate at which the cities are growing and developing (Turok, 2012). Though urbanisation is encouraged and seen as a sign of economic development, it is gradually causing the loss of the limited agricultural land

present in the country. According to Collet (2013), South Africa has only 3% to 4% high potential agricultural land that is suitable for sustainable production of food. Despite the scarcity of arable land globally, most economic development policies tend to promote industrial growth which stimulates land use change at the expense of food production (Collet, 2013).

Farmers are forced to convert their farm land into other uses aside from food production due to economic difficulties (Sroka et al., 2018). Farmers, especially smallholder farmers, tend to sell their land to infrastructure developers for immediate benefits to address issues of poverty (Sroka et al., 2018; Kizos et al., 2017). This has greatly impacted the nation's arable land in urban areas. As a result, if the necessary measures are not instituted, there will be no more land in the urban areas to support agricultural activities, which could be a detriment to the future of food security in major cities (Collet, 2013).

2.6 Chapter conclusion

The existing literature has revealed that urbanisation is an unavoidable consequence of socio-economic development and the rate and process vary across countries. It was identified that several factors influence the process of urbanisation. Though urban areas present many positive opportunities for its inhabitants, they also present challenges especially in the context of many developing nations, especially sub-Saharan African nations. Among the challenges of urbanisation is land use changes because of the processes of urban physical development to cater for the growing population who have migrated into the cities in search of better living conditions. This according to the literature has and would affected food production greatly in many cities especially, the unplanned ones.

CHAPTER THREE
METHODOLOGICAL CONSIDERATION

3.1 Introduction

Kothari (2004) defines a research methodology as the systematic approach taken to address a research problem as well as the logic behind the steps. In order to effectively understand the impact of urbanisation on urban agricultural land use in the City of Johannesburg, this study adopted a mixture of qualitative and qualitative approaches. This chapter consists of subsections which are outlined in the following order. Section 3.2 presents the research philosophy adopted for this study. Section 3.3 is the research study area. Section 3.4 presents the research design. Section 3.5 presents the data collection tools that were employed to obtain data for this study. Section 3.6 consists of the data analysis which explains how the obtained data would be presented and analysed to address the research objectives. Section 3.7 presents the scope and limitations of the study. Finally, section 3.8 presents the ethical considerations is conducting the entire research study.

3.2 Research Philosophy

Every research process is influenced by the philosophy and position of the researcher. Researchers are themselves products of society and are influenced socially or scientifically. Therefore, a study of this nature can be approached from different perspectives. This study, however, adopted a pragmatic approach to obtaining data to address the research objectives. The philosophy of pragmatism is not committed to one system of philosophy or reality and rejects the notion that social investigation is able to access the "truth" about the real world using a single scientific method (Mertens, 2005).

This is anchored on the premise that the best approach to research is by mixing the data collection methods and data analysis procedures within the research process (Creswell, 2003). In other words, pragmatism provides a framework that allows for mixed research methods to address the "how" and "what" of the research problem (Creswell, 2009; Somekh and Lewin, 2005; Tashakkori and Teddlie, 2003).

Pragmatists use methods or a combination of methods that advance a specific research in the best possible manner. This has been revealed to allow for relevant information to give an in-depth understanding of the issue being investigated (Creswell, 2009).
The key components of the pragmatic approach include;

i. Pragmatism rejects the distinction between realism and anti-realism. This philosophy believes there is a reality, however, it is ever changing based on human actions (Creswell, 2009).
ii. Owuegbuzie and Leech (2005), reveal that a pragmatic research often includes prolonged engagement and triangulation, which leads to the researcher pursuing their own apprehensions as well as the opinions of others. This means that it allows multiple stances and values.
iii. Pragmatism is a deconstructive paradigm that advocates for the use of mixed methods in research (Feilzer, 2010).
iv. It is appropriate for social research.

In view of this, the study adopted a pragmatic philosophy to enable the use of multiple data collection methods which included interviews, questionnaires, satellite images and existing literature to gain more information on the drivers of the City of Johannesburg's urban growth and how the processes of urbanisation have influenced urban agriculture land use.

3.3 The research study area

The City of Johannesburg (CoJ) is the largest metropolitan city in South Africa, located in Gauteng, the wealthiest province in the country (World Population Review, 2017). It is referred to as the richest city because it contributes 30% of the total Gross Domestic Product (GDP) of the entire country (The Gauteng Provincial Government, 2018). In terms of its urban growth, CoJ is ranked the 15th most urbanised area in the world by population (Smith, 2013).

The City of Johannesburg is situated on the Highveld plateau and has a subtropical highland climate. It has temperatures which range from 25.6 °C to 16 °C on the

average (South African Weather Service, 2012). According to Smith (2013), the study area is often referred to as the economic hub of Africa due to its modern and prosperous looks. It has multiple Central Business Districts, which includes Sandton, Midrand and the Central Business District referred to as a town, Johannesburg, Joburg or CBD. Right from the middle of the 19th Century, CoJ has experienced massive migration, both internally and externally due to the demand for labourers for the mines, following the discovery of gold in the region. Figure 1 below shows a map of the study area, the City of Johannesburg and its suburbs.

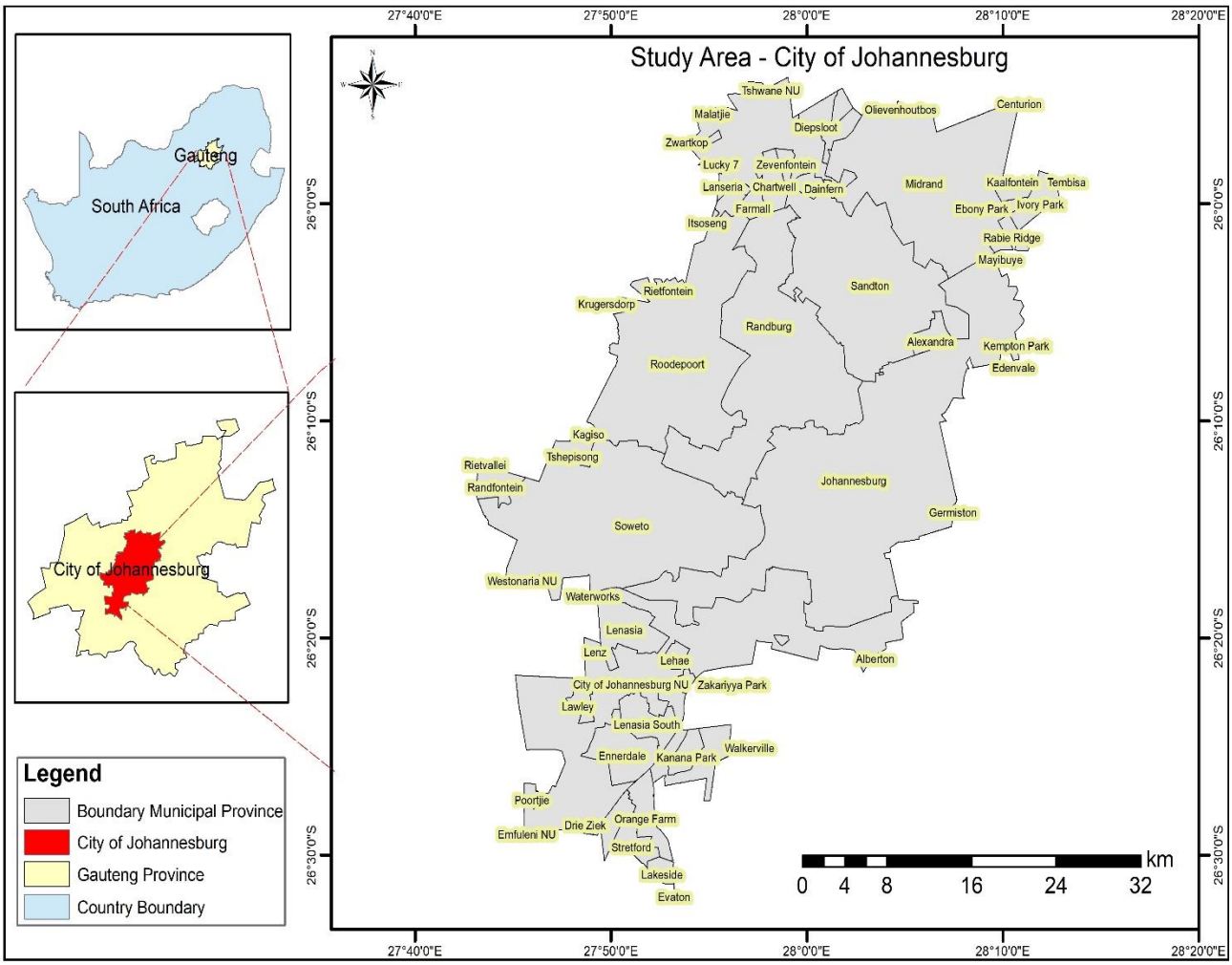


Figure 1 - The City of Johannesburg (Data source: National Geo-spatial Information, 2017).

3.4 Research Design

A research design, according to Parahoo (2006), is a plan that defines how, when and where data for a research would be obtained. The study used both quantitative and qualitative data collection methods. The use of both qualitative and quantitative methods proved to be very appropriate because of the many benefits associated with it. The identified benefits are summarised below,

i. It allows for the detailed description of variables such as land use change and built-up areas during the analysis of the results.

ii. It also allows for a detailed comparism between the variables over time.

iii. The study was able to determine the interactions that is the cause and effect between the variables (Vegetation and Agriculture land versus Built-up areas) over the study frame.

3.4.1. Sample population

According to Brynard and Hanekom (2006), a population is a group of people in the world with unique characteristics. In the context of this study, population refered to all the participants that were involved in either the interview process or responded to a questionnaire. According to Bless and Higson-Smith (2000), these participants were the focus of the study. A total of forty-one (41) participants were identified as a subset of the total population for this study. Participants were sampled from the Northern, central and the Southern part of CoJ, to form a representative sample.

A study of this nature required participants to have certain level of knowledge and understanding of the issue being investigated. Below are the characteristics defined to identify suitable candidates that partook in a study of this nature.

i. The participant was an adult from the ages of 25 years old and above. This was considered necessary because, most people by age 25 years would have obtained their first degree and are matured.

ii. The participant lived in or traveled to CoJ regularly. This was necessary because, one of the things the study was interested in was to identify the

contemporary drivers of the City's urban expansion. As such a criterion of this nature enabled the researcher to obtain certain information such as the reasons why the participant was in CoJ at the time of data collection.

iii. The participant had knowledge of the City's physical growth over time. This was necessary because responses to the questions in Appendix D enabled the researcher to obtain relevant information to support the analysis of how the development in the City had increased over time.

iv. Finally, the participant understood the issue and topic being investigated. This was necessary because it yielded relevant information, that enriched the research analysis.

3.4.2 Sample and Sampling technique

Bless and Higson-Smith (2000) reveal that a sample which is being investigated can be generalised to represent a whole population. In view of this, the study employed the non-probability method of sampling technique. The purposeful and snowball sampling technique were identified as the most convenient for this study. The purposeful sampling approach was used to select participants who met the criteria defined for the study to partake in the questionnaires, whiles the snowballing technique was used to identify the relevant participants to be interviewed.

The snowball technique allowed for data to be collected on the few known individuals who were easy to locate. They were then asked to provide information needed to locate other members of the same population whom they knew and could enrich the study. This was the most appropriate technique because the study aimed to obtain data from professionals in the field of study. This made this technique the most suitable for identifying interviewees for the research. Initially 10 participants were to be interviewed, however due to time constraints and participant availability, only nine (9) professionals participated in the study. The professionals identified for this study included officials from the City of Johannesburg, academia, environmental engineers, real estate developers, environmental scientists, structural engineers and Urban Planners.

Both techniques were identified as the most convenient sampling approach due to the limited time available to conduct this research as well as the limited financial budget to travel to collect data. The existing literature also favours the use of the purposeful sampling and snowball technique because they both allow the researcher to rely on their own judgement to select participants who are particularly knowledgeable and understand the issue being investigated (McBurney and White, 2007; Robson, 2007).

Since the research was only interested in people with ties to CoJ, only people who were in the boundary of the City of Johannesburg at the time of the study were sampled for this research.

In all a total of forty-one (41), respondents were drawn from the total population sample all over Johannesburg with emphasis on the Central Business District. Nine (9) of the participants who were professionals in the issue being studied were interviewed and the remaining thirty-two (32) were given questionnaires to complete.

3.5 Data collection tools

Data for the study were obtained from both primary and secondary sources. The secondary source of data consisted of previous studies conducted on the topic in the form of articles, journals, reports, conference proceedings and books. The primary source of data was obtained through structured questionnaires, interviews and land cover images from Landsat satellites (Landsat 5 TM, Landsat 7 ETM+, and Landsat 8 OLI for the years 1989, 1999, 2006 and 2016) of the City of Johannesburg.

3.5.1. Questionnaires

McLafferty (2010) argues that a questionnaire is the best tool to collect information for a study of this nature. This is because the process allows the researcher to obtain original data as well as gain insight into social issues (McLafferty, 2010). Using this data collection tool enabled the researcher to gain a deeper understanding as well as identify the drivers as to why people migrate to Johannesburg. It also allowed for larger geographical location coverage due to its flexibility in administering through many platforms, which includes the use of the internet such as through emailing platforms.

All the questionnaires were self-administered. The design of the questionnaire (refer to Appendix D) was based on the outcome of the literature review and the aim and objectives of the study. The questionnaires were structured to include both closed and open-ended questions. This was done to seek the opinions of the identified participants on the broader research question. According to McBurney and White (2007), the two benefits of structuring an open-ended questionnaire are firstly to allow the respondent to provide a more complete response by providing reasoning behind their choice of answers and secondly, to allow the researcher to discover new information which was not anticipated by the initial research design. In view of this, the questionnaire was structured in this format to gain;

i. the demographic information of the participants;

ii. information on the causes of migration to the study area, in order to understand the contemporary drivers of the City's urban growth,

iii. information on the impacts of urban growth on agricultural land use and

iv. the possible ways of mitigating the consequences of urban growth in order to ensure urban farming practices.

The questions were asked in English and written in simple format to avoid confusion. Each of the questionnaires took about ten (10) minutes to respond to by the participants. The information from the questionaries' was extracted, presented and analyzed using Microsoft Excel.

3.5.2 Interviews

In addition to the questionnaires, interviews were conducted with professionals on the issue being investigated. These included participants from the Johannesburg Food Resilience Unit, The Kotze Rooftop Gardening project, the City of Johannesburg Officials, Academia, a Real Estate Development Agency and other individual professionals with knowledge on urbanisation, urban development and urban food security. A semi-structured interview guide (Appendix C) was designed to guide the interviewer to ask the participants questions that will address the research objective.

The interviews were formally conducted and lasted about twenty-five (25) minutes each. They were conducted at a place of convenience for the participants and was recorded with a recording device (cell phone) and transcribed later for analysis.

3.5.3 Satellite Images

Remote sensing is the science of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area, or phenomenon being studied (Lillesand et al., 2004). it has been portrayed to be the fastest and cheapest way of obtaining data over a large area (Ibid). As a result, it was employed as an efficient data collection for a study of this nature.

The primary aim of the study was to understand the role of urbanisation on urban agricultural land use in CoJ. To achieve this aim, there was the need to understand the physical changes of CoJ over time. For this study, the time frame set was from the year 1989 to the year 2016. A time series analysis was performed on four images representing 1989, 1999, 2009 and 2016 to understand the changes in land over of CoJ over a period of 27 years. The time series change detection analysis of the images involved identifying differences in the state of an object or phenomenon (which is the study area) by observing it at different times (Singh, 1989). This is an important process in monitoring, managing, studying and understanding natural resources, urban development and land use changes over time.

The monitoring of landcover has been widely recognised as an important step to better understand and provide solutions for social, economic and environmental problems (Dewan and Yamaguchi, 2009). It is because of this that landcover / land use maps were considered as a source of reliable primary data to understand CoJ's land use changes over time.

To monitor changes in CoJ's land use, 30m resolution satellite images from Landat 5 Thematic Mapper, 7 E Thematic Mapper plus and 8 OLI sensors were obtained for the periods 1989, 1999, 2009 and 2016. The satellite images were downloaded from United States Geological Survey (USGS) website – www.earthexplorer.usgs.gov

The datasets were geometrically and radiometrically inaccurate and were therefore corrected by orthorectification and atmospheric correction techniques using Fast Line-

of-sight Atmospheric Analysis of Spectral Hypercubes (FLAASH) module in Environment for Visualizing Images (ENVI) software (Harris Corporation, Melbourne, FL, USA). The resulting layers were clipped to the extent of the study area boundary, City of Johannesburg, which was obtained from the South African National Geo-spatial Information database of shapefiles.

For the study, three (3) main land use classes were identified. They included Vegetation and Agricultural areas, Bare and Built-up areas and Water, however, the study only analysed the relationship between (Vegetation and Agricultural areas) and (Bare and Built-up areas) over time. Descriptions of these classes are presented below in table 2.

Table 1 - Land use classes and Characteristics

Land Use Category	**Description**
Built-up/Bare	Bare land and built-up areas included residential, commercial, industrial, transportation and all other impervious surfaces
Vegetation / Agriculture	Grassland, pasture, forest, cropland and shrubland
Water	All water bodies both natural and man-made

Using visual interpretation supported by high resolution data of the study area, the land use classes were identified and sampled for use as training sites in supervised classification. The pixels that exhibited similar reflectance to information classes were grouped using maximum likelihood algorithm. This algorithm Maximum Likelihood Classification is a statistical decision criterion to assist in the classification of pixels to a class of highest probability. Each land use category per year of investigation was calculated in square kilometers.

Change detection was performed after the classification to produce statistics about land use transitions over the four periods studied. Land use maps were composed using ArcGIS map software, with capabilities of uniform legend and appropriate mapping scale. Figure 2 shows and outlines the steps taken to produce the four-land cover change detection maps.

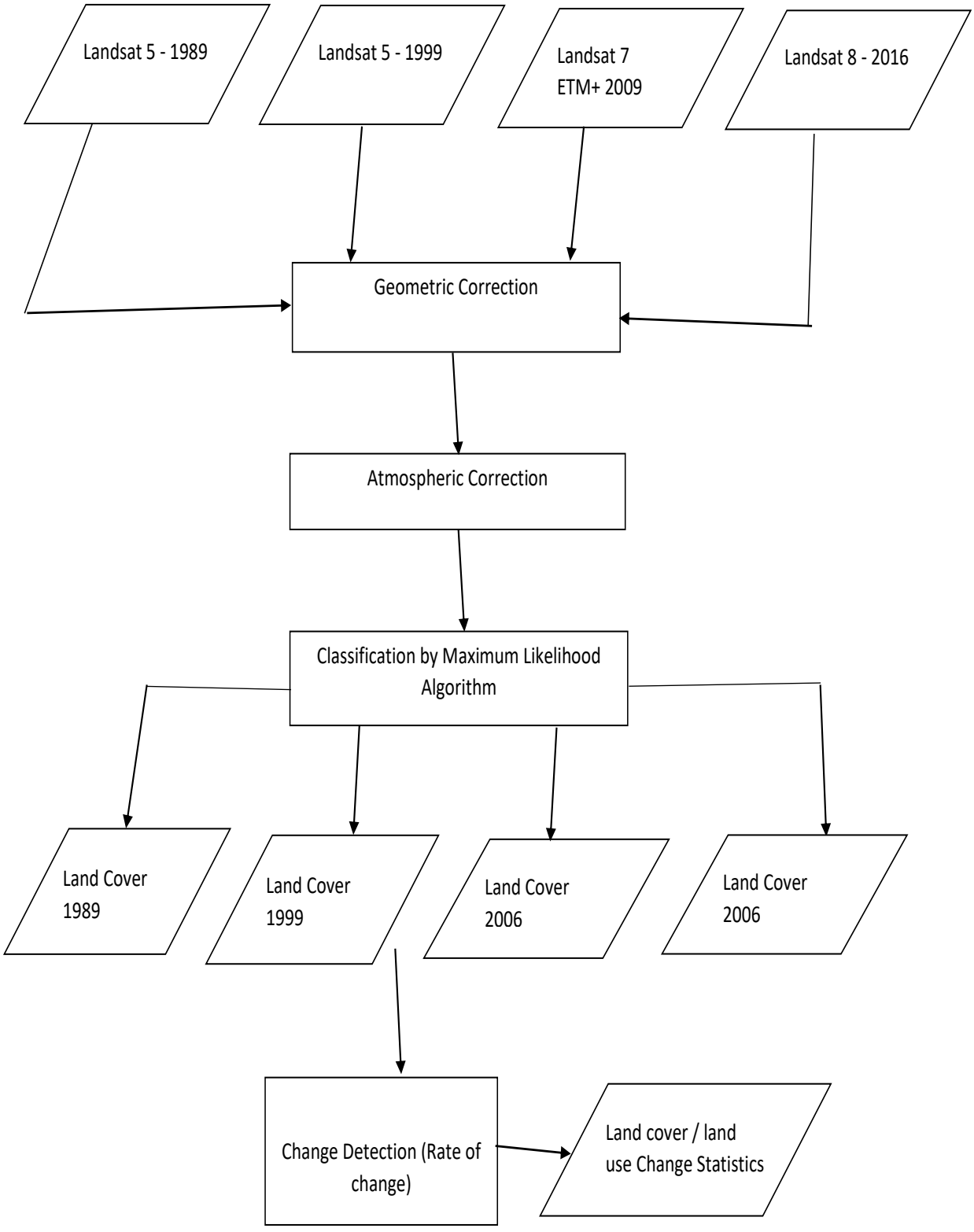


Figure 2 - Steps taken to develop four change detection maps (Annobea, 2018).[1]

[1] This framework was developed by the researcher to develop the change detection maps

3.6 Data analysis

This section formed the core stage of the qualitative methodology. Due to the diverse data sources, the thematic analysis approach was used to present and analyses the information gathered from the field survey. This approach presented an opportunity to categorise data for easy analysis of the study findings (Boyatzis., 1998). The data obtained were sorted into themes and discussed to address the research aims and objectives.

For a study of this nature which used multiple data sources, the triangulation approach of data analysis was identified as the most suitable. This is because, according to Olson (2004), this technique allows the researcher to draw much information from different sources and gain insight knowledge to tackle the issue being investigated using many sources of information. Since the success of the study required the use of data from different sources, this technique aided in improving the validity of the results by reducing the risk of a false interpretation of the collected information as emphasized by the Institute of Global Health (2009) as the strength of the triangulation method. Data were obtained from questionnaires, interviews, satellite images and existing literature. This method was very appropriate as it allowed the researcher to validate as well as eliminate any misinterpretation and false conclusions.

3.7 The Scope and limitation of the study

3.7.1 The scope of the study

This study aimed at using a mixed approach, backed by the pragmatic philosophy to understand the impact urbanisation has on urban agricultural land use in Johannesburg. The approach provided an in-depth understanding of human actions, processes and the reasons behind the actions and processes (Denzin and Lincoln 2005). It allowed the investigation of the what, why and the how of actions and processes. This was the most suitable approach because the study hoped to understand the ways people experience events, places, and processes in a constantly changing world.

These experiences were manipulated and analysed through diverse interpretations and filtered through multiple frames to derive concrete meanings and explanations as to what drives urban growth in the City of Johannesburg (McGuirk and O'Niell, 2016). Also, this approach recognised the complexity of everyday life that shapes human experiences in the changing world (DeLyser et al., 2012). As a result, it employed questionnaires and satellite images as tools to achieve the overall aim which was to understand how the growth of Johannesburg is impacting on urban agricultural land use.

The research was carried out and presented in phases. The study firstly explains and motivates why understanding the impact of urbanisation on agricultural land use is very critical to undertake in a period where infrastructure development is at its peak and not so far future projections on population growth threatens urban areas. The second phase focused on the literature review process. It draws information from existing articles and studies conducted on the impact of urbanisation on agricultural land use around the world. This enabled the deduction and understanding of the forces that drive urbanisation at all levels as well as how that process has caused the change in agricultural land use in urban areas. The third phase includes the thematic analysis as well as a time series analysis of the results and findings from the questionnaires and processed satellite images to understand how agriculture land has been affected over a period of time and the possible likely future situation of Johannesburg's agricultural land. The final phase is a conclusive summary of the findings of the study and recommendations on how urban growth can be approached in order to encourage urban agriculture practices in a sustainable manner.

3.8 Limitation to study

A study of this nature required time and financial resources in order to sample a larger population, however, with this being a self-funding project for academic purpose, the limited time available was of great challenge. A study of this nature would require a larger population sample of professionals and experts to gain more insight into the topic and enrich a study of this nature.

3.9 Ethical consideration

Since the success of this study depended on participant participation, ethical issues such as how the data would be collected, handled, formal consent, confidentiality, and anonymity were considered.

In considering the right and safety of the participants, the researcher adhered to the requirements of the University of Witwatersrand ethical guide and submitted the research proposal, data collection tools, formal consent form and participant information sheet to the Ethics Committee for approval. An ethics protocol number GAES2017-33 was issued to signify the University's approval and consent to collect data.

Before data were collected from any of the participants, an information sheet (refer to Appendix A) was given to the participants to introduce the researcher and the purpose of the study. It also contained details of the researcher and the supervisor, should any of the participants have any concerns. A consent form (refer to Appendix B) was given to guarantee participants their anonymity and confidentiality. This was done to establish trust between the researcher and the participants as revealed by Burns and Grove (2003) as being necessary when working with human subjects.

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Introduction

In order to achieve the aim and objectives set for this study, data were obtained from interviews, questionnaires and change detection maps generated from Landsat Satellite images. This chapter presents the findings from the survey and analysis of the results. The analysis is presented thematically to achieve the objectives of the study. This chapter is therefore structured in the following order. Section 4.2 provides a description of the research participants. Section 4.3 explores the contemporary drivers of the City of Johannesburg's urban growth. Section 4.4 reveals the extent to which urban development has impacted on agricultural land use in the City of Johannesburg. Finally, Section 4.5 identifies the likely future impacts urban growth development will have on urban agriculture and food production in Johannesburg.

4.2 Description of research participants

The aim of the study was to explore the impact of urbanisation on urban agriculture land use in the City of Johannesburg. In achieving this, the study was interested in identifying the various nationalities who participated in the questionnaires. A community survey conducted by Statistics South Africa in 2014 revealed that the Republic of South Africa has attracted many foreign nationals due to its economic position in Africa (Gauteng Provincial Government, 2016). As such it was necessary to explore the composition of nationalities in the study area.

Figure 3 below shows the response from question 4a in the questionnaire (Appendix D). According to the chart (figure 3), 59% of the respondents identified themselves as South African nationals while 41% were classified as foreign nationals. The foreign nationals included Cameroonians, Zimbabweans, Malawians, Pakistanis, Nigerians, and Europeans. From question 2 (Appendix D), it was revealed that 73%, being the bulk of respondents were between the ages of 25 and 44 years old, whiles the rest 27% were from 44 years old and above. All the identified respondents classified their race as either Caucasian, Indian or Black.

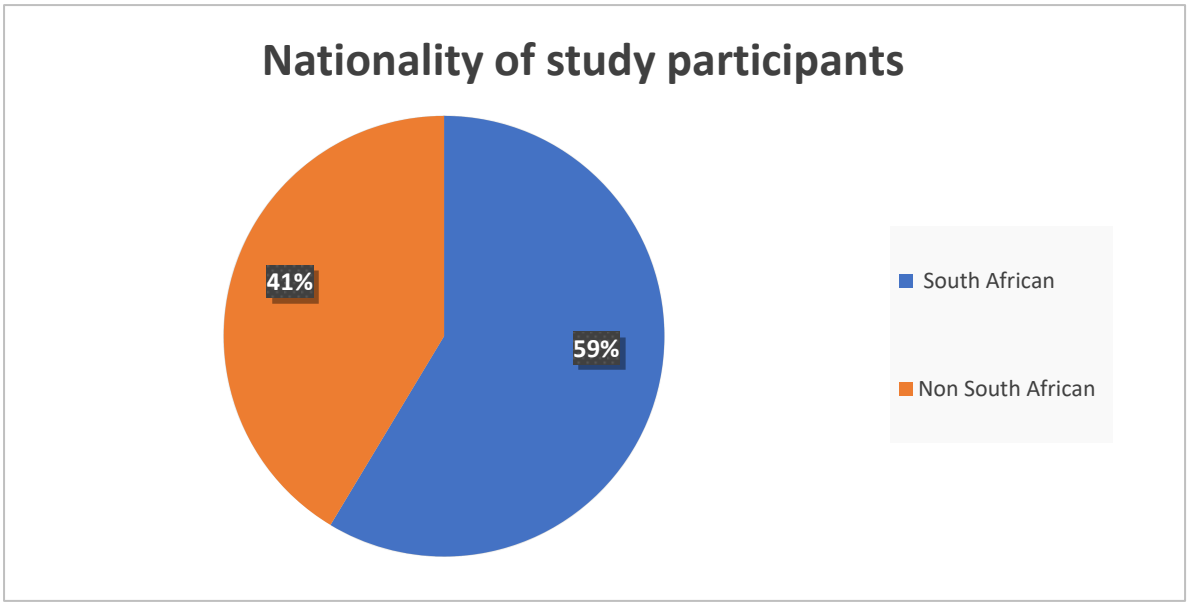


Figure 3 - Nationality of study participants.

According to Cohen (2006) and Rana (2011), the location of an urban area influences its growth. This is evident in South Africa. The location of South Africa within the southern African nations makes it easily accessible to its neighboring countries. The country shares borders with Botswana, Mozambique, Namibia, Lesotho, Swaziland, and Zimbabwe. Almost all these countries face some level of economic instability in their countries. The proximity of South Africa, in addition to the better economic and social environment in provides, attracts people into the country, especially to urban areas like the City of Johannesburg (StatsSA, 2017; Meny-Gibert and Chiumia, 2017). This confirms Ravenstein's Law (1885) of migration that distance is a driving force of migration, especially where there is development of industries and commence concentration in a place, that is South Africa, while the other neighboring locations lack these.

Countries like Zimbabwe, Namibia, Malawi and Zambia have been revealed to make the most yearly visits to South Africa (StasSA, 2017). Most of these trips have been by road which is about 80% with 19% being by air and 1% by sea according to Meny-Gibert and Chiumia (2017). Furthermore, it has been revealed that the high number of road travelers is as a result of the proximity of South Africa to the migrants, travel documents and most importantly, financial constraints as the bulk of people fall in the low-income migrant's category (Meny-Gibert and Chiumia, 2017). In addition, it is also

revealed that 35% of Pakistan's also come to the country by road despite their geographical location. This proves that, in addition to proximity of a nation being a driver for migration, other factors also cause people to move as seen in the case of the Pakistanis (Rana, 2011).

Figure 4 below shows the composition of people who participated in the study. Evidently, the study area has people from all over South Africa as well as outside South Africa. According to Figure 4 below, within South Africa, the bulk of the people sampled for the study were originally from Kwa-Zulu Natal, Mpumalanga and the Eastern Cape Province. Figure 4 also reveals that a large number of the respondents were from outside South Africa. Most of these non-South African citizens were mostly from the southern African region. Statistics South Africa's 2011 census report confirms that more than 75% of foreign-born national's migrants residing in South Africa are from the African continent, with the bulk of the people coming from the Southern African Development Community (SADC) countries, forming 68% of the total international migrants in the Republic of South Africa (Meny-Gibert and Chiumia, 2017).

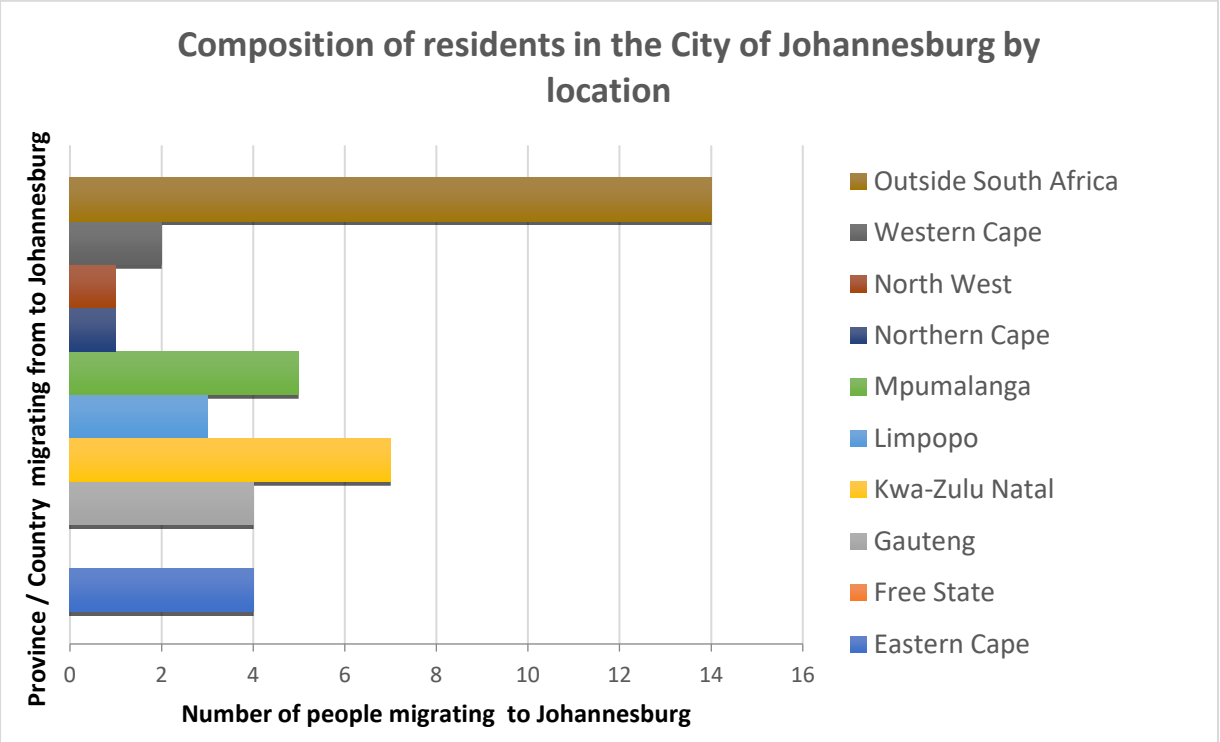


Figure 4 - Composition of residents in City of Johannesburg by location

Most foreign migrants who arrive in South Africa choose to live in the Gauteng province (Meny-Gibert and Chiumia, 2017). Smith (2013), reveals that this province is the economic hub of the country, thus the preferred location of most foreign migrants, especially those in search of better economic opportunities. The City of Johannesburg is the 40th largest urban agglomeration in the world and one of the two African global cities. The metropolitan area alone provides 16% of South Africa's GDP and is home to 40% of its economic activities. It has a high Human Development index of 0.7, making it the highest in the country. These characteristics of the city according to the literature, are the main reasons why people choose to locate in the City of Johannesburg (StatsSA, 2017).

The 2011 census revealed that 37% of the people who lived in the Gauteng province were South African nationals originally from different provinces (StasSA, 2011; Meny-Gibert and Chiumia, 2017). Meny-Gibert and Chiumia (2017) reveal that the mining areas of the province always show the highest number of foreign migrants. For instance, places like Westonaria had 17%, Merafong had 12%, Johannesburg had 13% and Midvaal had 10% of its population being foreign migrants. Mining sectors provide a lot of job opportunities for immigrants, especially unskilled labour. As a result, it is expected that people especially unskilled individuals in search of economic opportunities would occupy these areas.

4.3 The drivers of the City of Johannesburg's urban growth

4.3.1 Migration

One of the objectives of the study was to understand the contemporary drivers of the City of Johannesburg's urban growth. To achieve this, a questionnaire was structured to gain more information on the origin of migration of participants and the reasons for migrating to the study area (refer to Appendix D, questions 4b and 6). Figure 5 summaries the main factors identified in the survey which has caused the movement of people into the study area and also has influenced its growth. The main factors identified include economic and employment opportunities, education, social and political factors. As explained earlier, Gauteng is the richest Province in South Africa

(Gauteng Provincial Government, 2018; 2016). In addition, it offers a variety of top-class educational facilities and serves as the head office of many companies.

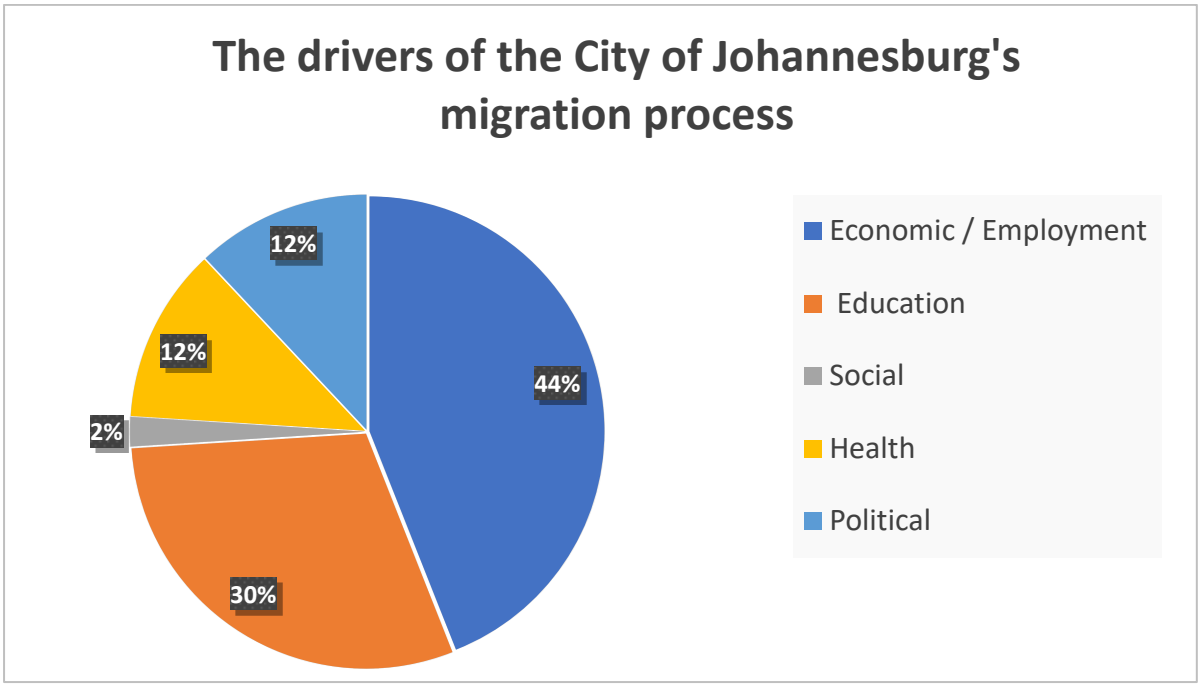


Figure 5 - The drivers of the City of Johannesburg 's migration process

According to figure 5 above, people have migrated from their place of origin to the City of Johannesburg due to varying reasons as identified by Krishnakumar and Indumathi (2014). From the survey, one of the main factors that have caused migration into the city is economic opportunities, representing 44%. The people in this category included daily commuters from nearby cities like Pretoria, who work in Johannesburg. A survey by StatsSA (2017) has confirmed CoJ to be the economic hub of the Republic of South Africa, which houses industries ranging from informal services, skilled and unskilled job markets. This setup has not only attracted people from within but also outside the country, especially from neighbouring Southern African countries.

Though there have been many explanations behind the drivers of internal movement within the country into CoJ, Natrass' (1983) overview of an Apartheid South Africa, presents a more realistic rational behind the movement of South African nationals into major cities like CoJ. Furthermore, Lohohla (2015) iterates that the political situation which was the Apartheid government, created uneven economic, social and environmental development across the nation which did not match the spatial

distribution of the disadvantaged race comprising predominately the African population. Due to this, the end of the Apartheid regime, which saw the abolishing of the Segregation Act and the effect of the freedom of movement bill encouraged people, especially the disadvantaged, to move around easily. The Act set aside segregating the people, also centralised development in certain areas previously inhabited by the white race, leaving out places occupied by the non-white race. It is therefore expected that people would move to CoJ, where there are many economic opportunities (Hove et al., 2013).

The survey also revealed that educational opportunities present in the City of Johannesburg has been a driver of migration. CoJ has a good number of educational facilities which includes the University of the Witwatersrand, University of Johannesburg, Monash University among others that attracts people from within and outside the country in pursuit of good and quality education. From figure 5 above, 30% of the people who participated in the study were in CoJ to benefit from the well-equipped and resourced educational facilities the city offered.

Krishnakumar and Indumathi (2014), reveal that human predicament affects several persons to be forced to flee their places of habitual residence to another nation. These include refugees, asylum seekers and people who are avoiding the effects of political and armed conflicts, natural disasters and bad economic conditions. CoJ has served as a political and social refuge for people in such situations. As revealed by Cohen (2006), the setting of CoJ provides modern lifestyles where people's rights of expression and association are respected. Among these is the freedom of people to express their social and gender orientation, without judgement and condemnation. This explains why 12% of the respondents are in CoJ due to political factors and 2% due to social drivers as revealed by figure 5.

Geographically, the location of South Africa makes it the nearest and safest haven for people seeking safety from their unstable political conditions. There are people from the Democratic Republic of Congo, Rwanda, Burundi, Somalia, Pakistan, Nigeria, Zimbabwe, Malawi who are seeking political, economic and social asylum in South Africa. Johannesburg being the hub of the nation's economic power provides a good location for new beginning and survival for these migrants who desire social liberation. Cities like Johannesburg are indeed centers for modern living as expressed by Cohen

(2006) due to the variety of social and cultural opportunities it offers to the different kinds of people.

4.3.2 Population growth and natural increase

According to the United Nations (2014), Population growth plays a crucial role in the growth of an urban area. In light of this, it was necessary to evaluate the growth trend of the City of Johannesburg. According to Statistics South Africa 2011 Census report, in 1996 the population size was 2,597,285. This increased to 3,226,055 in the year 2001. With a growth rate of 3.2% between 2001 and 2011, the population increased to 4,434,827 in 2011. According to World Population Review predictions and StatsSA estimations CoJ had a population of about 10.6 million in 2016.

Many explanations and theories have been provided by existing literature to explain the causes of population growth in urban areas. Specifically, in South Africa, Turok (2012) and Nattrass (1983), iterate that the political history of the country has influenced the growth of its cities to an extent. Before the end of the Apartheid regime in 1992, Black people were restricted to confined areas referred to as homelands, which were mostly rural areas and urban fringes with no to little economic and social opportunities (Turok, 2012). The end of the Apartheid regime enabled easy movement and access to opportunities, which are concentrated in the cities. The cities were areas previously occupied solely by the white population.

Though the past political situation caused uneven development in the country, development generally, in most African countries, of which South Africa is no exception, has been concentrated in urban areas at the expense of rural areas, this Lipton (1977) reveals as the biases of development. People generally, are drawn to good things as such the unfavorable conditions created as a result of the past policies, has been the centrifugal force which has pushed and pulled people into CoJ. This has been the main factor which has caused internal migration into the City of Johannesburg (Krishnakumar and Indumathi, 2014; Ravenstein, 1885; Lee, 1970).

In addition to migration being a cause of population growth, natural increase has also has contributed to population growth in CoJ. The term "natural increase" refers to the difference between a number of births and deaths within a given year (United Nations, 2014). According to Rana (2009), natural increase is one of the major drivers of urban

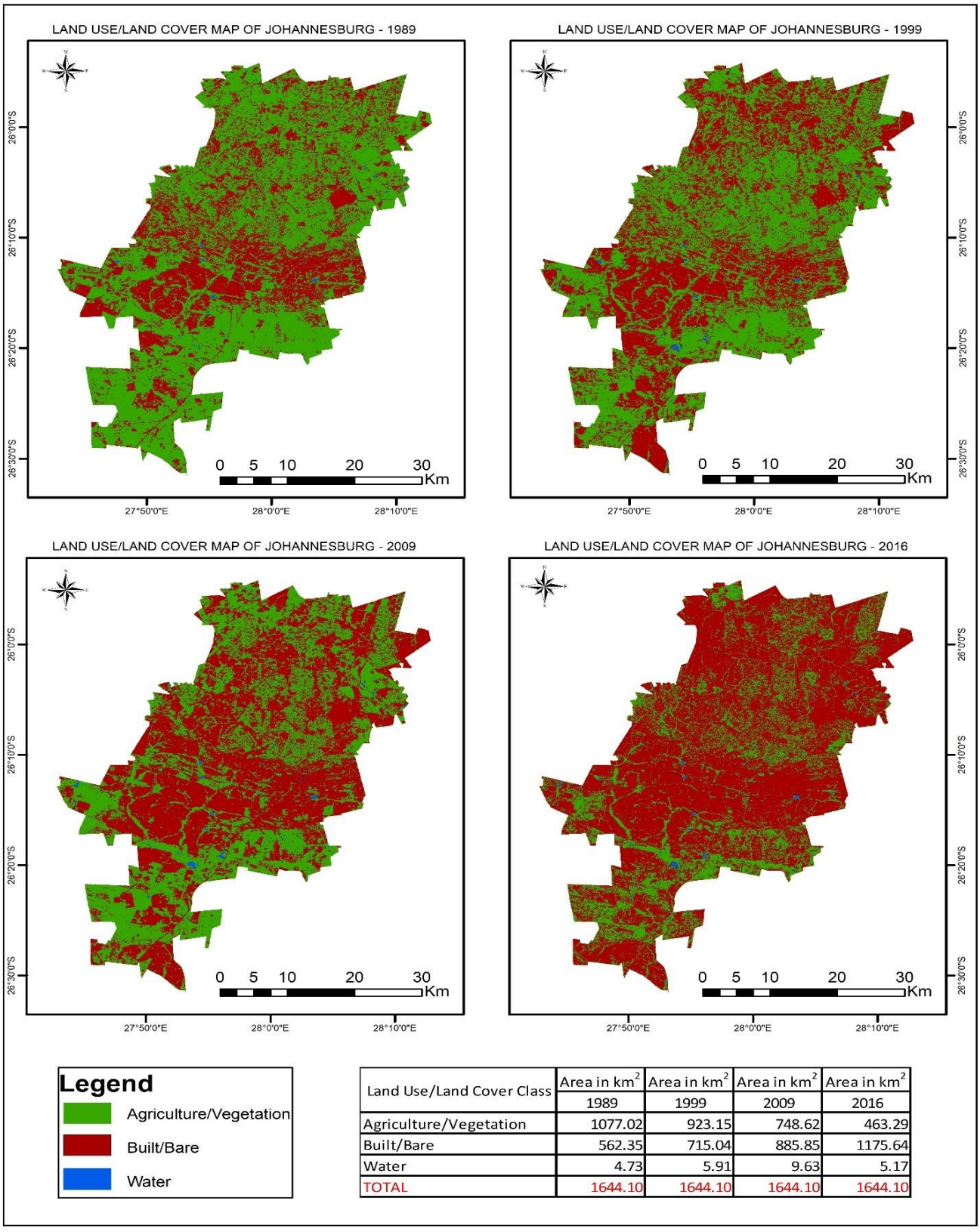
growth. The Cooperative Governance Traditional Affairs (2003) report and Cohen (2006), revealed that as cities expand in terms of population size they tend to have negative challenges like congestion, waste management issues, pollution and changes in land use pattern.

4.4 The effects of urban growth on urban agriculture land use

4.4.1 Urban land use changes

Migration and population growth have changed the dynamics of the physical infra-structure growth of the City and to an extent have affected land use greatly. The review of existing literature revealed that as migration and natural increase occur in urban areas, population in cities increase, which puts pressure on existing facilities. In order to meet the demands of urban population increase, infrastructural development such as residencies, health centers, educational facilities, transportation networks and recreation facilities amongst others have to be increased. In view of this, the study was interested in exploring how the growth of CoJ has impacted on agricultural land present in the urban areas.

The study investigated CoJ's land use changes over a period of 27 years, that is from 1989 to the year 2016. This was done using Landsat satellite images. Figure 6 below shows the land use changes that have occurred in CoJ over a period of 27 years.



Land Use/Land Cover Class	Area in km^2 1989	Area in km^2 1999	Area in km^2 2009	Area in km^2 2016
Agriculture/Vegetation	1077.02	923.15	748.62	463.29
Built/Bare	562.35	715.04	885.85	1175.64
Water	4.73	5.91	9.63	5.17
TOTAL	1644.10	1644.10	1644.10	1644.10

Figure 6 - Land use change detection maps - Figure 6 is a cluster of land use maps of the City of Johannesburg over a period of 27 years. The land area for the Three (3) classes is presented in square kilometers.

The four (4) land use maps in figure 6 above show the spatial distribution of land use change in the City of Johannesburg for the years 1989, 1999, 2009 and 2016. Since the study was interested in CoJ's arable farm lands and development, three (3) land use classes are portrayed in the maps. The three classes include built and bare areas, water bodies and agriculture and vegetation areas. The Built-up areas, which also symbolise development, comprises of zoned areas for residential facilities, health and educational facilities, recreational facilities, industrial and commercial areas; and the Bare areas include transport networks, brown sites zoned for future infrastructure development, whereas the Agricultural and Vegetation areas, symbolising arable agricultural lands comprises of areas previously zoned for agriculture practices and natural forests.

The time series analysis performed on the images shows the dynamics of land use per square kilometer (km^2) of CoJ over a period of 27 years. The results from the classified images portrayed in figure 6 above are an indication that there have been massive land use changes over the observed study period. With time the Built-up and Bare areas have increased from 562.35 km^2 in 1989 to 1175.64 km^2 in 2016, which is 51.17% increase over the last 27 years. At this rate, it is highly likely that infrastructural development would expand into Agricultural and Vegetation areas. Over the 27 years period, there has been a major decline in vegetation. This has resulted from the increase in Built-up and Bare areas. Vegetation has decreased from 1077.02 km^2 in 1989 to 463.29 km^2 in 2016. The city has lost about 56.98% of its total vegetation cover over the 27 years period.

The 1989 map in figure 6 above, shows that development was more concentrated in the central part of the study area. There are also scattered development in the north and southern part. In the year 1999, more built-up areas are observed in the southern and northern part than in 1989. The 2016 map shows a massive increase in Built-up and Bare areas and a decrease in Agricultural and Vegetation land compared to the 1989, 1999 and 2009 maps. This transformation is very visible in the Midrand areas which fall in the northern part of CoJ. This place was previously a green field site with many farm holdings. Today, Midrand is one of the most rapidly transforming suburbs in CoJ. Due to its proximity to another major city, Pretoria, and the presence of Waterfall city, the suburb has undergone massive physical development

transformation to support the growing human needs. The place offers variety of residential spaces and commercial facilities for all sort of income and class groups.

The land use change detection maps also reveal very interesting growth dynamics of the City of Johannesburg. Most cities expand and grow around the Central Business District (CBD), this is seen as not being the case in the study area. From the maps (figure 6), development which is represented by the red colour and classified as Built-up and Bare areas increases in a very unplanned manner. This confirms a participant's opinion that CoJ grew without any proper structures in place to guide and regulate physical development. To an extent, this opinion has been confirmed by the graphs. It is, however, important to understand that, the political situation in the country which prevented people especially the non-white race group to have access to urban areas and socio-economic opportunities influenced and played a key role in the type of legislation that guides the city's development as well as physical growth (Gauteng Provincial Government, 2016).

The Development Facilitation Act, for instance, was intended to streamline and speed up rezoning processes and allow people to live in better living conditions. Though this was a step to better the living conditions of the marginalized South Africans, it was also seen as an opportunity by "smart" property developers to make a fortune. Natrass (1983) reveals that the political situation in the country was very unstable and uncertain. According to an interviewee, the political instability caused the migration of lots of wealthy people who owned large semi-agricultural properties. These were bought by property developers at low prices and rezoned to other functions aside from agricultural activities.

The gaps identified in the law allowed subsequent rezoning of the previously agricultural land and properties in accordance with the Development Facilitation Act. Though these were things done with the best intentions of overcoming some of the legacies of apartheid, the rezoning mostly occurred in areas that were previously zoned as agriculture small holdings for farmland. During an interview discussion with a female research participant aged between 35-39 years, she pointed out the following,

> "*The Fourways I remember as a child had pasturage, there were some farms present. The agricultural activities were mostly organic farming, located on an*

open field with very few buildings. When the property owners moved out, property developers bought the land and rezoned it for commercial purposes. There was nothing that the city could do to block that zoning because it was the new owners right to convert their property into any development of their choice" (Personal communication, 2017).

The legislation of the country after the Apartheid era played a major role in the rezoning of agricultural holdings into infrastructure development. As suggested by a participant, the only intervention that could have protected and preserved the urban agricultural land in the City of Johannesburg, was if the City Officials expropriated the agricultural land to maintain its original zoned functions, which is for food production. Since this did not happen, the majority of the arable land in the city has been converted to built-up areas to support the infrastructure demands of the growing population at the experience of food production for the city.

The City of Johannesburg has experienced massive land transformation over the 27 years as seen in the maps (figure 6). The high level of infrastructural growth is an indication of development in the country. This by all standards is a positive action according to advocates of development (Busko and Szafranska, 2018). However, at the expense of agricultural practices and sustainable food production of the urban area, this transforming is seen more as being negative rather than positive. Evidently, responses from the research participants and analysis of satellite images reveal that physical development (Built-up and Bare areas) are taking over Agricultural and Vegetation zones. Even though there is some level of agricultural activities present in the City, some of the interviewees revealed that they are equestrian farms to satisfy the new edge of the rich who yearn for countryside living.

According to some respondents who were born in Johannesburg and have spent their entire life in Johannesburg, over the past 40 years the biggest agricultural changes with regards to land use has been the increase of pasturage rather than crop production. Also, in the northern part of Johannesburg, there was a limited number of multi-crop gardening practiced on a small scale and specialised farming, like organic farming the middle-upper-class group. This has almost disappeared to accommodate the development of golf estates, commercial shopping centers and office parks to meet the growing population needs. The southern part of Johannesburg had many small-

scale agriculture farms usually in a form of market gardens which are still in existence even though they are reducing with time.

Generally, the extent of space for agricultural practice has eroded quite substantially over the past 27 years as seen in figure 6 above. This is because infrastructural development is taking place to accommodate for the needs of the processes of urbanisation.

4.5 The effects of urban land use change on agricultural land

The change detection maps in figure 6, have shown that with time the City of Johannesburg's Agricultural and Vegetation areas are reducing whiles Built-up and Bare areas increase. It can be argued that rapid and unplanned urban growth in the City is posing a great threat to the sustainability of the city's agricultural land (Sroka et al., 2018). The rate of urbanisation in the City has been very rapid and is overtaking agricultural spaces as conveyed in figure 6. This means that without proper and effective legislation in place to guide physical development, food production which is equally a very fundamental need for the survival of humans would be ignored. With the City's land mass remaining the same while population size increases, the need for more infrastructure development would increase to sustain the growing population at the expense of potentially arable land (StatsSA, 2017; Runde, 2015).

The land use change detection maps in figure 6 emphasise the rate and extent to which Built up areas are claiming Agricultural and Vegetation areas which include farmland and potentially arable land in the city. It was revealed that most of the food products were obtained outside the municipal boundary of the City and the Gauteng province. This has not only decreased the freshness and nutritional value of the foodstuffs but also has made them more expensive for consumers, especially the urban poor. In addition to the distance, food items to CoJ travel in sophisticated transport systems. This increases the value of the foodstuffs for individuals especially those who desire fresh produce. An interview discussion with a female research participant aged 45 – 49 years revealed that;

> *“Having farmland within few kilometers to consumers will people to obtain fresh farm produce at all times. The direct link between the producers and consumers*

reduces the food travel time, making it affordable. This also has obvious health implications. For instance, when parents cannot afford fresh foods for their children, the children would eat more tinned foods, which does not have the same nutrient value as the fresh ones" (Personal communication, 2017b).

This suggests that the people are aware of the gravity of the land changes that are occurring in the City of Johannesburg and its implication on the ability of the City to produce its own food as well as the health implications food insecurity would have on their well-being. Though the City has many grocery outlets and shopping centers like Woolworth, Pick and Pay, Shoprite, Checkers and Food Lovers Market amongst others, foodstuffs on the average are considered more expensive in CoJ. According to a participant, animal protein-based foods were very expensive and cannot be afford on a regular basis by the average poor urban dweller.

In certain shops, it was discovered that bones and offal from animals were sold at a very affordable price to enable those who are unable to afford the "good stuff" add some animal protein to their diets. The concept of food security in the City of Johannesburg is not entirely the absence of food but the ability of everybody to afford the food of their choice at their own convenience (UNDP, 1996). Till the necessary steps are taken, Johannesburg would never be completely food secure mostly due to economic factors and the difficult accessibility of fresh produce, being threatened by the processes of urbanisation.

4.6 The future of urban agriculture in Johannesburg

South Africa's urban agriculture policies are seen and linked to issues of food security, local economic development and social welfare (Rogerson, 2011). This has led to lots of initiatives to assist urban farming projects by providing grants as well as develop relationships with supportive non-governmental organisation. Some of these initiatives include food gardens to support social, economic and community development as well as to empower the people who do not possess the relevant skills for formal employment (Collet, 2013).

An interview with a City Official explained that urban agriculture has gained attention as a viable intervention strategy not only for the urban poor to earn extra income but

also to increase food production in Johannesburg. It is also seen as a strategy to help the urban poor to reduce their reliance on cash for food by growing their own food crops. This is because, there has been the realisation that inequalities in the distribution and utilisation of resources have played a significant role in the issues of hunger. Currently, the issues of food security have moved from just being a question of the existence of food globally or even at the local levels to a more complex phenomenon pertaining to access by every human being (Satterthwaite, 2010; UNDP, 1996).

After the World Summit on Sustainable Development, the Gauteng Provincial government became extremely involved and committed to urban agriculture. The food security of the city has been reviewed as a local economic development agenda in the Gauteng Agricultural Development Strategy (GADS). As a follow-up, the City of Johannesburg started initiatives that focused on urban agriculture and food garden projects as a contemporary initiative aimed to promote sustainable agricultural practices in the city's metropolitan areas where infrastructure development is at its peak and taking over vegetation land. These initiatives have been geared towards improving food availability in Johannesburg by encouraging gardening at a micro-scale (Minerals Council South Africa, 2018).

There has also been the incorporation of urban agriculture into the planning of new settlement development in CoJ. With the lack of space available for agriculture activities, rooftop gardens have been encouraged as the best alternative to practice urban agriculture (Minerals Council South Africa, 2018). According to a participant between the ages of 50 – 54 years old with experience in sustainable urban planning, one must be innovative and creative in their approaches to practice urban agriculture in a city like Johannesburg, where physical development is replacing arable land.

It is in view of this that there has been the introduction of hydroponic farming by the City authorities. This is a system where plants are grown in a growth media other than natural soil. This is believed to be a smart approach to increasing food production as most of the open spaces that could support cultivation are paved. Also, the presence of unused open rooftops makes it an appropriate method to increase food supply. Hydroponics is the future of gardening and farming in a sprawling city like Johannesburg. (Minerals Council South Africa, 2018).

In addition to land availability being a hindrance to the practice of urban agriculture, water has also hindered agricultural activities in the city. Within South Africa, there is an uneven distribution of rainfall across the country. This has negatively impacted on the availability of water. According to Hoffman and Ashwell (2001), agricultural activities consume about 60% of the total amount of water present in the country. In addition, it was predicted that by 2013, the Gauteng province demand for water will outstrip supply (Rand Water, 2018). This would come with many challenges because the human population increases with the need for survival and the demand for water (Ibid). In view of these uncontrolled factors, it is very necessary water and land is used judiciously and sustainably to support both development and food production. Therefore, innovative farming ideas like hydroponic farming are very appropriate in a rapidly urbanising city like CoJ, where space and water are a challenge to many activities especially food production.

Progress has been made in hydroponic farming in CoJ. A conversation with a female research participant between the ages of 45 – 49 who is a hydroponic gardener revealed that the city has invested into rooftop hydroponic gardening projects by providing relevant training, skills and technical support to interested parties. The main aim of this initiative as revealed by a City Official is to empower the poor, who are also unemployed, as well as to promote food production to counter food insecurity. This was proposed as the most appropriate approach after the 2012 study by the African Food Security Urban Network on food security in Johannesburg. The study revealed that 56% of households were food insecure, with 27% being severely food insecure due to economic constraints. With development taking over land and water becoming scarce, it almost impossible to practice traditional farming which is the growing of crops in soil. Hydroponic farming is the option for a highly built-up area like CoJ.

Hydroponic farming due to its benefits has gained much attention all over the world. This is because it allows for the judicious use of water resources. Studies have revealed that hydroponics uses between 5% to 10% of the total amount of water used by the traditional method of growing crops (Minerals Council South Africa, 2018). In addition to using lesser water, the hydroponic system provides a controlled environment for plants to grow naturally thus no need for pesticides, making the produce healthier and safer for consumption.

Below are pictures showing some of the progress being made in rooftop gardening in the City at both the individual and municipal level.

Figure 7 - Images of traditional rooftop garden - Braamfontein and Hillbrow (Source: Author, 2017).

Figure 8 - Hydroponic garden practices in Hillbrow (Source: Author, 2017).

The structural appearance of roofs in Johannesburg make them very conducive to support rooftop gardening either using the traditional method or hydroponic method. The crops that can be grown in the rooftop space are shallow root vegetables such as spinach, onions, tomatoes, celery, butternuts, and beetroots among others. These though cannot be done on a very large scale due to the availability of space, it goes a long way to provide nutritious food to a fraction of the population.

Hydroponic gardening in the country generally has gain much attention as an initiative aimed at creating an urban agricultural ecosystem by repurposing disused rooftops to produce agricultural produce especially for Johannesburg's inner-city communities (Minerals Council South Africa, 2018). This initiative was created by the Johannesburg

Inner City Partnership, in which the Minerals Council South Africa (Minerals Council) is a key stakeholder, which funded pilot projects to assess the feasibility of growing herbs and vegetables on the rooftops of inner-city buildings including the Minerals Council's building. The results from the feasibility study revealed hydroponic farming of certain vegetables cannot be deemed a more sustainable option to conventional farming techniques. However, it provides promising concepts that could lead to more sustainable food production, if the high energy consumption can be overcome through improved efficiency and cost-effective renewables (Ibid).

The commencement of this initiative attracted other stakeholders like the First National Bank (FNB), who is currently producing enough non-starch vegetables for its canteen from its rooftop farm and with surplus to send branch canteens. The success of the Mineral Council's pilot project has brought in the Department of Small Business Development (DSBD) to fund the start-up costs of another 24 projects in the inner city of Johannesburg. In contributing to this goal, Property owners in the City have made sixty (60) buildings available to implement the rooftop farms in addition to the Minerals Council providing additional 400m^2 on its 93-year-old heritage building, to provide sustainable employment to 24 farmers (Minerals Council South Africa, 2018).

Johannesburg is one of many cities in the world turning to inner-city farming with the objective of addressing high unemployment and food insecurity while regenerating neighbourhoods. According to the Minerals Council (2018), this project will extend beyond rooftops to sidewalks and even to other under-utilized spaces for the benefit of the people in the inner City and beyond. Rooftop gardening in Johannesburg is one of the most effective ways to produce food in a rapidly urbanised city. This would contribute immensely to the food security of the city currently and in the future, when practiced in an efficient and sustainable manner (Minerals Council South Africa, 2018; Department of Agriculture, 2002).

4.7 Chapter conclusion

This chapter has revealed the contemporary drivers of Johannesburg's urban growth to be population growth which has been influenced by natural increase and migration process. CoJ provides many opportunities for both South African nationals and international migrants who find themselves in the urban area. These include economic

opportunities, educational services and facilities, political freedom and social well-being. This has been the main drivers of the city's growth, thus driven the processes of urbanisation. This has changed the dynamic of the natural land use in the essence that, physical development to cater for the infrastructural needs of the growing population in taking over arable agricultural land that can be used to support food production.

The responses from the interviews, questionnaires and satellite image analysis in a form of change detection maps (figure 6) have confirmed that urban growth has really impacted on urban agricultural land by changing the land use pattern. This means areas previously zoned for agricultural purposes to support food production are being converted to physical infrastructural development to accommodate population growth, which has been driven by both internal and external migration of people in pursuit of economic, social and political liberation. Though urban growth has had a massive impact on the ability of the city to produce its own food because of land use changes, other factors such as water availability have also been a deterrent to the City's ability to effectively and efficiently indulge in urban farming. It is in view of this that the city authorities have proposed initiatives such as rooftop and hydroponic gardening to support food production.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The previous chapter has presented, discussed and analysed the findings from the field survey to reveal the contemporary forces that drive the City of Johannesburg's urbanisation process. This study has been able to explore the main driving forces of Johannesburg's urban growth and deduced the impact the growth is having on urban agriculture in the city using Landsat satellite images. This final chapter is the conclusion and recommendation chapter and provides a conclusive summary of the main issues identified in the research and provides practical recommendations to them. The chapter ends by proposing an opportunity for further investigation. This chapter is therefore structured in the following order. Section 5.1 is a summary conclusion to the key findings of the research. Section 5.2 provides a detailed recommendation to the key issues identified in the research and the final Section 5.3 reveals the possibility of a future study to gain more insight into urbanisation and its effects on urban agricultural land and possible implication on food security in CoJ.

5.2 Summary

This study conducted has made a number of notable conclusions. Within the City of Johannesburg (CoJ), the process of urbanisation has played a key role in influencing urban agricultural land use, which to an extent may have an impact on food security. The study has revealed that CoJ has experienced massive urban growth over the twenty-seven (27) years' time frame proposed for this study. The field data and existing literature revealed that the City is growing due to population growth caused by natural increase and migration. To an extent, population growth has been the catalyst for the city's rapid infrastructural development with time. The increasing concentration of people in the City has increased the need for infrastructural development, to provide basic services to support human survival.

Cohen (2006), explains that a city generally is the center for modern living because of the vast opportunities it provides to its habitats. This can be said of CoJ. This is due to the many benefits identified within the City. The study observed that the bulk of

participants (44%) benefited economically from the City (figure 4). Others also benefited from the many educational facilities, health services, social and political freedom as seen in the figure 5.

The change detection maps in figure 6, show the changes in land use from the year 1989 to the year 2016. The maps clearly reveal how built-up areas have increased drastically over the 27 years' time frame proposed. The maps reveal that vegetated and agricultural areas have decreased with time while built-up areas increase. In 1989, out of a total land space area of 1644.10 km^2, only 562.35 km^2 was classified as built-up areas. With time it is observed that the Built-up areas are increasing whiles the vegetation and agricultural areas decrease with population increase revealed in figure 6. From 1989 to 2016, built-up areas have increased about 51.17% whiles vegetation and agricultural land decrease by 58.98%.

This rate is very alarming because infrastructural development could completely take over agricultural and vegetated areas. Development would continue to extend into zoned areas for agricultural practices. A lack of or inadequate arable space for cultivation means that the City would have to depend heavily on external food sources to feed its inhabitants. Obtaining food from outside the administrative boundary of the city has been revealed to have both economic and health constraints on city dwellers especially the urban poor. It was identified that foods that travel a long distance before they reach the consumers, in general, are expensive, not wholesome fresh and nutritious as compared to foods that travel a shorter distance to its consumers (Leavens, 2017).

Finally, this study identified some initiatives undertaken by the CoJ Officials to encourage urban farming. They include rooftop gardening and hydroponic farming. These initiatives are seen as good steps contributing to urban farming. Emphasised by a 50 – 54 years old Environmental Engineer, a City like Johannesburg requires innovative thinking and ways for sustainable living. As such these initiatives being supported by the City Officials are smart and innovative ways of inculcating farming into an urban lifestyle.

In conclusion, this study has shown that just like other urban areas in developing nations, pull and push factors have caused people to migrate to CoJ. Although the reasons behind the movement of individuals are subjective, the action is usually driven by favourable economic, social and political conditions. Migration in addition to natural increase has been responsible for the population growth of CoJ. The increase in population has driven the need for infrastructural development to provide basic amenities to meet the needs of humans. Since the land size has not increased with population growth, development has extended into potentially arable land in the City at the expense of agricultural practices. This study concludes that with time, the processes of urbanisation has changed urban agricultural land use to infrastructural development use.

In view of these findings, it is important that leaders and planners rethink the future of urbanisation in South Africa and its connection to urban agriculture if it hopes to achieve food security in the City of Johannesburg. In support of this, key recommendations are discussed in the following section.

5.3 Recommendations

5.3.1 Population growth and Urbanisation

Population growth is inevitable in South Africa and would continue to play a crucial role in the City of Johannesburg's physical growth, this means that it would continue to take over potentially arable land in order to meet the increasing infrastructure needs of the growing population. In view of this, it would be recommended that, the City strategies efficiently to ensure secondary cities are well developed to almost the same standards as major cities. It is believed that when secondary cities are made more desirable, it would attract people in search of city living, thereby decreasing the pressure of providing infrastructural services in major cities like CoJ.

The shifting of development attention to secondary cities in order to make them very attractive to be lived in has been proven to be an efficient way to decongest urban areas as well as reduce the pressure on urban land (Siba, 2017; Roberts, 2014). Even though the challenge globally is how to achieve this effectively and efficiently. It is

believed that if more efforts and research are invested into developing efficient secondary cities, it would attract people from the main cities (Siba, 2017). This is believed would decrease the number of people who migrate or relocate to CoJ in search of better living conditions. This to an extent, would decrease the pressure of converting vegetated arable land into infrastructural development sites to meet the needs of the people.

In addition, Lipton's (1977) urban bias theory is seen in the way development occurs in South Africa. It was observed that development, in general, is uniform and is concentrated in the main cities. In view of this, it would be recommended that development programmes be directed towards improving the economic and social condition in rural areas. Rural areas should also have infrastructural development that would satisfy their basic needs, thus, would not require them to migrate to urban areas like CoJ in search of better living standards. This would go a long way to reducing urban pressures especially in the context of land use changes from agrarian to other types of development.

5.3.2 Limited land availability

As portrayed by the change detection maps in figure 6, population growth and land use demands have made land very scarce in the City. The land has been one of the biggest barriers to practicing urban farming. In view of this, this study recommends and challenges City Officials to replace the planting of ornamental plants with edible plants in places like parks, city gardens, swales, and even cemeteries. The limited open spaces available should be used to support urban food production.

Rooftops of high-rise buildings should be viewed as good spaces for urban gardening. Used containers can be recycled to serve as pots and beds to support the growth of edible plants to support households.

Individuals should change their mindset about gardening and by doing so, should incorporate it into their lifestyle. It is believed these little initiatives would contribute to food availability, which would help address some of the food security concerns in the City.

5.3.3 Urban planning and urban agriculture

Poor physical planning leads to inadequacies and institutional incompetence. This has been identified in the literature surveys and field work as challenges facing CoJ. The City grew in an uncontrolled manner and with the political legacy of the country, little was done to protect previously zoned agriculture land from being converted into functions aside farming. It would, therefore, be recommended that more effort be put into the general planning of upcoming cities to make provisions for urban farming activities.

5.4 Future Research

Urban development is a very important area of study especially in the context of urbanisation and its impacts on urban agriculture. This study has laid down the groundwork and has contributed to the knowledge of urban growth and how it affects urban farming, with possible implications for food security in the City of Johannesburg. Though this study has been successful to an extent at the city level to identify the role physical expansion has on a city's ability to practice urban farming, it would be interesting to explore at the household level how people in urban areas are being affected by issues of food insecurities because of urban infrastructure development.

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APPENDIX A

Perspectives of the impact of urbanisation on urban agriculture landuse in Johannesburg, South Africa.

Participant Information Sheet

Dear Sir / Madam,

My name is Ernestina Maame Nyarkoa Annobea. I am pursuing a Master's degree in Environmental Sciences from the School of Animals, Plants and Environmental Sciences at the University of Witwatersrand. As part of my Master's degree, I am conducting a research entitled **"Perspectives of the impact of urbanisation on urban agriculture land use in Johannesburg, South Africa."**

I would like to conduct an interview with you at a time of your convenience and a place of your convenience on this topic. This interview will take about 20 minutes to complete. There are no benefits to you if you wish to participate as well as no disadvantages if you wish not to participate in this interview, you may also redraw at any time. I may ask you if I can record this interview with an audio device. I will not ask for your name and any other information that may expose your identity if you wish to remain anonymous.

Your cooperation and sincere responses to the questions would be greatly appreciated.

Yours faithfully,

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APPENDIX B

Perspectives of the impact of urbanisation on urban agriculture landuse in Johannesburg, South Africa.

Formal Consent Form

Dear Participant,

The aim of this questionnaire is to understand the factors that drive population growth in Johannesburg in order to gain more insight into the ***"Perspectives of the impact of urbanisation on urban agriculture land use in Johannesburg, South Africa".*** *This study guarantees confidentiality and anonymity. That is, it will not publish your name or use any words that may expose your identity, if you wish to stay anonymous.*

☑ ***Please tick where appropriate***

Do you agree to participate in this interview for the research project?

☐ Yes, I agree

☐ No, I do not agree

Do you agree for your interview to be audio recorded?

☐ Yes, I agree

☐ No, I do not agree

Do you wish for your interview to remain anonymous and for your name to be anonymised in the project report?

☐ Yes, I wish to remain anonymous

☐ No, I do not wish to remain anonymous

…… ……

Participant Signature Date

APPENDIX C

Interview Guide

Perspectives of the impact of urbanisation on urban agriculture landuse in Johannesburg, South Africa.

1. Greetings / Introduction and purpose of interview
2. How has Johannesburg's land use changed over the past 40 years
3. In your opinion how has these observed land changes affected agricultural land?
4. In your opinion how do you think the land changes from agricultural land use to other land use impacted on food production?
5. In your opinion, how do you see agricultural food production in Johannesburg in the future?
6. In your opinion how do you think changes in agricultural land use would affect food security in the future?
7. In your opinion how do you think urban growth has impacted on urban agriculture land?
8. How do you think urban agriculture land can be conserved for its main purpose?
9. In your opinion how do you think food security can be ensured in urban areas where urban growth is inevitable?

APPENDIX D

Perspectives of the impact of urbanisation on urban agriculture landuse in Johannesburg, South Africa.

Questionnaire

Please select where applicable and write in the spaces provided.

I. DEMOGRAPHIC INFORMATION

1. **I am** A. male B. Female C. Other ……

2. How old are you?

A. 25 - 29 D. 30 - 34 G. 45 - 49

B. 35 - 39 E. 40 - 44 H. 60 and above

C. 50 - 54 F. 55 - 59

Which racial group do you identify with?

A. Black B. White/Caucasian C. Coloured D. Indian

4a. **Are you a South African?**

A. Yes B. No

4b. **If YES which province / Country are you originally from?**

A. Eastern Cape D. Kwa-Zulu Natal G. Northern Cape

B. Free State E. Limpopo H. North West

C. Gauteng F. Mpumalanga I. Western Cape

4c. **If NO which country are you originally from?**

A. Southern Africa (please specify) ……. F. Asia (please specify) …….

B. Eastern Africa (please specify) ……. G. Europe (please specify) …….

C. Western Africa (please specify) ……... H. Australia (please specify ……...

D. Central Africa (Please specify) ……. I. North America (please specify) …….

E. Northern Africa (please specify) ……. J. South America (please specify) …….

5. Which metropolitan area in Johannesburg do you live?

A. Diepsloot E. Sandton I. Lanseria

B. Midrand F. Roodepoort J. Ennerdale

C. Randburg G. Johannesburg K. Orange Farm

D. Honey dew H. Johannesburg South L. Soweto

B. DRIVERS OF URBAN MIGRATION AND LAND CHANGES

6. **What brought you to Johannesburg?**

A. Economic E. Education

B. Social F. Health

C. Political G. Other (Please specify) ……

D. Religious

7. **How long have you lived in Johannesburg?** ……

8. **During your stay in Johannesburg have you identified any major land changes?**

A. Yes B. No

8b. **If yes, please specify the kind of land changes observed?**

……..……

……

……

……..

9. **In your opinion how has these observed land changes affected agricultural land use?**

……

……..……

……

……

……..……

10. **In your opinion how do you think the land changes from agricultural land use to other land use impacted on food production?**

……

……

……

……

……

11. **In your opinion, how do you see agricultural food production in Johannesburg in the future?**

……

……

……

……

Thank you for your participation