IMPACT OF URBANIZATION ON PERI-URBAN AGRICULTURAL LAND USE IN IGABI LOCAL GOVERNMENT, KADUNA STATE, NIGERIA.

By

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DECLARATION

I declare that this research work entitled "*Impact of Urbanization on Peri-Urban Agricultural Land Use in Igabi Local Government, Kaduna State*" has been performed by me in the Department of Economics under the supervision of Prof. Peter Njiforti and Dr. Dahiru Suleiman. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this dissertation was previously presented for another degree or diploma at this or any other institution.

Abdulyasar, Baba IDRIS _____ _____

Signature Date

CERTIFICATION

This dissertation entitled "IMPACT OF URBANIZATION ON PERI-URBAN AGRICULTURAL LAND USE IN IGABI LOCAL GOVERNMENT, KADUNA STATE" by Abdulyasar, Baba IDRIS meets the regulations governing the award of the degree of M.Sc. Economics of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This dissertation is dedicated to Almighty Allah and my beloved parents Alhaji Idris Baba Ibrahim and Hajiya Safara'u I. Baba.

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All thanks and gratitude are due to Almighty Allah (SWA) for sparing my life up to this moment, and who in His infinite mercy has given me the chance, ability, strength and privilege to successfully accomplish this study.

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ABSTRACT

Urbanization is a major driver of pressure on land use occasioned by encroachment into peri-urban agricultural lands which is as a result of a trade-off on rural land between agriculture and urban growth. Based on this, the study examines the impact of urbanization on peri-urban agricultural land use in Igabi local government, Kaduna state. The study employed the use of LandSat/GIS imagery of 1995, 2005 and 2015 as well as cross sectional survey to generate data. Data were analyzed using frequency tables, percentages, multinomial logistic regression and the multiple regression model. LandSat result shows that built-up areas increased from16.46% to 19.43% and 20.99% in 1995, 2005 and 2015 respectively while agricultural land use increased from 9.34% to 18.27% and 27.72% in 1995, 2005 and 2015. High forest area decreased by 55.0% between 1995 and 2005 and 27.9% between 2005 and 2015. Then water body decreased from 2.30% in 1995 to 1.21% in 2005 but rose by 2% in 2015. Degraded forest increased from 32.55% in 1995 to 43.39% in 2005 and then declined to 36.52 in 2015. The cross sectional survey shows that 64% of the respondents agreed that availability of market influenced agricultural land use pattern while 82.6% of the respondents agreed that the type of land ownership of the residents have affected agricultural land use in the study area. Also, 92.9% of the respondents agreed that shortage of land has affected agricultural land use while 94.4% of the respondents believed that distance to farmlands affected agricultural land use and 89.3% equally agreed that high demand for agricultural produce affects agricultural land use in the study area. Results from the regression analysis shows that build-up areas, degraded forest and water bodies were significant factors affecting agricultural land use in the study area at 5% significance level. Findings from the logit regression shows that land ownership is 3.18^{-07} times less likely to have a strong negative effect on the livelihood of dwellers while source of income is 0.22 times less likely to have a negative effect on the livelihood of settlers. The change in income is 0.18 times less likely to have a negative impact on the livelihood of dwellers in the study area. Also land conversion is 667882.7 times more likely to have a strong negative effect on the livelihood of dwellers while displaced off from farmlands was 433248.8 times more likely to have a negative effect on the livelihood of dwellers in the study area. The study therefore recommends policy intervention to serve as a check to peri-urban agricultural land use in order to control excessive land sub-division and intensifying and diversifying agriculture in order to supplement land loss and improve the livelihood of dwellers in the study area.

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 Background to the study

Land is a gift of nature to mankind and serves as a basic resource for wealth creation and human survival. Societal development depends largely on land use by individuals and government for various economic and social purposes. From an economic perspective an essential feature of land is that it is scarce and subject to competing uses. According to Wu (2008) land use is the backbone of agricultural economies as it provides substantial economic and social benefits which is necessary and essential for economic development.

Land use is related to the conservation of land from one major use to another general use (Nanvati, 1951). According to Lillesand and Kiefer (1987); "The term land use relates to human activities associated with specific piece of land, features present on the earth surface. Therefore, land use is generally seen as the various activities carried out by man in order to satisfy his needs. Land use can also be seen as a description of how people utilize land for socio-economic activity. Urban and agricultural land uses are two of the most common land use categories where land use for housing purpose could be seen as residential or urban use, while land use for farming activities could be seen as an agricultural land use. At any point in place, there may be multiple and alternate land uses for different purpose. The need for increase food production, residential settlement, infrastructural development and economic development has led to different changing pattern of land use due to human activities. Population growth and urban expansion are primarily responsible for changes in the land use pattern of an area. For instance, as population increases, construction of dwellings also increases thus engendering conversion of cropland and forest land to settlements

(Olaleye, Abiodun and Asonibare 2012). According to Cunningham, Cunningham and Siago (2005), rapidly increasing human populations and expanding agricultural activities have brought about extensive land use changes around the world.

Urbanization is a common phenomenon to both developed and developing countries. In developed countries, it is associated with economic advancement where urban centers are seen as engine of growth by enhancing rural development through creating market for agricultural products. However, in developing countries urbanization have positive and negative effect (Teketel, 2015). In Nigeria, as population increases, land becomes scarce. The growing population requires increasing area for agricultural production and, hence, large areas of forestland need to be opened up. As the rate of land area expansion falls short of the growth rate of population, land becomes scarce relative to labour. Urban environment belongs to one of the most dynamic systems on the earth due to heterogeneous nature of urban land uses with the consequence of rapid land use/land cover changes (Ndabula, Averik, Jidauna, Abaje, Oyatayo and Iguisi 2013).

Urbanization arises from an increase in population that put pressure on demand for more infrastructural development and residential settlements which encroaches into agricultural land use. Therefore, urban areas cannot economically, socially and physically be independent but have to be inter-dependent with the immediate rural agricultural environment located at the urban fringe for their food and services. Ndabula et al. (2013) states that land use in an urban environment and its attendant land degradation can increase cost of development and directly affect the urban poor who rely directly on the natural resources in urban areas for their subsistence. It is this encroachment on prime land that causes adverse environmental effects. Environmental degradation leads to reduction in crop yields and may reduce total factor productivity by requiring

the use of higher inputs to maintain yields. It may also lead to the conversion of land to lower value uses from agricultural uses and may cause temporary or permanent abandonment of plots.

Urbanization and changing socio-economic pattern are deriving forces that influence land use change in peri-urban areas (Jongkroy, 2009). Although multifaceted, the main cause of urban expansion is population pressure. Many cities are rapidly growing into their fringe, engulfing former villages and farm lands and transforming them into urban settlement. However, the principal reasons for urbanization and city growth are rural-urban migration, geographical expansion of urban areas through annexation and transformation and re-classification of rural villages into small urban settlements (Cohen, 2005).

Peri-urban areas denotes neighbourhoods, suburbans or villages abounding a city proper or characterized by a large urban agglomeration and active land market transactions. In particular it denotes the space economy between the city and its rural areas (Masanja, 2003). Therefore, rapid urban population growth means more people living in established urban areas, it also means more people living at the outskirt of these urban areas which form the peri-urban areas. As Kessides (2006) observes, urbanization involves the transformation of rural settlements at the urban periphery which become more densely populated and less dependent on agriculture. As a result of population pressure, rural areas of cities and towns are continuously converting to peri-urban status so that their land uses change from those dominated by agricultural to non-agricultural activities. The state of transition is characterized by interactions between the urban areas and their fringe lands so that the divide between rural and urban becomes very thin. This means is that, traditional (rural) farming activities come into conflict with alternative land uses that compete for the same land to serve economic, residential and recreational interests as households " retain footholds in both the rural and urban economies"(Kessides, 2006:8).

Generally, urban expansion is one of the basic problems that affect the living standard of people and food security of many agrarian economies. This encroachment leads to the loss of agricultural farmlands and reduction of crops/food productivity. Therefore, proper use and utilization of land is essential for sustainable agricultural production and economic development in Nigeria. However, land resource is under pressure for development which makes it difficult for increasing food production. At the same time this causes environmental degradation which directly or indirectly affect the livelihood of the people living at the urban fringe.

1.2 Statement of the Research Problem

Rapid population growth has led to more extensive use of land resources for either residential settlement, infrastructural development, national park, forest conservation or agricultural use of land which have an opportunity cost for each uses. Following outward urban expansion, peri-urban land use pattern would change from the one dominated by agriculture to multiple uses. The problem of rapid and uncontrolled urban growth and its consequence on regional landscape in developing countries have been a serious concern for government. Perhaps more worrisome is the surreptitious city encroachment on fertile agricultural land and other socio-economic implication on peri-urban areas of most cities (Adeboyejo, 2007).

Increased land use as a result of urbanization has become a major form of land degradation. Expansion of cities leads to the removal of large areas of the best agricultural land for production to built-up structures which consume large areas of land at the expense of agricultural land for food production. Land use change, however does not come without costs where conversion of farmlands and forests to urban development reduces the amount of lands available for food production (Wu, 2008). Adesina, *et al.* (1999) observed that in Nigeria, 400,000 hectares of

agricultural land is lost annually and most of this land is deliberately used to make way for mineral exploring, development of infrastructure such as roads and railway and expansion of settlements.

Land faces more pressure as a result of competing demand for land between urbanization and agricultural use which may affect the people living around the urban fringe. As many international urban expansion experiences have shown, it is the peripheral communities that are affected. During the process of urban expansion the loss of dwellings, assets and the uprooting from an existing pattern of living result in further impoverishment of the neighbourhoods (Teketel, 2015). Though the economic effects of urbanization have positive effects for the majority of urban dwellers, serious negative effects would occur for the nearby farmers and poor (Nebiyu, 2000). According to FAO (2015b) peri-urban agriculture is land availability due to changing land rights, uses and values. High population densities lead to competition and conflicts over land and natural resources as land is converted from agricultural to residential and business uses, and as the intensity of agriculture practiced on available spaces increases. Urbanization presents many challenges for farmers and dwellers on the urban fringe and may cause the "Impermanence syndrome" (i.e lack of confidence in the stability and long-run profitability of farming), leading to a reduction in investment in new technology or machinery, or idling of farmlands (Lopez, Adeleja and Andrew, 1988).

Kaduna metropolis is one of those fast growing cities in terms of population in Nigeria which grows from 896,055 (census 1991), 1,570,331 (census 2006) to 2,057,078 (NPC projection 2015). Igabi as one of the 23 local government areas in Kaduna state is situated at the fringe of the urban metropolis. This local government area has experienced a change in its agricultural land use pattern where most of the land that was previously meant for agriculture in Unguwan Kaji, Barakallahu, and Rigachikun are now built up areas with residential buildings, industrial estates, government

institutions etc. Since farming land at the study area is getting less and less due to these urban sprawls which in turn force the displacement of peripheral farming communities whose livelihood is primarily based on agriculture. This encroachment into agricultural lands affects the livelihood of the local residents who depend mostly on these lands to earn their living. Thereby, becoming landless which may cause food shortage and increased poverty among them. Hence, the expansion of the Kaduna town is becoming irregular, fast and creation of displacement of farming community in which this study analyses rapid urban expansion as it affects agricultural land use pattern of peripheral farming communities.

1.3 Research Questions

From the above stated problem, the following questions were raised;

i. What is the extent of urbanization on land use change in the study area?
ii. What are the factors affecting agricultural land use in the study area?
iii. What are the effects of urbanization on the livelihood of indigenous people in the study area?

1.4 Objectives of the study

The broad objective of this research is to examine the effect of urbanization on peri-urban agricultural land use in Igabi Local Government of Kaduna State, Nigeria. The specific objectives are as follows:

i. To examine the extent of urban expansion on land use change in the study area.
ii. To ascertain the factors affecting agricultural land use change pattern in the study area.

iii. To examine the effects of urbanization on the livelihood of indigenous people in the study area.

1.5 Justification of the Study

The study of land use practice is important throughout the world for both developed and developing regions because it has a direct bearing on human activity. Its importance also increased as a result of rapidly increasing population pressure and decreasing man to land ratio and constant rising demand for food and raw materials. Therefore, the need for optimum utilization of land in an integrated manner is imperative. Hence, intensive and proper use of every parcel of land has become very essential.

Empirical studies on agricultural land use have been carried out from within and outside Nigeria. Studies by Yaser and Muna (2016), Opatoyinbo, Adepetu and Abdullahi (2015), Ndabula et al. (2013), Enaruvbe and Atedhor (2015), Joel (2011), Saleh et al. (2014) use GIS in their studies to ascertain the environmental effect and forecast future land use. Therefore, the magnitude of the impact on agricultural land use is inconclusive and opened to further investigation.

Moreover, the methodological underpinnings of the literature is dominated by the use of GIS, descriptive statistics and a panel econometric panel. However, these methods are limited because it fails to capture livelihood effect on households. Therefore, this study integrates the use of both GIS/Landsat and cross sectional survey to ascertain the impact on individual households. Also, the study uses Multinomial logistic regression instead of panel econometrics because of the qualitative nature of the data.

The rate at which population increases over time in Igabi Local Government poses a concern because of the rate at which agricultural land is converted to other uses. For instance, rapid urban sprawl in Igabi has led to increasing and continuous encroachment into agricultural land for socio-economic development. A competing demand for urban land for settlement and infrastructural development use and agricultural land use for food production results in excessive clearing of forest land in order to satisfy human competing needs at the detriment of the environment. Therefore, urban expansion is at the expense of agricultural land and hence a trade-off exist.

Knowledge of the present distribution and area of such agricultural, recreational, and urban lands, as well as information on their changing patterns, is required by legislators, planners, and State and local governmental officials to formulate and implement land use policy.

1.6 Scope and Limitations of the Study

The study focused on Igabi Local Government area, Kaduna State and concentrates on specific locations which lie at the periphery of Kaduna metropolis. The peri-urban areas of Rigachikun, Unguwan Kaji and Barakallah were chosen because they experience a direct impact of urban expansion in Kaduna state. The study also accessed the potentials of GIS and Remote Sensing techniques in land resources management with particular reference to determining agricultural land loss due to urban encroachment in the Local Government Area from 1995 to 2015. These periods enables the researcher to show and analyze the magnitude of changes that exist within the time frame.

The data derived from GIS mapping or satellite imagery of the study area was limited to 20 years in order to achieve the stated objectives of the research in the study area over the years. Also, the GIS mapping covers the entire Igabi Local Government instead of the specific areas of

concentration which are Rigachikun, Unguwan Kaji and Barakallah. This is because of the inability of the technique to capture the specific area of interest which reduce the accuracy of the result. Time constraint limits the scope of the study to only one local government area in Kaduna State.

1.7 Organization of the Study

The study was organized and structured into five chapters. Chapter one provides the general introduction that includes background of the study, statement of research problem, objectives of the study, justification, scope and limitations and the organization of the study. Chapter two is the literature review which comprises the definition of concepts, theoretical literature, empirical review of studies, gap identified and an overview of urban expansion and encroachment in the study area. Chapter three is the research methodology, chapter four presents the analysis, discussion and interpretation of results while chapter five contains the summary, conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter comprises of the relevant key concepts that are pointed out and discussed in detail. Also, the theories that back up the study were reviewed and lastly, relevant scholarly work related to the research work were ineptly reviewed. Therefore, the section is divided into three sub-sections and they are; conceptual, theoretical and empirical reviews.

2.2 Conceptual Definition

a. Urban Expansion

Urban expansion is the outward growth of cities into the settlements around the city as a result persistent increase in population and pursuit for lower land rates. Urban land use is an inevitable process that accompanies development and rapid population growth. According to Robert and Clark (1965), the growth of metropolitan cities continue to take the form of continuous expansion around the edges, with a belt of land always in process of conversion from rural to urban use. Sprawl is sometimes described as the scattering of urban settlement over the rural landscape. Gottman uses this definition when he writes: "Where two cities are close together the intervening rural space becomes peppered with new developments. This kind of leap frogging sprawl outflanks some farms while it covers others." Christopher, Femke, Giovanni, Stephan, Burak, Karl-Heinz & Karen (2017), views urban land expansion as the process of creating the built environment to house urban populations and their activities. Thus, urban land expansion modifies habitats, biogeochemistry, hydrology, land cover, and surface energy balance. The rate and magnitude of urban land expansion are influenced by macro-economic factors such as income, economic development and population growth, as well as a number of local and regional factors such as land

use policies, the informal economy, capital flows, and transportation costs (Seto, Fragkias, Güneralp & Reilly 2011).

Rinkesh (2017), notes that urban sprawl refers to the migration of a population from populated towns and cities to low density residential development over more and more rural land situated at the suburb. Consequently, the city and its suburbs spread over more and more rural land. In other words, urban sprawl is defined as low density residential and commercial development on undeveloped land. Most of the time, people will move from these areas to try to find better areas to live. Moya (2017) perceives urban expansion as cities of the world that continue to grow until urbanization began threatening the very food supply that enabled its existence in the first place. Urban areas include not only the primary city, but also its suburbs and the sprawl that goes hand in hand with both. As people poured into urban areas looking for work, it soon became apparent that there was a housing deficit. Slums began to grow beyond city centers, on the periphery of urban areas, and spread like a cancer. As migration into cities continued, more and more factories were built and people were forced to live closer together for economic reasons. The growth trend which sees a population explode within a small area.

Urban expansion and competition for land results in changes in land use, ownership, property rights regime and land tenure (Wehrmann, 2008). The competition for secure and serviced land as a result of urbanization increases the importance of peri-urban land opportunities (Payne, 1997). Therefore, peri-urban areas are seen as the centre of almost all new developments that range from urban expansion both formally and informally to the decline of agricultural land and rural employment opportunities (Allen, 2003). It is generally believed that urbanization has both direct and indirect impacts on land use transformation such as urban sprawl and degradation. Urban areas and their links to rural communities are characterized by high dynamics of human endeavor and

the associated land use patterns. In order to effectively address the issue of land use change process, a well-founded knowledge of underlying causes and driving factors is needed (Rimal, 2011).

b. Peri-Urban Agricultural Land Use

Peri-urban agriculture is generally defined as agriculture undertaken in places on the fringes of urban areas. Peri-urban agriculture also refers to farm units close to town which operate intensive semi- or fully commercial farms to grow vegetables and other horticulture, raise chickens and other livestock, and produce milk and eggs (Iaquinta and Drescher, n.d). According to Hoi-Fei, Virginia, James, Kristal, Barker & Andrew (2013) Peri-urban agriculture provides environmental benefits by preserving or creating urban open space in city edges where green space may be threatened by expanding urbanization. Zhenshan, Jianming, Micheal and Douglas (2014) perceived Peri-urban farms that are also able to respond and market themselves in order to meet urban consumer demand, since they are able to be closer and more specialized, and are strongly linked to the urban economy.

Food and Agricultural Organization (2015a) defines peri-urban agriculture as "agriculture practices within and around cities which compete for resources (land, water, energy, labour) that serve other purposes to satisfy the requirements of the urban population. Peri-urban agriculture occurs within and outside the surrounding boundaries of cities around the world. According to FAO (2007) peri-urban agriculture is an important source of income for the urban poor. Farming households lower their food costs substantially and can generate income by selling excess produce, which is significant, as the urban poor usually spend 50-70% of their income on food. Agriculture is often an effective strategy for poverty reduction and social integration of disadvantaged groups.

The sector seeks to integrate them into the urban network by providing a decent livelihood and preventing social problems such as drugs and crime.

In summary, there is no universally agreed definition of peri-urban agriculture but its usage depends on the context to which the term is operational. For this research work, peri-urban agriculture is seen as the engagement of people living at the periphery of urban center who practice different agricultural activities in order to sustain their livelihood.

2.3 Theoretical Literature

2.3.1 Sinclair's Theory of Agricultural land-Use

Sinclair (1967) suggested an alternative land use pattern where he inverted von Thunen model for the zone of anticipated urban encroachment-distance relationships. Sinclair detected some interesting effects on production in the innermost agricultural land in the path of metropolitan encroachment.

Spreading urbanization appears to influence agriculture several miles in advance of the built-up frontier because farmers realize they cannot compete against the higher location rents earned by urban land uses. Thus, metropolitan expansion is perceived as a displacement threat on the farmers affected in inner rural zone and this reflects their spatial behavior (Wojciech, Jaroslaw, Tomasz, and Boguslawa, 2018). Those closest to the urban frontier feel most threatened and keep their agricultural investments low. These investments rise with distance away from the frontier where the specialized agriculture of the region takes over.

Sinclair who argued that, with urban sprawl, increasing competition for land comes from non-agricultural uses. He noted that, in many advanced industrialized parts of the world, the basic

forces determining agricultural land use near urban areas are associated with urban expansion. Where these forces are in operation, the agricultural pattern quite often is one of increasing intensity with distance from the city. Urban pressure encourages land conversion from agricultural to urban uses, while the structural weakness of agriculture makes conversion easy (Mazzocchi, Sali and Corsi 2013). To live and work, humans need space, so population growth, as well as high population density, migration, economic and employment growth lead to urban land development (Zasada, Fertner, Piorr and Nielsen, 2011). In accordance with the models developed by Alonso (1964) and Konagaya (1999), urban land use brings higher economic rents than agricultural land use, therefore, areas (e.g., municipalities) with high population density, a large number of non-agricultural enterprises, etc., have a relatively low share of agricultural land.

2.3.2 Burgess Theory of Urban Land Use

An early theory designed to explain the land use structures of cities was presented by Ernest Burgess in 1923. Burgess developed a concentric ring approach theorizing that a city expands from its original centre in a series of concentric zones. This was a development of Von Thunen's explanation of rural land uses and values, put forward in the early part of last century, and based upon the concept of a medieval village design.

It was assumed that the central district would be used for intensive high rent uses such as office buildings, department stores and other retailers, financial institutions, hotels, theatres etc. The ring immediately surrounding the central district would be made up of a variety of uses including low rent workers residences for those employed in the central area as well as manufacturing, wholesaling, storage and similar activities which are related directly or indirectly to those activities carried out in the central zone.

Rings further out in the hierarchy would in turn be devoted to low cost wage earner housing, middle class housing, and on the rural urban fringe higher cost upper income housing.

A later development of the concentric ring theory states that the central zone is the "100% spot" and again includes the principal stores, office buildings, banks, theatres and hotels. It is the focal point of the social, civic and commercial life of the city.

The surrounding area is termed a transitional zone, this is made up of older homes – some converted to flats, and other high density housing upon which factories and other business establishments are encroaching. To a large degree this area surrounding the CBD is blighted by the process of change and may be a high crime area. In some cities this can be slum type accommodation or other interim low rent type uses.

Beyond the central zone and the transitional zone is the inner ring of residential uses. The people living here are the wage workers of the central zone and the transitional zone. Their houses are generally small and relatively high density or they can also be former expensive housing now converted to flats or apartments. The inhabitants prefer to live in this location because of lower rents and values and because they are within easy commuting distance of the CBD and their places of work. There is a high percentage of rental accommodation and a relatively transient population.

Further out are again concentric rings of progressively higher valued housing.

Industry displaced from the inner core or transitional area does not encroach on these residential rings but instead leapfrogs out to urban periphery "greenfields" sites, usually alongside important transport routes.

In the concentric ring theory, the basis for the higher value properties being further out from the centre is that high income earners can better afford the accompanying commuting expenses, lower housing densities and larger houses. In addition the closeness to "green" rural land uses and the consequent distance away from industrial and commercial uses will give a greater "amenity" value (and thus economic value) to those properties.

Another development of this theory is the "ripple effect" that maintains land uses spread out from a central point of high intensity (or density) to progressively lower intensity in a similar manner to ripples from a stone dropped in a pond.

One of the major problems with this theory is that it fails to recognize the significant impact of transportation routes, commuting time, topographical features and competing satellite urban centres on the distribution of land uses.

2.3.3 Land Use Scanner

The Land Use Scanner is a GIS based model that simulates future land use and offers an integrated view on all types of land use. It is rooted in economic equilibrium theory. It deals with urban, natural and agricultural functions, normally distinguishing up to 15 different land use categories. It presents a highly disaggregated description of a country. Regional projections of land use change are used as input for the model. These projections are derived from the sectoral models of specialized institutes. The various land use claims are allocated to individual grid cells based on their suitability. Suitability maps are generated for all land use types based on location characteristics of the grid cells in terms of physical properties, operative policies and expected relations with nearby land use functions. Unlike many other land use models, the objective of the Land Use Scanner is not to forecast the dimension of land use change pattern but rather to integrate

and allocate future land use claims from different sectoral models whereby the outcome of the models are not interpreted as a fixed prediction for a particular location but rather as probable spatial pattern.

The Land Use Scanner employs the equilibrium principle to balance the demand for various land use functions with the supply of suitable land. The crucial variable for the allocation model is the suitability s_{cj} for land use of type j in grid cell c. This suitability can be interpreted to represent the net benefits (benefit minus costs) of land use j in cell c. the higher the suitability for land use type j, the higher the probability that the cell will be used for this type. The simplest version of the model is when logit type approach is used to determine this probability. The model is constrained by two conditions: the overall demand for the land use functions which is given in the initial claims and the total amount of land which is available for each function.

2.3.4 Econometric Land Use Models with Spatial Simulation

Econometric models of land use change derive from economic models of individual land use decisions in which landowners choose a land use in a given time period such that net expected returns over time are maximized. The theoretical framework for these models is well-established in urban economics while the models vary in their assumptions about space, expectations, durability of capital and uncertainty. They are forward-looking given that landowners make intertemporal land use decisions conditional on expectations over changes in land rents, e.g., due to population growth.

Econometric-based models of spatially heterogeneous land use patterns proceed in two steps.

First, the econometric model is specified based on hypotheses regarding the factors that influence expected land rents, which typically include multiple spatially heterogeneous landscape and location features and policy constraints. This model is then estimated using spatial micro panel data on land use over time at the scale of land ownership, e.g., land parcels, and additional spatially detailed data on the factors hypothesized to influence expected land rents. Second, parameter estimates are used to simulate hypothetical changes in land use pattern, e.g., under baseline and alternative scenarios, using a spatially explicit, GIS-based model of the actual landscape. This permits the role of individual-level factors in generating regional land use patterns, including land use policies and other spatially heterogeneous features of the landscape, to be investigated. The results can then be compared using spatial statistics or landscape metrics to draw conclusions regarding the predicted influence of these factors on the concentration, fragmentation or other spatial dimensions of land use. This two-step approach has been used to model urbanization and sprawl (Lewis and Plantinga 2007). Because of their ability to account for multiple sources of spatial heterogeneity, ecological features can be readily incorporated. In addition, the land use simulations can be linked with environmental impact models in which land use is the driver of environmental change to permit a fuller examination of the predicted effects of policy and other variables on ecosystem services.

The goal of the simulation is to understand the underlying causal mechanisms of land use patterns. Methodological issues also arise in the simulation used to generate land use pattern predictions. This substantially limits the usefulness of the simulation if the purpose is to uncover the causal effects of hypothesized socioeconomic factors on land use pattern.

2.4 Empirical Literature

Different researchers provides empirical evidence concerning issues on different land use pattern and how it impacts on agricultural land that may affects agricultural performance. However, this is linked with increasing population and urban growth and continuous demand for food and land for different human uses in Nigerian context and other developing countries. We therefore provide empirical review on impact of different land use patterns on agricultural land base on studies done.

2.4.1 Land Use Intensity Studies

Study by Raufu (2010) investigated how pattern of land use as a result of tenural arrangement being practiced in Osun state leads to farmland fragmentation and decline in nutrients status of the soil as land get over utilized by farmers. Descriptive and farming system analysis were used to analyze the primary data obtained from 360 farmers using Rutherberg value and Herfindal Index. Result in terms of intensity of cultivation shows that, Rutherberg value of 0.589 showed that farming system practiced in the area was moving towards permanent cultivation under the natural fallow management system. While Herfindal index at 0.578 showed low level of crop diversification. In a similar study by James (2014) who examined household size and agricultural land-use pattern in Obagaji area of Nigeria were a simple random sampling technique using the table of random digits and available sampling methods was used to select settlements and farmers investigated. Structured interview as used to generate data for the study where three variables were used namely; proportion of farmland cultivated, frequency of cultivation and crop combination level. Linear regression was used to determine the relationship between family size and agricultural land use intensity. The equation of the least square was first determined and then plotted. Results from the study shows that Obagaji area is a mixed cropping region where semi-permanent cultivation with rotational bush fallow system dominates the existing cultivation

systems. The direct variation in intensity of agricultural land use with regard to family size in the study area is significant.

Also, a study by Owoeye and Ogunleye (2015) use survey research design via questionnaire administration; observation and personal interview for data collection to investigate the impact of urban growth on the environment. The findings revealed that urban development affects the spatial heterogeneity of the landscape, especially the patterns of variation in land cover and changes in land use overtime. Similarly, Bello and Arowosegbe (2014), identified factors affecting land-use change on property values in Nigeria. They examine industrialization along with urbanization and growing deforestation, increasing trend of green house effect, raising temperature, and rapid climate change which has fallen a burden on the environmental resources. Data for the study was gathered through qualitative interviews, direct participant observations and the use of questionnaire. Conceptual models and computer simulation were applied as tools for analysis. Result from the analysis shows that urbanization and ineffective legal frameworks had been discovered to be the major impediments to the ever growing land use changes in Nigeria.

Ajijola, Saka, Aduramigba-Modupe (2014), carried out a study to determine the impact of land-use intensification pattern among farmers in the derived savanna agro ecologies in Southwest Nigeria. Methodologies employed in the study include the use of primary data and multi-stage clusters sampling techniques to select 144 respondents and were interviewed with well-structured questionnaire. Therefore, findings show that soil fertility depletion is possible under high land-use intensity and there is need to supplement available soil nutrient with fertilizer application to boost agricultural productivity.

Muhammad, Poshtiban and Koundinya (2013) carry out a study to identify effective factors on agricultural land use changes in Guilan province of northern Iran. The research uses descriptive method for the analysis. Data was obtained by the use of questionnaire as the main research instrument. Cronbach's alpha was used to measure the reliability of the instrument, which was 0.94 and was said to be reliable. Results from the study shows that economic factors had the greatest impact on agricultural land use changes in Guilan followed by social, management and policy making related, personal and technical factors. Population growth and expansion of the physical part of the city was the most effective social factor in land use change. Lack of support for manufacturer from managerial and policy making factors and increasing age of farmers were among the individual factors also impacted land use change. Traditional production methods and changes in cropping patterns were technical and technological factors respectively had less impact compared to the identified economic, social, and managerial factors.

Study carried out by Teketel (2015) examined the expansion of Hossana town and its effects on peripheral farming communities. The study employed descriptive research design; the study applied mix methods of both qualitative and quantitative approaches. 175 households were sampled thorough systematic sampling and non – random sampling techniques backed by tools such as open-ended interview guided questionnaires, semi-structured interviews, and focus group discussions while the secondary one was from different written and documented sources. Collected data was analyzed by SPSS software and the result indicated that urban expansion program around Hossana was not participatory, people were not given awareness, and the dislocated households did not have opportunity to bargain in the determination of the amount and kinds of compensation and calculating the value of assets.

Mutua (2013) investigate how peri-urban development affects the livelihoods of indigenous households, by using Lower Kiandani area of Machakos town. The study used a proportionate stratified random sampling technique to select samples for the study. Face-to-face interviews using semi-structured questionnaires, and direct observations using forms, were used for the collection of key household data. The data were analyzed using both descriptive and inferential methods. The study identified economic factors; commoditization of land; cultural factors and institutional factors as the main drivers of land sub-division and land use change. It also revealed that majority of the households, especially in the inner areas, have not taken advantage of the opportunities of urban-based land use/activities.

Nicodemus, Barry and Stefan (2010) conducted a study on peri-urban development, livelihood change and household income in Nyahururu, Kenya. Data for the study was collected through questionnaires and interviews with individual households in the peri-urban Nyahururu. Analysis shows a decline in full time farming households from 90% in the 1960s to 49% indicating a decline in economic significance of agriculture which was mainly due to rapidly shrinking household agricultural land as well as low and fluctuating agricultural output prices which reduced the profitability from agricultural production. The study recommends despite the declining economic significance of agriculture in the study area, they emphasize the importance of government intervention to enhance agricultural productivity and control agricultural land conversion for food security reasons.

Li, Xiangzheng and Karen (2013) examines the impact of urban expansion on agricultural land use intensity in China using panel econometric methods. Results show that urban expansion is associated with a decline in agricultural land use intensity. The area of cultivated land per capita, a measurement about land scarcity, is negatively correlated with agricultural land use intensity.

The study also find that GDP in the industrial sector negatively affects agricultural land use intensity. GDP per capita and agricultural investments both positively contribute to the intensification of agricultural land use. They suggest that together with the links between urbanization, agricultural land, and agricultural production imply that agricultural land expansion is highly likely with continued urban expansion and that pressures on the country's natural land resources will remain high in the future.

Kombe (2005) conducted a study on land use dynamics in peri-urban areas and their implications on the urban growth in order to examine recent trends in land-use transformation taking place in the peri-urban area of Dar es Salaam, Tanzania. Data was sourced through structured interviews and focus group discussion conducted with land sellers and buyers in the study area. The study demonstrates that urbanization in poverty is the key factor underpinning and catalyzing changes in land use, land transaction, increased rural-urban migration and the overall transformation of land use in the peri urban areas. It therefore, recommends that planners and policy makers need to decentralize land management anchored on the subsisting local government administrative structures, introduction of user-friendly and pro-poor land regularization systems and embarking on land banking by local authorities are some of the key immediate policy action areas of concern.

2.4.2 Landsat/GIS Studies

Yaser and Muna (2016), uses three sets of remotely sensed data to measure the land use/land cover changes in WadiZiqlab catchment during the period 1953-2008. Population increased from 11,162 in 1952 to 63,970 in 2004. The population growth have resulted into changing the land use/land cover of 4,414 ha (42%) of the catchment area. The main changes show that orchard trees and urban areas increased by 22.4% and 6.2% into field crops, forest and rangeland areas. The ownership data indicates the presence of 44,843 plots in the catchment, 68.9% of these have the

area of less than 1 ha. Therefore, the distressing features are that deforestation, cultivation on slope area, and land fragmentation are all leading to increased land degradation.

A study carried out by Oluabunmi and Ayoade (2014) examines change in land use and its effect on the amount of land available for agricultural production as basis for decision on land use planning for sustainable agriculture. The study was carried out in Ido local government area of Oyo state and Land Sat images of Oyo state for the years 1984, 2000 and 2010 were used for the land use classification covering a period of 26 years. Maximum likelihood algorithm was used to classify different land use categories such as forested areas, bare lands, urban areas, water bodies and agricultural lands. The results show that from 1984 to 2010, the urban areas increased by 8.29%, forested area decreased by 4.88% and the agricultural land also decreased by 3.80%. These suggest that the trend must be checked so as to enhance sustainable agricultural production and thereby avoid food insecurity in the future.

Opatoyinbo, Adepetu and Abdullahi (2015) examines the population growth in relation to urban land use changes along River Kaduna floodplain in Kaduna North Western Nigeria. Projected population data, Remote Sensing Technology and Geographic Information System were employed to determine the trend of population growth and urban land use changes with reference to urban land use types along the river floodplain in Kaduna for the period of 1976 to 2010. The results revealed amongst others that population growth is not the only factor that can effect changes on urban land use along River Kaduna floodplain in Kaduna metropolis. Also, Ndabula et al. (2013) analyses the spatio-temporal dynamics of landuse/landcover structures in Kaduna innercore city using five (5) quantitative indices; Normalized Vegetation Difference Index (NVDI), Landuse/Landcover Change Intensity Index (T_i), Dynamic Index (K_i), Integrated Index (L_d), and Rate of Change (A_i). The NDVI on one hand allows analysis of these LULC in terms of change in

quantity of vegetation cover or bareness of the land surface, while the other four indices on the other hand expressed the intensity with which the land surface is subjected to human activities. RS/GIS was used for the mapping and NDVI analysis using multi-temporal satellite data sets. Results showed significant dynamics amongst the various LULC in both space and time with implication of decreasing vegetation cover and increasing bare surfaces and hence land degradation processes.

Enaruvbe and Atedhor (2015) examines agricultural land use change due to urban encroachment into agricultural landscape. It analyses the pattern and rate of land use change in Asaba between 1987 and 2013, and determines the impact of the observed changes on agricultural land use. A three time point multi-temporal remote sensing images are analyzed using hybrid unsupervised/supervised image classification technique to identify four dominant land cover classes in the study area. The results shows that cultivation and settlement increased by 1.4% and 1.5% respectively while forest and water decreased by 0.7% and 1.2% in the first interval, 1987-2000. In the second interval, however, cultivation increased by 0.8% while settlement, forest and water decreased by 0.2%, 0.1% and 1% respectively. Inspite of an average overall increase observed for cultivation and settlement, the result shows a reduction in total area cultivated in the second interval while forest and water also declined by 0.4% and 1.1% respectively. The study concludes that urban encroachment into rural landscape should be controlled and sustainable rural strategies to minimize rural-urban migration be implemented so as to curb the loss of interest in agriculture.

However, Joel (2011), in his study on changing pattern of land use examined various land uses and the changes that have occurred and the rates of such changes in the Calabar River Catchment between 1967 and 2008 in Nigeria. Data for the study was obtained from both topographic maps

and satellite imagery. The following mosaics of land-uses; built-up, plantation, fallow land/scattered cultivation, high forest, low forest mangrove, river and quarry were identified. Result shows that high forest was the most affected of land uses, decreasing by 29.92% at the rate of 0.73 per $year^{-1}$ (or loss of 11045.51m^2 $year^{-1}$).

Saleh, Badr, El Banna and Shahata (2014) assess agricultural land-use change in Kaduna metropolis where the study combined the use of remote sensing and geographic information system (GIS) application to ascertain the rate of agricultural land-use change from 1980 to 2012. The four imageries (Landsat MSS 1980, Landsat TM 1990, Landsat ETM+ 2005 and Nigeria Sat X 2012) used were classified and compared to understand the rate and extent of agricultural land use change at different periods. The findings revealed that the study area experienced a significant reduction in agricultural land and these leads to continued disappearance of farmlands and also leads to loss of livelihood, reduction in food supply and increase poverty.

2.5 Gap from the Literatures

From the foregoing empirical studies reviewed, Li Xiangzheng and Karen (2013) uses panel econometric model to determine the relationship between urban expansion and agricultural land use intensity using GDP of China. This could not give the actual rate of urban expansion and the socioeconomic effect on the people. Yaser and Muna (2016), Opatoyinbo, Adepetu and Abdullahi (2015), Ndabula et al. (2013), Enaruvbe and Atedhor (2015), Joel (2011), Saleh et al. (2014) use GIS in their studies to ascertain the environmental effect and forecast future land use not considering household or the economic effect on the living condition of people.

Also, the works of Raufu (2010), James (2013), Ajijola et al. (2014), Teketel (2015). Mutua (2013) and Kombe (2005) uses primary survey instruments to determine the socioeconomic effect of land

use change on the people in different communities. These studies did not use GIS in order to capture the extent of land use in the communities which makes their studies one sided.

Therefore, this study employ and integrated the use of both GIS/Landsat, econometric analysis and cross sectional survey instruments in order to ascertain the environmental, physical, social and economic effect of urban expansion on peri-urban agricultural land use pattern at the urban fringe of Kaduna metropolitan city to include Rigachikun, Unguwankaji and Barakallahu. In addition, this study employed the use of Multinomial logistic regression and Regression analysis in order to achieve the stated objectives of the study.

2.6 Overview of Urban Expansion and Encroachment in the Study Area

Nigeria is experiencing an increasing population growth as it maintained number one position with the highest population in Africa with about 186,304,724 (worldometer, 2016). Therefore Kaduna state and hence Igabi Local Government are included in the spate of population increase. Kaduna is the third largest state in terms of population and comes after Lagos and Kano states with more than 6 million people living within the state (NPC 2006) and that population is growing at about 3.3% per annum according to (NPC 2006).

Steady population growth is inherent in Kaduna which leads to increasing urban sprawl that become ever more pressing on nearby land. With an estimated population of 1.5 million people (UN-Population Division 2014) and 2 million in 2015 (Saleh et al, 2014), the metropolitan city is unique for its rapid urbanization and urban expansion which resulted in transformation of the farmlands, river flood plains and forests into settlements thereby causing urban land use changes (Opatoyinbo, Adepoto and Abdullahi 2015). As a result, more settlements were created outside the major city to include part of Igabi Local government.

Igabi population is on the increase from 308,239 in 1991, to 430,753 in 2006 to 500,460 in 2011 (NPC 2015). Development has occurred along the major road of Kaduna-Kano expressway out of the city to the north where new settlements like Kawo extension, Unguwankaji and Barakallahu have merged with the existing settlement of Rigachikun as a result of the city's urban expansion.

Table 2.1 Population Growth Rate of Kaduna Metropolis (1919-2015)

Year	Population	Percent Change	Year	Population	Percent Change
1919	3,000		1931	10,653	-0.94
1921	3,791	2.16	1948	20,874	5.6
1923	5,206	18.6	1952 Census	45,000	28.8
1924	6,097	17	1963 Census	147,317	20.6
1925	7,800	28	1991Census	896,055	18.1
1926	8,649	10.8	2006Census	1,570,331	5
1927	9,368	8.3	2011 Estimate	1,824,464	3.2
1928	10,048	7.2	2013 Estimate	1,937,283	3
1929	10,859	8	2015 Estimate	2,057,078	3

Source: Saleh *et al* (2014).

The population of Igabi local government are mostly agrarian and depend on farming as their major source of livelihood. Rigachikun ward lies at the periphery of Kaduna metropolis in which an outward expansion of the city as it merged with the surrounding communities at the fringes. This expansion engulf the lands of the residents in this communities which they depend on for farming.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter involves several information and techniques on how the research was designed in order to achieve its objectives. The nature of the data used for analysis determined our decision on the type of technique used. Therefore, this chapter consist of an overview of the study area, theoretical framework, model specification, research design, and sources of data.

3.2 The Study Area

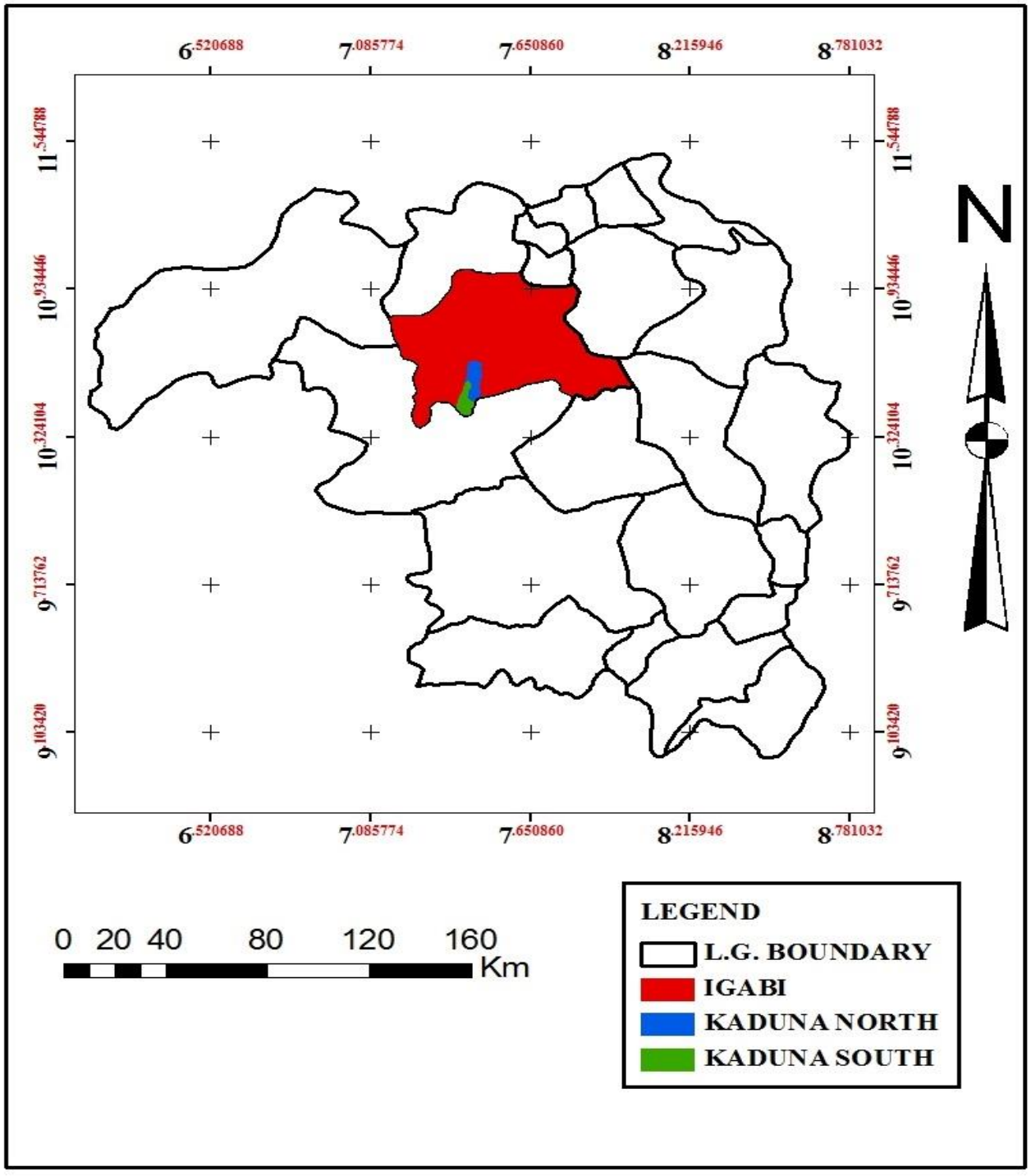
Kaduna is one of the northern Nigeria's leading manufacturing centres, specializing in textile production, petroleum refining, vehicle assembling, brewing, food processing, printing and publishing. Presently it is well connected and accessible through state and federal highways with railways linking Abuja, Kano and Katsina. Thus it remains the heartbeat of most economic activities in northern Nigeria. Due to these urban characteristics, many people from adjacent rural and urban communities move to Kaduna thereby increasing urban space (Ahmad *et al*, 2013). The rapid population increase and urbanization of Kaduna metropolitan city brings about expansion of the city into more land areas of Igabi local government as Kaduna city metropolitan has a population of 1,570,331 (Census, 2006) and an estimated population of 2,057,078 by 2015 (NPC, 2006) which shows a continuous increase in population.

Igabi local government area is one of the 23 local government areas in Kaduna State which is located in the North West geo-political zone of Nigeria at latitude $10^{o}47^{1}$N and longitude $7^{o}46^{1}$E with a total land area of about 3,727 km^2. It forms part of Kaduna metropolitan area and includes

part of Igabi local government, Kaduna north local government, Kaduna South local government and part of Chikun local government. The major economic activities of the people is farming and commerce and has a mean annual rainfall of between 1000mm-1500mm. It has two main seasons which are the rainy and dry seasons. The rainy season usually starts around April and ends around October (i.e six months period) while the dry season covers the period from November to March.

The study area which covers Rigachikun, Barakallah and Unguwan Kaji lies at the urban fringe of Kaduna metropolitan city which is experiencing the effect of urban out push into the areas. Therefore, the communities were chosen because they are situated at the edge of the city and because they have a direct connection with Kaduna city.

Figure 3.1: Map of Kaduna State showing Igabi and Kaduna metropolis



Source: ARC GIS, (2016)

3.3 Theoretical Framework

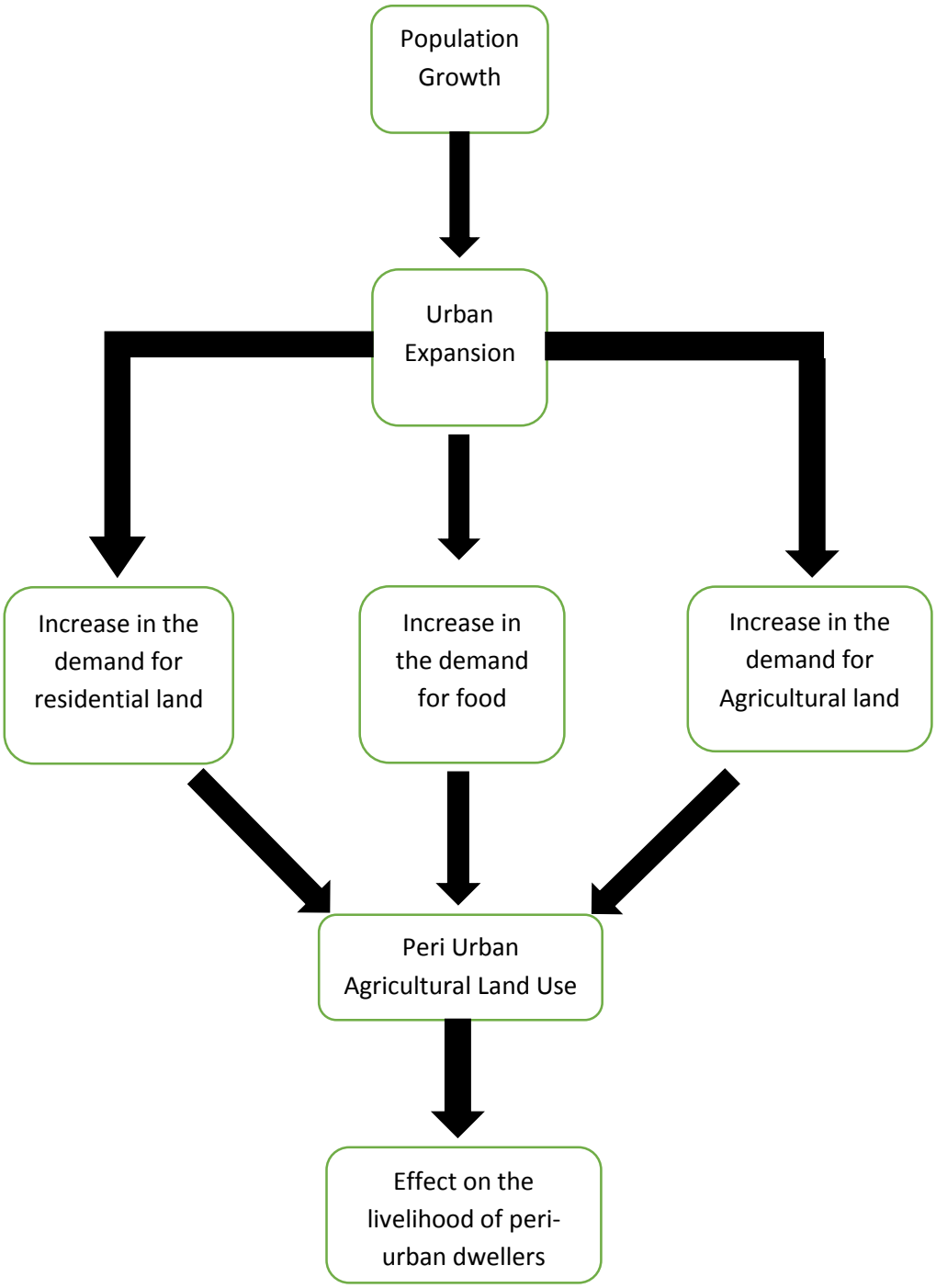
According to Sinclair's theory of Agricultural land-use, he detected some interesting effects of production in the innermost agricultural land in the path of metropolitan encroachment. He stated that urbanization appears to influence agriculture several miles in advance of the built-up frontier because farmers realize they cannot compete against higher location rents earned by urban land uses. Therefore those closest to the urban frontier feel more threatened and keep their agricultural investments minimized.

The theory depicts a situation where urban sprawl which is as a result of increase in population may encroach into agricultural land use. In this case farmers may have to leave agricultural lands for the purpose of residential and infrastructural buildings. Based on this, the theory explains the situation in Igabi local government given the scenario captured by satellite image.

The satellite image shows how agricultural land is being encroached by rapid urbanization in Igabi local government, Kaduna state. Therefore, farmers closest to urban frontier keep their investment on land as minimum as possible for the short run period for fear of possible eviction from the land for development purpose. As such, those that are far away from the urban frontier are more secured to engage on extensive agriculture and long term investment on the land.

However, a trade-off exists between agricultural land and built-up areas where by development may lead to less agricultural land and vice versa. As less development process will lead to more agricultural land for food production with the resultant effect on agricultural degradation where agricultural production will be negatively affected. As such a threat to food security and livelihood of the peri-urban dwellers.

Figure 3.2: Transmission mechanism showing the impact of population growth and urban expansion on peri urban agricultural land use.



Source: *Author's Conception, 2016.*

The above diagram depicts the transmission mechanism through which population growth and urban expansion impact on peri urban agricultural land. An increase in population leads to an increase in the demand for food, increase in the demand for residential settlement and also increase in the demand for agricultural land. These would create a high demand for land in order to satisfy human needs. Therefore, encroachment into agricultural land is inevitable as a result of population increase and increased urban demand for land which may have an effect on the livelihood of the people.

3.4 Model Specification

To achieve objective iii of the study, the multinomial logistics regression (MLR) was chosen instead of panel econometric model used by Li, Xiangzheng and Karen (2013) base on the literature. Therefore, the explicit model for capturing the effect size of livelihood of people is given as;

$$\ln(Lvlhd_i) = \alpha + \beta_1 lown_i + \beta_2 sinc_i + \beta_3 lcon_i + \beta_4 doff_i + \beta_5 cinc_i + u_i \quad \ldots\ldots\ldots\ldots\ldots\ldots 3.1$$

Where, Lvlhd represents livelihood of people, α is the intercept, $\beta_1\beta_{2\ldots}\beta_n$ are the parameters, lown represents land ownership, sinc represents sources of income, lcon represents land conversion, doff represents displaced from farmland, cinc represents change in income and u is the error term.

Where i is the binary operator of 1 and 0

The exponentials of the coefficients βi associated with the independent variables are interpreted as the Risk Ratio (RR) of effect size on the livelihood of people (or of occurrence of the event). The important aspect of the logistic regression model is that we can jointly analyze various factors with a view to examining how they can affect the livelihood of people in the study area.

Therefore, β_1, β_2 and β_5 are expected to have positive relationship with livelihood of people (lvlhd) and predictor variables. This implies that increase in land ownership, source of income and change in income would result to an increase in their livelihood and vice versa. Likewise, β_3 and β_4 are expected to have negative relationship between livelihood and the respective predictor variables.

In order to achieve objective ii, a causal modelling technique developed by Rao (2005) was adapted from the study of Jinadu (2008) with a multiple regression model technique. Therefore the functional relation of the model is specified as follows:

$$ALU = f\,(BU, FA, DF, WB) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 3.2$$

Where, ALU represents agricultural land use, BU represents built-up areas, FA represents forest areas, DF represents disturbed/degraded forest and WB represents water bodies.

For this study, the multiple linear regression model is specified for estimation and is expressed in stochastic form as;

$$ALU_t = \beta_o + \beta_1 BU_t + \beta_2 FA_t + \beta_3 DF_t + \beta_4 WB_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 3.3$$

Where, β_o is the constant term (intercept), β_i is the regression parameters (1….. 4), t is the time (t = 1,……., n) and ε is the error term.

Therefore, only β_2 is expected to have positive relationship with agricultural land use (ALU) and predictor variable. This implies that increase in forest area (FA) would result to an increase in agricultural land use. Likewise, β_1, β_3 and β_4 are expected to have negative relationship between agricultural land use and the respective predictor variables.

3.5 Estimation techniques

The techniques used for the estimation of data for the study were informed by the nature and type of data for the research. Therefore, both qualitative and quantitative data were captured through field survey and Landsat imagery. The data were summarized in tables for report writing through the use of descriptive analysis, regression analysis and discrete choice/logistic regression model. Descriptive analysis was used to clearly show the extent of different land use activities that occurred with the use of frequencies, percentages and a multiple bar chart and the regression determine the factors affecting agricultural land use pattern in the study area base on the landsat result. Logistic regression for multinomial outcomes was also used to evaluate the effect of urban expansion on the livelihood of people in the study area.

To achieve the objectives of this study, two models were utilized, which are;

3.5.1 Multinomial Logistic Model

In order to capture the effect of urban expansion on the livelihood of people living in the study area (Rigachikun, Barakallahu and Unguwankaji) which lies at the fringe of Kaduna metropolitan city.

The multinomial logistic model is given as:

$$\ln(\theta_j) = \alpha_j + \beta X_{ij} + \cdots + \beta X_{nj} + u_i \quad \text{.....3.4}$$

where j goes from I to the number of categories minus 1.

The model was estimated using the maximum likelihood technique as this was the preferred technique used in MLR. This technique was chosen because of the qualitative response/discrete

choice nature of the data and the dependent variable was not ranked or ordered but categorical and MLR also deals with situations where the outcome can have three or more possible types that are not ordered.

3.5.2 Regression Model

The regression model has been employed to analyze factors affecting agricultural land use base on the data captured from the GIS. The use of linear regression is to find the impact of the identified land use factors on the dependent variable (Agricultural land use).

The basic form of the model is expressed as;

$$Y= \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots \beta_n X_n \qquad 3.5$$

Where: Y = dependent variable,

X_1, X_2, ……..X_n = independent variables.

3.6 Research Design

This is the overall strategy that integrates the different components of the study in a coherent and logical way so that the research problem will be effectively addressed. The study employs two different study designs which are as follows;

3.6.1 Landsat/Geographic Information System (GIS)

The research explored the use of GIS which is an emerging information tool that can perform active role in urban development management. GIS can be defined as a computerized system that permits or facilitates the phases of data entry, data analysis and data presentation especially in

cases when dealing with geo–referenced data (Rolf, 2001). GIS has the capabilities of retrieving and managing data based on mapping, image processing and query and statistical analysis. A GIS defines features or entity or real world objects on a map using spatial and descriptive or attribute data. Spatial data indicates information about location characteristics and dimension of a feature. Therefore a multi-temporal satellite images that represent a ten year interval for 1995, 2005 and 2015 were generated from the following programmes; LandSat MSS 1995, Spot.XS 2005 and Quickbird 2015 and used for the study. ENVI image processing software was used for classification of images. The LandSat image of 1995, 2005 and 2015 was used to generate data on the variables and they are, Built-up areas (BU), Agricultural land (AL), High forest area (HF), Water body (WB) and Disturbed/degraded forest (DF) over a period of 20 years.

3.6.2 Cross Sectional Survey Design

A cross sectional survey was used to examine the changes on economic activities and livelihood of the population/settlers in the semi-urban fringe as a result of increase in population growth and urban sprawl of the metropolitan city of Kaduna. This was used to obtain an overall picture of the changes at a single point in time by observing different set of dominant economic activities inherent in the study area. The data collected were used to draw inferences about the sampled population of the study area based on the magnitude of the population growth/urban sprawl as it positively or negatively affects the economic activities and livelihood of residents near the city.

3.6.2.1 Population, Sample Size and Sampling Technique

The total number of households in Rigahikun Ward is the population of this study. The population of households was estimated to be 13,083 (State Primary Health Care Agency, 2017). The

population is distributed across Rigachikun, Barakallahu and UnguwanKaji which constitutes the study area.

A sample size was selected from the population of the study area which is derived as a subset of the total population. The targeted population/respondents for the study were the peri-urban residents of the Kaduna metropolis to whom a structured questionnaire was administered to. To determine the sample size of the population for the study, the Yamane's (1967) formula for calculating the size of the sample was adopted from the work of Teketel (2015). This is expressed as:

$$n = \frac{N}{1+N(e)^2} \quad \text{..... 3.6}$$

Where n = Sample size

N = Total population of the study

e = Margin of error

$$n = \frac{13083}{1+ 13083\ (0.07)^2}$$

$$= \frac{13083}{1+ 13083\ (0.0049)}$$

$$= \frac{13083}{1+ 64.1067}$$

$$= \frac{13083}{65.1067}$$

n = 200.95 ≈ 200

Therefore, the sample size is approximately 200 out of the total population in the study area which takes consideration of only the household heads who may have vast knowledge of the study area since 1995.

A purposive sampling technique was employed to select part of Igabi local government area that is close to the metropolitan city of Kaduna which have a direct impact with the urban city. They include Rigachikun, Barakallahu and Unguwankaji. In order to ensure adequate representation of the population in the study area, the study make use of simple random sampling technique where each respondent has equal opportunity of being selected to represent the population. The respondents considered in the study area were the original residents/indigenes of the area because they have a better knowledge of the study area.

3.7 Sources of Data

The study relied essentially on both primary data and secondary information generated from questionnaire, interviews, satellite imagery/GIS and literatures. LandSat images of 1995, 2005 and 2015 and data series for 20 years was used for the study in order to carry out the analysis. The variables for which the data was collected includes, Built-up areas (BU), Agricultural land (AL), High forest area (HF), Water body (WB) and Disturbed/degraded forest (DF) which covers 20 years.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

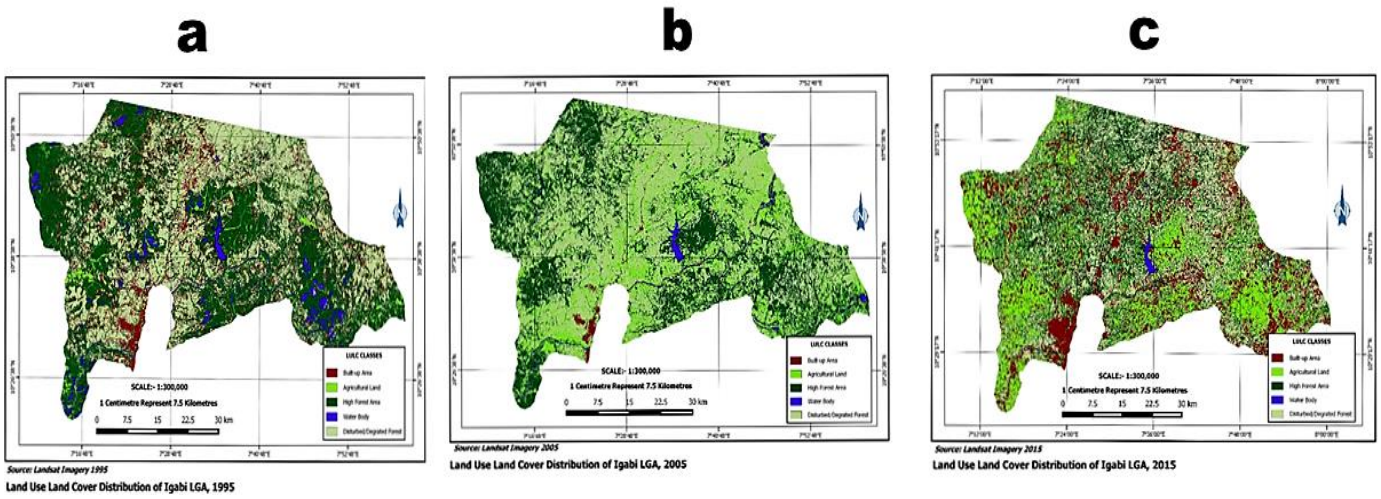
This chapter deals with the presentation of research findings and analysis of data which reflects the objectives of the study. Three communities (Rigachikun, Barakallahu and Unguwankaji) were selected to represent the urban fringe of the Kaduna metropolitan city. Questionnaires were administered to 200 heads of households out of which 196 of them were retrieved and 5 key informant interviews who are leaders and influential elders from the communities was carried out. Information from the LandSat imagery was also generated for the analysis. These were carried out for the analysis in order to achieve accuracy and easy understanding of the results obtained. The results were presented according to the objective of the research work.

4.2 Extent of Urban expansion and Land Use change pattern in the study area

This section analyzed the extent of urban expansion using satellite images and GIS between 1995, 2005 and 2015. Information generated from the Landsat imagery for the study sought to monitor and analyze urban expansion using satellite images and GIS for the periods 1995, 2005 and 2015. Arc GIS 10.1 was used to map urban expansion and were characterized into five major land use classes and they are; built-up areas, agricultural land, high forest area, water body and disturbed/degraded forests. The values presented represent the area in hectares and percentage of each land cover for each year under study obtained from the supervised classification.

The study area was characterized and mapped into five (5) major Land use common in the area which reveal the different patterns of these land use dynamics as shown in Figure 4.1 (a, b & c)

representing 1995, 2005, and 2015 respectively. These changes were estimated and summarized in Tables 4.1 & 4.2, the Built-up, Agricultural land areas and water bodies showed increasing trend, while High forest and Disturbed/degraded forest showed decreasing trends.



Source: Arc GIS satellite imagery

Figure 4.1: GIS Mapping of Igabi LGA for 1995, 2005 and 2015

The distribution of different land use activities by man shown in figure 4.1 (a, b & c) were built-up structures which covered 5326.6 ha of land as it is larger than agricultural/cultivated land which accounted for 3022.5 ha of land.

The result of the satellite imagery revealed that built-up area (which is shaded with red colour) in figure 4.1 (a, b & c) thickens as the year increases which shows an expansion. The area that shows the highest concentration is the area that covers (Rigachikun, Barakallahu and UnguwanKaji) which lies at the fringe Kaduna town. The built-up land expands in the study area at the expense of agricultural land which was more pronounced around the study area during the review period.

Therefore, the result from fig. 4.1 shows that total built up area has expanded between 1995, 2005 and 2015 which represent expansion of structures such as residential, commercial etc. significantly at the detriment of agricultural land which the satellite image shows for the study area.

The land cover area and percentage of each land use and land cover category were derived from the satellite image for the review periods. As shown in Table 4.1, in 1995, 16.5% of Igabi land was covered by built-up structures (residential and commercial), 9.3% by agricultural land, 39.6% by high forest area, 2.3% by water body and 32.6% by disturbed forest. In 2005, 19.63% was covered by built-up structures, 18.3% by agricultural land, 17.7% by high forest area, 1.2% by water body and 43.4% by disturbed forest. While in 2015, built-up area was covered by 21.0%, agricultural land by 27.7%, high forest area by 12.8%, water body by 2.0% and disturbed forest by 36.5%.

Table 4.1 clearly shows the extent to which land use activities changed from 1995 to 2015 due to population increase and urban expansion of Kaduna metropolis into the study area which intensifies the different land use activities in the area.

Table 4.1: Distribution of different land use activities (1995-2015)

	1995		**2005**		**2015**	
Land Use Activities	**Area (Hectares)**	**%**	**Area (Hectares)**	**%**	**Area (Hectares)**	**%**
Built-up Area	5326.6	16.46	6284.9	19.43	6791.2	20.99
Agricultural Land	3022.5	09.34	5909.6	18.27	8969.7	27.72
High Forest Area	12732.1	39.35	5731.0	17.70	4132.0	12.77
Water Body	739.9	02.30	390.5	01.21	648.1	02.00
Disturbed/Degraded Forest	10532.3	32.55	14037.4	43.39	11812.4	36.52
TOTAL	**32353.4**	**100**	**32353.4**	**100**	**32353.4**	**100**

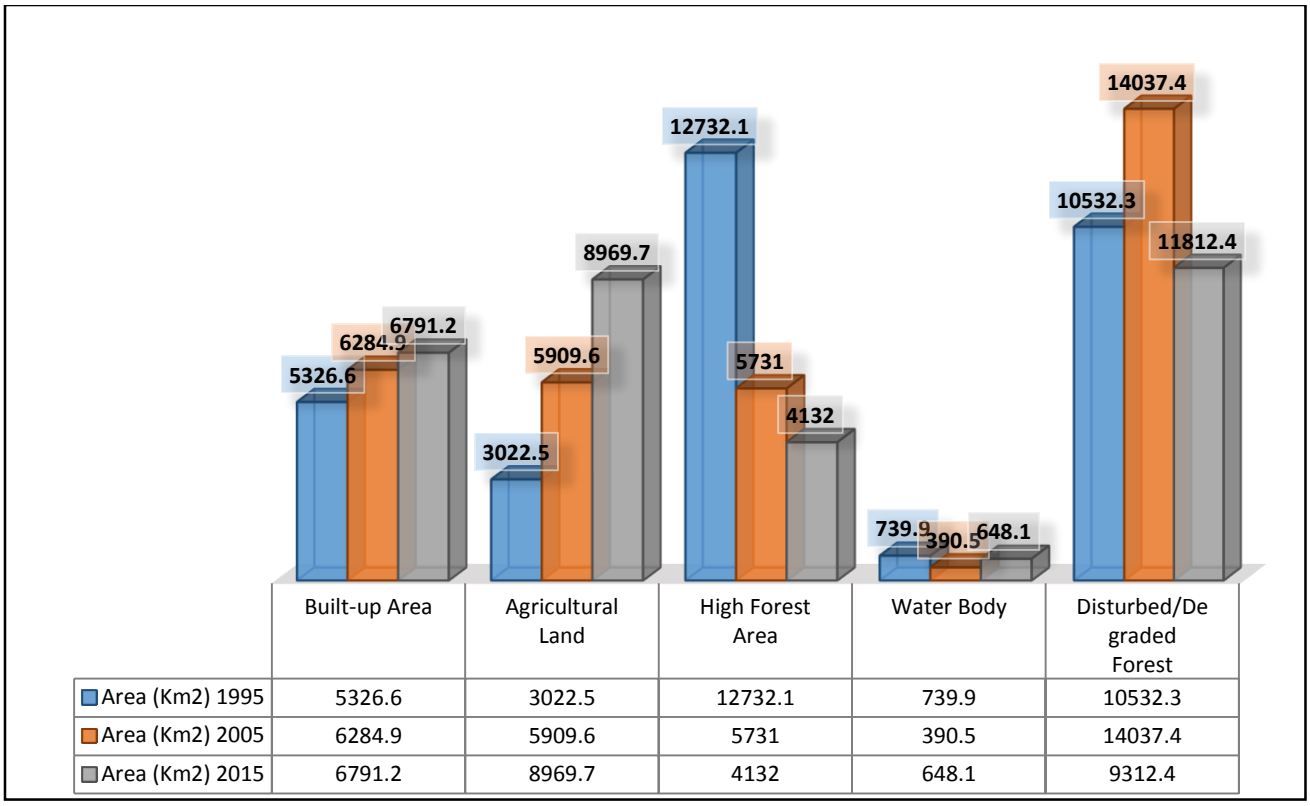
Source: GIS satellite mapping, 2016.

Table 4.2 shows the changes that occurs between the period of 1995, 2005 and 2015, whereby built-up land increased by 958.3 ha (18.0%) between the period of 1995 to 2005 and a further increase by 506.3 ha (8.1%) between the period of 2005 to 2014. Agricultural land also increases by 2887.1 ha (95.5%) between 1995 to 2005 and increased further by 3060.1 ha (51.8%) between the period of 2005 to 2015. On the other hand disturbed forest increased by 3505.1 ha (33.3%) within 1995 to 2005 and also declined by 2225 ha (15.9%) of land between the period of 2005 to 2015 while high forest area declined by 7001.1 ha (55.0%) of land between 1995 to 2005 and a further decline by 1599 ha (27.9%) between the period of 2005 to 2015. Water body shows a decline of 349.4 ha (47.2%) within 1995 to 2005 and then increased by 257.6 ha (66.0%) between the period of 2005 to 2015. These land use changes is as a result population growth and urban sprawl of Kaduna metropolis which encroached into the communities that lies at the fringe of the city.

Table 4.2: Changes on different Land Use activities (1995-2015)

Land Use Observed activities	Land Use Change (Ha) in 1995-2005	Percentage Change (%) 1995-2005	Land Use Change (Ha) in 2005-2015	Percentage Change (%) 2005-2015
Built-up Area	958.3	18.0%	506.3	8.1%
Agricultural Land	2887.1	95.5%	3060.1	51.8%
High Forest Area	-7001.1	55.0%	-1599	27.9%
Water Body	-349.4	47.2%	257.6	66.0%
Disturbed/Degraded Forest	3505.1	33.3%	-2225	15.9%

Source: GIS satellite mapping, 2016.



	Built-up Area	Agricultural Land	High Forest Area	Water Body	Disturbed/Degraded Forest
Area (Km2) 1995	5326.6	3022.5	12732.1	739.9	10532.3
Area (Km2) 2005	6284.9	5909.6	5731	390.5	14037.4
Area (Km2) 2015	6791.2	8969.7	4132	648.1	9312.4

Source: Landsat/GIS Data, 2016

Figure 4.2: A multiple bar chart showing different land use activities for 1995, 2005 and 2015

The figure above depicts different land use activities (Bult-up area, Agricultural land, High forest area, Water body and Degraded forest) for 1995, 2005 and 2015. These clearly shows an increasing trend for built-up areas and agricultural areas, high forest area shows a decreasing trend while the water bodies and disturbed forest shows an increasing and decreasing trend.

4.2.1 Extent of land use change pattern

A cross sectional survey was conducted in order to ascertain the extent of land use change pattern in the study area using both questionnaire and interview schedules to generate information from the residents in the study area.

Table 4.3: Responds on the extent of land use change pattern

What can you say about the build-up of the locality now as compared to 10 or 20 years ago?		
	Frequency	Percent
Has not increased	63	32.1
Has increased	132	67.3
No Response	1	0.5
Total	196	100.0
What are the common economic activities now compared to 10 or 20 years ago?		
	Frequency	Percent
Business	138	70.4
Farming	51	26.0
Services	7	3.6
Total	196	100.0
Has there been a noticeable change in these activities?		
	Frequency	Percent
No Response	18	9.2
Yes	178	90.8
Total	196	100.0
If yes, what would have brought about these changes?		
	Frequency	Percent
No Response	1	.5
Increase in population	2	1.0
Urbanization	142	72.4
Both	51	26.0
Total	196	100.0
How would you consider these changes?		
	Frequency	Percent
No Response	37	18.9
Positive	159	81.1
Total	196	100.0
Can you attribute the development above to population increase in the metropolis?		
	Frequency	Percent
No Response	8	4.1
Yes	188	95.9
Total	196	100.0
Has the land use pattern in your locality changed?		
	Frequency	Percent
Yes	196	100.0
No	0	0.0
Total	196	100.0

Table 4.3 Cont'd…

What kind of change do you notice?		
	Frequency	Percent
No Response	4	2.0
More buildings	3	1.5
More agricultural activities	2	1.0
Both	187	95.4
Total	196	100.0

Source: Field survey, 2017

Table 4.4 gives a summary of respondent's perception using frequencies and percentages. From the table, 67.3% of respondents agreed that built-up areas have increased in the locality now as compared to 20 years back and 32.1% believed that the locality did not witness any changes in the built-up areas. Also, about 90.8% of the respondents agreed that indeed there is a change in economic activities of people in that locality with 72.4% of the respondents attributing the fact that urbanization is what causes the changes while 81.1% believed that these changes are positive. All the respondents (i.e 100%) agreed that the land use change pattern in the localities have changed. This is because 95.9% of the respondents attributed the change to population increase of the metropolitan city of Kaduna while 95.4% of the respondents notice a change of both more buildings and more agricultural activities from the people in the locality.

These clearly shows that responses from the respondents conform to the satellite imagery result which shows a continuous expansion of Kaduna city into the study area and the extent of such expansion. Evident also shows that there is a great increase in built-up structures (residential homes, roads, infrastructures etc.).

However, according to one of the community heads:

> *"Some decades ago, there were few houses in this area, but now there are more houses that you hardly count, most of which were farmlands before, but were now turned into houses and schools"*

Another elder observes that:

> *"There is improvement/development in the area which led government occupying our farmlands because part of Kaduna is dominating here"*

Another one said:

> *"The areas of Trade fare complex up to Kawo were farmlands before, but now it has been transformed to built-up structures"*

4.3 Factors affecting Agricultural land use pattern

In order to examine the factors that affect agricultural land use pattern in the study area, responses from the respondents are therefore shown in Table 4.5 where factors such as available market, land ownership, price of food, price of land, shortage of land, distance to farmlands, closeness of farmlands to the city and high demand for produce were analyzed.

Table 4.4: Factors affecting Agricultural land use pattern

1	**Available market**	
	Frequency	Percentage
Accept	126	64.3
Not Accept	70	35.7
Total	196	100
2	**Land ownership**	
	Frequency	Percentage
Accept	169	86.2
Not Accept	27	13.8
Total	196	100
3	**Price of food**	
	Frequency	Percentage
Accept	22	11.2
Not Accept	174	88.8
Total	196	100
4	**Price of land**	
	Frequency	Percentage
Accept	21	10.7
Not Accept	175	89.3
Total	196	100
5	**Shortage of land**	
	Frequency	Percentage
Accept	182	92.9
Not Accept	14	7.1
Total	196	100
6	**Distance to farmlands**	
	Frequency	Percentage
Accept	185	94.4
Not Accept	11	5.6
Total	196	100
7	**Closeness of farmlands to the city**	
	Frequency	Percentage
Accept	4	2.0
Not Accept	192	98.0
Total	196	100
8	**High demand for a produce**	
	Frequency	Percentage
Accept	175	89.3
Not Accept	21	10.7
Total	196	100

Source: Field Survey, 2017

Availability of market is said to have influenced agricultural land use pattern in the study area as 64.3% of the respondents agreed and 35.7% did not agree to the fact that available market for their produce affect their agricultural pattern. Respondents in the study area believed that availability of market for their produce influence the type of agriculture to engage in. This can be attributed to population growth and urban expansion which makes demand for food to increase and the need for available goods market so as to meet up the demand of the teaming population.

Land ownership affects agricultural land use pattern in the study area where 86.2% agrees while 13. 8% did not agree. That is, majority of the respondents accepted the fact that land ownership is one of the factors that influence agricultural land use pattern in the localities. That is to say, those who owns land may have the liberty to determine what type of agriculture to engage in unlike those who do not own a land and may have to rent land in order to engage in agriculture.

Table 4.4 also shows that 88.8% did not agree and only 11.2% agreed that prices of food affects agricultural land use pattern in the study area. That is, most of the respondents feels that price of food does not influence their agricultural land use pattern. That is, whether the price of food increases or decreases will not affect agricultural production in the localities. This can be attributed to the fact that most agricultural production in the study area are not purely for commercial purpose but rather farmers consume some of their harvest and sell the excess in the market.

From Table 4.4, 92.9% of the respondents agrees and 7.1% did not agree that shortage of land affects agricultural land use pattern in the study area. From the responses gathered from the field, most of the respondents agreed that shortage of land greatly influence agricultural production of people in the study area. This is attributable to the fact that residents in the study area lose their agricultural lands for built-up structures (residential buildings and infrastructures) and hence will

affect their agricultural practices. Those who do not get an alternative land to farm on will remain landless or tenants on other lands which affects agricultural pattern in the locality.

Table 4.4 shows 94.4% of the respondents agrees while only 5.6% did not agree that distance to farmlands from their community affects agricultural pattern of production in the study area. That is, majority of the respondents agreed that distance to farmlands affects the agricultural pattern of people in the localities. Farmlands located far away may likely influence agricultural pattern of people in the study area. Distance to farmlands is as a result of urban expansion of Kaduna metropolis occupy lands at the fringe of the city. This makes residents to lose their farm lands and forced to find an alternative farmland that may be farther away from their homes.

Respondents do not agree that closeness of farmlands to the city influence their agricultural pattern where 98.0% did not agree and only 2.0% are on the contrary. This is in line with the factor that agrees that distance to farmlands affects agricultural pattern in the study area.

Most of the respondents agreed that demand for a produce whether high or low affects agricultural land use pattern in the study area as 89.3% of the respondents agrees and 10.7% did not agree. This is because of urbanization of Kaduna city that put the demand for food to be high. This influence agricultural pattern of production in the study area where farmers are engaged in grain food production, horticulture, orchards and livestock production so as to meet the demand of the population.

Further analysis from the interview conducted in the study area reveals that farmlands are no more close to the town as before, farming activities now tend to be more difficult because the highest distance covered to farm before was not more than half a kilometer, but now farmers have to move more than 2 kilometers in search of land to farm on which is mostly on hire basis. These reasons

affect productivity of farmers as they are unable to be fully productive which in turn affects their yields.

According to an elder interviewed in one of the communities said:

> *"We are faced with shortage of lands for farming in Rigachikun because before within less than half kilometer you will be at your farmland but now you will have to travel 2 to 3 kilometers to your farm i.e distance to farm has affected our productions as not all of us can afford the distance"*

He further added that:

> *"Farmers now hire farmlands in the neighboring villages but only few among us purchase the lands"*

Another elder from Barakallahu said:

> *"No lands to farm because farmlands have been turned into built-up areas, as such farmers have to resort to other villages for farmlands e.g Dalwa village, Kura kura Village, Kafin Gwari and Gadan gayan in order to hire land to farm on. This has seriously affected our production as we can no longer produce much as before"*

4.3.1 Estimated Regression Model on Factors Affecting Agricultural Land Use

A regression analysis was employed to quantitatively analyze the factors that affects agricultural land use in the study area based on the data generated from Landsat/GIS for the period of 20 years i.e. 1995 to 2015. Therefore, the factors considered are; Built-up areas, Forest areas, Degraded

forest and Water bodies. The estimated result is presented in table 4.5 where the dependent variable is Agricultural and use (ALU).

Table: 4.5: Estimated regression result of factors affecting Agricultural land use

Variables	***Coefficient***	***Std. Error***	***t-statistics***	***P - value***
C	-0.01066	0.002241	-4.75751	0.0003
DLOG(BUILT,2)	6.058151	2.467083	2.455593	0.0277
DLOG(DEGFOR,2)	-3.7441	0.74603	-5.0187	0.0002
DLOG(FORES,2)	-0.0102	0.118207	-0.0863	0.9325
DLOG(WATR,2)	-1.11293	0.381292	-2.91885	0.0112
$R^2 = 0.897976$				
F-stat (P.value) = 30.81(0.00001)				

Source: *E-views Output, 2017*

The result of the estimation from table 4.5 shows the F-stat (30.81) with a p-value (0.00001) at 5% significant level which is less than 0.05 and indicates that the model is statistically significant where we conclude that the overall model provides a better fit than the intercept-only model. Also, the R squared value of 0.897976 means that the model explains about 89% of the variability in the response and hence the model fits the data. However, the coefficients becomes elasticity and in addition the use of rate of change because the variables have been differenced.

The regression result in table 4.5 shows the percentage changes in the rate of growth of the independent variables (Built-Up areas, Degraded forest, Forest area and Water body) influencing/affecting the dependent variable (Agricultural land use) in the study area. Therefore, built-up areas, degraded forest and water body were statistically significant and forest area was not significant at 5%.

From Table 4.5, a 1% change in the rate of growth of built up areas increased agricultural land use by 6.1%. This shows a positive and significant relationship because of the increase in population which result to increase demand for farmland and agricultural produce (e.g. vegetables, fruits, livestock etc.) that are highly profitable in the study area. That is, urban expansion into the study area paves way for forest clearing for an increased agricultural land in order to supplement the land loss to built-up structures. Also, agricultural land use may intensifies in order to produce the need of the growing population as observation shows the presence of orchards and poultry farms around the study area. However, the apriori expectation is that increase in built-up areas supposed to have an inverse relationship with agricultural land but shows a positive relationship due to the nature of LandSat/GIS result.

Also, the regression result shows that degraded forest is negative and statistically significant in explaining its effect on agricultural land use in the study area. That is, a 1% increase in the rate of growth in degraded forest reduces agricultural land use by 3.7%. This shows that an increase in degraded land caused by natural or human factors reduces the amount of land use for agricultural purposes. This can be as a result of leaching soil, erosion and excessive use of land to the extent of soil nutrient exhaustion and lands that happens to be barren.

Water bodies from the regression result depicts that the coefficient is negative and statistically significant in determining agricultural land use. A 1% increase in the rate of growth of water bodies leads to 1.1% decrease in agricultural land use. It is assumed that increase in water bodies during rainy season will result to expansion of the river banks and thus eating up agricultural lands close to it.

Forest land area from the regression result shows a negative relationship with agricultural land and is not statistically significant at 5%. This means that despite clearing of forest land area in order to increase agricultural land use by the dwellers, this result to extinction or environmental degradation which disrupts the natural ecosystem with consequences of climate effect on the agricultural land. Although, the forest cleared may not be very suitable for farming practices.

4.4 Effect of Urban Expansion on the Livelihood of Peri-urban dwellers

To analyze the extent to which urban expansion affects the livelihood of peri-urban dwellers, a cross sectional survey was carried out on residents in the three study locations. This is to ascertain how their livelihood has been affected as a result of urban expansion of Kaduna. The information in this section starts by describing the socioeconomic characteristics of the community members who were mainly household heads as presented in table 4.6 below.

Table 4.6: Demographic information of the Respondents

Age	**Frequency**	**Percentage (%)**
25-40	31	15.8
41-55	108	55.1
56-70	47	24.0
71-85	9	4.6
No Response	1	.5
Total	**196**	**100.0**
Gender		
Male	196	100.0
Female	0.00	0.00
Total	**196**	**100.0**
Type of education		
Western	0.00	0.00
Islamic	1	.5
Both	195	99.5
Total	**196**	**100.0**
Level of Education		
Primary	16	8.2
Secondary	58	29.6
Tertiary	120	61.2
Others	2	1.0
Total	**196**	**100.0**
Occupation		
Farmer	108	55.1
Civil servant	69	35.2
Business	18	9.2
Student	1	.5
Total	**196**	**100.0**
Religion		
Islam	190	96.9
Christianity	6	3.1
Traditional	0.00	0.00
Others	0.00	0.00
Total	**196**	**100.0**
Ethnicity		
Hausa	183	93.4
Yoruba	0.00	0.00
Igbo	0.00	0.00
Others (Gwari)	13	6.6
Total	**196**	**100.0**

Source: Field Survey, 2017

The table shows that those respondents that fall between ages 41-55 are the dominant age group with 55.1% followed by 56-70 age group with 24.0%, respondents between the ages of 25-40 covers 15.8% while the aged group which is 71-85 had the least proportion of respondents with 4.6%. This implies that the middle age group (41-55) who fall within the active population are those that participated mostly in farming and non-farming activities.

The study recorded a 100% male respondents. This is because of the culture of the people in the study area in which male are the household heads and all the burden of the family is shouldered on them with women serving as housewives. Distribution of respondents' based on their level of education shows that 61.2% of the respondents attended post-secondary school with qualifications of either OND, first degree or post graduate and 2.9% of the respondents attended only secondary school while 8.2% have basic primary education. The type of education in which the respondents have is 99.5% for those who acquire both Islamic and western education. This shows that respondents in the study area are prone to education and farming activities as it implies that they engage in farming and as well as pursue western education.

Concerning occupation, 55.1% of the respondents are farmers and are the dominant, 35.2% are civil servants, 9.2% are businessmen and 0.5% happen to be student. The distribution shows that respondents who engage in farming were also civil servants, businessmen and the student coupled with their present occupation. But with these, majority are purely farmers (subsistence farmers) who earn their living on farming. On religion, the table shows that Islam is dominant in the study area with 96.9% of the respondents as only 3.1% practiced Christianity. Also, the Hausa ethnic group recorded 93.4% and Gwari 6.6% among the respondents in the study area with none respondent from Yoruba and Igbo tribes. This shows that the study area is a Hausa and Muslim dominated community.

Figure 4.3: Picture showing a plantation before and after in the study area

Source: Author's field observation, 2017

Figure 4.6 shows the presence of mango plantation in picture A and a cleared land in picture B. picture B was also a plantation as picture A but was removed in order to build an estate of residential buildings. This clearly shows that the production of the fruit will fall in the area and it will have an effect on those who directly depend on it as a source of their livelihood.

Figure 4.4: Construction of a Boarding Science Secondary School in the study area

Source: Author's field observation, 2017

Figure 4.7 shows construction underway of a Boarding Science Secondary School which is a developmental stride for the communities in the study area. This will provide easy access to a quality education for their children and also serve as an employment opportunity for the dwellers in the area. But a very large size of farmlands have to be consumed to pave way for this development which affects the farming activities of the owners and hence their livelihood.

4.4.1 Estimated Multinomial Logistic Regression Model on the Effect of Urban Expansion on Livelihood of Peri-urban dwellers.

In furtherance to the above discussion, the Multinomial Logistic Regression (MLR) was used to analyze the effect of urban expansion on the livelihood of the community dwellers in the study area. The MLR was used because of its ability to determine differential characteristics of groups

of variables through estimation of coefficients for each level of the comparison of the independent/dependent variable relationships (Petrucci 2009). The result is therefore presented in Table 4.7.

Table 4.7: Livelihood effect of Residents

	Livelihood = f(Land ownership, Sources of income, Land conversion, Displaced off from farmlands, Change in income)		
Variables		*RRR*	*Pvalue*
Strongly Negative Effect	*Land ownership*	*3.18e-07*	*0.000*
	Sources of income	*0.2216*	*0.019*
	Land conversion	*667882.7*	*0.000*
	Displaced off from farmlands	*433248.8*	*0.000*
	Change in income	*0.1822*	*0.004*
Strongly Positive Effect	***Land ownership***	***0.7843***	***0.527***
	Sources of income	***1.2845***	***0.806***
	Land conversion	***1.9237***	***0.145***
	Displaced off from farmlands	***0.9604***	***0.915***
	Change in income	*0.0056*	*0.000*
No Effect	*Base Outcome*		
Pseudo R^2	*0.5967*		
Log pseudo R^2	*-63.020796*		
Number of Observation	*196*		

Source: Output from STATA 14

Table 4.7 shows the summary result of the estimated multinomial logistics regression (MLR). The model has two options of either coefficient outcomes or Odd ratio/Relative outcome but the study utilized the Relative Risk ratio (RRR) as provided from the STATA software output. The RRR is a measure that quantifies how much risk of suffering (impact effect) of an event is present in the individual with the risk factor versus the individual without the risk factor. Therefore, ratio less

than 1 indicates a lower likelihood for the event of interest; ratios greater than 1 indicate greater likelihood for the event of interest (Petrucci 2009).

The result from table 4.7 were divided into two sections. Section one looks at the negative effect of some categorical outcomes of determinant of livelihood of people while section two looked at the positive effect with the same set of categorical outcomes as was captured by the MLR. From section one, all the variables (Land ownership, Sources of income, Land conversion, Displaced off from farmlands) were statistically significant as indicated by the p.value at 1%, 5% and 10% level of significance. Nonetheless, same could not be said of section two as only one variable was statistically significant (Change in income).

The RRR for land ownership indicates that this variable is 3.18^{-07} times less likely to have negative effect on the livelihood of people in the study area as compared to the base outcome of "no effect" which is more likely to be an effect on the livelihood of people. This is because the survey shows that a good number of the community dwellers still have ownership of land despite the fact that most of the lands have been taking over by urban expansion (appendix IV, Table A). That is to say the livelihood of those who owns land through purchase or inheritance will not be affected as compared to those who are tenants on a land because those who owns land may get compensated or sold out in order to improve their livelihood and hence ownership of land will tend to be less likely to have a negative effect on the livelihood of people base on ownership of land.

Sources of income of the people is 0.22 times less likely to have a negative effect on the livelihood of people living in the study area as compared to the base/reference outcome of "no effect" which is more likely to have an effect on the livelihood of people. That is to say farming or non farming activities as a source of income (appendix IV, Table B) does not have a negative impact on the

livelihood of people in the localities. Farmers who are still engaged in farming and those who have an alternative source of income may not have a negative effect on their livelihood as compared to those who lose their farms and finds it difficult to cope.

Land conversion variable is 667882.7 times more likely to have a negative effect on the livelihood of people living in the study area as compared to the base outcome of "no effect" which is less likely to have an effect on the livelihood of people. This means that farmlands that have been converted to built-up structures in the study area as a result of urban expansion have a great effect size on the livelihood of the people who lose their farmlands as most of them will be landless.

Displaced off from farmland variable is 433248.8 times more likely to have a negative effect on the livelihood of people in the study area as compared to the base outcome of "no effect" which is less likely to have an effect on the livelihood of people. That is people who were displaced off from their farmlands as a result of urban expansion where their lands were transformed to built-up structures were negatively affected as to those that were not affected in terms of displacement from their farmlands.

Change in income is 0.18 less likely to have a negative effect on the livelihood of people in the study area as compared to reference outcome of "no effect" which is more likely to affect the livelihood of the people.

Change in income is 0.0056 less likely to have positive effect on the livelihood of people in the study area as compared to the reference outcome of "no effect" which is more likely to have an effect on their livelihood. This is because majority of the respondents believed that urban expansion has caused a reduction in their income which can be attributed to the factors that affect agricultural land use pattern in the study area.

The pseudo R^2 statistics was used to assess model fit by determining the effect size of the model. For this analysis, pseudo R^2 statistics is 0.5967. The advantages of fitting one multinomial model over fitting several binary models are that there is one likelihood ratio χ^2 for the fit of the entire model. The log likelihood (-63.020796) can then be used in comparison of the null model. The R^2 for the linear model is interpreted as the proportion of the variation in the response that can be explained by the regressors. However, there is no clear interpretation of the Psudo-R^2 in terms of variance of the outcome in the model (Bo et al 2006).

The elders in the communities attest to the fact that in general terms, urban encroachment has affected their livelihood both positively and negatively because of the infrastructural development in the area such as access roads, health care units, schools, drainages, electricity and modern farming which have improved their livelihood. Young male adults are mostly engaged in trades such as hair-cutting, cobbling, bus or taxi driving, tailoring, vulcanizing and vehicle repair in order to earn a living and be less dependent on their parents. Farming is said to be the dominant economic activity in the study area with the production of mostly maize, rice, beans, soya bean and sorghum with maize as the dominant crop produced which makes farming major source of livelihood to the people.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study analyzed urban expansion and its effect on peri-urban agricultural land use pattern in Rigachikun ward of Igabi Local Government, Kaduna State. The study examined the extent to which urban expansion encroached into the peri-urban agricultural land use in the study area. It also determined the factors that affects agricultural land use pattern and also examined the economic effect of urban encroachment of land use on the livelihood of people in the study area.

The study integrated the use of Geographic Information System (GIS) and Cross sectional survey. The GIS survey was used to capture satellite images at an interval for the period of 1995, 2005 and 2015 while cross sectional survey uses questionnaire, interview and observations. The study area which includes Rigachikun, Unguwankaji and Barakallah of Igabi local government lies at the periphery of Kaduna metropolis.

Using a purposive sampling and simple random sampling techniques, 200 questionnaires were administered to household farmers and 5 key informant interview on elders was carried out. The analytical techniques used were descriptive statistics such as frequency tables and percentages; linear regression model was used to determine factors affecting agricultural land use and econometric multinomial logistic model was used to measure the livelihood effect of the people in the study area.

The results of the study from GIS shows that total built-up area has expanded between 1995, 2005 and 2015 which represents a significant expansion of structures such as residential, commercial,

infrastructures etc. at the detriment of agricultural land as shown by the satellite images. Also responds from the respondents conform to the satellite imagery result which shows a continuous expansion of Kaduna city into the study area and the extent of such expansion. Evidence also shows that there is a great increase in built-up structures (residential homes, roads, infrastructures etc.).

The GIS result shows that agricultural land use pattern have been affected by all these factors (built-up areas, agricultural land, high forest area, water bodies and degraded forest), in that, farmlands were transformed into built up structures and forest lands were converted into agricultural lands and degraded forest were at increase which can be attributed to urban expansion of Kaduna metropolis, increased human population and continuous high demand for land for several socio-economic purposes. Factors from the field survey such as land ownership, price of land, shortage of farmlands and distance of farmlands affects farming activities in the communities.

Different land use activities by man (built-up areas, agricultural land, high forest area, water bodies and degraded forest) captured from GIS has consequences on agricultural land use where regression analysis was used in order to establish such relationships. The threat that environmental effect pose to agricultural production does cover both crop production, livestock and the living condition of the people. Also, result from the multinomial logistic analysis and the structured interview carried out shows both positive and negative effect of urban encroachment on the livelihood of people living in the study area.

The major driving force of these land use changes is the socio-economic factor of urbanization processes such as population, economic, technological and institutional growth which have

triggered competition for space for various urban development purposes such as residential, industrial, commercial, institutional, recreation, transportation thereby increasing built-up, and decreasing agricultural land in the study area.

5.2 Conclusion

From the result of the study, we therefore conclude that urban expansion of Kaduna metropolitan city has significantly encroached into the peri-urban areas of Rigachikun, Unguwan kaji and Barakallahu thereby affecting the agricultural land use pattern and the livelihood of people living in the area. The positive effect were attributed to improvement in basic amenities and way of life of people in the communities as some change from subsistence to intensive farming so as to cater for the growing population in the urban center while the negative effect resulted to loss of farmlands, destruction of natural environment, low productivity of agricultural production and distance to farmlands which affects the well-being of the people.

5.3 Recommendations

From the findings of this study, the following recommendations were made;

i) Urban expansion of Kaduna city is an inevitable phenomenon due to continuous increase in population, as result from the GIS shows a continuous expansion and encroachment of the city into the peri-urban fringe, as such, the KADGIS need to provide a development plan strategy so as to check mate uneven development and predict possible future expansion.

ii) The government need to develop a new master plan that will cover the areas of the urban fringe because of the continuous growth and expansion of the urban center to the

suburbs. This will help to checkmate scattered and unplanned development so as to avoid environmental problems in the near future such as floods, pollution etc.

iii) Urban expansion of Kaduna metropolis into the peri-urban fringe causes loss of prime agricultural land of farmers living in the study area, therefore stakeholders in the communities should checkmate the sale of farmlands as some lands will deprive the owner a farm and will be abandoned by the new owners.

iv) Result from the study shows that high forest area is on the decrease and degraded/disturbed forest on the increase which is as a result of continuous human activities of clearing forest to increase agricultural land and excessive falling of trees for log wood or fire wood as a means of livelihood. Therefore, the government and stakeholders in the communities should regulate such activities as the adverse effect falls back on the people and the ecosystem.

v) Measures should be put in place by the government to control encroachment into farmland at the urban fringe as good agricultural land lost due to degradation by built-up structures can never be reclaimed.

vi) Factors such as land ownership, price of land, shortage of farmlands and distance to farmlands which according to the study affects agricultural land use pattern in the study area, should be reviewed by the government. These will go a long way to help revive economic activities and also improve living standard of people in the communities.

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APPENDICES

APPENDIX I: QUESTIONNAIRE

Dear Respondent,

I am **Abdulyasar Idris Baba**, an M.Sc. student of the Department of Economics, Ahmadu Bello University, Zaria, carrying out a study on **"The Analysis of Population Growth on Peri-Urban Agricultural Land Use Pattern in Igabi Local Government Area of Kaduna State"**. The questionnaire intends to acquire information that will be used to assess the above topic in your community. Your responses will help to facilitate the process and make meaningful contribution toward achieving the objective of the study. Kindly fill in the enclosed questionnaire as all information provided will be treated as confidential.

Thanks for your anticipated cooperation

SECTION A: DEMOGRAPHIC INFORMATION

Age	Gender 1=male 2=female	Household size	Type of education 1=western 2=Islamic 3=both	Level of education 1=primary 2=secondary 3=tertiary 4=others	Occupation	Religion 1=islam 2=christianity 3=traditional 4=others	Ethnicity 1=Hausa 2=Yoruba 3=Igbo 4=others

SECTION B

B1 PERSONAL INFORMATION

Duration of residence	Ownership status of land 1=purchase 2=inherited 3=tenant 4=gift	Place of residence before here	Size of land in acres

B2 GENERAL INFORMATION

1. What can you say about the built-up of this locality now as compared to 10 or 20 years ago?

(a) Has not increased ( ) (b) Has increased ( )

2. What are the common economic activities now as compared to 10 or 20 years ago?

(a) Business ( ) (b) Farming ( ) (c) Services ( )

3. Has there been a noticeable change in these activities? (a) Yes ( ) (b) No ( )

4. If yes, what would have brought about these changes?

(a) Increase in population ( ) (b) Urbanization ( ) (c) Both

5. How would you consider these changes? (a) Positive ( ) (b) Negative ( )

6. How many more estimated new residence have been constructed in your area for the past 10 or 20 years? ……..

7. Can you attribute the development above to population increase in the metropolis?

(a) Yes ( ) (b) No ( )

8. Has the land use pattern in your locality changed? (a) Yes ( ) (b) No ( )

9. What kind of change do you notice?

(a) More Buildings ( ) (b) More Agricultural activities ( ) (c) Both ( )

10. Are you aware of any public agency that are mandated to regulate how you use your land?

(a) Yes ( ) (b) No ( )

11. If yes, name the agency/agencies ……

B3 LIVELIHOOD EFFECT

1. What is the major source of income in your locality?

(a) Farming ( ) (b) Non farming ( )

2. Has your farmland being converted to residential building? (a) Yes ( ) (b) No ( )

3. If yes, how did you lose your land?

(a) Sold it ( ) (b) Government occupied it ( ) (c) Shared it among family members ( ) (d) Gave someone as a gift ( )

4. Have you subdivided your land in the past? (a) Yes ( ) (b) No ( )

5. If yes, why did you subdivided it? .....

6. Do you think some people have been displaced off their farmlands? (a) Yes ( ) (b) No ( )

7. When a farmer loses his land, what does he resort to? ……

8. What do you do during the off season period? ……..

9. Would you choose any occupation other than your current one if you have the opportunity?

(a) Yes ( ) (b) No ( )

10. If yes, which job would you prefer? ……..

11. Why do you want to change your occupation? ……..

12. If no, why do you want to maintain your current occupation? ……..

13. Do you have any other source of livelihood other than your current livelihood?

(a) Yes ( ) (b) No ( )

14. If yes, specify …….

15. Why do you resort to this alternative type of livelihood? ……

16. How has your income changed now compared to 10 or 20 years ago?

(a) Increased ( ) (b) Decreased ( ) (c) Remained the same ( )

17. How would you assess the effect of Kaduna metropolitan growth on your livelihood?

(a) Strong negative effect ( ) (b) Strong positive effect ( ) (c) No effect

18. How is the growth of Kaduna metropolis affecting the development of the community? ……

B4 AGRICULTURAL LAND USE CHANGE PATTERN

1. Has agricultural land use pattern changed now compared to 10 or 20 years ago?

(a) Yes ( ) (b) No ( )

2. If yes, what is therefore the extent of change of these agricultural activities?

Agricultural Activities	**Rate of agricultural activities. *In %**	**Size of plots used**	**Number of plots**
Crop farming			
Horticulture			
Livestock farming			

3. What type of agricultural activity are you engaged in?

(a) Crop farming ( ) (b) Horticulture ( ) (c) Livestock faming ( )

4. Has the type of crop/vegetable/animal grown changed? (a) Yes ( ) (b) No ( )

5. Why do farmers change the type of crop/vegetable/livestock grown? (**Tick all that apply**)

(a) Population increase ( ) (b) Available market ( ) (c) Land ownership ( ) (d) Price of produce ( ) (e) Consumption (f) Shortage of land ( ) (g) Distance of farmland ( ) (h) Others specify…….

6. What do you do with the crop/vegetable/livestock produced?

(a) Consume all ( ) (b) Sell all ( ) (c) Consume some and sell some

7. Has your mode of farming changed in recent years? (a) Yes ( ) (b) No ( )

8. If yes, what motivate you to change the mode of your farming now? ……

9. If no, what motivate you to maintain the mode of your farming now? ……

10. Which of these factors influence agricultural pattern in your locality? (**Tick all that apply**)

(a) Available market ( ) (b) land ownership ( )

(c) price of food ( ) (d) price of land ( )

(e) shortage of land ( ) (f) distance of farmlands ( )

(g) closeness of farmlands to the city ( ) (h) high demand of a produce ( )

(i) Others specify…….

11. When did you start witnessing changes in agricultural activities?

(a) 1 year ago ( ) (b) 5 years ago ( ) (c)10 years ago ( ) (d) No change ( )

12. What is the main reason for practicing agriculture? (a) Food supply ( ) (b) Income ( ) Both( )

13. Do you face problems/challenges in your practice of farming? (a) Yes ( ) (b) No ( )

14, If yes, what challenges do you face as a farmer in your area? (**Tick all that apply**)

(a) Low rainfall ( ) (b) Lack of enough land ( )

(c) Cost of inputs ( ) (d) Theft of crops ( )

(e) Lack of market ( ) (f) Distance of farmlands ( )

(g) High price of land rent ( ) (h) Storage problem ( )

(i) Transport problem ( ) (j) Loss of land ( ) (k) Others specify……

15. What are you doing to remedy this problems? .....

APPENDIX II: MULTIPLE REGRESSION RESULT

Dependent Variable: DLOG(AGRI,2)

Method: Least Squares

Date: 10/27/17 Time: 11:13

Sample (adjusted): 1997 2015

Included observations: 19 after adjustments

White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.010660	0.002241	-4.757509	0.0003
DLOG(BUILT,2)	6.058151	2.467083	2.455593	0.0277
DLOG(DEGFOR,2)	-3.744099	0.746030	-5.018696	0.0002
DLOG(FORES,2)	-0.010201	0.118207	-0.086297	0.9325
DLOG(WATR,2)	-1.112934	0.381292	-2.918847	0.0112

R-squared	0.897976	Mean dependent var	-0.002975
Adjusted R-squared	0.868827	S.D. dependent var	0.001998
S.E. of regression	0.000724	Akaike info criterion	-11.40324
Sum squared resid	7.33E-06	Schwarz criterion	-11.15470
Log likelihood	113.3308	Hannan-Quinn criter.	-11.36118
F-statistic	30.80575	Durbin-Watson stat	0.537292
Prob(F-statistic)	0.000001	Wald F-statistic	132.6356
Prob(Wald F-statistic)	0.000000		

APPENDIX III: MULTINOMIAL LOGISTIC REGRESSION RESULT

```
. mlogit Var40 Ownshp_of_land Var24 Var25 Var39 Var29, vce(robust) rrr

Iteration 0:   log pseudolikelihood =  -156.2574
Iteration 1:   log pseudolikelihood = -88.679784
Iteration 2:   log pseudolikelihood = -64.843286
Iteration 3:   log pseudolikelihood = -63.313326
Iteration 4:   log pseudolikelihood = -63.089214
Iteration 5:   log pseudolikelihood = -63.037489
Iteration 6:   log pseudolikelihood = -63.024633
Iteration 7:   log pseudolikelihood = -63.021668
Iteration 8:   log pseudolikelihood = -63.020971
Iteration 9:   log pseudolikelihood = -63.020822
Iteration 10:  log pseudolikelihood = -63.020798
Iteration 11:  log pseudolikelihood = -63.020796

Multinomial logistic regression                 Number of obs     =        196
                                                Wald chi2(13)     =          .
                                                Prob > chi2       =          .
Log pseudolikelihood = -63.020796               Pseudo R2         =     0.5967
```

Var40	RRR	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
No_Response						
Ownshp_of_~d	.2407932	.1282952	-2.67	0.008	.0847466	.6841737
Var24	.8441558	1.255714	-0.11	0.909	.0457328	15.58178
Var25	3.938482	3.422399	1.58	0.115	.7172415	21.62681
Var39	.0026638	.0075887	-2.08	0.037	.00001	.7086903
Var29	.23509	.1574096	-2.16	0.031	.063284	.8733222
_cons	6836.665	34679.65	1.74	0.082	.3288834	1.42e+08
Strong_neg~t						
Ownshp_of_~d	3.18e-07	3.28e-07	-14.52	0.000	4.22e-08	2.40e-06
Var24	.221641	.142603	-2.34	0.019	.0628044	.7821859
Var25	667882.7	757890.9	11.82	0.000	72241.24	6174690
Var39	.1822109	.1072122	-2.89	0.004	.0575083	.5773222
Var29	433248.8	557715.4	10.08	0.000	34753.39	5401043
_cons	.0001038	.0002134	-4.46	0.000	1.85e-06	.0058338
Strong_pos~t						
Ownshp_of_~d	.7843581	.3012604	-0.63	0.527	.3694711	1.665131
Var24	1.284543	1.312776	0.25	0.806	.173316	9.520473
Var25	1.923713	.863005	1.46	0.145	.7985076	4.634484
Var39	.0056263	.0054289	-5.37	0.000	.000849	.0372868
Var29	.9603802	.3638459	-0.11	0.915	.4570464	2.018023
_cons	1686.695	3497.174	3.58	0.000	28.98445	98154.01
No_effect	(base outcome)					

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```

APPENDIX IV: FREQUENCY TABLES

Table a: Ownership Status of Land

	Frequency	Percentage
Purchase	38	19.4
Inherited	83	42.3
Tenant	75	38.3
Total	196	100.0

Table b: Major Source of Income in the Locality

	Frequency	Percentage
No Response	1	.5
Farming	58	29.6
Non farming	137	69.9
Total	196	100.0