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DEPARTMENT OF CIVIL ENGINEERING

OPTION OF LAND SURVEYING

**ASSESSING THE IMPACT OF URBAN EXPANSION ON
AGRICULTURE LAND IN RWANDA.**

CASE STUDY: RUBAVU DISTRICT (2014 -2024)

*Submitted in partial fulfillment of the requirements for the Award of advanced diploma in
land surveying.*

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Under the guidance of:

Eng. Bonaventure NKIRANUYE

Kigali, September 2024

DECLARATION

I do hereby declare that the work presented in this dissertation is my own contribution to the best of my knowledge. The same work has never been submitted to any other University or Institution. I, therefore declare that this work is my own for the partial fulfillment of the award of advanced diploma in Land Surveying at ULK Polytechnic Institute.

The name of candidate: KABWANA Jean Damour.....

Signature of the candidate:.....

Date of submission:.....

CERTIFICATION

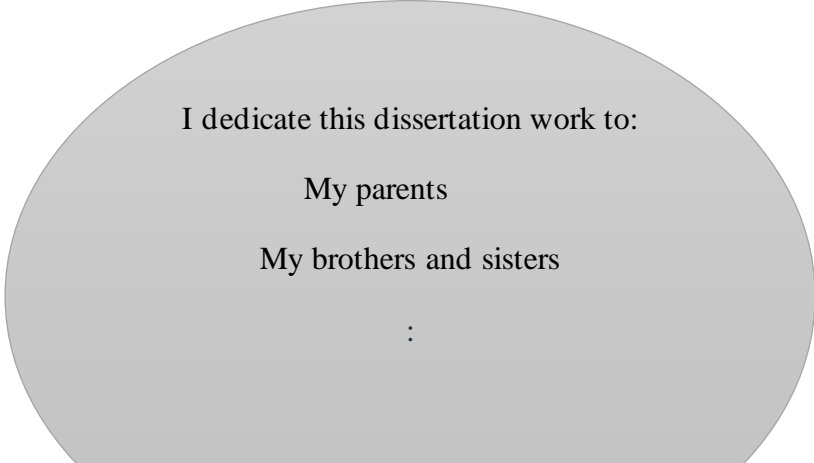
This is to certify this dissertation work entitled “**assessing the impact of urban expansion on agriculture in Rwanda. Case study: Rubavu district (2014-2024)**” is an original student conducted by KABWANA Jean Damour under my supervision and guidance.

Supervisor’s name **Eng. Bonaventure NKIRANUYE**.....

Signature of the supervisor.....

Submission date.....

DEDICATION



I dedicate this dissertation work to:

My parents

My brothers and sisters

:

ACKNOWLEDGMENT

This Thesis has benefited greatly from substantial inputs, guidance and comments from many people and institutions.

First of all, I would like to thank to the Almighty God for giving the wisdom and granting me resources whether financial and non-financial that has made a great contribution to this research project and my education in general.

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We wish to express our sincere thanks to the authorities of ULK Polytechnic Institute, in particular the Department of Civil Engineering, land surveying option, for their support in terms of knowledge that led to the success of the university struggle.

Thanks also to our all classmates and friends for their moral support and invaluable prayers.

May God bless you all!!!

KABWANA Jean Damour

ABSTRACT

The urban expansion processes put pressure on farmers, making agriculture activities harder through reduced agricultural land. The general objective of this study was to assess the impact of urban expansion on agriculture activities in Rwanda specifically in Rubavu district (2014-2024). Specific objectives were to identify the major factors driving urbanization and loss of agricultural activities in Rubavu district between 2014 and 2024, to assess the level to which agricultural activities have been changed between 2014 and 2024 and to determine how urbanization is impacting agricultural activities in Rubavu district between 2014 and 2024. In this study, the application of Geo-spatial technology was identified and used as a vital tool to evaluate how agriculture activities changed due to urbanization using ERDAS and ArcGIS software. This study was focused to assess the impact of urban expansion on agricultural land in Rubavu district (2014-2024). During our assessment the image classification and accuracy assessment was done by analyzing three classes such as residential, forest and agriculture. The results showed that the urban expansion is not only

y changed depend on the period of time but also the agricultural activities decrease when urban expansion come. The assessment identifies that the urban expansion affecting the agricultural land area as period of time increasingly and if these expansions are not well managed and controlled, the large area of Rubavudistrict will be occupied by infrastructure that will highly reduce the quantities of production that will be obtained from agricultural land. The results also showed that they are big quantities of agricultural land that lost within 11 years and with this loss the agricultural activities in Rubavudistrict as the urbanization increasing the land for cultivation also reduced. Therefore, Policies and programmers required for development planning. Decrease area under agricultural land might directly or indirectly caused degradation of environment. The major findings of the image analysis revealed that area under residential land have been increasing significantly in the border area of Rubavudistrict. Due to increasing population pressure in Rubavudistrict area is already becoming congested this lead to decrease agricultural land use. This study was not only subjected to the data constraints which is a serious problem in accomplishing this project but low knowledge in statistical method also take influence.

Keywords: residential land use area increased at high level that has resulted in urban growth from 2014 to 2024. This scenario causes the decreasing in agriculture land use area from 2014 to 2024. As clearly seen on the map, the urban expansion will play a great impact on change of agricultural activities in 2033 compared to 11 last year.

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LISTOFACRONYMSANDABBREVIATIONS

AGL	:AustralianGasLightCompany.
AHP	:AnalyticHierarchyProcess.
AWEA	:AmericanWindEnergyAssociation.
DEM	:DigitalElevationModel.
ERDAS	:EarthResourcesDataAnalysisSystem.
GCPS	:Groundcontrolpoints.
GIS	:GeographicalInformationSystem.
IDW	:InverseDistanceWeighted.
LPG	:liquefiedpetroleumgas.
LU/LC	:LandUseLandCover.
MCA	:Multi-criteriaanalysis.
MCDA	:Multicriteriadecisionanalysisstructure.
MCE	:multi-criteriaevaluation
MW	:Megawatt.
RGB	:RedGreenBlue.
SMCA	:Spatialmulti-criteriaanalysis.
UNDP	:UnitedNationsDevelopmentProgramme.

CHAPTER 1. GENERAL INTRODUCTION

1.0. Introduction of the study

This chapter highlights the background of the study, problem statement, purpose of the study, objective of the study, research questions/hypothesis, scope of the study, significance of the study, research methodology and organisation of the research.

1.1. Background of the study

Urban expansion is an expected tendency in the development of human and it has been recognized as one of the crucial elements of advancement achieved in science and technology. Accordingly, more than half of the world's human population now lives in urban areas, than in rural areas confirming that the world has now entered the urban society age (Patra et al., 2018). Urban expansion is the principal mechanism by which cities accommodate their population growth (Angel, 2015). Agricultural activities mean those activities performed on farmland in order to cultivate the soil, produce crops, or raise livestock. The urban expansion process puts pressure on farmers, making farming activities harder through reduced agricultural land (Nsanzimfura, 2020).

The movement of people from rural to urban areas in search of better livelihood can lead to the expansion of urban areas and an increase in social and economic activities (Thuo, 2013). Agricultural production is a series of activities that result in a product that will ultimately be sold at retail. The four categories are foods, fuels, fibres, and raw materials. Crops and animal products are used for food, animal feed, and non-food products used by human (Growth, 1991). There are major concerns over the continuing farmland loss due to urban expansion. First, the diversion of the most fertile agricultural land to urban development decreases agricultural productivity, thus decreasing short-term food supplies and endangering food production in the long term (WIJITKOSUM & Sriburi, 2008).

In China for example, urban expansion is likely to strongly affect two important aspects of agriculture production and food security: the aggregate availability of domestically agriculture based produced food, and the access of individuals and households to food (Zhong et al., 2020). Most urban households rely on food purchases; therefore, low-income households that spend a large share of their incomes on food can be vulnerable to increases in the

availability and prices of staple foods. As China becomes more urbanized, it is likely that it will become more dependent over time on imports of agriculture products (Leju et al., 2019).

Malaysia's urban population has been increasing at an average annual rate of 4%, now accounting for 75% of the total population, with a national population density of 94.21 people/km². This is mainly caused by rural-urban migration activities along with high intensity of industrial development in the West coast of Peninsular Malaysia. The agriculture industry in Malaysia relies heavily on the farming sector and its cash crops, palm oil and rubber. These crops are grown mainly for their commercial value to be exported all over the world. The value of Malaysia's agricultural exports increased by more than 30 percent in 2021, with palm oil and palm-based products as its major export commodities (Patra et al., 2018). Urban expansion affects agriculture activities in Malaysia because most land of agriculture are likely converted to build up so as to adjust to increasing land demand (Rosly & Rashid, 2013).

The general characteristics of rapid urban expansion experienced by most east African countries, such as Rwanda and Uganda, is growing in both population and in land cover, these present a problem to the integrity of land use and land cover change (Ndereye et al., 2016). Growth in urban population goes with no equivalent growth in land supply and land is fixed in supply and does not increase with increasing population growth (ibid). The pressure exerted by increase in population and rapid urbanization prevents other sectors of the needed land. Agricultural lands are the most affected by rapid urban expansion and its functions of demand. Land uses for residential, industry and commercial, civic and culture tend to dominate agricultural lands in the bid for space in the urban place. This dominance tends to deprive farmers of arable land to cultivate thereby reducing agricultural productivity (Leju et al., 2019).

In Kenya, urban expansion is changing the face of poverty. Nairobi's population is set to nearly double to almost six million by 2025, and 60% of residents live in slums with no or limited access to even the most basic services such as clean water, sanitation, housing, education and healthcare (Mandere et al., 2018). In Kenya, agriculture activities revolve into growing of most of the corn and also produce potatoes, bananas, beans, peas and chillies (Njora & Yilmaz, 2022). Urban expansion in Kenya results in farm size reduction, eviction of farming households from their main source of income generation and conversion of farmland to build up (Acosta & Strecker, 2015).

Another case is the case where in Nigeria, the population of Makurdi city has grown more than double in twenty years and it is projected to further double that increase in thirty years (Bloch et al., 2015). Therefore, agriculture competes for land with other urban land uses, which generate higher economic rents. If this growth in population continues unchecked, agricultural land as well as agriculture productivity will decrease significantly in the future in this area (Potts, 2018). It has been established that urban expansion has significant effects on agricultural land in the area and these effects include decreasing agricultural land, decreasing agricultural activities and a decrease in farm size (Ohwo & Abotutu, 2015). Less number of people are into agriculture in Nigeria and large expanse of land in rural areas are left uncultivated (Brown., 2012). The price of all types of food are very high, which makes it difficult for many poor in the society to afford the three meals a day (Satterthwaite et al., 2010).

Rwanda is one of the most populated countries in Africa. It has registered an annual population growth rate of 2.3% over the last 10 years, reaching 13,246,394 in August 2022 and is projected to be 23.6 million by 2052. The nation is experiencing a steady period of growth, in terms of both population and economic development (MUHIZI, 2019). Rwanda is one of the countries which are facing the problem of agricultural land reduction due to its high population density and rapid urban expansion. This leads to the reduction of agricultural production in some parts of the country where agricultural areas are experiencing a rapid urban expansion (Bolca, Turkyilmaz and Kurucu, 2007).

The country's natural resources and in particular arable land are not increasing. There is higher movement of people moving from rural areas to urban areas, in hope of finding better job opportunities in industries and affordable land for residential use this rapid urbanization becomes a threat to agriculture production in Rwanda (Samal & Pradhan, 2019). In Rwanda, over 70% of the population engaged in agriculture sector, and around 72% of the working population employed in agriculture. Depriving the sector of land brings an increase in the unemployment rate. In the urban areas, the cumulative effect of succession and dominance factors has made land increasingly insufficient for career-urban farmers (Iheke, 2017).

Rapid urban expansion in Rwanda has adversely affected development efforts in many cities. Changes in land uses subsequently lead to decreased agricultural land in favor of the provision of residential accommodation in most urban settlements. This is reflected in the form of dormitory and satellite towns that are being developed in the urban limit which were agricultural land in the urban setting (Iheke, 2017). A major pr

problem of rapid urban growth is changing land use patterns. In addition, the twin pressures of urban expansion and a fast growing population have great impact on agricultural land reduction in Rubavu district. This leads to the unavailability of prime agricultural lands, consequently this causes low agricultural land, low agricultural productivity, low standard of living and food insecurity (Nsanzimfura, 2020).

Therefore, Rubavu district, continues to feel pressure from excessive difficulties of competing land with other urban land uses which generate higher income to government when trying to avoid food insecurity which could result from less agriculture farming activities.

1.2. Problem statement

Rwanda has witnessed the unplanned growth in urbanization industry mainly due to the lack of formal land administration and management in last decades (Gatwaza, 2016). In many developing countries, rapid rates of urban expansion have resulted in unplanned and unregulated growth (Ahmed, 2011). In Rubavu district as one of the secondary cities, there is rapid urban expansion driven by people moving from Kigali and other places to Rubavu district where they can build big, good and affordable houses and get a good life. This urban expansion is affecting the agriculture activities. The insufficiency of agriculture land is mainly caused by conversion of agriculture land to residential or built-up land and other urban land uses in Rubavu district.

Different studies Gakuru & Uwiringiyimana (2012); World Bank, (2015) showed that the implementation of the urbanization program and agriculture productivity in Rwanda have been carried out, but there is a gap in their outcomes due to the fact that they did not show the impact of urban expansion on agriculture land. Thus, this study is conducted as the way of assessing the impact of urban expansion on agriculture activities in Rubavu district.

1.3. Purpose of the study

The purpose of this study is to conduct a research on assessing the impact of urban expansion on agriculture land. Case study of Rubavu district (2014-2024). In addition, this study is carried out in partial fulfillment of the requirements for the award of advanced diploma in land surveying.

1.4. Objective of the Study

1.4.1. Main objective

This research intends to assess the impact of urban expansion on agriculture land in Rwanda (2014-2024).

1.4.2. Specific objectives

This project's specific objectives were as follows:

- a) To identify the major factors contributing to the urban expansion and loss of agricultural activities in Rubavu district from 2014 to 2024
- b) To assess the level to which agricultural activities have been changed between 2014 and 2024
- c) To determine how urban expansion is impacting agricultural land in Rubavu district between 2014 and 2024

1.5. Research questions

Based on the project's serviceability and functionality, answers to the following research questions will be offered in order to fulfil the above particular objectives.

- a) What are the major factors contributing to the urban expansion and loss of agricultural activities in Rubavu district between 2014 and 2024?
- b) What is the level to which agricultural activities have been changed between 2014 and 2024?
- c) How is urban expansion affecting agricultural land in Rubavu district between 2014 and 2024?

1.6. Research hypotheses

Urban expansion has negatively affected agriculture activities in Rubavu district. The urban expansion in this district has caused many harm to agriculture activities due to the fact that the big part of agriculture land has been converted to residential land. This resulted in less agriculture activities productivity.

1.7. Scope and limitation of the study

This study will be delimited in terms of space, time, content and domain. In terms of space, this study will be delimited in Rubavud district. In terms of content, this study will be delimited in assessing the impact of urban expansion on agriculture activities. In terms of time, this study will be carried out in a period from 2014 to 2024. In terms of domain, this study will be delimited in the domain of land surveying.

1.8. Significance of the study

This research will help the researcher to get some information about the impact of urban expansion on agriculture activities in Rubavud district. This study will help the researcher as a land surveyor to get an advanced diploma certificate in land surveying. Further, researchers will use the results of the present research in the conduction of related studies in the domain of urban expansion and agriculture activities. This study will help the institution to gain another reference book in land surveying for future students doing final year dissertation in the same domain.

1.9. Organization of the study

This work consists of five chapters, where chapter one will be the general introduction, which comprises a brief detail of all above-mentioned points from the background to the research that researchers will use in the study. This chapter comprises the introduction of the study, background of the study, problem statement, purpose of the study, the objectives of the study, research questions, scope of the study, significance of the study and the organization of the study.

The second chapter will be the literature review, which will be about the general understanding of the reviews of other researchers with the related studies.

The third chapter will be the research methodology and it will focus on the methods and materials which will be used to achieve the objectives of the study.

The fourth chapter will be the results and discussions and it will be the most important one because it will show the presentation of the results acquired.

The fifth one, which will be the last chapter, will cover the conclusion and recommendations with respect to the predefined objectives.

CHAPTER 2. LITERATURE REVIEW

2.0. Introduction

This section of the study explains the definitions of the key terms and included the theoretical frameworks related to this research.

2.1. Definition of key concepts

The definition of the key concepts of this research projects included: Urban, urban expansion and agriculture land. The usefulness of defining those key concepts was enable the user to understand clearly the content of this research projects.

2.1.1. Urban

Urban means belonging to, or relating to, a town or city. Urban is a name with Latin roots, and it means "city-dweller." It's probably known more for the surname of country-rock singer Keith Urban, but it sounds just as great as a first name. Parents may hope someday that baby Urban follows the dream of making it big in a city they love. Urban means "related to a city". In that sense, the term may refer to an urban area, a geographical area distinct from rural areas. Urban culture, the culture of towns and cities. Nsanzimfura, T., & Nyandwi, S.

2.1.2. Urban area

An urban area includes the city itself, as well as the surrounding areas. An urban area is the region surrounding a city. Most inhabitants of urban areas have non-agricultural jobs. Urban areas are very developed, meaning there is a density of human structures, such as houses, commercial buildings, roads, bridges, and railways. "Urban area" can refer to towns, cities, and suburbs. An urban area includes the city itself, as well as the surrounding areas. Many urban areas are called metropolitan areas, or "greater," as in Greater New York or Greater London. Mortoja, M.G., & Yigitcilar, T.

An urban area, built-up area or urban agglomeration is a human settlement with a high population density and an infrastructure of built environment. Urban areas are in cities and towns. An urban area is often the main area of employment. Urban areas have the most human-built structures. This built environment creates opportunities for health such as sidewalks and public transit.

2.1.3. Urban expansion

Urban expansion is a consequence of urban population growth because urban settlements consume land. Urban expansion is defined simply as the physical extension of the geographical footprint of towns, cities, and metropolitan areas into the surrounding countryside, encompassing surrounding villages and towns in the process. Urban sprawl is defined as "the spreading of urban development on undeveloped land near

amoreorlessdenselypopulatedcity"(Zhang,2018).Urbanexpansionisdefinedsimplyasthephysicalex-
tensionofthegeographicalfootprintsoftowns,cities,andmetropolitanareasintothesurroundingcountr-
yside,encompassingsurroundingvillagesandtownsintheprocess.Urban expansioningeographicpac-
eisoftenill-
definedanditsmeasurementandprojectionintothe futurearecontroversial.Urbangrowthisanincrease
intheurbanizedlandcover.Onepossiblemeansofurbangrowthisbyurbanextension(Poelmans&VanR-
ompaey,2010).

2.1.4. Agricultureland

Agriculturallandisdefinedasthelandareathatiseitherarable,underpermanentcrops,orunderpermanen-
tpastures.Agriculturallandistypicallylanddevotedtoagriculture,thesystematicandcontrolleduseof
therformsoflifeparticularlytherearingoflivestockandproductionofcropstoproducefoodforhumans.It
isgenerallysynonymouswithbothfarmlandorcropland,aswellaspastureorangeland.Agriculturallan-
dreferstotheshareoflandareathatarable,underpermanentcrops,andunderpermanentpasturesFarah,
N.,Khan,I.

Agriculturallandisdefinedasthelandareathatiseitherarable,underpermanentcrops,orunderpermanen-
tpastures.Arablelandincludeslandundertemporarycropssuchascereals,temporarymeadowsformowi-
ngorforpasture,landundermarketorkitchengardens,andlandtemporarilyfallow.Landabandonedasa-
resultofshiftingcultivationisexcluded.Landunderpermanentcropsiscultivatedwithcropsthatoccupy
helandforlongperiodsandneednotbereplantedaftereachharvest,suchasorchardsandvineyards.This
ategoryexcludeslandundertreesgrownforwoodortimber.Permanentpastureislandusedforfiveormor-
eyearsforforage,includingnaturalandcultivatedcrops.Additionalagro-
environmentalindicatorsincludeorganicfarmlandandtransgeniccropland.Thisindicatorispresenteda-
satotalandpertypeofagriculturallandandismeasuredinhectaresandinpercentageFarah,N.,Khan,I.

2.1.5. Agricultureactivities

Agriculturalactivitiesaredefinedasincome-
producingactivitiesorusesatarecharacterizedbythecropcultivation,notallofwhicharerestrictedtofl-
oral,fruitsandveggies,vegetation,graze,andwood;andfarmingorraisinglivestockactivitiesorusesata-

are connected to livestock farming, fish farming. Agricultural activities means the process of producing crops and/or raising or keeping livestock, which includes operation and maintenance of ponds, ditches, irrigation systems and then normal operation, maintenance and repair of existing structures or facilities, and practicing aquaculture. Agricultural activities encompass all human actions related to cultivating crops, raising livestock, and producing food, fibre, and other agricultural products (Rosell & Sanz, 2012).

2.2. Driving factors of urban expansion and loss of agricultural activities in Rwanda

Urban expansion in Rwanda, like in many other developing countries, is influenced by a combination of socio-economic, demographic, and policy-related factors. The loss of agricultural activities in these areas is a significant consequence of this expansion. Here are the main driving factors (Nsanjira & Nyandwi, 2020):

2.2.1. Population Growth and Urbanization

Rapid growth and urbanization are driving factors of urban expansion. Rapid Population Growth: Rwanda has a high population growth rate, which increases the demand for housing and services in urban areas (Uwimbabazi & Lawrence, 2017). Urbanization: As people move from rural areas to cities in search of better economic opportunities, there is a need for expanded urban infrastructure, leading to the development of peri-urban areas (Nduwayezu et al., 2021).

2.2.2. Economic Development

Economic Transformation: Rwanda's economic policies aim at transforming the economy from agriculture-based to more industrial and service-oriented sectors. This transformation requires more urban infrastructure and spaces (Sebikaba et al., 2020). Investment in infrastructure: significant investments in roads, utilities, and other infrastructure attract businesses and residential development in urban areas (Mugisha & Nyandwi, 2015).

2.2.3. Land Policies and Regulations

Land Tenure System: Changes in land tenure and ownership policies can incentivize the sale and conversion of agricultural land for urban development (Jaganyi et al., 2018). Land Use Planning: Inadequate or out

dated land use planning can lead to unregulated expansion of urban areas into agricultural zones (Nzakamwita & Tuyishime, 2022).

2.2.4. Socio-Economic Factors

Rural Poverty: High levels of poverty in rural areas push people to migrate to urban zones where they perceive better employment opportunities (Modeste et al., 2018). **Income Diversification:** Farmers seek to diversify their income sources by selling land for urban development, leading to the conversion of agricultural land (Nyabyenda et al., 2020).

2.2.5. Infrastructure Development

Transport Networks: Improved transportation links between cities and urban areas make these areas attractive for residential and commercial development (Kimta et al., 2023). **Public Services:** Access to better public services such as healthcare, education, and utilities in urban areas draws people from rural regions (Nahayo et al., 2016).

2.2.6. Environmental and climate factors

Land degradation: poor soil quality and land degradation in some rural areas can make agricultural activities less viable, prompting a shift to urban land uses (Uwimbabazi & Lawrence, 2017). **Climate change:** variability in climate conditions affects agricultural productivity, making urban livelihoods more attractive (Simon, 2018).

2.2.7. Government Policies and Programs

Vision 2020 and Vision 2050: Rwanda's strategic development plan emphasizes urbanization as a pathway to economic growth (Mugish & Nyandwi, 2015). **Decentralization Policies:** Efforts to decentralize economic activities and administrative functions to secondary cities contribute to urban expansion (Jaganyie et al., 2018).

2.3. Level to which agricultural activities have been changed between 2014 and 2024

Rwanda is one of the most populated countries in Africa. The nation is experiencing a steady period of growth, in terms of both population and economic development (MUHIZI, 2019). The country's natural resources and in particular arable land are not increasing. There is higher movement of people moving from rural areas to urban areas, in hope of finding better job opportunities in industries and affordable land for residential use. This rapid urbanization becomes a threat to agriculture production in Rwanda. Therefore, Rubavu District, continues to feel pain from excessive difficulties of competing land with other urban land uses which generate higher income to government when trying to avoid food insecurity which could result from less agriculture harvest.

In Rwanda, the development of cities is very recent and the urbanization rate currently stands at around 17.72%. Still, the share reached its highest value in the observed period in 2022 (Nduwayezu et al., 2021). Rwanda is one of the most populated countries in Africa. The nation is experiencing a steady period of growth, in terms of both population and economic development (Nsanzimfura & Nyandwi, 2020). The country's natural resources and in particular arable land are not increasing.

Urbanization as a form of urbanization gradually incorporates urban zones into the city (Nyabyenda et al., 2020). In Rwanda, Kigali City outward expansion is a major concern for future land use as it accelerates depletion of land for other uses (Nzakamwita & Tuyishime, 2022). This urban expansion puts pressure on agriculture activities through increasing land demand which causes reduction of land for agricultural activities. This poses a threat to future food security (Nahayo et al., 2016).

2.4. Influences of urban expansion on agriculture land

Urban expansion in Rwanda has profound influences on agricultural land, including the reduction of agricultural land, changes in farming practices, environmental impacts, and economic and social consequences (Mihigo & John, 2022).

2.4.1.ReductioninAgriculturalLand

2.4.1.1.LandConversion

UrbanDevelopment:Asurbanareasesexpand,agriculturallandisconvertedintoresidential,commercial, andindustrialzones.Thisreducestheoverallareaavailableforfarming(Nahayoetal.,2016).

InfrastructureProjects:Theconstructionofroads,utilities,andotherinfrastructuretosupporturbangrowthoftentakesupsignificantamountsofagriculturalland(Nzakamwitaetal.,2022).

2.4.1.2.LandFragmentation

SubdivisionofLand:Thedivisionofagriculturallandintosmallerplotsforhousingandcommercialpurposesleadstolandfragmentation,makingitdifficulttomaintainviablefarmingoperations(Sebikabuetal.,2020).

2.4.2.ChangesinAgriculturalPractices

2.4.2.1.ShifttoNon-AgriculturalEmployment

LabourMigration:Asurbanareasesdevelop,agriculturallabourersmayshifttonon-agriculturaljobs,leadingtoalabourshortageinfarming(Uwimbabazi&Lawrence,2017).

DiversificationofIncome:Farmersmaydiversifytheirincomesourcesbyengaginginnon-farmactivities,reducingthefocusandinvestmentinagriculture(Jane&Mbabazize,2016).

2.4.3.EnvironmentalImpacts

2.4.3.1.SoilDegradation

ErosionandDepletion:Increasedconstructionandlandusechangecanleadtosoilerosionanddepletionofsoilnutrients,negativelyaffectingagriculturalproductivity(Rwanyizirietal.,2020).

Pollution:Urbanactivitiescanleadtopollutionofsoilandwaterresources,affectingagriculturallands(Mugish&Nyandwi,2015).

2.4.3.2. Water Resources

Water Diversion: Urban expansion often requires substantial water resources, which can lead to the diversion of water from agricultural uses (Nzakamwita & Tuyishime, 2022).

Contamination: Runoff from urban areas can contaminate water sources used for irrigation, affecting crop yields and soil health (Twarabamenye, & Nyandwi, 2019).

2.4.4. Economic and Social Impacts

2.4.4.1. Increased Land Prices

Land Value Appreciation: The value of land in peri-urban areas typically increases, making it more expensive for agricultural purposes and leading to the sale of agricultural land for development (Shibanda, 2019).

Speculation: Land speculation can drive up prices further, making it difficult for farmers to retain or expand their agricultural operations (Farah et al., 2016).

2.5. Mitigation Strategies

2.5.1. Sustainable Land Management

Promoting Sustainable Agriculture: Implementing practices that enhance soil fertility and water management can make agriculture more sustainable and viable (Jaganyi et al., 2018).

Land Use Planning: Effective land use planning that balances urban expansion with agricultural preservation can help mitigate the loss of agricultural land (Nzakamwita & Tuyishime, 2022).

2.5.2. Support for Farmers

Access to Resources: Providing farmers with access to credit, modern farming techniques, and markets can encourage continued investment in agriculture (Nyabyenda et al., 2020).

Education and Training: Training farmers in sustainable practices and diversification can enhance agricultural productivity and resilience (Coulibaly & Li, 2020).

2.5.3. Policy Interventions

Integrated Development Policies: Developing policies that integrate urban and rural development can ensure balanced growth and support for agriculture (Nsanzimfura & Nyandwi, 2020).

Incentives for Agriculture: Providing incentives for agricultural development, such as subsidies or tax breaks, can help sustain agricultural activities (Nahayo et al., 2016).

CHAPTER 3. MATERIALS AND METHODS

3.0. Introduction

This chapter presents the methodology that will be used in the study. It indicates the research design, the target population, data collection methods and the procedures of data collection, the sample size, data collection instruments, data processing and data analysis.

3.1. Presentation of the study area

This study will be carried out in Rubavu district. Rubavu district is one of the seven districts of the country located in Western Province, Rwanda. It is bordered by Gisenyi, Bugeshi, Busasamana, Cyankwiza, Gisenyi, Kanama, Kanzenze, Mudende, Nyakiliba, Nyamyumba, Nyundo, Rubavu and Rukerero. The geographical coordinates

of Rubavu district are $01^{\circ}40'52.53''\text{S}$ and $29^{\circ}19'45.55''\text{E}$. This district According to NISR (2022), this district has 388.4 km^2 Area, 546,683 populations and $1,408/\text{km}^2$ Population Density (NISR, 2022).

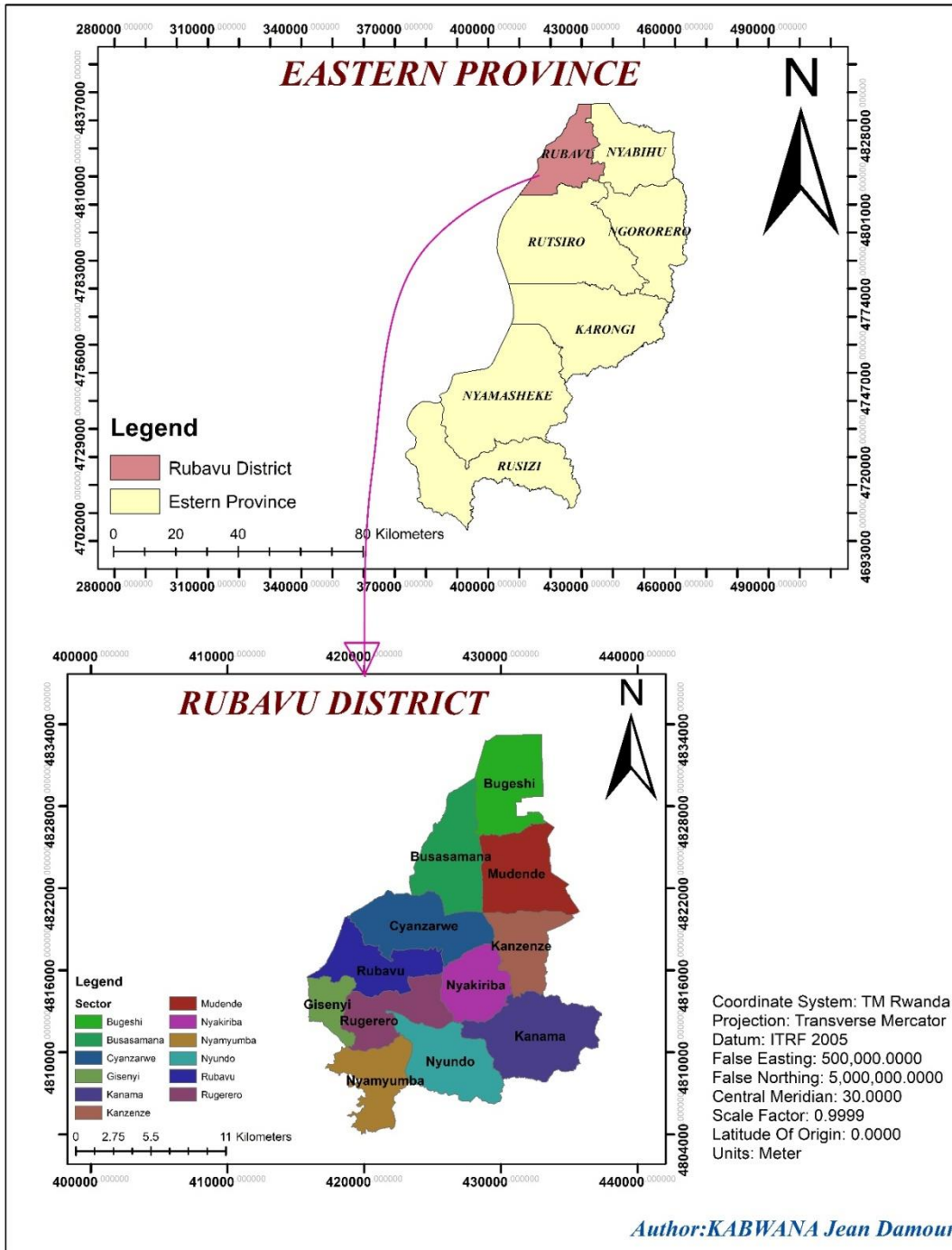


Figure3.1

3.2. Research design

This study will use both a qualitative and quantitative research design. Qualitative, as well as quantitative approaches will be employed to collect data. It will use both qualitative and quantitative approaches during sampling, data collection, and analysis. At data collection stage, Qualitative approach will be used to collect ideas and opinions from farmers in an open-ended interview to the respondents where people provided their experiences in agriculture, while quantitative approach will be used to collect responses from government institutions and nongovernment organizations in a closed-ended interview. A questionnaire will be used to collect numerical data and also observation method will be used to evaluate what was being done.

3.3. Source of data

In this research, researcher will use both primary and secondary data. In this research, Primary and secondary source of data will be used for collecting data on the major factors contributing to the urban expansion and loss of agricultural activities in Rubavu district between 2014 and 2024, the level to which agricultural activities have been changed between 2014 and 2024 and the effect of urban expansion on agricultural activities in Rubavu district between 2014 and 2024.

3.3.1. Primary source of data

The primary data are those data which will be collected afresh and for the first time and thus happen to be original in character (Sapsford & Jupp, 1996). The primary data of this research are data which are related to the major factors contributing to the urban expansion and loss of agricultural activities in Rubavu district between 2014 and 2024, the level to which agricultural activities have been changed between 2014 and 2024 and the effect of urban expansion on agricultural activities in Rubavu district between 2014 and 2024. These data will be obtained through the survey by observation on the field, direct communication with the respondents through personal interview and using questionnaires in order to explore the impact of urban expansion on agriculture land in Rwanda (2014-2024).

3.3.2.Secondarysourceofdata

SecondarydatawillbeobtainedfromvariousourceslikedocumentsavailableinINESmainlibrary,onth internet,Rubavudistrictreports;writtenorrecordedd documents,thesisanddissertationsinrelationtothe needswillbeconsultedforexploringtheimpactofurbanexpansiononagriculturelandinRwanda(2014-2024),especiallyinRubavudistrict,andsatelliteimageries.

Inthisresearch,theLandsatimageimagesof2014and2024

willbedownloadedfromUSGSEarthExplorerwebsitebyusingERDASImagine9.2andArcGIS10.8.1. TheimagedatafileswillbedownloadedinzipedfilesfromtheUnitedStatesGeologicalSurvey(USGS) websiteandextractedtoTiffformatfiles.ThedownloadedimageswillbeconvertedtoimageformatinTiff andthepre-processingprocedure.

3.4.Datacollectiontechniques

Incollectingdataofthisstudy,questionnaire,interview,anddocumentationtechniquewillbeusedinorder togetinformationforexploringtheimpactofurbanexpansiononagriculturelandinRwanda,specifically inRubavudistrict(2014-2024)

3.4.1.Primarydatacollectiontechniques

3.4.1.1.Questionnairetechnique

Questionnaireisawrittenorprintformusedingatheringinformationconsistingofalistofquestionstobesub mittedtooneormorepersonsorrespondents(Kothari,2004).Theformulationofquestionnaireitemsbas edonthenatureoftheproblemtobesolvedandrespondentsbriefedontheobjectivesofthestudy(Gagnon, 2010).Inthisresearchproject,questionnaireswillbeformulatedinEnglishandcaretooktoensurethatque stionsarenotsubjectiveanditwillbeusedtogatherinformationfromlocalfarmersandlocalleaderslivingi nRubavudistrictastherespondentsofthisresearchproject.

3.4.1.2. Interview technique

An interview is defined as a more personal form of survey research in which questions are posed in face or telephone exchange between the interviewer and respondent (De Leeuw, 1992). The study will use a face-to-face interview method to gather data related to the impact of urban expansion on agriculture activities and the data will be collected through person-to-person interaction where structured and semi-structured interviews will be used to the farmers, district and sectors agronomist and director of one stop centre of Rubavu district to collect qualitative data in order to address all the questions of this research.

3.4.2. Secondary data collection techniques

In this research, the Landsat image images of 2014 and 2024 will be downloaded from USGS Search Explorer website by using ERDAS Imagine 9.2 and ArcGIS 10.8.1. The image data files will be downloaded in zip files from the United States Geological Survey (USGS) website and extracted to Tiff format files. The downloaded image then will be converted to image format in Tiff and the pre-processing procedure.

3.5. Software to be used in the project

The software types will be used for different types of activities in the process of analysing the impact of urban expansion on agriculture activities in Rwanda and specifically in Rubavu district (2014-2024) include ArcGIS 10.8.1, ERDAS Image 9.2, MS Excel and MS Word. ERDAS Imagine 9.2 will be used for the image processing. ArcGIS 10.8.1 software will be utilized to prepare the administrative map of the study area and the map of the output of the research; Microsoft Word and Excel 2016 will be used to write the report and ArcGIS and ERDAS Image 9.2 software will be employed in combination with automatic classification.

3.6. Sampling technique and sample size

Due to the limitations of resources, time and logistics in contacting people within the project of analysing the impact of urban expansion on agriculture land in Rwanda (2014-2024), case study of Rubavu district, purposive sampling technique will be adopted because it will enable the researcher to reach the targeted respondents quickly, where selected by using Yamane's formula in order

ertodeterminethesamplesizeandwhichwillbeusedtoinvestigatetheunitswhichfittheddesiredresearcho bjectives.

3.6.1.Samplingtechniques

Samplingtechniquesprovidearangeofmethodsthathelptoreducetheamountofdatacollectionbyco nsideringonlydatafromsubgroupratherthanallpossiblecaseelements(Saunders&Allen,2010). T hisresearchprojectwillusepurposivesamplingtechniqueforselectingrespondentsofthestudy.Pur purposivesamplingtechniquewillbeusedtoensurethateachmemberofthetargetpopulationhasanequa landindependentchanceofbeinginvolvedinthesample.Itwillbeusedtoselectbothfamersandllocal eadersinRubavudistrict.

3.6.2.Sample size

ThestudywillbeconductedbasedonthesurveyinRubavudistrict.Thesamplefarmerswillbeselectedby utilizingapurposivesamplingtechnique.Fromthetotalnumberoffarmersthatareusingagricultureasthe irprimaryincomesourceintheselectedstudyareas,90respondentswillbetakenfromallsectorsofRubav udistrict.ThesummaryofthenumberofrespondentswhowillbeselectedfromstudyareaispresentedinT able.

Table3.1

Category of respondents	Sample Size	Sampling Technique
Farmers	90(10each Sector)	Purposivesampling
DirectorofonestopcentreofRubavudistrict	1	Purposivesampling
Agronomistatsector	12	Purposivesampling
Agronomistatdistrictlevel	1	Purposivesampling
Executivesecretaryofsector	12	Purposivesampling
Total	116	

3.7. Data processing and analysis

3.7.1. Image Classification and Accuracy Assessment

When the classification data are to be useful in detection of change analysis, it is essential to perform accuracy assessment for individual classification. Accuracy assessment is an essential and crucial part of studying image classification and thus LULCC detection in order to understand and estimate the changes accurately. It reveals the extent of correspondence between what is on the ground and the classification results. It is important to be able to derive accuracy for individual classification if the resulting data are to be useful in change detection analysis. In this study, accuracy assessment will be done for the geospatial data, for which the ground truth data likely equates.

An overall accuracy will be calculated by dividing the sum of the correctly classified sample units by the total number of sample units. And also the use of GIS software is more important during map finishing and making layout and addition of legend, title, scale, north arrow GIS will be used.

3.7.2. Change detection

In the case of the study area, maximum likelihood supervised classification and post-classification change detection techniques will be applied to geospatial data acquired 2014 and 2024 respectively, to map land cover changes in Rubavud district between 2014 and 2024. A supervised classification will be carried out on the twelve reflective bands for the images individually with the aid of very high-resolution images. Post-classification change detection technique will help researchers to produce change images through cross-tabulation, thus changes among different land cover classes of Rubavud district will be assessed. Regardless of the technique used, imagery will depend on both the nature of the change involved and the success of the image pre-processing and classification procedures. Normally, this chapter is important as it explains all methods and materials will be adopted in this study to achieve the main objective of this project.

3.7.3. Data processing.

In this research, Very-

High Resolution images (Aerial Images) will be processed in ArcGIS 10.8.1. Classification of land use/land cover of Rubavud district will be done in ArcGIS 10.8.1. Software by using unsupervised classification method with satellite images, then through accuracy assessment with random reference points will be calculated to clarify if the classification made was in conformance with what was on the ground.

3.7.4. Visual image interpretation

Image enhancement techniques will be used to improve the quality of an image as perceived by a human. These techniques are most useful because many satellite images when examined on colour, it gives inadequate information for image interpretation and true colour composite will be used to visualize the Satellite images of Rubavud district before urbanization of this district and.

3.7.5. Recording

After the classification process, all signature sample point will be grouped as class by record function according to the determined land cover classification type in study area. Recording will involve the assignment of new values to one or more classes and will be used to reduce the number of classes and combine classes.

3.7.6. Accuracy assessment report

In this research, each of land use/land cover map will be compared to the referenced data to assess accuracy of the classification. The Reference Data will be prepared by considering the ground control point, the field knowledge and Google Earth image. During this classification in accuracy assessment, the actual land uses that exist on ground will be compared to the planned land uses on the master plan using GIS overlay tools.

CHAPTER 4. RESULTS AND DISCUSSIONS

4.1. Introduction

Uncontrolled force of urban expansion on agricultural activities especially in Rubavudistrict raises many issues which might have both positive and negative impacts. The monitoring of these changes is crucial and it is difficult to understand its dynamic over different timescales. So the impacts of urban expansion on agriculture land were assessed in Rubavudistrict for the years 2014 to 2024.

4.2. Presentation of the major findings

4.2.1. Major factors contributing to the urban expansion and loss of agricultural activities in Rubavud district from 2014 to 2024

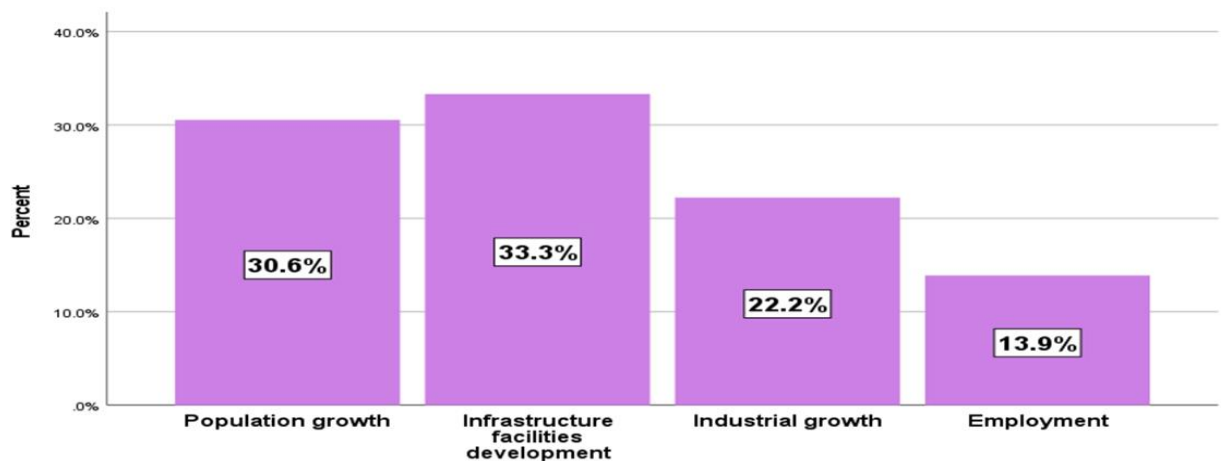
The surveyed respondents were asked on the driving factors of urban expansion and loss of agricultural activities in Rubavud district. The findings show that the driving factors of urban expansion and loss of agricultural activities in Rubavud district were population growth, infrastructure facilities development, industrial growth and employment. Here is their view on the question:

Figure 4.1: Driving factors of urban expansion and loss of agricultural activities in Rubavud district

The Figure 4.1 illustrates that 30.6% of respondents reported population growth as the one of the driving factors of urban expansion and loss of agricultural activities in Rubavud district. In Rubavud district, population growth contributed to urban expansion and loss of agricultural activities. This implies that from 2014 to 2024 in Rubavud district as peri-

urban area, the increase of population in this sector from different areas has resulted in the growth of building settlements and the reduction of agricultural activities and gradual causing food insecurities

33.3% of respondents reported that driving factors of urban expansion and loss of agricultural activities in Rubavud district is infrastructure facilities development. This implies that urban advantages include great opportunities to different kind of infrastructures including feeder roads; electricity supply, piped water



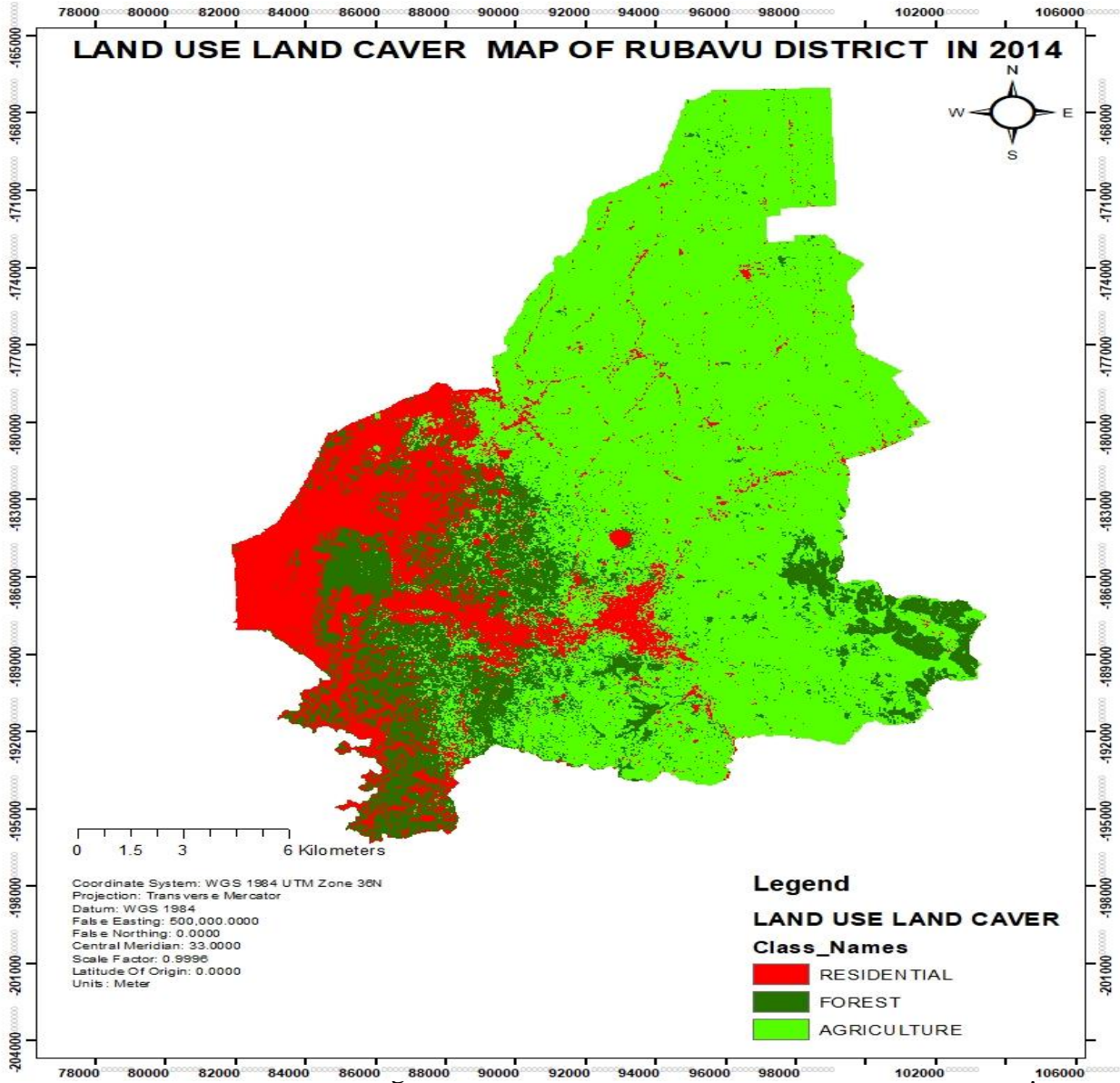
22.2% of respondents reported that industrial growth is one of the driving factors of urban expansion and loss of agricultural activities in Rubavud district. This implies that from 2014 to 2024, the explosion of industrialization and manufacturing enterprises within a Rubavud district gives rise to more employment opportunities which is another factor of urban expansion and loss of agricultural activities in Rubavud district.

13.9% of respondents reported that employment contributes to urban expansion and loss of agricultural activities in Rubavud district. From 2014 to 2024, in Rubavud district there is high urban development and industrial growth create opportunities for jobs that resulted in urban expansion and loss of agricultural activities in Rubavud district

4.2.2. Level to which agricultural activities have been changed between 2014 and 2024

4.2.2.1. Level of agricultural land in 2014

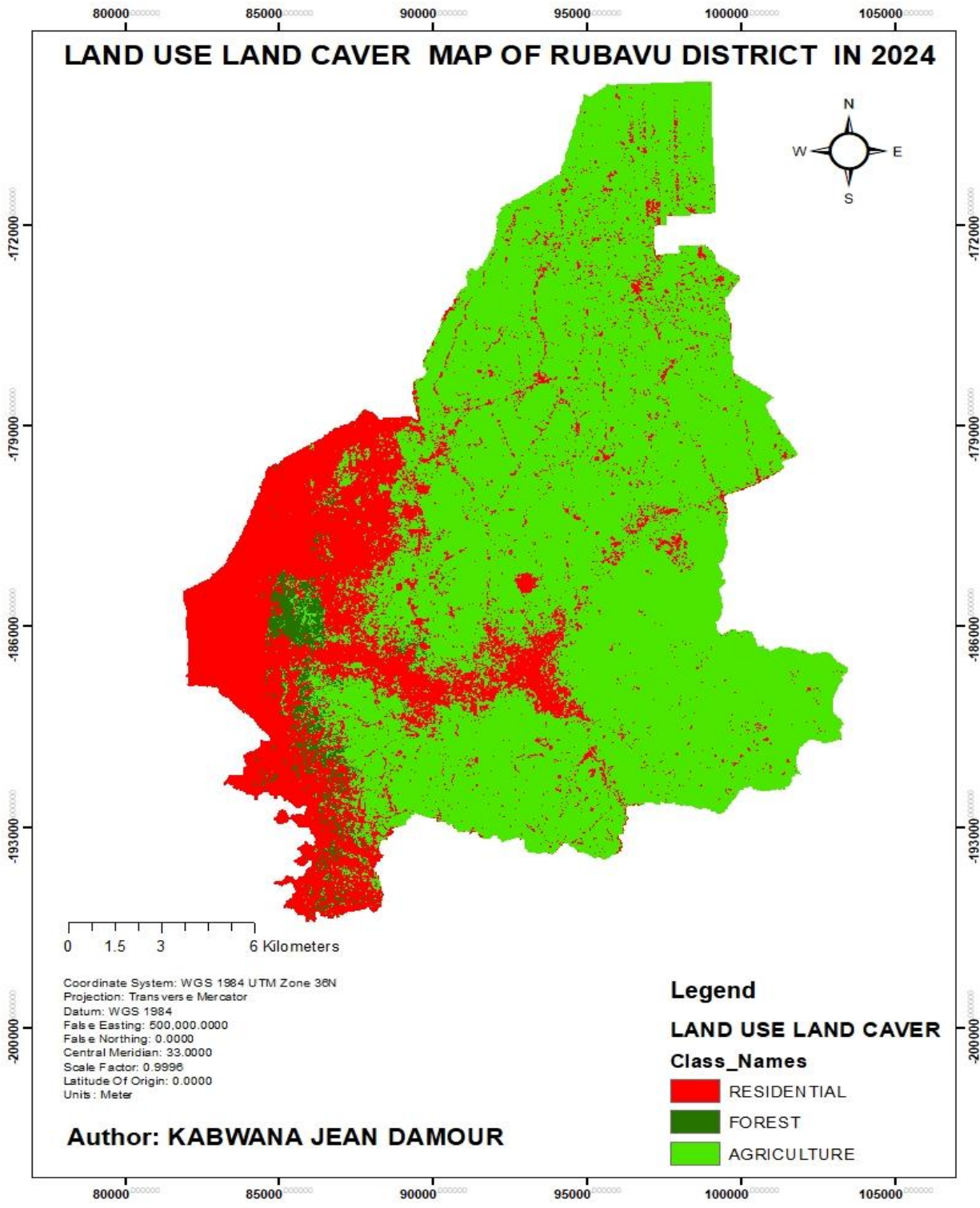
In order to analyze the level of agricultural activities in 2014, the land use/land cover map of Rubavu district



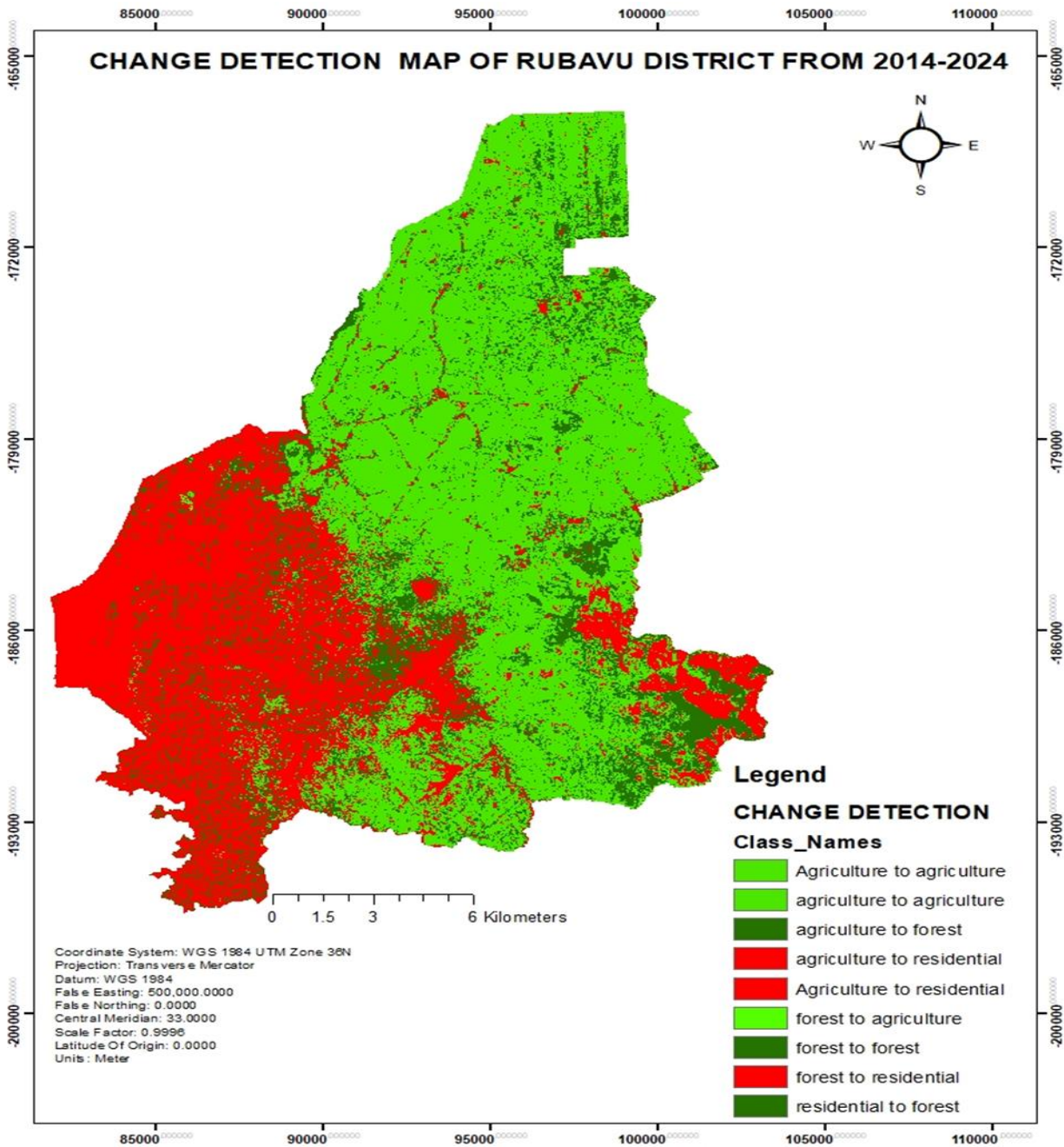
that agriculture land use was at a high level with 20638.46 ha which is 53.2% of the total area of Rubavu district. The forest and residential land uses are relatively low compared to agriculture land as seen from the map above and the table above. The researcher concluded that in 2014, agricultural activities have a big area (20638.46 ha) with 53.2% compared to the other types of land uses

4.2.2.2. Level of agricultural land in 2024

In order to analyze the level of agricultural activities in 2024, the land use\land cover map of Rubavud district in 2024 was used. Below is the discussion on it



4.2.2.3.ChangedetectionoflanduseandlandcoverofRubavudistrictfrom2014to2024



From the obtained results by analysis of researcher, the status of agriculture activities and land cover after urbanization in Rubavu district was characterized by less area for agriculture land use, less agriculture land investments, less agriculture harvest and less agriculture based market. Below is the graph to represent the obtained results.

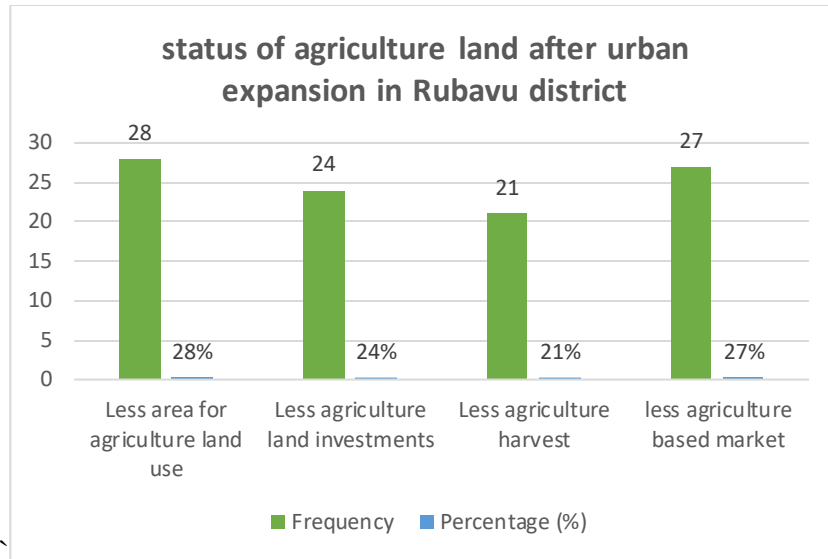


Table 6

The obtained results show that after urban expansion, agriculture land use becomes less because it has been converted to build up use which harmed the agriculture production hence there was small land for agriculture realso the harvest becomes small in addition, agriculture land investment became less as many people were investing in build up land which on the other hand decreased agriculture production as. The agriculture based land market becomes less as all the efforts were put in build up so people are more concerned with land markets for built up purpose than agriculture.

The obtained results are like some of authors who said that Urban expansion leads to a continuous loss of agricultural production, both directly under the form of land take, and indirectly with agricultural land for non-productive rural activities like recreation, horse keeping or hobby farming (Beckers et al., 2020). These urbanization processes put pressure on farmers, making farming activities harder through reduced agricultural land, negative externalities and the competition for land (Losada et al., 2018).

Also, from the obtained results, it has been found that urbanization influences agriculture production by converting agriculture land to build up, more land investments in built up and population growth. As said by Satterthwaite and others (2010) due to overpopulation and rapid population increase in most urban areas, there is a shortage of agriculture land and the agriculture activities are very decreased, then this decrease affects the agriculture production. Urban expansion occurs mainly because people move from rural areas to

ourbanareasanditresultsingrowthinthesizeoftheurbanpopulationandtheextentofurbanareas,allofthesedecreasetheagricultureproduction(Wilonoyudhoetal.,2017).

CHAPTER5:CONCLUSIONANDRECOMMENDATION

5.1.Conclusion

ThisstudywasfocusedtoassesstheimpactofurbanexpansiononagriculturallandinRubavudistrict(2014-2024).Duringourassessmenttheimageclassificationandaccuracyassessmentwasdonebyanalysis

ee classes such as residential, forest and agriculture. The results showed that the urban expansion is not only changed depend on the period of time but also the agricultural activities decrease when urban expansion come. The assessment identifies that the urban expansion affecting the agricultural land area as period of time increasingly and if these expansions are not well managed and controlled, the large area of Rubavud district will be occupied by infrastructure that will highly reduce the quantities of production that will be obtained from agricultural land. The results also showed that they are big quantities of agricultural land that lost within 11 years and with this loss the agricultural activities in Rubavud district as the urbanization increasing the land for cultivation also reduced. Therefore, Policies and programmers required for development planning. Decrease area under agricultural land might directly or indirectly caused degradation of environment. The major findings of the image analysis revealed that area under residential land have been increasing significantly in the border area of Rubavud district. Due to increasing population pressure in Rubavud district area is already becoming congested this lead to decrease agricultural land use. This study was not only subjected to the data constraints which is a serious problem in accomplishing this project but low knowledge in statistical method also take influence.

5.2. Recommendation

Governments have arrange policy of urban and agricultural policy. Practical approach that could be in most cities include:

- ❖ To deliver education, training and bridging courses to local communities. The contact of city residents with urban and agriculture officers is the main source from which urban residents receive advice to avoid the big rate of agriculture land loss,
- ❖ To organize special agriculture campaigns about the good use of land and its effect on agricultural production,
- ❖ To improve a strong collaboration between city residents and other stakeholders in urban planning and development,
- ❖ To mobilize the population and other stakeholders to construct the multi-storied buildings instead of many single houses which are occupying large spaces which were supposed to be used for agriculture

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