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DRIVING FORCES THAT DETERMINE LAND USE CONVERSION TREND IN URBAN AREAS: THE CASE OF GONDAR CITY

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JUNE, 2019
ADDIS ABABA, ETHIOPIA

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This Thesis is submitted to the school of graduate studies of Addis Ababa University, Ethiopian Institute of Architecture, Building Construction and City Development (EiABC), in partial fulfillment for a Master of Science in Urban Planning.

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This thesis is submitted to Ethiopian Institute of Architecture, Building Construction and City Development (EiABC), Addis Ababa University in partial fulfillment of the requirements for the degree of Masters of Science in Urban Planning.

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Declaration

I,the undersigned, declare that this thesis prepared for the partial fulfillment of the requirements for degree of Master of science in urban planning entitled "**Driving forces that determine land use conversion trend in urban areas: the case of Gondar City"** is my original work and has not been presented for a degree in any other university, and that all sources of material used for the thesis have been duly acknowledged.

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Confirmation

This thesis can be submitted for examination with my approval as a university advisor.

_____

Daghachew Adugna (PhD)

June, 2019

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Acronyms & Abbreviations

AAU	Addis Ababa University
CAD	Computer Aided Drafting
CSA	Central statistical agency of Ethiopia
DTM	Digital Terrain Model
E.C	Ethiopian calendar
EiABC	Ethiopian institute of Architecture, Building construction, and City Development
EPRDF	Ethiopian people revolutionary Democratic Front
FAO	Food and Agricultural organization
GAO	Government Accountant organization
GP	Global positioning
G.C	Gregorian calendar
GIS	Geographical Information System
HHs	house holds
KII	key informant interview
KML	Key hole Markup Language
LU-LC	Land use land cover
LULCC	Land use land cover change
NUPI	National urban planning institute
KM^2	kilo meter square
SSA	Sub-saharan African
SNA	System of nation account
UNCHS	United nation center for human settlement
UNFPA	United nations population fund

Abstract

Knowing the driving forces behind LULCC is essential for the efficient and effective use of the scarce property in urban areas. Land use and cover change can be caused by multiple driving forces that control some environmental, social and economic variables. It is important to study the driving forces of land use change to understand the change process. Thus this paper was aimed at driving forces that determine land use conversion trend in urban area the case of Gondar City by formulating objectives to answer questions of driving forces, land use land cover change trend and future expansion scenario. The study used more of quantitative methods and very few qualitative approaches by administering questionnaire, interview and field observation as data collection tools using purposive sampling. In purposive sampling; 24 professionals, 60 farmers, 190 housing cooperative associations, 66 informal settlers and 42 residents (poor of the poorest) that have lived a long time in the study area and have enough information have been selected purposively. Moreover, google earth image of 1991, 2006, and 2019 were used for the research. Based on the socio economic data result the major driving forces in the city were identified. These are societal factors, biophysical factors and economic factors. In addition to this Google earth image was used and analysed to know the land use land cover change of the city. The result revealed that from the four classified land use classes only the built up area were increased during the past 30 years. In the contrary vegetation, farmland and water body decreased through time in these periods.Therefore, controlling the population growth, biophysical and economic factors with its associated impacts on the natural environment requires the right policy packages by national and regional governments such as awareness creation, provision of family planning services, increasing productivity, working on the pushing factors of migration , controlling illegal settlements and use the right land use plan are some of the action should be taken by the city administration. Moreover, decision makers, policy makers and professionals like planners should have up to date information on land use land cover for a city.

Key Words: *Driving forces, Land use Conversion, trend analysis and urban area.*

Chapter One: Introduction

1.1 Back ground

Urbanization is a natural process that grows and expands from time to time parallel with the humankind's settlement preferences all over the world. It is also an inevitable part of economic development. Urbanization results in changes in the landscape, specifically the proliferation of concrete and impervious surfaces, and the displacement of agriculture and forestland. Understanding these interactions between human activities and their consequences in landscape is especially important in areas of the world that are experiencing rapid land use land cover change. (Mihiret, 2015).

According to the United Nations report on World Urbanization Prospects, the world urban population is expected to increase by 72 % by 2050, from 3.6 billion in 2011 to 6.3 billion in 2050. Thus, the urban areas of the world are expected to absorb all the population growth expected over the next four decades while at the same time people are moving to rural areas by assuming that rural life is seen as simpler and less stressful. Furthermore, in the cities and towns of less developed regions the expected population growth is more concentrated than the developed regions of Europe and America (Atalel, 2014).

Associated with the rapid expansion of urbanization, a lot of land has been converted from rural to urban. From the land use conversion point of view, expansion of urban areas is of greater importance because of its strong effect on other land cover classes, such as agricultural lands, non-built areas, forests and others. Currently the population of Ethiopia, which is the second largest population in Africa, estimated as a total of over 100 million populations. As Atalel, 2014 mentioned in his research work, It has a 2.3% of annual growth rate and having 4.6% average annual urban growth rate. In spite of its low economic development and unguided urbanization using urban planning approaches as compared to other African countries, the impact of land use conversion becomes a big challenge to the country of Ethiopia. These problems are happening today in most cities and towns in Ethiopia. Gondar is one of the cities, where this study was conducted, has also experienced greater changes. Knowing different variables used in the above-stated studies mainly focus on the driving forces or factors that determine the land use conversion trend in the study area like demography, bio-physical factors, land market, individual factors, economic opportunities, policy and institutional factors that are difficult to find in consistent manner but have significant influence on urban land use change in rapidly growing cities of developing

countries. These driving forces for the land use conversion in the cities helps to provide better information for professionals and decision makers that administered the concerned cities helps to develop guiding principles and strategies and solutions to overcome the problems of land use conversion in both spatial and thematic scales. For a city like Gondar that is undergoing a rapid change in recent past, there is a need for reliable and timely land use land cover information. In addition to this, the study focused not only on the spatial aspect of change, but also understanding the driving factors behind these changes , which are vital in knowing the land use land cover change of the study area.

1.2 Statement of the problem

Over the last two decades or so, the whole world has experienced rapid changes and socioeconomic transformations. The socioeconomic changes affected and caused severe stress mainly to isolated, peripheral and rural areas of the world. The changes in the economic and social structure of the world caused decreased farm revenues, changing in the farmland values and high rates of unemployment, leading to a mass exodus of the productive forces and lack of balance in the demographics of rural areas and on the other side a growth in the number of population on urban areas (Gannon, 1993 cited by Ziena,2017).

This Rapid rate of urban growth lead to rapid changes of land use conversion than ever before, particularly in developing nations, are often characterized by unrestrained urban rambling, land degradation or the transformation of agricultural land to other uses and resulting massive cost to the environment (Sankhala et al., 2014 cited by Tulu, 2016).

According to Lambin, et al (2003) to understand land use conversion, their rate of change and the social and physical forces that drive those changes, land use/ cover change information is needed. The requirement of Land-cover and land-use information is important for many different kinds of spatial planning, from a local level up to regional development in the area of urban and regional planning. These information plays an important role in developing strategies, regulations, decision for a day to day activities for implementers and policy making. Moreover, land-cover data are used as basic information for sustainable management of natural resources; they are increasingly needed for the assessment of impacts of economic development on the environment. Hence, they are fundamental for guiding decision making at various geographical levels for both planners and decision makers in urban areas of many developing countries. Ethiopia, one of the developing countries characterized by its low urbanization and rapid rate of growth as compared to other African countries and the impact

of land use and land cover changes become a big challenge in many cities and towns of the country. Gondar is a city in Ethiopia, where this study was conducted, has also an experience of greater changes concerning land use conversion currently and in the previous years. The land use conversion has different aspect like a change from one land use or cover for the other and in other way round there is a change from one type of use to the other type of use by the cause of different driving forces. Analyzing and identifying these driving forces and knowing the changes in the current and the previous time is very important to provide better information for the city professionals and decision makers to design strategies and solutions to manage land use and land cover changes in urban scales for the future career of the city. Therefore, the motivation behind this study is based on the fact that during the last few three decades the growth of Gondar city was dramatic. The growth of the city is more concentrated and expanded in the southwest direction and it brings a change in land use and land cover from previous forest, agricultural use to urban built up area and in the contrary the central part of the city changed from residential to mixed and commercial use. However, at the same time there is a realization that certain parts of the city, especially in the northern direction have been left behind in development. For these land use land cover change as well as the area in which does not go under similar changes has many causal factors. So the research focused on these driving forces that bring land use land cover change for the last three decades in Gondar city. This requires an assessment of the past and existing land use and land cover change and its driving forces that brought the change.

1.3 Objective

1.3.1 General Objective

The general objective of this study was to assess the driving factors that determine a land use land cover conversion trend in Gondar City.

1.3.2 Specific objectives

(I) To investigate the land use conversion trend of Gondar City for three decades;

(ii) To identify the driving forces that cause land use - land cover change in the study area

(iii) To predict future land use/land cover expansion scenario.

1.4 Research Questions

1. What looks like the land use land cover change trend of the study area for the last three decades?

2. What are the main driving forces for the land use land cover change in Gondar City?

3. What will be the future scenario in land use land cover change in Gondar?

1.5 Significance of the study

The study of land use conversion trend in urban areas and the driving forces behind the changes helps to know how the land was being used in the past, what type of changes have occurred and are expected in the future. Knowing land use land cover can assist planners for multipurpose and in time will become an essential base for all land administration and urban planning functions such as legislators, planners, and state and local government officials to determine better land use policy, to project transportation and utility demand, to identify future development pressure points and areas, and to implement effective plans for urban and regional development. Therefore, the research will be the base for these issues, it puts proper land use management for implementation of urban planning and it will be a hint for further projects (Clawson et al, 1965). Moreover, it can provide data to policy and decision makers to design appropriate policies and strategies for monitoring resources which is scared in its nature and promote sustainable management of the resources.

Besides, potential researchers in the field of study can make of this for further studies and as a reference.

1.6 Scope of the Study

Spatially the study was limited to the premises of Gondar city. It focuses on the driving forces that determine the land use conversion trend in in the city during the last thirty years. The study assessed LU/LCC and drivers of the change, and then it predicted future LU/LCC. Methodologically the study used different methods and approaches (field observation, key informant interview, and secondary data such as image of 10/26/1991,11/16/2006 and1/23/2019. The present research was conducted starting from January until June 2019.

1.7 Limitation of the study

The present research is not completely free from limitation. In this research many constraints were faced from data acquiring to analysis, from these the following is mentioned. To do land use land cover change driving force both primary and secondary data is very essential but it was difficult to address in a short period of time and small financial support with the required amount. Secondary data, especially time series land use conversion trend for thirty years was not found at the required scale to the satisfaction of the researcher. Besides, image analysis of

land use land cover changes was difficult during the interpretation and classification of images due to lack of high resolution image particularly google earth image of 1991 and 2006.

1.8 Structure of the document

This thesis has been divided into seven chapters**.** The first chapter is an introduction that presents the research background, statement of the problem, objectives, research questions, significance, scope and limitation of the study. The second chapter consists of the literature review section; while the third chapter provides methodology and materials which includes a description of the area, study approach, the specific methods, sampling techniques, source of data and material used. The fourth chapter describes the main results and discussion part based on image classifications and socioeconomic data. The finally, the fifth chapter presents the main conclusions and recommendations.

Chapter Two: Literature Review

2.1 Conceptual frame work

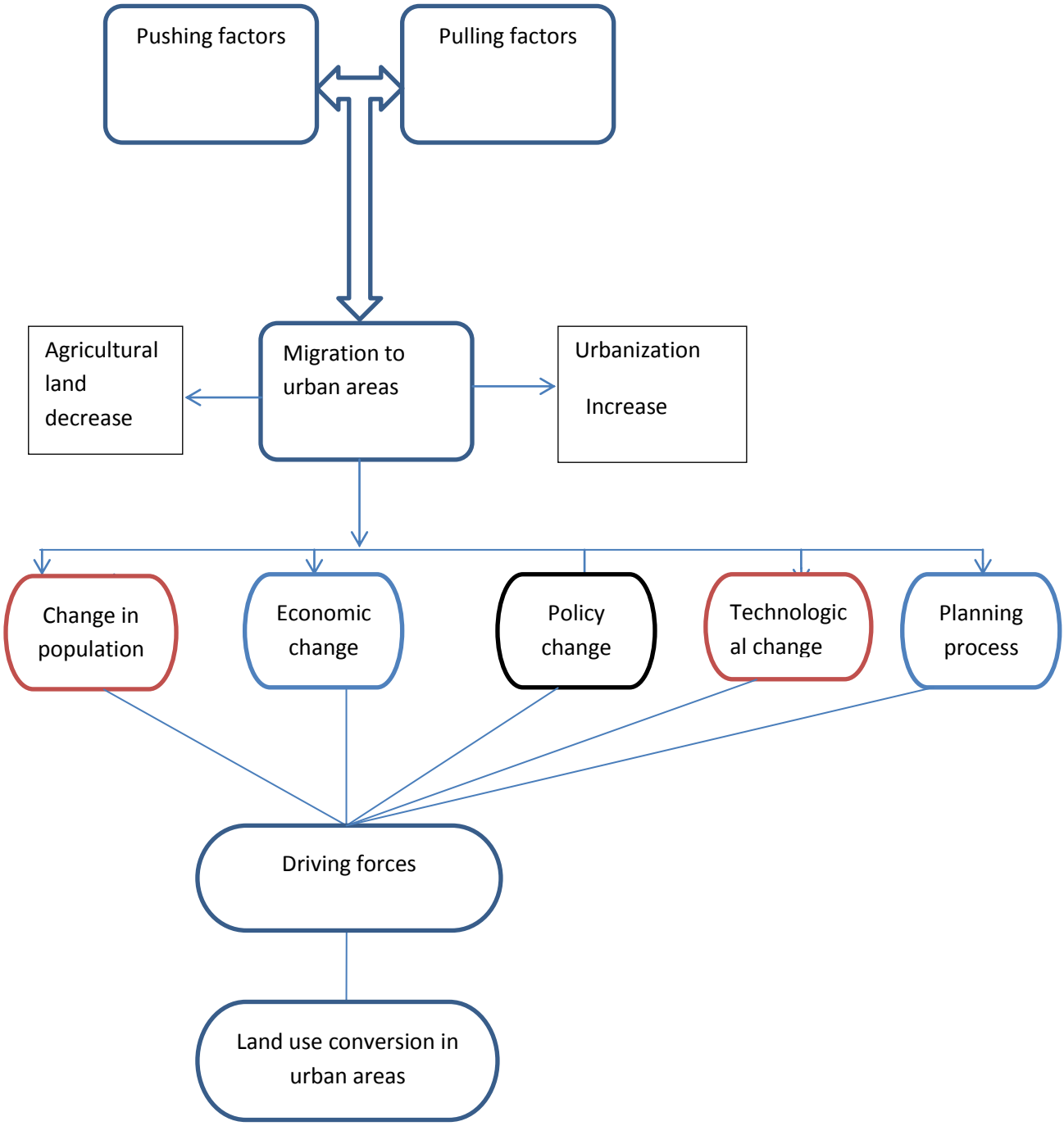


Figure 1 : Conceptual frame work

2.2 Definitions of concepts and terms

Land use: The term land use has been attempted to be defined differently from various perspectives by different scholars. Land use has seen as a product of interactions between a

society's cultural background, skill and its physical needs in one hand and the natural potential of land on the other hand (Ram Kolakar, 1993).and Land use is also defined as men's activities on land, which are directly related to land. Land use is characterized by the arrangements, activities and inputs by people to produce change or maintain a certain land cover type (Di Gregorio and Jansen, 1998). Land use defined in this way establishes a direct link between land cover and the actions of people in their environment. Land cover is the observed (bio) physical cover on the earth's surface (Deng and others, 2009). Land cover + Land utilization = Land use. According to FAO (2000) "Land use is the arrangements, activities and inputs that people undertake on a certain land cover type, According to this definitions land use reflects human activities such as the use of the land like industrial zones, residential zones, and agricultural fields etc. The above definitions establish a direct link between land use and the actions of people in the environment.

Land cover refers the biophysical coverage of land like natural areas, forests, buildings, lakes and roads. The term land cover describes the types of resources/features present on the surface of the earth. It is the observed (bio) physical over on the earth's surface.

Land Use Conversion: Conversion is a normal part of urban development in both developed and developing world (Riebsame and others, 1996). Conversion means change to land use from agricultural to non-agricultural or vice versa from non-agriculture to agriculture purposes. Riebsame, et al, (1992) maintains, "The primary reason for the conversion is that under urban uses a much higher rent is recovered. The conversion from one land use to another is the activity most severely affecting terrestrial environments. The nature of conversion depends on the end use of the land." Land conversion is a phenomenon that is almost unavoidable during economic development and population growth periods. Edrijani (1994) stated, "Land conversion is a process by which land is changed from agricultural to urban uses. There is a debate on whether agricultural land fringing should be maintained or converted to other uses. This debate can be shown from both the pro-ruralist and the pro-urbanist perspectives. The pro-urbanists argue that, "land conversion is a logical consequence of urban growth. The decline of agricultural production, they argue, can be solved by intensification and technological production. Hence, land conversion is not considered as a threat in their view."

2.3 Urbanization and Land use land Cover change

Urbanization: Andrea Emma Pravitasari (2015) Explained urbanization as a growth in the proportion of a country's population living in urban centers of a particular size. He also

mentioned that urbanization synonymous with the increasing of population in cities or towns through migration from rural areas because of social and economic changes, or in other words, a transformation from a rural to urban-based societies.

Rapid urbanization causes disorganized and unplanned growth of the towns and cities. The pressure of an ever growing population becomes the burden on the limited civic amenities which are virtually collapsing; there is the need to balance present requirements of land against future needs. Prevention of agriculture land in the fringe area of expanding cities is a vital for preserving and maintaining open space and therefore environmental qualities (Farooq and Ahmad, 2008). Urban growth has resulted in the conversion of land for urban uses without any systematic development plan and without a corresponding investment in infrastructure. Poor land management has resulted in urban areas with inadequate services, infrastructure and corresponding lack of accessibility, that may prove very costly to resolve in future (Gupta and Sen, 2008). To prevent urban sprawl and leads to an improper development in any city on future, it is necessary to monitor the growth of city for sustainable urban development (Kumar et. al., 2007). It is important to study the and understand these trend of urban sprawl as it is one of the potential threats to sustainable development where urban planning with effective resource utilization and allocation of infrastructure initiatives are the key concerns and would help in effective land use planning in urban areas (Saravanan and Ilangovan, 2010).

All cities have an image. Infect, it would be truer to say that all cities have, and always have had, a number of images. The only consistent thing about cities is that they are always changing (Verma 2008). Urbanization is one of the dynamic and serious issues at present. Rapid urbanization results the unsystematic and unplanned growth of urban centers. The pressure of an ever growing population becomes a burden on the limited civic amenities which are nearly failing (Emtehani, M R. et al., 2012). Urbanization is a process through which the productive agricultural land, forests, surface water bodies and ground water prospects are being irretrievably lost. Growth of infrastructure has not kept pace with the growth of the population, resulting in disequilibrium in the level of development (Tali, J.A. and Murthy, K. 2012).

land use and land cover change: (Di Gregorio and Jansen, 2000).in his research work explain how the definition of land use and land cover has been used interchangeably in the land use research community because of the availability of many existing information systems. However, these two terms explain two different issues and meanings. Land cover refers to the observed biophysical cover on the earth's surface including vegetation, bare soil, hard surfaces and water bodies. Whereas land use is the utilization of land cover type by human activities for the purpose of agriculture, forestry, settlement and pasture by altering land surface processes including biogeochemistry, hydrology and biodiversity (Di Gregorio and Jansen, 2000).

Changes in land use and land cover caused through direct and indirect consequences of human activities on the environment for the purpose of having better life. One of the direct impacts of humans is population growth where its increase and decrease have effects on land use especially in developing world at longer time scales. According to Lambin et al (2003), it can also be caused by the mutual interactions between environmental and social factors at different spatial and temporal scales as land use and land cover change is a complex process.

Verburg et al (2004) showed that causes of land use and land cover change can be categorized as direct (proximate) or indirect (underlying). The direct causes comprise human activities that could arise from the continuous use of land and directly alter land cover which reflect that human are driving forces. They are generally operating at local levels and explain how and why local land cover and ecosystem processes are modified directly by humans. On the other hand, indirect causes are fundamental forces that strengthen the more direct causes of land cover changes. These causes are resulted due to the complex interaction of social, political, economic, technological and biophysical variables.

Identifying the causes and impacts of land use and land cover change require understanding both how people make land-use decisions and how specific environmental and social factors interact to influence these decisions (Lambin et al, 2001).

2.4. Urbanization and urban land-use planning

From a broader point of view urbanization is one of the ways in which human activities altering the global land cover. Although the urbanization trend is global, according to the reports of the United Nations Centre for Human Settlements (Habitat, 2001), it has shown most remarked changes in developing countries associated with the migration of rural people to cities for better opportunities. Following this there had been estimated a rapid growth of population in urban areas at an average rate of 2.3% per year from 2000-2030 (Nations,

2001). Urban growth, particularly the movement of residential and commercial land use to rural areas at the periphery of metropolitan areas, have long been considered as a sign of regional economic vitality (Yuan et al, 2005). However, its importance becomes unbalanced with impacts on ecosystems, greater economic differences and social fragmentation. It can be defined as the rate increase in urban population. Dynamic processes due to urban change, especially the tremendous worldwide expansion of urban population and urbanized area, affect both human and natural systems at all geographic scales (Brockerhoff, 2000).

Araya and Cabral (2010) have shown that urban growth in Setúbal and Sesimbra, Portugal has been increased significantly between 1990 and 2000 by 91.11%. Much of this growth, however, was towards the periphery of urban areas due to the coalescence of a number of smaller settlements as well as through the consumption of agricultural land. The growth was predicted to continue in the future and would have wide range of consequences on natural resources.

The ability to monitor urban land cover and land use changes is highly desirable by local communities and policy decision makers. Due to the increased availability and improved quality of multi spatio-temporal data and new analytical techniques, nowadays it is possible to monitor urban land cover and land use changes and urban sprawl in a timely and cost-effective way (Yang et al, 2003).

Urban land-use planning: An essential component of the comprehensive development plan, it designates the future use or reuse of the land and the structure built upon the land within a given jurisdiction's planning area and the policies and reasoning used in arriving at the decisions in the plan. public and private land uses in accordance with the planned spatial organization of economic and social activities and the traffic of goods and people.

Urban Land use planning is also the systematic assessment of urban land and its potential, alternatives for land use and economic and social conditions in order to select and adopt the best land-use options. Its purpose is to select and put into practice those land uses that will best meet the needs of the people while safeguarding resources for the future. The driving force in planning is the need for change, the need for improved management or the need for a quite different pattern of land use dictated by changing circumstances.

All kinds of urban land use are involved: residential, mixed use, commercial, institutional, administrative, industrial, recreational, urban agriculture and tourism. Planning also provides guidance in cases of conflict between rural land use and urban or industrial expansion, by indicating which areas of land are most valuable under rural use.

Central Idea of Land use Planning: Wherever groups of people use land and its resources, land use is planned being aware of it or not. Land use does not consider production only, but also land functions such as protected areas, land recreation, road-building, waste disposal sides and use restricted areas such as buffer zones for exhaust gases, areas for regenerating groundwater, buffer zones for traffic noise pollution, etc.

Land use planning (LUP) is not only practiced when national authorities intervene or because of development projects. LUP happens in every society, even if the term is not used. It deals with cases in which an intervention occurs in order to improve land use and to sustain natural resources. In the past, decisions made on land use have resulted in the degradation of land resources, or an imbalance between supply and demand of those resources.

These LUP-guidelines are not intended to standardize and impose compulsory procedures for all conceivable variants. It appears more appropriate to offer support for different situations, taking into consideration the specific conditions. In addition, the exact role and scope of LUP has still to be determined according to the context and local conditions by those responsible for planning and implementation of projects.

Even fundamental concepts are perceived differently within each project. Whereas some will consider an approach that gives these directives on how land related subjects should be organized in a defined region, others will promote a process of organization and learning.

The Essence of land-use planning : Our basic needs of food, water, fuel, clothing and shelter must be met from the land, which is in limited supply. As population and aspirations increase, so land becomes an increasingly scarce resource. Land must change to meet new demands yet change brings new conflicts between competing uses of the land and between the interests of individual land users and the common good. Land taken for towns and industry is no longer available for farming.

Planning to make the best use of land is not a new idea. The community decisions have been made according to their own needs, their knowledge of the land and the technology, labour and capital available. As the size of the area, the number of people involved and the complexity of the problems increase, so does the need for information and rigorous methods of analysis and planning.

Urban Land Planning involves anticipation of the need for change as well as reactions to it. Its objectives are set by social or political imperatives and must take account of the existing situation. In many places, the existing situation cannot continue because the land itself is being degraded. Examples of unwise land use include: the low-rise urban structures/slum

areas, clearance of forest on steep lands or on poor soils for which sustainable systems of developing have not been developed; and industrial, agricultural and urban activities that produce pollution. Degradation of land resources may be attributed to greed, ignorance, uncertainty or lack of an alternative but, essentially, it is a consequence of using land today without investing in tomorrow**.**

Land use consideration: can be divided into different parts. First, identifying objectives and principles pertaining to residential, administration, commercial, services, Transportation and formal green, forest and informal green, urban agriculture and special or other functions; second, focuses on the nature and pattern of development within the existing city boundaries; Third, looking at the area of land surrounding the community, area of influence, existing land uses and factors affecting the present and future land uses; Fourth integrating the analysis and findings of the proceeding sections and then exploring and identifying different tools which could be used to implement the proposed plan. Some of these land use plan implementation tools are standards, plans, dates polices and urban land related regulations and different actors who will participate at different stages in the process of operational functions(urban land use planning & control training manual, Ethiopian Civil Service University, 2012).

2.5 Land use change conversion trend in general

The world is undergoing the largest wave of urban growth in history. According to the United Nations Population Fund (UNFPA, 2013), rapid population growth has been concentrated in towns and cities of the world. The report also projected that by the year 2030 the vast majority of this growth will be observed in the developing world of Africa and Asia where urban growth is highly concentrated. Because cities offer a lot of opportunities such as jobs and sources of income than the corresponding rural areas, they attracted a lot of people.

Following the rapid increase of population in urban areas, the growth of the world's rural population has been decreasing.

Regarding to projection of population growth, the world's urban population is expected to increase by almost 2 billion over the next 30 years, whereas the world's rural population is actually expected to decline slightly falling from 3.3 billion in 2003 to 3.2 billion in 2030. Ethiopia is one of the second largest populated countries in Africa with a total population of over 80 million and having an annual growth rate of 3.02%. The country is experiencing an average annual urban growth rate of 4.6%, which is a high rate by world standard (Cohen, 2004).

2.5.1 Trends of land use land cover change in Ethiopia

Ethiopia's urbanization is low relative to other Sub-Saharan African (SSA) countries. Since the majority of the population (85%) is living in the rural areas, where agriculture is the backbone of the country's economy, it is evident that urban growth being low. The self-sufficiency of agriculture also contributed to reinforcing of the rural peasant life from their territory. According to Central Statistical Agency of Ethiopia (CSA), it is only 16% of the population lived in urban areas. Among these are in small cities and towns (Schmidt and Kedir, 2009).Due to urbanization the land use land cover change was increasing in many cities and towns of Ethiopia especially after to some years ago and until the present time.

2.6 Spatial evolution of Gondar City

2.6.1 Early settlement quarters: - The expansion trend of the settlement of the city seems to be concentrated around the Imperial compound, Fasil Gibbi. The main direction however follows a south and southeast areas of the Gibbi (Rifkind, 2011).Most of the existing 'safars' (districts) of the town have been the principal residential quarters of the town which emerged when Gondar became the Imperial capital. These safars include the left and right sides of the fasiledes castle, Abun bet, Islam bet (Addis alem), Dingaye, Kayla Meda, Walaqa, Qaha and Qusquam.

In particular, an important landmark of the town has been the fasiledes castle. Accordingly, all the area to the left of the palace, named gira bet, was a living quarter for the prostitutes and persons of lower class origin. All the area to the right side of the palace, known as Qagn bet, was the residence of members of the aristocracy the houses in this area, constructed in rows, accommodated large number of population. The Abun bet locality also found north west of the palace and at the foot of the hill commonly known as Tigre mechohiya; it is also known by church, Abun bet Gabreal or Gabreal bet (Rifkind, 2011).

Addis Alem, located west of the palace, was another residential area, assigned to the Muslim community during Yohannes I (1660-1695) and was named as Islam bet. It is said that before this decree it was known by the name 'godguadit', which literally means depressed land mass (Rifkind, 2011).

2.6.2 Settlements during Italian occupation

Most of Gondar’s 14,000 Ethiopian inhabitants lived south of the main castle complex called the Fasil Ghebbi where the ridge slopes gently down toward the major market at the southern

edge of town. Ethiopian residents, including the large Yemeni and Sudanese expatriate communities, were restricted to the existing districts between the Ghebbi and market, which included Cherkos, Debre Mitmaq, Fit Mikael, Baata, Fit Abbo debres, the Enkoye Mesk and Echege Bet locality. The Kidame Gebya (saturday market) and the Echege Bet, Addis Alem localities were also the centers of the black quarter (Rifkind, 2011).

Italians lived in the more elevated areas north and west of the Ghebbi, around the commercial and administrative precincts. The Italian authorities and the city's chief designer, Florentine architect Gherardo Bosio, recognized that the castle complex, which divided the ridge in half, served as an effective barrier between the city's neighborhoods (Rifkind, 2011).

The Italians concentrated their building activity north of the Fasil Ghebbi on two adjacent level areas, but separated by a twenty-meter change in elevation (Rifkind, 2011). The lower area served as a commercial district, with a wide, tree-lined street running north from the castles, past the cinema to the prominently sited post office. The higher area immediately to the east comprised the governmental district, centered on two monumental buildings for the military authorities, whose towers commanded distant views and marked the center of power in the new Gondar.

2.6.3. Post Italian occupation settlement

Immediately after the liberation, the population of the city fell sharply due to the final skirmish between the Italians and the liberators. Firstly, most of (if not all) the Italians left the town in a hurry. Secondly, due to the war, many of the local residents fled the town for safety. These and other economic setbacks had driven many people out of the town.

However, with the improvement of stability and peace as well as the steady growth of economic activities, the population recovered and grew steadfastly. Accordingly, what was about 20,000 around the late 1940s grew to 36,562 by the mid of 1960s; and this number almost doubled 64,260 by 1976 (NUPI 1994). Today, the city boasts to have more than 390,000 residents (Gondar city economic development office, 2019).

From its historical back ground Gondar initially that was developed between Angereb River on the east and Kaha River on the west which meet in the south eastern part of the town and then expanded towards the south, south east and south west and finally adjoining the earlier settlement of Azezo. The City is surrounded by hills in the north, west and east and large farming area to south and south west in the direction of Dembeya and Metema road. Early settlements those are concentrated in the areas between Angereb and Kehai River and at Azezo.

2.6.4 Settlement expansion in the past three to four decades

In the past three to four decades the city expands the area continued from the previous in between Azezo and Gondar, northern part of Gondar, around Azezo and the south eastern parts, east and west part of the city. (Mihiret, 2015).

Gondar has got three boundaries divided by time intervals those are: - the existing built-up and allocated land, the upcoming long term of Gondar structural plan boundary that is 2015-2025 and beyond this period, and the third the new urban development strategy of the regional government also envisages Gondar and the surrounding rural kebeles, small towns found within a radius of 20km to become one of the three Metropolitan areas in the region .

Now the existing boundary area covers 556.559km^2 it incorporates built-up and allocated land which is going to be built within the 6 urban sub-cities and 23 urban kebele Administration as well as 12 rural kebeles. (Gonder structural plan preparation, 2014).

2.6.5 Trends of land use land cover change in Gondar city

The city of Gondar, where this study has been conducted, is one of the fastest growing cities in the country. The urban area is believed to be in a dynamic state of expansion following the direction of north to south direction. This is may be the topographical nature of the city for this rapid expansion. Especially during the last thirty years in the urban land use conversion in the city is expanded in a very rapid nature with intentional and sprawl condition which is like a leap frog development for many reasons. These were different types of driving forces i.e Biophysical, socio-economic, technological, political or institutional change.

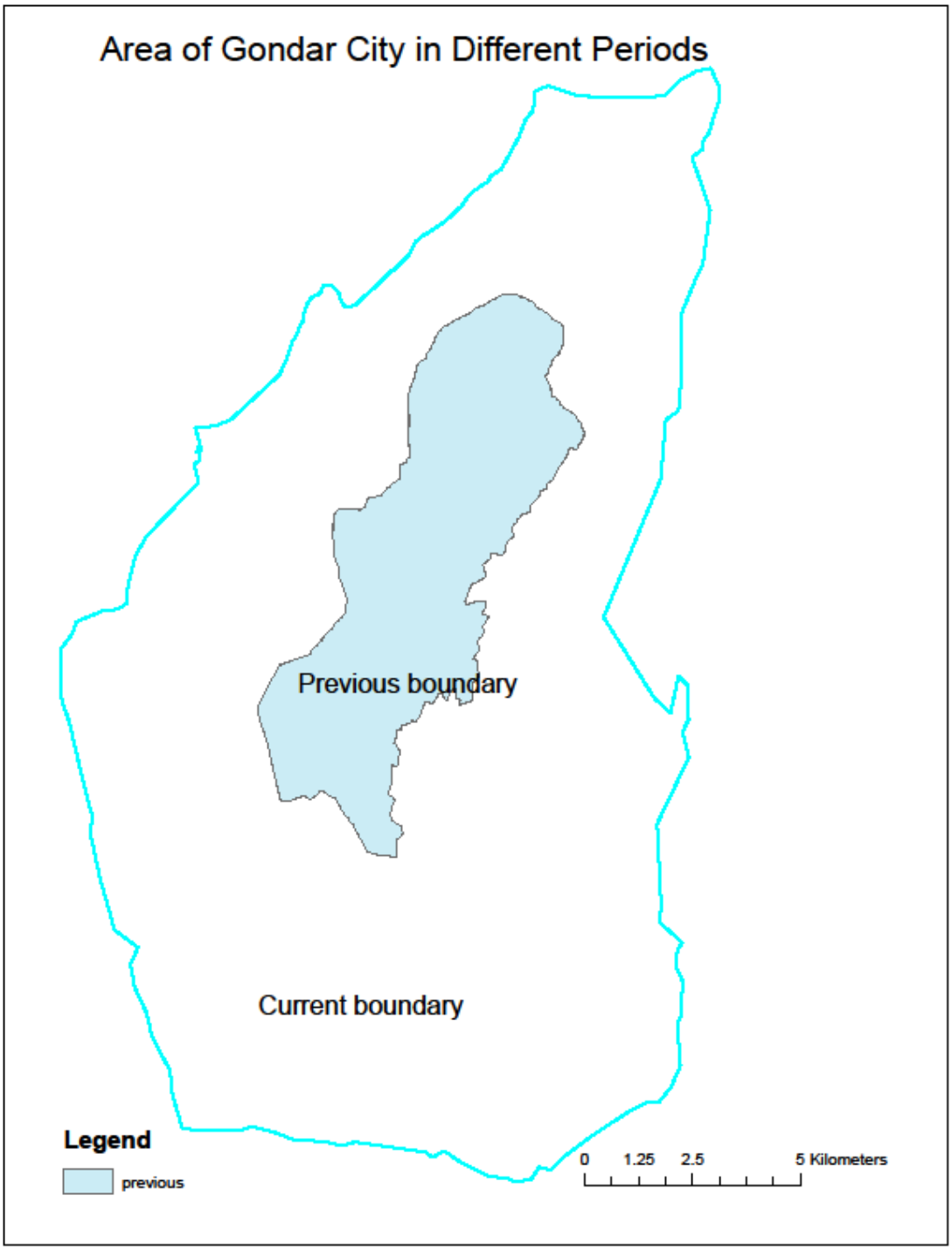


Figure 2: Evolution Map of Gondar (Source: city administration 2019)

2.6.6 Factors for land use land cover change of Gondar till now and the future

The city expansion magnitude increases time to time in the different sub cities that surrounding the city mainly it's South, Southwest and Southeast. For these magnitude and direction of the expansion it is because of many different reasons. Some of these include:

2.6.6.1 Population size and rate of growth: - A population size and its growth rate gives the average annual change in the population resulting from a surplus (or deficit) of births over deaths, the balance of migrant entering & leaving a town. The growth rate is a factor in determining how great a burden would be imposed on a country by changing needs of its people for infrastructure(eg.Housing, Hospital, school roads…), resources(e.g food, water, electricity and jobs) and land for the establishment of all these needs there for population pressure is one of the causes the city to be expanded.

Table 1: Projected population of Gondar city

Growth rate	Projected Gondar town population				
	2015	2020	2025	2030	2035
High variant (6.45%(	380322	519853	710573	971263	1327594
Medium variant (5.63%)	377393	496284	652629	858228	1128598
Low variant(4.8%)	373963	469829	590270	741587	931693

Source: Gonder structural plan computation, 2014.

Table 2: Projected rate of Growth of Gondar City

Study	Year		
	2015-20	2021-25	2026-30
CSA 1994 Low variant	3.9	3.8	3.6
CSA 1994 Medium variant	4.1	4.0	3.8
CSA 1994 High variant	4.6	4.4	4.3
Eyob Defere 2008	4.25	4.05	3.85
Ms consultancy	4.416	4.253	4.116

Source: Long term feasibility study for Gondar City water supply system, October 2012

2.6.6.2 Potential future development needs of the city

The City is located along the road transport corridor to the Sudan. Not only this, Route 7 (Wereta-Azezo-Metema) of the new future national railway line project passes through Gonder at Azezo. Gonder is and will continue to be an important center of collection and distribution of cash crops and also center for international trade i.e. export and import of goods to the Sudan and also Djibouti. The potential of the town for development, existing

universities and envisaged expansions, the town being center of the Tana Catchment growth corridor, future regional and national infrastructure developments. On the other hand currently the city experience investment in the southern part of Gondar, are becoming close to Teda boundary and are only about 2 km apart. New land allocation is being studied by the city's investment office. Gondar also an administrative center of the zone as well as the surrounding rural areas and weredas shall benefit from developments of the city. These requires careful planning and proposing collection and distribution centers, storages, depots, markets, stock markets, public and freight transport terminals, routes, parking, loading and unloading, hotels, motels, and expansion of social and municipal services.(Mihiret, 2015).

2.7 Driving forces for land use land cover change

Assessing the driving forces behind LUCC is essential if previous patterns can explain and be utilized in forecasting future patterns. Land use and cover change can be caused by multiple driving forces that control some environmental, social and economic variables. These driving forces can contain any factor which influences human activities, including local culture, economic and financial matters, environmental circumstances (i.e. greenness, land quality, terrain situation, water availability and accessibility to recreation), current land policy and development plans, and also interactions between these factors. Therefore, these drivers have to be found to pursue these controlling variables. The driving forces will be utilized in order to manage land change. The human race has always used and modified land to meet its material, social, and cultural needs (Briassoulis, 2009).There is a range of factors which drive land use change, all of which tend to interact and influence each other. According to Briassoulis, 2009, the following driving forces are identified for the analysis of land use land cover change study.

2.7.1 Biophysical Factors

These include the range of biophysical influences which can affect land use decisions:

I. Soil type -whether free-draining or not, whether suitable for horticulture compared with pastoral agriculture, how deep the topsoil, how fertile it is.

II. Topography -how flat or steep the land is, the aspect of the land, how suitable for mechanized farming, how prone to erosion.

III. Climate -how much rainfall, how windy, sunshine hours, degree of seasonal variation, how hot or cold it is at different times of the year.

IV. Availability of water –availability of water used irrigation or domestic/industrial consumption, and the quality of that water.

2.7.2 Economic Factors

These include a range of factors which are somewhat loosely defined around "economic", and include:

I. Profit -what are the costs and returns from particular land uses, particularly on a comparative basis?

II. Capital -access to capital for investment, development and seasonal finance. This can vary; at an aggregate level New Zealand is not short of capital, but at an individual level it varies widely.

III. Markets - is there a market for whatever land use is envisioned, what is the proximity to the market.

IV. Infrastructure - whether there is infrastructure available to support the proposed land use is it servicing firms, processing firms, marketing firms. If no infrastructure currently exists, what is the likelihood/speed of development? Infrastructure also relates to access to road transport and other transport infrastructure, e.g. airports, ports. Infrastructure can also involve "landscape" factors such as availability/accessibility of irrigation and/or land drainage systems, and water supply networks.

2.7.3 Technological Factors

This relates to understanding the current technology around a particular land use, and/or understanding how technology or farm system management knowledge is changing, which may allow for a land use change previously not thought possible. For example, the development of aerial top-dressing enabled significant fertility improvements on steep hill country, and significant increases in stock numbers on this land generating more economic hill country farms, which previously could only carry a low number of stocks of particular classes.

2.7.4 Regulatory Factors/Governmental factors

The regulatory factors which have a direct potential to affect both land use and land use change. This potential can act in one of two ways: regulations around discharges (e.g. particulates, smell, agri-chemicals, nutrients, greenhouse gases) could restrict or promote land use change, and other regulatory/incentive frameworks (i.e. taxation, subsidies) can also influence land use change.

2.7.5 Societal factors

Include wider driving forces such as population change and the demand for land for urban settlement, changes in food preferences which may result in demand for a "new" food, or a decline in demand for an existing food product.

2.7.6 Individual Factors

This covers the wide range of difference in individuals which may affect their thinking around land use change. It would include aspects such as age, education and experience, family circumstances, attitude to risk, access to capital, access to information, and attitude to change. This comes down to personal preference; a farmer running livestock on land suited to horticulture will (often) not necessarily change land use they prefer livestock over plants, for a variety of personal reasons.

2.8 Determinants of land-use change

Land-use change can be described by the complex interaction of behavioral and structural factors associated with the demand, technological capacity, social relations affecting demand and capacity, and the nature of the environment in question. It is doubtful that a relatively simple explanation of why we transform the environment the way we do will be forthcoming (Turner et al, 1990). A theory of land-use change needs to conceptualize the relations among the driving forces of land-use change, their mitigating processes and activities, and human behavior and organization. Although no single all-compassing theory of land-use change exists, different disciplinary theories can help us to analyze aspects of land-use change in concrete cases, their synthesis being essential.

2.9 The use of GIS and remote sensing in spatial data analysis

GIS data sources which can be referenced spatially can be used in this type of environment such as digital map of soil type, land cover classes, forest species, road networks and many others, depending on the application. It is now being widely used in land use change management (Basudeb Bhatta, 2013).

GIS can analyze large amount of spatial data. This allows for better understanding of environment processes and better insight into the effect of human activities .The GIS and remote sensing can help people arrive at informed decisions about their environment. GIS and field observation in a common denominator so that the maximum possible information

can be accumulated and analyses with maximum possible efficiency and reliability. Accordingly GIS helps in this study the following main activities.

Remote sensing: Remote sensing refers to the science or art of acquiring information of an object or phenomena in the earth's surface without any physical contact with it. And this can be done though sensing and recording of either reflected or emitted energy or the information being processed, analyzed and applied to a given problem (Campbell, 2002). Remote sensing of land use/land covers by integrating current knowledge and scientific understanding and provides an outlook for the future. Specific topics emphasize current and emerging concepts in land-use/land-cover mapping, an overview of advanced and automated land-cover interpretation methodologies, and a description and future projection of the major land-cover types of the world (Chanara et al., 2012).

The primarily goal of remote sensing is not only the pursuit of knowledge, but also the application of any knowledge gained. Visual and digital image processing helps this goal further by allowing scientist to manipulate and analyses the image data produced by the remote sensors in such a way as to reveal information that may not be immediately recognizable in the original form (Basudeb, 2011).This integration also provides an important application for mapping land use land cover classification and change detection.

2.9.1 Geo-referencing of the image

Geo-referencing refers to the process of correcting raster or vector data to overlay a ground measurement coordinate system. This enables the assignment of ground coordinates to the different features in the datasets. If the map projection (and map projection parameters) of the ground coordinates are known, equivalent geographic coordinates (degrees of Latitude and Longitude) can be produced which enables positioning the features of the coverage into a World context. Once datasets are in a World context, they can be merged with others that exist in overlapping areas. This can be accomplished for datasets with the same or different map projections. (http://www.gisat.cz/images/upload/1718f_georeferencing)

2.9.2 Image mosaicking

Image mosaicking overlays two or more images that have overlapping areas (typically geo referenced) or to put together a variety of non-overlapping images and/or plots for presentation output (typically pixel-based). Individual bands, entire files, and multi resolution geo-referenced images can be mosaicked. We can use mouse or pixel-pixel or map-based coordinates to place images in mosaics and we can apply a feathering technique to blend image boundaries (Morshed Anwar, 2002).

2.9.3 Image classification

Image classification is a complex and time-consuming process. In order to improve the classification accuracy, the selection of appropriate classification method is required. This would also enable the analyst to detect changes successfully (Elnazir et al., 2004). There are different types of image classification techniques. However for this study, the supervised classification was applied. It is a type of the classification that is based on the prior knowledge of the researcher of the study area. It requires the manual identification of point of interest areas as the reference (Ground Truth) within the images to determine the spectral signature of identified features.The image classification was performed considering Maximum Likelihood Algorithm.This is a parametric decision and its rule is based on the probability that a pixel belongs to a particular class (Eguavoen, 2007). The maximum likelihood classifier forms the power classification as it is implemented quantitatively to consider several classes and several spectral channels simultaneously. This classifier has been reported to provide the higher classification accuracy in LULCC study (Foody, 2002). Therefore, this classifier was considered as the most suitable for LULCC analysis in this study.

2.9.4 Accuracy assessment

Accuracy assessment is a post-classification operation because the classified results were not thoroughly validated and the accuracy assessment is important. According to Foody (2002), the accuracy assessment generated randomly training samples and analyzed the confusion matrix. The error matrix allows us to calculate the following accuracy metrics:

- Overall Accuracy
- User's accuracy
- Producer's accuracy
- Accuracy statistics (e.g., Kappa)

2.9.4.1 Overall Accuracy

Overall accuracy is the easiest to calculate and understand, but ultimately only provides the map user and producer with basic accuracy information. The diagonal elements represent the areas that were correctly classified. To calculate the overall accuracy by adding the number of correctly classified sites and divide it by the total number of reference site.

2.9.4.2 Producer's Accuracy

Producer's Accuracy is the map accuracy from the point of view of the map maker (the producer).This is how often are real features on the ground correctly shown on the classified map or the probability that a certain land cover of an area on the ground is classified as such. It is also the number of reference sites classified accurately divided by the total number of reference sites for that class.

2.9.4.3 User's Accuracy

The User's Accuracy is the accuracy from the point of view of a map user, not the map maker. The User's accuracy essentially tells us how often the class on the map will actually be present on the ground. This is referred to as reliability. The User's Accuracy is calculating by taking the total number of correct classifications for a particular class and dividing it by the row total.

2.10 The importance of land use land cover change information in urban planning

In many countries there have been significant changes in land use /land cover as a consequence of development process (Scholten et al.,1999).Historically, more land has been used for agricultural and urban purposes. The lack of collection of land use/land cover data or information at national, regional or local level is increasingly important to determine the likely impact of specific projects or policy in advance of their implementation .Recently, with land use/land cover data available on a digital basis from remotely sensed data and GIS, the lack of information on land use land cover change can be eliminated. Therefore, knowing the land use land cover information of a certain urban area helps to a better understanding of the overall management of that particular urban area. The following figure 3 shows how current land use land cover information a base for other information in spatial planning point of view.

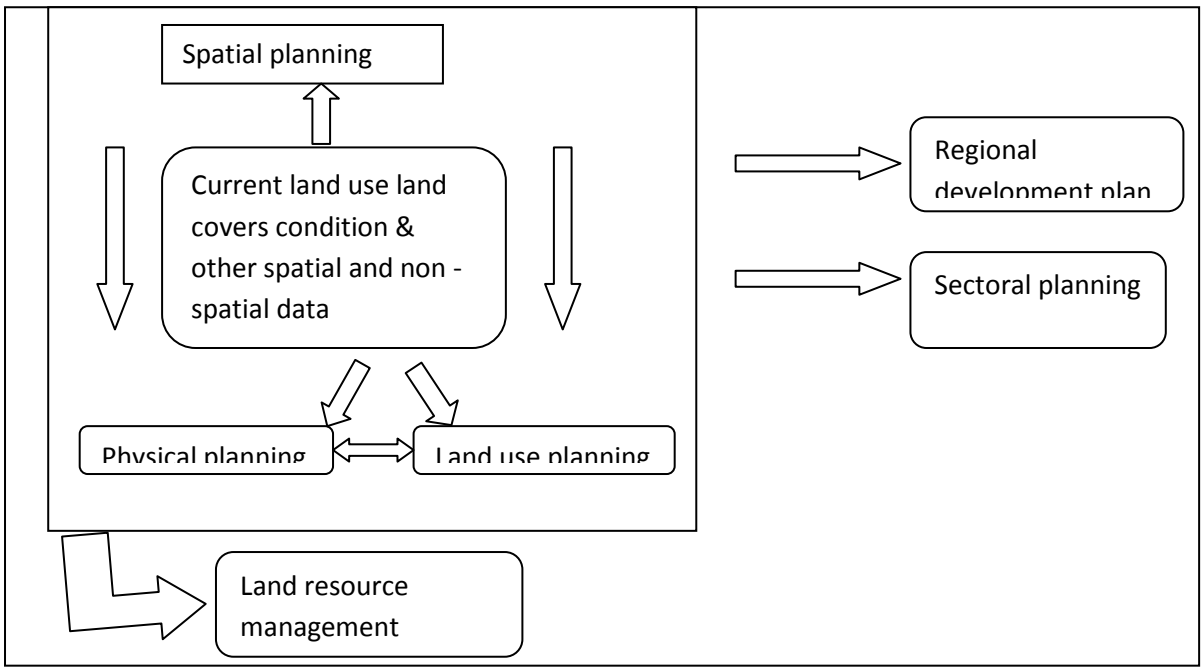


Figure 3 Land use Land cover information in spatial planning (Source: Asep Karsidi ,2004)

2.11 Policy issues on land use

Land Use Restrictions: General Land use control refers to the body of laws and regulations which limits the use rights of a land and a building. These laws can be found in the Ethiopian civil code itself and in different other legislations such as urban planning, building legislation, forestry, water laws, and environmental laws and so on. We may begin by briefly considering why the law makes it possible in certain cases to regulate land use and to acquire land and property rights by compulsory purchase (expropriation).Heilbrum indicates two central criteria to be taken into account in decisions concerning land use: Efficiency and equity are two of the general criteria to be applied in comparing alternative (economic) policies. To the economist, efficiency means the most productive use of resources to satisfy competing material wants. In order for the market to function efficiently, certain conditions have to be satisfied. There are the wider effects of the land use, effects which are not reflected in the market price and cost of the development. Externalities are sometimes referred to as spillover or neighborhood effects and in the context of land use typically include visual intrusion, increased traffic, pedestrian and resident inconvenience and congestion of existing public facilities. These market failure, then, mean that the market cannot, unaided, guarantee the efficient management of resources. In other words, they justify public intervention with a view to correcting malfunctions of the market and to co-ordinate land-use activities.

Planning law can an owner of a building change the plan of the building? Can he build a new building on the land leased or demolished it whenever he wishes it? A study of planning and building legislations of different countries of course reveal some difference between them. One fundamental principle, however, is distinguishable, including Ethiopia. A change the use of such building requires a permit. Basically change can be divided in to three categories: construction of new building, work on existing building, and demolition of the building. This means use of land d building becomes under extensive official control.

At Federal level a proclamation that provides for urban plans has been adopted under Proc. No. 574/2008 which governs the above kind of regulations. Among others it 226 empowers municipalities to control land use in urban areas. According to article 25 of the proclamation, "no development activity may be carried out in an urban center without a prior development authorization." In this case the word "development" is defined as, "carrying out of building, engineering works, mining or other operations under the ground, or the making of any substantial change in the life of any structure or neighborhood (Art. 24)" The above article hence includes the two aspects, i.e., constructing a new construction and making a change on it. So as you may know, people after getting a plot of land must get a building permission to construct a new building.

Since, the law also provide that urban plans must contain rules about zoning, height of building, housing typology etc (art.11(3)) owner of a house may not the type and design of the house in a way that violates the planning laws, and as a result owner must secure prior permit. The other point is that owner of a building may not demolish it without a permission as envisaged under article 32 of the proclamation. Environmental concerns Other legislation which relate to environment (proc. No. 300/2002), provides different restriction on property owners concerning management and release of dangerous and hazardous activities that may damage the environment. It among others prohibits people from emitting or releasing, toxic substances, chemical, or radioactive substance from their property that harms human health and wellbeing, the biota and the aesthetic value of nature.

2.12 Empirical literature

The practice of Portugal at the regional level (NUTS II) from 1995 to 2010 and discusses the main driving forces and implications associated with these LUCC. (Meneses, B., Reis, E., Pereira, S., Vale, M., & Reis, R. (2017). Understanding driving forces and implications associated with the land use and land cover changes in Portugal. *Sustainability*, *9*(3), 351.)

1. Introduction

The land use and land cover (LUC) of territories is changing and these transitions have influences in the landscape. The evaluation of these changes, both spatially and temporally, is increasingly important in the context of the sustainable use of the territories. The evaluations of land use intensity and also the land use and land cover changes (LUCC) with environmental, economic and social impacts are particularly important in this context.

Methods for the preparation of land cover mapping have evolved, in particular, the methods of data retrieval by remote sensing (supervised or unsupervised analyses) that fostered the proliferation of studies about LUCC in different territories and scales.

Landscape changes have been evaluated around the world by different authors, using different models and tools (e.g., artificial neural network, Conversion of Land Use and its Effects at Small regional extent—CLUE-S, Dinamica EGO, Cellular Automata (CA) MARKOV, Land Change Modeler-IDRISI, Cellular automata, Multi-Agent Systems, Spatial autocorrelation, GWR, etc.) and different geographic datasets (thematic maps, satellite images, institutional LUC cartography at different scales, among others). Deforestation is currently a major problem due to its large effect on the reduction of air and water quality and climate changes. These LUCC have indirect influence on the environment and contribute to the reduction of the quality of life, and further affect all living beings that depend on specific life conditions in the territories subject to these LUCC. In some countries, forest land has been turned into agriculture land. In order to maximize the agricultural production, some soils are being intensively exploited through the use of machinery and agrochemicals. However, the intense use of these soils generates negative impacts that contribute to the physiochemical and biological degradation of them, some of which are currently undergoing desertification process.

Another current issue is the high artificialization of soils, mainly explained by the urban expansion process that includes the construction of roads, telecommunications infrastructures or urban facilities. Soil sealing reduces the infiltration of rain water into the soil and consequently the runoff increases, often causing floods, loss of human lives and material damage. There are several research studies involving LUCC assessments that aim to identify the driving forces and studies about the impacts on the environment, economy and society, and its influence on the development of the territories. The driving forces of land changes have been categorized into different types, such as economic, cultural, social, political, and, in some cases, may include two or more categories simultaneously. However, the changing patterns can be the result of a complex interaction between different driving forces at

different scales of action and LUC. The proven relationships between the LUC and economic variables have been analyzed and explained in detail. It is also important to consider the temporal component of the driving forces in this analysis in order to understand if these have the same influence on LUCC over time, but also to figure out if these temporal variations are similar (among regions). Landscape changes that occurred in the last decades in Portugal have been evaluated in some parts of the territory and in different contexts, such as the LUCC estimation in the LANDYN Project, in the reporting of emissions and carbon sequestration in the LUC sector and in governmental reports, and other publications revealing clear evidence of LUCC. These studies show that the great landscape transitions that occurred in the last decades in Portugal derived largely from LUCC along the coastal areas with the increase of land artificialization and reduction of forest land due to forest fires and anthropic actions.

The evaluation of LUCC is crucial for landscape changes assessments and evaluation of territorial dynamics, as well as for the implementation of new investments, policy development (sustainability development) and spatial planning actions among others. However, the assessment of landscape changes that quantifies the full spatial variations to allow regional differentiation, as well as the temporal variations to identify the main driving forces, has not yet been made in Portugal. The identification of driving forces associated with LUCC has been done in different locations and in different contexts in Portugal, e.g., LANDYN Project, detecting the relationship between LUCC and the resulting impacts on natural resources, such as water.

On the other hand, these studies do not address the identification of the relationships between LUCC and socio-economic disturbances in land-use planning. This topic has already been studied by other researchers albeit in other study areas. In this context, the current research has the following objectives: (a) to quantify the LUC types (level I of LUC cartography) by NUT II in Portugal for the years 1995, 2007 and 2010; (b) to assess the spatio-temporal changes (LUCC); and (c) to identify and discuss the main driving forces of LUCC and corresponding implications (socio economic and environment factors).

2.13 Research Gaps

- ✓ During the last few three decades the growth of Gondar city was dramatic.
- ✓ The population of the city grew from 109,817 in 1991 to 390,644 in 2019 (City Administration 2019) resulting in pressure on the city to avail more land for different purposes.

- ✓ Besides, the Area of the city expanded from 8.7 hectare to 26,027.6 hectare (Figure 1 Shows the change in area from previous to currently).
- ✓ The growth of the city brings a change in land use land cover.
- ✓ These land use land cover changes has many causal factors.

This requires an assessment of the past and existing land use and land cover change and its driving forces that brought the change.

2.14 Parameter for the selection of Future expansion Direction

In order to avoid or minimized the negative effects of urban expansion parameters were developed to guide professionals working in this area for the selection of expansion area the the following criteria defined by the urban planning institute:-

a. Availability of suitable and sufficient open area for expansion;
b. Availability of infrastructure or ease of expansion;
c. Existence of natural and man-made constraints;
d. Suitability and preference of the areas for human settlement;
e. Fertility of the area for agriculture, soil condition and suitability for construction;
f. Existence of natural resources: underground water, minerals, quarry reserves;
g. Suitability of topography and land form;
h. Existence of historical site;
i. Existence of reserved areas: forest, irrigation and dams;
j. Existence of settlements;
h. Suitability of the micro-climatic condition

2.15 Lesson learned

Urbanization process is one of the important global land use/land cover change. Rapid urbanization causes disorganized and unplanned growth of the towns and cities. The pressure of an ever growing population becomes the burden on the limited civic amenities which are virtually collapsing; there is the need to balance present requirements of land against future needs. This Rapid urbanization also promoted the economic and social development as well as a physical land use land cover change. To understand the change Land use land cover information is a very important aspect in the management of urban areas. Land cover serves as an important source of information for both the scientific and business communities, and remote sensing represents a cost-effective method to generate land cover information. The

ability to analyze remote sensing data is important because it allows changes in earth's surface to be monitored as they occur.

The term land cover relates to the type of features present on the surfaces of the earth. Water bodies, forest area, grass lands and wetlands are all examples for land cover types. The term land use relates to the human activity or economic function associated with a specific piece of land.

Urban Land use planning is also the systematic assessment of urban land and its potential, alternatives for land use and economic and social conditions in order to select and adopt the best land-use options. Its purpose is to select and put into practice those land uses that will best meet the needs of the people while safeguarding resources for the future. The driving force in planning is the need for change, the need for improved management or the need for a quite different pattern of land use dictated by changing circumstances.

The Spatial evolution of Gondar City starting from its previous settlement quarters to the present expansion trend of the settlement of the City seems to be concentrated around the Imperial compound, Fasil castle. The main direction however follows a south and southeast areas of the Gibbi were reviewed which is important for the development of the methodological part. The different types of driving forces and their indicators are identified which helps for the analysis part. Besides, the use of GIS and remote sensing in the study of land use land cover were reviewed to understand the land conversion trend in the study area. Moreover, the review focuses on image georeferencing, image classification and accuracy assessment which help in the design of methods and materials section.

Chapter Three: Materials and Methods

3.1 Study Area and its description

The study area is located in northern part of Amhara National Regional State and capital of Central Gondar Administrative zone. It stretches along a ridge in the northern Ethiopian highlands. The city sits at an elevation of 2,200 meters, and is surrounded on three sides by a crown of 3,000-meter high mountains; the climatic zone is weyina dega.(Tewdros Ferede 2012).The Average temperature of the study area is 20°C and has a population number of 390,644.Gondar City covers an area of approximately 5560 hectares of land. The city expands to the south, the landscape opens to a valley and distant views of Lake Tana, and source of the Blue Nile is situated 735 km far from Addis Ababa and 180 km from the regional capital Bahirdar.

The rainfall pattern of Gondar, as information obtained from meteorological station, is Unimodal and characterized by single maximum rainfall pattern with peaks in July and August about 80%-90% of the mean annual rainfall falls in the main rainy season ("Kiremt"), which starts in June/July and extends to August/September. Rainfall variability in time is considerably high especially at the beginning and end of the main rainy season. The rainfall records for 51 years shows that the average annual precipitation at azezo airport is about 1,172 mm. Moreover, the Soil Characteristics of the study area in accordance with the FAO classification the city has grouped into three major categories: Eutric cambisols (stony phase), Eutric cambisols (lithic phase) and Lithosols. Besides, the city is covered with trees, shrubs, grasses and bushes.

The city has also farms, trees within plots, government institutions, churches and mosques, sloppy areas, hills and mountains and has relatively rich green frame. The natural setup of the city contributed to the rich green frame because un-built able areas including river banks, low-slope areas, hills and mountains are covered by trees. Eucalyptus tree is the most abundant tree in the city. This is mainly due to the commercial value and the short time needed for maturing. However, these trees are found to have poor land protection. Other cultivated tree species in and around the city includes: camaldulensis, Shinus mole, Phoenix reclinata, Delonix regia and Cupressus lusitanica (NIRAS, 2012). (Situational analysis of Gondar structural plan proposal, 2014/. The Economic structure of Gondar City, according to the survey result of Gondar structural plan preparation in 2014/15 shows that the people of Gondar engaged in different activities of which 37.6%, 24.8% and 24.5% of the household produce fruits & vegetables, crops & pulses and animal husbandry respectively. However;

some 9.7% of the household produced mixed products and engaged in retail activities, while 3.4% produce tubers.

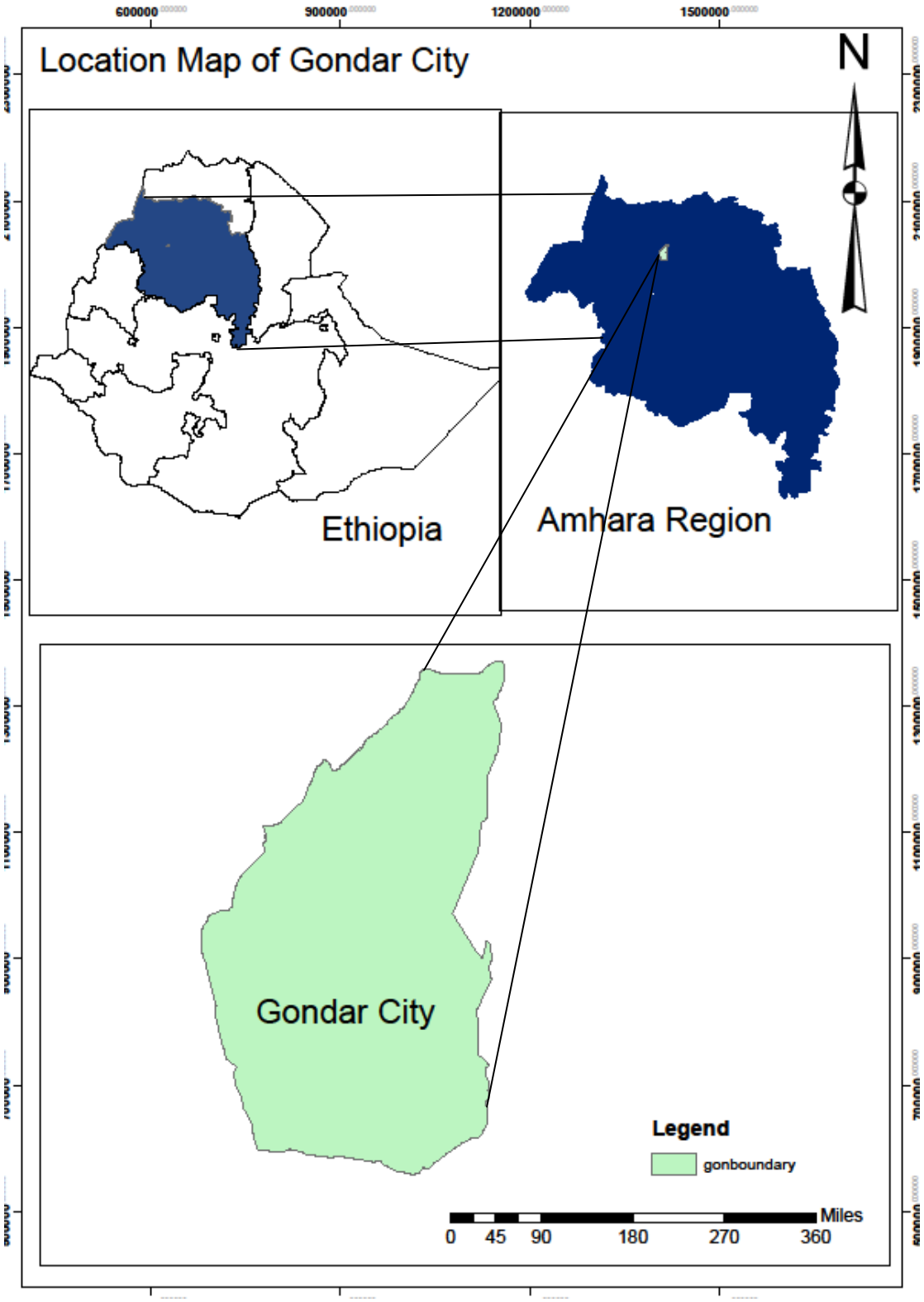


Figure 4: Location map of Gondar city

3.2 Research and Data types

The study was employing a descriptive type of research design to make intensive investigation of the extent of urban land use conversion in the study area. Hence, to maintain triangulation in its findings, the design was conducted using qualitative and quantitative research approaches. The overall research procedure is depicted in Figure 8.

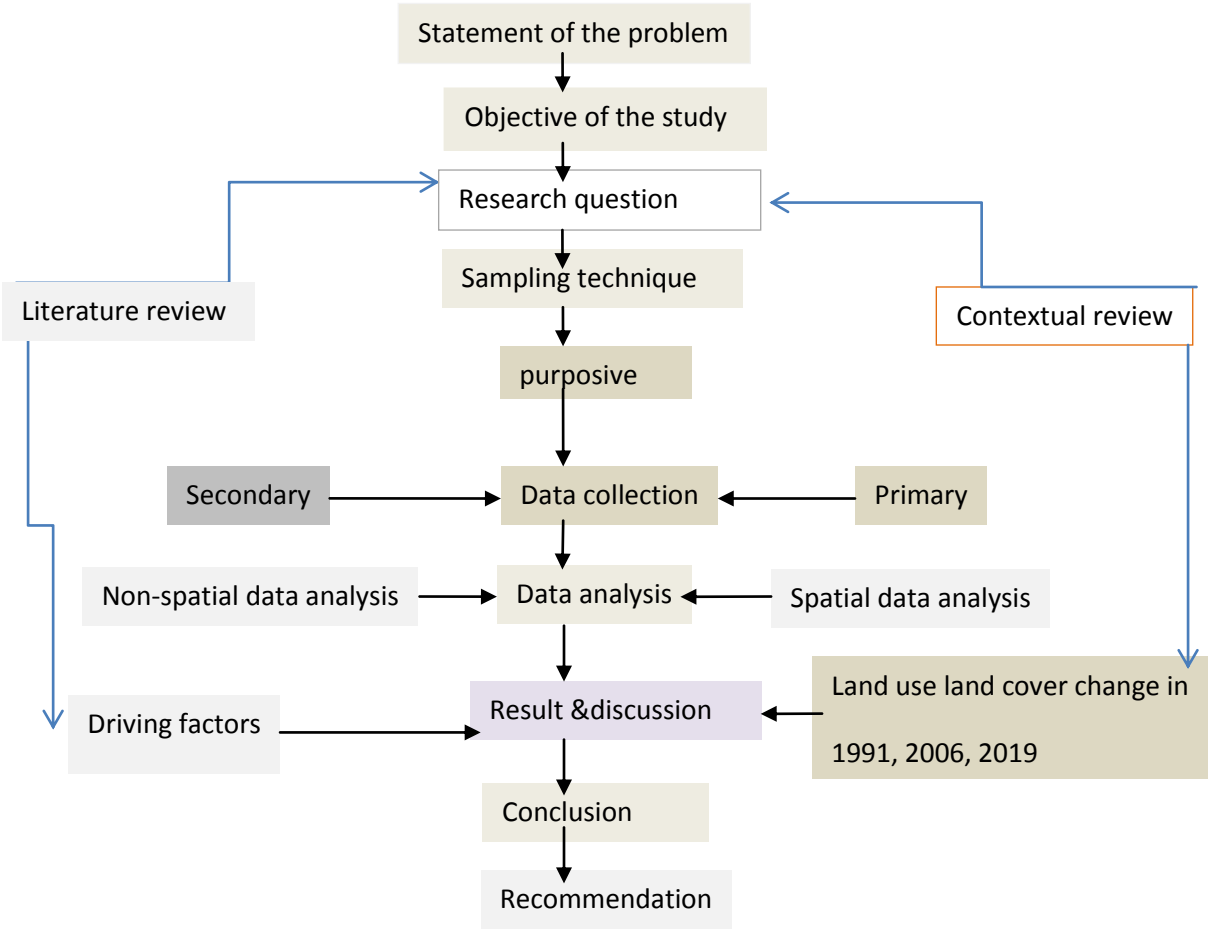


Figure 5:Research design flow chart

3.3 Data sources

The research was involved the combination of both primary and secondary data sources by which it had been supported by spatial data. Primary data sources were collected using open ended and close ended questionnaires, structured interviews for farmers, elders, city dwellers. Moreover, to triangulate the data collected from these sources, it was supported by google earth image and CAD files. The secondary sources were collected from books, journals, research reports, and papers, magazines, newsletters and newspapers, and internet materials. Moreover, before conducting the actual research a reconnaissance survey was conducted to know the current existing condition of the city. Accordingly, the recent imagery of the city

was downloaded from google earth and by geo-referencing it and used to understand the physical characteristics of the study area. It was also assisted by visual observations for updating the current land use of selected sites for the identification of surface features and land-use types. The physical observation was included new and upcoming urban developments, current state of agricultural land parcels in the area, infrastructure expansion, commercial or industrial areas, forests.

3.4 Sampling techniques and sample size

3.4.1 Study Population

The target population includes government institution such as land administration, urban planning, Cadaster, road authority, economic development and agricultural office in the city administration. Moreover elders and previous city administrators that have a knowledge about the trend of the urban growth, the city administrator in special occasion constructs kebele houses for the poor in different sub-cities around the periphery of each sub-cities after 1997EC, rural communities dislocate from their land taking compensation in different years and urban communities that take the land through cooperative organizations , those getting permission from the city administration for other use of land in recent years .

3.4.2 Sample Size Determination

In order to determine an adequate sample size, the standard statistical approach equation had been employed (Fowler, 2002). Accordingly, the size of the sample (n) was given by; $n = z^2 * p (1-p)/d^2$, where, n=desired sample size when population is greater than 10,000

Z= the standard number variable at a required level of confidence which is 95% with the z score is 1.96 for this study

p=the proportion of target population estimated to have the characteristics being measured which is 50% for this study (this proportion is the common for the studies whose variable are not estimated yet)

q=1-p ,The standard value of the confidence interval or margins of error,d, is 5%.

Thus,$n=z^{2*} p * q/d^2$=> (1.962) (.5*.5)/$(.05)^2$=>**385**

The distribution of households in the study is presented in Table 1.

Table 3: Distribution of sample household

s.no	Study population	Sample HHs	Percentage of HHs	Remarks
1.	Cooperatives	190	49.35%	From 95 cooperatives 2 individuals each were taken
2.	farmers	60	15.58%	For six consecutive years of displaced farmers 10 samples were taken in each year
3.	Informal settlers	66	17.14%	From two sub city 25 each and from one sub city sixteen hhs taken randomly
4.	Professionals	24	6.23%	From six offices and two Subcity three hhs each selected purposively
5.	Poors living in Kebele houses at the periphery	42	10.91%	seven hhs selected from each sub cities purposively
6.	Elders	6	1.56%	Six elders are selected from one from each sub city
	Total		100	

The households were purposively selected due to the fact that they are assumed to have knowledge of the issues raised by the present study. The number of households under each study population was different. This was done purposively to take more views based on the proportion of households who settled in the period.

3.5 Data Collection Methods

The data collection methods employed in study includes questionnaires, key informant interview and physical observation.

3.5.1 Questionnaires

Questionnaires were prepared for institutional officers with purposive methods because these officers have had enough knowledge and have a direct contact with land use conversion in urban areas, and they had a great understanding about the factors/forces that bring a change during the last few years and more in the study area. Purposive sampling technique was used in the selection of institutional respondents from land administration, urban planning,

Cadaster, road authority, economic development and agricultural office both from the city administration. Moreover, from two sub -cities professionals were included experts related to land use change aspects because they had a direct or indirect role in one way or the other regarding the land use conversion. For this purpose 24 respondents were selected from the city administration to get the required information.

In addition, in different years ago the city administration tries to solve the housing problem of the residents and the economic challenges of the city dwellers with a special emphasis to the poor constructing kebele houses and provided to them. In doing so, the city dwellers know everything or have enough information. Therefore the researcher was assessed those individuals taking compensation and received Kebele houses from the city administration on the periphery site of the city and took their list from the land management department and organized by sub city and was took the required sample data from each sub city. Choosing the sample data of land owners and local residents within the sub-cities using purposive method help to avoid costly and time as well as redundancy. The questions which were presented to the respondents are presented in Annex 1.

3.5.2 Key Informant Interview (KII)

For the sake of in-depth understanding of the historical trend of urban expansion, KII was conducted with elders and previous city administrators. Generally, the researcher was used purposive sampling technique for getting information from elders who knows the spatial expansion of the city in the last three decade. To do this activity the city has six sub cities from these six sub cities the researcher was selected six elders one from each sub city. Here the general issue of discussion under this part was include factors of LU-LC, before and after conversion, the forces behind the land use conversion, identifying the major determinants of land use land cover change in the city when putting in hierarchical order and the solution forwarded. The questions which were presented to the KII are presented in Annex 1.

3.5.3 Physical observation

Checklists were prepared to observe the existing condition of the study area (refer Annex 4). The main points which be included under the checklist includes current status of land use of the area, classification of land use with a dominant type of land use, previous land use, the topography of the area, main road outlets, density of settlements, sprawl characteristics of settlements, new and old settlements.

3.6. Mapping the existing land use land cover changes (Remote sensing & GIS)

Using the city's base map the existing land-uses were mapped using ArcGIS (version 10.2). Furthermore, google map images of 1991, 2006 and 2019 were used to trace back the previous land-use - land cover of the study area. The google image intervals were selected to consider the major land-use changes that happened with the emerging of EPRDF regime, the 1997 E.C. (2006) election period and the present situation.

3.7 Data Analysis Methods

3.7.1. Mixed impeded and concurrent Data Analysis

3.7.1.1Variables and Indicators were used in the Analysis

In this paper six variables and their indicators were selected for scoring from different literature. Accordingly, during data collection the variables that get the highest score were the highest driving force for the land use conversion in the study area after adding each indicator and taking their average mean result and then making the rank of each variable. The first with the highest ranked score amongst the variables are used. The data that was collected from different sources were analyzed using ArcGIS, excel and SPSS. The qualitative data were also narrated.

Quantitative data analysis; was analyzed through the frequency distribution tables and makes use of relative measures, such as percentages, which includes the mean and finally tables, maps and graphs were prepared. The Mean score and Weight of Each Indicator were used in determining the weight of each driving force variables in terms of degree of influence in the study area. The respondents were asked to give score or quantify the indicators (out of 10) in order of measuring the influence for the land use conversion of driving factors in which biophysical, economical, technological, regulatory, societal and individual factors as a reason for occurring a land use land cover change in the study area.

The criteria were scored from 1 to 10, where 10 were the maximum influence to bring the change with respect to driving forces. Qualitative data analysis; the data that were collected from various sources were analyzed following a detail description according to the pattern and themes that emerge during questionnaires and interview from respondents. Data regarding the driving forces of land use conversion that were not analyzed quantitatively was analyzed qualitatively. Based on the analysis the major driving forces were presented using a scoring method.(ref. table 14)

3.7.2.2 Geo-referencing of the three different year image

The process of geo-refercing employed the standard methods of ESRI, as presented in section 2, sub section 2.9.1 Moreover, the various georeferncing techniques were reviewed from (http://www.gisat.cz/images/upload/1718f_georeferencing. These techniques include:

-The three year image date of acquisition (10/26/1991 , 11/16/2006 and 1/23/2019) google earth image was added to Arc 10.2

-Using control points by taking four different point coordinates were entered

-Rectification of the image was made and saved.

3.7.2.3. Image classification

Image classification is a complex and time-consuming process. In order to improve the classification accuracy, the selection of appropriate classification method was required. In this study the following classification techniques were employed.

- ☞ The Supervised classification technique was used
- ☞ Training sites were chosen for each of the four classes
- ☞ After clustering the pixels to the required class each class was identified
- ☞ Maximum likelihood classification was processed
- ☞ The three year images were classified

3.7.2.4 Accuracy assessment

The need of accuracy assessment is that we need to show whether the pixels that are classified or a particular class classification actually belongs to that particular class or not. Or it is the agreement between the classified image and the reference image. For this technique the following activities were performed.

- ☞ In Arc GIS 10.2 by using Arc tool box random points were created
- ☞ 50 sample points each were taken for the three year image
- ☞ Shape file was created
- ☞ Shape file was changed into KML file format
- ☞ The KML file with random points were opened in Google earth image
- ☞ Truth points were filled in attribute tables of Arc GIS

- ☞ Error matrix table was developed
- ☞ Accuracy assessment percentage was formulated

3.8 Data Presentation

The analyzed data were presented using statistical tools such as Tables, Graphs, Charts, and maps.

Chapter Four: Result and Discussion

Introduction

This part of the research thesis deals with the description of the general characteristics of the sample respondents and then information's are presenting, analyzing and interpreting. The collected data getting from housing associations through cooperative, informal settlers, farmers displaced from their farm and key informants such as professionals ,city dwellers who are poor and getting kebele houses after 2007 E.c interviewed through conducting questionnaires and interviews.

Moreover, google earth images of the year 1991, 2006 and 2019 were analyzed for the trend analysis of land use land cover change of the study area.

Generally, both the socioeconomic and the spatial data result were processed with different approaches and bring the following result.

4.1 General background of the respondents

The description of the respondents are presented in Table 4.

Table 4:Sex, family size & living year in the town

s.r no	respondents	Sex of HHs heads Of the respondents			Total family size	Year of living in the city		
		Male	Female	total		10 to 15 years	16 to 20 years	Above 20 years
1.	Cooperatives &professionals	162	52	214	632	28	151	35
2.	Informal settlers	58	2	60	147	29	25	6
3.	Residents (poor of the poor)	24	16	40	233	2	16	22
4.	elders	5	0	5	46	0	0	5
5.	farmers	36	3	39	313	0	0	39
Total		285	73	358	1371	59	192	107

(Source: Households survey, 2019)

As shown from Table 4 most of the respondents (53.63%) lived from 16 to 20 years and 29.89 % of them lived above 20 years (refer Figure 6).This shows that the respondents might have enough knowledge about the land use land cover change occurred in the city during the last three decades because they lived a long time and have an opportunity to see in the last

three decades. Moreover, from the total respondents about 83.52% lived above 16 years. This implies that if someone lives a long time in a certain place, they can understand the physical change of the area.

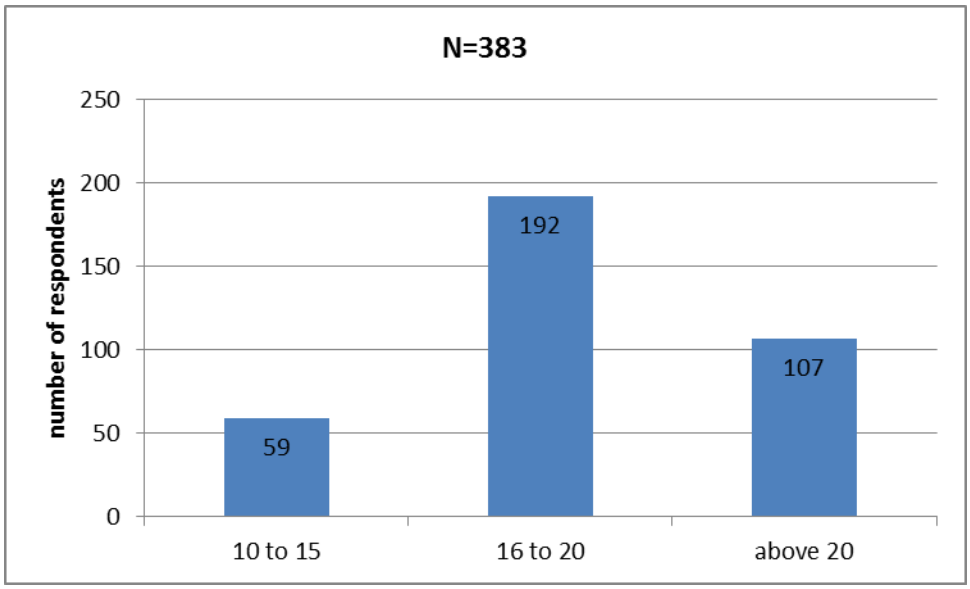


Figure 6: Year of living in the city (Source: from survey data, 2019)

Figure 7 shows the gender distribution of respondents, out of the total 358 samples majority 72.07% of the sample respondents were males (male-headed households) and 20.39 % were females. This implies that males have more exposure than females for the physical environment.

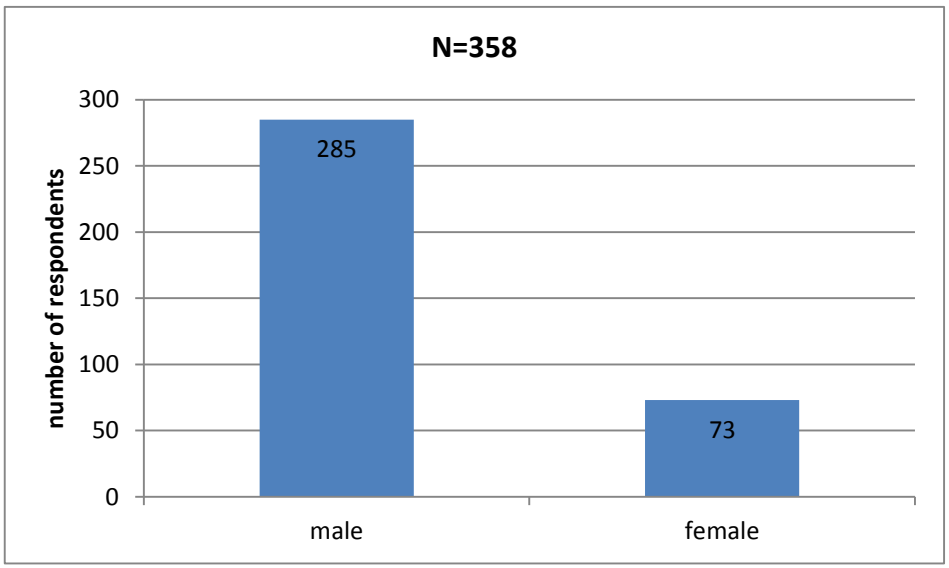


Figure 7:Sex of respondents(Source: survey data, 2019)

In the study area total family of the sample were 1371 refer (Table 4) with the average family size of 3.8 per household. AS figure 8 shows 61.73% had a family size of one to three families, While, 37.43% had a family size of four to six. In the contrary, a smallest family size which shares 6.42% had a family size of seven to ten.

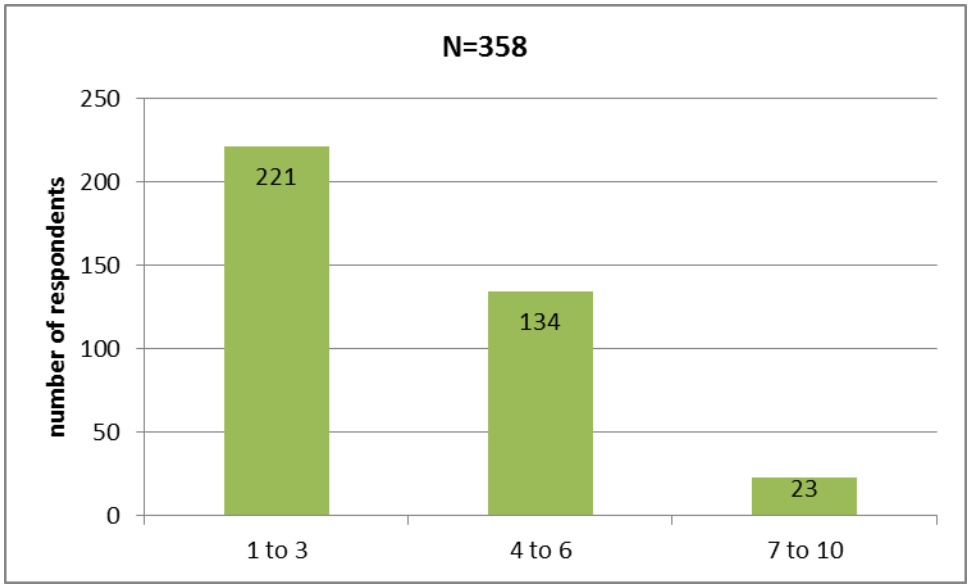


Figure 8:Number of family of the respondents(Source: survey data of 2019)

4.1.1 Age, level of education and marital status

4.1.2.1 Age

The age group structures of the respondents, majority of them 38.83 % were aged between 31-40,28.49 % were between 41-50,about 17.88 % were 51 and above and 53%from 20-30 age group structures. This means the majority were middle age households which is active age group. The graph shows more or less a fare distribution. Refer Figure 9.

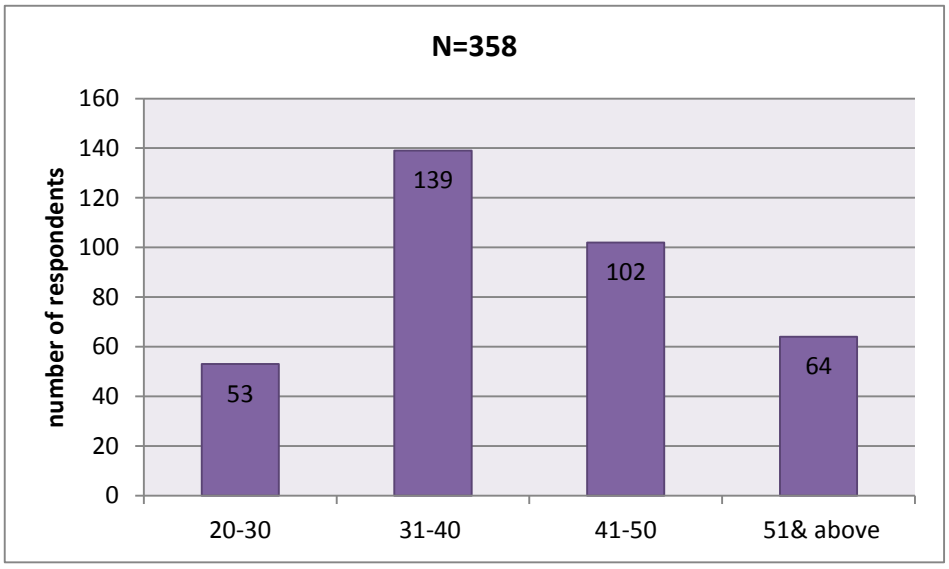


Figure 9:Age of respondents(Source: survey data, 2019)

4.1.2.2 Level of education

The educational background of the respondents as indicated in figure 10 shows that 10.61% were second degree and above, however 20.67% were degrees, while those who have attained grade 9 to 12 were 15.92 % and from grade one to eight were 10.06%. More over 11.17%, 18.16%, 6.7%, and 6.7% were respectively represented the households of "10+3","Diploma","certificate" and "illiterate" level of education. The result assures that the largest educational percentage level coverage were degree followed by diploma. It was good during data collection getting the required information on land use land cover change in the study area. This is the reason why purposive method was taken.

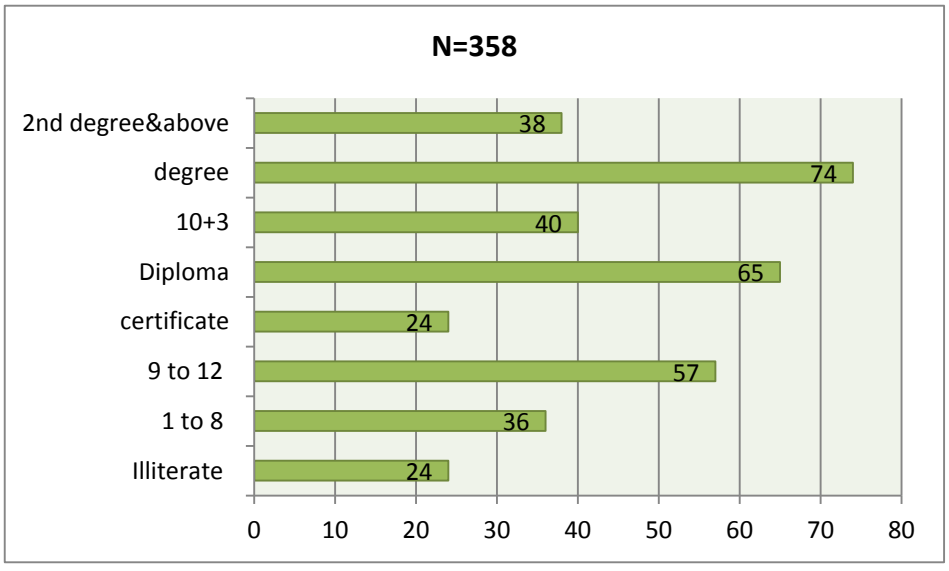


Figure 10:Education level of respondents (Source: Survey data, 2019)

Figure 11 tells as the marital status of the respondents of the 358 respondents 62.29 % was married. But, 4.19%, 5.59% and 27.93 % were widowed, divorced and single respectively. The more the married the more stayed in that area and due to this most of the respondents lived in the city for a long time. This implies that, they have knowledge on the required information what the researcher needs from them.

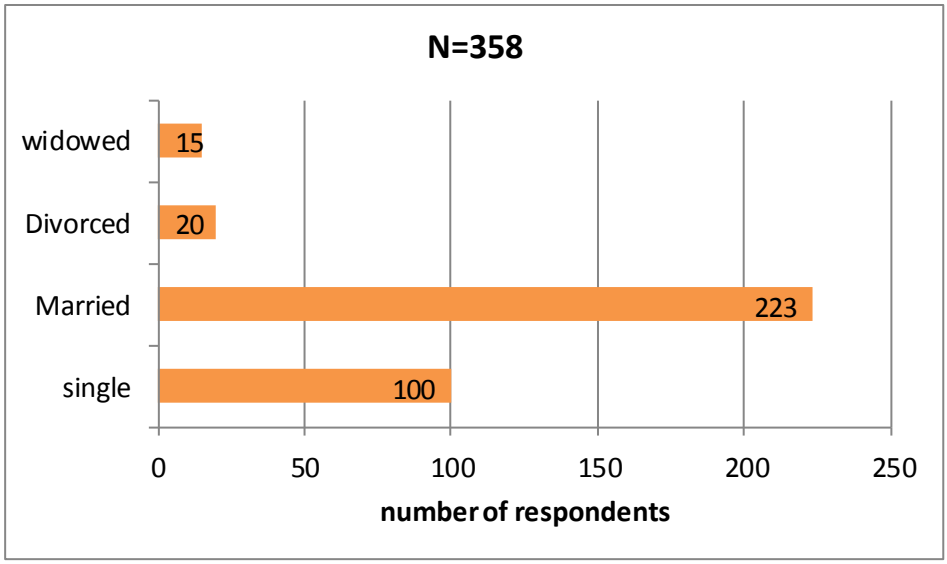


Figure 11:Marital status (Source: computed from survey data 2019)

4.1.2.3 Percentage rate of Respondent

According to GAO internal guidance/resource, Calculating and Reporting Survey Response Rates is important. The GAO internal guidance defined as a response rate is the percentage of the eligible sampled elements of a survey population who provide usable data for the analysis. The response rate for a sample survey should be calculated as follows: response rate = usable responses/eligible sampled elements where usable responses total number of eligible respondents who provide usable data for the analysis, and eligible sampled elements = all elements drawn into the initial sample who were not later identified as out of scope (i.e., outside the survey population).

This is the sum of the survey respondents and non-respondents after out-of-scope elements have been deleted. Based on this definition the percentage of each sampled respondents were calculated. From 215 samples of associations through cooperatives and professionals 214 were answered the questionnaires which is 99.5 %, from 42 samples of residents (poor of the poorest) that got kebele house by the city administration through special consideration were

answered 40 of them which covers 95.2%,the other sampling is the dislocated farmers that was 60 in number, but from this number only 39 of them answered the questionnaire which is 65%, more over the sample was also the informal settlers in which its number was 66,but from this number 60 of them gave response which is 90.9%.finally elders were interviewed from 6 samples 5 were answered the questionnaire which is 83.3%.

The overall percentage rate of respondents were=% of associations through cooperatives and professionals + % residents (poor of the poorest) + % farmers +% informal settlers +% elders/5

Over all % rate of respondents= (99.5%+95.2%+65%+83.3%+90.9%)/5=86.78%

Generally, it is preferable to getting the response rate (80% or higher) from a random sample or purposive sampling. In this research work the total percentage rate of the respondents were 86.78%. This percentage indicates that it is good and satisfies the minimum requirement based on GAO internal guidance. The following Figure 12 shows the summary of the sample rates of the respondents.

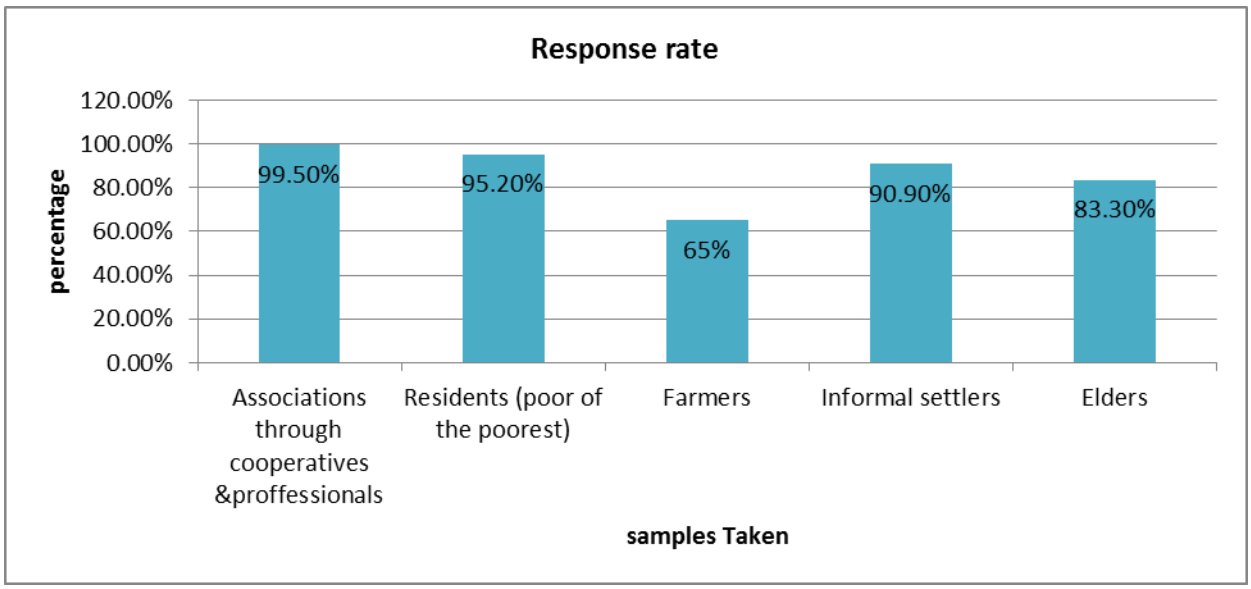


Figure 12: Response rate of each sample (Source: survey data 2019)

The reason why the absentees were not answered the questionnaire is that most of them rejecting the questionnaire by creating different reasons .Some of them appointing the interviewer and they were absent from their appointment place. The other reason also due to unknown things they did not have willingness to answer the question.

4.2 Land use conversion trend of Gondar town for three decades

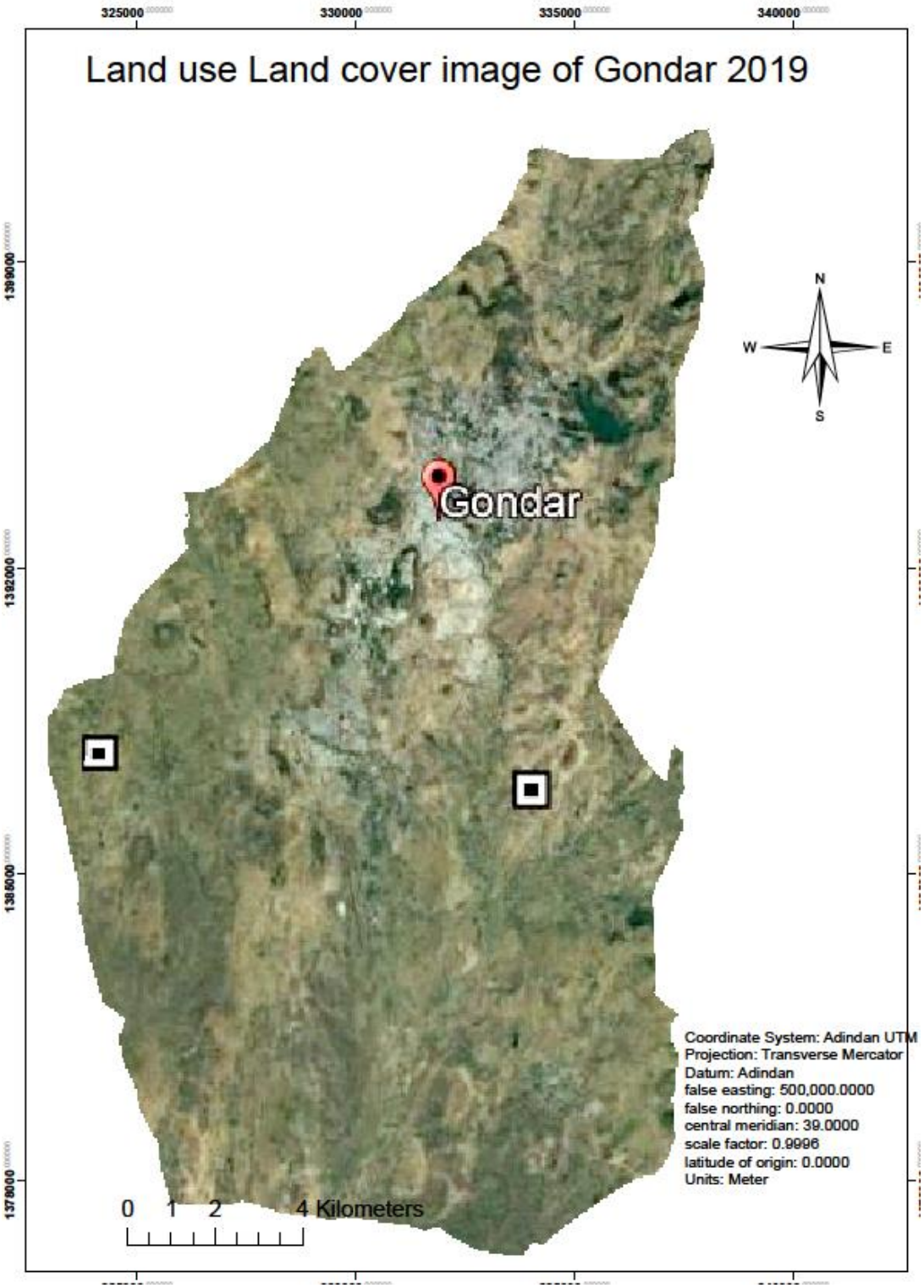


Figure 13: sample image of Gondar 2019 (source: google earth image, 2019)

4.2.1 Image classification

The georeferenced image of the three years of; 1991, 2006, and 2019 of the land use, land cover map prepared based on the supervised classification technique that requires the analyst to select training areas where by selecting the known place on the ground and then digitize a polygon within that area for the three years georeferenced google earth images. Then the land use, land cover maps were generated by running the maximum likelihood supervised classification.

4.2.2 Accuracy assessment of the classified Map

According to (FAO 2014), the underlying principle of the accuracy assessment is that it compares the mapped land classification of higher quality reference data, collected through a sample based approach. The higher quality reference data can be obtained through ground collected data, but as this is expensive and labor intensive it is more commonly obtained through google earth imagery or aerial photography with finer spatial resolution than the data that was used to create the map data. Therefore, to know to what extent the produced classification map was compatible with the existing ground, it was important to evaluate the accuracy of classification results. To do this the researcher was took 50, 50, 50 random points for image 1991, 2006, and 2019 respectively. And then add on the geo referenced map and after rearranging in a KML file format and computed the truth GP points on the google earth image and filling in the attribute table and processed by using the Arc GIS 10.2 tool to get the Error Matrix. Accordingly, error matrix was produced from all images in this study. To be clear, an error matrix is a square array of rows and columns and presents the relationship between the classes in the classified and reference data. The reference data used for accuracy assessment were obtained from google earth and original mosaic image. Based on the following Error Matrix tables the overall accuracy of each sample year was computed.

Table 5 Error matrix of classified map of 1991

class_name	Reference					
	TRUTH1	TRUTH2	TRUTH3	TRUTH4	Total	User accuracy
built up	2	0	0	1	3	66.7%
vegetation	0	3	1	0	4	75%
farm land	1	1	4	0	6	66.7%
water body	0	0	0	3	3	100%
Total	3	4	5	4	16	
Producer accuracy	66.67%	75%	80%	75%	Overall accuracy=75%	

Table 6:Error Matrix of classified Map of 2006

Class Name	Reference					
	TRUTH1	TRUTH2	TRUTH3	TRUTH4	Total	User accuracy
water body	1	0	0	1	2	50%
built up	0	5	4	0	9	55.56%
Farm land	1	2	15	1	19	78.95%
vegetation	0	0	0	4	4	100.00
Total	2	7	19	6	34	
Producers accuracy	50%	71.43%	78.95%	66.67%	Over all accuracy=73.53%	

Source: computed from classified map of 2006

Table 7: Error matrix of classified map of 2019

Class name	Reference					
	Truth1	Truth2	Truth3	Truth4	Total	Users accuracy
water body	2	0	1	0	3	66.67%
built up	0	2	0	0	2	100%
Vegetation	0	2	7	1	10	70%
farm land &open space	0	0	0	4	4	100%
Total	2	4	8	5	19	
Producers accuracy	100%	50%	87.5%	80%	Over all accuracy=78.95%	

Source: computed from classified map of 2019

The overall accuracy assessment of the classified map of the years can be calculated as:

- ✓ For a classified map of 1991 is:

Number of correctly classified site: 2 + 3+ 4+3 = 12, Total number of reference sites = 16

Overall Accuracy = 12/16*100 = 75%

- ✓ For a classified map of 2006 is:

Number of correctly classified sites: 1+5+15 + 4 = 25, Total number of reference sites = 34

Overall Accuracy = 25/34*100 = 73.53%

- ✓ For a classified map of 2019 is:

Number of correctly classified sites: 2+2+7+4 = 15, Total number of reference sites =19

Overall Accuracy = 15/19*100 = 78.95%

Therefore, the overall accuracy of a classified map of 1991, 2006, 2019 was 75%, 73.5% and 78.85%, respectively. According to (Andersen. et,.al 2014) the accuracy percentage of image classification is good if it is greater or equal to 75%. The overall accuracy assessment of this study of classified image of 1991 and 2019 was correctly classified. However image of 2006 was not correctly classified there were over lapping of pixels this is due lack of image qualification.

4.2.3 Land use, land cover of the study area in the three selected years

4.2.3.1 Characteristics of land use classes

In this study four major LU/LC types were identified by using the field data and google earth images of, 1991, 2006 and 2019.These were water body, Farm land &open spaces, built up areas, and vegetation(Table 8).These classifications are based on FAO, 2014 classification technique and satellite SNA (System of National Account ,1993) land use classification. For water body: rivers, streams and spring included under the category of water.

In the classification vegetation includes human made plantation vegetation, riverine vegetation, dry evergreen forest and moist mountain forest. This is because as they had the same spectral nature of the images, it was difficult to differentiate one from the other. This classification is in line with (Tesfaye *et al.* (2014) cited in Adane, 2016) who grouped both natural forest and plantation forests under forest or vegetation category. On the other hand it was difficult to identify settlements, especially rural settlements from agricultural land on 30m spatial resolution image and in most cases the two are spatially integrated. Therefore, settlements were grouped under agricultural land covers. This classification is in agreement with (Desalegn *et al.* (2014) cited in Adane, 2016) who grouped agriculture and settlement under one class for the same reason listed above. Land use/land cover (LU/LC) changes in urban areas of the city of Gondar were assessed by taking the google earth image data of the mentioned years to quantify the spatial changes over time.

Table 8:Land use land cover description

Sr.no	Land use/cover type	Land use/cover description
1.	**Vegetation**	It includes forest during classification the purpose of identifying the green area proportion of the metropolitan cities. • forest(Area with high density of trees which include deciduous forest land, ever green forest land, mixed forest land and plantation forests that mainly are eucalyptus, junipers and conifers. In the classification vegetation also includes human made plantation vegetation, riverine vegetation, dry evergreen forest and moist mountain forest. This is because as they had the same spectral nature of the images, it was difficult to differentiate one from the other • Shrubs land: Areas covered with shrubs, bushes and small trees, with little wood, mixed with some grasses.
2.	**Water body**	• Water and marshy land: Area which remains water logged and swampy throughout the year, the man made water harvesting ponds, the rivers and its main tributaries. • water body also includes: rivers, streams and spring included under the category of water
3.	**Farm land & open space**	Areas used for both annual and perennial crop cultivation, and the open spaces used for different activity that are closely associated with the large sized cultivated fields. Bare land is also merged with agricultural land during classification.
4.	**Built-up**	Areas of land covered by houses and roads. This category includes areas currently used as residence, commerce, manufacturing etc.

For this study, the current planning boundary of the city administrations was includes to see the spatial change due to urban expansion as well.

4.2.3.2 Land use land cover of Gondar City in 1991

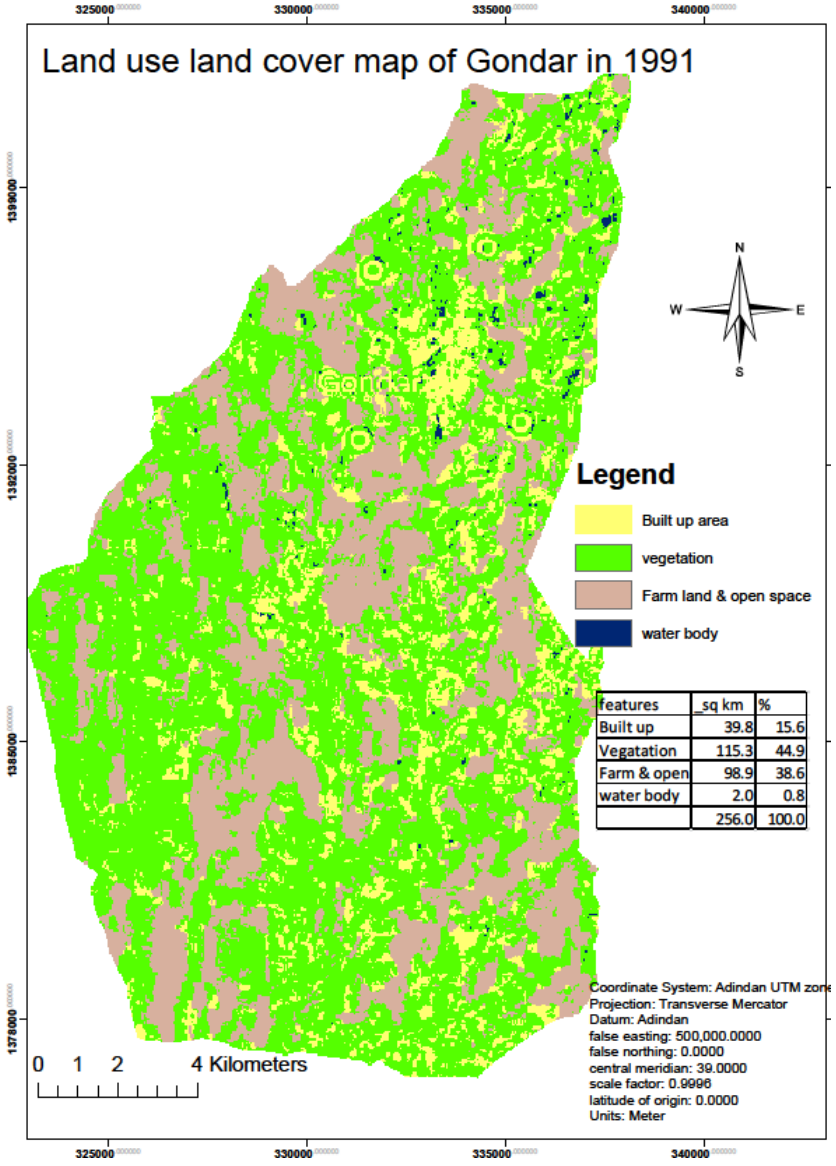


Figure 14: Land use land cover map 1991 (Source: map computed from google earth image 1991)

In figure 14 the land use land cover map of 1991 shows the trends farm land and open space accounts 98.9 sq km which is 38.6% from the total, the largest land use land cover of the 1991 image were the vegetation that covers115.3 sqkm that had a percentage of 44.9% from the total, this shows us almost nearest to half the coverage contains vegetation of the land use land cover of the area occupied with vegetation that includes area with high density of trees contains deciduous forest land, ever green forest land, mixed forest land and plantation forests that mainly are eucalyptus, junipers and conifers. And more over Shrub land which is areas covered with shrubs, bushes and small trees, with a little wood, mixed with some

grasses. While the built up accounts 39.8 sq km that has a percentage coverage of 15.6%, this coverage was small compared to vegetation and farmland and open spaces, Because at that time, urbanization was at a lower rate in the country as a whole and it was with less infrastructure development .Moreover, it was the transition period from the dergu regim to EPDRF there were no pulling factors people to migrate urban places specially in the study area. The smallest area coverage of the 1991 land use land cover map was water body that covers 2.04 sq km and had a total percentage of 0.79%.

4.2.3.3 Land use land cover of Gondar City in 2006

The land use land cover information of the year 2006 was to some extent a great change among the land use classes. As shown in Figure 15 the major dominant land use land cover in 2006 was vegetation (41.37%), followed by farm land and open space (35.68%) and built up (22.32%) and then water body (0.63%). During this period vegetation, farm land and water body were decrease by (-9.15 %), (-2.92%) and (-0.16) respectively as compared with what was in 1991.

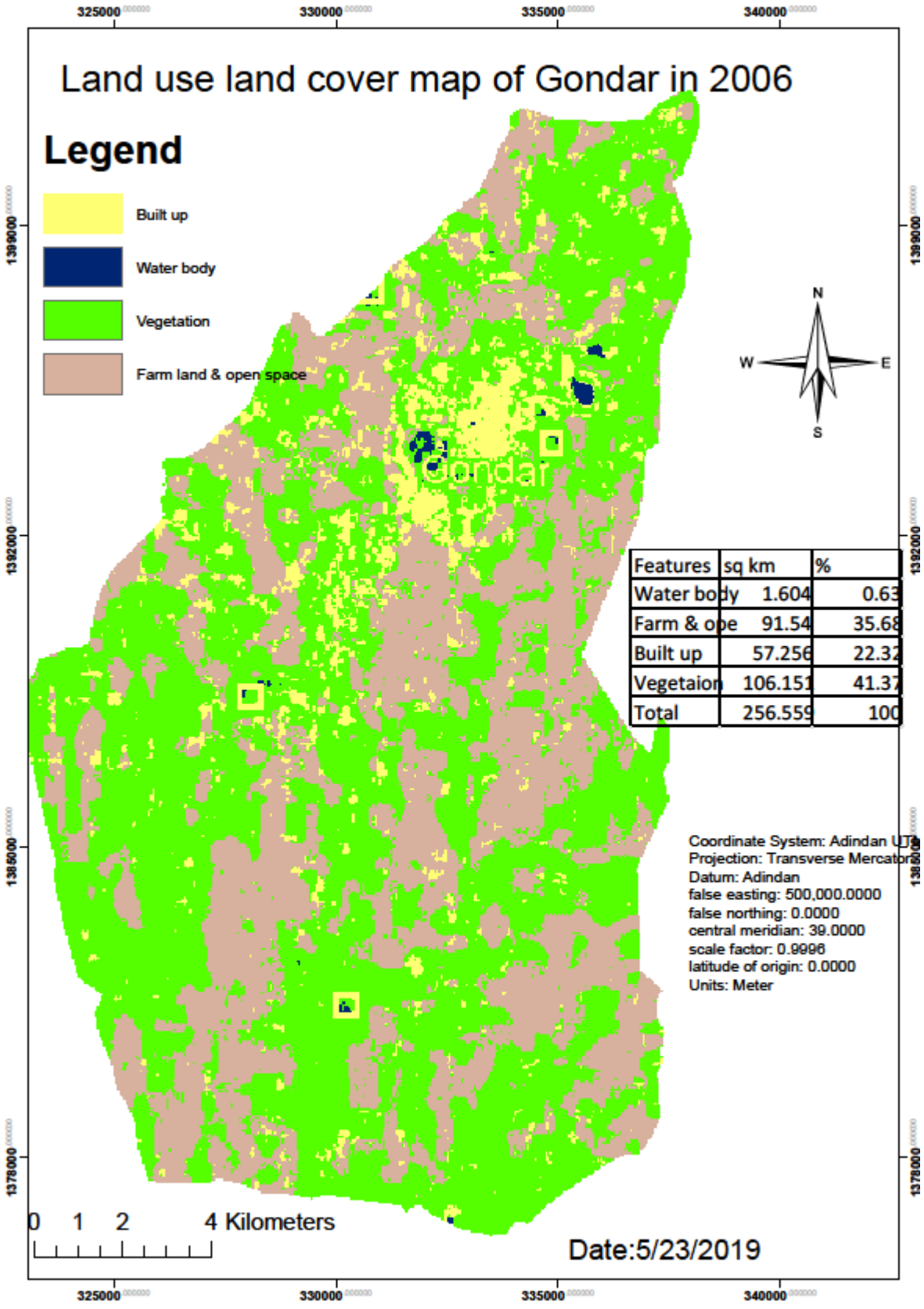


Figure 15: Land use land cover map of the city in 2006(Source :computed from image 2006)

4.2.3.4 Land use land cover map of Gondar City 2019

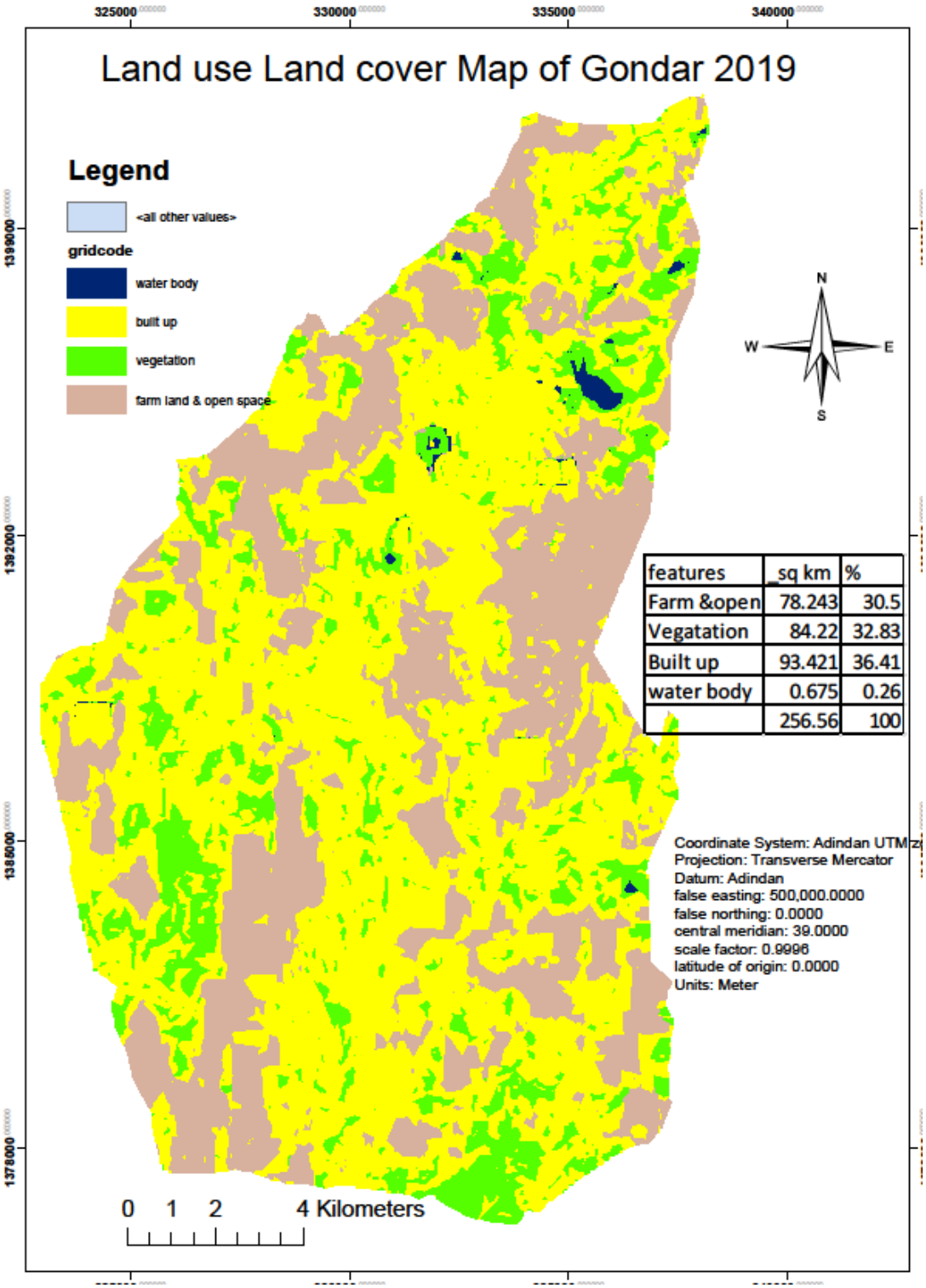


Figure 16: Land use land cover map of 2019(Source :computed from image 2019)

Figure 16 describe the land use land cover map of 2019 contains the largest proportion of built up area that accounts (36.41%) of the total area coverage of the city. From the land use description states that built up area contains a land covered by houses and roads or any built

able structures. This category includes areas currently used as a residence, commerce, manufacturing and etc. The second largest proportion of the land use land cover of this particular year was the farm land and open space that accounts (32.83%) of the total of the study area. While vegetation accounts 32.83 %, it is decreased from previous coverages.

4.2.3.5 Land use conversion trend of Gondar City in the last three decade

4.2.3.5.1 Land use land cover trend from 1991 to 2006

Between these periods there were great changes in economic, social and political perspective. Because it was a time of Governmental change and an election period that seems as a democratic election but latter it was changing into uprising in some parts of the country. These changes were further brings a land use conversion, especially in urban and the periphery of rural areas.

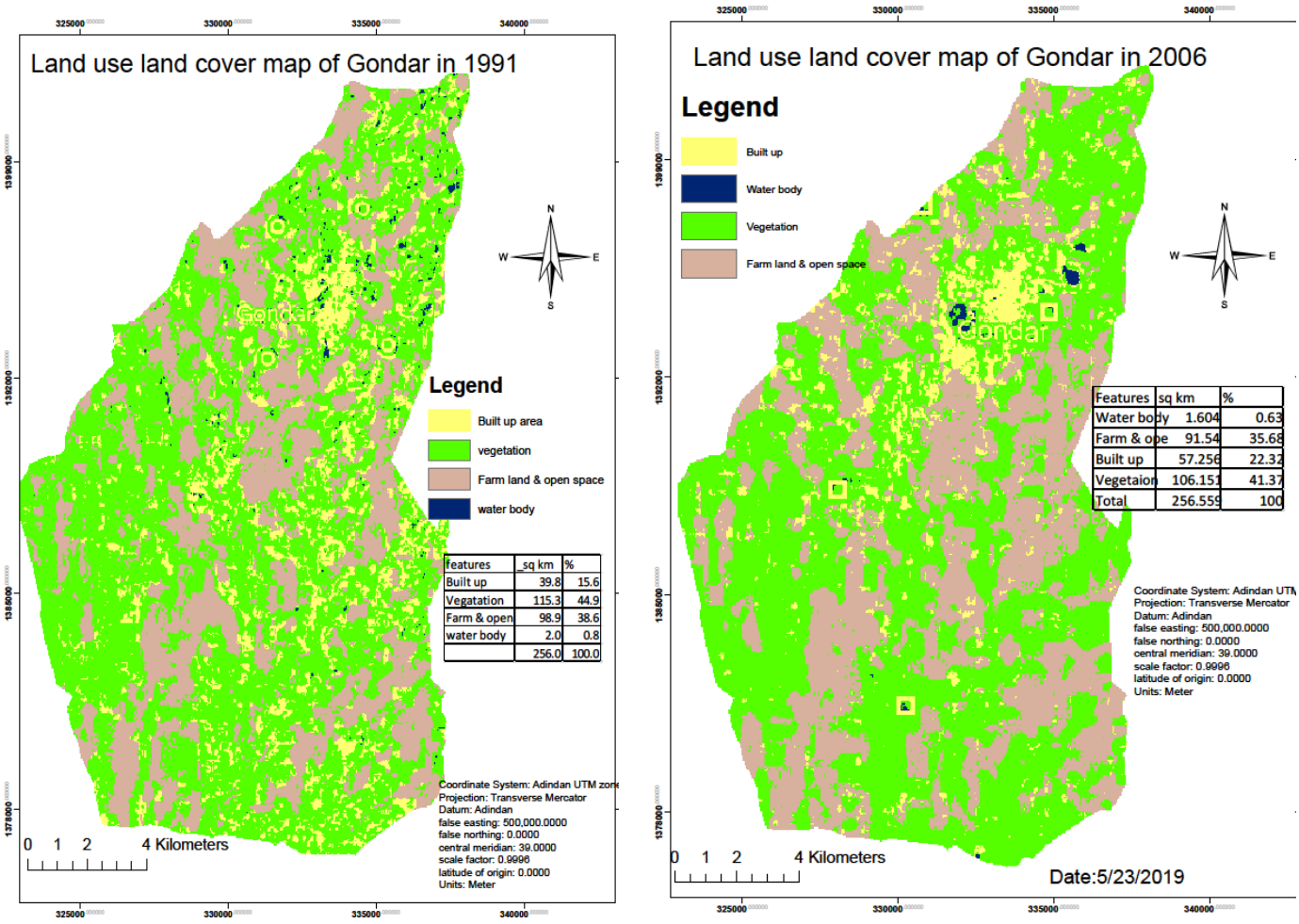


Figure 17:Land use land cover comparison b/n 1991-2006(Source: computed from 1991& 2006)

Table 9: Land use conversion trend from 1991 to 2006

	features	1991		2006	
		Area (Km^2)	%	Area(Km^2)	%
1.	Water body	2.03	0.8	1.604	0.63
2.	Farm land& open space	98.9	38.6	91.54	35.68
3.	built up	39.8	15.6	57.26	22.32
4.	vegetation	115.3	44.9	106.151	41.37
	Total	256.559	100	256.559	100

1991to 2006 LULCC		
features	area in km^2	%
water	-0.433	-0.16
Farm land &open space	-7.36	-2.92
built up	17.463	6.81
Vegetation	-9.15	-3.53

In figure 17 & table 9 shows the trend of land use land cover change from 1991 to 2006 were farm land & open space ,vegetation and water body presented a loss that are converted to built-up land use classes with 17.46km2(1991-2006).In these periods the built up class presented the highest total gain with a percentage of (6.81 %) .While the greatest loss occurred in vegetation (-3.53%).Moreover, farm land and open space, followed with a coverage loss of (-2.92%).

4.2.3.5.2 Land use land cover trend from 2006 to 2019

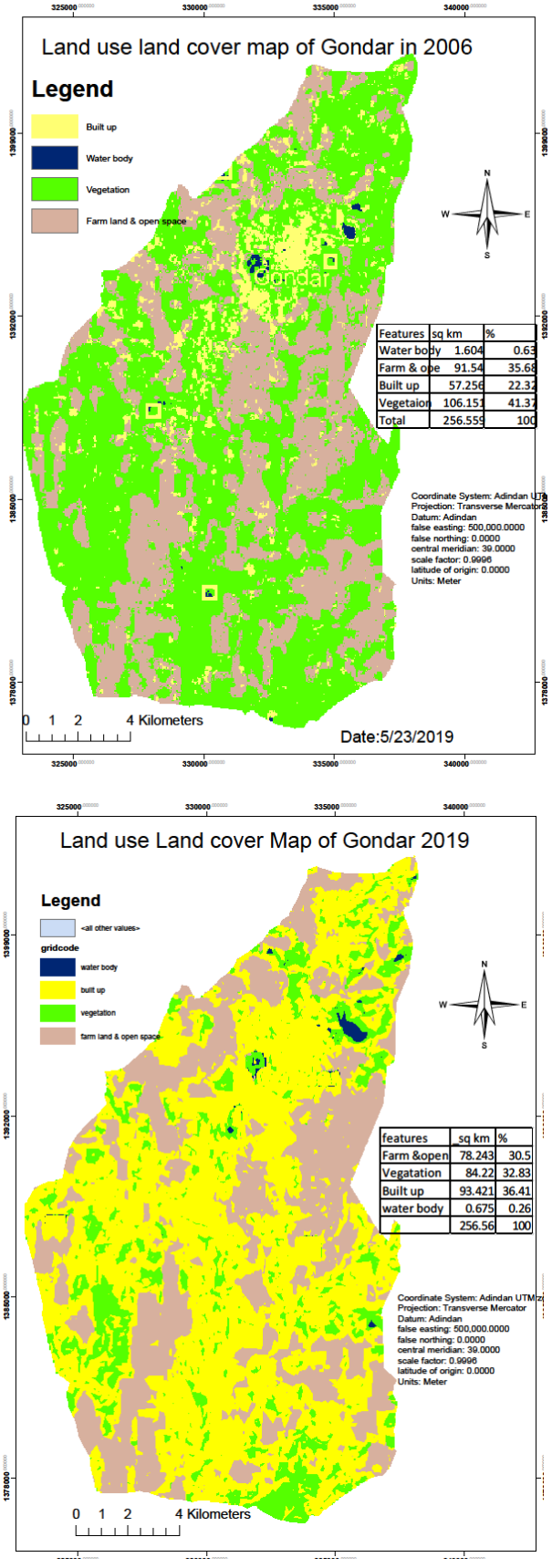


Figure 18:Land use land cover comparison b/n 1991-2006

Table 10:shows the land use land cover change from2006- 2019

Features	2006		2019		2006 to 2019 LULCC		
	Area km^2	%	Area km^2	%			
Water body	1.604	0.63	0.675	0.26	Features	area in km^2	%
Farm land& open space	91.54	35.68	78.243	30.5	Water	-0.929	-0.37
Built up	57.26	22.32	93.421	36.41	Farm land &open space	-13.29	-5.18
Vegetation	106.151	41.37	84.22	32.83	Built up	36.16	14.09
Total	256.559	100	256.559	100	Vegetation	-21.93	-- 8.54

Figure 20 & Table 10 tells us the trend of land use land cover change from 2006 to 2019 .In these periods the built up class like the previous periods presented the highest total gain with a percentage of (14.09 %) .While the greatest loss occurred in vegetation(-8.54%). Moreover, farm land and open space followed with a coverage loss of (-5.18%). In addition water body continue decrease and reaches (-0.37%).

4.2.3.5.3 Land use land cover trend from 1991 to 2019

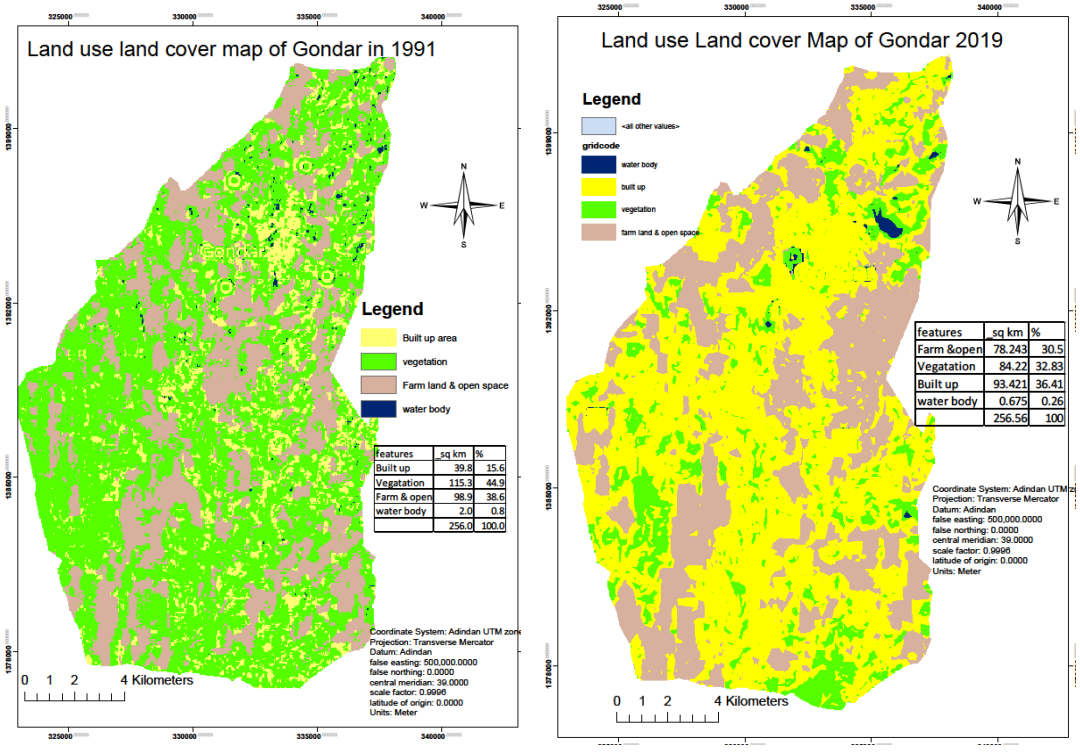


Figure 19 : Land use land cover comparison b/n 1991-2019 (Source: computed from 1991- 2019)

Table 11: Land use conversion trend from 1991 to 2019

	features	1991		2019		1991to 2019 LULCC		
		Area km^2	%	Area km^2	%			
1.	Water body	2.03	0.8	0.675	0.26	features	area in km^2	%
2.	Farm land& open space	98.9	38.6	78.243	30.5	water	-1.362	-0.53
3.	built up	39.8	15.6	93.421	36.41	Farm land &open space	-20.66	-8.1
4.	vegetation	115.3	44.9	84.22	32.83	built up	53.62	20.82
	Total	256.559	100	256.559	100	Vegetation	-31.08	-12.07

The land use land cover trend analysis of the past 30 years shown in Figure 19 & Table 11 tells us there was a highest increase of built up area as compared to other land use classes. It was covered by (20.82%) from the total. While, the greatest loss occurred in vegetation (-12.07 %). Moreover, farm land and open space followed with a coverage loss of (-8.1%). In addition water body continually decrease and reaches (-0.53%).

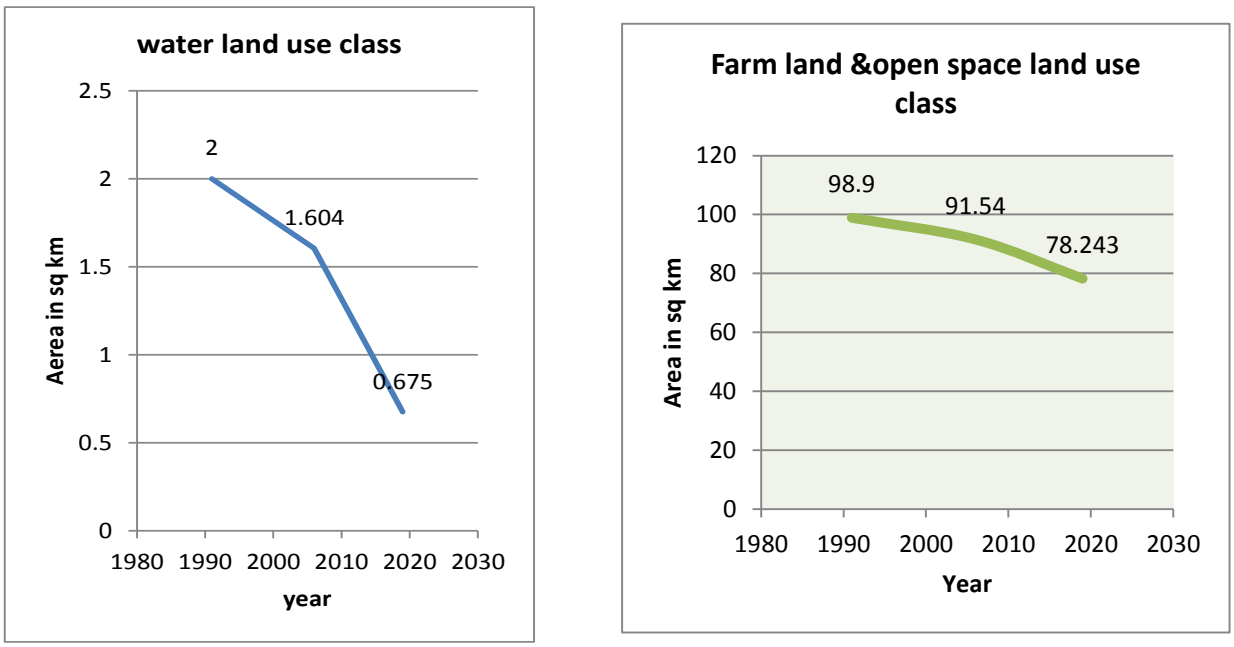
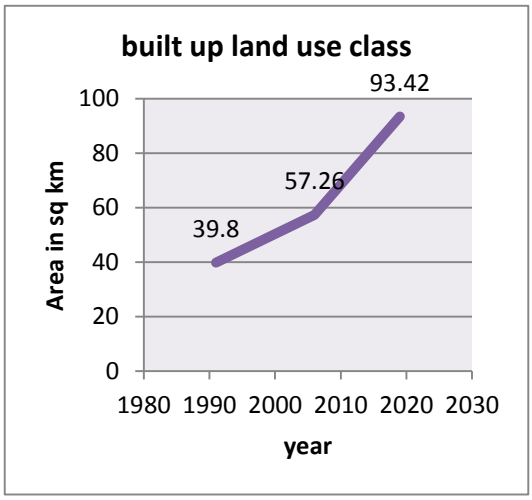


Figure 20: water & farm land area coverage in different years



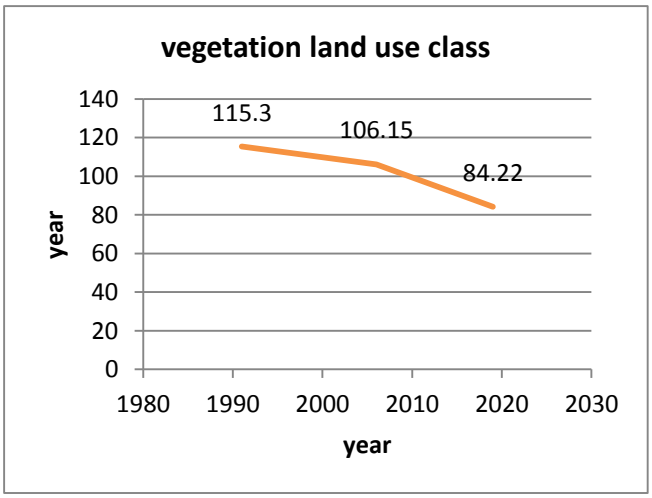


Figure 21: Built up and vegetation area coverage in different years

The line graph 20&21 shows that the built-up area had been expanding at the expense of other land use classes during the last 30 years in the city of Gondar. The other three land use classes are decreasing in different rate.

Table 12:Land use land cover change (gain &loss) for the selected years

Land use land cover change in sq.km from 1991 to 2019 of the city of Gondar						
	1991 to 2006		2006 to 2019		1991 to 2019	
features	area in km^2	%	area in km^2	%	area in km^2	%
water	-0.433	-0.16	-0.929	-0.37	-1.362	-0.53
Farm land &open space	-7.36	-2.92	-13.29	-5.18	-20.66	-8.1
built up	17.463	6.79	63.983	24.9	81.45	31.75
Vegetation	-9.15	-3.53	-21.93	-8.54	-31.08	-12.07
Total	0.52	0.17	27.834	10.81	28.35	11.05

(Source: computed from image interpretation)

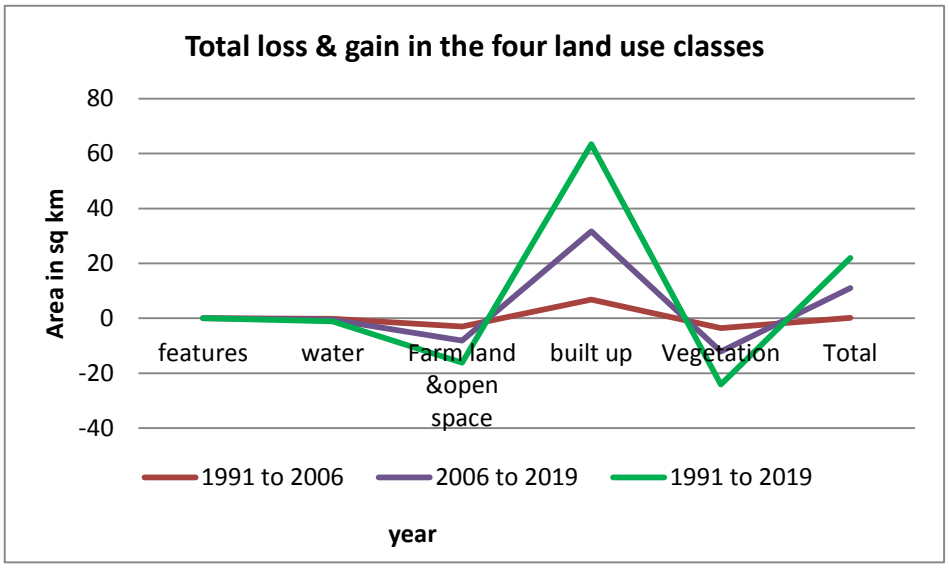


Figure 22 :Land use land cover conversion trend (Source: computed from LULCC table)

From table 12 and figure 22 one can conclude that even though there is a land use land cover change in each period a large share was seen in the period between 2006 to 2019 (10.81%).This implies that different driving factors like population pressure, economical factors and biophysical factors play a great role in the conversion. However the smallest land use land cover change occurred between the 1991 to 2006 (0.17%).This shows that during this period the driving factors were lesser than the other periods. The overall increments from 1991 to 2019 were 11.05%.This implies that the land use land cover change in the last three decades was occurring with different rate of increment.

Moreover, the line graph/figure 22 shows that how vegetation decreased with the highest rate through time, in the contrary built up area increased through time, while the water body decreases with a constant rate. For these changes there must be a driving force that is independent of these dependent variables to bring conversion among land use land cover of the study area. Generally the major findings from the analysis of images revealed a great reduction in the area of vegetation and farm land &open space while a corresponding increase in the area of built up and farmland over the 30 year period. From the interviews conducted elders and other residents also support this trend showing increase in built up with a corresponding reduction in land under vegetation and farm land. In 1991 Vegetation were the dominant LU/LC types in the study area. This is because, during that time the area were characterized by relatively low population pressure, small agricultural activities and to some

extent undisturbed environmental condition. However the largest part of lands that were covered by vegetation in the 30 years now most parts occupied by built up area.

4.3. Socioeconomic data

A socio economic survey was conducted which includes key informant interview, questionnaire and observation to generate information on land use/ land cover changes driving forces.

Generally, the data collected through observation, key informant interview and questionnaire helps the researcher to identify the major driving forces of land use land cover change were identified as; population pressure, biophysical factors, economic factors through scoring method.

4.3.1 Major factors for land use land cover change in the study area

Land use land cover change could not shift by itself from one type of land use into the other type of land use or land cover, but there must be a causal factor for the change. These causal factors do not contribute similar forces for the change of land conversion in the study area. The following major factors were answered by the respondents. (refer figure 23).These were population pressure, establishment of manufacturing &industries, economic factors &government policy change /transition period.

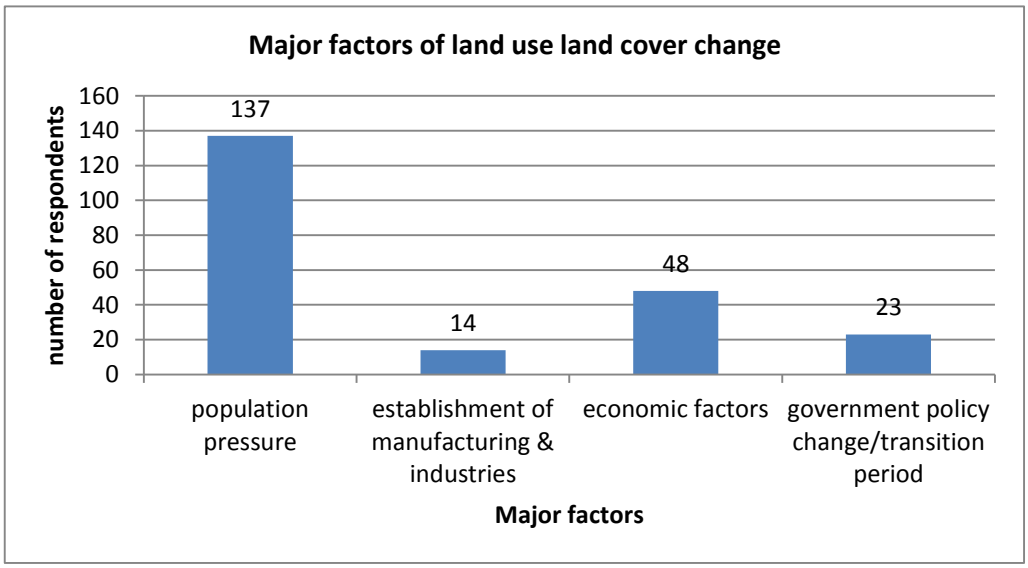


Figure 23: Major factors of land use land cover change (Source: from survey data of 2019)

population pressure is the major factor in the land use land cover change. While 6.3% which is the smallest number of respondents said that the major factor of land use land cover change

was due to the establishment manufacturing and industries. However 21.6% respondents said that the land use conversion is due to economic factors and government policy change.

4.3.2 Driving forces that cause land use - land cover change in the study area

The data collected through questionnaire survey, observation and key informant interview with individual elder households and different city administration officers helped me to know the characteristics of LULCC classes such as built up, vegetation, water body, farm land & open space. These are dependent variables that depend on the independent one for their timely change. Driving force forces that facilitate land use conversion. Even though, these factors are very complicated in its nature to get the required information to see in detail the researcher was covered the sample frame using the purposive method by assuming they had a good knowledge concerning land use land cover change. For this purpose professionals and associations were selected .They were acquired to fill each variable and indicator in the given table that quantified based on scoring method. In the table the values for scoring were given by the respondents filled from one to ten; one means less influential while ten was the most influential. Based on these a value was filled by the respondents with three levels. A value from 1 to 3 will be less influential, while a value from 4 to 6 medium influential and a scoring value from 7 to 10 is a maximum influential or the most driving force for the land use land cover change of the study area during the past thirty years. Table 13, describes the result of the summarized scoring method.

Table 13:Driving factors of variables based on scoring method

s.no	Variables	Indicators	Scoring method(1-10)			
			Summation of each indicator	Mean average	mean Average of the variable	Rank based on respondents value
1.	Biophysical Factors	I.Soil type	444	2.07	2.87	2nd
		II. Topography	1032	4.82		
		III. Climate	460	2.15		
		IV. Availability of water	518	2.42		
2.	Economic factors	I.profit	461	2.15	2.41	3rd
		II. Capital	397	1.86		
		III.Market expansion	524	2.36		
		IV..infrastructure expansion	698	3.26		
3.	Technological factors	I.The use fertilizer for improvement of the land	442	2.07	2.07	6th
4.	Regulatory/policy/ factors	II.Taxiation	367	1.71	2.36	4th
		II.Subsides	390	1.82		
		III.Land law	538	2.51		
		IV.Transition period/policy change/	727	3.4		
5.	Societal factors	I.Migration	1266	5.92	5.48	1st
		II.natural population growth	1076	5.03		
6.	Individual factors	I.Age	490	2.28	2.35	5th
		II.Attitude to change	485	2.27		
		III.Education and exprience	486	2.27		
		IV.Access to information	560	2.62		

Table 13 shows that the independent variables that cause or drive a land use land cover change on the dependent variables such as built up area, farm land & open space, vegetation and water body. The above independent variables were scored by professionals that have a good understanding on the issue. After scoring by the respondents the researcher had been

calculated the total summation of each indicator and sum up to get each variable, then finally calculated the mean average of both indicators and variables. Based on this the following result was obtained. For indicators migration get the highest value which is 5.92, followed by natural population growth 5.03 ,Topography got the third value that scores the average mean of 4.82.Moreover,policy change (transition period) (3.4) and infrastructure expansion (3.26) were the main driving forces that cause land use land cover change identified by the respondents using scoring method. In its overall summation the society, biophysical and economic factors were got a value of 5.48, 2.87 and 2.41 respectively, with the highest influential factors scored by the respondents.

4.3.2.1 Societal Factors

Based on scoring method and interviews of this study confirmed that population migration and growth is the first drivers of LU/LCC identified in the study area (refer table 13). For this they argue that especially in the interview and open ended question part, the respondents said that population growth in the area increased the demand for built up and farm land from time to time. These in turn resulted in increased unemployed in the study area and a great expansion of informal settlement around and inside the city. The place where the current informal settlers found is that previously covered by vegetation and farm land. The result obtained from scoring method and interview supported by the data obtained from the city administration showed that the population number from 1984 to 2018 within a ten year interval in the following table (14) confirmed that there is a huge change in population number.

Table 14:Population change from 1984 to2018

Year	Male	Female	Total	Population no. change
1984	34513	46162	80675	38855
1994	52143	67387	119530	87,457
2007	98085	108902	206987	99,259
2014	149970	156276	306246	65104
2018	178447	192903	371350	

(Source: city administration taken from CSA data 2019)

In addition to this the data obtained from the city administration supports that and the land management officer confirmed that currently greater than 5000 informal settlements constructed in and around the city of Gondar.

The following figure 24, described the average mean value of societal factors getting from a scoring method by the respondents.

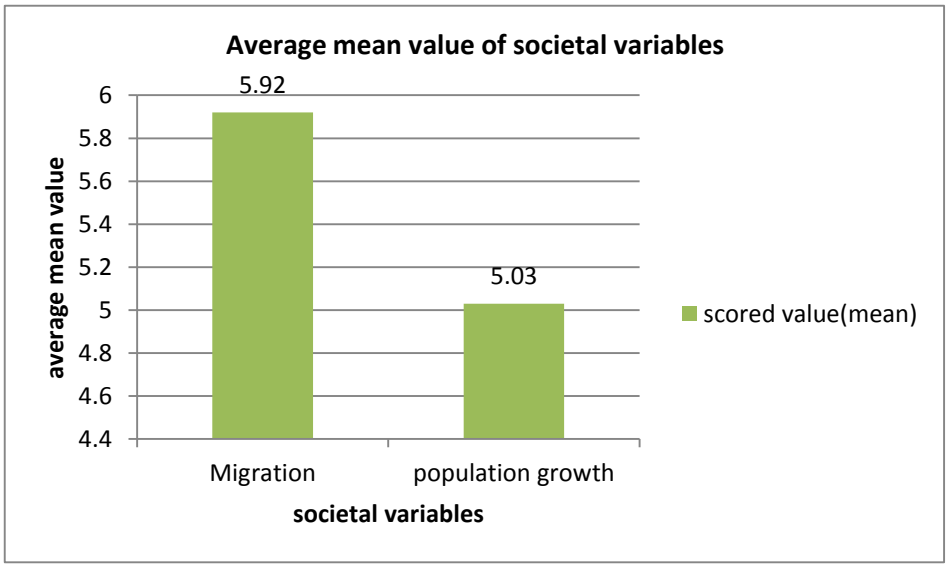


Figure 24:Average mean value of societal variables(Source: computed from the scoring table)

According to the scorers from the societal indicators migration is the highest with the average mean of 5.92 while natural population growth is relatively lower than migration from both rural and urban areas that accounts 5.03.

4.3.2.2 Biophysical Factors

The biophysical factor considered in this study was soil, topography, climate and water availability. From these indicators the respondents scored the values in table 14 with a mean average of soil (2.07), topography (4.82), climate (2.15), and water availability (2.42). From the result topography got the highest scored value than the others. This result and idea were assured by observation time the topographic nature of the city that has undulating and consists of hills, sloppy areas, gentle slope areas, rivers and streams (refer topography in chapter 3 materials & method). In the other way soil type has got the least scored values by the respondents as compared with the rest of the biophysical indicators or variables. Each variable had its own contribution on the land use land cover change of the study area in a significant manner but they had not the same value(Refer figure 25).

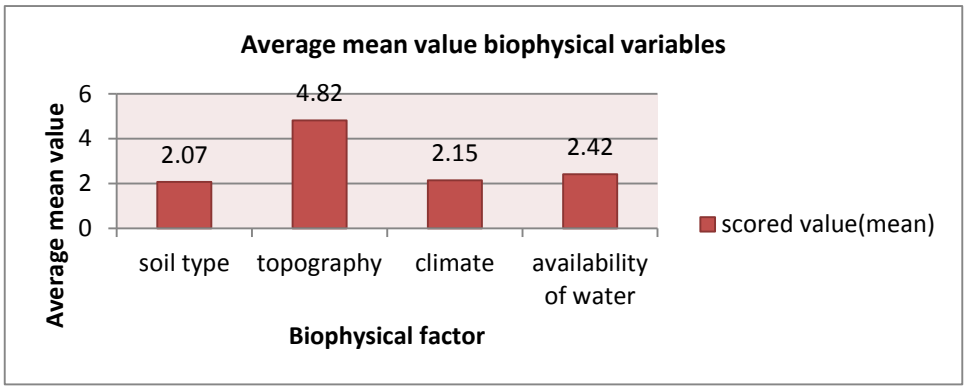


Figure 25:Average mean value of biophysical variables(Source: computed from survey data 2019)

4.3.2.3 Economic Factors

The economic causes of LU/LCC of the study area contains profit increments, capital, market expansion and infrastructure expansion are the main indicators or variables that drive land use conversion with the addition of other variables. From these variables as the results show in table 14 the scoring method infrastructure plays the most drivers of the economic factors. Moreover the following figure 26 describes the mean average value of the economic variables.

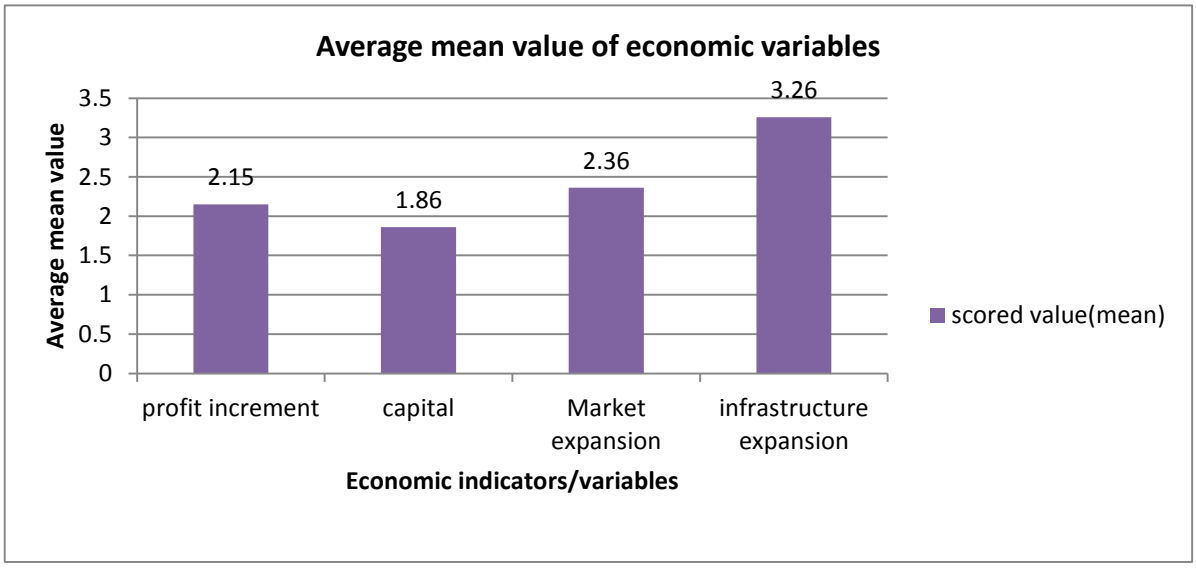


Figure 26:Average mean value of economic variables(Source: computed from scoring table)

According to figure 26 infrastructure expansion is the highest variable which scored a mean of 3.26, while, capital is the least that have a mean scored value indicator with a value of 1.86 in the land use land cover change scenario. This indicates that when you expand more infrastructures there will be a tendency of land use land cover change. Therefore, infrastructure expansion is the main driving forces of the study area.

4.3.2.4 Regulatory/policy/ factors

As per the information obtained from the scoring method and interviews for open ended questionnaires the institutional factors include taxation, subsides, land law and transition period. The interviewee said that these driving factors observed in the study area in different situation like during election time, especially in the year 2005 the government focused on the election process however, the people were engaged in informal settlement.

Moreover the respondents focused on how informal settlement is done by the speculators and the farmers in detail. So as the respondents explained about the condition of informal settlement at that time were high. The other issue that the interviewee raised, the cause of government change from Dergue regium to EPRDF .Moreover, some respondents' underling the issue of 2017 revolution in some part of the country particularly in the study area plays a great role in land use land cover change. Besides, this as the respondents explained during interview time to solve the problem of informal settlements in the city the regional government took action by demolishing the informal settlements and give them 100m2 for each individual with a planned manner.

However, this solution was not as such protective from squatting rather it expands in a radical way by assuming government could not be demolished but regularize like what was done in the past. Due to these conditions there was a large land use land cover change in the city of Gondar. On the other way the scoring method result obtained from regulatory or policy or institutional factors the transition period was the crucial time that drives the land use land cover change of the city with other corresponding factors. Moreover, National and regional policies on land use and economic development through investment in agriculture were other factors contributing to LU/LCC. Lack of proper land use plans is another policy related driver of land use land cover change. Besides these, Weak law enforcement is also a significant driver of LU/LCC in the study area as respondents discussed.

The information obtained from interviews, manifestations of weak law enforcements in the study area where corruption, and delay in decision making. The following Figure 27

illustrates the mean average value of each indicator with the highest transition period scored 3.4 and the least mean value scored by taxation with1.71.This implies that the transition period plays a major role in land use land cover change of the study area.

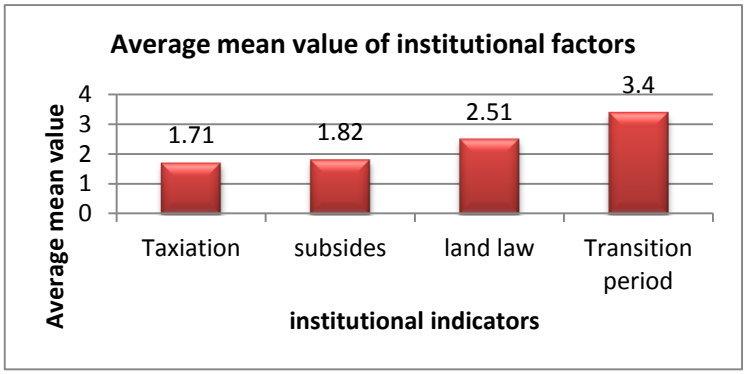


Figure 27: Average mean value of institutional factors (Source: computed from scoring table 2019)

4.3.2.5 Individual factors

Individual factors are the wide range of difference in individuals which may affect their thinking around land use change. It would include aspects such as age, education, experience and attitude to change and access to information. According to the scoring method the scorers give an average mean value for each indicator, age has got (2.28), attitude to change (2.27), education experience (2.27) and access to information (2.62).

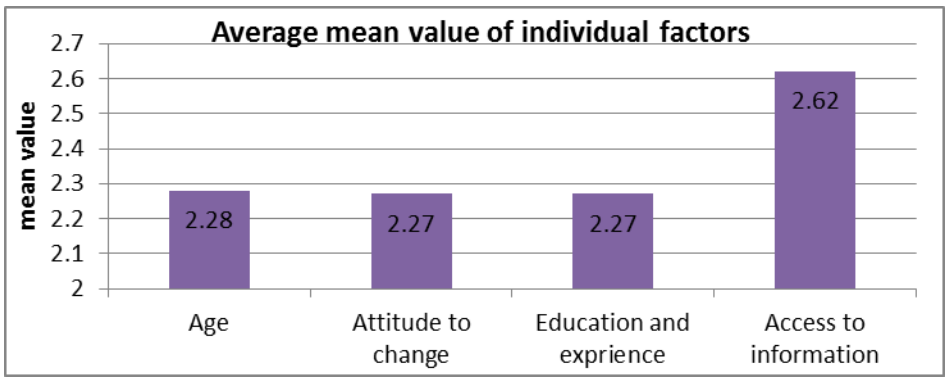


Figure 28:Average mean value of individual factors (Source: computed from scoring table 2019)

As indicated in figure 28 access to information scored the highest value, whereas access to age got the least. This implies that when there is access of information increased human beings wants to do activities on time base because information is power. Therefore,

individual factors are the other basic factor or driving forces that bring land use conversion in the last thirty years in the study area.

4.3.2.6 Technological factors

This relates to understanding the current technology around a particular land use, and/or understanding how technology or farm system management knowledge is changing, which may allow for a land use change previously not thought possible. Based on The scoring method technological factors has got the least value among the six variables. Not only this, but also the interviewers were not considered as a driving factor in the land use land cover change of the study area during the last thirty years.

4.4 The major detrimental/driving forces in the city

As the survey result shows the detrimental or driving forces are forces that are basic in their nature among the stated factors. The following summary table 15 shows the result given by the respondents.

Table 15: summary result of the variables

s.no	Name of driving factors	Average mean value in scoring method	Rank
1.	Societal factors	5.48	1st
2.	Biophysical factors	2.87	2nd
3.	Economic Factors	2.41	3rd
4.	Regulatory factors	2.36	4th
5.	Individual factors	2.35	5th
6.	Technological factors	2.07	6th

(Source: from survey data 2019)

Identifying the above six independent variables by the value scored by the respondents and arranging them in rank based on their mean value. Variables who stood from one up to three selected as the most influential factors for the land use land cover change of the study area. Depending on this idea the following factors were the three most influential factors that drive land use land cover change in the city for thirty years and more. These are: societal factors, biophysical factors and economic factors.

4.4.1 Societal factors

These factors are the most influential forces in many developing countries like Ethiopia with the absence of up to date information on the rapid growth of the urban population number of cities and towns. Population pressure comes from both migration and natural population growth in the study area. As many research revealed that as the amount of population increase through time in urban areas, there will be a demand for basic needs fulfilled by the concerned body or the population themselves. In doing so there were a land use land cover change in the study area and the factors play a significant change in the issues.

4.4.2 Biophysical factors

Biophysical factors are also important for other land-use types, for example, the soil, climate and topography conditions determine the suitability of a location for residential construction. Therefore, a preference will exist to direct these developments to locations better suited for construction. In most land-use-change analyses the biophysical characteristics have incorporated as the potential gains that can be achieved by a particular land-use type in a location. From the survey result the biophysical factors are the other basic factor in the land use land cover change of the study area. From these indicators, Even though all of these factors have a direct or indirect contribution on the change of land use land cover of the study area, however topography is the most influential factor. The scoring method result in table 14 shows that topography is standing in third position from the total of ten indicators. The result getting from table 14 assured that during interview, observation and informal discussion topographic indicator is the most driving factor land use conversion in the city of Gondar. Because of this most of the construction and planning activity were not exercised based on its topographic nature. Due to this city did not use its space efficiently and effectively.so it aggravates to un planed land use conversion.

4.4.3 Economic factors

Like societal and biophysical factors, economic factors play a major role in the trend of land use land cover change. For instance a large number of unemployment forced to see other options.AS the respondents told me that both economically poor and rich people are the cause of land use conversion. The poor do not afford the land market in the central part of the city; rather they prefer buying land at the periphery from farmers or land speculators, while the rich through investment or other means of occupation opportunity tries to accommodate the farming area or any other land use into industrial or other investment options. These facts are seen in the study area during data collection time where most of the informal settlers were the

poor. The following figure 29 shows that mean score value of variables that drive a land use land cover change.

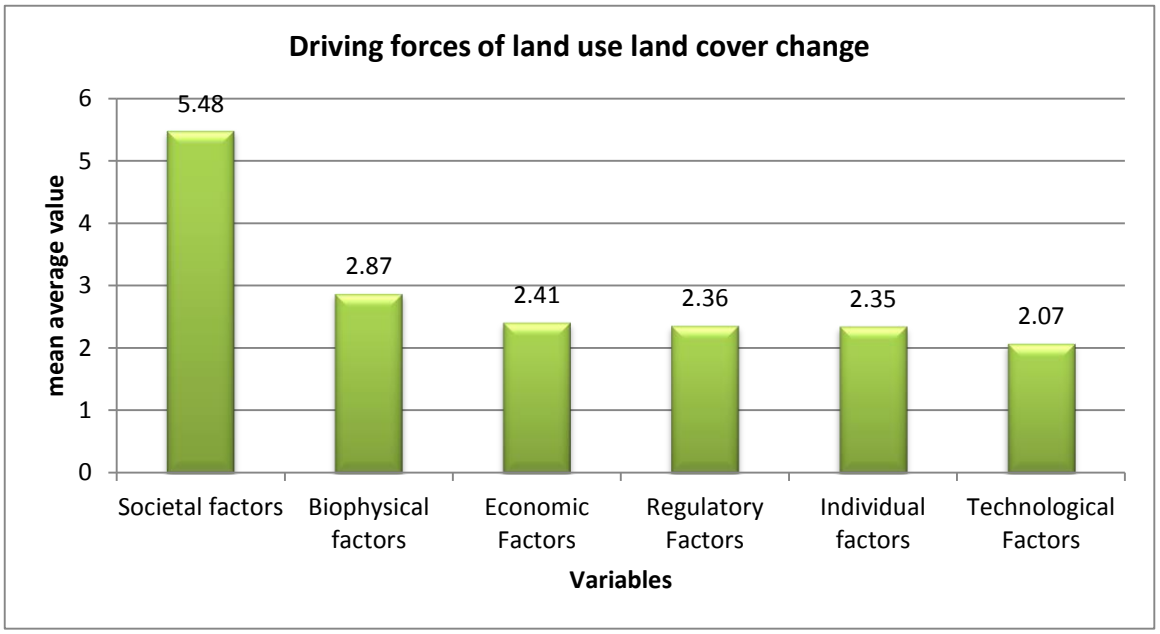


Figure 29: Driving forces of land use land cover change (Source: computed from scoring table 2019)

4.5 Future land use/land cover Expansion of the town

Cities could not stay what they are today. They need to be expanding due to social, economic and environmental consequences. Due to this expansion, there will be a land use land cover change. To tackle the problem knowing its future expansion direction or scenario is very important. For this part the researcher compiled both the survey results and considering NUPI manuals criteria's for future expansion direction. The result in Figure 30 revealed that the city developed to the south, south east and south west direction. Not only this the city expansion magnitude increases time to time, mostly in the two sub cities that are found on the periphery side of the city mainly almost in all directions.

The magnitude and direction of the expansion of this city had got different reasons as the respondents explained. Most of the interviewee said that due to its topographical nature of the city which is bounded by mountains and three historic rivers the expansion of the city is directed into one direction. It does not mean that the other direction was not free from expansion but the trend dominates in the described direction. Moreover, as the elders told me that in the expansion direction of Lake Tana, future light rain station which passes into the neighboring country to Sudan found in this direction promotes people to squat in this part of

the city. Moreover, there were objective and subjective types of questions to know the demand of the residents for future settlement as well as future expansion of the city of Gondar. Most of the respondents answered that the future expansion direction of Gondar goes into the south direction. The following Figure 33 shows the number of respondents answered future expansion direction.

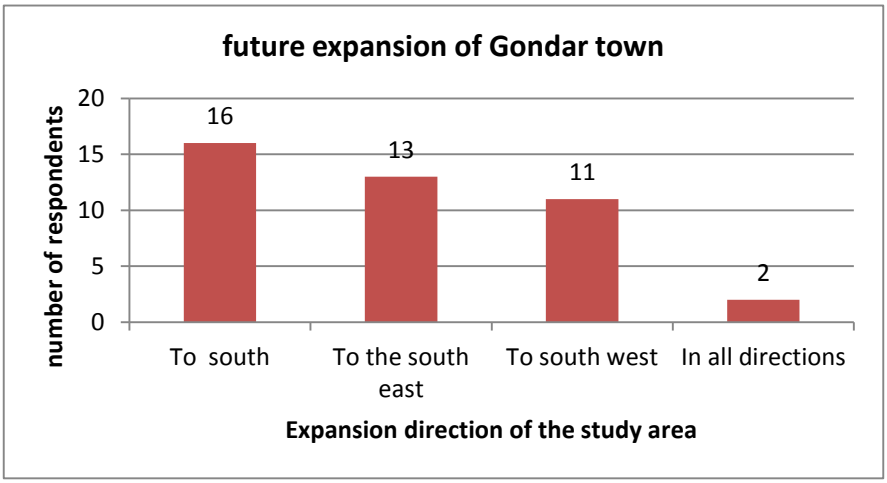


Figure 30 :Future expansion of Gondar town (Source: computed from field survey march 2019)

Based on the survey result and the general characteristics of the town in its future development through observation the researcher saw that there were some infill areas inside the city which is vacant space. These vacant spaces should be developed that means should start its development from the inner part. Then it will expand based on the planning principles. In order to avoid or minimized the negative effects of urban expansion parameters were developed to guide professionals working in this area for the selection of future expansion. To do this there should be open area, ease of infrastructure expansion, there should not be natural and man-made constraint, the site should be preferred by the residents, soil suitability for construction and other topographic nature was considered in scenario development.

During survey time through observation and interview these conditions or criteria were identified. In my observation, the above mentioned criteria well identified at the time of data collection. These were assured by taking some informal interview and discussion whether the idea was align with what the general criteria described above. More over there interview were taken. From the total 42 interviewed respondents, 16 preferred the direction of the city is to

the south followed by 13 and 11 to the south east and south west direction respectively. Based on the above expansion the following future expansion scenario map was developed.

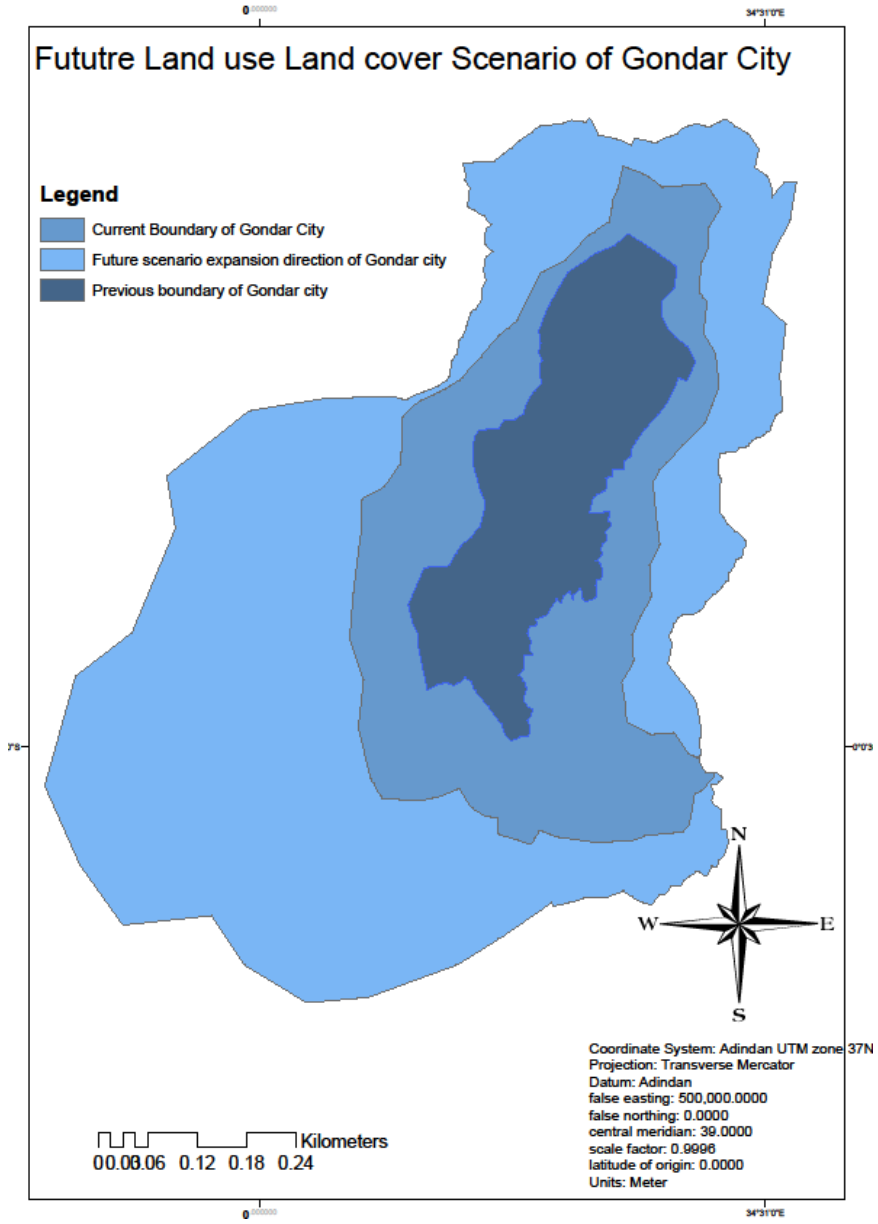


Figure 31: future land use land cover expansion map (Source: prepared from the result)

4.6: Discussion and findings

Although some of the issues obtained from the result were discussed in the result and analysis part here the discussion focused on the two basic objectives of the study obtained from both the spatial and socio economic of the study area.

4.6.1 Land use conversion trend of Gondar town in the last three decade

The percentage change of each land use class from 1991 to 2006, 2006 to 2019 and 1991 to 2019. Water body decreased by- 0.16%,-0.37% and-0.53% respectively. These shows as water body eliminate its half part during these periods. This is may be due to the global warming and other manmade activities like plantation of eclupitus tree near water body is common in the study area. Naturally this plant has high absorbing power of nutrients, ground and surface water. While Farm land and open space shows also a significant decrease by -2.92%, -5.18% and -8.1% respectively. A decrease in farm land occurred may be it is changed into built up areas.

However built up area increase rapidly in each year, for the first period it was increased by 6.81 %, in the second period it was grown by almost two times from the first period which is 14.09% and in the third period increased by three times from the first period which is 20.81%.The last land use class is the vegetation, this land use class is decreased by relatively with a large amount than the other land use classes from its first coverage i.e.by -3.53%,-8.54% and -12.07 % respectively. This result is supported by other similar studies like (Adane 2016)study land use land cover change trend in Bale region confirmed that there is a great reduction in the area of woodland and forest and a corresponding increase in the area of agriculture/settlement over the 30 year period .Adane confirmed that both agriculture and settlement were increase but in my study agriculture was decrease while built up was increase.

Moreover, studies In agreement to the finding of this research, according to Eyaya 2014 in his journal entitled Impact of Urban Expansion on the Agricultural Land Using a Remote Sensing and GIS Approach: A Case of Gondar City, Ethiopia confirmed that a loss of agricultural land from 1966 to 2014 which is in line with my result. Moreover, (Md. Abdul Halim1, Md. Mizanoor Rahman2* and Md. Zahidul Hassan3 in 2013) in their Journal entitled Agricultural Land Conversion In The Sub-Urban Area: A Case Study Of Rajshahi Metropolitan City confirmed that agricultural land decrease due to the expansion of urban area which is similar to my result.

4.6.2 Driving forces that cause land use - land cover change in the study area

For the exercise of urban strategies and urban development plans or land use plans needs further data and information about buildings, recreational areas, impervious surface, land use land cover information and the overall driving forces for the change. From the survey result

the driving forces were identified in the study area that includes societal, biophysical, economic, regulatory, technological and individual. The result obtained from the scoring method describes as societal, biophysical and economic forces are the most influential factors in the study area for the land use land cover change. According to Verburg et al.2004, in their journal entitled: Determinants of land-use change patterns in the Netherlands identified four basic driving factors which includes biophysical, economic, societal and spatial factors are the main land use land cover driving factors in the study area. This result is in line with this study.

The selected driving factors have a direct effect on the land use conversion. For instance due to its topographic characteristics much infill area are left without specified use. This shows us the city administration do not use efficiently and effectively the scarce land for the intended purpose. It can also bring other kiosks for the residents such as corruption and power misuse will be develop through the management process. Identifying of the causal factor is important for investigating the exact solution for the specified problems. Here knowing the driving forces for land use conversion in urban areas is a key point for the overall land use characteristics information to administered the resource in a planned and economical way.

4.6.3 Future land use land cover scenario

Scenario analysis is a process of analyzing possible future events by considering alternative possible outcomes or scenarios (using expert judgment, rather than quantitative forecasts). It is generally agreed that rapid and unplanned urban growth threatens sustainable development when the necessary infrastructure is not developed or when policies are not implemented. In some cities, unplanned or inadequately managed urban expansion leads to rapid sprawl, pollution, and environmental degradation, together with unsustainable production and consumption pattern.

Thus accurate, consistent and timely data on trends in urbanization and city growth are critical for assessing current and future needs with respect to urban growth and for setting policy priorities to promote inclusive and equitable urban and rural development (United Nations, 2014). Therefore, developing a scenario for the future expansion of the study area was very essential. The future development of the city was shown in figure 45. The map developed by considering the existing condition of the city as well as its surrounding rural kebels starting from its previous, current development and finally a future direction was estimated. These scenarios can be used by the city administration and planning authorities to point out the demand for sustainable and guided urban expansion.

Chapter Five: Conclusion and Recommendation

Introduction

This chapter concludes previous results and discussions of the research and which then makes a recommendation for future urban development in different aspects of urban planning policy derivation and implementation procedures for the decision makers as well as professionals at large.

5.1 Conclusion

The Rapid rate of urban growth leads to rapid changes of land use conversion than ever before, particularly in cities like Gondar, it is often characterized by uncontrolled urban rambling, land degradation or the transformation of agricultural land to other uses and resulting massive cost to the environment. The transformation from one type of land use to any other type is caused by different driving forces. Identifying the complex interaction between changes and its drivers over space and time is important to predict future developments, set decision making mechanisms and construct alternative scenarios.

For the identification of drivers both socio-economic and spatial data were computed. From the socio economic part the most influential driving forces such as societal factors, biophysical and economic factors were identified as the most causal forces for the land use land cover change in the study area in the last thirty years. While in its spatial data the general land use conversion trend in the last thirty years were known. To do this the researcher took the current planning boundary of the city administration was taken to see the spatial change due to urban expansion as well.

Based on this boundary the image was down loaded from google earth and georeferencing the selected images with the help of GIS tool and a maximum likelihood supervised image classification was done. Whether or not the image classifications was correct or incorrect or satisfy the basic requirement accuracy assessment was done. As (Andrsen.et al.; 2014) explained the accuracy assessment should be greater than 75% .In this study the accuracy assessment of image 1991, 2006 and 2019 were 75%, 73.53% and 78.95 respectively. The two percentages are satisfying the requirement of accuracy assessment. But the percentage of 73.53 % dissatisfied as compared with the minimum requirement. This is because of image classification problem detection. Four Major land use land cover types were identified by using the field data and Google earth image of 1991, 2006 and 2019. As we see the land use land cover of the city in these three particular years were known based on the four land use

classes. During 1991 the vegetation coverage is the highest, almost half of the total coverage area that was 44.9% followed by farm land and open space that accounts 38.6%. However, the smallest share covered by built up (15.6%) and water (0.8%) respectively. Whereas, in 2006 the largest coverage is still occupied by the vegetation part but, decrease their rate of growth. The coverage was 41.37% that diminished from its half coverage from previous what was in 1991. Moreover, the proportional coverage of water and Farm land were decreased to 0.63% and 35.68 respectively as compared to other land use classes.The built up (22.32%) increase with a good proportion by consuming the largest part from vegetation, farm land, and open space.

In 2019, the great proportional land use land cover was taken by built up that covers 36.41%.This percentage was almost greater than one-third of the total coverage of the city. Vegetation coverage was diminished with a great number of changes from its previous coverage. Farm land and open space have got a certain land use change that covers 30.5% which is in third place from the total coverage. In a similar manner water body is still decrease that covers only 0.26% from the total land use class of the city.

5.2 Recommendation

Based on the results of this study, the following recommendations are forwarded:

- One of the causes of land use land cover change of the city is rapid population growth resulted from natural increase and rural urban and urban-urban migrations; therefore working on these area with the concerned body is very important to improve the overall spatial planning and urban planning challenges. As you all know planning is for the people. So knowing the approximate number of people living in urban areas is very important. Not only this, but also controlling the population growth and its associated impacts on the natural environment requires the right policy packages by national and regional governments such as awareness creation, provision of family planning services, increasing productivity, working on the pushing factors of migration and controlling illegal settlements are some of the action taken by the city administration.
- The city is expanding horizontally on the expense of other land use like forest or vegetation and farm land coverage in the south, south west and south east direction without considering its future land value of the area, in the absence of planning principles and overall beautification and tourism attraction because this city is a

historic cultural city that contributed a great potential for the dwellers in its topographical and cultural advantage. Moreover, due to its topography nature in many parts of the city there is vacant spaces or infill area without giving the required purpose for the city dwellers. Therefore, the concerned body such as the city administration should start the city development from the inside. Knowing the amount of land that are not developed in the inner part of the city is crucial, then develop the strategy based on the planning point of view or the required land use plan should be developed. After that by following phasing development one can solve the problem. Moreover, planners should consider vertical development of the city and identifying development in line with its topography nature.

- Currently, economic factors play a significant role for the rapid land use land cover change in the study area, therefore the city administration should incorporate and done actively the economic sources for the residents to protect from illegal activities. In the city there is a shortage of recreational places and the city is bounded by a mountainous area, to solve the economic problem without affecting the natural set up by organizing the youth in association form provided the idle land to use as a source of money.
- Land use land cover information is very important for the city administration for decision making in a day to day activities. For policy makers to make strategies and for planners to know the whole spatial characteristics of the city and to give professional advice for its future growth. If so the concerned body should give emphasis for the land use land cover.

  The city administration should use the scenario development for its upcoming growth in the near future by putting strategies to guide its future growth.
- Poorly planned and managed urban development is affecting the physical environment, health, economy and the general quality of life. It is necessary to be equipped with best professional in their ethics and skill. Therefore the city administration should build its capacity and employ professionals by seeking on job training programs for its staff and apply modern technology to manage the land resources in a proper way. It is necessary to modifying the existing situation and trend and induces the policies that implement vertical growth of the city in order to maximize the benefits of urbanization and minimize its negative externalities.
- Poor land management and housing problem with weak governance system makes the development behind the required status as compared to its historical perspective.

Therefore, strong and effective land and housing law is important for the management of land use land cover.

- This study focused on the land use conversion trend and the driving forces behind the change. Therefore, further study is required to assess impacts brought by LU/LCC

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Annex I

1. Questionnaire for associations that are organized through cooperatives

Annex I: Survey Questions

Annex I (1): The City Land Development and Management Workers': Officers

Survey questions for government officials of Gondar City Land Development and Management Dear respondent, Thank you in advance for your willingness to participate in my survey. This questionnaire is developed to generate first-hand information for a research about driving forces that determine land use conversion in urban area:the case of Gondar city. The research is carried out as a partial fulfillment of the Msc program at Addis Ababa University EiABC. This questionnaire is intended to gather data from government officials related to driving forces or factors that determine or facilitate land use conversion in Gondar city. Recognizing the invaluable role that your responses have for successful completion of this research, you are kindly requested to provide all relevant and genuine data, to the best of your understanding. Regarding your privacy, I would like to assure you that your responses will be kept confidential and used for the purpose of this academic research only.

If you have any feedback or need for further clarification, please do not hesitate to contact me through my cell phone +251904940693// +251904641947 (Ayelign Tebeje) or email address ayeligntebe@gmail.com

With best regards,

I. General Guidelines:

While you fill up the questionnaire hereunder, please make note of the following issues:

For questions in tables, you are required to rate each statement against the prevailing situation in your city. So, you are requested to respond each question by putting (X) mark for the givin boxes in one of the respective alternatives based on your perceived degree of appropriateness. And for the scoring method you are required to put values ranging from strongly infulence (10) to less infulencial (1).You are not expected to write your name on the questionnaires.

Part II. General demographic information

1. **Sex:** ☐**male** ☐**female** 2. Age: ☐20-30 ☐31 -40 ☐ 41 -50 ☐above 51

3. Level of education: ☐ 9-12 ☐Certificate ☐ 10 + 3 ☐12+2(Diploma) ☐ 1st Degree ☐ second Degree and above

4. Marital status: ☐Single ☐Married ☐ Divorced ☐Widowed

5. Number of families: ☐1 to 3 ☐ 4 to 6 ☐7 to 9 ☐ 10 and above

6. Living year in Gondar city: ☐from 10 to 15years ☐ 16 to 20years ☐above 20years

Part III. Information related to land use conversion trend

7. Which is the major factor for the emergence of the city?

☐ Service center ☐ Market place ☐ Religious ☐ Agglomerations of rural farmers ☐Administrative center ☐any other----------

8. What do you think the major land use and land cover of the city during its emergence?

☐Commercial ☐ Residential ☐ Social Services ☐ Urban Agriculture ☐ Forest area

9. What do you think the major Factors of land use and cover change in Gondar city?

☐Population growth ☐ Establishment of manufacturing and industries ☐ Economic factors ☐Government policy change ☐ Other factor, _____

10. land use conversion trend in transferring from one type of use to the other for the last 15 years in Gondar city

Part IV.

11. Questions related to driving forces for the determination of land use conversion

s.no	Variables	indicators	Scoring method(1-10)
1.	Biophysical Factors	i.soil type	
		ii.topography	
		iii.climate	
		iv.availability of water	
2.	Economic factors	i.profit	
		ii.capital	
		iii.market	
		iv.infrastructure	
3.	Technological factors	i.the use fertilizer for improvement of the land	
4.	Regulatory/policy/ factors	i.taxiation	
		ii.subsides	
		iii.land law	
		iv.transition period/policy change/	
5.	Societal factors	i.migration	
		ii.natural population growth	
6.	Individual factors	i.age	
		ii.attitude to change	
		iii.education and exprience	
		iv.access to information	

Part v. other related questions

12. What are the main Challenges concerning land use conversion trend in Gondar city for the last 15 years?

_____

13. How do you evaluate the existing land use vs the existing development?

_____

14. Is there any informal settlement in the town? ☐yes no ☐

14.1 Which areas are dominated by informal land holding? The reason why?

_____

14.2 In which direction of the town do residents prefer to settle?

_____

15. What do you think about the sustainable development of Gondar city in relation with land use land cover change?----------

2. Questionnaires for farmers

1. Sex 1. male 2. Female
2. Age 1.20-30 2.31-40 3.41-50 4. Greater than 51
3. Level of education 1. Illiterate 2. From grade one to grade eight 3. From grade nine to twelve 4. Diploma 5.degree and above
4. Martital status 1.single 2. Married 3. Divorced 4 .widowed
5. Number of families 1. One to three 2. Four to six 3.seven to ten 4.morethan ten
6. How many hectares of land taken by the city administration ? 1.half hectars 2.one hectars 3.two hectars of land 4.three hectar and above
7. What was the main purpose of your land conserning land use? 1.for agricultural 2.for forest 3. Grazing land 4.other mention----------
8. Have you seen any land use land cover change in your surrounding ? 1.yes 2.no
9. In question number 8 if you say yes,what kind of change do perceive? 1.from agriculture to residential 2.from forest to residential 3.from residential to commercial 4.from agricultural to industry
10. How do you perceive the direction of the expansion of Gondar city? 1.from north to south 2.from south to north 3.from north to east 4. From north to south west 5. from north to south east

3.Questionnaires for informal settlers

1. Sex 1. male 2. Female
2. Age 1.20-30 2.31-40 3.41-50 4. Greater than 51
3. Level of education 1. Illiterate 2. From grade one to grade eight 3. From grade nine to twelve 4. Diploma 5.degree and above
4. Martital status 1.single 2. Married 3. Divorced 4 .widowed 5. Separated 5.Number of families 1. One to three 2. Four to six 3.seven to ten 4.morethan ten
6. How do you get the land ? 1.buying from farmers 2.buying from speculators 3.transfer from families 4.any other, mension
7.what is the main reason getting the land through the above mensioned way?1.due to weak enforcement of law by the city administrative 2.due to high price of land that have a title dead 3.due to access free selled land from farmers 4.others
8. Where you living before moving to the informal settlement of Gondar ?1.from other woreda 2.from the nearest rural village 3.from the city of Gondar 4.from other zones
9. Does the cost of living here differ from where you previously lived? 1. Yes 2.no
10. what are the main socio-economic challenges?----------

11.how do you perceive the general land use land cover change of the area?
---

4. Questionnaire for different residents in the city

1.Gender 1. Male 2. Female
2.Age 1.20-30 2.31-40 3.41-50 4. Greater than 51
3.Level of education 1. Illiterate 2. From grade one to grade eight 3. From grade nine to twelve 4. Diploma 5.degree and above
4.Marital status 1.single 2. Married 3. Divorced 4 .widowed
5. Family size 1.one to three 2. Four to six 3. Seven to ten 4.greater than 10
6. How many years do you live in the city of Gondar?
   1. 10 to 15 years 2.16 to 20 years 3. Above 20
7. Have you seen any land use land cover change in your surrounding? 1.yes 2.no
8. Where have you lived before coming to this place?
   1. Living in kebele house 2.renting from private owners 3.living in my relatives 4.any other specify----------
9. What was the land use land cover of this area?

1. Forest 2.Bare land 3. Agriculture 4.residential 5.commercial

10 what is the current use of your house

1. Residential 2.Commercial 3.Recreation 4. Urban agriculture

11. what do you think about the future expansion of the city

1. To south 2. To the south east 3. To south west 4. In all directions

5. <u>Questionnaire for Proffesionals</u>

5.1**: The City road authority Workers': Officers**

Survey questions for government officials of Gondar City road authority

I. General Guidelines:

While you fill up the questionnaire hereunder, please make note of the following issues:

For questions in tables, you are required to rate each statement against the prevailing situation in your city. So, you are requested to respond each question by putting (X) mark for the givin boxes in one of the respective alternatives based on your perceived degree of appropriateness. And for the scoring method you are required to put values ranging from strongly infulence (10) to less infulencial (1).You are not expected to write your name on the questionnaires.

Part II. General demographic information

1. **Sex:** ☐**male** ☐**female** 2. Age: ☐20-30 ☐31 -40 ☐ 41 -50 ☐above 51

3. Level of education: ☐ 9-12 ☐Certificate ☐ 10 + 3 ☐12+2(Diploma) ☐ 1st Degree ☐ second Degree and above 4. Marital status: ☐Single ☐Married ☐ Divorced ☐Widowed ☐Separated

5. Total service year in the organization: ☐Below 2 year ☐2 years and above

6. Service year in current job position: ☐Below 2 year ☐2 years and above

Part III. Information related to land use conversion trend

7.Which one is the major factor for the emergence of the city?

☐ service center ☐ Market place ☐ Religious ☐ Agglomerations of rural farmers ☐Administrative center ☐any other----------

8.What do you think the major land use and land cover of the city during its emergence?

☐ Commercial ☐ Residential ☐ Social Services ☐ Urban Agriculture ☐ Forest area

9.What do you think the major Factors of land use and cover change in Gondar city?

☐Population growth ☐ Establishment of manufacturing and industries ☐ Economic factors

☐Government policy change ☐ infrastructure expansion, _____

10. land use conversion trend in the last 15 years in Gondar city

Part IV.

11.Questions related to driving forces for the determination of land use conversion due to the expansion of road infrastructure

s.no	Variables	indicators	Scoring method(1-10)
1.	Biophysical Factors	i.soil type	
		ii.topography	
		iii.climate	
		iv.availability of water	
2.	Economic factors	i.profit	
		ii.capital	
		iii.market	
		iv.infrastructure	
3.	Technological factors	i.the use fertilizer for improvement of the land	
4.	Regulatory/policy/ factors	i.taxiation	
		ii.subsides	
		iii.land law	
		iv.transition period/policy change/	
5.	Societal factors	i.migration	
		ii.natural population growth	
6.	Individual factors	i.age	
		ii.attitude to change	
		iii.education and exprience	
		iv.access to information	

14. In which direction the city will expand? Why ?----------

5.2 : The City Land Development and Management Workers'

I. General Guidelines:

While you fill up the questionnaire hereunder, please make note of the following issues:
For questions in tables, you are required to rate each statement against the prevailing situation in your city. So, you are requested to respond each question by putting (X) mark for the givin boxes in one of the respective alternatives based on your perceived degree of

appropriateness. And for the scoring method you are required to put values ranging from strongly infulence (10) to less infulencial (1).You are not expected to write your name on the questionnaires.

Part II. General demographic information

1. **Sex:** ☐**male** ☐**female** 2. Age: ☐20-30 ☐31 -40 ☐ 41 -50 ☐above 51

3. Level of education: ☐ 9-12 ☐Certificate ☐ 10 + 3 ☐12+2(Diploma) ☐ 1st Degree ☐ second Degree and above 4. Marital status: ☐Single ☐Married ☐ Divorced ☐Widowed ☐Separated

5. year of stay in the city: 1. 10 to 15 2.16 to 20 3. Above 20

Part III. Information related to land use conversion trend

7.Which is the major factor for the emergence of the city?

☐ service center ☐ Market place ☐ Religious ☐ Agglomerations of rural farmers ☐Administrative center ☐any other----------

8.What do you think the major land use and land cover of the city during its emergence?

☐ Commercial ☐ Residential ☐ Social Services ☐ Urban Agriculture ☐ Forest area

9.What do you think the major Factors of land use and cover change in Gondar city?

☐Population growth ☐ Establishment of manufacturing and industries ☐ Economic factors

☐Government policy change ☐ Other factor, _____

10. land use conversion trend in transferring from one type of use to the other for the last 15 years in Gondar city

6. Interview questionnaires

1.Gender 1. Male 2. Female

2.Age 1.20-30 2.31-40 3.41-50 4. Greater than 51

3.Level of education 1. Illiterate 2. From grade one to grade eight 3. From grade nine to twelve 4. Diploma 5.degree and above

4.Marital status 1.single 2. Married 3. Divorced 4 .widowed

5. family size 1.one to three 2. Four to six 3. Seven to ten 4.greater than 10

6. How many years do you live in the city of Gondar?

7. What looks like the historical trend of Gondar city?----------

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8. How do you fill the land use land cover change of the city during the last 30 years and above ?----------

9. What are the main driving forces for the rapid expansion of the city?

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10. What are the main challenges of the city of Gondar?

Annex 2

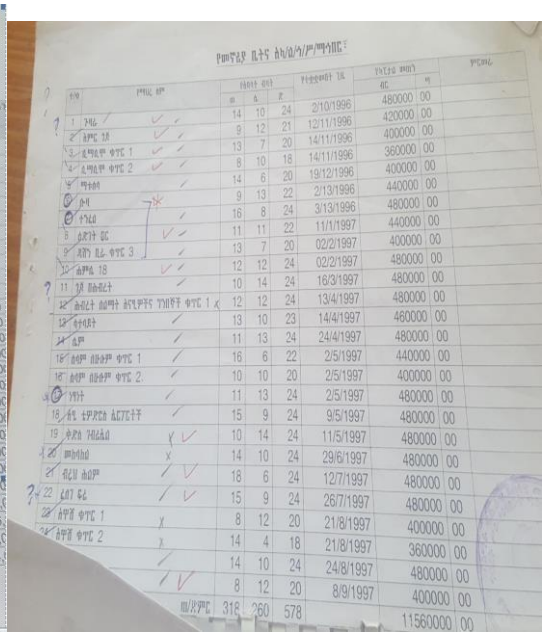
Image 1 a photo showing how its topography affects the land use land cover change

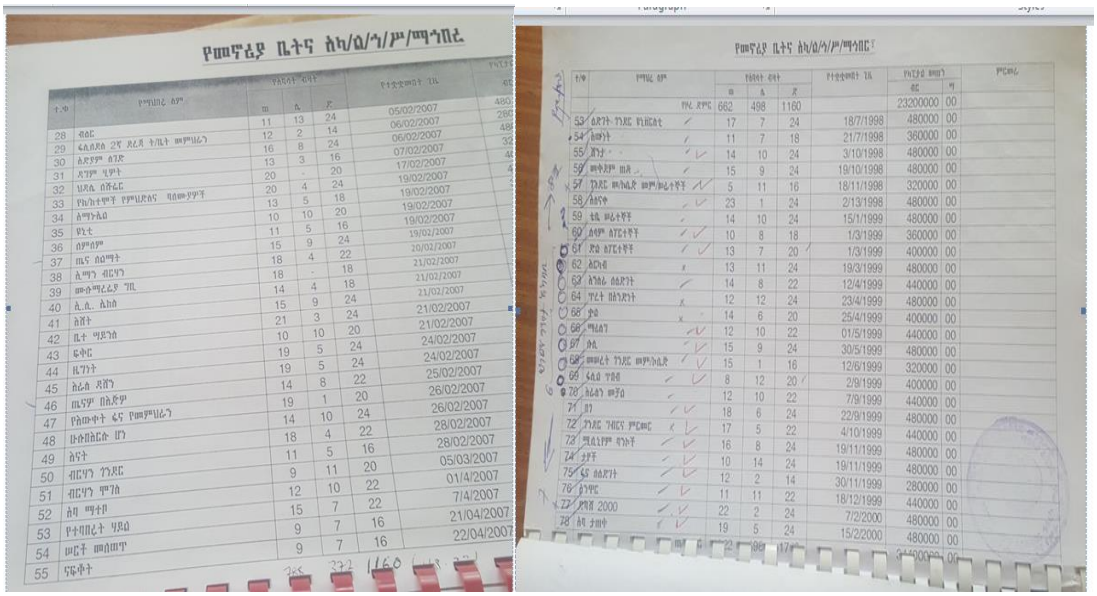
Annex 3

List of cooperatives through association

የመኖሪያ ቤትና አካ/ል/ኅ/ ሥ/ ማህበር

ተ.ቁ	የማህበሩ ስም	የአባላት ብዛት			የተቋቋመበት ጊዜ	የካርታ መጠን
		ሠ	ሴ	ድ		ብር
1	አርዒያንትና ግንባሮች ቁ.2	14	10	24	1304/1997	480,000
2	ወንድማማችነት	16	8	24	16/12/1997	480,000
3	ሰንትት	7	17	24	13/02/2000	480,000
4	ጂ.ኤ.ቲ	13	9	22	12/03/2000	44,0000
5	ሰፈረግኑት	15	9	24	04/04/2000	480,000
6	ፍሬ ሰላም	9	9	18	12/07/2000	36,0000
7	ቁም ነገር	19	5	24	15/12/2006	48,0000
8	ወሃይ ፍንሃን	11	11	22	16/12/2006	44,0000
9	ስምረት	23	1	24	16/12/2006	48,0000
10	ለውጤት	12	4	16	16/12/2006	32,0000
11	መከ	11	3	14	16/12/2006	28,0000
12	ኩራዝ	17	1	18	16/12/2006	40,0000
13	ጀን ባንከት	14	10	24	16/12/2006	48,0000
14	አለም ብርሃን	14	10	24	16/12/2006	48,0000
15	ሳይንስ አንባ	21	3	24	19/12/2006	48,0000
16	አዲስ ትይንት	14	8	22	19/12/2006	44,0000
17	ቱይ ቱብሮ	21	3	24	21/12/2006	48,0000
18	ጥረት ለሳጀ	16	8	24	22/12/2006	48,0000
19	ነጭ ወርቅ	15	7	22	27/12/2006	44,0000
20	ማሪፊያ ለሁሉም	11	13	24	27/01/2007	48,0000
21	ውሃ ፍሰሽ ቁ.3	17	5	22	27/01/2007	44,0000
22	ሰላም-ኅ/ዩኒ/ሆ/ ሰራተኞች	18	4	22	27/01/2007	44,0
23	አረንጓዴ ሰፈር	12	12	24	28/01/2007	48,0
24	ዋንዛሆ	17	7	24	28/01/2007	48,0
25	የእኛ ተስፋ	6	12	18	28/01/2007	36,0
26	ሰላም ብርሃን	9	11	20	28/01/2007	4,0
27	አፀደ ገነት	14	6	20	29/01/2007	4,0





Annex 4

Chek list for land use land cover information

No	Topic	Sub topic	Methodology for data collection
1	General description of the project	☞ Location of city ☞ Historical background ☞ Settlement evolution ☞ Topography -Slope ☞ Vegetation coverage ☞ Climatic condition (temperature, etc)	Digitizing base map Updating base map through field observation
2	Existing Land use analysis of town	1.Land use land cover characteristics	Field inventory Interviewing
3	Land management system of the city	Application of technologies like GIS ,in Land use change	“