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URBAN SPRAWL AND ITS IMPLICATIONS ON LAND USE/LAND COVER DYNAMICS: THE CASE BAHIR DAR CITY, AMHARA REGION, NORTH CENTRAL ETHIOPIA

BY

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Urban sprawl and its implications on Land use/Land cover Dynamics: The case Bahir Bar city, Amhara region, north central Ethiopia

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This is to certify that the thesis prepared by Fentahun Abebe, entitled: Urban sprawl and its implications on Land use/Land cover Dynamics: The case Bahir Bar city, Amhara region, north central Ethiopia and submitted in partial fulfillment of the requirement for the degree of Degree for Masters of Art (in Geography and Environmental Studies Specialization in Geographic Information System, Remote Sensing and Digital Cartography) compiles with the regulation of the university and meets the accepted standard of with respect to originality and quality .

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Abstract

Due to urban sprawl different land use /land cover change was registered, this change had its own impacts on the environment and lives of the population. The general objective of this research was to evaluate the impact of urban sprawl on land use/ land cover dynamics in Bahir Dar city. This research was mixed types of research, with concurrent research design. To achieve the objective, stratified and systematic random sampling techniques were used. The sample size of this study was 387 samples, from those samples 27 of them were interviewed, the remaining 360 respondents filled the questionnaires. The findings shows that, the majority of the respondents explained that rural to urban migration, absences of quality of urban planning, the existence of accessible areas, and demand for more living space were the causes of urban sprawl. Due to the above factors the expansion of Bahir Dar city occurred to the east (Gondar outlet), west (Airport and Hospital Street), and south (Merawi and Adet outlet) directions, whereas expansion to the north was limited by Lake Tana. From 1991 to 2021, there has been a persistent increase in built up area while some of the classes have had an inconsistent or irregular increase or decrease in their land cover. Water, for instance, increased in 2001 and 2011, but decreased in 2021. Vegetation somewhat increased starting from 2001, but Agricultural lands decreased throughout the years except in 2001. In addition due to urban sprawl the agricultural production was reduced, ecosystem, and lifestyle was disturbed, income status was declined, infrastructure supply was reduced , and land value was increased in the study area. To minimize this problem the government and concerned stakeholders shall manage the urban sprawl by decreasing informal settlement, and preparing smart growth to combat urban sprawl by developing in a way that does not endanger the land or community. Planners and architects who promote smart growth seek to develop a stronger sense of place through a more compact way of development, also known as mixed-use.

Keywords: Urban sprawl, Land use/Land cover, built up area, GIS, Bahir Dar city

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ACRONYMS AND ABBREVIATIONS

BU/NBU	Built up and non-built up area
CSA	Central Statistics Agency
GIS	Geographic Information System
GPS	Global Positioning System
IGBP	International Geosphere and Biosphere Programme
IHDP	International Human Dimensions Programme on Global Environmental Change
LU/LC	Land use /land Cover
RS	Remote Sensing
SPSS	Statistical Package for the Social Sciences
UNFPA	United Nations Fund for Population Activities
UNESCO	United Nations Educational, Scientific and Cultural Organization
USGS	United States Geological Survey

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the Study

In human history, urban regions have played an imperative part in modifying society. They have been the portion and condition of primary social, financial and political change. Urbanization has been an basic social and financial frequency taking put at an uncommon scale and rate all over the world *(Sun et al., 2013).* In spite of the fact that urban zones cover a really minor parcel of the world's arrive surface, their fast development has seriously changed the characteristic scene and made gigantic natural, biological system, and social impacts (Mundia & Murayama, 2010). The unavoidable results from this prepare are the spatial extension of towns and cities exterior their juridical limits and into their hinterlands and peripheries in arrange to suit the developing urban populace *(Mosammam, et al., 2016).*

Due to the increase of the global urbanization in both intensity and extent, there is a growing interest in considerate its implications with respect to a broad set of environmental factors including damage of arable land *(Lopez et al.,2001),* deterioration in natural vegetation cover and climate at local, regional, and global scales *(Grimm et al.,2000).* The unplanned and unrestrained rapid growth has resulted in serious negative effects on the urban residents and their environment (Chadchan,& Shankar,2012). It is also related with health risks including air pollution, occupational hazards, and traffic injury, and risks caused by dietary and social changes. Primary causes of urbanization are population explosion, migration from other places, industries, economy and nearness to resources and basic services.

As population rises in an area or a city, the border of the city enlarges to accommodate the growth; this expansion is considered as sprawl. The built-up is generally reflected as the parameter for quantifying urban sprawl. The ponder on urban sprawl is attempted within the developed nations *(Barnes et al., 2001)* and as of late in developing nations such as India *(Cheng & Masser, 2003)* and other Asian nations *(Sudhira et al., 2003)*. These days, we live in a built environment which harms from the spatial side-effects of innovative overdose that has been managed in a rush. These innovative developments and large-scale relocation of rural individuals towards the urban regions has driven to urban environmental deprivation. Portion of the method of natural debasement is the marvelous sum of arrive being hooked up by sprawl *(Barnes et al., 2001).*

When urban sprawl takes place, land use /land cover modification has been practiced in that area. Land use and land cover alter has been examined from diverse perspectives in arrange to recognize the causes of land use and land cover modification, their process and results. Urban growth, especially the relocation of residential and commercial space to rural areas outside metropolitan areas, has long been a sign of regional economic strength. There are some positive effects of urban sprawl ,such as a rise in economic production ,an increase in opportunities for employment ,better opportunities and better services creating better living conditions ,and better lifestyle .Urban sprawl can extend basic services, infrastructure and social capital such as transportation, and water, better educational facilities, and health care facilities, to larger populations. But, its benefits are increasingly balanced against ecosystem impacts, including distortion of air and water quality and loss of farmland and forests, and socioeconomic effects of economic disparities, social fragmentation and infrastructure costs. The rapid variations of land cover are often characterized by urban sprawl farmland displacement and deforestation leading

to the loss of arable land *(Lopez et al., 2001)*, habitat destruction (Alphan, 2003), and the decline of the natural greenery areas .These losses have a considerable impact on urban environmental conditions such as biodiversity, climate change, and atmosphere particulate pollution at local and/or global scales *(Sun et al., 2016).*

Current technologies such as geographic information systems (GIS) and remote sensing offer cost-effective and accurate alternatives for detecting landscape dynamics *(Raziq et al., 2016).* Recent enhancements in satellite image quality and availability have made it possible to make image analysis at a much larger scale than in the past. Satellite imagery has been well used in the natural science communities for measuring qualitative and quantitative terrestrial land-cover changes. Landsat data are most widely used for studying the Land use and Land cover alterations *(Herold et al., 2002).*

Bahir Dar, which is the capital city of Amhara National Regional State (ANRS) of Ethiopia, has experienced larger challenges due to speedy urbanization. The city is one of the fastest growing cities positioned in the northwestern part of the country .After the city was chosen in 1948 as the capital of Gojjam Awraja, an administrative unit or hierarchy next to a region used under previous rules, it is supposed to be growing rapidly. Bahir Dar was chosen as the seat of the regional government of the Amhara National Regional State following the fall of the previous Ethiopian government in 1991. With this; Bahir Dar experienced main development and enlargement. The expansion has posed severe threats to the land use- land cover of the city and its neighboring natural environment. Therefore, the study was initiated to explore Bahir Dar city expansion and associated land use land cover (LULC) to change Bahir Dar city urban sprawl extending from 1991-2021 .

1.2 Statement of the Problem

Currently, industries and developments are increasing the population of urban inhabitants and urban centers. The growth in urban population and urban centers are altering vegetative lands or land covers into impervious surfaces. Although these conversions and their effects are globally found in metropolitan areas, it is becoming a disaster in developing countries *(Applah et al., 2017).* Expansion of urban centers has enlarged the conversion of natural resources and changed the pattern of land cover and land use. Wandl and Magoni (2017) reported that about 50% of the world's population now lives in urban centers and this is making the urban landscapes relatively the fastest land cover type. According to *Dominguez et al. (2018),* the world population is expected to go up from the previous estimate of 6.8 billion in 2009 to 9.1 billion by the year 2050 and the urban population is predicted to rise from 3.4 billion in 2009 to 6.3 billion by 2050. As the number of people living in the urban centers goes up, the margins are targeted as an escape from congestion and problems that come from overpopulation *(Guzmán et al., 2017).* This changes the land cover pattern at the peripheries through the pressure and the transformation it undergoes.

In developing countries, urban expansion negatively affects agricultural lands which are essential factors in determining land use and land cover change .Issues of urban sprawl have not only given rise to new approaches in achieving a suitable urban form, but also to new methods used to monitor and examine urban sprawl and its effects *(Mosammam et al., 2017).* To monitor and analyze urban sprawl, some researchers like (*Bhatta et al. 2010)* propose using sprawl indicators like by using boost of population number, and observation of land use /land cover changes whereas other researchers like *(Epstein et al., 2002)* highlights the use of geospatial techniques such as remote sensing and GIS in addition to statistical techniques *(Yang et al., 2003).*

The remote sensing research community continues to face a challenge with the mostly computer-aided production of spatially detailed and thematically accurate LU/LC information from satellite images *(Civcon et al.,2002).*This is because urban environments are so diverse that it is hard to distinguish between different land cover classes. It could also be because there aren't enough effective classification methods. However, researchers have been able to examine and notice the dynamic nature of urban structures in a more efficient manner thanks to recent advancements in GIS and RS tools and methods. Some recent researches such as Ernest Biney & , Ebenezer Boakye in 2021 where studied urban sprawl and its impact on land use land cover dynamics of Sekondi-Takoradi metropolitan assembly, Ghana on this research the researchers were studied the impacts of urban sprawl based on Landsat images only, this were not properly indicate the impacts of urban sprawl on the residences . Again Krishnaveni K.S. and, Anilkumar P.P. in 2019 also studied the management of urban sprawl using remote sensing and GIS on this research were they tried to show how the land use changed from time to time, but what are the causes of urban sprawl were not clearly studied. So still the previous researches did not explain how urban sprawl affects the surrounding peoples and areas rather they simply expresses the changes of land use /land covers by using Landsat images without asking the residences. In addition, according to the researcher's observation in Ethiopia, especially in Bahir Dar city, the peoples need land for different purposes without considering the impacts of urban sprawl, which means that there is the practical gap of urban planning. So this research tried to fill those both knowledge, and research gaps.

The city of Bahir Dar is thought to be a place where one could live better; due to superior opportunities, infrastructures, services, and lifestyles compared to the surrounding woredas. By many standards, it is also regarded as one of the most beautiful, well-planned, and safest cities.

In 2002, it received the UNESCO Cities for Peace prize for addressing the difficulties posed by rapid urbanization *(Dachasa et al., 2014).* As a result, more people are moving to the city from the countryside. This would have a significant effect on the ecosystem around it: loss of agricultural land, destruction of forest cover, depletion of water resources, and impact on the land's benefits. Planners and policymakers lack the precise, timely, and cost-effective urban land use data they need to make decisions about land resource management due to the rapid growth of the urban-rural border. In Bahir Dar, Ethiopia, land use and land cover change must be quantified and modeled to identify and resolve adverse impacts. This could aid in better land use management and environmental development of the study area.

1.3. Objectives of the Study

1.3.1 General objective of the study

The general objective of this study is to determine how urban sprawl affects the dynamics of land use and land cover in Bahir Dar city.

1.3.2 Specific objectives of the study

The specific objectives of this research were the following:

- To examine the land use / land cover changes that took place in the study area 1991-2021

- To assess the magnitude of Bahir Dar City expansion from 1991-2021

- To investigate the cause of urban sprawl in Bahir Dar city

- To assess the impacts of urban sprawl on land use /land cover changes in Bahir Dar city.

- To evaluate the effects of urban sprawl on agricultural production, infrastructure, income, ecosystem, lifestyle, and land value.

1.4. Research Questions

How has the land use /land cover changed in Bahir Dar city from 1991_2021?

How did the magnitudes of Bahir Dar City expansion take place from 1991_2021?

What conditions primarily contribute to urban sprawl of Bahir Dar city?

What are the influences of urban sprawl on the land use /land cover alterations in Bahir Dar city?

What are the effects of urban sprawl on agricultural production, infrastructure, income, ecosystem, lifestyle, and land value?

1.5. Significance of the Study

Local management and urban planners can use information on urban growth, land use, and land cover change study to develop sustainable development plans for any area in the future.. Assessing the impacts of urban sprawl on land use /land cover changes in the case of Bahir Dar is very important to understand and evaluate the achievement gained in the implementation of urban planning. Plus to that it is used as a source of information for Bahir Dar city municipalities and, Bahir Dar city urban development and construction office to identify the gaps that are related with urban sprawl; they can reduce different urban related problems like informal settlement, loss of lands, and the like. It is hoped that results of this study were used to improve policy makers', planners' and researchers' understanding of the impacts of urban sprawl on the land use/land cover changes in the study area and may serve as an important tool for any possible information towards reducing urban related problems. Assessing the effects of urban sprawl on the land use /land cover fluctuations is also used to create awareness concerning the definition of urban sprawl, good practice and trend to the others by minimizing to reduce urban related

problems**.** Lastly, this study is important to society; it may be used to create awareness and recognition about the impacts of Urban sprawl.

1.6. Delimitation (scope) of the Study

The study's focus is on determining how urban sprawl affects the dynamics of land use and land cover in Bahir Dar city.

The time scope of this study for the household survey was 2021_2022, meaning that it was undertaken one year to identify the most significant variable related with causes of urban sprawl, and the impact on land use /land cover changes needs time. On the other hand, satellite image data from 1991 to 2021 was taken to uncover the expansion of Bahir Dar city.

1.7. Limitations of the Study

The use of primary data during data collection through questionnaire and interview some respondents were not willing to give appropriate data, this problem was solved by asking the respondents again and again until they returned the answers. Another limitation of the study was the availability of cloud-free Landsat images for the required time-points of the study area; again this problem was solved by looking at the image before download and selecting the best image.

1.8. Definition of Terms or Concepts

Urban Sprawl; it denotes to the outgrowth of urban areas caused by uncontrolled, uncoordinated and unplanned growth (*Alphan, H. 2003*).

Land use ; It is the alteration of land surface processes such as biogeochemistry, hydrology, and biodiversity by human activities for the purposes of agriculture, forestry, settlement, and pasture (Di Gregorio and Jansen, 2000).

Land cover; According to Di Gregorio and Jansen (2000), the term "land cover" refers to the observed biophysical cover of the earth's surface, which includes water bodies, hard surfaces, vegetation, and bare soil.

In this research both words (land use and land cover) are used as a similar concept means that this research considers both terms are similar, as they are a debatable concept.

1.9. Thesis Organization

There are five chapters to the thesis. The first part of the chapter is the introduction, which includes: context of the study; the problem's statement, the thesis's goals, and the significance of the study; and the study's scope and limitations. Chapter Two provides a brief literature review to assess the impact of urban sprawl on land use/ land cover dynamics in Bahir Dar city. Under the literature review, the findings of relevant studies were examined. Description of the study area, data collection process is regarding the methodology under Chapter three. Data analysis which includes results and discussion, and conclusion and recommendation were explained under chapter four and five respectively.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Introduction

Due to urbanization, agriculture, and deforestation, the earth's surface has undergone significant alteration in recent years. Even though rates of land conversion to agriculture and deforestation vary worldwide, the number of people living in cities has steadily increased. According to Ouz (2004), urbanization has increased steadily ever since World War II and is likely to continue into the twenty-first century. In order to strengthen the particular study, previous related published works are discussed in this chapter.

2.2 Conceptual Literature Review

2.2. 1.The definition of urban sprawl

Many definitions can be ready for urban sprawl from different viewpoints. *Galster et al. (2001)* set precise definitions which can be substituted for or can be used at the same time with urban sprawl; specific land utilization model, land development process, reasons of land utilization behaviors, results of urban land utilization behaviors. Parallel to the rapid growth of population, urban growth which develops according to demands of dwelling, industry and business sectors is in the trend of intensifying towards city boundaries and causes occupation of agricultural lands and forests. This uncontrolled and unplanned growth is defined as urban sprawl that is the effect of urban growth (Zhang, 2004, Sudhira , and Ramachandra, 2007). Urban sprawl which is indicated to be carried out for urban growth is in fact not suitable either for urban growth or rural environment in real sense. In this sense, since it is carried out in a disorganized and uncontrolled way, it has effects which hinder regional sustainable development (Bhatta, 2010). These areas can be depressed by infrastructure

services, basic amenities such as health, education (Sudhira and Ramachandra, 2007). After the 1960's urban growth and urban sprawl are regarded as a vital problem in many cities all over the world and particularly in metropolitan cities (Squires, 2002, and Pengiun, 2011).

The lands of urban sprawl which are defined as lands that have lost their rural faces and yet cannot be defined as urban include specific uncertainties and outcomes in numerous problems such as unplanned urban growth and use of non-agricultural purposes. Therefore, urban sprawl can be demarcated as a hinterland among rural and urban areas. While Gordon and Richardson (1997) describe urban sprawl as leapfrog development. DiLorenzo (2000) states it as growth with cancer or virus.

In order to mark general characteristics of urban sprawl throughout Europe, global socio-economic powers are rather in interaction with local environmental and spatial restrictions. These socio-economic powers include socio-economic trends at macro and micro level such as transport, land values, personal favorite of dwelling, demographic trends, cultural traditions and limits, growing attraction of the city, applies of local and regional land use policies. Despite this interaction, urban sprawl continues quickly with developing transportation networks and growing personal flexibility (EEA, 2006)

2.2.2. The cause of urban sprawl

Factors triggering urban sprawl vary according to the growth level of countries or according to the organization of society. For example, in America demand for having a large house detached with a garden which is in touch with nature, introverted lifestyles (Bruegmann, 2005) and racism (Nechyba & Walsh, 2004) are the main reasons for urban sprawl. In a report prepared by the European Commission, reasons causing urban sprawl in Europe were gathered under 7 main titles (table 2.1).

Table 2.1 Causes of urban sprawl

Macroeconomic factors	Economic growth
	Globalization
	European integration
Micro economic factors	Rising living standards
	Price of land
	Availability of cheap agricultural land
	Competition between municipalities
Demographic factors	Population growth
	Increase in household formation
Housing preferences	More space per person
	Housing preferences
Inner city problems	Poor air quality
	Noise
	Small apartments
	Unsafe environments
	Social problems
	Lack of green open space
	Poor quality of school
Transportation	Private car ownership
	Availability of roads
	Low cost of fuel
	Poor public transport.
	Weak land use planning
Regulatory frameworks	Poor enforcement of existing plans
	Lack of horizontal and vertical coordination and collaboration

Source: EEA, 2006.

Indicators of economic growth such as rise of income per capita, increase in the number of workers, and increase demand for residence which causes rapid urban growth and housing. Depending on economic growth, industrialization increasing at city boundaries and housing demand of people employed in these production areas are listed among the reasons for sprawl (Bhatta, 2010). Bhatta (2010) emphasizes that speculations of urban development based government policies are also the reason for urban sprawl. It is uncontrolled, disorganized planning and untimely growth emerging depending on speculations (EEA, 2006).

2.2.3. Definition of land use and land cover changes

Due to the accessibility of numerous existing information systems, the terms "explanation of land use" and "land cover" have been used interchangeably within the community of researchers interested in land use. However, the issues and meanings of these two terms are distinct. The identified biophysical cover on the earth's surface, which includes water bodies, hard surfaces, vegetation, and bare soil, is referred to as "land cover. “According to Di Gregorio and Jansen (2000), land use is the alteration of land surface processes such as biogeochemistry, and biodiversity for the purposes of agriculture, forestry, settlement, and pasture.

According to Meyer and Turner (1994), the two types of alterations to land cover are conversion and modification. The former refers to a shift from one type of land cover to another (for example, from grassland to cropland).However, the last is a change within a class of land cover (such as a forest's thinning or a change in its composition).A single type of cover could support multiple uses (forest used for timbering, slash-and-burn agriculture, fuel wood collection, and soil protection in combination) because of changes in land cover brought about by human activity. However, due to the fact that some farming systems combine cultivated land, improved pasture, and settlements, a single land use system can maintain multiple covers.

From a broader perspective, urbanization is one way that human activities are changing the land cover of the world. According to the United Nations Center for Human Settlements' reports (United Nations Habitat, 2001), despite the fact that the global trend toward urbanization is present, the most striking changes have occurred in developing nations as a result of the migration of people from rural areas to urban areas in search of better opportunities. Following this, it was anticipated that urban populations would expand rapidly at an average annual rate of 2.3% between the years 2000 and 2030 (United Nations, 2001).Long considered a sign of regional economic vitality, urban expansions, particularly the relocation of residential and commercial land use to rural areas near metropolitan centers *(Yuan et al., 2005)*.However, due to their effects on the ecosystem, wider economic disparities, and social fragmentation, their importance shifts out of balance. It can be described as the rate of population growth in urban areas.

At all geographic scales, both human and natural systems are disrupted by dynamic processes brought on by urban change, particularly the remarkable global expansion of urban population and urbanized area (Brockerhoff, 2000).According to Araya and Cabral (2010), urban growth in Setbal and Sesimbra, Portugal, increased significantly by 91.11 percent between 1990 and 2000.However, a combination of a number of smaller settlements and the use of agricultural land contributed to much of this growth toward the outskirts of urban areas. It was anticipated that the expansion would continue in the future and would have numerous effects on natural resources. Their study also found that one of the main reasons for the area's rapid growth was population growth. The evaluation of urban sprawl has traditionally relied on demographic data (Carlson and Traci, 2000).In the meantime, aerial photography has become an essential tool for updating land cover maps. The community was unable to comprehend the changes because human activity

was increasingly causing regional changes in land cover. To design strategies for sustainable development and to improve cities' means of subsistence, accurate and up-to-date information is therefore essential. Local communities and policymakers greatly value the ability to monitor changes in urban land cover and land use. It is now possible to monitor fluctuations in urban land cover and land use as well as urban sprawl in a timely and cost-effective manner thanks to new analytical techniques, improved quality of multi spatial-temporal data *(Yang et al., 2003)*.As a result, the applications of satellite data benefit urban ecology and regional planning.

2.3. Trends of Urban Growth

The world is going through the most significant period of urban expansion in history. According to the United Nations Population Fund (UNFPA, 2013), the world's towns and cities have experienced the fastest population growth. Additionally, the report anticipated that by 2030, the majority of this growth would be practical in Asia and Africa, two developing nations where urban growth is extremely concentrated. Cities draw a lot of people because they offer more opportunities, like jobs and income, than rural areas do. The pattern of population growth in the world's rural areas has been gradually declining in tandem with the rapid population growth in urban areas. According to UNFPA (2013), the world's urban population is projected to rise by almost 2 billion over the next 30 years, while the world's rural population is actually projected to fall by 3.3 billion from 2003 to 2030.

With a total population of more than 80 million and an annual growth rate of 3.02 percent, Ethiopia is one of the second most populous countries in Africa. According to Cohen (2004), the country is experiencing an exceptional urban growth rate of 4.6% on average annually. Ethiopia’s urbanization rate is low in comparison to other countries in Sub-Saharan Africa (SSA), even though rates vary depending on the methodologies used. It is evident that urban

growth is low because the majority of the population 85% resides in rural areas, where agriculture serves as the nation's economic foundation. According to Cohen (2004), the self-sufficiency of agriculture also contributed to the consolidation of rural peasant life on their territory.

Only 16% of the population, according to the Central Statistical Agency of Ethiopia (CSA), lived in urban areas. Small towns and cities are among these (Schmidt and Kedir, 2011). This research is carried out in the northwestern region of Ethiopia in the city of Bahir Dar. It ranks among the nation's fastest-growing cities. After the city was chosen in 1948 as the capital of Awraja, an administrative unit or hierarchy next to a region used by previous regimes, the urban area is supposed to be growing rapidly. According to *Haregeweyn et al. (2012),* Bahir Dar was chosen as the seat of the regional government of the Amhara National Regional State following the fall of the previous Ethiopian government in 1991.

2.4 The Impact of Urban Sprawl

Many difficulties particularly observed in metropolitans cause creation of urban sprawl. Increase of environmental pollution, air pollution and noise depending on rising population; increase of security difficulties and reduction of green areas depending on growth of housing areas make life outside the city gorgeous for people which outcome in urban sprawl in return. Urban sprawl has its influence on the land use /land cover changes, because when the urban sprawl takes place in a certain area, the land use is altered from rural area to urban area without any plan, or with lack of organization. The enlargement of urban and suburban areas desires more land and endorses the alteration of rural to urban Land use/ Land cover (LU/LC) *(Lambin et al 2003).*

Changes in land cover and use brought about by the values that humans place on the environment, both directly and indirectly, in order to live better lives. Population growth is one

of humanity's direct influences; its rise and fall have long-term effects on land use, particularly in developing nations. Because land use and land cover change is a complicated process, *Lambin et al. (2003)* say that it can also be caused by shared interactions between environmental and social factors at different spatial and temporal scales.

Climate change, hydrology, air pollution, and biodiversity are all significantly impacted by variations in land use and land cover. According to Meyer and Turner's study from 1994, it caused numerous microclimatic changes. Through changes in land use, deforestation is linked to an increase in global surface temperature. Urban heat islands are the result of this strong warming in the urban environment. Water pollution was also shown to occur when land cover shifts from cultivation to settlement (in urban areas) in their study. Additionally, it has been reported that a wide range of impacts on biodiversity result from the loss of forest species. Understanding how individuals make decisions regarding land use as well as the specific environmental and social factors that relate to these decisions is necessary for recognizing the causes and effects of land use and land cover change *(Lambin et al., 2001).*

2.5. The Role of Remote Sensing on Land use and Land cover Changes

Maktav et al. (2005) demonstrated that demographic data, census data, and sample maps—traditional data collection methods—were unappealing for the purpose of urban land use management. As a result, accurate data on land use and change in land cover are extremely important to many clusters. Because it provides information about land cover, remotely sensed data can be used to get this information. The science or art of gathering information about an object or phenomenon on Earth's surface without physically touching it is referred to as "remote sensing. “And this can be accomplished by sensing and recording either emitted or reflected

energy, as well as the information that is being processed, analyzed, and applied to a particular issue (Campbell, 2002).

For estimating levels and rates of deforestation, habitat fragmentation, urbanization, wetland degradation, and numerous other landscape-level phenomena, remote sensing is essential. After that, this useful data can be incorporated into a variety of models that operate on a global to regional scale, such as those that are used to increase the parameters for hydrological cycles and carbon fluxes. As a result, significant ecological questions can be answered using regional to global inferences from remote sensing data *(Vogelmann et al., 2001).*

Herold et al. (2005) also mentioned that one of the advantages of remote sensing is that it can provide spatially consistent data sets with high temporal frequency and high detail over large areas, such as historical time series. Nearly all research on remote sensing in recent decades has placed a greater emphasis on the natural environment than on urban areas. The reason for this was that urban areas are naturally diverse and multifaceted *(Melesse et al., 2007).*However, according to *Herold et al. (2005),* urban remote sensing is rapidly gaining interest in the remote sensing community thanks to the availability of high-resolution imagery and appropriate techniques. According to *Melesse et al. (2007),* urban remote sensing is now a new field of geospatial technology that is applicable to all socioeconomic environments and is supported by cutting-edge technology and significant social needs.

Following this, a number of applications of remote sensing for urban studies have demonstrated the capability of mapping and monitoring the infrastructure and land use of urban areas. Furthermore, Herold and Menz (2001) demonstrated high thematic, temporal, and spatial accuracy of urban land use information derived from remotely sensed data an essential

requirement for city planners, economists, ecologists, and resource managers to make decisions. The quality of water, land, and air resources, as well as the processes and functions of ecosystems, are all affected by changes in land use and land cover in general (Rimal, 2011).As a result, accurate, timely, and comprehensive data and analysis methods from remote sensing can be used to detect and track changes in land use and cover.

2.6. Image Classification

To observe and evaluate socioeconomic and environmental applications like: It is necessary to detect urban change and socioeconomic variables, and image classification results must be more accurate. According to Weng (2012), image classification is the process of separating distinct classes or themes, typically land cover and land use groups, from raw remotely sensed digital satellite data.

The research community has been interested in image classification using remote sensing techniques because the results of image classification are the foundation of applications for the environment, society, and economy (Lu and Weng, 2007).There are a lot of things that make it hard to get a more accurate classification result because it is done with data from remote sensors. Here are some of the factors:

- A study area's characteristics, the availability of high-resolution remotely sensed data,
- Ancillary and ground reference data,
- Suitable classification algorithms, the analyst's experience, and a limited amount of time the kind of classification algorithm that should be used for image classification is heavily influenced by these issues. According to Lu and Weng (2007), there are a number of image classification methods that can be used to extract information about land cover from remotely sensed images. However, their request is contingent on the data type and methodology to be utilized. Some of these methods include: fuzzy sets, artificial neural networks, and expert systems.

Image classification techniques can be broken down into supervised and unsupervised, parametric and nonparametric, hard and soft (fuzzy) classification, per-pixel, sub-pixel, and per-field categories in greater detail. The following is a discussion of some of the methods for classifying images that are used the most.

2.6.1. Object-oriented image classification methods

Recognizing image objects, or segments with similar texture, color, and tone of spatially contiguous pixels, is the foundation of this method of image classification (Gao and Mas, 2008; Weng, 2012). According to MacLean and Cong Alton (2012), this method allows for the consideration of shape, size, context, and spectral content. The first step in the classification phase is to group the pixels next to each other into meaningful areas. In the object-oriented classification method, *Qian et al. (2007)* noted that; Rather than categorizing individual pixels, homogeneous image objects are extracted during the segmentation phase. In object-oriented, image analysis is based on homogeneous, contiguous image regions created by initial image segmentation.

2.6.2. Pixel-based Image classification methods

All of an image's pixels are automatically sorted into land cover classes using pixel-based classification techniques *(Qian et al., 2007*; Weng, 2012).By summarizing all pixels; these kinds of classifiers advance a signature. According to Weng (2012), this means that the advanced signature includes only the essential elements found in the training pixels but does not take into account the impact of mixed pixels. According to *Tadesse et al. (2003),* remotely sensed data is classified using two primary types of pixel-based classification algorithms: supervised as well as unsupervised Classifying each pixel into unknown cluster centers and then moving from one cluster center to another using a method in which the Supervised Spatial Encoder (SSE) measure of the previous section is reduced data are the foundations of unsupervised image classification

algorithms. In contrast, in the case of supervised image classification, the expert has prior knowledge of pixels to generate representative parameters for each class of interest in land cover.

According to *Qian et al. (2007),* the most widely used per-pixel method is the Maximum Likelihood classification, which is part of the supervised classification category and takes into account spectral information about land cover classes. Although pixel-based classification methods are widely used and accepted, spatial pattern inclusion in classification has some drawbacks. This occurred particularly in Maximum Likelihood Classification methods, which disregard contextual and texture information and only take into account spectral information (Zhou and Robson, 2001; 2003, Dean and Smith).

2.6.3. Contextual image classification approaches

Through the process of detecting each pixel, the pixels in the maximum likelihood classification method are assigned to represent the classes taken into consideration. However, misclassification errors may occur, particularly in the presence of random noise, which makes distinct classes appear to be the same (Sharma and Sarkar, 1998). Contextual classification techniques that take advantage of spatial information between adjacent pixels have been chosen to avoid these issues. The idea that the response and class of two spatially adjacent pixels are highly correlated is the foundation of these techniques. By lowering spectral property-related error rates, the advantage of employing contextual techniques will enhance image classification outcomes (Weng, 2012).

2.7. Land use Change Detection Analysis

According to Singh (1989), change detection is the process of determining differences in the state of objects or phenomena by observing them at various times using remote sensing methods. The ability to use multiple temporal data sets to quantify temporal effects is also essential. Change detection is reflected as one of the primary requests for remotely sensed data obtained

from Earth-orbiting satellites due to the reliable image quality and repetitive spatial coverage at short intervals (Singh, 1989).

Analysis of land use change, forest management, flora phenology, seasonal changes in pasture production, risk assessment, and other environmental changes are just a few of the many fields in which change detection can be used (Singh, 1989).According to *Lu et al. (2004),* the primary goal of change detection is to compare the spatial representation of two points over time by controlling all variances caused by differences in non-target variables and calculating variations caused by differences in the variables of interest.

For a change detection investigation to be successful, it should provide the following solid data: change paths for various types of land cover, accuracy assessment of the consequences of change detection, and area change and degree of change. The nature of the changes that took place in landscapes and the manner in which those changes are visible in images are extremely important factors in determining changes in land use and land cover and in selecting appropriate change detection methods. Continuous or specific changes could occur. Change detection in continuous land cover changes, according to *Abuelgasim et al. (1999),* focuses on calculating the degree of changes in quantity or concentration over time. In the case of categorical land cover changes, on the other hand, the objective of change detection is to identify new land cover classes as well as changes in land cover between classes over time.

Because constraints like spatial, spectral, thematic, and temporal properties affect digital change detection, selecting the appropriate technique or algorithm for change detection is crucial to achieving a more accurate result. Image differencing; for instance, can only provide information about change or non-change, whereas post classification comparison, on the other hand, can

provide a comprehensive matrix of alteration directions. Bekalo (2009) asserts that, depending on the algorithm they used, a variety of change discovery methods could result in a variety of changes to maps.

Researchers are divided into image ratio, image regression, image differencing, and the technique of change detection after classification (post classification method) in remote sensing of image classification methods are categorized primarily based on the applied analysis methods and, if they exist, data transformation procedures*(Xu et al., 2009;*2009, Bekalo). Therefore, the most recent common change detection methods are discussed below in light of these circumstances.

2.7.1. Image regression method

Pixels from time t1 are assumed to be a linear function of time t2 in the image regression method of change detection (Singh, 1989). Least-squares regression could theoretically be used to approximate the image from t2 in this scenario. The image regression method, as stated by *Abuelgasim et al. (1999),* takes into account variations in the mean and variance of pixel values for various dates. This idea reduces the impact of different atmospheric conditions. Regression has more advantages over image differencing when it comes to detecting changes in urban areas.

2.7.2. Image ratio method

Images must first be registered before being rationed band by band using the image ratio method. A range of values is used to interpret the effects of image ratio. A ratio value of greater or lesser than 1 indicates a change in land cover courses, whereas a ratio value of one indicates no change in the land cover classes (Singh, 1989; 2009, Bekalo) In relative terms, this method quickly identifies areas of change.

2.7.3. Image differencing method

One of the most widely used approaches to change detection is image differencing. It can work with a wide range of images and geographical settings. Images of the same area from times t1 and t2 are subtracted pixel-by-pixel using this approach. Most of the time, it is done using a gray scale to show the 20 changes in the two images' spatial extent. In order to examine the changed and unchanged regions in the gray of difference image, a threshold value is required *(Xu et al., 2009).*

2.7.4. Post classification method

Based on the comparison of independently categorized images, this method is the easiest and clearest change detection method (Singh, 1989).The researcher is able to create maps of changes that display a comprehensive matrix of changes from times t1 to t2.According to this matrix, a pixel has either been altered or not been altered if the category labels of the corresponding pixels are identical *(Xu et al., 2009).*

2.8. Empirical Review

With the idea that processes in the earth's surface influence climate, land use and land cover changes became a topic of study on global environmental change several decades ago. In the 1980s, it became clear that changes in land use and land cover had an impact on the global climate through the carbon cycle, with terrestrial ecosystems serving as sources and sinks. The research community has since identified three fundamental topics as a result of the provision of the land use and land cover alteration project by the International Geosphere and Biosphere Programme (IGBP) and the International Human Dimensions Programme on Global Environmental Change (IHDP).These understood the factors that changed land use and land cover, how to calculate them, and how to use forecasting models to predict them *(Lambin et al., 2003).*

Studies in Ethiopia, where 85% of the population lives in rural areas, 85% of the economy is reliant on agriculture with outdated farming (plow), the occasional rise in urban population, and the inspiring land lease policy to investors make it important to study land use and land cover changes and their effects on Ethiopian management and monitoring policies, *Amsalu et al. (2007)*;Depending on the availability of data and analysis tools, research on land use and land cover change in Ethiopia involved a variety of disciplines and regions.

However, the majority of studies have focused on the consequences of deforestation, the expansion of cultivated land into land degradation, river catchments and watersheds, natural ecosystems, and forests. These include:(2007) *Amsalu et al,2007* , Bewket and Abebe (2013), Tekle and Hedlund;We found Zeleke and Hurni (2001).Urban growth and modeling studies in cities of developing nations like Ethiopia were limited, despite the fact that urban growth and its influences are relatively studied in megacities (a metropolitan area with more than ten million people) around the world. However, relatively few studies have been reported, such as: Haregeweyn and colleagues Schmidt and Dorosh (2010); Zeleke and Hurni (2001);Bekalo and *Amsalu et al. (2007).*According to Zeleke and Hurni (2001), the Dembecha region in northwestern Ethiopia saw an increase in cultivated land at the expense of natural forest cover between 1957 and 1982.The expansion of cultivated land on steep slopes at the expense of natural forests was also the subject of the study, which looked at a number of trends of land deprivation.

According to *Amsalu et al. (2007),* the amount of natural vegetation was significantly decreasing; however, between 1957 and 2000, plantations increased in Ethiopia's central highlands' Beressa watershed. Even though eucalyptus tree plantations have increased since the 1980s, *Yeshaneh et al. (2013)* found that natural woody vegetation in the Koga catchment has

decreased significantly since 1950 as a result of deforestation. According to Bewket and Abebe (2013), the Gish Abay watershed in northwestern Ethiopia has less natural vegetation but more open grassland, cultivated areas, and settlements. According to Tegene (2002), the natural vegetation cover in the Derekolli catchment of the South Wollo Zone of the Amhara Region, Ethiopia, changed significantly from 1957 to 1986 into cultivated land. In Munessa, a Shashemene landscape in the Ethiopian Highlands, *Kindu et al. (2013)* examined a significant decrease in natural forest cover and grasslands but an increase in croplands between 1973 and 2012.

Between 1958 and 1986, a parallel study by Tekle and Hedlund (2000) found that open areas and settlements increased in Ethiopia's Kalu District, Southern Wollo, and the loss of forests and shrub land. Numerous studies have stated that changes in land use and land cover affect the watershed's hydrological flow system. The runoff response and the equilibrium between rainfall and evaporation are altered by the influence land use/cover change. According to Muluneh and Arnalds (2011), long-term changes in land use and land cover led to an annual increase in direct runoff in the gum-selassa and maileba catchments from 1964 to 2006.

According to a similar study, these long-term influences led to the drying of Lake Cheleleka and the disappearance of Lake Haramaya. Geremew (2013) also stated that the stream flow in the Gilgel Abay watershed in Ethiopia was affected by changes in land use and land cover. As a result of the conversion of cultivated land, his study found that stream flow increased by 16.26 m3/s during wet months and decreased by 5.41 m3/s between 1986 and 2001.*Haregeweyn et al. (2012)* in the urban fringe of the Bahir Dar area recognized an annual extension of urban areas from 1957 to 2009 as a result of growing population. These studies also stated that land use and land cover alterations in response to urban growth.

According to Bekalo (2009), the expenditure of agricultural land and vegetated areas caused by population growth in Addis Ababa, Ethiopia, increased significantly from 34% in 1986 to 51% in 2000.According to Dorosh and Schmidt (2010), the Ethiopian highlands' population growth has also led to significant urban expansion over the past three decades. According to Haile (2004), Muluneh and Arnalds (2011), unsustainable population growth contributed to environmental deprivation, particularly in the most populous regions, like the Ethiopian highlands.

According to Zeleke and Hurni (2001) and *Amsalu et al. (2007),* population pressure is one of the primary causes of land use and land cover alterations through the destruction of forest and vegetation cover for the purpose of agricultural and urban extension. According to Zeleke and Hurni's (2001) research, the western highlands of Ethiopia frequently experience a loss of vegetation cover as a result of population growth and migration from rural to urban areas.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1 Description of the Study Area

3.1.1. Location of the study area

Bahir Dar is placed at the exit of the Abay from Lake Tana at an altitude of 1,820 meters (5,970 ft) above sea level. In its absolute location, it is found 11°35′37″ N& 11°36'0"N latitude and 37°22'60"E & 37°23′26″ E longitude. Along the Addis Ababa-Debre Markos Road, Bahir Dar is located 578 kilometers away from the Ethiopian capital. Literally, Bahir Dar means a city situated on or very close to the shore of Lake Tana and Blue Nile (Fikirte Demisse 2014). The city has been the capital of Amhara National Regional State since 1991. Currently, the city covers a total area of 256.4km2.The Lake Tana region is a UNESCO biosphere reserve since 2015.Moreover, the next map shows the locations of the study area.

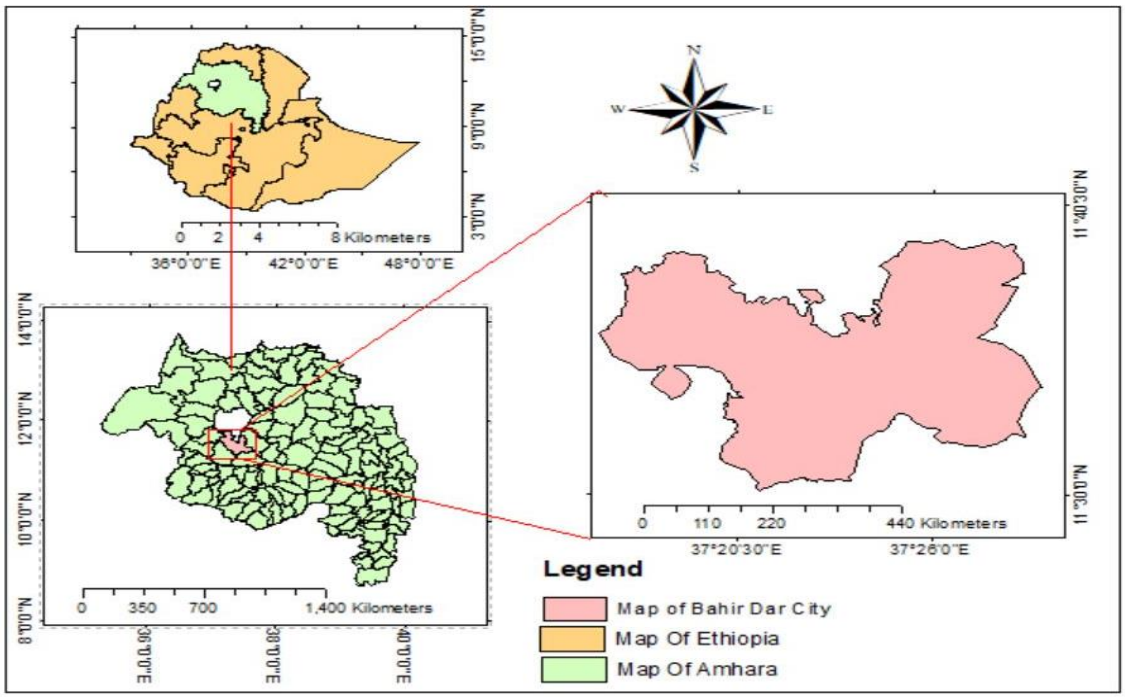


Figure 3.1 locational map of the study area, source; prepared by the author via ArcGIS; June, 2022

3.1.2. Physical characteristics of the study area

Bahir Dar has a borderline tropical savanna climate (Köppen *Aw*), very close to a subtropical highland climate (*Cwb*). Afternoon temperatures are actual warm to hot year-round, and morning temperatures cool; but, the diurnal range is much larger in the largely cloudless dry season. The altitude of the city is about 1820 m above mean sea level and covers an area of 16,000 hectares. Bahir Dar lies on a very gentle slope with elevation ranging between 1783 m and 1889 meter above sea level. It occupies the head stream of the Blue Nile basin. The city is positioned at the southern shore of Lake Tana, a freshwater lake with weak seasonal variation. At 3156 km2 in area, it is the largest lake in Ethiopia and the third largest in the Nile Basin. Of more than 40 rivers serving the lake, Gilgel-Abay, Reb, Gumera and Magetch fund more than 93% of the inflow. The only surface outflow is the Blue Nile, which comprises 7% of the Blue Nile flow at the Ethio-Sudanese border. The city experiences a tropical climate with annual average rainfall of 1409 mm and average temperature of 21.3°c. The area receives maximum rainfall during summer season (June to August) and short rainfall in spring season (September and October). The rainy season accounts for nearly over 96% of the total annual rainfall. The natural vegetation mainly consisted of a few remnants of different tree species, bushes, shrubs and grasses. There is no more forested area in the town except some eucalyptus trees in the homestead (Fikirte & Fistum, 2014).

3.1.3 .Demographic characteristics of the study area

According to the central statistical agency of Ethiopia (CSA)'s 2007 Census, the population of Bahir Dar zuria woreda is 182,676, with 93,610 men and 89,06 women. At the town of Bahir Dar there are 155,428 inhabitants; the rest of urban population is living at Meshenti, Tis Abay and Zege towns and rural parts which are part of Bahir Dar zuria woreda. As Philip Briggs

notes, Bahir Dar "is not only one of the largest towns in Ethiopia, but also one of the fastest growing."

3.1.4. Economic characteristics of the study area

Historically, the beginning of the city was 'associated' with the establishment of Kidane Mihret Church at the current site of St. George's Church around the 14th century. Later for the first time the Bahir Dar city municipality was established in 1936. Thus, there has been a settlement at or around Bahir Dar for many centuries, but the economic growth of the city began in earnest in the 1950s, when its status was raised to a capital of awuraja. The city has been the regional capital and economic center for northwestern Ethiopia since 1958, when German experts prepared a comprehensive master plan for its development. The city was the capital of Western Gojjam Administrative Region in 1987 and since 1991 has been the capital city of the ANRS. With this investment in hotels and factories is growing and expansion of the city has given further opportunities for construction and related businesses (Fikirte & Fistum, 2014).

Today, it is one of the fastest growing largest cities in the country. With its growth, different service sectors such as education, health, transport, and communication have grown and the city has expanded rapidly throughout the 20th century. Due to this it is becoming a top commercial center of the Amhara National Regional State and used as a center for the city metropolitan administration. Thus, a number of factors that include commercial, administrative importance, service as well as historical factors have accounted for the growth and development of Bahir Dar.

3.2 Research Approach and Research Design

This study has used mixed types of research. As widely accepted, the mixed method of research is an approach to an inquiry involving collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve empirical

assumptions and theoretical frameworks. The study opted for this form of approach because the combination of qualitative and quantitative approaches provides a more complete understanding of a research problem than either approach alone so as to formulate rational and sound conclusions and recommendations for the study (Creswell, J.W. 2003).

Here the study used a concurrent research design that means that the collection of qualitative and quantitative data was made simultaneously. Quantitative driven concurrent research design (QUANT + quall): Here the core component is quantitative and the supplementary component is qualitative or primacy where given to the quantitative data as it is often important in explaining the fundamental process of issues in a phenomena to the possible detail.

3.3 Data Sources

The study use both primary and secondary data sources. One of secondary data is land sat images .Landsat images from various years have been used to study urban sprawl and its effect on the dynamics of land use and land cover in the area under study. The data were categorized into reference data and remote sensing (RS) data. The remote sensing data used were time series of Landsat images; Thematic mapper(TM) , Enhanced Thematic Mapper Plus (ETM+), again Enhanced Thematic Mapper Plus (ETM+), and Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) obtained in the years of, 1991, 2001,2011,and 2021 respectively . There is a special reason why remotely sensed data were collected starting from 1991 ,because Bahir Dar was a seat of regional state starting from this year then it starts to expand rapidly .The Landsat images were acquired from U.S.G.S on the earth explorer with a standard of images having less than 10% cloud cover.

The Landsat images had a path and row of 170 /52 for all images that were used for this study. The spectral and spatial resolution of the obtained images was 30 × 30 m and this was similar to

all the images, therefore, the images were used to define the purposes of the study. The four images have been used for this study to have a better understanding of how the land cover has changed over the years. The downloaded images were in GeoTIFF format, and data were initially pre-processed and finally cropped to the extent of the study area. High-resolution Google earth images of 1991, 2001, 2011, and 2021 are used for training data and in assessing the accuracy of the classes during classification.

The 1991 image was Landsat 4-5 Thematic Mapper, the 2001 &2011 images were Landsat 7 Enhanced Thematic Mapper image, but the 2021 image was a Landsat 8 Operational Land Image and Thermal Infrared Sensor (OLI/TIRS) image. In addition to Landsat images (it can be downloaded from USGS), the study also used secondary data like previously worked researches which are related with the urban sprawl.

In this study, both quantitative and qualitative data types were used so as to get efficient information for the research. Primary and secondary data sources were considered and used in this study. Secondary data were collected from different prior studies which are related to the impacts of urban sprawl on land use /land cover change dynamics in Bahir Dar city. Secondary data sources where helped to develop a conceptual and theoretical framework for the study and to substantiate the valuable information. Primary data which was collected via, interview and questionnaires was used to investigate the causes of urban sprawl and to assess the impacts of urban sprawl on the land use /land covers. Moreover the following table shows the data which are taken from USGS on the earth explorer.

Table 3.1 the datasets used for the study

Remote sensing Data	Resolution	Data acquired	Source	Band Number	Reference data
Landsat TM	30M	1991-02-03	USGS	8	Google earth 1991
Landsat ETM	30 M	2001-02-03	USGS	8	Google earth 2001
Landsat ETM+	30 M	2011-10-12	USGS	8	Google earth ,2011
Landsat OLI/TIRS	30 M	2021-12-18	USGS	11	Google earth ,2021

Source; organized by Author, June, 2022

3.4 Image Pre-processing and Classification

The images which were acquired from the Landsat satellite means that the 1991, 2001, 2011, and 2021 were geometrically corrected from source and geo-referenced. Using the clipper tool in ArcGIS, the study area for all the satellite images has been extracted for further processing and analysis. Sub-setting, or combining the images in ArcGIS were practiced either by using a polygon shape file as a mask layer or by specifying directly the area of extent.

In this study, subsets were done using a vector polygon shape file. The subset images were band-loaded and kept as separate files in a Geo-TIF format. True color composite and false color composite were together used to recognize the land cover classes on the images in the Google earth engine for image classification.

In this study, the grouping was done by first gaining training samples, creating training sites, and engaging the supervised classification method to categorize the images into their respective classes. The supervised classification was selected due to its capability with training samples to classify a specific land cover type as well as giving specialists full control of the process. Being aware of the study area over field experience, knowledge from literature, and based on the

images spectral characteristics as well as using a standard classification scheme. Four LULC classification arrangements were selected (Table 3.2) bearing in mind the standard classes defined by the US Geological Survey as well as the study detail and objectives *(Mohan et al., 2011).* Thompson (1996) delineated the need to contextualize the LULC classification schemes to the local condition for the aim that no universally recognized classification scheme exists as it is inclined by the specific users' objectives and also often by geographic location. These classes are explained in Table 3. 2.

Table 3.2 a classification scheme of land use/land cover classes

Land use/land cover type	Explanation
Water	Includes : river, open water, lakes, ponds, and reservoirs and marshlands
Agriculture land	Includes; crop fields, grazing areas, and cultivated lands, fallow lands & land under preparation , community open lands and areas along the lake shore that are used for agricultural proposes when the lake level retreats following the long dry-season
Vegetation	Includes: forestland, bush forest, nursery, dense vegetation cover and every kind of garden plots.
Built-up or Settlement	Include areas with all types of artificial surfaces residential, commercial and services, industrial, transportation roads, construction sites, mixed urban, and other urban

Source; organized by the Author; July, 2022

On the identified land cover classes points were taken after classification then cross-checked with the images in the Google earth. This makes it easier to assess the accuracy portion of each analysis.

3.5 Accuracy Assessment

Assessing the quality of results after classification is performed from satellite images is very important for change detection analysis *(Othow et al., 2017).* Accuracy assessment displays the level of confidence among the classified images and the reference data to recognize how accurately the classified satellite image approves with the reference data *(Mosammam et al., 2017).*

In this study, an accuracy assessment was conducted on the classified images of 1991, 2001, 2011, &2021 to determine the quality of classification information obtained. Independent sample points selected from reference data have been used to ascertain the classification accuracy for this study. By extracting the random points from classified images and by taking another point from Google earth the study was tried to perform the accuracy assessment. Kappa statistics and overall accuracy and were computed for all the images during the accuracy assessment. So here the study checked the accuracy of classification based high resolution Google earth images.

3.6. Change Detection

Change detection is the process of detecting the changes that have taken place in the state of an object, observed at different periods. To examine the alterations in the land cover, post-classification change detection was used. The reason for using post-classification change detection is that it provides comprehensive information on changes that occur in a class cover to other classes concerning the place of change, the amount, and the extent of the alteration *(Abuelgasim et al., 1999).*The post-classification change detection was conducted in ArcGIS and

it was employed to determine changes in the land cover in three intervals (1991–2001, 2001–2011, and 2011–2021).

3.7 Data Collection Tools

The data have been collected from earth explorer as well as via questionnaire surveys and interview methods. Cloud Free Landsat satellite data of four years available in the past four decades has been downloaded from USGS Earth Explorer website. The preprocessed satellite data is all that is received by the Universal Transverse Mercator (UTM) projection system. In addition data were collected via questionnaires which were distributed for the households of Bahir Dar city. The questionnaire includes both close and open ended questions. Those questionnaires and interviews were taking place on the households and employees respectively to investigate the cause of urban sprawl and also to identify the impacts of urban sprawl in the study area.

As described on the above the study collected the data via closed and open ended questionnaires from 360 household heads of Bahir Dar city. Again the study used interviews from Bahir Dar city administration land ownership registration and information agency office and Sub city leaders. Under Bahir Dar city administration land ownership registration and information agency office there are several branches for this study 13 of sample were interviewed from urban planning branch, 9 from infrastructure expansion branch ,the remaining 5 from the sub city leaders.

3.8 Sample and Sampling Procedure

3.8.1 Target Population

The peoples who use the urban lands of Bahir Dar city directly as well as indirectly were the target population of this research .In addition to the above the employees of Bahir Dar city municipalities were also the target population.

3.8.2 Sample Size Determination

To investigate the cause of urban sprawl on Bahir Dar city as well as to assess the impacts of urban sprawl on land use /land cover changes in Bahir Dar city the study has used the Yemane formula to limit the sample size. From all sub cities of Bahir Dar city, five (Shimbit , Tana , Belay Zeleke ,Ginbot 20 and Hidar11) sub cities were selected purposefully, because according to the municipality office information those sub cities were highly affected by urban sprawl. Again to take the sample on those sub cities, this study has consider the total households number of the sub cities ,then use the following formal to take the sample number of the household .The study were use rationale of the total household number of the sub cities to determine the sample size formula;-(Yemane,1996)

$n= N /1+N (e^2)$…….

Where n= total sample size, e=error (0.05), N=total household size of the five sub cities

*According to Bahir Dar city municipality office information, the total household's population of the five sub cities of Bahir Dar City was 21156. So

$n= 21156/1+21156(0.05^2)$

n=21156 /52.8925=399.98 = so the minimum sample size is 399.98, but here the study has been planned to use 400 samples, means that 360 samples for the questionnaire; the remaining 40

samples were planned for a semi-structured interview to get the qualitative data , but from the interview respondents only 27 of them were available. So the total sample was reduced from 400 to 387 samples. 360 samples were categorized on five strata's based on their locations of household heads then the samples were selected from those sub cites proportionally .Again to show the land use /land cover changes the satellite images of Bahir Dar city in, 1991, 2001, in 2011, and 2021 were selected systematically with 10 years interval. Moreover the following table shows sample size determination and distribution.

Table 3.3 Households distribution on five sub cities of Bahir Dar City

Name of sub cities	Total household heads	Sample of Household heads
Shimbt	4234	72
Tana	3789	65
Ginbot 20	4776	82
Hidar 11	4167	71
Belay Zeleke	4190	70
Total	21156	360

Source; organized by the author: July, 2022

3. 8.3 Sampling and Sampling Technique

The study used both stratified random sampling and systematic sampling techniques. Stratified random sampling was used to identify the household heads for the involvement of filling the questionnaires. Stratified random sampling is a form of probability sampling that provides a methodology for dividing a population into smaller subgroups as a means of ensuring greater accuracy of your high-level survey results. In addition the employee was also selected via

propulsive sampling for a semi structured interview. Again systematic random techniques were placed to select samples on the satellite images starting from the year 1991 , systematically 2001 ,2011 ,and 2021 satellite images were downloaded and selected based on a 10 years interval from the earth explorer from USGS .

3.9. Method of data analysis

For quantitative data, the study used descriptive data analysis techniques with the help of statistical Software SPSS Version 25. The study used SPSS version 25 to investigate the cause of urban sprawl and to assess the effects of urban sprawl. In descriptive statistics, frequencies, percentages, tables, graphs, and pie charts, were deployed. The data collected through the aforementioned research tools were organized in a way suitable for analysis using computer software. Again the data were analyzed via Geographic information software ArcGIS 10.8, and Erdas imagine14 software especially to examine the changes of land use /land cover in the study area and to assess the impacts of urban sprawl on land use /land cover change the study used the above software's.

CHAPTER FOUR

4 .RESULTS AND DISCUSSION

4.1 Introduction

This chapter explains the impacts of urban sprawl on land use land cover changes in Bahir Dar city based on the collected data and satellite data. It starts from the description of the respondents up to discussion of the results gained in the research. It basically reveals the finding of the research along with discussion which is surrounded in every piece of its section. The chapter has five sections. The first section presents and discusses the demographic characteristics of respondents while the second section is related to examine the land use / land cover changes that took place in the study area 1991-2021. The third section is related with the identification of the magnitude/direction of Bahir Dar city expansion from 1991-2021.The fourth section presents the causes of urban sprawl in Bahir Dar city, and the last section investigating the impact of urban sprawl on land use /land cover changes in Bahir Dar city.

4.2. Demographic Characteristics of the Respondents.

This part had tried to show the general demographic characteristics of respondents for this research. The study used 387 samples, from those samples 27 of them were interviewed, the remaining 360 respondents were filling the questionnaires. Based on the questionnaires here in this part the study analyzes the Gender, Age, and Educational qualification of the respondents.

4.2.1 Age and Sex of the respondents

Age is a human attribute that has long been taken for granted. However, we know very little about the age beneath the skin and beyond the body. Older age and the age concept need to be explored from discourses of age that have been constructed over social practices and time since they are ascribed to the leader's identity, especially when using it in relation to the capability perception. Sex is a biological categorization based primarily on reproductive potential. Based on the above definition here this study tried to assess the sex and age of the respondents.

Table 4.1 Age and sex number and percentage distribution of the respondents

	Age of the respondents						Sex of the respondents		
	18-25	26-35	36-45	46-65	>65	Total	Male	Female	Total
Count	15	103	132	86	24	360	312	48	360
percent	4.2	28.6	36.7	23.9	6.7	100.0	86.7	13.3	100.0

Source; computed from field survey, August, 2022

Based on Table 4.1 most of the respondents were male headed households, meaning that 312 (86.7%) of respondents were male headed households, whereas the remaining 48 (13.3%) of respondents were female headed households. This is perhaps attributed to sampling. Being males has its own impact on the practice of uncontrolled urban expansion, because males are more exposed to do informal settlement than females, due to this sex has its own impact for the expansion of the city.

Again in the Table 4.1 five age brackets were represented ; those aged between 18-25 years on respondents were 15 accounting 4.2 % ,from 26-35 years were 103 (28.6 %) ,from 36-45 years on the households were accounting 132 (36.7%), and the rest 86 (23.9%) and 24 (6.7%)

were aged on 46-65 and above 65 years respectively . As it can be easily understood, most of the households in the study area which were included in this study were between the ages of 36-45 years. This implies that most of the respondents were categorized as middle age. Age is an extra significant factor in order to clarify the phenomenon of urban sprawl. Adult and middle age households mainly inspire city sprawl and styles via ways of seeking out cheap housing inside the suburbs. Finally, even as city sprawl may be an unsustainable form of the successful, it must now no longer be abandoned that the populace desires to stay in large plots of peripheral communities.

4.2.2 Educational Qualification of the respondents

Educational qualifications are the degrees, diplomas, certificates, professional titles and so forth that an individual has acquired whether by full-time study, part-time study or private study, whether conferred in the home country or abroad and whether conferred by educational authorities, special examining bodies or professional bodies. More over the next table shows the educational qualification level of the respondents.

Table 4.2 educational level of the respondents

		Frequency	Percent
	Primary Education(1-8)	43	11.9
	Secondary & preparatory School education(9-12)	82	22.8
	TVET/Diploma	153	42.5
	First Degree	67	18.6
	Master/PhD	15	4.2
	Total	360	100.0

Source: Computed from field survey: August, 2022

As the above table depicts most of the respondents of the study were not that much educated, 153(42.5 %) and 82 (22.8%) of the respondents have learned TVET/diploma, and secondary & preparatory school education respectively. 67(18.63%), and 43(11.9 %) have first degree and primary school respectively. The remaining 15 (4.2%) of respondents have Master /Doctorate degrees. Therefore this indicates that the majority of household heads were not well educated .Consequently, they may lack knowledge about the impacts of urban sprawl as well as the cause of urban sprawl. The household that has a low educational qualification background necessitates the government to provide training on regular bases in order to develop their awareness about the impacts of urban sprawl on the land use /land cover.

4.3. Land use /land cover classes in Bahir Dar city from 1991-2021

By using land use /land cover maps of Bahir Dar city in different years, an attempt was made to explain the amount of land use/ land cover classes of Bahir Dar city. As displayed in Fig. 4.2 1991, 2001, 2011, and 2022 images of the study area was categorized into four classes, namely; water, vegetation, built-up and agricultural lands. As shown in Table 4.9 in the year 1991; water bodies covered an area of 560.40 hectare representing (2.62%) of the total area, vegetation covered 4654.51hectare representing (21.81 %) of the total area, built up area covered an area of 1485.07 hectare representing (6.96%) of the total area and agricultural lands covered 14642.94 hectare representing (68.61%) of the total area. From Table 4.9, and Fig. 4.1 agricultural land covered the highest land area and water body covered the least land area in 1991.

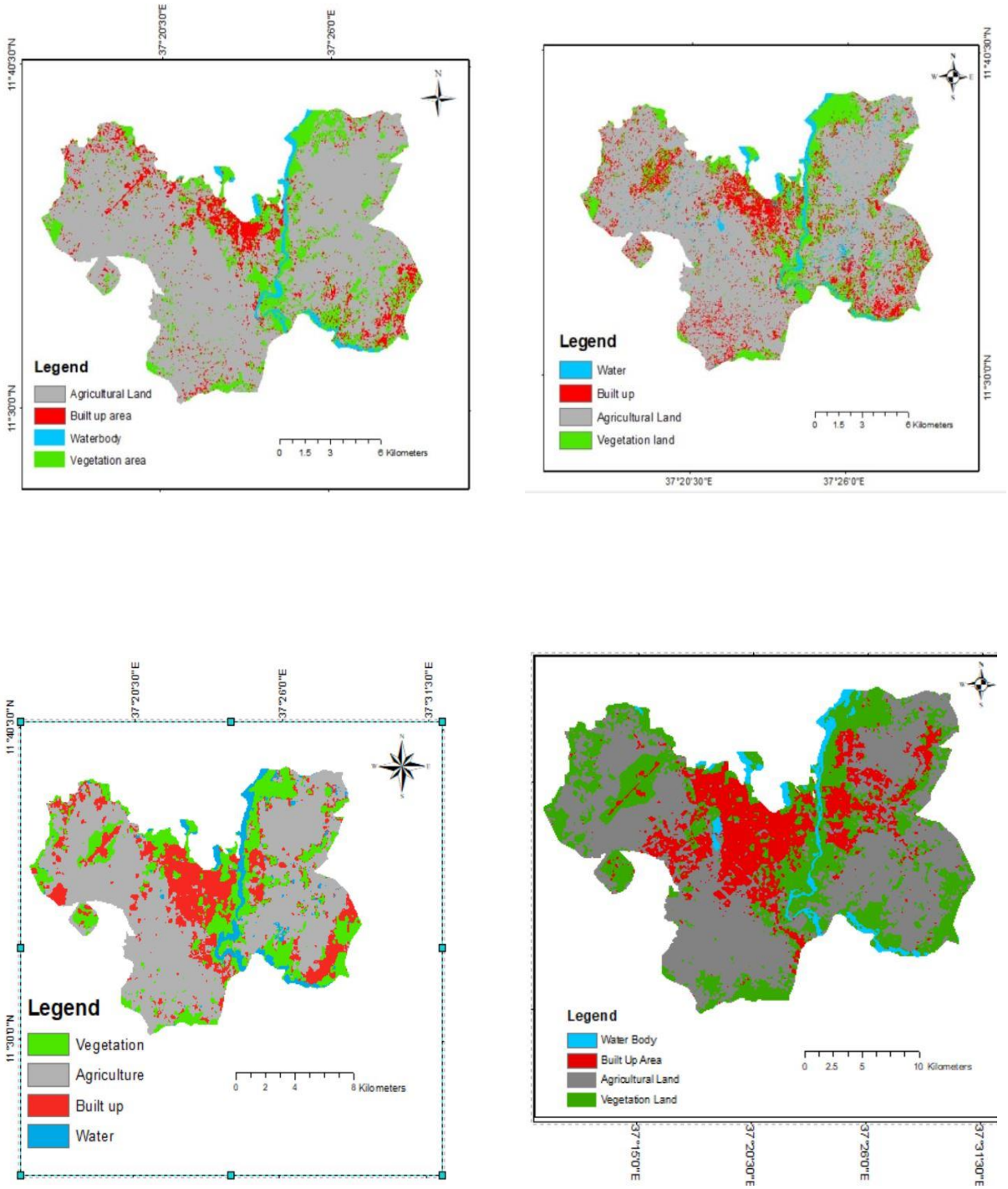


Figure 4.1 Land use /Land cover map of Bahir Dar in 1991, 2001, 2011 and 2021 respectively,

Source; from earth explore USGS: August, 2022

Table 4.9 Land use /Land use change detection of Bahir Dar in 1991,2001,20011 &2021

LU/LC Class	Area in hectare (1991)	Area in hectare (2001)	Area in hectare (2011)	Area in hectare (2021)
Agricultural land	14642.94	14686.58	13989.13	10886.08
Built up	1485.07	2675.16	3191.24	4009.98
Vegetation	4654.51	3190.95	3316.29	5846.79
Water Body	560.40	790.23	846.26	596.39

Source; organized by the Author: July, 2022

The classified results of the 2001 image presented in Table 4.9 showed an increase in water to 790.23 hectare representing about 3.70 %, vegetation decrease to 3190.95 hectare representing 14.95%, built up area increasing to 2675.16 hectare representing 12.53 % and agricultural land increased to 14686.58 hectare representing 68.81 % than the 1991. From the results, like 1991, in 2001 agricultural land was the highest land area. So in both years (1991 and 2001) agricultural land was higher than other classes, but the water body in 2001 increased in a smaller amount than 1991. Vegetation area was decreased in 2001 than in 1991. The reduction in these land cover kinds led to a significant rise in settlement.

In 2011, water covered an area of 846.26 hectare representing about 3.96 %, vegetation covered an area of 3316.29 hectare representing 15.54 %, built up area covered an area of 3191.24 hectare representing 14.95 %, and agricultural land covered 13989.13 hectare representing about 65.45 %.From the 2011 classified map, both vegetation, and settlement were increased, but

agricultural land decreased than 2001.Expansion in built-up and vegetation took place by taking portions of land area occupied by other land use/cover classes. There was a considerable increase in built-up due to decrease in the agriculture land classes.

Observing from Table 4.9 of the 2021 classified map, water covers an area of 596.39 hectare representing 3 %,of the total land, vegetation covered an area of 5846.79 representing 27%, built up area covered an area of 4009.98 hectare representing 19 % and agricultural land covered an area of 10886.08 hectare representing 51 %. As shown clearly in Fig 4.1 and from Table 4.9, still agricultural land occupies the highest land area, whereas water still has the lowest area coverage. Comparing the 2021 classified map to the 2011 classified map, it can be seen that, in 2021, there was a reduction in the area coverage of water, and agricultural land. Built up area and vegetation class had an increase in its area coverage. This shows that building and construction have enhanced meaningfully over the years. Also, transitioning from 1991 to 2021, there has been a persistent increase in built up while some of the classes have had an inconsistent or irregular increase or decrease in their land cover. Water, for instance, increased in 2001and 2011 but decreased in 2021.Vegetation where somewhat increased starting from 2011, but agricultural lands where decreased throughout the four decade years except in 2001.

4.4 .Urban Sprawl analysis

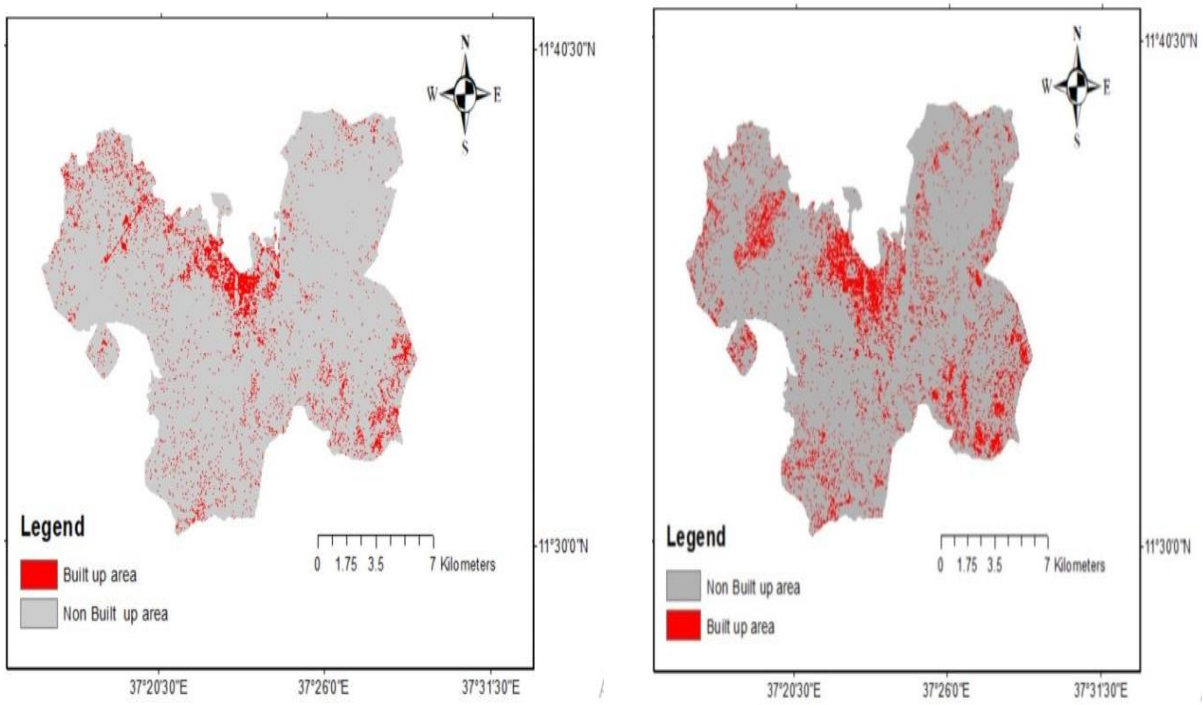
To analyze the nature and pattern of urban sprawl, the land cover maps of 1991, 2001, 2011, and 2021 were first reclassified into build-up and non- build-up as shown in Fig. 4.5. It is observed from fig 4.5 that built-up increased from 1991 to 2021, and is highly concentrated at central or northern part t of the study area (due to the presence of the old bus stations, different city centers, which is the Central Business District). From Table 4.5 it could be seen that there have been significant changes in the built-up from 1991 to 2021. The built-up area increased from 1485.07

hectare to 4009.08 hectare between the period 1991 and 2021. From the total area of Bahir Dar city in 1991 (1485.05 hectare) were used for the built-up area and the non-built-up covered an area of 19,857.85 hectare. In 2001 built-up covered an area of 2675.16 hectare; non-built-up marked the area of 18,667.76 hectare. In 2011 built-up and non-built-up respectively covered an area of 3191.24, and 18,151.68 hectare. The study's land area in 2021 was 21,342.92 hectare. 4009.08 hectare of the total area in 2021 was built-up land and 17,333.84 hectare was non-built-up land. The changes in built-up from the year 1991 to 2021 are summarized in Table 4.14 .Therefore, from 1991 to 2021 urban sprawl has been high in the city. Sprawl was continuously increased from 1991 to 2021.This indicates that in all years starting from 1991 to 2021 the city was sprawled. With the fact of the city facing high spreading, the spatial distribution of infrastructures and provision of basic facilities such as roads, water, electricity, and schools, etc. will be problematic. It is, therefore, essential as advised by *Aduah et al. (2013),* for the city's planning authorities to accept and pay appropriate sustainable planning approaches that right every feature of the city to safeguard resourceful utilization of the limited land resource and to govern the rate of urban dispersion. The substantial increase in built up indicates the conversion of most of the land cover types into impervious surfaces, hence, showing that urban expansion is taking place within the study area. This finding was aligned with the findings of *Zhenfenget, al, 2021*. They expressed that the built-up area of the Morogoro urban municipality expanded during the study period as the sprawl corresponded with increase in population of the Morogoro urban municipality between 2012 and 2017.

Table 4.14 Built and non-built up area of Bahir Dar (1991-2021)

Class of Urban land	Area_1991(ha)	Area_2001(ha|)	Area_2011(ha)	Area_2021(ha)
Built up	1485.07	2675.16	3191.24	4009.08
non built up	19,857.85	18,667.76	18,151.68	17,333.84
Grand total	21,342.92	21,342.92	21,342.92	21,342.92

Source; organized by the Author, August, 2022



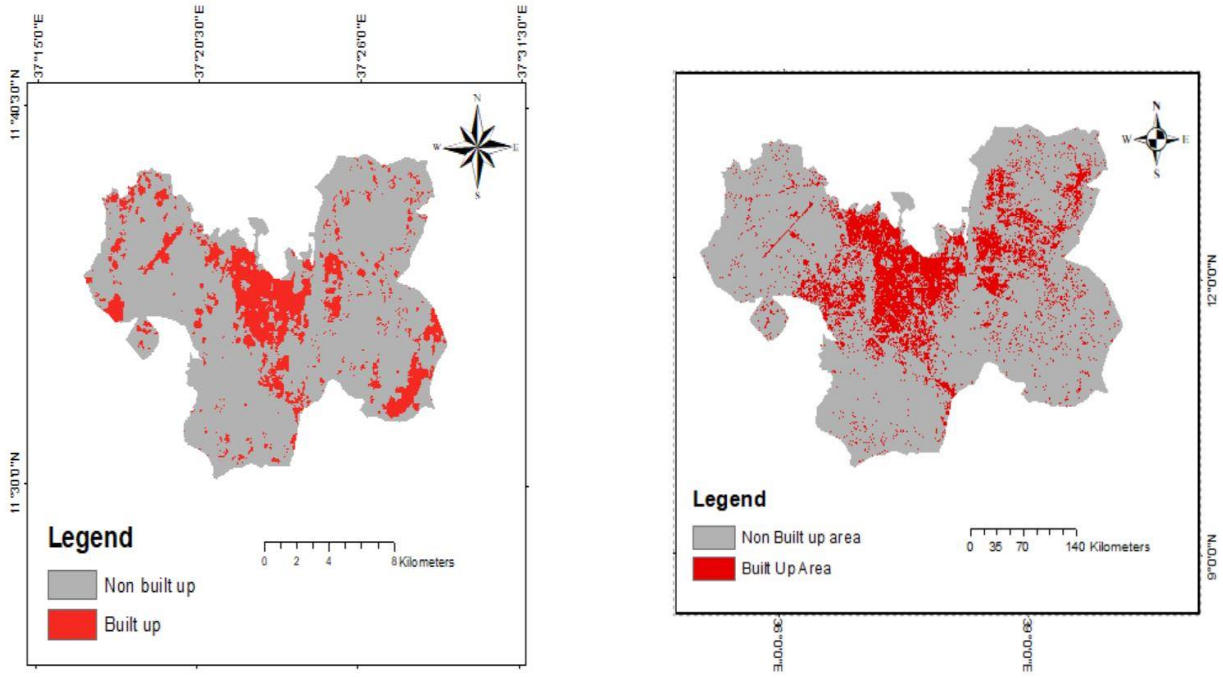


Figure 4.2 Built up and non-built up areas of Bahir Dar City in 1991, 2001, 2011 and 2021

Source; organized by the Author, August, 2022

4.5 The Magnitudes of Bahir Dar city Expansion (from 1991 up to 2021)

The extent and direction of Bahir Dar city expansion were assessed by delineating its administrative boundary for the years 1991, 2001, 2011, and 2021. The study used the high resolution Google earth to delineate the administrative boundary of Bahir Dar city for the year of 1991 and 2001. Furthermore, the 2011 and 2021 has been included by shape files given by the municipality employees for the main aim to show the extent of urban expansion and hence to capture more accurately the impacts associated with the recent expansion on the urban fringes. The digitalization of the Bahir Dar city for the year 1991 and 2001 were done by comparing the previous maps which were done by other scholars for different purposes.

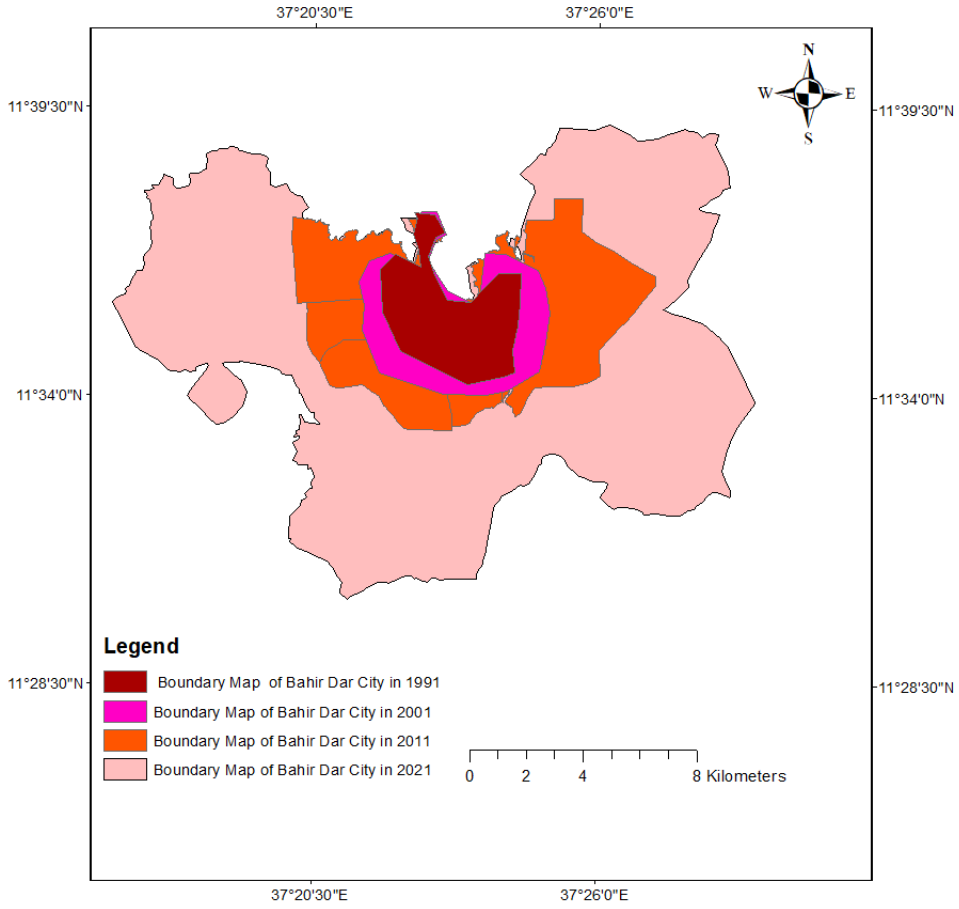


Figure 4.3 the magnitude /direction of Bahir Dar City expansionfrom1991_2021, source prepared by Author via ArcGIS, August, 2022

Fig.4.1 shows an overlay of Bahir Dar administrative boundaries in 1991, 2001, 2011, and 2021. The total urban areas for the four respective periods were estimated at 1770, 2974, 6221, and 21345 ha (Table 4.8). Analysis of the annual rate of change between the three periods (1991–2001, 2001–2011, and 2011–2021) showed that the area expanded by 1204 ha, 3247 ha, and 15,121.92 ha, respectively. The expansion occurred to the east (Gondar outlet), west (Airport and Hospital Street), and south (Merawi and Adet outlet) directions, whereas expansion to the north was limited by Lake Tana. The eastward expansion was the greatest and is attributed to the presence of the Abay River, which offered easy access to water, and the availability of abundant

flat land suitable for housing construction. A major road connecting the country's capital with Gondar city is also passing through Bahir Dar in this area. This finding were parallel with findings of *Haregeweyn et,al 2012.* Haregeweyn et,al 2012, described that due the rise of population growth and migration, there is the expansion of the city, especially in eastward direction.

Table 4.8 the magnitude expansion of Bahir Dar city from 1991-2021

Year	Urban area(ha)	Change (year)		
		2001-1991	2011-2001	2021-2011
1991	1770			
2001	2974			
2011	6221			
2021	21 342.92			
Change(ha year)		1204	3247	15,121.92

Source; organized by the Author: July, 2022

4.6 Causes of Urban Sprawl

There are so many causes of urban sprawl, but the most common causes of urban sprawl are related with demographic factors, management issues, economic factors, geographical and household issues (Bhatta, 2010). Based on this, this research addressed the cause of urban sprawl in Bahir Dar city.

4.6.1. Demographic Factors

one of the most important reasons of urban sprawl, especially in the developing world countries, is rapid growth of urban population. The growth of urban population is a result of natural increase in urban population and migration to urban settlements. This implies that in large cities not only people from rural areas are migrating but also people from small and medium towns are migrating to the large cities. Consequently, the population of large

cities are increasing very rapidly and city planning very often fails to plan for this ever-increasing population which leads to unplanned and unorganized outgrowth of the city.

Table 4.3 causes of urban sprawl related with demographic factors

		Count	Percent %
Investment has its own impact for the expansion of the city	Strongly disagree	62	17.2
	Disagree	47	13.1
	Neutral	46	12.8
	Agree	112	31.1
	Strongly agree	93	25.8
Informal settlement is the cause of urban sprawl	Strongly disagree	51	14.2
	Disagree	52	14.4
	Neutral	28	7.8
	Agree	107	29.7
	Strongly agree	122	33.9
Rural to urban migration is the causes of urban sprawl	Strongly disagree	37	10.3
	Disagree	46	12.8
	Neutral	35	9.7
	Agree	152	42.2
	Strongly agree	90	25.0
Rapid urban population growth (high birth rate) is the cause of urban sprawl	Strongly disagree	26	7.2
	Disagree	46	12.8
	Neutral	35	9.7
	Agree	176	48.9
	Strongly agree	77	21.4

Source: computed from Field Survey, August, 2022

According to Table 4.3 majorities of the respondents were in agreement and strongly agree that the population migration from rural to urban was the cause of urban sprawl. From the respondents 152 (42.2%) and 90 (25.0%) were agree and strongly agree about the reasons of

population migration from rural to urban migration for urban sprawl. 46 (12.8%) and 37(10.3%) of respondents were disagree and strongly disagree about the causes of population migration from rural to urban for urban sprawl respectively .The rest of respondents about 35 (9.7%) did not clarify their ideas ,they were neutral to explain their feeling about the causes of rural to urban population migration for urban sprawl. But overall, according to the majority of respondents, rural to urban migration was the cause of urban sprawl; this finding was similar with Zuhal, (2016) findings. According to Zuhal, the rapidly increasing population lies on the basis of various factors causing urban sprawl. Apart from the increase in birth rate, relocation from rural to urban residence also has excessive influence on rapid population increase in urban areas. As a result of this uncontrolled growth, difficulties arising from the city becoming crowded direct people to live out of the city center which causes urban sprawl

To one side from rural migration rapid population growth within the city (high birth rate) was among the factors of urban sprawl .Regarding to the rapid population growth of the town, again majority of the respondents were agreed and strongly agree about its factor for urban sprawl. 176(48.9%) and 77(2.4%) of respondents were agreed and strongly agreed about the causes of urban population growth for urban sprawl.46 (12.8%) and 26 (7.6%) of the respondents were disagree and strongly disagree about the causes of rapid population growth of the town for urban sprawl. The remaining 35 (9.7%) of respondents were not given information about whether rapid population growth is the cause of urban sprawl, or not. This finding is similar to (EEA, 2006) indicating that rapidly increasing population lies on the basis of various factors causing urban sprawl.

According to major response of the respondents investment has its own impact for the expansion of the city, 93(25.8%) and 112 (31.1%) of the respondents strongly agree and agree respectively,

they clarified that investment has its own impact for the expansion of the city, but the remaining 47(13.1%) and 62 (17.2%) of the respondents strongly disagree and disagree respectively, they explained that investment is not the cause of urban sprawl. Due to the existence of large tracts of land in suburban areas, many investments exist in the outer part of the city. Moreover, in some areas, the number of jobs in suburbs increased in the last few years. Therefore, the number of workers in suburbs rises, which marks it further attractive for people to live here. Thus, the motivation for people to move to these areas increases, which also increases the likelihood of urban sprawl. This finding was similar with the scholars of (Sharma, 1998), Sharma explained that since many firms are not able to find affordable office or production spaces in the cities, they locate their businesses in suburban areas, and they attract many people to the suburban areas.

Again majority of respondents justified that informal settlement is also the cause of urban sprawl, 122 (33.9%) and 107(29.9%) of the respondents were strongly agree and agree, that means they explained that informal settlement is the cause of urban sprawl, but the remaining 51(14.2%) and 52(14.4%) of the respondents were strongly disagree and disagree respectively, they described that informal settlement is not the cause of urban sprawl. Informal settlement was done via misleading the farmers and inspiring them to sell their plots otherwise the government will take their property without compensation. The low awareness of farmers about the urban land lease laws makes them to be cuckolded such that they engage in selling their plots so that they get relief with the money gained. Because of this mechanisms informal settlement in Bahir Dar city is one of the causes for the expansion of urban areas ,this finding strength the ideas of (Loretta Muzondi,2014) this scholar explained that informal settlement is occurred due to high population growth ,rural to urban migration, lack of affordable house ,low paid works and other reasons and then it becomes the cause of urban sprawl.

4.6.2. Management factors for urban sprawl in Bahir Dar city

The main goal in many urban growth management programmers is the containment of urban land, i.e. the implementation of a containment strategy through a vision or a plan. This includes often zoning regulations in the form of green belts, which are typically very tight, containment boundaries or also urban service areas, which are looser in their character. mostly the developing countries planning polices lacks inclusiveness ,that is way urban sprawl is highly practiced .

Table 4.4 causes of urban sprawl related with management factors

		Count	Column N %
The absence of quality of urban planning is the main causes of urban sprawl	Strongly disagree	26	7.2
	Disagree	28	7.8
	Neutral	16	4.4
	Agree	254	70.6
	Strongly agree	36	10.0
Weak regulation procedures is the causes of urban sprawl	Strongly disagree	65	18.1
	Disagree	48	13.3
	Neutral	19	5.3
	Agree	149	41.4
	Strongly agree	79	21.9
Lack of proper planning policies is the causes of urban sprawl	Strongly disagree	27	7.5
	Disagree	79	21.9
	Neutral	33	9.2
	Agree	140	38.9
	Strongly agree	81	22.5
Poor government developmental policies is the causes of urban sprawl	Strongly disagree	24	6.7
	Disagree	34	9.4
	Neutral	51	14.2
	Agree	184	51.1
	Strongly agree	67	18.6
Failure to enforce planning policies is the causes of urban sprawl	Strongly disagree	28	7.8
	Disagree	58	16.1
	Neutral	3	0.8
	Agree	185	51.4
	Strongly agree	86	23.9

Source computed from field survey: August, 2022

As indicated in Table 4.4 the absence of quality of urban planning is the cause of urban sprawl. This is evidenced that the majority of the respondents were assured of this idea. 254(70.6%) and 36(10.0%) of the respondents explained that the absence of quality urban planning is the cause of urban sprawl. Whereas 28 (7.8%), and 26(7.2%) of respondents disagree and strongly disagree that the absence of quality urban planning is the cause of urban sprawl. Again a few respondents 16(4.4%) did not explain their ideas about the absence of quality urban planning is the cause of urban sprawl. Little to no regional planning is one of the main causes of urban sprawl. If officials in closely populated urban centers plan in separation without asking neighboring communities, the result is sometimes poorly planned developments on the borders of urban centers. Instead of bridging the existing infrastructure and amenities of surrounding communities, these less densely populated areas often experience new public expenses for infrastructure improvements without regard to a regional plan or pooled resources. A regional plan would expect the growth of new areas and slowly implement the required planning initiatives to generate a cohesive community. People love to find areas that are less trafficked and more quiet, which leads them to sprawl out to other pieces of the city. Due to this absence of quality urban planning is the cause of urban sprawl, this finding were similar with Acioly and Davidson 1996 the application of inclusive policies in the urban planning of an area can aid to end dissimilarity within that area.

Even though 48(13.3%) and 65(18.1%) of respondents were disagree and strongly disagree about weak regulation procedures is the causes of urban sprawl, majority of respondents 149(41.4%) and 79 (21.9%) for agree and strongly agree about weak regulation procedures is the causes of urban sprawl .The remaining 19 (5.3%) of the respondents their idea via neutral .So overall weak regulation procedure is the cause of urban sprawl in Bahir Dar city. Regulating processes that are not appropriately bound by the law can be extremely problematic. Such is the

case with urban sprawling. Since there are no tough laws that administer the scheme of urbanization, it becomes a somewhat wayward and unrestrained process that develops the problem of urban sprawling. This finding is similar to (Priyanka et,al.2018), they explained that a strong government can contribute to better urban planning, but mostly in developing countries this is not applied, that is urban sprawl is still expanding .

As shown in Table 4.4 many respondents explained that lack of proper planning policies is the causes of urban sprawl, here lack of proper planning policies means that the absence of good or proper policies that guides to prepare appropriate urban plan is the causes of urban sprawl. 140 (38.9%) and 81(22.5%) respondents agree and strongly agree respectively about one of the causes of urban sprawl is related with lack of proper planning policies .79(21.9%) and 27(7.5%) of respondents were disagree and strongly disagree respectively about the causes of urban sprawl is related with lack of proper planning policies .The remaining respondents about 33(9.2%) of respondents reserve their ideas regarding about the causes of urban sprawl. This finding was similar with Acioly and Davidson 1996 findings .According to those scholars lack of reliable and well-experimented planning policies may also source urban sprawl. A city may be planned with exclusive zoning policies; this means separation of residential, commercial, industrial, office, institutional, or other land uses. Completely separate zoning created isolated islands of each type of development.

Poor_ government developmental policies are the causes of urban sprawl, meaning that the government policies related with the development are poor, so this was the cause of urban sprawl according to the respondent's reflection. 184 (51.1%) and 67(18.6%) of respondents were agree and strongly agree respectively about poor governmental development policies were the causes of urban sprawl. 34 (9.4%) and 24 (6.7%) of the respondents were disagree and strongly disagree

respectively about the causes of urban sprawl was not related with poor governmental developmental policies. 51 (14.2%) of respondents were answered by saying neutral.

Again failure to enforce planning policies is the causes of urban sprawl, the majority of the respondents, 185 (51.4%) and 86 (23.9%) from samples of Bahir Dar city explained that failure to enforce planning policies were the causes of urban policies: but the remaining 58(16.1%0 and 28 (7.8 %) of respondents were disagree and strongly disagree by explaining failure to enforce the existing planning policies were not the causes of urban sprawl. The rest 3(0.8%) of respondents were reflected by becoming neutral about this idea. This finding supports the finding of *Barnes et al. 2001*. He explained that having a proper planning policy is not enough, rather its successful implementation and enforcement is more important. Ineffective implementation of land-use plans is one of the causes of sprawl in developing countries, since the enforcement is often unethical and irregular in these countries.

4.6.3. Economic causes for urban sprawl in Bahir Dar city

Economic growth is another important cause of urban sprawl. The increase in income and increase in number of employed people through economic growth creates demand for housing as well as better housing with more living space on better location. In USA, the phenomenon of urban sprawl came to prominence as people started moving to outskirt of city where they could afford large single dwelling units due to increase in income level. The result was low density development in the fringe zone of city causing urban sprawl.

Table 4.5 causes of urban sprawl related with economic issues

		Count	Column Total N %
Industrialization means the development of industry is the cause of urban sprawl.	Strongly disagree	37	10.3
	Disagree	40	11.1
	Neutral	8	2.2
	Agree	177	49.2
	Strongly agree	98	27.2
Land hunger attitudes means that want of many land is the causes of urban sprawl	Strongly disagree	30	8.3
	Disagree	34	9.4
	Neutral	12	3.3
	Agree	131	36.4
	Strongly agree	153	42.5
Lack of affordable houses in the urban area is the causes of urban sprawl	Strongly disagree	31	8.6
	Disagree	37	10.3
	Neutral	9	2.5
	Agree	163	45.3
	Strongly agree	120	33.3
	Total	360	100.0

Source computed from field survey; August, 2022

The above Table 4.5 illustrates that most of the respondents i.e., 177 (49.2%) agree and 98(27.2%) strongly agree the reason for urban sprawl is the development of industry is the cause of urban sprawl. But 40(11.1%) and 37 (10.3%) of the respondents were disagree and strongly disagree respectively about industrialization means that the development of industry is the causes

of urban sprawl. 8 (2.2%) of respondents were neutral means that they did not reflect their ideas about whether industrialization means that the development of industry is the causes of urban sprawl or not. Here majority of respondents indicated that industrialization or the expansion of industries where the causes of urban sprawl this finding where similar with Bahatta ,2010 findings ,this scholar were explained that depending on economic growth, industrialization increasing at city boundaries and housing demand of people employed on these production areas are listed among the reasons of sprawl .

In addition the respondents explained that land hunger attitudes means that want of land for different purpose is the causes of urban sprawl, based on this 131 (36.4%) and 153 (42.5%) of the respondents explained their agreement level by clarified they were agree and strongly agree about land hunger attitudes means that want of many land is the causes of urban sprawl. But 30(8.35) and 34 (9.4%) of respondents disagreed and strongly disagreed respectively about land hunger attitudes, which means that want of much land is not the cause of urban sprawl. The remaining 12 (3.3%) of respondents enlightened their reflection via neutral. Again according to the above table generally land hunger attitudes were also the causes of urban sprawl, this finding where similar with (Harvey and Clark 1965) findings, those scholars indicated that many institutions and even individuals desire for the ownership of land. Often these lands are left available within the core city area and makes infill policies unsuccessful. As a result the city grows outward leaving the undeveloped land within the city.

As Table 4.5 indicates the majority of respondents, 163(45.3%) and 120 (33.3%) respondents indicate that lack of affordable houses in the urban area is the causes of urban sprawl, where us 37 (8.6%) and 31(8.6%) of respondents where disagree and strongly disagree related lack of affordable houses in the urban area is the causes of urban sprawl. The remaining 9(2.5%) of

respondents explained their feelings via neutral. Often in metropolitans purchase second homes in the rural area as upcoming investments *(Barnes et al. 2001)*. This inspires the developers for construction in the countryside. These homes are often left vacant but the government is forced to maintain urban facilities and services in a low-density area. Small interest rates and excessive housing requests make the rural area-housing investment more gorgeous.

4.6.4. Geographic related factors for urban sprawl in Bahir Dar city.

A good transport network is a must for economic growth of a city. However, this development of transport specially the expressways and highways cause urban sprawl. In developing courtiers also, construction of highways and major roads has caused urban sprawl along the roads, i.e. ribbon sprawl.

Table 4.6 causes of urban sprawl related with geographic factors

		Count	Column N %
The availability of agricultural area is the cause of urban sprawl.	Strongly disagree	20	5.6
	Disagree	37	10.3
	Neutral	16	4.4
	Agree	133	36.9
	Strongly agree	154	42.8
Availability of transportation infrastructures is the cause of urban sprawl	Strongly disagree	24	6.7
	Disagree	44	12.2
	Neutral	3	0.8
	Agree	168	46.7
	Strongly agree	121	33.6
	Total	360	100.0

Source; computed from field survey: August, 2022

As indicated in Table 4.6 the majority of the respondents was agreeing and strongly agreed that the availability of agricultural area in the periphery area were the cause of urban sprawl. 133

(36.9% and 154 (42.8%) of respondents were agree and strongly agree respectively. 37 (10.3%) and 20 (5.6%) of the respondents were disagree and strongly disagree respectively about the availability of agricultural area is the cause of urban sprawl. The rest 16 (4.4%) of the respondents did not clarify their ideas. This finding, similar with EEA, 2006 findings, means that the price of agricultural land is quite lower than plot is an important factor causing urban sprawl (EEA, 2006). Low prices of land were the cause of heavy demand of sectors such as industry, trade and construction. The preference of these sectors in agricultural land in its place of plots as the founding place both causes urban sprawl and inefficient use of resources due to non-agricultural use of agricultural land.

As Table 4.6 indicates that availability of transportation infrastructures were the causes of urban sprawl according to the respondent's response. 168 (46.7%) and 121 (33.6%) of the respondents were agree and strongly agree respectively about its causes for urban sprawl. The other respondents 44 (12.2%) and 24(6.7%) of the respondents were disagree and strongly disagree respectively about the causes of available transport infrastructure for urban sprawl. The rest 3(0.8%) of the respondents did not reflect their ideas. This idea was supported by other scholars. *T*ransportation routes open the access of the city to the countryside and are responsible for the development of urban areas (Harvey and Clark 1965). Roads are commonly considered in modeling and forecasting urban sprawl (Cheng and Masser 2003; Yang and Lo 2003), because they are a major catalyst of sprawl.

4.6.5. Household related factors for urban sprawl in Bahir Dar city.

Households hold land as they speculate to get higher prices for the land in times to come which very often lead to leapfrog development, a form of urban sprawl. The preference of household regrading to build the home is vary from household to household, some of them they prefer the

suburban areas, other prefer central areas. This preference has its own impact for the expansion of urban areas .Next table shows how household preference is a cause of urban sprawl.

Table 4.7 causes of Urban sprawl related with household factors

		Count	Column N %
Demand of more living space is the cause of urban sprawl	Strongly disagree	12	3.3
	Disagree	62	17.2
	Neutral	18	5.0
	Agree	75	20.8
	Strongly agree	193	53.6
Tendency for having a second house is the means of urban sprawl	Strongly disagree	12	3.3
	Disagree	22	6.1
	Neutral	20	5.6
	Agree	233	64.9
	Strongly agree	72	20.1
Need of quality environment is the causes of urban Sprawl	Strongly disagree	16	4.4
	Disagree	51	14.2
	Neutral	28	7.8
	Agree	102	28.3
	Strongly agree	163	45.3
	Total	360	100.0

Source: computed from field survey; April; 2022

The above Table 4.7 illustrates that most of the respondents 75 (20.8%) and 193 (63 (53.6%) were believed that demand of more living space is the causes of urban sprawl, but 62(17.2%) and 12(3.3%) of the respondents were disagree and strongly disagree respectively about demand of more living spaces is the causes of urban sprawl. 18 (5%) of the respondents were neutral. In several developing countries, inhabitants of the core city lack adequate living space. This inspires countryside expansion for more living space. People can purchase more living space on

the outside than in the central city, since the price of property is less in the countryside. However, consumption of more living space does not continuously cause sprawl. Population density is a main concern in this issue. Cities in emerging states are three times denser than the cities in developed countries (Acioly and Davidson 1996). Therefore, higher per capita consumption of built-up area (or living space) is wanted in many cases. In such cases, higher per capita consumption of living space may show well and extended living amenities within the limits of compact urban growth. However, if the request of more living space forces quick low-density development in the countryside then it must be a sign of sprawl.

As Table 4.7 indicated that tendency for having second house is also the causes of urban sprawl , because 233 (64.9%) and 72(20.1%) of the respondents were agree and strongly agree respectively about tendency for having a second house is also the causes of urban sprawl ,where us 22 (6.1%) and 12 (3.3%) of the respondents were disagree and strongly disagree about tendency for having a second house is the cause of urban sprawl.20(5.6%) of the respondents were neutral. One cause of urban sprawl that is difficult to quantify is favorite. A desire for many houses, more bedrooms and bigger yards is one of the causes of urban sprawl. Some people simply prefer many houses which hold more home square footage than what is affordable or available in more crowded city centers.

As shown in Table 4.7 majority of the respondents 102(28.3%) and 163(45.3%) of respondents indicated that the need for a quality environment is the cause of urban sprawl, because they were agreed and strongly agreed respectively. But 51(14.2%) and 16 (4.4%) of the respondents disagreed and strongly disagreed respectively. The rest 28(7.8%) of the respondents were answered via neutral. One of the original inspirations for exodus to the suburbs was access to nature. People generally choose to live with trees, birds, and flowers; and these are more

available in the suburbs than in denser urban areas. Moreover, contact with nature may compromise benefits outside the purely aesthetic; it may benefit mutually mental and physical health. In addition, the sense of escaping from the chaos of urban life to the suburbs, the feeling of peaceful refuge, may be soothing and restorative to some people. In these respects, there may be health aids to peripheral lifestyles (Frumkin 2002) this scholar supports the above idea.

To support the quantitative data, the study where interviewed twenty seven (27) employees of Bahir Dar city administration land ownership registration and information agency office and Sub city leader for semi structured interview, those employees were explained what was existed in their office and in outside office. Based on that the major causes of urban sprawl in Bahir Dar city were the followings; citizens favorite large houses and large areas, hate of building houses in central part of the city due to the cost of the land and other additional reasons like the existence of noise and vocal sounds, lack of understanding of, or ignoring the consequences of unplanned growth of metropolitan areas, on cities itself, on the smaller cities, and towns, giving developers too much freedom to do as they please, underpaying for the public cost of infrastructure as they go, shortage of moderate- and low-cost housing at the central part of the city encourages buyers to look further and further out into suburbs and rural areas, population and income growth, low price of land and access to appropriate housing in sub urban areas than the central urban area gives some advantages to build their home in suburban areas, the creation of new centers in suburbs facilities the building of shelters in sub urban areas, the existence of informal settlements ,and also the presence of rural and urban migration, peoples need of better environments ,and the existence of land hunger attitudes, moving away from congested areas, need of green open spaces, and presence of housing rents very high in central area makes people to build their home in outside part of the city .In addition the qualitative data also assures that,

due to several factors , urban sprawl were take place in Bahir Dar city, means that there is uncontrolled expansion of the city. There are different manifestations for the existence of urban sprawl in Bahir Dar city like the existence of informal settlement, the expansion of built-up areas without planning and others. People built their shelter outside the city center because they needed cheap land, more space and a good environment. The peoples have a lack of information /understanding about the impact of urban sprawl that is why they built their shelter in outside part of the city, by ignoring the central part of the city.

4.7 The impact of urban sprawl in Bahir Dar town

4.7.1 The impacts of urban sprawl on land use /land cover changes in Bahir Dar city

Due to the existence of urban sprawl or due to the expansion of urban areas different land use/ covers were converted or shirked, so based on this here the study was tried to assess the impacts of urban sprawl on different land use /land covers. To assess the impacts of urban sprawl on land use /land cover in the study area the study where assess the trend analysis on land use and land cover indicates where the land cover types are changing to other. In this study, this was completed via the initial years of comparison as the base. Between 1991 and 2001 agricultural land increased by 43.64 hectare, vegetation decreased by 1463.56 hectare, built up increased by 1109.09 hectare and water body increased by 229.83 hectare (Fig. 4.6).From the results, even though vegetation was reduced, whereas built up, agricultural land, water body, had a substantial increase.

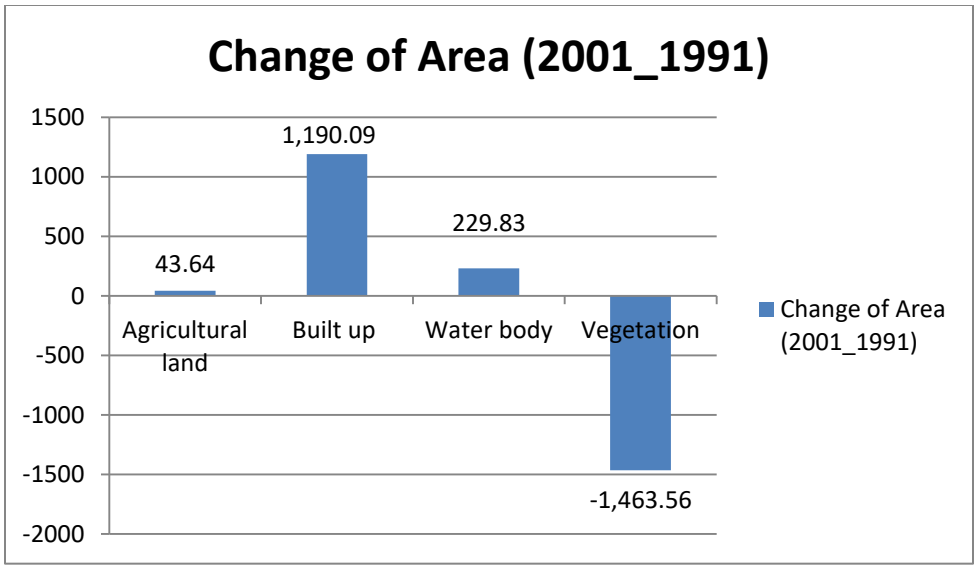


Figure 4.4 Land use /Land cover change of Bahir Dar in 1991 and 2001, Source: organized by the author, August, 2022

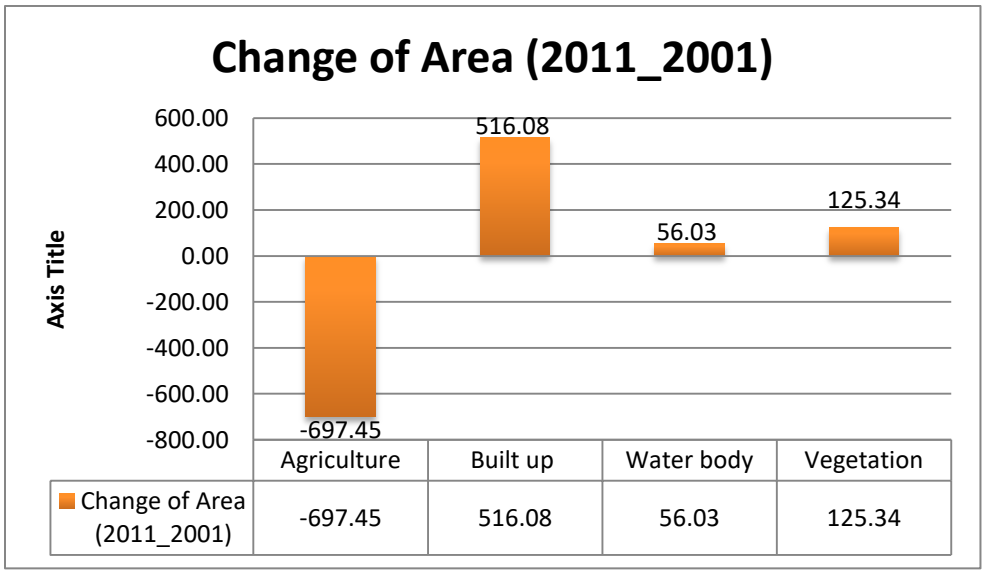


Figure 4.5 Land use/land covers Changes of Bahir Dar in 2001 and 2011, Source: organized by the author, August, 2022

From 2011 to 2001, the magnitude of water increased by 56.03 hectare, vegetation increased by 125.54 hectare built up where also increased by 516.08 hectare, however agricultural land

decreased by 697.45 hectare (Fig.4.7). According to the results of Figure 4.7, built up, water, and vegetation had an increase whereas agricultural land saw a decrease in the area coverage. The trend of change in the classes from 2001 to 2011 indicates the prevalence of urban expansion through increased construction of buildings and impervious surfaces. As a result of this, portions of the other class's especially agricultural land were converted to settlement or build-up. Generally, when the use of land is changing from agricultural land to other land uses, build-up or settlement becomes the dominant land use. The changing trend in the classes between 2011 and 2001 is evidence of build-up being predominant in the change of agricultural class to other land classes. Observing from Figure 4.7, it indicates that the above idea

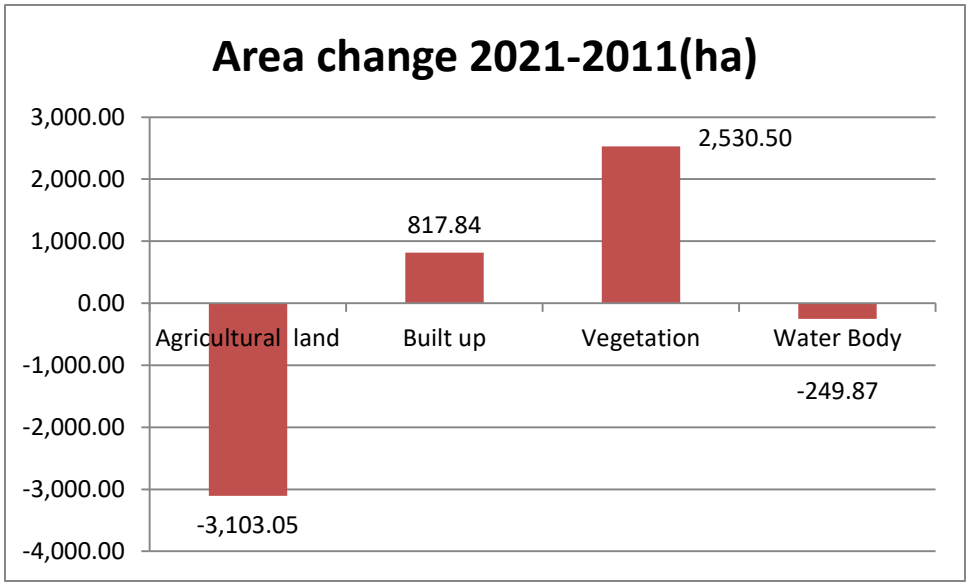


Figure 4.7 Land use /land cover changes of Bahir Dar in 2011 and 2021, Source: organized by the author, August, 2022

As the above Figure 4.8 indicates that there was an increment of both built up and vegetation area, but agricultural land and water body where decreased from 2011 to 2021.For example built up where increased by 817.84 hectare, again vegetation increased 2530.50 by hectare, but

agricultural land and water body where decreased by 3103.05, and 249.87.41 hectare respectively. Here due to the rapid migration of population from rural to urban areas most of the agricultural land was converted into built up areas that is why agricultural land has decreased in a large amount. Again due to the plantation of eucalyptus trees and other reforestation and afforestation mechanisms vegetation becomes larger.

4.7.2. The impacts of Urban Sprawl on Agricultural production

Agricultural production means the production of any growing grass or crop attached to the surface of the land, whether or not the grass or crop is to be sold commercially, and the production of any farm animals, including farmed elk, whether or not the animals are to be sold commercially. Regarding about the impact of urban sprawl the next graph shows that. By opposing many respondents, some of respondents explained that urban sprawl is not impact on agricultural production, because they practice urban agriculture. Urban Agriculture is a kind of a local food system where food is formed within an urban area and marketed to consumers within that area. Urban farming can also comprise animal husbandry (e.g., breeding and raising livestock), beekeeping, aquaculture (e.g., fish farming), aquaponics (e.g., integrating fish farming and agriculture), and non-food products such as making seeds, cultivating seedlings, and growing flowers.

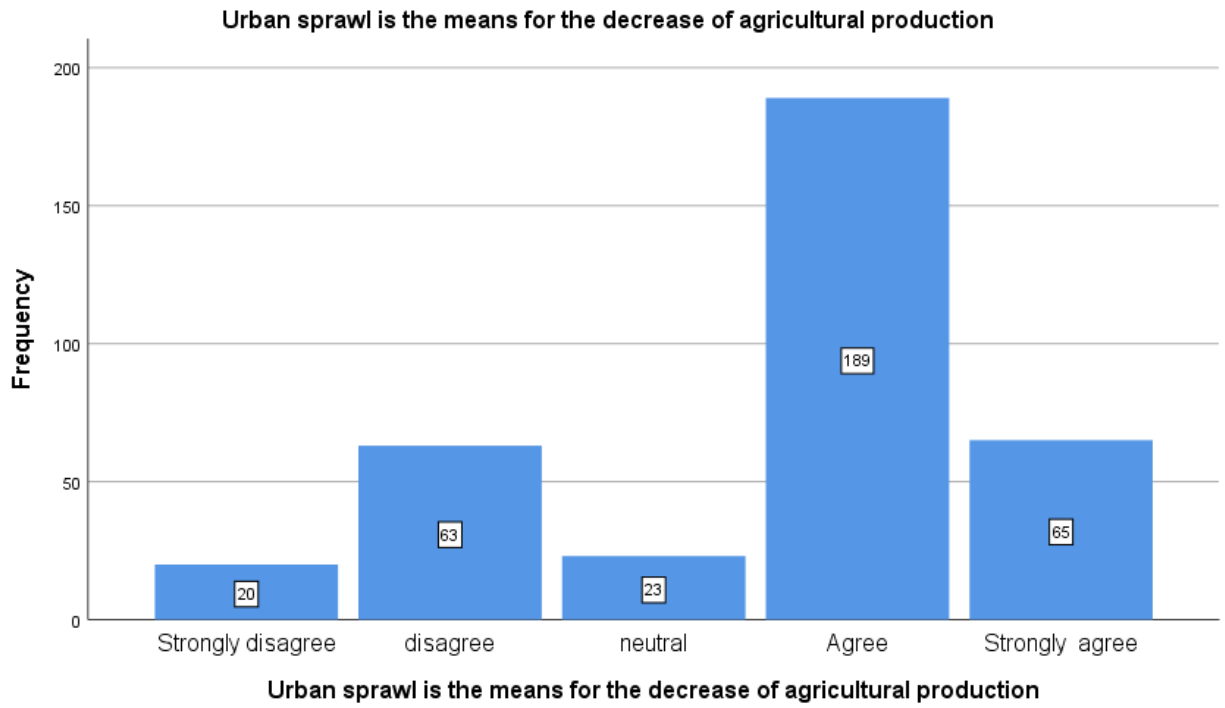


Figure 4.9 the impacts of urban sprawl on agricultural production, Source: organized by the author, August, 2022

The above figure 4.9 indicates that 189 (52.5%) and 65 (18.0%) of the respondents from household heads of Bahir Dar city explained that urban sprawl is the means for the decrease of agricultural production, but 20 (5.6%) and 63 (17.5%2) of the respondents from the households explained that urban sprawl where not the means of decreasing agricultural production because they were strongly disagree and disagree respectively .The remaining 23 of respondents where neutral ,means that they did not explained their ideas. The peoples who give their response via strongly disagree and disagree were justified that they were beneficiary with dairying, and other urban agriculture activities. But overall according to many respondents urban sprawl in the study had its own impact on agricultural production, this finding supports the

following ideas raised by berry and fischel in 1982.The idea was the loss of agricultural land to urban sprawl means not only the loss of fresh local food sources but also the loss of habitat and species variety, since farms contain plant and animal habitat in woodlots and hedgerows. Urbanization generally and sprawl in particular contribute to loss of farmlands and open spaces; this loss of farmland leads to the decline of agricultural production (Berry and Plaut 1978, Fischel 1982).

4.7.3 The impacts of Urban sprawl on lifestyle of the Bahir Dar city peoples

Lifestyle is the term that is given for a mode of living adopted by an individual, a group, a nation or a commonwealth of nations. Lifestyles depend on—and in turn co-create—the characteristics of a civilization or a culture within a given space and time. A lifestyle takes shape within the specific interweaving of economic, political, cultural and religious frameworks, patterns and discourses.

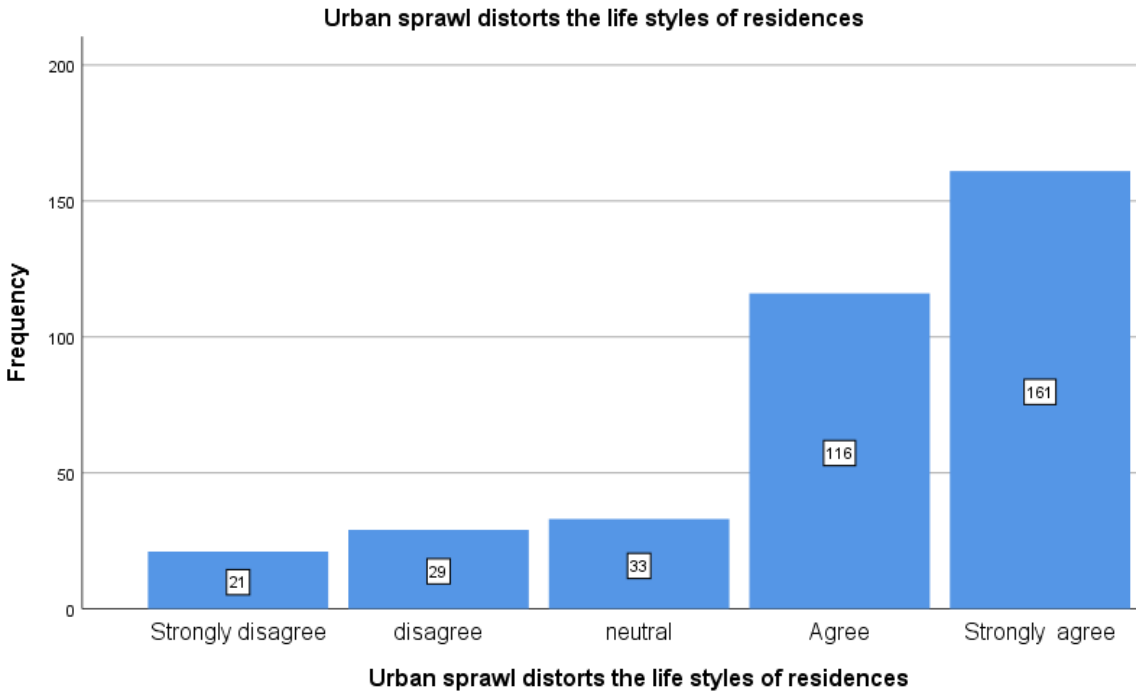


Figure 4.10 the impacts of urban sprawl on lifestyle of the households, Source: organized by the author, August, 2022

According to the above figure 4.10 indicated that most of respondents 116 (32.2%) and 161 (44.7%) of household were justify that urban sprawl was the cause of the distortion of lifestyle, where us 21 (5.8 %) and 29 (8.1%) of households clarified that urban sprawl where not distort the lifestyle of the residences .3 (9.2%) of respondents were neutral. Urban sprawl creates reduction of rural character or community sense of place. Urban sprawl is the means of increasing automobile dependency that leads to the existence of pollution, traffic congestion, habitat fragmentation, degradation and diminishes the local characters of the community. The manifestation of distortion of lifestyle is related with breaking of social bonds, concentration of poverty, increased crime rates, higher level of frustration, congestion, high housing, changes of daily social lives, increase in public costs, and psychic problems.

4.7.4 The impacts of urban sprawl on the infrastructure of Bahir Dar city

Here are also high public costs related to urban sprawl. This includes infrastructure costs, but also costs from pollution. Infrastructure is quite expensive in areas with low settlement density since streets have to be built and will be used by fewer cars compared to cities. In addition, the pollution from commuting results in further social costs since air pollution causes acid rain and also contributes to global warming.

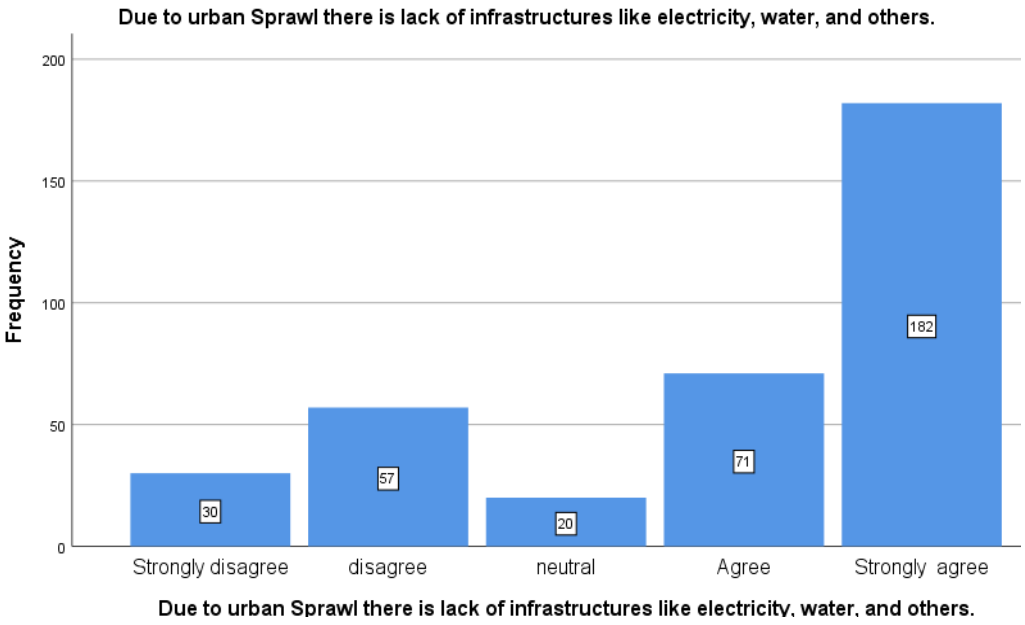


Figure 4.11 the impacts of urban sprawl on infrastructure, source; computed from filed Survey; August, 2022

As Figure 4.11 shows that, the majority of the respondents, 71 (19.7 %) and 182 (50.5%) of the respondents clarified that urban sprawl creates lack of infrastructure usage like electricity ,water ,choosing of transport modes problems , but the remaining 30(8.3%) and (15.8%) of respondents are where strongly disagree and disagree on the occurrence of lack of infrastructure usage due to urban sprawl .20 (5.6%) of respondents were neutral. Due to urban sprawl, different costs were raised like increased community costs for maintaining roads, school bus routes, sewers, and other services needed when businesses and residences are spread out. Urbanization is always attended by the development of physical infrastructure, which requires huge investments and determines the structure of a city over long periods of time. Moreover, it cannot be readily adjusted to changing patterns of the demanded services, e.g., triggered by population shrinking. Thus, the influences of urban sprawl on the local urban infrastructure asset signify complex and important issues to be careful in this context.

4.7.5 The impacts of urban sprawl on the income status of the Bahir Dar city

Income status refers to the position of a person or household's income in relation to a low income line. Person refers to an individual and is the unit of analysis for most social statistics programs.

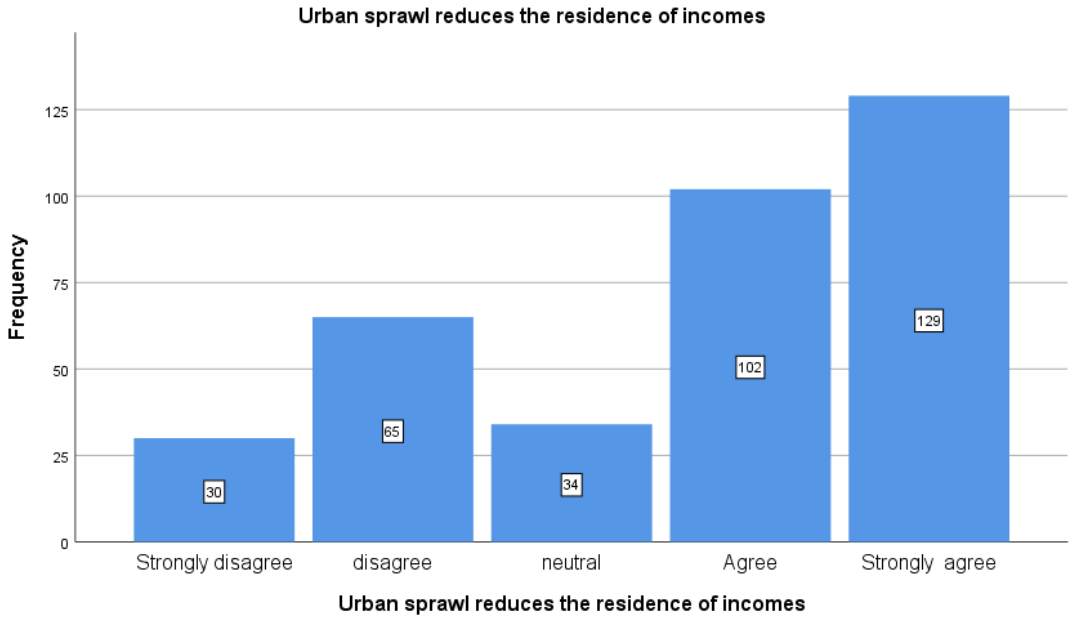


Figure 4 .12 the impacts of urban sprawl on income status of households, source; computed from field Survey: August, 2022

As the above figure 4.12 shows that, the majority of the respondents, 129 (35.8 %) and 102 (28.3 %) of the residences explained that urban sprawl had its own impact on income level of the society ,because they were agree and strongly agree on this idea those respondents explained that their income was decreased because they were deepened on agricultural production ,when they lost their land their income were reduced than the previous .But the remaining 30 (8.3 %) and 65 (18.1%) of respondents are strongly disagree and disagree on the impacts of urban sprawl on the income status of the residences, they explained that they diversify their income generation means they were converted from agricultural way of life to trading . 34 (9.4%) neutral

means that they did not explain their ideas regarding the impacts of urban sprawl on the income status of the residences. The income was declining , because many households were dependent on agricultural activities, meaning they were dependent on the production of agricultural products, but due to the urban sprawl their land size was reduced then their income was declined than the previous. But this does not mean that the income of all households declined, because some of the households benefited via urban sprawl through urban agriculture activities. That is why 30 and 57 households were answered via strongly disagreeing and disagree. When the farmlands are affected, crop yield (output) is reduced and the resultant effect would be reduction in farmers 'income, which would eventually lead to poverty. Bahir Dar is not the only District that has been impacted negatively by urban sprawl. This results in loss of food crops and eventually causes reduction in farmer's income (Small, 2004).

4.7.6. The impacts of urban sprawl on land values of Bahir Dar city

Land value indicates the market value that people ascribe to specific places. These values are affected by demand factors, such as views, amenities, and proximities to employment opportunities and transport infrastructure.

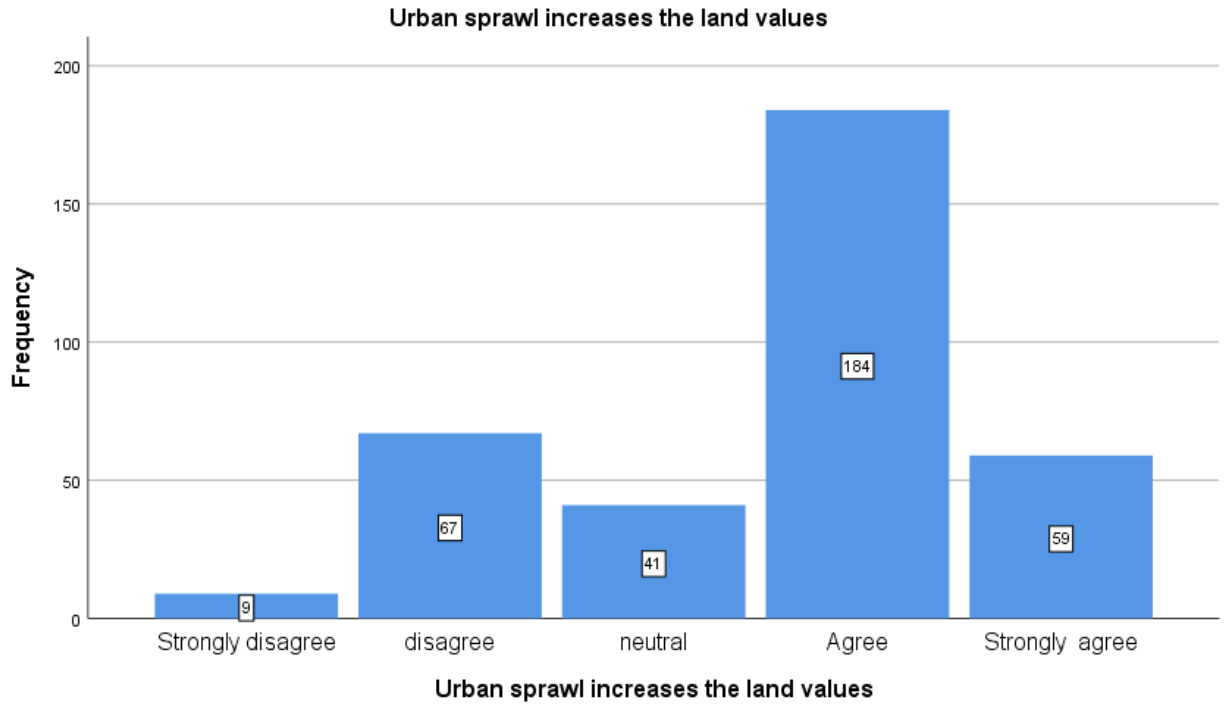


Figure 4.13 the impacts of urban sprawl on land values source; computed from field Survey: August, 2022

As the above Figure 4.13 shows that, the majority of the respondents, 184 (51.1%) and 59 (16.4 %) of the respondents were agree and strongly agree about the impacts of urban sprawl on the increment of land value ,means that due to the expansion of urban areas the value of land was increase illegally .The other respondents 9 (2.5 %), and 67 (18.6 (%) of respondents were strongly disagree and disagree about the impacts of urban sprawl on the increments of land value .The remaining 41(11.4%) neutral. The increments of land value were the results of urban sprawl according to respondents. This was due to the practice of selling lands without any legal restriction, which means that the lands were sold by the negotiation of the buyers and sellers. In relation to the land value, the respondents explained that mostly the land was sold illegally because selling the land via legal process is highly bureaucratic and the given compensation

value was unfair, which means that it does not satisfy the landowner. According to the respondents response even though the land value is increased from time to time , the compensation that is given by the government were unfair ,because it is very low means that not consider the current price of the land ,again their payment system were also highly autocratic ,because of this it is unsatisfied compensation system . The satisfaction level of the respondents was low; when they thought about the amount of money given by compensation they said it was boring because of the unfair system. Sprawl is powered by the expansion of previously agricultural land or open space. As population within an urban center grows, the demand for property increases, while the supply of available land in the urban center decreases causing property values to increase. This in turn creates market division where mid-level income households are priced out of the more financially exclusive urban markets (Carruthers and Ulfarsson 2002). As the chain of events unfolds, consumers are forced to geographically expand their search for land, which leads them to the urban/rural fringe where property value remains lower due, in large part, to its current use which is typically of an agricultural nature. Land value stems from the fact that land is necessary for construction, and buildings are necessary for most kinds of production of goods or services and for some types of consumption, such as housing. Land originates its value from the fact that it is an indispensable input, or a factor of production. Due to the existence of illegal land traders, the value of land becomes large from time to time.

4.7.7 The impacts of urban sprawl on ecosystem

Urban sprawl sources changes in land use and deterioration in many ecosystem services. Large areas of natural vegetation and agricultural land were converted to urban settlements in the past four decades

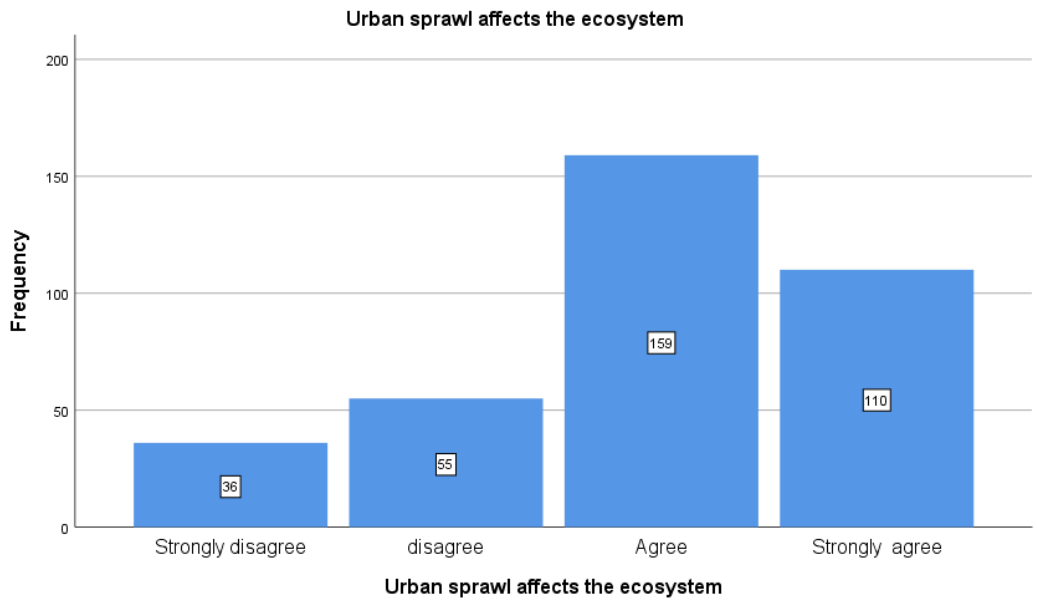


Figure 4.14 the impacts of urban sprawl on ecosystem, source; computed from filed Survey: August, 2022

As the above Figure 4.14 shows that, the majority of the respondents, 110 (30.6 %) and 159 (44.2%) of the households of Bahir Dar city clarified that ecosystem affected by urban sprawl because those respondents where agree and strongly agree respectively .But 36 (10 %) and 55(15.3%) of respondents where disagree and strongly disagree about the impacts of urban sprawl on the ecosystem respectively. The remaining respondents were not clarifying their ideas regarding the impacts of urban sprawl on the ecosystem. Urban ecosystem, any environmental system positioned within a city or other densely settled area or, in a broader sense, the greater ecological scheme that makes up a whole metropolitan area. A lot of natural calamities and phenomena have taken place, e.g.: untimely floods, global warming, habitat loss, etc. caused by urban sprawl and one of the biggest threats that it poses i.e. the loss of ecosystems. As human populations increase in cities and towns, the effect of urban sprawl becomes large. Because

those people practice deforestation .This makes it difficult to maintain carbon dioxide concentrations and the greenhouse effect occurs, increasing world temperatures and altering weather patterns. It's not just the extinction of animals but the pattern of migration of birds has also changed due to the urban sprawl.. The citizens of Bahir Dar city believe that the quality and provision of ecosystem services have declined in the recent past and strongly correlate the deteriorating ecosystem services with urban sprawl. Evidence recommends that urban sprawl has noticeable effects on ecosystem facilities, such as water quality, microclimate, green spaces, and biodiversity. The survey results suggested that citizens of Bahir Dar strongly believe that air and water quality and green spaces have reduced in the recent past, which corresponds to the assumption that decreasing vegetation cover has obvious effects on the quality and provision of ecosystem services. Similarly, urban infrastructure can impact the urban microclimate by rising air pollution, creating heat stress, altering wind direction and speed, and changing surface ozone concentration. Urban sprawl has been stated to growth the urban temperature, a phenomenon known as the Urban Heat Island Effect. Spatial analysis of Bahir Dar city indicated a rapid expansion of the footprint in the last couple of decades, and the effects of this expansion were reflected in the survey study where the citizens not only showed strong agreement that the urban temperature of Bahir Dar has increased but also agreed that the increasing urban temperature is strongly correlated to the urban sprawl. The negative correlation of the provision and quality of ecosystem services with unplanned and sporadic urban expansion has been widely reported which is similar with this study finding .For instance in areas where sprawl is not controlled, the concentration of human presence in residential and industrial settings may lead to an alteration of ecosystems patterns and processes *(Grimm et al. 2000).*

According to the information that was given by the interviewees due to urban sprawl the land coverage and usage where converted ,means that the previously bare land that was used for different purposes like for agricultural purpose where converted in to built-up areas .Again urban sprawl affects the agricultural production, because urban sprawl creates the loss of land which was used for agriculture where converted in to built-up areas, due to this the peoples cannot produce more product if the land amount becomes lower. The ecosystems were highly disturbed due to urban sprawl, because due to the existence of rapid urban sprawl in the study area, the weather, climate, and water amount where disturbed, means cannot get quality environments. Moreover urban sprawl highly affects the infrastructure usage of the city, because due to the rapid expansion of urban areas, the peoples cannot get enough electricity, water, and other infrastructures properly. This is because sprawl were done rapidly without any interruption ,but the supply of infrastructure where limited in amount ,so this create unbalanced between the people who lives in the city and the supply of infrastructure

To minimize the difficulties that were created by urban sprawl: The city municipalities shall take the following measurements those are; Prepare clear policies and strategies regarding about urban sprawl, strong stand of the government over development of urban areas ,create linkage the development of urban areas with other surrounding woreda areas, increase the awareness of peoples by giving further information about the importance of planned development of urban areas, and give quality training for employees who are working the urban areas related works.

Due to urban sprawl the land use /land cover of the Bahir Dar city were converted or changed from time to time ,for example most of the Gonder outlet and Adept/Marawi outlet previously agricultural area ,but now it is become suburban area due to urban sprawl .This has its own impact on agricultural products ,because urban sprawl leads the loss of land this results the

decrease of agricultural production. Again due to the existence of urban sprawl the land was sold without considering the legal procedure, because the communities have no that much information about land lease polices, and also the enforcements of the government were weak.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

GIS and remote sensing techniques were used to examine and determine changes that took place in the study area from 1991 to 2021. Results of the study showed considerable change in the land covers in which settlement or built-up had an average yearly increment over the 30 years (from 1991 to 2021). Water, for instance, increased in 2001 and 2011 than 1991 but decreased in 2021. Built up showed a constant increase from 1991 to 2021. Agricultural land was constantly decreased from 2001 up to 2021 .Vegetation was decreased in 2001 than 1991, but somewhat increased with 2011 than 2001, and in 2021 there was a larger increment of vegetation cover than other years. Geographical related issues, management related issues, economical related issues, household related issues, demographic related issues were identified as the major factor behind the increase in settlement and built-up, or the major causes of urban sprawl . Due to urban sprawl different problems where occurred in the study area like lack of supplying enough amount of infrastructure, environmental issues where disturbed, means the surrounding ecosystem where disturbed, agricultural production where reduced, and the land value becomes very high .This, undoubtedly, support the notion that human activities or anthropogenic activities greatly affect the earth's surface.

5.2 RECOMMENDATION

There were not that much study in relative to the impacts of urban sprawl on land use and land cover changes in Bahir Dar City .The main objectives of the study were to analyze the causes of urban sprawl and to assess the impacts of urban sprawl on land use /land cover changes in Bahir Dar City.

Based on the results of the study, to decrease the difficulties related with the causes of urban sprawl as well as the impacts of urban sprawl on land use /land cover changes in the Bahir Dar city, the researcher recommends the following points;

- ✔ The stakeholders like the municipalities should plan to combat urban sprawl by developing in a way that does not endanger the land or community via preparing smart growth.
- ✔ Planners and architects who promote smart growth seek to develop a stronger sense of place through a more compact way of development, also known as mixed-use.
- ✔ Mixed-use development combines residential areas with places of employment and commerce instead of isolating individual areas, allowing for more pedestrians and public transit as opposed to traffic and pollution.
- ✔ Communities can also consider implementing smart growth audits, which provide an assessment of the region and community to evaluate how well existing policies meet the principles of smart growth.
- ✔ The municipalities /stakeholders should integrate environmental objectives into urban and spatial planning policies by enlightening partnership, organization and assistance between all levels of the significant authorities.
- ✔ The municipalities should practice the revitalization of existing urban centers and towns to preserve the existing natural environment, thereby reducing urban sprawl.

- ✔ Preparing local planning policies ,financial incentives ,building permit limits ,and assure affordable houses in central part of the city
- ✔ Developers were encouraged to use space more efficiently, and rather than leaving abandoned buildings to decay, these buildings are often cleaned up and turned, once again, into housing, office, or commercial spaces.
- ✔ Protect farmers and green land, because without farmland there would be no food, and without Greenfield, our landscape would be a never-ending chain of strip malls, big box stores, and subdivisions connected by pavement.
- ✔ By forming a coalition, their concerns about land-use practices are better represented and create a stronger impact on local governments
- ✔ Land-use decisions are best made when looking at the entire region, rather than just a small portion of it. Development not only affects the small area, but those to the north, south, east, and west of the surrounding areas.
- ✔ Communities may be created within political boundaries, but ecosystems, rivers, wildlife habitats, and the air you breathe don't follow these boundaries, so by including other communities in planning development, more responsible and efficient growth can result.
- ✔ The municipalities should develop new ways of thinking about growth and development, such as new urbanism and smart growth. New urbanism seeks to redesign towns so that they have a central downtown area, walk able neighborhoods, and public meeting spaces, while smart growth addresses these issues by redirecting public spending away from projects and programs that promote sprawl and toward those that revitalize cities and towns.
- ✔ The city administers shall be integrates the urban land use types with the other plans
- ✔ Our communities will grow, and change is unstoppable. But we can either let development

proceed randomly, or we can plan for development and move toward communities that are efficient, environment-friendly, and pleasant to live in or visit.

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Appendix

ADDIS ABABA UNIVERSITY

Department of Geography and Environmental Studies

Dear Respondents

Dear respondent :I am Fentahun Abebe , from MA graduating class student from Addis Ababa University to conducting research study on *" Urban sprawl and its implication on land use /land cover dynamics' in Bahir dar city "* for the purpose of partial fulfillment of Master degree (MA) in Geography and Environmental Studies Specialization in Geographic Information System ,Remote Sensing and Digital Cartography . So, you are kindly requested to give accurate and relevant information which is the most valuable input for the success of my study. Please be aware that there is no any political, economic, social or psychological harm on you due to responding to these questions, therefore the researcher hopes that you will answer all questions confidently and frankly.

Thank you in advance

Read each statement carefully and respond by giving the answer that most accurately you are feeling. If you have questions, do not hesitate to call …. 0931434337

B.N:- Don't write your name

Part I Part one demographic characteristic of respondents

1 .Personal information

A. Age; 18-26 ☐ 26-35 ☐ 36-45 ☐ 46-65 ☐ > 65 ☐

B. Gender; Male ☐ Female ☐

C. Educational Level

Primary education (1-8) ☐ Secondary Preparatory (9-12) ☐ TVET /Diploma ☐

First Degree ☐ Masters /PhD ☐

Part II. Cause of Urban Sprawl in Bahir Dar

2.1 Questionnaires related to the causes of urban sprawl in Bahir Dar city. There are so many causes for urban sprawl, but according to many scholars the following listed points are the main causes of urban sprawl. On the following causes of urban sprawl write down the √ sign on your agreement, or disagreement level below the numbers.

1. Strongly disagree 2.Disagree 3.Neutral 4.Agree 5.Strongly Agree

Causes of urban Sprawl	**1**	**2**	**3**	**4**	**5**
● Demographic factors Rapid population growth is the cause of urban sprawl					
Rural to Urban migration is the causes of urban sprawl					
Investment is the cause of urban sprawl					
Informal settlement is the cause of urban sprawl					
● Management related causes The absence of quality of urban planning is the main causes of urban sprawl					
Weak Regulation procedures is the causes of urban sprawl					
Poor Government developmental Policies is the causes of urban sprawl					
Lack of proper planning policies is the causes of urban sprawl					
Failure to enforce planning Policies is the causes of urban sprawl					
● Economic causes Industrialization means the development of industry is the cause of urban sprawl.					
Land hunger attitudes means that want of many land is the causes of urban sprawl					
Lack of affordable houses in the urban area is the causes of urban sprawl					
● Geographic related causes The existence of availability of agricultural areas in sub urban areas than the center is the cause of urban sprawl.					
Availability of transportation infrastructures is the cause of urban sprawl					
● Household related causes Demand of more living space is the causes of urban sprawl					
Tendency for having a second house is the means of urban sprawl					
Need of quality environment is the causes of urban Sprawl					

2.2 In addition to the above, the following questions were related to the causes of urban sprawl, so please answer carefully?

2.2.1, Do you believe urban sprawl takes place in Bahir Dar city ?

A yes B no

If your answer is yes, can you list the causes of urban sprawl of Bahir Dar city ?

……

……

2.2.2, Why the peoples were built their shelter in outside part of the city, by ignoring the central part of the city?

Can you justify the reason?

……

……

2.2.3. Do you believe the communities have a good understanding about the impacts of urban sprawl, unplanned or uncontrolled growth urban areas?

A yes B no

If your answer is no please justified why the communities did not have knowledge about the impacts of urban sprawl?

……

……

Part .III .Examining the land use / land cover changes in Bahir Dar in 1991-2021, and assessing the impacts of urban sprawl on land use /land cover changes in Bahir Dar town.

3.1. To examine the land use /land cover changes in Bahir Dar from 1991-2021 and also to assess the impacts of urban sprawl on the land use /land cover changes from 1991-2021 ,the

researcher where used the satellite images ,means that by downloading the satellite images of different years (1991_2021) then classifying the satellite images then examining and assessing the land use /land cover changes and the impacts of urban sprawl on land use/land cover changes were take placed by a researcher ,so here the involvements of residences/employees is not necessary so please jump it.

Part IV. Assesses the impacts of urban sprawl

4.1 Urban sprawl has so many impacts on the residences as well as on the land use /land cover changes ,here the researcher will assess the impacts of urban sprawl on different aspects in addition to the impacts of land use /land cover changes ,so please give your response on the following impacts of urban sprawl in Bahir Dar city , So write down the √ sign below the numbers which are existed on the table.

1. Strongly disagree 2.Disagree 3.Neutral 4.Agree 5.Strongly Agree

Impact of urban sprawl	**1**	**2**	**3**	**4**	**5**
Urban sprawl is the means for the decrease of agricultural production					
Due to urban Sprawl there is a lack of infrastructures like electricity, water, and others.					
Urban sprawl reduces the residence of income					
Urban sprawl distorts the life styles of residences					
Urban sprawl increases the land values					
Urban sprawl affects the ecosystem					

3.2, do you believe that due to urban sprawl the land use/land cover changes were converted?

A. Yes B. No

If your answer were yes, can you explain from where land use /land cover were converted?

.....

3.3. Do you think the land value is practiced based on legal procedures?

A. Yes, B. No

If your answer is No, why can you write the reason?

.....

3.4. Do you believe agricultural production is affected by urban sprawl? A. yes B. no

3.5. Can you list the impacts of urban sprawl?

……

Interview for employers

1. Do you think urban sprawl takes place in Bahir Dar city?

2. What is the manifestation of urban sprawl in Bahir Dar city?

3. Can you list the causes of urban sprawl in Bahir Dar city?

4. How do you explained the land use /land cover changes of Bahir Dar city

5. What are the effects of urban sprawl in the residences of Bahir Dar city?

6. What solution do you recommend to reduce the problem of urban Sprawl?

4.5.1 Accuracy Assessments

Accuracy assessment is an important part of classification .For accuracy assessment, the study where used based on the selected data points on the classified image, and then the spatial locations of these points were identified with the high resolution Google earth pro. Totally about 331 filed data points were selected. The ground sample points are overlapped on each of the maps to determine the classification accuracies. To check the accuracy of classification the study where selected 84 points from the classified images then cross checked with high resolution Google earth pro image so the accuracy assessment 1991 classified images where used totally 84 points taken randomly that represent the classified land classes. Then the study where used the accuracy assessment formula

The formula is like the following

User accuracy is equal to the sum of the number of corrected classified pixels in each category divided by the total number of classified pixels in that category (the total of the rows) x 100.

Producer accuracy is equal to the sum of the total number of corrected classified pixels in each category and the total number of reference categories (the total in the columns) times 100.

Over all accuracy = Overall number of properly categorized pixel (Diagonal) / Total number of Referenced pixels)*100

Kappa Coefficient = (TS*TCS) –∑ (column total* Row total)/TS2-∑ (column total-row total)*100

Where TS is total sample, but TCS is the sum total of corrected samples

Table 4.10 Accuracy Assessment of 1991

	Built up	Water	Agricultural	Vegetation	Total (user)
Built up	15	0	1	1	17
Water	0	16	2	0	18
Agricultural	2	0	15	0	17
Vegetation	1	0	1	30	32
Total(producer)	17	17	20	30	84

Source; organized by the Author: August, 2022

Over all accuracy = Total number of properly categorized pixel (Diagonal) / Total number of referenced pixels)*100

$$\frac{15+16+15+30}{84}*100$$

$$=\frac{76}{84}*100$$

$$= 90.47\ \%$$

User Accuracy =Amount of corrected categorized pixel in each category/ total number of categorized pixel in that group (the row total)* 100

Built up = 15/17*100 =88.23%

Agricultural land =15/17*100=88.23%

Water =16/18*100=88.88%

Vegetation =30/32*100 =93.75 %

Producer Accuracy = total amount of corrected categorized pixel in each category/Total amount of Reference category (the column total) *100

Built up= 15/17*100 =88.23%

Water =16/17*100 =94.11%

Agricultural land =15/20*100 =75% Vegetation =3/30*100 = 100%

Kappa Coefficient = (TS*TCS) –∑ (column total* Row total)/TS^2-∑ (column total-row total)*100

Kappa coefficient = 84*76 -∑ ((17*17)+ (17*18) +(20*17) + (30*32)) /7056-((17*17)+(17*18)+(20*17)+(30*32)*100 then =86.97%

Accuracy assessment in 2001; to check the accuracy of land use land cover classification the researcher where used totally 87 Google earth points which were taken randomly that represent the classified land classes. Then the researcher where used the accuracy assessment formula

The formula is like the following

User accuracy =Amount of corrected categorized pixel in each category/ total amount of categorized pixel in that category (the row total)* 100

Producer accuracy = total number of properly classified pixel in each category / Total amount of Reference category (the column total) *100

Over all accuracy = Total amount of correctly categorized pixel (Diagonal) / Total amount of referenced pixels)*100

Kappa Coefficient = (TS*TCS) –∑ (column total* Row total)/TS^2-∑(column total-row total)*100

Table 4.11 Accuracy Assessment of 2001

	Water	Built up	Agricultural land	Vegetation	Total(user)
Water	15	0	0	1	16
Built up	0	17	0	3	20
Agriculture	1	0	30	2	33
Vegetation	0	0	2	16	18
Total(producer)	16	17	32	22	87

Source; organized by the Author: August, 2022

Over all accuracy = Total number of correctly classified pixel (Diagonal) / Total number of Referenced pixels)*100

$$\frac{15+17+30+16}{87}\mathbf{*100}$$

$$= \frac{78}{87}*100$$

=89.65%

User Accuracy =Amount of corrected categorized pixel in each category/ total number of classified pixel in that category (the row total)* 100

Water body = 15/16*100 =93.75% Built up =17/20*100= 85%

Agricultural land =30/33*100=90.90% Vegetation =16/18 *100 =88.88%

Producer accuracy = total number of corrected categorized pixel in each category/Total amount of Reference category (the column total) *100

Water =15/16 *100 = 93.75% Agricultural land = 30/32*100 = 93.75%

Built up = 17/17 *100 = 100% Vegetation =16/22 *100 =72.72%

Kappa Coefficient = (TS*TCS) – ∑ (column total* Row total)/TS^2-∑ (column total-row total)*100

Kappa coefficient = (87*78) - ∑((16*16)+(20*17)+(32*33)+(22*18))/7569-∑((19*20)+(6*10)+(16*18)+(39*32)

= 6786-(2048) /7569-(2048)*100

=4738/5521*100

85.81%

Accuracy Assessment in 2011: Again here the researcher where used total of 80 points which are taken randomly that represent the classified land classes, then the researcher where used the accuracy assessment formula

The formula is like the following

User accuracy =Amount of corrected categorized pixel in each category / total amount of classified pixel in that group (the row total)* 100

Producer accuracy = total number of corrected categorized pixel in each category /Total number of Reference class (the column total) *100

Over all accuracy = Total amount of correctly classified pixel (Diagonal) / Total amount of Referenced pixels)*100

Kappa Coefficient = (TS*TCS) –∑ (column total* Row total)/TS2-∑(column total-row total)*100

Table 4.12 Accuracy Assessment of 2011

	Water	Built up	Agriculture	Vegetation	Total(user)
Water	36	0	1	1	38
Built up	0	13	1	2	16
Agriculture	0	1	11	1	13
Vegetation	2	0	3	12	14
Total (producer)	36	14	16	15	80

Source; organized by the Author: August, 2022

Over all accuracy = Total amount of correctly categorized pixel (Diagonal) / Total amount of Referenced pixels)*100

$$\frac{36+13+11+12}{80}*100$$

$$\frac{72}{81}*100$$

= 88.88%

User Accuracy =Amount of corrected categorized pixel in each class / total number of categorized pixel in that group (the row total)* 100

Water body = 36/38*100 =94.73%

Agricultural =11/13*100=84.61%

Built up =13/16*100= 81.25%

Vegetation =12/14 *100 =85.71%

Producer accuracy = total number of corrected categorized pixel in each group /Total amount of Reference group (the column total) *100

Water =36/36 *100 = 100%

Agricultural land = 11/16*100 = 68.75%

Built up = 13/14 *100 = 92.85%

Vegetation =12/15*100 =80%

Kappa Coefficient = (TS*TCS) –∑ (column total* Row total)/TS^2-∑ (column total-row total)*100

= (81*72)-∑((36*38)+(14*16)+(16*13)+(15*14)) /((6561)-∑((36*38)+(14*16)+(16*13)+(15*14))*100

5832-(2010) /6561-(2010))*100

= 3822/4551*100

= 84.20%

Accuracy Assessment in 2021 : the researcher where check the classified images 2021 by taking 81 points randomly from classified images then tried cross cheeked with the points of high resolution Google earth images pro ,then to check the amount the researcher were used the accuracy assessment formula. The formula is like the following

User accuracy = the total number of classified pixels in each category divided by the number of corrected pixels (the row total)* 100

Producer accuracy = total number of corrected classified pixels in each category divided by the total number of references in each category (the total in the columns)*100

Overall accuracy = Number of correctly classified pixels (Diagonal) divided by number of referenced pixels)*100

Kappa Coefficient = (TS*TCS) –∑ (column total* Row total)/TS2-∑ (column total-row total)*100

Table 4.13 Accuracy Assessment of 2021

	Water	Built up	Agricultural	Vegetation	Total(user)
Water	13	0	0	1	14
Built up	0	29	2	1	32
Agricultural	0	0	27	0	27
Vegetation	0	0	0	8	8
Total(producer)	13	29	29	10	81

Source; organized by the Author: August, 2022

Overall accuracy = Total number of correctly categorized pixel (Diagonal)/ Total number of Referenced pixels)*100

$$\frac{13 + 29 + 27 + 8}{81} * 100$$

$\frac{77}{81}$*100

=95.06%

User Accuracy =Amount of corrected categorized pixel in each category/ total amount of classified pixel in that group (the row total)* 100

Water = 13/14*100 =92.85%

Agricultural = 27/27*100= 100%

Built up =29/32*100= 90.62%

Vegetation =8/8 *100 = 100%

Producer accuracy = total amount of corrected categorized pixel in each class/Total number of Reference group (the column total) *100

Water =13/13 *100 = 100%

Agricultural land = 27/29*100 = 93.10%

Vegetation=8/10*100 = 80%

Built up = 29/29 *100 = 100%

Kappa Coefficient = (TS*TCS) –∑ (column total* Row total)/TS^2-∑(column total-row total)*100

= (81*77)-∑((13*14)+(29*32)+(29*27)+(10*8)/6400-∑((13*14)+(29*32)+(29*27)+(10*8)*100

= 6237 – (1973) / 6561-(1973)*100

= 4264/4588*100

= 92.93%