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URBAN EXPANSION AND ITS IMPLICATIONS ON LAND USE/LAND COVER DYNAMICS AROUND BURAYU TOWN, CENTRAL ETHIOPIA

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URBAN EXPANSION AND ITS IMPLICATIONS ON LAND USE/LAND COVER DYNAMICS AROUND BURAYU TOWN, CENTRAL ETHIOPIA

A Thesis Submitted to the Department of Geography and Environmental Studies in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Geography and Environmental Studies (Specialization in Urban and Regional Development Planning)

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This is to certify that the thesis prepared by **Ageri Gerbi**, entitled: ***Urban Expansion and its Implications on Land Use/Land Cover Dynamics around Burayu Town, Central Ethiopia*** and submitted in partial fulfillment of the requirements for the degree of Master of Arts in Geography and Environmental Studies (Specialization in Urban and Regional Development Planning) complies with the regulations of the university and meets the accepted standards with respect to the originality and quality.

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This is to certify that the work is entirely my own and not of any other person, unless explicitly acknowledged (including citation of published and unpublished sources). The work has not previously been submitted in any form to any University or other institution for assessment of any other purpose.

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ABSTRACT

Urban green areas play a great role in determining urban development strategies. Urban green provide multiple ecosystem services for human beings. Though urban green provide numerous benefits, but become deteriorated in many parts of Ethiopian towns. Therefore, this study aimed at analyzing the urban expansion and its implications of land use/land cover dynamics for green areas using geospatial techniques in Burayu Town. The study employed mixed approached to achieve the stated objectives. Three different remotely sensed data of Landsat7 ETM+ (2000 and 2010) as well as Landsat8 OLI/TIRS (2020) were used in the study. The study revealed that there was a radical change in Land Use/Land Cover (LU/LC) dynamics. The rapid expansion of the built-up areas and deterioration of vegetation covers are the two most implication of LU/LC dynamic in Burayu Town. Vegetation cover has decreased and the non-vegetated area has been increasing gradually over the study period. With the change in LU/LC for the periods 2000 to 2020, the built-up area was expanded by an area of 672.5ha. The average value of the Normalized Difference Vegetation Index (NDVI) of the year 2000 was reduced by fifty percent by the year 2020. Relatively, a high value of NDVI in 2020 is observed in the northeast and southwestern parts particularly in Gefersa Burayu and the rest parts of the study areas have low values of NDVI. Town administrators should control the rapid urban expansions and pay great attention for developing spaces for green vegetation.

*Keywords***:** *Land Use/Land Covers; Urban Green Areas; Normalized Difference Vegetation Index*

ACRONYMSAND ABBREVIATIONS

CEUP:	Center of Expertise for Urban Programming
CSA:	Central Statistical Agency
EPA:	Environmental Protection Agency
ERDAS:	Earth Resources Data Analysis System
FCC:	False Color Composition
GIS:	Geographic Information System
LUTM	Land Use Transfer Matrix
MEF:	Ministry of Environment and Forest
MoUDH:	Ministry of Urban Development and Construction
MSS:	Multi Spectral Scanner
NDBI:	Normalized Difference Built up Index
NDVI:	Normalized Difference Vegetation Index
OLI:	Operational Land Imagery
TIR:	Thermal Infrared
TIRS:	Thermal Infra-Red Sensor
TM:	Thematic Mapper
USGS:	United State Geological Survey

CHAPTER ONE

1. INTRODUCTION

1.1.Background of the Study

Urbanization outcome results in an increasing proportion of the population living in cities. Urban living limits access to the environment and can raise exposure to certain environmental hazards, such as air and noise pollution. Many urban areas face increasing stress from expanding populations, limited resources, and growing impacts of global climate change. These challenges must be addressed in order for cities to provide well and sustainable living environments (McMichael, 2000).

Green spaces and other nature-based solutions recommend innovative approaches to increase the quality of urban settings enhance local resilience and promote sustainable lifestyles, improving both the health and thus the well-being of urban residents. Parks, playgrounds, or vegetation publicly and personal places are a central component of those approaches (Kabisch et al., 2017). Urban green space can be understood as an integrated area comprising natural, semi-natural, or artificial green land, providing manifold benefits to different groups of people within the city extent (Zhou and Rana, 2012). It can also be defined as outdoor places with significant amounts of vegetation, and exist mainly as semi-natural areas (Jim et al., 2008). Urban green space is defined as “an open space situated within the town limits with an honest vegetation cover planted deliberately or inherited from pre-urbanization vegetation and left intentionally or by default” (Delano, 2015). Urban green space includes urban forest as well as other green areas, for example, public parks, sports fields, edges of roads, public or private gardens, and remnant patches of natural vegetation also as individual street trees (Davies et al., 2008). Urban green areas include open spaces and environmentally sensitive areas (parks, urban agriculture, recreation, mineral resources). Changes in land use, particularly the replacement of green space by buildings, roads, and parking lots cause urban green areas to become damaged (EPA, 2017).

Cities cover 2% of land space worldwide but consume 75% of the resources (Satterthwaite, 2008). The lack of well-known and zoned green space is a factor of urban sprawl as people move to the edge of a city to be closer to the rural setting that feels like a healthier environment (Fuwape and Onyekwelu, 2011). To meet the socio-economic, environmental, psychological needs of urban dwellers, there should develop some criteria based on the attitudes of the perceived users to shape adequate uses of land and provide facilities within urban green spaces in cities (Balram and Dragicevic, 2005).

About 60 percent of Africa`s urban population lives in low-quality living conditions, inadequate access to water and sanitation, and crowded living conditions with low capital and degraded environmental conditions (Gulyani et al., 2018). Urbanization in sub-Sahara countries is changing the land use due to infrastructure development and land-use change has a direct impact on the urban environmental condition, ecosystem, and energy balance (Wuy and Shen, 2011). Appropriate measurements, monitoring, planning, management, and integrative approach are very essential for cities in developing countries, and most importantly in the developing regions (Wang, 2009).

As one of the basic elements of the urban environment, urban green space is the only type of land use with natural or semi-natural conditions inside a city/town; and plays a significant role in the protection of the ecological environment of cities (Ngom*et al*., 2016). Vegetation is a vital element of the global environment. It modifies the ecosystem through water preservation, terrestrial soil constancy, and atmospheric circulation. It also helps to sustain a balance of ecosystems prominently. Urban greenery also acts as a natural agent against air pollution in the urban environment (Buyadi*et al.,* 2015). Trees and green spaces contribute considerably to the improvement of the urban climate and to the UHI (Urban Heat Island) mitigation. Urban parks provide thermal comfort and a high mitigation potential (Cohen et al., 2013). Because of transpiration, greenery plays a significant role in alleviating UHIs (Urban Heat Islands) by dropping temperature and increasing humidity. Their cooling effects are especially important and they have been regarded as natural resources for city planning (Sandra et al., 2011).

Urban green space management practice is characterized by a unique set of governing criteria and sub-criteria that could be grouped under Ecological, Economic, Social, and Planning (Haq, 2011). Understanding the relationship between the urban population and the number of green spaces is particularly important for the evaluation of their functionality (Sandstrom et al., 2006). The evaluation of recreational green spaces has to be centered on a variety of available quality and with a proper standard, to accommodate future changes. Public participation in the planning and design is important to incorporate their values and pattern of life throughout the development (Haq, 2011).

Ethiopia is among developing countries characterized by high migration from rural areas to urban areas for searching employment, urban infrastructures, better living conditions and expansion of industries, rapid population growth, and environmental degradation (UNDP, 2016). Environmental Policy of Ethiopia (EPE) has documented the importance of planning for the green spaces for urban areas of the country; that gives room for various stakeholders to develop and manage urban forests, street trees, etc.as elements of urban green areas. The urban planning, preparation, and implementation strategy allocated 30% of the land for roads and infrastructure, 30% for green areas and shared public use, and 40% for building construction in their urban land management plan (MoUDH, 2015).

The spatial characteristics of urban areas are the leading important elements of urban green areas analysis. There are many reasons to research urban green areas in urban development in both developed and developing countries. The foremost important reason is to know long-term interactions between humans and nature (Bi et al., 2011). The natural environment is struggling from the human impacts involved in urban development processes. Urban development decisions have a substantial impact in shaping current urban green areas in cities (Aronson et al., 2017). There's no got to prove that land use/land cover is one of the important elements for analyzing urban green areas in urban development plans.

GIS and remote sensing tools are now providing new tools for advanced environmental management. Satellite data facilitate synoptic dissection of the world system, patterning and changes from local to global scales over time. This study will compare the spatial distribution of green spaces and non-green areas to research the main determinants of green areas controlling under land use/land cover dynamics in Burayu Town, Oromiya Special Zone. Therefore, an effort was made during this study to research the extent of greenness by taking the Normalized Difference Vegetation Index (NDVI) and Normalize Difference Built-up Index (NDBI) into consideration.

1.2.Statement of the Problem

Most cities in the world are experiencing environmental challenges such as poor air quality, water pollution, street noises, and heat island effects, which undermine the urban development process and environmental sustainability. In addition to these environmental problems, urban residents also complain against intensive work stress and less social communication among them both at the individual and community level (Chen and Jim, 2008).

Unplanned urban development, demographic and environmental changes have forced many cities into more uncertainty and risk, challenging economic, social, and environmental sustainability. As a result of the expansion of urban sprawl and the decreasing of urban green spaces cause tremendous pressure on urban daily life and the ecological environment (UNDESA, 2015).

The process of urbanization, with an ever-growing population in the city, consumes a large amount of green spaces at the periphery of the city and also changes the internal green space pattern. Ethiopia is being challenged with overpopulation, environmental degradation, food insecurity, and unemployment in urban areas (UNDP, 2016). The establishment of urban green areas across the urban centers has not been uniform and there is a great deal of variation among the urban centers. Some of them have established some of the components of the green areas. Furthermore, the establishment and management of green areas across the urban centers in the country have not been standardized and the urban-dwelling communities in the country have not been receiving the goods and services that well-planned and well-developed green areas are supposed to provide (MoUDH, 2015).

More than half of the residences in Burayu Town were informal (Bekele*et al*., 2014). The growth rate of built-up lands exceeds significantly that of population, which demonstrates a massive urban land growth and inefficient use of land resources in Burayu Town. Due to the uncontrolled urban expansion, spatial planning designs could not guarantee the adverse impacts of sprawling growth patterns on green spaces. Burayu Town is facing problems of rapid expansion of built-up and the Town is facing diminishing of green areas. The rapid expansion of the built-up area in recent decades and population growth has caused the significant transformation of land use/land cover to another form in the Town. All of these differences translate into differences in the role of green spaces and the respective management approaches. Clearly, such problems at the level of the Town deserve attention (O'Sullivan, 2020).

Although many studies have been conducted on the development and management of urban green areas in some cities of the country, for instance; (Bizuayehu, 2018; Gebrye and Tebarek, 2019) their main emphasis was on the challenges and opportunities for the development and focusing on the spatial distribution of green spaces with respective of its magnitude under land use/land cover dynamics. The methodology applied for these studies was also not as much adequate to clearly analyze the major determinants of green spaces extent under land use/land cover dynamics. The quantitative analysis of the spatial distribution of green spaces under land use/land cover dynamics in the study area is remaining uncertain. Therefore, this study attempts to fill the existing research gap by applying the Land Use Transfer Matrix (LUTM) method and Geospatial techniques to analyze the patterns and change of urban green spaces with respective of built-up through incorporating Normalized Difference Vegetation Index (NDVI) and Normalized Difference Built-up Index (NDBI) in Burayu Town, Ethiopia.

1.3. Objectives

1.3.1. General Objective

The general objective of the study is to assess the Urban Expansion and its Implications on Land Use/Land Cover Dynamics around Burayu Town, Central Ethiopia.

1.3.2. Specific Objectives

- To investigate the land use/land cover dynamics and its implication on urban green areas in Burayu Town;
- To assess the change in green vegetation cover of the last two decades in study area; and
- To analyze the magnitude of urban expansion and its implication on LU/LC change.

1.4. Research Questions

1. What are the major driving factors of land use/land cover dynamics for green areas management in Burayu Town?
2. To what extent the vegetation cover of the study area has changed in the last two decades?
3. What is the magnitude of urban expansion and its implication on LU/LC change?

1.5. Significance of the Study

The urban green area is very important for sustainable urban development and human well-being. It requires adequate development and management system in order to develop properly. Therefore, the study provides scientific knowledge by filling literature gaps for developing an effective green area planning, implementation, and management strategy for the Burayu Town of Ethiopia. The outcome of this study contributes to establishing an understanding of the relationships between the spatial distributions of green spaces and built-up areas in Burayu Town. The study benefit decision-makers who are involved in incorporating a land-use plan into policies, government and non-government organizations, urban planners, policy and decision-makers, and researchers for further activities as well. Moreover, it helps as pertinent literature and input for policymakers in formulating policies and strategies along with the issue. It may also be a source of information for further study in the same or other studies. Furthermore, the study may use as baseline information for further investigation to enrich the research findings in this area.

1.6. Scope of the Study

Geographically, this study takes into consideration the emerging town of Oromia special zone surrounding Addis Ababa. The special zone consists of eight emerging towns namely Sebeta, Gelan, Dukam, Legetafo, Burayu, Holeta, Sululta, and Sendafa. Among the eight towns, Burayu Town was selected purposively for this study. The town was selected for two major reasons. First, the town has the potential for being absorbed by the capital city, thereby housing millions of people and affecting their life quality. Secondly, the town is particularly fast-growing in terms of population, infrastructures, and physical size again because of pressures from the capital. The town has similar characteristics with other emerging towns found in the Oromia special zone surrounding Addis Ababa in terms of problems related to urban green space components planning and management. In the emerging Towns of Oromia special zone surrounding Addis Ababa playground, sports fields, parks, and gardens, and green along river have been identified as the most common components of urban green infrastructure in the structural plan of the Towns. Moreover, according to the data obtained from the field observation, gardens, street trees, and urban forests have been also identified as the most common established components of urban green infrastructure in the emerging towns of Oromia special zone surrounding Addis Ababa. Therefore, since the objective of this study is to analyze urban expansion and implications of land use/land cover dynamics for green areas for the purpose of this study the components identified both on the structural plan of the towns and from the field survey were used. Thematically, quantifying and analyzing the spatial distribution of green spaces under urban land use/land cover dynamics were another scope of the study. Urban green space in the context of this study is areas covered with the soft landscape elements such as grass, shrub, bush, and tree established outside urban plans, proposed in urban plans, and established as a result of the implementation of urban plans which includes a mix of street trees, parks, playground, green corridors, and sports field. The time horizon of the study is from January 2000 to Sept. of the 2021 academic year.

1.7. Limitation of the Study

As it is common in many studies, there are some constraints for the study concerning the availability of proper data. I exhaustively did for getting the real data that show the urban green space. The researcher tried to get high-resolution satellite images both from internal agencies such as the Geospatial Agency but that had ended unsuccessfully for both unavailability (in the case of internal sources) and affordability (external sources) of data that cover the spatial and temporal extent of the study area. For these reasons, the researcher is forced to look into using Google Earth by which can minimize the limitation of the data on a spatial resolution by consulting my supervisor. Covid 19 was another constraint to collect primary data from the respondents.

1.8. Organization of the Thesis

The thesis was organized into five chapters. The first chapter is about the introduction of the paper dealing with background, objectives, statement of the problem, research questions, scope, significance, and limitation of the study as well as the organization of the paper. Chapter two is devoted to the literature review. The third chapter is about the methods and materials. It deals with the description of the study area, data sources, software used, image preprocessing, and classification. Chapter four is all about results and discussions. The last chapter focuses on the conclusion and recommendations based on the findings of the study.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Concepts and Definitions

The term “green spaces” can be drawn from the urban landscape conservation movement and the European thinking about green space preparation which started in the UK (De Sousa, 2003). Green space figuratively covers all municipal and private open spaces in urban areas, mostly covered by natural or artificial plants including trees, bushes, and grasses that are directly or indirectly available for use. Green spaces contain any vegetated land or arrangement, water, or geological features situated in a given geographical location. It can also be defined as the cover of all green structures that exist either naturally or artificially (Di Gregorio, 2005).

2.1.1. Urban Green Space

Urban Green Spaces (UGS) is an integral part of any urban area and their importance is very well known for maintaining environmental quality, sustainability. It constitutes parks, gardens and recreation venues, informal Urban Green Spaces (UGS) such as rivers or seafronts, green spaces surrounding historical sites, railway corridors, and indigenous vegetation types (Gupta et al., 2012).

Urban Green Spaces (UGS) has been shown two method cool islands and improve thermal comfort throughout warm seasons, as well as significantly reduce environmental tension produced by heat islands. Urban green spaces can also provide critical ecosystem services that could improve residents’ health and wellbeing (Enssle and Kabisch, 2020). It can cool climates through two major processes: shading and by providing higher evapotranspiration (Akbari, 2002).

Urban green space can be defined as formal and informal. Formal green areas include protected public parks, street gardens, playgrounds, sports fields, squares, private gardens, and vegetation cover in schools, hospitals, churches, mosques, embassies, cemeteries, parking lots, pedestrian lanes, etc (Mohammed, 2020). On the other hand, informal green areas include forest areas, river valleys, reserved expansion areas, agricultural lands, open leftover spaces, grazing lands, steeper degraded areas, shrub lands, etc. “Urban green spaces are urban areas which are covered in natural or semi-natural ecosystems converted to urban spaces by human influence” (Bilgili and Gokyer, 2012). Urban greening is almost a new term, which means making or keeping cities greener by designing, establishing, maintaining, and managing green areas (Ong, 2003). This concept emphasizes looking at greenery not as luxury goods for making cities more pleasant, but as the basic part of urban infrastructure. It contributes notably to quality of life and ecosystem services in cities (Meurk et al., 2013).

Urban green space is divided into eight types inspired by the classifications of green spaces by Panduro and Veie, (2013).

i. **Parks:** Greenspace categorized as a park has a high maintenance level with well-kept vegetation and a wide range of recreational possibilities. Footpaths open the green area to the public and make it possible to walk in the area and enjoy different features such as small lakes, trees, lawns, flowers, and sports activities.

ii. **Lakes:** Some green space in cities is characterized primarily by the presence of water bodies such as lakes. In cases where a lake is the dominant feature of the green space, this is treated as a distinct type of space as the access and maintenance features differ from that of a park or a natural area, suggesting that the services provided differ as well.

iii. **Nature:** On the edge of the city, large areas of green space can be found which often contain open fields of grass and tree cover. Most often these areas contain small gravel roads and nature paths, which enable people to move through the landscape. The area is less well kept than an urban park. Fields and pastures often border the natural area.

iv. **Churchyards:** These are often open to the public during the daytime and have a high level of maintenance with flowers and hedges. While footpaths provide internal accessibility, there is little space for other activities than walking, and more lively social activities are rarely socially acceptable.

v. **Sports fields:** Schools and institutions often have access to green space, which facilitates sports activities and playgrounds for the pupils. These areas often form a square and are outlined by trees. Sports facilities connected to sports clubs often have similar characteristics, e.g. similar size. In some cases, these facilities are fenced limiting access.

vi. **Common areas:** Communities of houses often have shared “common green space” which is maintained by the property owner association. Well-kept lawns and small playgrounds often dominate such space. The users are mainly local residents and as such the areas are semi-public in terms of accessibility. Common areas are often relatively small, consisting of patches of green space connected by footpaths. Given the semi-public character of common areas, they are mainly used by residents in the immediate vicinity.

vii. **Agriculture fields:** These areas are usually relatively large and homogeneous in nature. Most often there are no footpaths or roads allowing access into the fields and often meadows are fenced.

viii. **Green buffers:** Green space can be found in connection to infrastructure such as highway, larger roads, and railways. Often covered by trees, the main function of such areas is to reduce the negative impact of noise and air pollution coming from the neighboring infrastructure. Likewise, industrial areas often contain patches of green space. The latter areas often consist of a kept lawn potentially surrounded by trees and do not invite recreational activities (Sen, 2020).

Several studies have shown that planted areas are effective in influencing the city's microclimate and they have been recommended as a passive adaptation strategy to reduce thermal stress. This cooling effect has been described by different terms "Oasis effect" because the direct environment around an isolated moisture source is always cooler than its surroundings in an arid region, due to evaporation cooling. In contrast to urban heat islands also the term "urban cool island" (UCI) has been used in addition, Greenspace cool islands (GCI) and cool island intensity (CII) (Skoulika*et al.*, 2014). Park cooling intensity (PCI) is another term which defines the cooling effect of a specific type of green space (Feyisa*et al*., 2014).

2.2. Benefits of Urban Green Spaces

2.2.1. Environmental Benefits

Urban green spaces have many functions and benefits. These functions and benefits are important to improving life quality in urban areas. Green spaces provide linkage between people (who live in the urban) and nature. The benefits of urban green areas are described below under the main headings (Alm, 2007).

Ecological Benefits: Urban green spaces supply cities with ecosystem services ranging from maintenance of biodiversity to the regulation of urban climate. Comparing with rural areas, differences in solar input, rainfall pattern and temperature are usual in urban areas. Solar radiation, air temperature, wind speed, and relative humidity vary significantly due to the built environment in cities (Mohammad and Zhirayr, 2013). The urban heat island effect is caused by the large areas of heat-absorbing surfaces, in a combination with high energy use in cities. The urban heat island effect can increase urban temperatures by 5^0C. Therefore, an adequate forest plantation, vegetation around urban dweller's houses, management of water bodies by authorities can help to mitigate the situation (Fratini*et al*., 2011).

Pollution Control: Pollution in cities as a form of pollutants includes chemicals, particulate matter, and biological materials, which occur in the form of solid particles, liquid droplets, or gases. Air and noise pollution is a common phenomenon in urban areas. The presence of many motor vehicles in urban areas produces noise and air pollutants such as carbon dioxide and carbon monoxide. Emissions from factories such as sculpture dioxide and nitrogen oxides are very toxic to both human beings and the environment. The most affected by such detrimental contaminants are children, the elderly, and people with respiratory problems (Bayram*et al.*, 2012). Urban greening can reduce air pollutants directly when dust and smoke particles are trapped by vegetation. Research has shown that on average, 85% of air pollution in a park can be filtered (Heidt and Neef, 2008)

Noise pollution from traffic and other sources can be stressful and creates health problems for people in urban areas. The overall costs of noise have been estimated to be in the range of 0.2% - 2% of the European Union gross domestic product. Urban green spaces in overcrowded cities can largely reduce the levels of noise depending on their quantity, quality,and distance from the source of noise pollution. The contemporary studies on urban green spaces consider the complex urban eco-system, conservation of the urban green spaces to maintain the natural ecological network for environmental sustainability in cities. For the cities in fast urbanizing and growing economy, countries like China should consider the dynamic form of urban expanding to manage effective urban green spaces which will contribute to reducing the overall CO2 by maintaining or even increasing the ability of CO2 absorption via natural eco-system (Gao, 2009).

Biodiversity and Nature Conservation: Green spaces do functions as protection center for the reproduction of species and conservation of plants, soil and water quality. Urban green spaces provide the linkage of the urban and rural areas. They provide visual relief, seasonal change, and link with the natural world (Bayram*et al.,* 2012). A functional network of green spaces is important for the maintenance of ecological aspects of the sustainable urban landscape, with greenways and use of plant species adapted to the local condition with a low maintenance cost, self-sufficient and sustainability (Samson, 2014).

2.2.2. Economic and Aesthetic Benefits

Energy Savings: Using vegetation to reduce the energy costs of cooling buildings has been increasingly recognized as a cost-effective reason for increasing green space and tree planting in temperate climate cities (Alm, 2007).Plants improve air circulation, provide shade and evapo-transpire. This provides a cooling effect and helps to lower air temperatures. A park of 1.2 km by 1.0 km can produce an air temperature between the park and the surrounding city that is detectable up to 4 km away. A study in Chicago has shown that increasing tree cover in the city by 10% may reduce the total energy for heating and cooling by 5 to 10%.

Property Value: Areas of the city with enough greenery are aesthetically pleasing and attractive to both residents and investors. Still, indicators are very strong that green spaces and landscaping increase property values and financial returns for land developers, of between 5% and 15% depending on the type of project.

2.2.3. Social and Psychological Benefits

Recreation and Wellbeing: People satisfy most of their recreational needs within the locality where they live. Over 80% of the UK's population live in urban areas, and thus green spaces within urban areas provide a sustainable proportion of the total outdoor lei sure opportunities. A study conducted in Helsinki, Fin- land, indicated that nearly all (97%) city residents participate in some outdoor recreation during the year. Half of the residents make outdoor visits on a daily basis or every second day. Urban green spaces serve as a near resource for relaxation; provide emotional warmth. In Mexico City, the centrally located Chapultepec Park draws up to three million visitors a week who enjoy a wide variety of activities (Nicol and Blake, 2000).

Human Health: For people who were exposed to the natural environment, the level of stress decreased rapidly as compared to people who were exposed to the urban environment, their stress level remained high. In the same review, patients in a hospital whose rooms were facing a park had a 10% faster recovery and needed 50% less strong pain-relieving medication as compared to patients whose rooms were facing a building wall. This is a clear indication that urban green spaces can increase the physical and psychological well-being of urban citizens. In another research conducted in Swedish cities showed that the more time people spend outdoors in urban green spaces, the less they are affected by stress. Certainly, improvements in air quality due to vegetation have a positive impact on physical health with such obvious benefits as a decrease in respiratory illnesses. The connection between people and nature is important for everyday enjoyment (Alm, 2007).

2.2.4. Urban (Built-up Area)

Urban is a fairly complex concept. It is a function of sheer population size, space (land area), the ratio of population to space (density or concentration), and economic and social organization (United Nations Population Division, 2008).It is defined as a characteristic of a place, rather than people; and places are defined as 'urban', and the people living there are thought of as being part of the urban population. Urban is a place-based characteristic that includes elements of population density, social and economic organization, and the alteration of the natural environment into a built environment (Weeks, 2008). They are usually characterized by the presence of administrative structures such as government offices and courts and a relative concentration of services such as hospitals and financial institutions such as banks. In an urban setting, the forms of livelihood and income generation activities were diverse and unlike rural areas not bound mainly to agricultural production (CEUP, 2013).

2.3. Urbanization Effects on Urban Green Space Development

Urbanization remains a major factor that has been predominantly linked to causing green space destructions (Mensah, 2014). Urbanization takes the form of either densification of urban core or spatial expansion of urban areas outwards (urban sprawl). Densification of urban core refers to high population density and an increase in the built environment (building structures) in relation to open spaces (Mensah, 2014). The urban sprawl, on the other hand, relates to the outward expansion of urban areas often taking place in the urban fringe, peri-urban lands, and former agricultural lands. Rapid urbanization has resulted in the conversion of several urban lands into built-up structures and excessive destruction of the natural ecosystem, including green spaces (Honu*et al.,* 2009).

Changes in land use, particularly the replacement of green space by buildings, roads, and parking lots causes urban areas to become warmer than surrounding areas because these impermeable materials absorb heat and release it more slowly. Solar reflectance is influenced by the color of materials, with darker colors, like asphalt and tar roofs, reflecting less and absorbing more solar energy, which warms the air above them (EPA, 2008).

Housing and Sustainable Urban Development report, Ethiopia is one of the least urbanized countries in Sub-Saharan Africa. Currently, 20 percent of the total population lives in urban areas. However, the country has one of the highest rates of urbanization even by the standards of developing countries, which is estimated at 4.1 percent. In Addis Ababa, more than 3 million people live in 500,000 housing units with an average density of 6 persons per household. 30% of the households live in informal settlements and 5% are homeless. The city has already used over 75% of its potential expansion area for development within its administrative boundary. The potential expansion area of 10,000 hectares within the city's administrative boundary was expected to get exhausted by 2010 (MoUDC, 2014).

2.4. Practical Experience of Planning of Urban Green Areas in Ethiopia

The Ethiopian Constitution establishes a series of general principles requiring that all people be given the opportunity to live in a clean, healthy environment. The concept of sustainable development and environmental rights are also enshrinedin Article 43, 44, and 92 of the Constitution of the Federal Democratic Republic of Ethiopia (FDRE) while different action plans and proclamations are designed in line with the Constitution, federal, regional, and local governments can design and implement supporting proclamations and various action plans designed to develop and manage cooperative housing green areas and street trees. Moreover, the Environmental Policy of Ethiopia has recognized the importance of planning and creating green spaces within urban areas. This provision also creates opportunities for various stakeholders to develop and manage cooperative housing green areas and street trees as elements of urban green areas. Moreover, the Urban Development Policy of Ethiopia has recognized cities as entities that strive to work towards minimizing any serious risks to the urban environment (Ministry of Federal Affairs, 2006).

In order to address these problems, the government of Ethiopia has issued various supporting guidelines, policies, and proclamations. These include the Ethiopian Constitution of 1995 (FDRE, 1995), the Ethiopian Environmental Policy of 1997 (FDRE, 1997), the Ethiopian Urban Development Policy of 2006 (Ministry of Federal Affairs, 2006), and its Urban Planning Proclamation no. 574/2008c (FDRE, 2008).

2.5. The conceptual Framework for Urban Green spaces studies

Pertaining to green space management, the definition of green space has been utilized to abstract and present the concept of green space management (Jansson, 2012). The Green Spaces Management Framework also offers an opportunity to assess the different urban green spaces within the case study area, especially the parks, gardens, street trees, forests, parks, and area closures including the wetlands. The assessment would be observations taken by primary data sources using recent satellite raster data land use cover classification with ground truth (field observation). In this study, a methodology that would not only help planners or policymakers to decide how much emphasis should be given to a particular spatial range of UGS.

CHAPTER THREE

3. MATERIALS AND METHODS

3.1. Description of the Study Area

3.1.1. The Physical Setting

Burayu town is bounded: in the East by: Addis Ababa, in West by Walmera district, in Nort by Sululta Woreda and in South by Sebatahawas Wored. As per the definition of Oromia National Regional State and as recognized by the Ministry of Urban Development and Construction, Burayutown is one of the developing towns in Oromia National Regional State. Burayu is a Town and district in the Oromia Region of Ethiopia, located in the Oromia Special Zone Surrounding Addis Ababa in the Oromia Region, directly adjacent to the Oromia capital and Federal seat Addis Ababa (also Known as Addis Ababa) With the growth of the capital in recent decades. Burayutown is very proximate to Addis Ababa metropolis, the capital of Ethiopia. It is located about 15 Km from the Office of Addis Ababa City government in Piyassa towards the North West on the way to Ambo immediately outside the city limits of Addis Ababa metropolis. The Absolute location of Burayutown stretches between $9^0$30' to $9^0$60'North and $38^0$39' to $38^0$42' 50'' East and covering a total area of 2996.0ha (Figure 2).

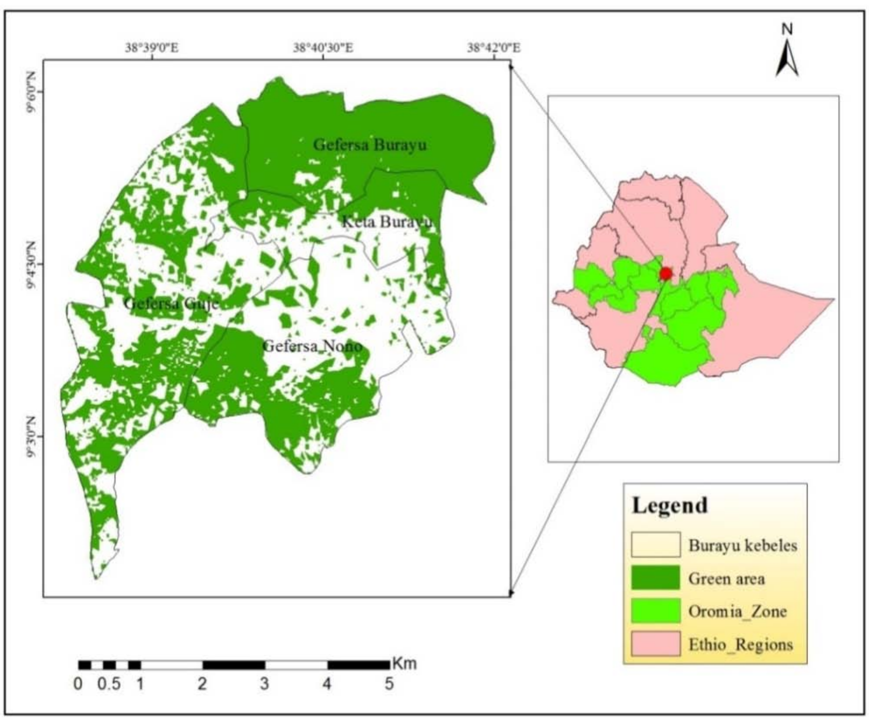


Figure 1: Location Map of the Study Area

Source: Author's construct, 2021

Topography

The topography of the area varies from chains of mountains around Entoto ridge in the Northeast to plateau lands in the south, south-west, and west. The built up area of Burayu town is 6361 ha excluding Gujekebele and it has linear shape. The town is a high land area located at an altitude of 2580m above sea level. The prevailing wind direction is from East to West. The principal natural constraints for the physical expansion of the town is the steep topography of the land and flooding while manmade constrains are existence of informal settlement, high tension lines, rugged and steep slopes in Gujekebele. Study area mostly covered by flat and rolling terrain types of landscapes. The town has been entirely endowed with different impressive and attractive land escapes and features from which it actually achieved its grace. The town is categorized under Dega (Temperate) agro-ecological zone. The land seems gentle slopping area compared to the other side of the town.

Rainfall

The mean annual rainfall of Burayu Town is 1067mm i.e. (1300mm-834mm). As shown in the below figure the mean annual rainfall is 1,188mm.

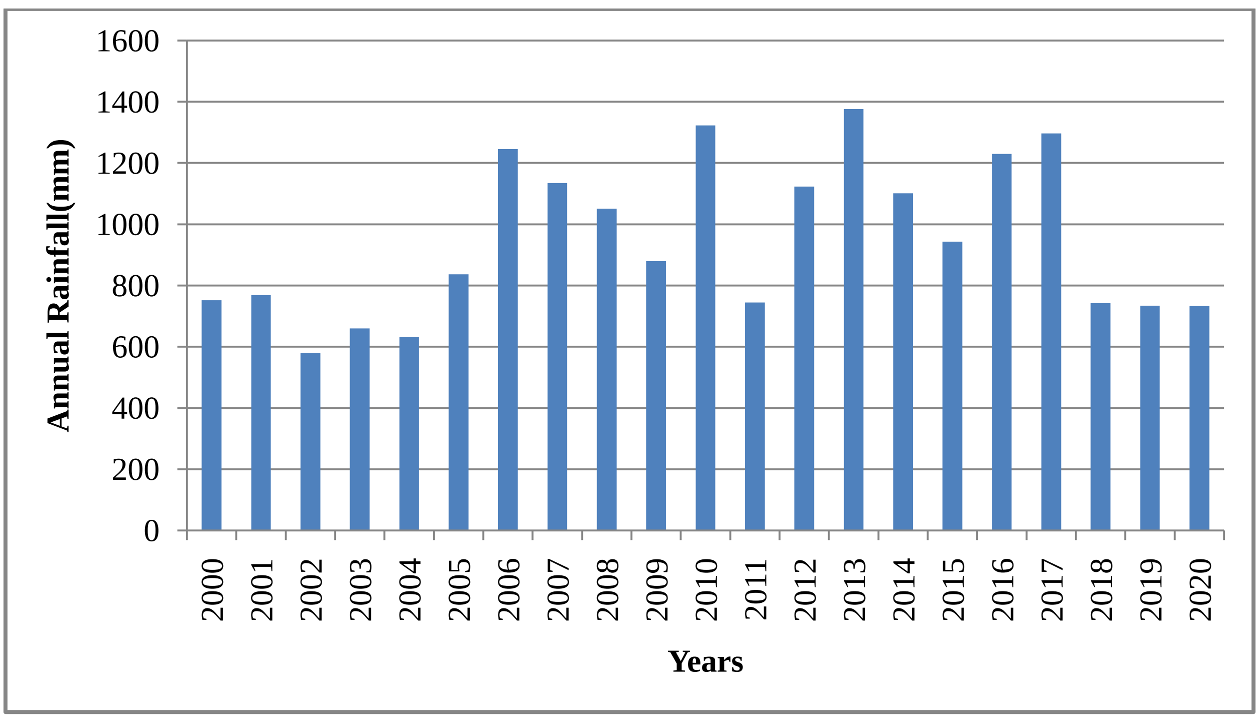


Figure 2: Mean annual rainfall distribution (2000-2020)

Source: Computed from National Meteorological Agency (NMA) of Ethiopia, 2020

Temperature

The mean minimum and maximum annual temperature range between 16 and 23^{0}C. The annual temperature is 16^{0}C i.e.(26^{0}C-6^{0}C); it has Mean Annual Temperature of 14^{0}C and the study area is highland (Burayutown Communication Offices, 2019).

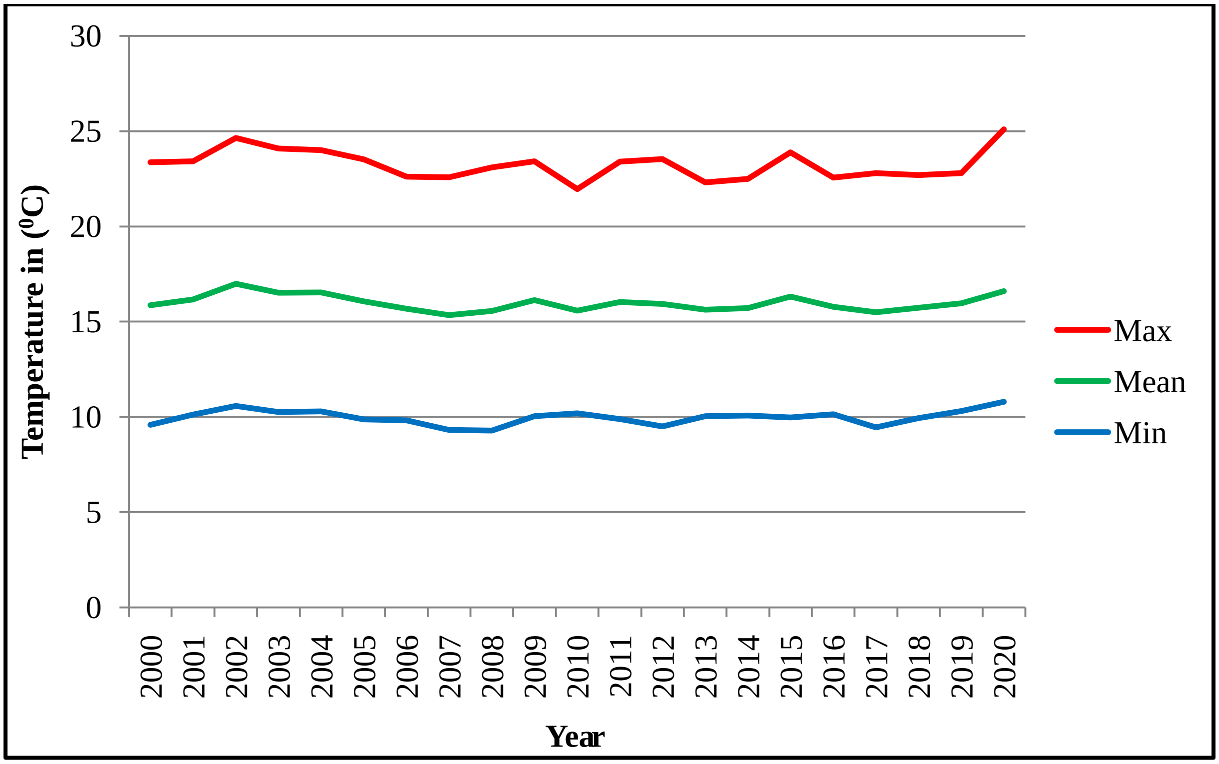


Figure 3: Maximum, minimum and mean annual temperature distribution (2000-2020)

Source: Computed from National Meteorological Agency (NMA) of Ethiopia, 2020

3.1.2. Demographic and Socio-Economic Characteristics

Population

According to census in 2007, the population of Burayutown was 4,138 in 1984; 10,027 in 1994, 63,873 in 2007 and 100,200 in 2010 (estimated). Burayutown administration has estimated that the population of the Town has grown to more than 150,000 in 2014 showing that the town is growing very fast (CSA, 2007). Burayu is one of the largest towns in Oromia Special Zone surrounding the country's capital with 100,200 populations in 2010 (Bekele et al., 2014). Formal and informal land transactions are dominant features of the town. There are four kebele administrative units under Burayutown administrations. There were 18,789 housing units (HUS) for households (HHS) in Burayutown; the ratio of the total number of HHS per 100 HUS becomes 1.0403. At the same period, the number of households who owned their residence is 11,376, and those who rent shared houses is 10, 855. The percentage of households with house-made of durable material is 14,633 (Burayutown profile, 2015). The detailed information of the population of the town is indicated in Figure 5.Below.

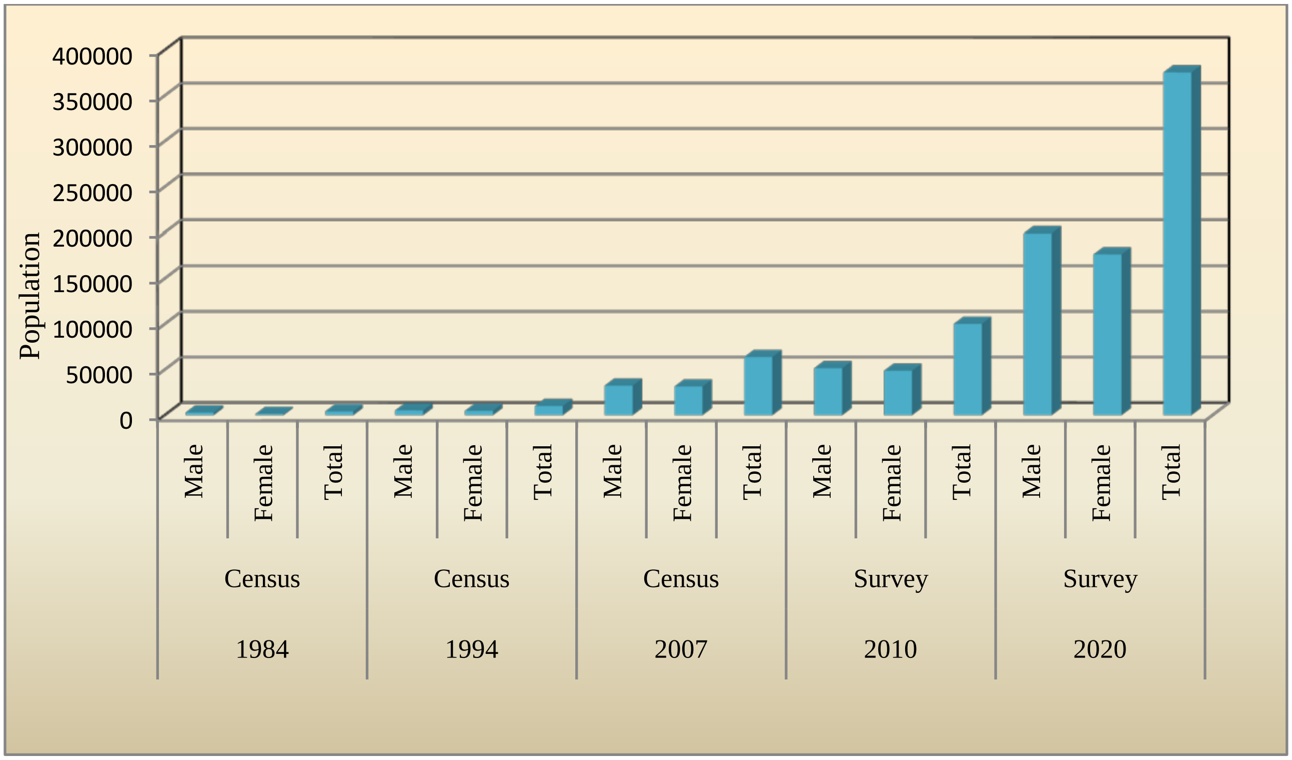


Figure 4: Population of Burayutown

Source: Burayutown Administration, 2010

Economic activities

Because of its proximity to the capital city of the country, better infrastructure developments, relatively high cost, and tedious procedures to get land for residence in Addis Ababa metropolis, and other reasons, many people want to have their residence in Burayu Town. Crop production, merchants, employers, and livestock rearing activities are taking place in the town and its environs. Vegetables are the dominant type of crops produced while livestock production includes dairy farms, cattle, sheep, and goat fattening. Both crop production and livestock rearing activities are taking place in the city and periphery parts of the Towns (Burayu City Agriculture Office, 2014).

3.2. Research Method

3.2.1. Research Design and approach

In this study explanatory research design with GIS, remote sensing and statistical techniques were used in the analysis of urban expansion and its implication on Land use/Land cover change (LU/LCC) with the application of both qualitative and quantitative approaches was used. Thus, it used a mixed research method. The reason for using this method was to compare the results from two different perspectives as relying on quantitative methods alone can hide important facts obtained from qualitative methods (Johnson and Onwuegbuzie, 2004).

3.2.2. Data Types and Sources

In order to achieve the stated research objectives, different data were collected from different sources. Satellite images of three different years (2000, 2010, and 2020) the reason that this year selected was in 2000 there was a police of urban expansion to the surrounding rural because of peoples need the development. ASTER DEM-30m was used for the analysis elevation of the study area.

This study was carried out with an integrated approach of Remote Sensing and GIS techniques in order to identify the land use land cover types such as built up, open spaces, water bodies, and green spaces (vegetation cover) in the study area. Field observation was also conducted in order to characterize and understand the physical or spatial condition of the study area. This method was applied to observe the various impacts of urban expansion especially, its impact on green areas development and management in Burayutown.

The secondary data were collected from different sources like published and unpublished materials, books, journals, articles, reports from Town Sanitation Beautification and Green Areas Development and Management Office (TSBGADMO) at different times, and resources was undertaken almost throughout the course of the research period. The entire data used in this study are summarized in the table below.

Table 1: Sources of Data

	Data category	Source	Description	Purpose
1	DEM	USGS	ASTER 30m resolution	topography analysis
2	Landsat Images TM 2000, ETM+ 2010 and OLI/TIRS 2020	USGS	30m resolution Path/Raw_168 and 054	For LU/LCC, NDVI and NDBI analysis,
3	Master plan/structural plan of the city	Burayu Town Municipality	_	For land use map validation

3.3. Data analysis and presentation

The analysis and quantification of the spatio-temporal dynamics of the LU/LC from 2000 to 2020 were achieved through Landsat image processing, classification, and post-processing. Image preprocessing involved geometric and radiometric correction before the image analysis. A combination of explanatory and descriptive forms of research method was used in the study (Mensah, 2014). The explanatory case study establishes the cause-and-effect relationships of a phenomenon with the ultimate goal of determining how events occur and which ones may influence particular outcomes; whilst the descriptive case study provides an absolute description of a phenomenon within its real context (Hancock and Algozzine, 2006).

3.3.1. Land use/land cover

Multispectral data was used to perform image classification and the spectral pattern present within the data for each pixel was used as the numerical basis for categorization (Lillesand*et al.*, 2004).

In order to detect land use/land cover of Burayu Town during the year 2000, 2010, and 2020 Landsat image was converted to thematic map also, to investigate their relationships with the spatial patterns of land surface temperature, visible and near-infrared bands of TM, ETM+, and OLI/TIRS images was used for classification of the land use/land cover types using a maximum likelihood algorithm. Because of the supervised classification method using a maximum likelihood classifier (MLC) became one of the most commonly used classification methods for Landsat imagery (Pire and Morgenroth, 2017).

Image classification was computed using ERDAS imagine 2015 software. To increase the accuracy of the classifications, a Google Earth image of the study area was used (Jusuf*et al*., 2007).

$$NDBI = L\lambda(\frac{\text{MIR} - \text{NIR}}{\text{MIR} + NIR}) \ldots\ldots(1)$$

Where: NDBI=Normalized Difference Built-up Index,

MIR=Mid-Infrared and

NIR=Near-Infrared.

Based on the objective of this study, land use/land covers of the study area were classified into six main classes as presented in Table 2 below.

Table 2: Details of land use/land cover classes

LU/LC classes	**Description**
Built-up	The area occupied by residential, industrial and commercial complexes, road networks, communication and utilities (airport and bus station)
Bare land	Areas with little or no vegetation cover, open lands, eroded gullies and exposed rocks
Water body	Mainly including rivers, creeks, ponds, lakes, permanent and seasonal wetlands
Vegetation	Areas covered with green trees, woodland, dense shrub land and plantations such as eucalyptus tree
Farmland	Arable agricultural land, areas used for grazing, partially wet lands
Grass land	Area covered with small grasses, scattered bushes and trees, and wetland (intermittent) used for grazing.

Source: Mensah, 2014; DMSLB *et al*., 2019

3.3.2. Accuracy assessment

Classification is not complete until a satisfactory level of accuracy is achieved (Lillesand*et al.*, 2008); Thus, an error matrix was performed to assess classification accuracy. Accuracy assessment was carried out with the following procedure. Firstly, for each year's image, 12 samples for each land use/land cover class were selected from Google Earth images using the random stratified method to represent different land use/land cover classes of the study area. Accordingly, the study area with areal size of 2996.0ha the land use/land cover classes consists of six major classes were identified for each time period (Table 2). Therefore, in this study a total of 72 reference data points from each year were collected, for classification and accuracy assessments respectively. Then after classification, an accuracy measurement (user and producer accuracies) was derived from the error matrix in percentage.

Kappa coefficient (Khat) is a measure of the agreement between two maps taking into account all elements of the error matrix (Anand, 2018). It was used to evaluate the actual and a chance agreement between reference data and land use/land cover class. Overall accuracies were computed by summing the number of pixels and classified them correctly (diagonal numbers) then dividing them bythe total number of pixels. User's and producer's accuracies were computed by dividing the numbers of pixels that were classified correctly in each category (diagonal entries) divided by the total number of pixels in that category of row total and in the same category of column total respectively. To test land use/land cover classification accuracy multi-variety statistical measure was determined and selected for each time periodby applying the formula given below equations.

$$OAC = \frac{\Sigma Xij}{N} * 100 \quad (2)$$

$$UAC = \frac{Xii}{X_{+i}} * 100 \quad (3)$$

$$PAC = \frac{Xii}{X_{i+}} * 100 \quad (4)$$

$$Khat = \frac{(Obs - exp)}{(1 - Exp)} \quad (5)$$

Where: OAC= over all accuracy, K_{hat}=Kappa statistics, UAC=user accuracy, X_{i+}= column total, and

PAC=producer accuracy, X_{ij}= diagonal values,

N= total number of samples, X_{+I} = row total and obs= (OAC),

Xii=number of categories, Exp =correct classification.

3.3.3. Land use/land cover change detection

A post-classification comparison was employed to perform land use/land cover change detection (Yang *et al*., 2012). The land use/land cover change matrix was produced, which was showed quantitative data of the overall land use/land cover changes between 2000 and 2020 in the study area. The study period was divided into three-time intervals: 2000 to 2010, 2010 to 2020, and 2000 to 2020. Accordingly, gains, losses, and rate changes for each of the corresponding time periods were computed using a change matrix in form of a table, as recommended by (Pal and Ziaul, 2017). It is also possible to compute the amount of increase (positive) and/or decrease (negative) of each category change in percent in each year using the following formula:

Once the land cover classifications were derived, ArcGIS 10.3 was used to prepare the LU/LC maps of 2000, 2010, and 2020. Then, the areas of the LU/LC classes were calculated from the maps, and analysis of LULCC and rates of changes were computed. Total LULCC between the two periods is calculated as follows:

Total LU/LC Gain/loss = Area of the final year − Area of the initial year……………….…..(6)

Percentage of LU/LC Gain/loss = $\frac{(\text{Area of the final year} - \text{Area of the initial year})}{\text{Total area of the study area}}$…………..(7)

LU/LC matrix was developed by ArcGIS to analyze the LU/LC inter-category transitions and examined the study area experience in LU/LC transitions. The matrix was developed for the 2000–2010 and 2010–2020 transitions. Through the matrix, the area of gains, losses, persistence, and swapping between the LU/LC types especially for green areas were calculated. The result was helpful to see how continuous demand for green spaces had brought changes in LU/LC of the study area.

The idea is that the NDVI was taken as an indicator of vegetation coverage. Normalized Difference Vegetation Index (NDVI) was used to identify the distributions of vegetation covers and their greenness as well. Consequently, it also explores the transformation of NDVI into values associated with cover fraction using empirical relationships with vegetation indices, as a possible basis function (Tomar*et al*., 2013). The NDVI formula is given by (Eq. 8):

$$\mathrm{NDVI} = \mathrm{L}\lambda\left(\frac{\mathrm{NIR} - \mathrm{R}}{\mathrm{NIR} + \mathrm{R}}\right) \quad \text{.....(8)}$$

Where: NDVI= Normalized Difference Vegetation Index,

Lλ= spectral radiance at the top of the atmosphere and

NIR= near infrared band

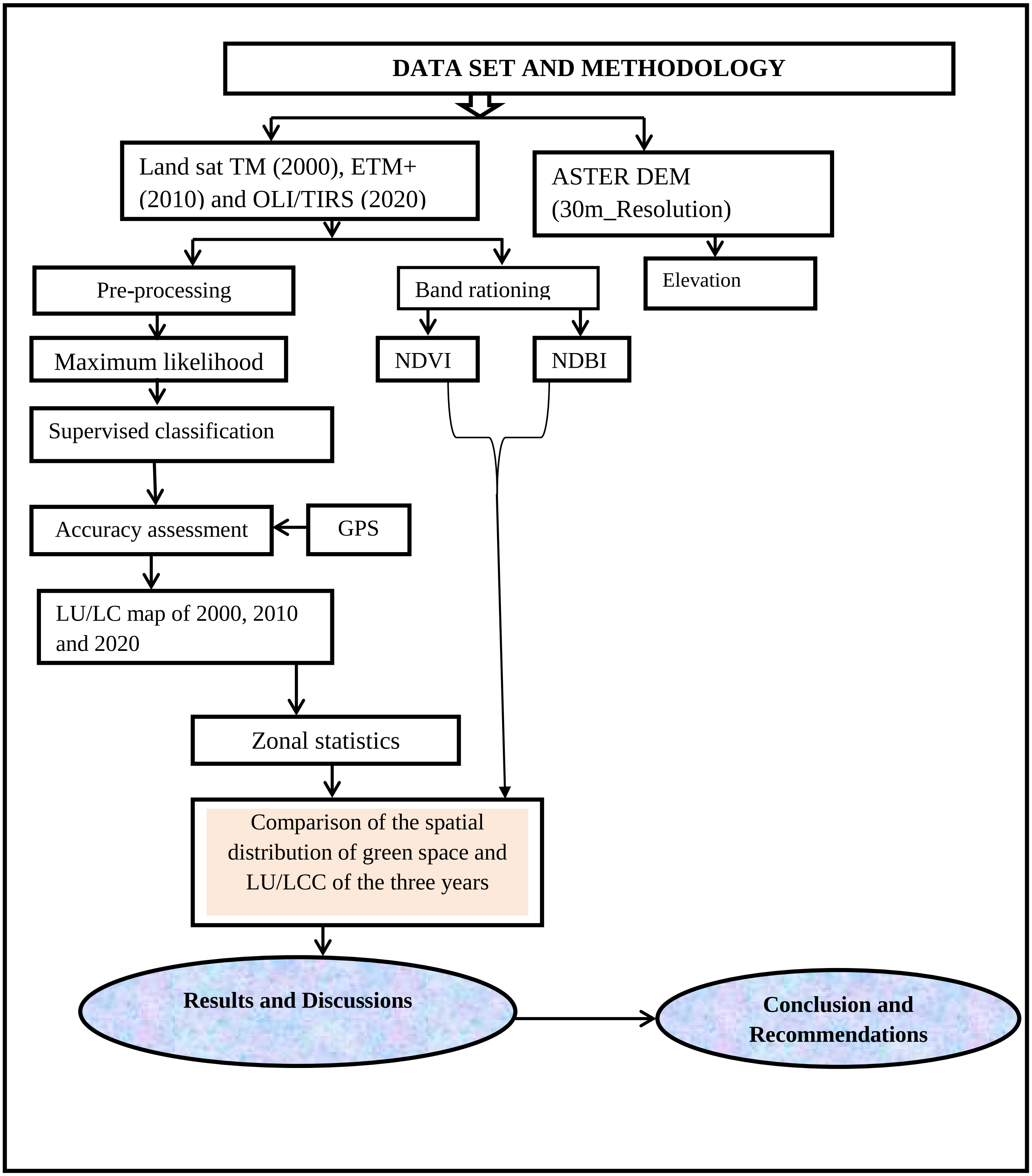
R= red band.

3.3.4. Sampling Technique

There are many spatial sampling techniques available for the selection of sample reference data such as random, systematic, clustered, stratified, or a combination of them. In this study, the stratified random sampling technique was used because all LU/LC types can be sufficiently represented, no matter how a LU/LC size small or limited in its spatial distribution (Gao, 2009). The minimum sample size for each LU/LC category necessary for 85% interpretation accuracy is set to 20 and for 90 % accuracy to 30 (van Genderen and Lock, 1977). Therefore, by considering the size of Burayu Town and five LU/LC classes a minimum of 72 samples per LU/LC category were used. During the field survey, sample reference data positions were collected using GPS/Google Earth.

3.3.5. The overall methodologyof the study

Figure 5: Work Flow Diagram



CHAPTER FOUR

4. RESULTS AND DISCUSSION

The result and discussion part of the study displayed in this chapter in the descriptive and econometric analysis. Spatial and temporal data was interpreted to show the extent of urban expansion and change in land use classes.

4.1. Land Use/Land Cover Dynamics of Burayu Town for the year 2000, 2010 and 2020

In this study, through applying the remote sensing technique for interpreting the three years Land sat images, the land use/land cover types of the Burayu town were classified. The result reveled from land use/land cover types in the study area for the three years (2000, 2010, and 2020) were classified into six land use/land cover types, like built-up area, Vegetation, grassland, bare land, farm land and water body for Burayutown.

4.1.1. Land use/Land cover dynamics of Burayu Town in 2000

The land use/land cover types of the study area; Grassland was the most dominant land use/land covers classes during the year 2000 by an area of 1298.4ha (43.3%). Vegetation and built-up area were dominant next to grassland by area of 989ha (33%) and 326.9ha (10.9%), respectively. The total extent or composition of individual LU/LC classes by hectares and percent of Burayu Town is presented in (Table 5).

Table 3:Land use/land cover types of 2000

S/No	LU/LC Classes	Area in 2000	
		(Ha)	(%)
1	Bare land	37.3	1.2
2	Built-up area	326.9	10.9
3	Farmland	297.0	9.9
4	Grassland	1298.4	43.3
5	Vegetation	989.0	33.0
6	Water body	47.3	1.6
	Total	**2996.0**	**100.0**

Source: Computed by author from Landsat image,2021

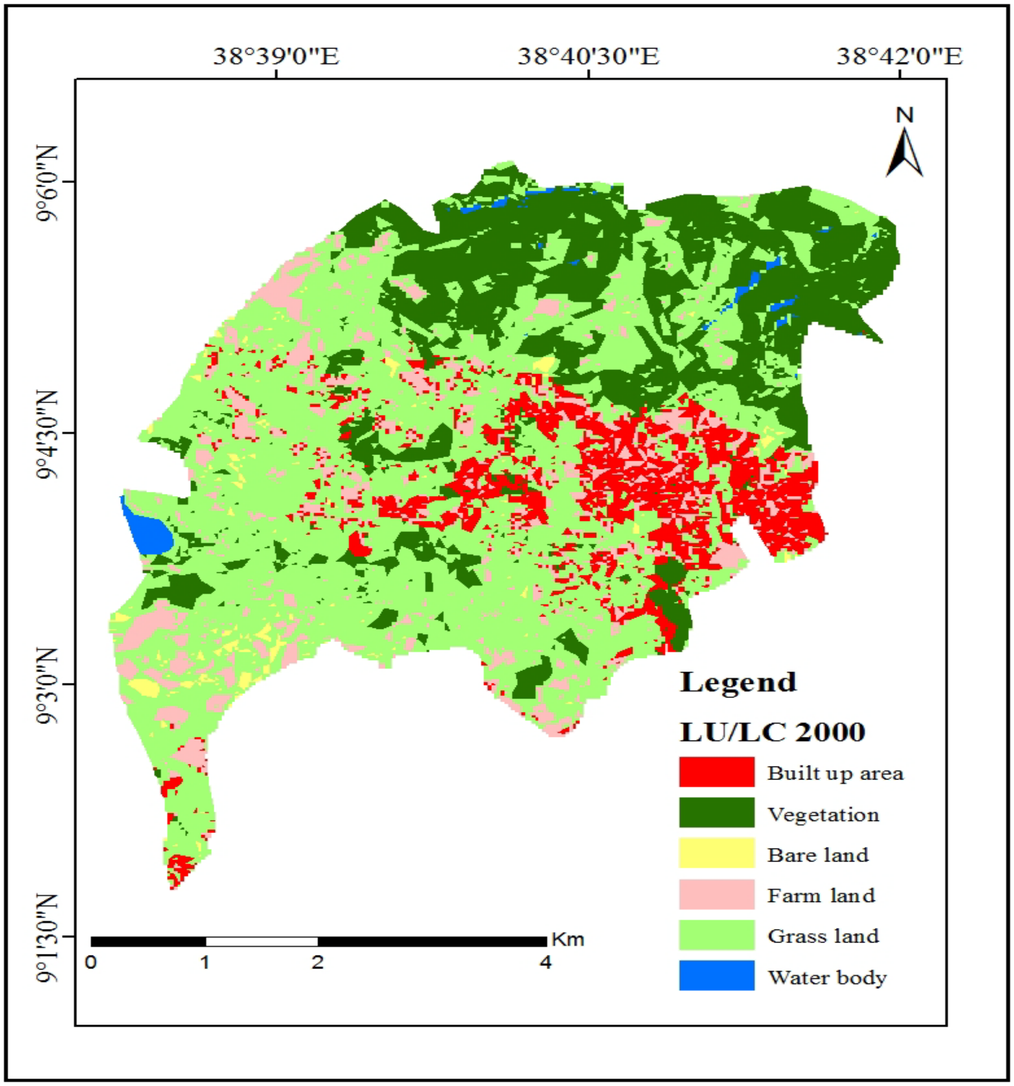


Figure 6:Land use/land cover map of 2000

Source: Computed by author from Landsat image,, 2021

4.1.2. Land use/Land cover dynamics of Burayu Town in 2010

From the classification of land use/land cover types of Burayu Town Grassland is the most dominant land use/land cover class in 2010 (Figure 8). It covers an area of 1021.1ha (34.1%) and built-up and vegetation covers an area by 974.0ha (32.5%) and 743.4ha (24.8%), respectively next to grassland. From the result, vegetation cover decreased by the expansion of built-up area when compared with an area those land use/land cover classes in the year of 2000. The detailed information of all land use/land cover types of 2010 is presented in Table 6 below.

Table 4: Land use/Land cover class of 2010

S/No	LU/LC Classes	Area (2010)	
		(Ha)	(%)
1	Bare land	46.0	1.5
2	Built-up area	974.0	32.5
3	Farmland	191.4	6.4
4	Grassland	1021.1	34.1
5	Vegetation	743.4	24.8
6	Water body	20.1	0.8
	Total	**2996.0**	**100.0**

Source: Computed by author from Landsat image,, 2021

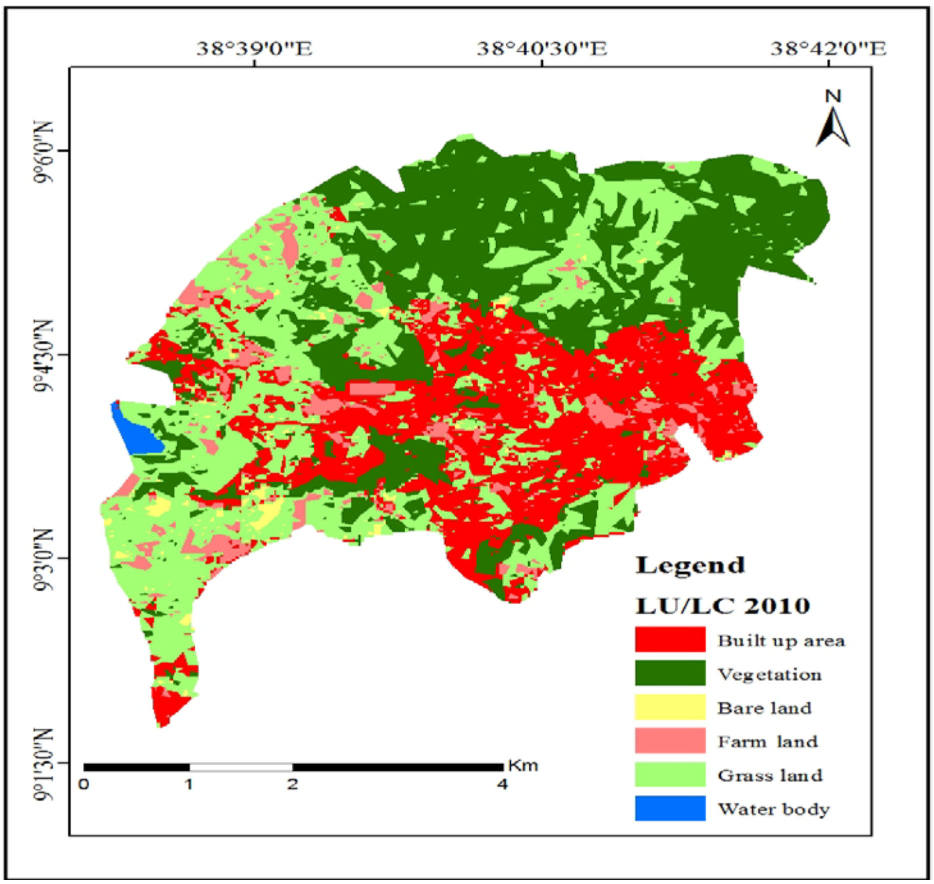


Figure 7: Land use/Land cover map of 2010

Source: Computed by author from Landsat image,, 2021

4.1.3. Land use/Land cover dynamics of Burayu Town in 2020

From the last classification of land use/land cover classes of the study area Built-up area was highly expanded when compared with the years 2000 and 2010 (Figure 9). It covers an area of 999.4ha (33.4%). Due to the expansion of built-up area grassland and vegetation was decreased in 2020. The area of grassland and vegetation covered an area of 996.1ha (33.2%) and 700.3ha (23.4%) respectively. Consequently, the rest land use/land cover classes were declined by the expansion of built-up areas except bare land. Abebe*et al.* (2019) confirmed that expansion of built-up area is the main factor for the decrement of vegetation and open land in Jimma City. The detailed information on land uses land cover classes of 2020 presented in (Table 7).

Table 5: Land use/Land cover classes of 2020

S/No	**LU/LC Classes**	**Area of land use land cover in 2020**	
		(Ha)	(%)
1	Bare land	96.7	3.2
2	Built-up area	999.4	33.4
3	Farm land	187.9	6.3
4	Grass land	996.1	33.2
5	Vegetation	700.3	23.4
6	Water body	15.6	0.5
	Total	**2996.0**	**100.0**

Source: Computed by author from Landsat image,2021

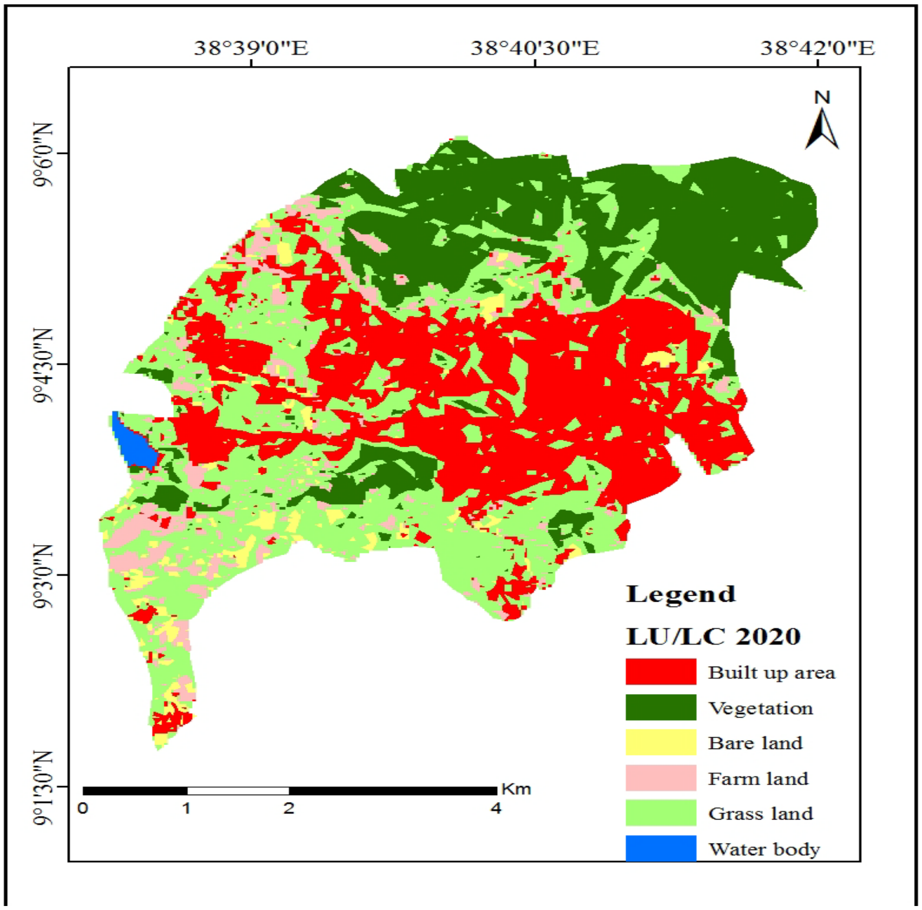


Figure 8: Land use/Land cover map of 2020

Source: Computed by author from Landsat image,2021

4.1.4. Accuracy Assessment

Before analyzing land use/land cover change detection accuracy assessment was done. From the result of this study land use/land cover accuracy assessment for 2000, 2010, and 2020 years were produced. The overall classification accuracy of LU/LC of the year 2000, 2010, and 2020 is 97.8%, 98.7%, and 97.7%, respectively. The overall land-use and land cover classification Kappa statistics for the study periods were 2000 (0.95), 2010 (0.97), and 2020 (0.96). Details of each year's land use/land cover class accuracy assessment for each year under the investigation period were presented in (Table 8).

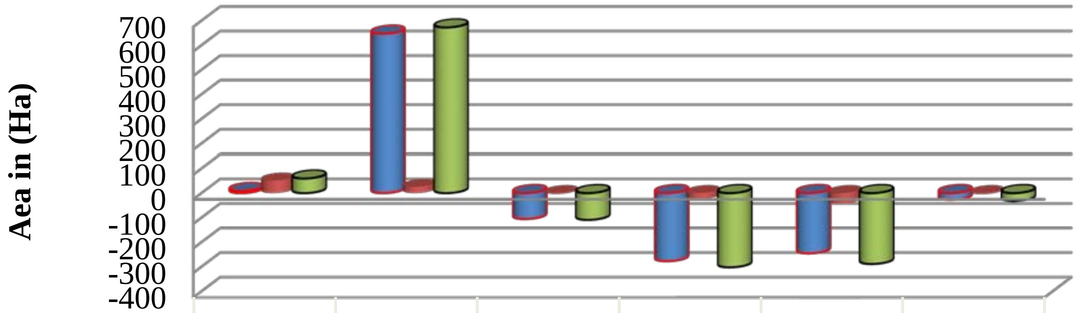
Table 6: Accuracy assessment of land use and land cover for 2000, 2010 and 2020

LU/LC Types	2000		2010		2020	
	Producers Accuracy (%)	Users Accuracy (%)	Producers Accuracy (%)	Users Accuracy (%)	Producers Accuracy (%)	Users Accuracy (%)
Bare land	95	82.6	87.5	100	88.6	92.8
Built-Up area	96	95	98	99	99	99
Farmland	96	97.3	98.3	98.8	97.3	98.2
Water body	99	99.7	99.8	99.4	99.4	99
Grassland	88	88	96	88.9	95.2	90.9
Vegetation	87	99	93	99	79	81
Overall Accuracy	97.8%		98.7%		97.7%	
kappa coefficient	0.95		0.97		0.96	

Source: Computed by author from Landsat image, 2021

4.1.5. Land use/Land Cover Change detection

The change in LU/LC for the periods 2000 to 2020 was analyzed by using the post-classification change detection technique in a GIS environment. The change in areal coverage for each category is clearly visible on the maps (Figure 10). The result shows that there was a big change in vegetation cover. The negative values in trend or rate of change show decreased in that particular land use/land cover and the positive values show the increase of land use/land cover types. According to the findings, the built-up area expanded by an area of672.5ha from 2000 to 2020. Grassland and vegetation area were decreased by -302.3ha and -288.7ha from 2000 to 2020 respectively. The main factor for the declined of grass land and vegetation cover were the expansion of built-up areas for settlement and commercial areas and etc. The result shows that the urban expansion has been negative on land use/land cover dynamics in the Burayu Town. This result is in agreement with (Sewunet, 2017; Abebe*et al.*, 2019).



	Bare land	Built-up area	Farm land	Grass land	Vegetation	Water body
2000-2010	8.7	647.1	-105.6	-277.3	-245.6	-27.2
2010-2020	50.7	25.4	-3.5	-25	-43.1	-4.5
2000-2020	59.4	672.5	-109.1	-302.3	-288.7	-31.7

Figure 9: Trend of Land use/land cover change in Burayu town

Source: Computed by author from Landsat image,2021

4.1.6. Land-Use/Land-Cover Change Matrix

In this study, Land Use Transfer Matrix (LUTM) and post-classification method were used to detect land use/land cover change from 2000 to 2020 (Figure 11). The LUTM method is derived from the quantitative description of state transition system analysis.The land use/land cover matrix was produced by overlaying two land use/land cover maps of the same area to show the probability that one particular LU/LC category changed into other land cover categories. It is used to predicting the likely possible change between different particular states. In this study, from initial to final year transitional land cover matrixes were produced for periods of the studies in which column stands for the initial state of land use/land cover categories and the row stands for the final state of land use/land cover categories.

The rate of change for the three periods from 2000 to 2020 indicates that the trend of decrement in the green area is more and more rapid. The two largest percentage share of land conversion from one type to another are grassland 467.2ha and vegetation cover 95.3ha into built-up areas. This finding is in agreement with several studies. For instance; (Kumar *et al.,* 2014) and (Redman ad Jones, 2004) indicates that the process of rapid urbanization takes place in developing countries significantly contributes to decreasing in the green area for the need of construction land. The land use/land cover matrix indicated in (Table 9) shows that the bare land area gained about 59.8ha and 3.1ha of extra land from grassland and vegetation, land respectively. This finding is in agreement with several studies. For instance; (Seid, 2007) pointed out that the major land use/land cover converted in to bare land areas are grass land, vegetation cover, and cultivated lands as well.

Table 7: Land use/land cover change matrix of the year 2000, 2020 in hectares

		2020						
LU/LC Types		Bare land	Built up area	Farm land	Grass land	Vegetation	Water body	Total
2000	Bare land	9.7	8.8	2.9	15.8	0.1	0.0	37.2
	Built-up area	7.0	247.2	6.5	60.6	5.3	0.0	326.6
	Farm land	15.9	125.5	86.4	91.8	2.7	0.5	322.8
	Grass land	59.8	467.2	106.4	734.1	172.2	2.2	1541.9
	Vegetation	3.1	95.3	11.1	106.4	526.4	0.2	742.5
	Water body	0.0	0.6	0.0	0.9	10.8	12.7	25.1
	Total	95.4	944.6	213.2	1009.6	717.5	15.6	2996.0

Source: Computed by author from Landsat image, 2021

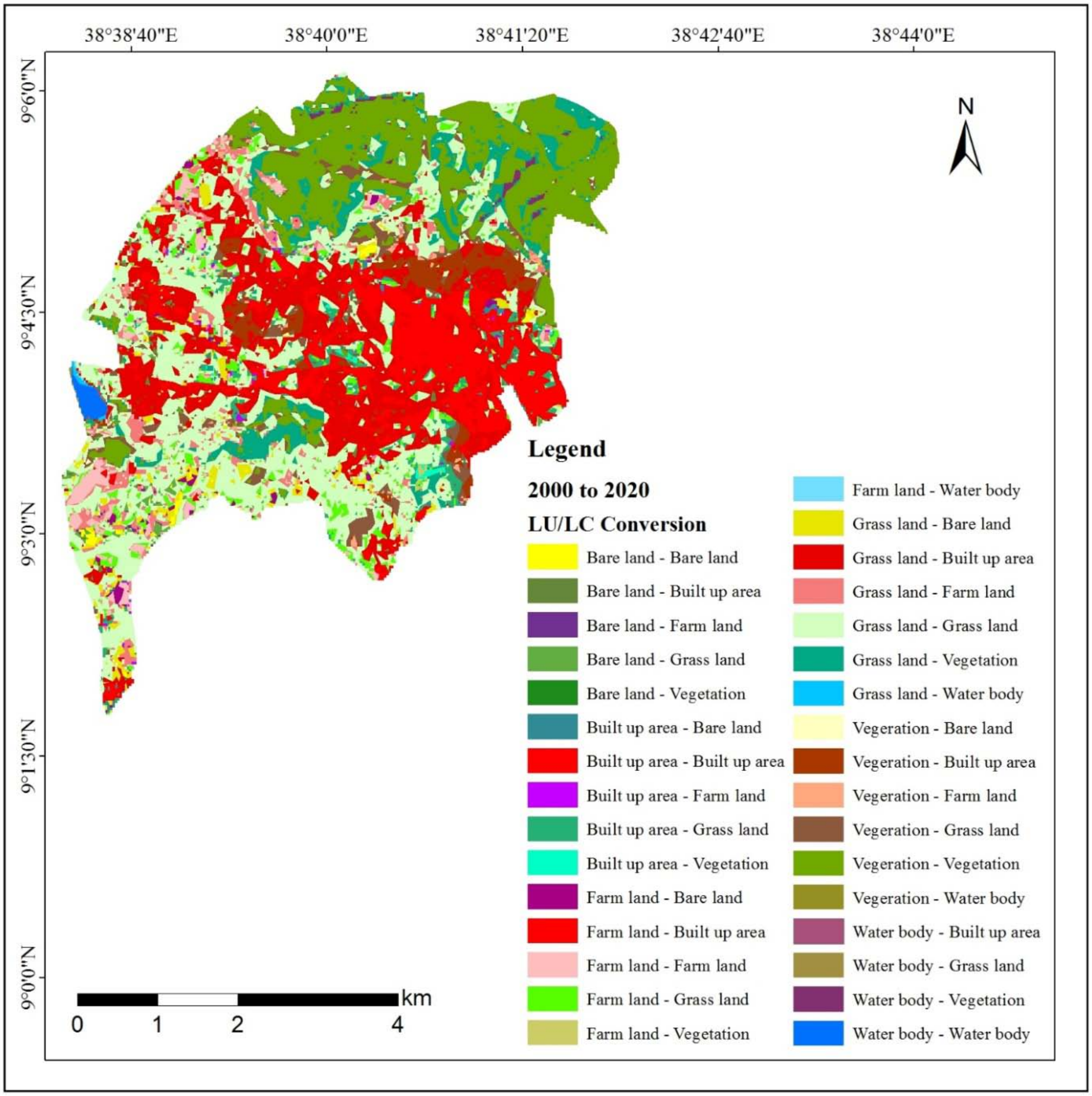


Figure 10: Map of LU/LC conversion from 2000 to 2020

Source: Computed by author from Landsat image,2021

4.2. Analysis of Normalized Difference Vegetation Index (NDVI)

The results of NDVI of 2000, 2010, and 2020 showed that northeast and southwest parts of the study area have higher NDVI value. The little values of NDVI were also observed in dense residential areas with less vegetation coverage. As indicated in (Figure 12) vegetation cover has decreased and the non-vegetated area has been increasing gradually over the study period. The average value of NDVI of the year 2000 was reduced by half percent by the year 2020. Relatively, a high value of NDVI in 2020 is observed on the northeast and southwestern parts particularly in Gefersa Burayu and the rest parts of the study areas have low values of NDVI. By comparing NDVI of the two different periods (2000 and 2020), it is observed that maximum NDVI values were decreased over the study period.

NDVI values between 0.6-0.46 represent agricultural fields in the surrounding periphery. Patches of dense vegetation cover in the southern and parts of the City show relatively high NDVI values. A number of studies have also shown that NDVI values of river banks and around water bodies experience higher NDVI values than other classes, owing to the presence of agricultural land (Feyisa*et al.*, 2014; Samson *et al.*, 2018). Table 10 shows the comparison of the NDVI values of the different years showed that there has been a marked vegetation cover change during the study period of 20 years.

Table 8: Comparisons of the NDVI values in the year 2000, 2020

	NDVI_2000			**NDVI_2010**			**NDVI_2020**		
Kebeles	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
GefersaGuje	-0.29	0.57	0.20	-0.18	0.40	0.15	-0.52	0.28	-0.11
GefersaBurayu	0.06	0.61	0.36	0.01	0.46	0.28	-0.25	0.31	0.08
KetaBurayu	-0.02	0.53	0.28	0.01	0.39	0.17	-0.31	0.27	-0.03
GefersaNono	-0.07	0.49	0.19	-0.02	0.38	0.13	-0.35	0.22	-0.12

Source: Computed by author from Landsat image, 2021

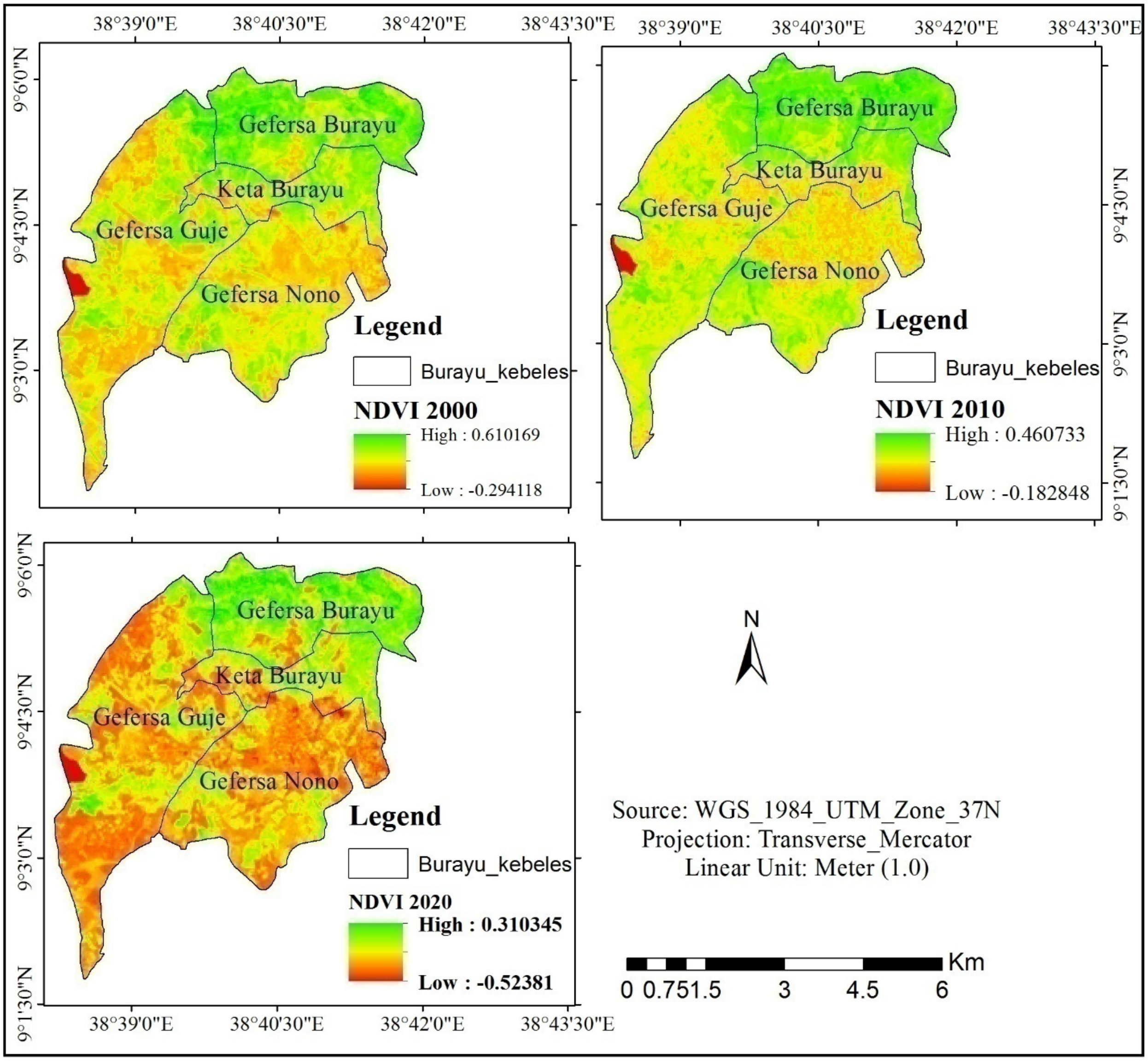


Figure 6: Normalized Difference Vegetation Index results for the year 2000, 2010 and 2020
Source: Computed by author from Landsat image,, 2021

4.2.1. Spatial distribution of Vegetation Cover during the Year 2000, 2010 and 2020

This finding clearly shows that vegetation cover was in its decreasing trend mainly due to the rapid expansion of built-up areas in Burayu Town. The total area of grassland and vegetation covers in the study area was covered by an area of 2532.6ha in 2000 whereas, due to expansion of built-up area grassland and vegetation covers were decreased to 1718.4ha in the year of 2020 (Table 11). The process of destruction was predominantly marked in the southern parts of the Town such as *GefersaNono and GefersaGujekebeles.* In contrast, some amounts of green spaces

(Vegetation and grassland) exist in Northern parts of the Burayu Town such as in Gefersa Burayu and Keta Burayukebeles between 2000 and 2020 (Figure 13). Finally, the built-up areas became highly increased by consuming considerable lands from green spaces. The result of direct post-classification comparison revealed that most of the urban green spaces were converted to built-up areas. This result is in agreement with a number of studies (Sewunet, 2017; Abebe*et al.*, 2019) also pointed out that green vegetation has been declined by the expansion of the built-up area.

Table 9: Spatial distributions of vegetation in Burayu Town from 2000, 2020

S/No	LU/LC Types	Area in 2000 (Ha)	Area in 2010 (Ha)	Area in 2020 (Ha)
1	Grass land	1543.6	1023.1	996.1
2	Vegetation	989.0	743.4	722.3

Source: Computed by author from Landsat image, 2021

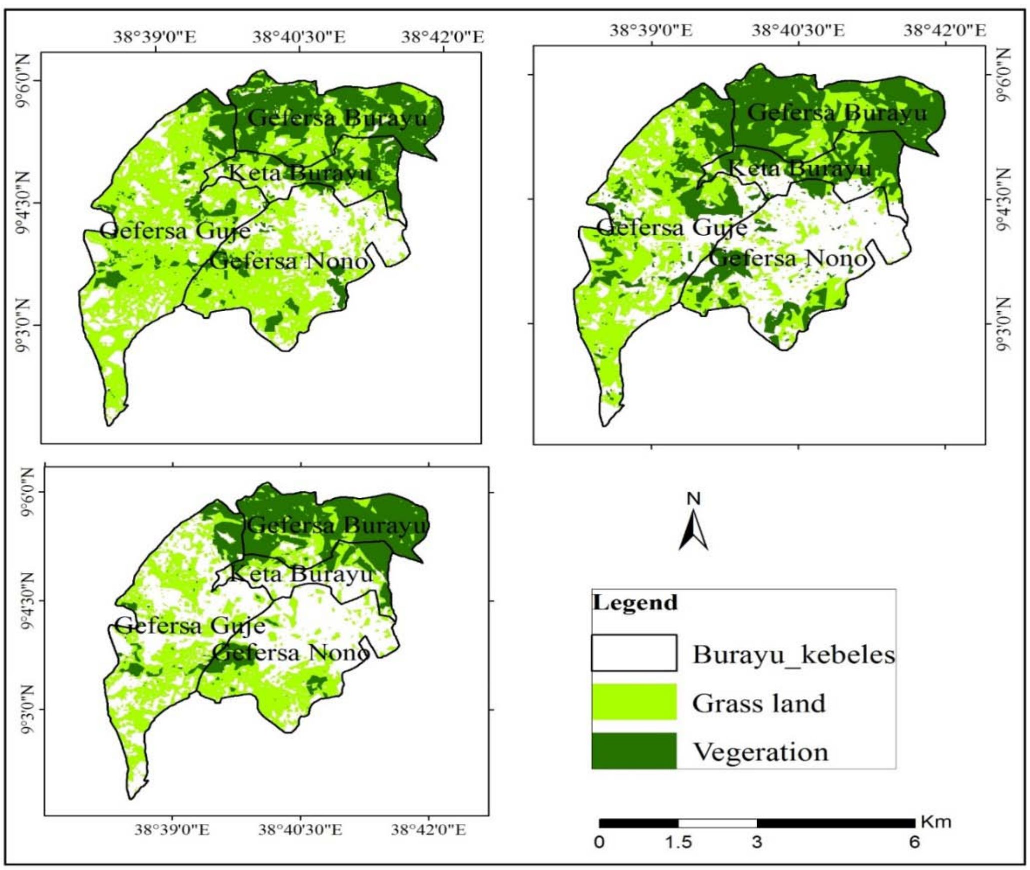


Figure 7: Distribution of Dense Green Spaces in Burayu Town 2000-2020

Source: Computed by author from Landsat image, 2021

4.3. The magnitude of urban expansion and its implication on LU/LC change

As displayed in table below, the built-up area of Burayu town is highly expanded. The expansion condition of the town indicates that the area covered by built-up is grown from 10.9% in 2000 to 33.4% in 2020 while other land use/land cover decreases especially vegetation decreased from 33.0% in 2000 to 23.4% in 2020.Urban expansion is caused in part by the essential to accommodate a rising urban population; conversely, in many metropolitan areas it consequences from a desire for enlarged living space and other residential amenities. Besides, by increasing the physical and environmental "footprints" of urban areas, the phenomenon leads to the destruction of remaining natural areas (Bekele, 2005). Many experts also believe that weak planning laws and single-use zoning also contribute to urban sprawl (Dadi et al., 2016).

Table 10:magnitude of urban expansion in Burayu Town from 2000, 2020

Years	Built-up area		Vegetation	
	ha	%	ha	%
2000	326.9	10.9	989.0	33.0
2010	974.0	32.5	743.4	24.8
2020	999.4	33.4	700.3	23.4

Source: Computed by author from Landsat image, 2021

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

Geographic Information System and Remote Sensing become one of the widely used technologies for analyzing the interaction between man and its environmental contribution.

This study compared land use /land cover of different years with green and non-green areas to analyze the driving actors of urban green spaces from the year 2000 to 2020 through considering the variations of the Normalized Difference Vegetation Index (NDVI) resulted from Land Use/Land Cover (LU/LC) dynamics.

The study revealed that there was a radical change in Land Use/Land Cover (LU/LC) dynamics. The rapid urban expansion of the built-up areas and deterioration of vegetation cover are the two most important challenges that urban planners are facing today. From the classification of land use/land cover types of Burayu Town, grassland is the most dominant land use/land cover class in 2010. It covers an area of 1021.1ha (34.1%) and the built-up and vegetation covers of an area were 974.0ha (32.5%) and 743.4ha (24.8%), respectively next to grassland. From the result, vegetation cover was decreased and replaced by built-up area when compared with LU/LC of the year 2000. With the change in LU/LC for the periods 2000 to 2020, the built-up area was expanded by an area of 672.5ha.

Vegetation cover has decreased and the non-vegetated area has been increasing gradually over the study period. The average value of NDVI of the year 2000 was reduced by half percent by the year 2020. Relatively, a high value of NDVI in 2020 is observed in the northeast and southwestern parts particularly in Gefersa Burayu and the rest parts of the study areas have low values of NDVI. By comparing NDVI of the two different periods (2000 and 2020), it is observed that maximum NDVI values were decreased over the study period.

5.2. Recommendations

The findings of the research are of practical relevance for planning climate-sensitive cities in Ethiopia. Based on this finding, the following recommendations were forwarded:

- Town administration and beautification, park and sustainable development administration agency need to:
  - Update the LULC using remote sensing and GIS technologies, and formulate guidelines to develop and manage the urban green space in the context of the GIS approach.
  - Urban greening efforts in Burayutown and areas with similar environments may need to integrate and optimize the multiple environmental and social values of green spaces.
  - Town administrators should control the rapid urban expansions and pay great attention for developing spaces for green area.

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Appendix 1: LU/LC Classes with respective actual photograph

Burayu Town Administration Office