Addis Ababa University Institute of Technology (AAiT)

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EVALUATING THE STATUS OF LAND USE LAND COVER CHANGE: A CASE STUDY OF EAST GOJJAM ZONE DEBRE MARKOS TOWN, ETHIOPIA

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Declaration

This is to certify the Thesis Prepared by Dawit Belay Nega Entitled as "Evaluating the Status of Land Use Land Cover Change: A Case Study of East Gojjam Zone Debre Markos Town, Ethiopia" Is Submitted in Partial Fulfillment of the Requirements for The Degree of Master of Science in Geodesy and Geomatics (Specialization in Geomatics) Compiles with the Regulations of the University and Meets the Accepted Standards with its Originality and Quality.

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This thesis has been presented for evaluation with my endorsement as an academic mentor at the university.

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Abstract

This research was conducted to evaluate the status of urban land use land cover change. To analyze the LULC change of this study satellite images (Landsat 1986, 2003 and 2020) have been used for retrieving information, adopting image classification method. In addition accuracy analysis has been done by comparing the reference data with the classification results to evaluate the effectiveness of the image classification. The changes between the defined years was evaluated using land use Land cover maps that belongs to different years adopting cross tabulation and overlay analysis methods. The main aim of this study was to evaluate the status of urban land use land cover change in the study area. The result indicates that the main changes in the study area were the transformation of Agricultural Lands 41.62%, 32.60 changes 22.5 % and converted into Built up lands in the study area. Accordingly, around 980 ha of area of Agricultural land were transformed to build up in the last two decades.

Keywords: DEBREMARKOS TOWN, GIS, ERDAS Imagine 2015, Remote sensing, LULC,

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ACCRONYMS

AOI	Area of Interest
CSA	Central Statistics Agency
EGA	Ethiopian Geospatial Agency
ETM+	Enhanced Thematic Mapper plus
ERDAS	Earth Resource Data Analysis System
FAO	Food and Agricultural Organization
IGBP	International Geosphere-Biosphere Program
GIS	Geographic Information System
LULCC	Land Use Land Cover Change
OLI-TIRS	Operational Land Imager-Thematic Infrared Sensor
RS	Remote Sensing
TIFF	Tagged Image File Format
USGS	United State Geological Survey
UTM	Universal Transverse Mercator
WGS	World Geodetic System

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the Study

Since the beginning of time, all have been changes to the natural land cover on Earth which can be attributed to both natural occurrences and the actions of humans. For a greater percentage of the world's population, towns and cities today form a starting point of the human experience. Several assessments indicate that urban areas of today must find a way of meeting the demands of expanding people and developing nations with minimizing their detrimental impact on the environment. It continues to be expensive and challenging to perform detailed surveillance of urban land use regulation on a city-by-city foundation, resulting in it challenging to assess urban trajectories, land use features, or the impact of several visualizations and policy modifications (K. Kavitha et al., 2012). Urban development is an international trend which has been recorded in the any urban center's past. The Babylonians had been the first culture of humans to be involved in this (Cemea, 1997).

Particularly in developing nations with fast expanding populations and economies focused on agriculture, land usage and land cover have changed significantly. Many both natural and human-made factors contribute to changes in land use and land cover (Meyer and Turner, 1994). Any natural, biological, or chemical transformation attributed to agricultural practices has been referred to as land use other options, based on Quentin et al. (2006). That may additionally involve plantations, building cultivating land dams, transferring from grazing to cropping, fertilizer use changes, drainage improvements, irrigation setup and use, pollution, and land degradation (BELLO, et al 2018)

Use for Land Surface area Maps are essential for critical and accurate decision-making and are widely utilized in many different industries for a wide range of goals. Maps based on LULC are generated by identifying photos, which are mainly satellite or aerial photos. Urban environments have changing by nature; consequently present statistics are needed for timely information and analysis (M. Cavur et al., 2019).

Use of Land Coverage on Land Maps is widely utilized for a variety of reasons in a wide variety of institutions. The significance of the information itself and the interpretation of data are truly necessary for critical and accurate decisions, since the usage and purpose vary. LULC maps are produced by categorizing images, which are primarily satellite or aerial photos. Urban environments are dynamic by nature; hence current data are necessary for timely information and assessment (M. Cavur et al., 2019).

Unavoidably, population expansion leads to a rapid expansion of urban growth, inflicting changes in land use and land cover in many urban areas. The rate of such change is obvious in developing countries with high population increases. These unmanageable city changes in the region of the Ethiopian towns can build up a massive range of communal. Many groups now require information about land use and land cover transformation; remotely sensed data can be used as a source of this information because it provides information about land cover. Estimating the extent and costs of habitat fragmentation, urbanization, wetland and soil deprivation, deforestation, and numerous other landscape-level phenomena are likewise dependent on it (Edward et al., 2010).

Urban agriculture (UA) is an important land-use type and it is a most vital supply of livelihood for many people and urban dwellers plant plots/bare lands to support financially their income and maintain their livelihoods. Though, lands used for UA are turning into gradually scarcer due to high competition from other land uses and the rapid population growth being skilled in many cities of the developing world. Information about land use /land covers change and its consequence on agricultural lands in-town location is important for enhancing food security and for appropriate management of land use (Foeken, 2006). This study's primary goal is to examine the effects of changes in land cover and use.

Urbanization and urban growth are considered modern ways of life manifesting economic growth and development. However, urbanization and urban development in Ethiopia faced some socio-economic problems (Tegenge, 2000).

For the purpose to determine the state of urban land use and land cover change in Deber Markos town, this study used multi-date satellite imagery to track these changes.

1.2 Statement of the Problem

The high cost of urbanization (settlements), agriculture, pasturing, deforestation, and road construction are some of the causes that lead to changes in land cover in Deber Markos town.

The population increase, land consumption charge, and climate are all reflected in these variations in LULC. The settlement of Deber Markos has grown, and this has caused environmental degradation in addition to the depletion of natural resources. Residential and other land use groups have replaced forest and agriculturally productive and unproductive land. The environmental and socioeconomic elements that affect a town's land use and land cover sample are the result of human usage of those factors throughout time and space. Rapid price of a city increase leads to speedy changes in land use and cowl than ever before, particularly in growing nations, are regularly characterized by the aid of unrestrained urban rambling, land degradation, or the transformation of agricultural land to other uses and resulting massive cost to the environment (Sankhala et al., 2014).

Planning problems in the study area include inappropriate land uses due to a lack of awareness or misconception about physical environment modifications due to land use changes, city policymakers being unsuccessful to provide due interest to urban agriculture and poor availability of spatial facts integral for urban planning. This improper land use extremely influences the local and/or regional environment, which was subsequently affecting the world's surroundings and it minimizes city greenness (Maru, 2014).

Over the years, Deber Markos City has also hosted LULCCs. The over-reliance on the land's resources has put a lot of burden on it. The town of Deber Markos has had fast population growth in the past, which has led to an overuse of the land and its resources. As a result of being primarily agricultural, most communities rely on the land for their nourishment and means of subsistence (Ziena Lingereh, 2017):

The purpose of this study is to evaluate and examine Debre Markos town's urban expansion. The vast majority of the nation's municipalities are currently receiving insufficient attention in terms of physical development and rapid population increase, which has a negative impact on agricultural output. In order to preserve some degree of influence over urban expansion, planning and decision-making are necessary given the uncontrollable issues with urban growth that exist now and in the future. Without current knowledge on a variety of urban area factors, this is not feasible. GIS and remote sensing methods can be used to obtain current data on urban expansion at a low cost and with frequent coverage.Thus, the goal is to investigate into how the dynamics of the urban landscape have influenced the research area's agricultural land since 1986.

1.3 Limitation of the Thesis

There are certain restrictions with the current project. Numerous obstacles must be overcome in this undertaking, ranging from gathering data to doing analysis. A few of these are listed below. Ground truth and verification are crucial for land use and land cover change detection, but they are challenging to get because of the political unrest in the research region. Despite its importance, this project encountered significant challenges related to funding and schedule limitations. The spectral signature of features is similar, making it challenging to map changes in urban land use and cover during picture interpretation and classification.

1.4 The study's objective

This study's main goals are to assess the state of urban land use and land cover change utilizing geographic information system and remote sensing techniques.

1.4.2 Specific Objectives

- Asses the trend of land use land cover (LULC) changes in the study area since 1986.
- Quantify the magnitude of urban land use land cover change.
- Evaluate the rate of urban land use land cover change on the study area.

1.4.3 Questions for Research

The following research questions were created in order to address the aforementioned goals.

- What has been the study area's trend in land cover and use changes since 1986?
- What is the magnitude of land use land cover changes in the study area?
- What is the rate of land use land cover change on the study area?

1.5 Scope of the Study

This study was focus mainly on the evaluating the status of land use land cover change detection by integrated GIS and remote sensing data and to mapping land use land cover change for Debre Markos town boundary since 1986 to 2020.

1.6 Importance of the Research

Changes in land cover and use have a big effect on the environment, socioeconomic systems, and natural resources. But in order to evaluate how changes in land use and cover will affect agriculture, it's critical to comprehend the patterns of land use and cover as well as the watershed's hydrological processes. An essential indicator for resource base analysis and the creation of suitable and effective response strategies for the sustainable management of natural resources in the nation as a whole, and in the study area specifically, is an understanding of the types and impacts of land use and land cover change.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Concepts and Definitions

The concept of urbanization is defined indifferent but interconnected ways. Urbanization is a process by which rural and areas are transforms in to town areas and which included the growth of city Population and natural increases of population (Mefekir W, 2017)

2.1.1 Land Use Land Cover

Land use and land cover changes are the most necessary and without difficulty detectable indicators of world ecological alternate (Birendra etal). Human activity has caused significant changes to the earth's surface over the past few decades, including deforestation, urbanization, and agricultural activities. Land is the biosphere's last remaining valuable resource, and research has exclusively used the concept of LU/LC as one. Regardless, these two phrases have distinct meanings and explain two separate problems. The term "land-cover" describes the biophysical cover that is present on the surface of the earth and comprises soil, water, plant, and rough surfaces. According to Di Gregorio and Jansen (2000), land-use refers to the exploitation or utilization of the land by human activities for the purposes of settlements, agriculture, forestry, and grazing modifying land surface approaches, which includes biogeochemistry, hydrology, and biodiversity.

The biophysical covering of land, such as natural areas, forests, structures, lakes, and highways, is referred to as land cover. The resources and features that are present on Earth's surface are referred to as land cover. It is the biological body found on the surface of the earth. The socioeconomic use of land for a specific purpose, such as agriculture, trade, residential usage, or recreation, is referred to as land use. At any one location, there may be several and alternative land uses. It depicts the way a society interacts with its physical surroundings, a fact that becomes evident when it is possible to see different social and economic systems occupying comparable spaces.

Changes in land-use and land-cover have emerged as major global issues, and they are a major force behind global environmental adjustments (FAO, 1999). International structures and cycles are changing as a result of these large-scale land-use classes brought about by the growth of agricultural land in rural areas, deforestation (tree clearing), urbanization, and other natural and man-made processes. Nonetheless, historically, the global expansion of agricultural land has been the primary alteration in land use (Houghton, 1994). The most important natural resource is land, which also includes water, soil, and the flora and flowers that grow there. As a result, the entire ecosystem is affected. Planning and administrative tasks require an understanding of the spatial pattern of land use and land cover. The characteristics of land use are means of the preparation, actions, and contributions people make to a particular sort of land in order to create, alter, or preserve it.

Urbanization refers to the process by which the growing proportion of the total population lives in the city and its suburbs. This is the movement of population from rural to urban areas, resulting in an increase in the proportion of the population living in urban areas rather than rural areas. Urbanization is a form of metropolitan growth, a response to a series of often embarrassing economic, social and political forces, and the physical geography of the region. Especially in developing countries, urban areas are increasing significantly due to population growth and immigration from rural areas to large cities. The pattern and pace of land development known as "urban sprawl" occurs when the amount of land used for urban purposes surpasses the rate of population increase. This leads to the wasteful and inefficient use of land and the resources that go along with it. Vanum and Meles (2012).

2.1.2 Application of GIS and Remote Sensing for the Field of ULULC

In the field of urban growth, remote sensing and geographic information systems have emerged as key instruments that support the assessment, monitoring, and management of land use and land cover resources. It enables the distinct theme layers of spatial data to be manipulated and analyzed. It is employed for modeling and assessing how the layers interact. Mapping land cover and use, as well as monitoring and managing land resources, can be done economically with remote sensing technologies. The literature on remote sensing demonstrates the enormous amount of work that has been done to map, track, and model land use and cover at the local, regional, and global stages (Chanara.p et al.,2012).

Remote sensing images are often composed of spectral classes that are relatively uniform in brightness levels across several bands. These images are useful to accurate analysis of land use and land cover mapping in part because land cover information can be interpreted more or less directly from evidence visible on aerial and satellite images. These satellites provide images that are extremely useful for managing, mapping, and keeping an eye on Earth's resources. Typically, these remotely sensed data have been used to create LULC maps (Luong, 1993). Because it can map inaccessible locations and provides a vast area coverage of data, remote sensing offers many advantages over ground survey methods (Baban, 1999). Remotely sensed picture acquisition frequency (temporal resolution) makes the system applicable to LULC change monitoring. To measure these changes, images of the same region taken at many times (multi-temporal) can be examined fast. Thus, remote sensing data offers comprehensive, precise, economical, and current information about various vegetation kinds and land uses. Data from remote sensing have shown to be helpful in data-poor areas with a deficiency of current, trustworthy spatial data (Dong et al. 1997).

The wealth of information offered by remote sensing data, particularly Landsat data, has proven beneficial to numerous LULC mapping initiatives (Seto et al. 2002, Yin et al. 2005). The world's longest continuously acquired collection of data from space-based terrestrial remote sensing is represented by Landsat. The Landsat satellite, which was first launched in 1972, has given scientists a wealth of data about our surroundings. People who work in the fields of agriculture, geology, forestry, education, regional planning, mapping, and global change study might benefit greatly from these photographs.

For this purpose, accurate information about changes in land cover and use is crucial to many groups. Since remotely sensed data offers information about land cover, it can be used to obtain this information. The study or practice of gathering data about an object or phenomenon on the surface of the earth without making direct physical touch with it is known as remote sensing. And this can be achieved by processing, analyzing, and applying the knowledge to a particular situation or by sensing and recording energy that is either emitted or reflected (Campbell, 2002). By fusing scientific insight with current knowledge, remote sensing of land cover and use offers

a glimpse into the future. Particular subjects include an outline of sophisticated and automated land-cover interpretation, as well as new and developing ideas in land-use/land-cover mapping.
Approaches, as well as an outline and forecast of the world's primary land-cover types (Chanara et al., 2012).

Not only is knowledge acquisition the main objective of remote sensing, but so is knowledge application. This objective is furthered by visual and digital image processing, which enables scientists to edit and analyze the picture data generated by the distant sensors in ways that may not be immediately apparent in the original form (Basudeb, 2011).An significant application for mapping land usage, land cover classification, and change detection is also made possible by this combination.

. In addition to traditional surveys, the utilization of contemporary technologies such as remote sensing and geographic information systems has shown promise in the research of geological, structural, and geomorphological conditions. Because satellite pictures are useful for identifying a variety of ground characteristics that might act as direct or indirect indicators of the presence of a groundwater potential zone, they are being employed more and more in the delineation of groundwater. An effective instrument for evaluating and measuring such multivariate characteristics of groundwater occurrence is the Geographic Information System.

2.1.3 Use of Land Mapping of Land Cover

The use of panchromatic, medium-scale aerial photographs to map land use has been an prevalent exercise in view that the 1940s. More recently, small-scale aerial snap shots and satellite pictures have been utilized for land use/land cowl mapping. Land cover Mapping serves as a simple stock of land resources for all degrees of authorities' environmental agencies, and personal enterprise all through the world. Whether regional or nearby in scope, remote sensing affords a potential of acquiring and providing land cowl records in a well-timed manner. Remote sensing techniques are the most sensible and price successfully system for obtaining a well-timed regional overview of land cover. Remote sensing information are successful of capturing changes in plant phonology (growth) in the course of the growing season, whether or not touching on to adjustments in chlorophyll content (detectable with VNIR) or structure adjustments via radar In addition, one-of-a-kind Land cover classes are normally mapped from digital remotely sensed statistics via the techniques of photograph classification (Basudeb.B. 2011)

2.1.4 Urban Agriculture

Agricultural communities are inhabitants of rural settlements that are mainly engaged in agriculture both crop and livestock production as well as forestry, fisheries and the development of land and water resource (Ciparisse, 2003).

Urban expansion has long been considered an indicator of regional economic viability and has been a significant area of study, mostly due to the movement of residential and commercial land to rural areas on the outskirts of urban cities. The production of food through agricultural and animal husbandry in and around urban areas is known as urban agriculture, or UA. It is probably as old as the first urban settlement, thus it is no longer a new phenomenon. Nowadays, agriculture makes up a larger and larger portion of the urban environment all over the world. Similar to many urban trends, agriculture transcends national boundaries and is evident in both wealthy and developing nations. Small communities and the largest city, temperate and tropical climates, sea level and high altitudes are all places where it is noticed.

2.1.5 Change Detection Analysis

Change detection is the process of identifying differences in the state of an object or phenomenon through observing its variation overtimes by using remote sensing techniques. The present usage of change detection is to track short-term processes like vegetation succession and geomorphologic processes, as well as long-term effects like long-term climatic changes caused by astronomical sources (Story and Congalton, 1986). Furthermore, according to Story and Congalton (2009), it is employed to keep an eye on human-caused climate change, deforestation, urbanization, and agricultural growth.

In the same way, changes in the environment are a reflection of land management practices, and change detection techniques can aid in the assessment of these actions (Brothers and Fish, 1978). There are four aspects of change detection which are important when monitoring natural resources and urban growth patterns namely: recognizing the changes that have taken place, determining their nature, verifying their area-wide breadth, and evaluating their spatial pattern (Pathak, 2014).

2.1.6 Training Samples/Signature Editor

Training sample is the process of defining the criteria with the aid of which these patterns are identified. To recognize patterns in the data, the computer system needs to be conducted. Both supervised and unsupervised image class techniques can be used for training. You specify representative samples for each land cover class in supervised classification. These "training sites" are then used by the software, which applies them to the full image. The spectral signature specified in the training set is used by the supervised type. For instance, it decides which class in the training set most closely resembles the other. The most popular methods for supervised classification are minimum-distance classification and maximum likelihood classification.

Maximum Likelihood Category was applied in the current study. A set of signatures that characterize a training sample or cluster is the end result of training. Every signature has a class associated with it. It is applied in conjunction with a decision rule to categorize the pixels in the image document. Both parametric and nonparametric signatures are possible. A parametric signature is one that relies on the statistical characteristics of the pixels, either within a cluster or the training pattern. A set of parametric signatures can be used to teach a statistically-based totally classifier to define the classes. Nonparametric signature: It isn't always based on information, however on discrete objects in a feature space image. These feature space objects are used to define the boundaries for the training. In supervised classification, spectral signatures are developed from specified locations in the image. These specified locations are given the generic name 'training sites' and were defined by means of the user.

2.2 Previous Related Findings

The impact of urbanization on peri-urban environment and livelihoods can be seen in two ways: positive and negative. According to Alaci (2010). The benefits could be seen in terms of high demand on agricultural produces, access to developed extension services, and opportunities to non-farm employment (Satterthwaite and Tacoli, 2003).

Ethiopia and other least urbanized nations continue to be advised to urbanize (Woldehanna, 2008). Government policies are regarded as important development interventions in encouraging urbanization, in addition to the multiple elements that drive it. Accordingly, the effects of urbanization on the peri-urban environment and livelihoods can be assessed in the same way as the consequences of any development project. The systematic identification of these intended or unintended good or negative consequences that a particular development effort brings about for households and the environment is known as impact evaluation (WB, 2004). Considering this idea, evaluation literatures can be divided into two main categories: the impact of urbanization-induced displacement on peri-urban livelihoods and environmental impact assessment, which focuses on land use and land cover dynamics analysis as a driver of change to peri-urban livelihoods.

Mandere et al. (2010) studied peri-urban livelihoods in peri-urban Nyahururu, Kenya, with the goal of determining how peri-urban development dynamics affected household income. Their findings demonstrated a drop in the economic importance of agriculture in these areas as a result of the urbanization effect, which is causing agricultural land to diminish significantly. The key elements that increased household participation in non-farm activities were determined to be the advancements in infrastructure and newly formed businesses. They came to the conclusion that peri-urban development depends on government policy, socioeconomic possibilities, and infrastructure advancements in addition to infrastructure. Lastly, they stressed how crucial it is for the government to get involved in order to improve agricultural productivity and manage the conversion of agricultural land for the sake of food security.

Tho (2006) also carried out research in the Ho Chi Minh City, Vietnam, Peri-Urban Area. The study sought to understand how household livelihood outcomes were constructed and to investigate livelihoods, particularly in agriculture. Tho applied descriptive analysis and a mix of qualitative and quantitative methodologies for data collection. One of his main conclusions was that young people are less likely to work in agriculture and are more likely to diversify their income sources into non-agricultural endeavors. Furthermore, it was discovered that lower-class households were more likely to rely on non-farm and rice-based income sources, whereas higher-income groups were more likely to focus on cash crop production.

However, differences were identified in the theoretical justifications of livelihood analysis based on the researchers' areas of interest and academic experience. For example, social anthropologist

Tadele (1999) explained the process of displacement and resettlement caused by urbanization using Scudder and Colsons's Prosessual Model and Cernea's Impoverishment Risk Model. This methodology describes development-induced displacement and resettlement initiatives more qualitatively. Additionally, it does not establish objectively quantifiable indicators for the welfare status following displacement.

Assessment of households that have been relocated due to urbanization. Abdissa (2005) described the displacement brought on by urbanization in the peri-urban districts of Addis Abeba city using the sustainable livelihoods framework (DFID, 1999). This paradigm aids in answering the question, "Given a particular context, what combination of livelihood resources results in the ability to follow what combination of livelihood strategies with what outcomes?" as stated by Scoones (1998). Despite being extensively utilized in the research of rural livelihoods, this framework is increasingly finding application in the analysis of urban livelihoods (Farrington et al 2002). Although these frameworks are used to qualitatively explain livelihood conditions, it appears that quantitative analysis techniques are rarely applied.

When it is not possible to create treatment and comparison groups through experimental design, quasi-experimental methods can be employed to assess the impact of urbanization-induced displacement on the welfare condition of displaced households. These methods provide comparison groups that, in terms of observable traits at least, are similar to the treatment group. Ecometric methods, such as matching procedures, can be used to accomplish this. Matching comparison procedures are widely regarded as the second-best alternative to experimental design among quasi-experimental design techniques. Propensity score matching approaches have made significant strides in recent years (Rosenbaum and Rubin, 1983; Jalan and Ravallion, 1999).

Because this method can be applied to a single cross-section of data, it is particularly attractive to evaluators who are working under time restrictions and do not have access to baseline data (Baker, 2000). Using the random utility model (Verbeek, 2004), participation decisions in livelihood strategies can be observed. According to this concept, a certain alternative for a livelihood strategy is selected if its value outweighs that of other options. Put otherwise, the random utility model is based on the idea that the decision-maker choose the option that would maximize his or her own utility. Multinomial logit (MNL) and multinomial probit (MNP) models are the most widely utilized multinomial models for unordered categorical response variables (Greene, 2003; Maddala, 1993; Verbeek, 2004). In this study, MNP and MNL models underwent testing. The MNP model was run using the asmprobit function in STATA (Kropko, 2010; STATA Corp, 2007). Nevertheless, the MNL model was employed since the algorithm was unable to converge (Keane, 1992; Khan, 2008) both MNP and MNL models were tested. The MNP model was executed following asmprobit procedure in STATA (STATA Corp, 2007; Kropko, 2010). However, the algorithm failed to converge, and MNL model was used (Keane, 1992; Khan, 2008).

CHAPTER THREE

3. Study Methodology

3.1 Description of the Study Area

The town's administrator, Dejazmach Tedla Gualu, established Debre Markos Town in 1852. At first, it was known as Menkorer. The town was renamed Debre Markos after King Tekle Haimanot, who came to power in 1879, declared that the town would now be called Debre Markos rather than Menkorer as a result of the founding of Saint Markos church. When it was founded, the entire area covered 272 hectares. The town currently serves as the seat of the East Gojjam zone and was the administrative center of the province of Gojjam until 1995. A 2009 structure plan was created for the town. In spite of the town's advanced age, the socioeconomic standing of its residents while the region's infrastructure improvements were virtually put on hold for several decades. However, the socioeconomic standing of society is currently making significant development, driven by the liberalized free market economy and other stimulating tools provided by the local government (Temesgen Me, 2019).

3.1.1 Topography

Debre Markos town characterized by plain flat plain topographic landscape although there have been different rivers and hill shade features towards to peripheral town which are the main constraints for physical expansion of the town.Debre Markosis far from Addis Ababa by 300 km the elevation of town is fail between 2249_2509 (Debre Markos Town Administration).

Hills, marshes, streams, and timberlands with a slope of between 2 and 10% are the basic characteristics that restrict the Debre Markos town's physical growth. Illegal settlements and urban-rural limit confrontations are the synthetic constraints. The Debre Markos town region is not very conducive to urban growth. This is mostly due to the town's layout, which is divided by three sections of swamps and, to a lesser degree, by ridges, gullies, and escarpments. Three rivers that flow to the south but in various directions drain the town as well: the Wuseta, Wutrin, and Abahim. For example, Wutrin drains the town's western portion, and Wuseta drains its eastern portion. The main water supply in Wutrin is especially the marshy area.availability. Generally, the town and its surroundings rely mostly on the marshy areas along these riverbanks for grazing land (NUPI, 2001 quoted by Mulualem: 2009; Ziena, 2017)

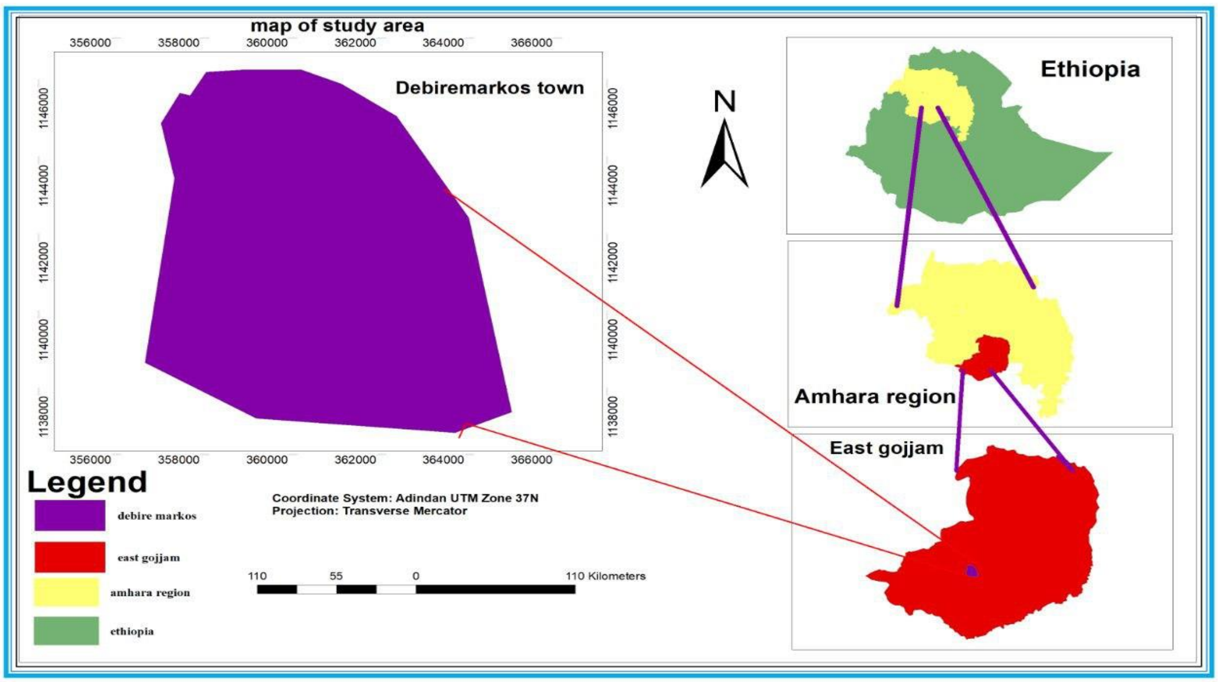

Figure 3-1 Location of the Study Area

3.1.2 Population

The Central Statistical Agency of Ethiopia (CSA) performed a national census in 2007, which gave the population of Debre Markos 262,497 people in 2012—129,921 men and 132,576 women. 97.03% of the population identified as Ethiopian Orthodox Christians, with 1.7% and 1.1% of the population being Muslims and Protestants, respectively, making up the majority.

3.1.3 Climate

Despite being close to the equator, the climate is subtropical highland (Köppen: Cwb), as is typical of Ethiopia's higher regions. With an average monthly temperature of 25.1 °C, March is the warmest month and July is the coldest (18.9 °C). Rainfall varies significantly throughout the year, ranging from 12 mm in January to 309 mm in July. As such, it continues to be the primary factor separating the four seasons.

3.1.4 Software and materials Used

The following software's were used for this study;

(a) ERDAS Imagine 2015: this program was used to display the image and then process and improve it. This software was also used in the development of the land LULC classes.
(b) ArcGIS 10.8: This was also utilized to enhance the way the data was processed and displayed. Analysis for change detection also made use of this.
(c) Other's Microsoft Word 2010 and Microsoft Excel 2013.

3.2 Acquiring of Satellite Images

In order to achieve the current study's goals, three satellite images are available for download from the USGS's online databases. These images are then spatially referenced in the Universal Transverse Mercator (UTM) projection using the World Geodetic System (WGS) 1984 UTM zone 37N as the datum. After the photos are extracted into Tiff formats for processing, table 3.1 below provides a summary of each image's detailed attributes. For the purpose of detecting changes in urban land use and land cover, data from Landsat Thematic Mapper (TM), Enhanced Thematic Mapper (ETM+), and Operational Land Imager-Thematic Infrared Sensor (OLI-TIRS) offers a number of benefits. The present analysis utilizes Landsat imagery from TM, ETM+, and OLI-TIRS, which were obtained during the same February season and at the same resolution for the years 1986, 2003, and 2020.The outcome of the height of these Landsat photos is 30 meters.

They are therefore useful for comparing trends and changes that have happened over the time under discussion. Due to their constant spatial and temporal resolutions. These remotely sensed images were used and processed for identifying urban land use/land cover change as an indicator of urban landscape dynamics patterns of the study area.

Table 3-0-1 Characteristics of Satellite Image

No.	Data type	Date of acquisition	Path/row	Source
1	Landsat -5 TM image	12/3/1986	169/53	earthexplorer.usgs.gov
2	Landsat -7 TM image	8/3/2003	169/53	earthexplorer.usgs.gov
3	Landsat -8 OLI image	27/3/2020	169/53	earthexplorer.usgs.gov

3.3 Pre-processing raw satellite image

Raw satellite image will not be directly utilized for features identification and different associated. Applications because of the hassle to correctly identify every features of the picture. As a result, Pre-processing is carried out earlier than the principle statistics evaluation and extraction of information. Preprocessing entails primary strategies: geometric correction and radiometric correction or Haze elimination. Faraway sensing imageries are inherently subjected to geometric distortions. Therefore, on this look at the subsequent pre-processing become carried out:

Land sat 8 bands 5-4-three (R-G-B), Land-sat TM bands 4-3- 2 (R-G-B) and ETM+ 4-three-2 (R-G-B) due to the fact multispectral photo bands help in next Human interpretation or gadget analysis. There are numerous alternative of radiometric correction for this study histogram equalization and haze reduction methods employed using ERDAS Imagine 2015. First, choose the tagged imagine file format (tiff) from the data source, upload the data, and then use the raster tab radiometric tool set (a set of instruments for brightness correction). Finally, the image's haze was erased.

3.4 Image Enhancement and Visual Interpretation

The aim of image enhancement is to enhance the overall visual interpretability of an image by increasing the apparent difference among the features. Image enhancement improves the clarity of images for human viewing by removing blurring and noise, increasing contrast, and revealing details. The process of visually decoding more appropriate digital imagery aims to maximize the complementing abilities of computers and human minds. The human mind is remarkably adept at interpreting spatial characteristics in images and can discern subtle or hazy aspects (Lillesand and Kiefer, 1994). All of the photos underwent comparison stretching, resulting in the creation of fake color composites (FCC). On-screen digitization is used to visually interpret these FCC in order to distinguish between kinds of land cover that are easily understood, including water and urban areas. Using novel techniques, satellite bands were created to detect floor characteristics in the research area.The RGB 321 combination has become widely utilized to represent true color composites, in which band 3 represents red, band 2 represents green, and band 1 represents blue. An further composite with the name "false color composite" makes use of the RGB combination 432. Band 2 corresponds to green, band 3 to red, and band 4 to the NIR infrared in this band combination. When detecting flora that appears red in 432 combinations, this combination provides a stronger visual representation. When the false color (432) combination is used, the water seems blue and in various degrees of blue, while the vegetation appears red and dark red.

3.5 Sub setting/Clipping of AIO/Area of interest

Area of Interest/Study Area is referred to as AIO. It refers to the region displayed in the remote sensing image in remote sensing. The study area and AIO should be subsetted or clipped using a shape file or by utilizing GIS or ERDAS IMADINE software to determine the study area's border, as the Landsat image acquired from USGS online services covers a broad area beyond the study area.

3.6 Training and Test Point Collection

Training areas/sample objects which are typical representatives of the classes were collected Using high resolution images; existing land cover maps, analyst's personal experiences and knowledge of the physiographical nature of the area. In addition, image enhancement And composition were applied for better discriminating the land cover classes. Training samples for 1986,2003 and 2020 images were collected using topographic maps for each classes , agriculture, 171, Built up 123 ,forest 114 , grassland 72 wetland 77 and totally 303 polygons also accuracy testing points were randomly collected from Topographic maps and field data collection. From Google earth.

Table 3-0-2 Random Test points for sample data

Class Name	year			Total
	1986	2003	2020	
Agriculture area	68	74	29	171
Built-up	17	37	32	123
Forest Area	23	47	44	114
Grasslands Area	38	18	16	72
Wetland area	11	38	28	77

The accuracy of the 1986, 2003, and 2020 classified imagery was generally assessed with 520 points.

3.7 After Classification

By eliminating extraneous pixels from the image and creating more homogeneous class areas, post classification filtering broadens the dataset. Prior to evaluating the accuracy of the image data, filtering is advised. Therefore, post classification was carried out following supervised classification. Maximum likelihood and minimum-distance classification are two popular supervised classification techniques. Maximum Likelihood Classification in This Study

were applied. While some strategies make generalizations or eliminate small class patches, others smooth out boundaries. Majority analysis was done in this project. Due to variations in the phonology of the vegetation and soil wetness between the two scenarios, poor performance may have resulted from the application of image augmentation techniques. Classification-based methods have been proven to be more robust when processing data taken at different periods of the year and less sensitive at these spectral fluctuations. As a result, it will be the most accurate method and have the benefit of showing how land use and land cover have changed in the studied area.

3.8 Accuracy Assessments

An accuracy assessment is used to examine the land cover classifications produced from remotely sensed data. By creating an error matrix that contrasted the interpreted land cover map with a map that shows the findings of ground truth inquiry, an accuracy evaluation study was carried out.

.In the study of image processing the term "accuracy" means a measure of consistency with reliable information in a spatial point with data on the classified image [Jensen 1996].

The following steps for error assessment were used in this project. First, identify the total quantity of samples required for every category; second, devise a suitable sampling plan; third, gather ground reference data at the sample sites; fourth, create an error matrix; and fifth, assess the error matrices, producer accuracy, user accuracy, commission, and omission. The degree of agreement between categorization and truth values is gauged by the kappa coefficient. Perfect agreement is represented by a kappa value of 1, and no agreement is represented by a value of 0. This is how the kappa coefficient is calculated:

$$\kappa = \frac{N \sum_{i=1}^{n} m_{i,i} - \sum_{i=1}^{n}(G_i\, C_i)}{N^2 - \sum_{i=1}^{n}(G_i\, C_i)}$$

Where:

- N is the total number of classified values relative to truth values;
- I is the class number.

  • M i, i is the total number of values (i.e., values discovered along the confusion matrix's diagonal) that are classed as class i and belong to the truth class i.

  • The total number of expected values that belong to class I is denoted by Ci.

  • Gi is the total amount of class I truth values.

Generally the following procedure was described in the whole Methodology of the project:

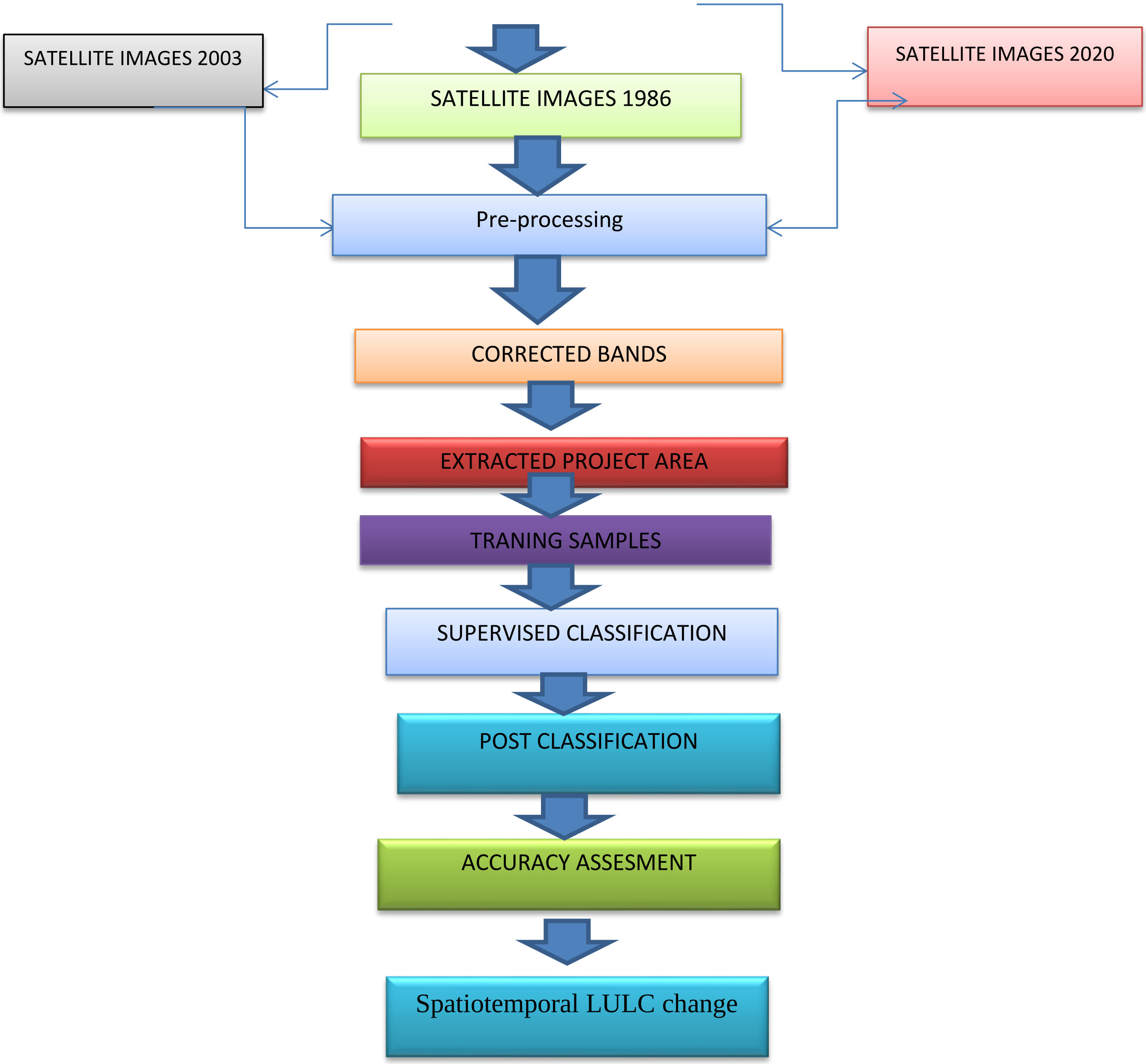

Figure 3-2 Flow Chart of Research Methodology

CHAPTER FOUR

4. Result and Discussion

4.1 Accuracy of the Classification maps

There are many different kinds of inaccuracies in classified land cover maps created from remotely sensed imagery. It is the duty of the researcher to identify these mistakes so that the resulting land cover maps are trustworthy and simple for consumers to understand. Accuracy evaluation should be handled after the classified image is incorporated into a GIS so that it may serve as a resource for scholars and urban planners. This is because it can restrict the classification outcomes of remotely sensed imagery data. To evaluate the accuracy of the classification, a land use/land cover result classification accuracy assessment was conducted.The reference data was obtained from sample points which were prepared by considering random sampling that was collected from field observation, using information from key informants during field observation and Google earth.

Based on these classification accuracies, the overall accuracy for the year 1986, 2003 and 2020 are 96%, 93% and 99% respectively. According to the study's user accuracy results, in 1986 the class with the most accuracy was grassland, which was correctly classified at 96%, while the class with the lowest accuracy was agriculture, which was only 58% accurate, as shown in table 4.3 below. As shown in tables 4.1 and 4.2, respectively, the class accuracies vary from 67% to 88% in 2003 and from 74% to 99% in 2020. The vegetation class had the highest class accuracy (user accuracy) for the year 2003, 96%, and the open space class had the lowest, 58%, as shown in table 4.1 below. According to table 4.2, the highest user accuracy in 2020 was 89% for correctly categorized aquatic bodies, while the lowest accuracy was 74% for built-up regions.Because the spectral properties of several land cover classes were similar, the lowest values of class accuracies were misclassified. Tables 4.1 and 4.2 demonstrate that the user's accuracy was lowest for open area since a significant portion of it was incorrectly labeled as built up. vegetation and farm land. In addition table 4.3 shows the detailed result of accuracy assessment of each year and feature class's classification accuracies result. The kappa coefficient (K_hat) for the year 1986, 2003, and 2020 are 94.6%, 91% and 93% respectively. According to

(Thomas M. Lillesand et al, 2004), when the kappa coefficient is approaches to 1 indicates that the classification is better and if it approaches to negative value indicates that the classification is poor performance. Based on this analysis the kappa coefficients Are approaches to 1 therefore the classification is good performance. The three days accuracy assessments all classes (open area, Farm land, built up area and) had relatively high producer accuracies and they had low omission errors. This indicates that the reference sample point was relatively correctly classified. However, the producer accuracy in 2003 for wetland and forest relatively low when compare to the other classes, it indicating that exposed overlap between

Table 4-1 Confusion Matrix Table for 1986 land use and land cover

		Reference Data							
Classified Data		**Agriculture**	**Built-up**	**Forest**	**Grassland**	**Wetland Area**	**Total**	**User Accur**	**Commission error**
	Agriculture	**68**	**1**	**0**	**0**	**0**	**69**	**98%**	1.5%
	Built-up	**0**	**13**	**0**	**0**	**0**	**13**	**100%**	0
	Forest	**0**	**1**	**23**	**0**	**0**	**24**	**96%**	4%
	Grassland	**0**	**2**	**0**	**36**	**0**	**38**	**95%**	5%
	Wetland Area	**0**	**0**	**0**	**2**	**11**	**13**	**85%**	15%
	Total	**68**	**17**	**23**	**38**	**11**	**157**		
	Producer Accuracy	**100%**	**76%**	**100%**	**95%**	**100%**			
	Omission error	**0**	**23.5%**	**0**	**5%**	**0**			

Overall accuracy=96%

Kappa Coefficient=94.6%

4.1.1 User's Accuracy

User precision The number of pixels in each class grouping that were correctly classified divided by the total number of pixels that were classified in that category of the classified image (row total) is sometimes used to calculate consumer accuracy. It shows the likelihood that a pixel classified into a certain category corresponds to that category in reality. The study's results on user accuracy revealed that, in 1986, the highest class accuracy was 100%, indicating that all pixels were correctly identified. The lowest class accuracy was 85%, indicating that some pixels were incorrectly labeled as agricultural land. Table 4.5 below illustrates this data. While the class accuracies in 2003 ranged from 67% to 88%, they vary from 86% to 88% in 2020.

The lowest values of class accuracies were misclassified because of spectral property similarities among different land cover classes, as seen in tables 4.3, where it varies from 86% to 97%. Especially spectral in grasslands and wetlands Accuracy of grassland class was impacted by similarities. Tables 4.1, 4.2, and 4.3 demonstrate that in 1986, the user's accuracy was lowest for wetlands. In 2020, a wetland was misclassified.During the research periods, there was a general misclassification of agricultural land and vegetation cover. Furthermore, a major factor in these misclassification issues is the timing of image acquisition. With a relatively lengthy history of space-based data gathering at a worldwide scale, Landsat pictures may be the most popular data source for classifying land use and cover, even in the study of urban environments.

4.1.2 Producer's Accuracy

The number of correctly classified pixels in each class (category) divided by the total number of pixels in the reference data that fall into that category (column total) is the measure of the accuracy of the producer. is classified. As shown in table 4.6 grassland was largely misclassified as 58 % because the number of training samples was lower .grassland became a low accuracy of 67 % following wetland however wetland lower classification is also not solved in the 2020 may be Agricultural land reflectance similarity leads to lower accuracy of the vegetation or Forest misclassified. The lowest values for Agricultural as compared with other land use land to cover the best producer accuracy in the study period 1986, 2003 and 2020.

4.1.3 Overall Accuracy

It is calculated by dividing the total number of reference pixels by the total number of correctly identified pixels, or the sum of the elements along the major diagonal. It displays the total tabular error matrix findings. It is calculated by dividing the total number of reference pixels by the total number of correctly identified pixels, or the sum of the elements along the major diagonal. It displays the tabular error matrix's total findings. During this study period, the overall accuracy was 96% (4.1) in 1986, 93% (4.2) in 2003, and 94% (4.3) in 2020. According to Anderson et al. (1976), for a trustworthy classification of land cover, the error matrix should yield a minimum overall accuracy value of 85%. Foody (2002), however, shown that this baseline is meaningless as a globally recognized accuracy criterion. This is thus because a universal standard does not have a precise relationship to any one field of study. Foody (2002) further highlights the fact that the criteria for map evaluation for universal applications are not thoroughly explained by Anderson et al. (1976). Furthermore, Lu et al. (2004) pointed out that a wide range of factors, including the quantity and quality of ground truth data, the study area's complexity, the change detection methods or algorithms employed, and the classification and change detection schemes, all have a significant impact on the accuracy of change detection results. Thus, both maps' overall accuracies

Table 4 2: Land Cover Map of 2003 Confusion Matrix

		Reference Data							
Classified Data		**Agriculture**	**Built-up**	**Forest**	**Grassland**	**Wetland Area**	**Total**	**User Accuracy%**	**Commission error**
	Agriculture	**70**	**0**	**0**	**2**	**0**	**72**	**97%**	**3%**
	Built-up	**1**	**37**	**1**	**1**	**0**	**40**	**92%**	**8%**
	Forest	**2**	**0**	**44**	**2**	**0**	**48**	**92%**	**8%**
	Grassland	**0**	**0**	**0**	**11**	**0**	**11**	**100%**	**0%**
	Wetland Area	**1**	**0**	**2**	**2**	**38**	**43**	**88%**	**12%**
	Total	**74**	**37**	**47**	**18**	**38**	**214**		
	Producer Accuracy%	**94%**	**100%**	**94%**	**61%**	**100%**			
	Omission error	5%	0%	6%	39%	0%			

OVER ALL ACCURACY = 93%

Kappa Coefficient=91%

Table 4 3: Land Cover Map of 2020 Confusion Matrix

		Reference Data							
Classified Data		Agriculture	Built-up	Forest	Grassland	Wetland Area	Total	User Accuracy%	Commission error
	Agriculture	26	1	0	0	0	27	96%	3.7%
	Built-up	1	31	0	0	0	32	96%	3%
	Forest	0	0	44	0	1	45	97%	2.2%
	Grassland	0	0	0	14	1	15	93%	6.7%
	Wetland Area	2	0	0	2	26	30	86%	13.3%
	Total	29	32	44	16	28	149		
	Producer Accuracy %	89%	96|%	1	87%	92%			
	Omission error	10%	3%	0	12.5%	7%			

OVER ALL ACCURACY = 94%

Kappa Coefficient=93%

4.2 Spatial Distribution of Land Cover Dynamics

Table 4.1 displays the land cover dynamics' spatial distribution in the area as of 1986. A forest containing permanent, farmed, and fallow fields is considered agricultural land. The majority of the land, covering the maximum area of 2538.78 hectares, was farmed on a massive scale. The town's economy in 1986 depended heavily on large-scale agricultural production, which needed to continue in order to keep the economy strong. Debre-Markos was primarily made up of farmed and barren land in 1986, together making up 41.62% of the total area. On the other hand, only 1380.33 ha, or 16.93% of the total area, were covered by the urban built-up area. 1380.33

hectares of built-up land, made up of residential, commercial, and industrial spaces, were ascribed to less developments and an increase in

Farming pursuits. This scenario, which involves a small, condensed metropolitan region, illustrates the low degree of growth in 1986. This suggested that Debre Markos was predominantly an agricultural area at a time when urban development was only getting started. This was explained by the fact that farmland had been cleared in advance of planting season. There are around 775.43 hectares shared by grassland cover, 8.12 hectares under wetland, and the least amount of land occupied by forest.

Table 4-2 Land Cover Dynamics below 1986

No.	Class_name86	Area (H)	Area (%)
1	Wetland area	495.43	8.121670137
2	Grassland Area	775.43	12.71175882
3	forest Area	910.13	14.91991935
4	Built-up Area	1380.33	22.62798971
5	Agriculture area	2538.78	41.61866199
		6100.1	100
Total			

Table 4.2 shows that the overall area of agricultural land in the study region in 2003 was 1872.596 hectares, a drop from the 2538.78 hectares recorded in 1986. As part of the urbanization trend, agricultural land was continuously being pushed and transformed to urban uses. 32.60% of the research area was comprised of agricultural areas in 2003. The study area's most common land cover class was agricultural land, as shown by figures 4.3 below and Table 4.2. However, from 32.62% in 2003 to 25.23% in 2020, there was a consistent decline in this land cover class. Throughout the studied periods, built-up areas have dynamically risen due to the continuous decreases in agricultural areas. A decline in farm size or the total eviction of agricultural land has resulted from this horizontal physical expansion.

The poor use of energy and land resources as well as the widespread encroachment of urban expansion onto agricultural land have been criticized (Cheng, 2003). There was a reduction in both the agricultural and plantation covers. According to Rahman et al. (2008), urban sprawl is defined as a condition in which urban development adversely affects an urban setting that is neither appropriate for an agricultural rural environment nor an acceptable urban situation. On the other hand, the area covered by built-up land grew from 1380.33 hectares in 1986 to 1990.59 hectares in 2003. The analysis of land cover change during the first ten years, from 1986 to 2003, showed that the built-up area increased steadily and eventually tripled. This concentrated especially in the western-east portion of the city, where the percentage of land covered by built-up or settlement land went from 16.93% in 1986 to 22.53% in 2003. This increase was directly linked to the ongoing development of residential and commercial structures to support the local population. The clearing of agricultural land for planting season is responsible for the rise in the area covered by built-up land.From 905 hectares in 1986 to 910.13 hectares in the present, less land was covered by forest cover. Grassland bodies unexpectedly grew from 775.35 hectares in 1986 to 882.35 hectares in 2003. The area covered by wetlands dropped from 449.1444 hectares in 1986 to 495.43 hectares. Depicts the land use distribution in the Debre Markos region in 2003. It is apparent that the developed had grown in comparison to 1986 and was now dispersing throughout the study area's north, south, and southwest.

Table 4-3 Land Cover Dynamics below 2003

Id	class_name2003	area(H)	Area (%)
1	built-up	1990.596	16.93107627
2	wetland	449.1444	7.421947863
3	agriculture	1872.596	32.5964315
4	forest	905.882	18.27429786
5	grassland	882.352	24.77624651
	Total	6100.57	100

Source: Extracted from Landsat 7(ETM+) image of 2003

In 2020, the area under agricultural land had decreased from 1872.596 hectares (32.59% of the total study area) to 1539.37 hectares (25.23% of the total study area); while built-up land had increased to an area of 2904.87 hectares (47.62% of the total study area, gaining more than 914 hectares of land representing 22.39% of the land area in the study area. This indicates that the majority of urban growth was happening beyond the city center, in the surrounding area. The area under forest cover decreased to 582.9 hectares as compared to 905 hectares recorded in

2003.The area covered by wetland decreased to cover 397.43 hectares compared to 449.1444 hectares in 2020, while the area under grassland decreased and occupied a total area of 882.352 hectares compared to 676.17 hectares in 2020 compared to 676.17 hectares in 2020.

Table 4-4 Land Cover Dynamics below 2020

No.	Class_name2020	Area(ha)	Area (%)
1	Agriculture	1539.37	25.23
2	Built-up	2904.87	47.62
3	Forest	582.9	9.55
4	Grassland	676.17	11.08
5	Wetland Area	397.43	6.51
	Total	6100.196	100

Source: Extracted from Landsat 8(OLI) image 2020

It is clear that there was a decrease in the area used for agriculture. There was only a slight decrease in the area covered by agricultural land between 1986 and 2020; it occupied 2538.78 hectares and 1539.37 hectares, respectively, a decrease of 999.41 hectares. This stands in stark contrast to the built-up land reduction of 1990.596 hectares between 2003 and 2020, when it occupied an area of 2904.87 hectares, further inclined. The surrounding farmland had been swallowed up by this growth of built-up area.

Table 4-5 Rate and Magnitude of Built up Area Expansion (1986-2020)

	Study period	**Built-up** area in(ha)	Expansion(ha)	Expansion (%)
1	1986	1380.33	16.93	0
2	2003	1990.596	22.63	5.7
3	2020	2904.87	47.62	29.99

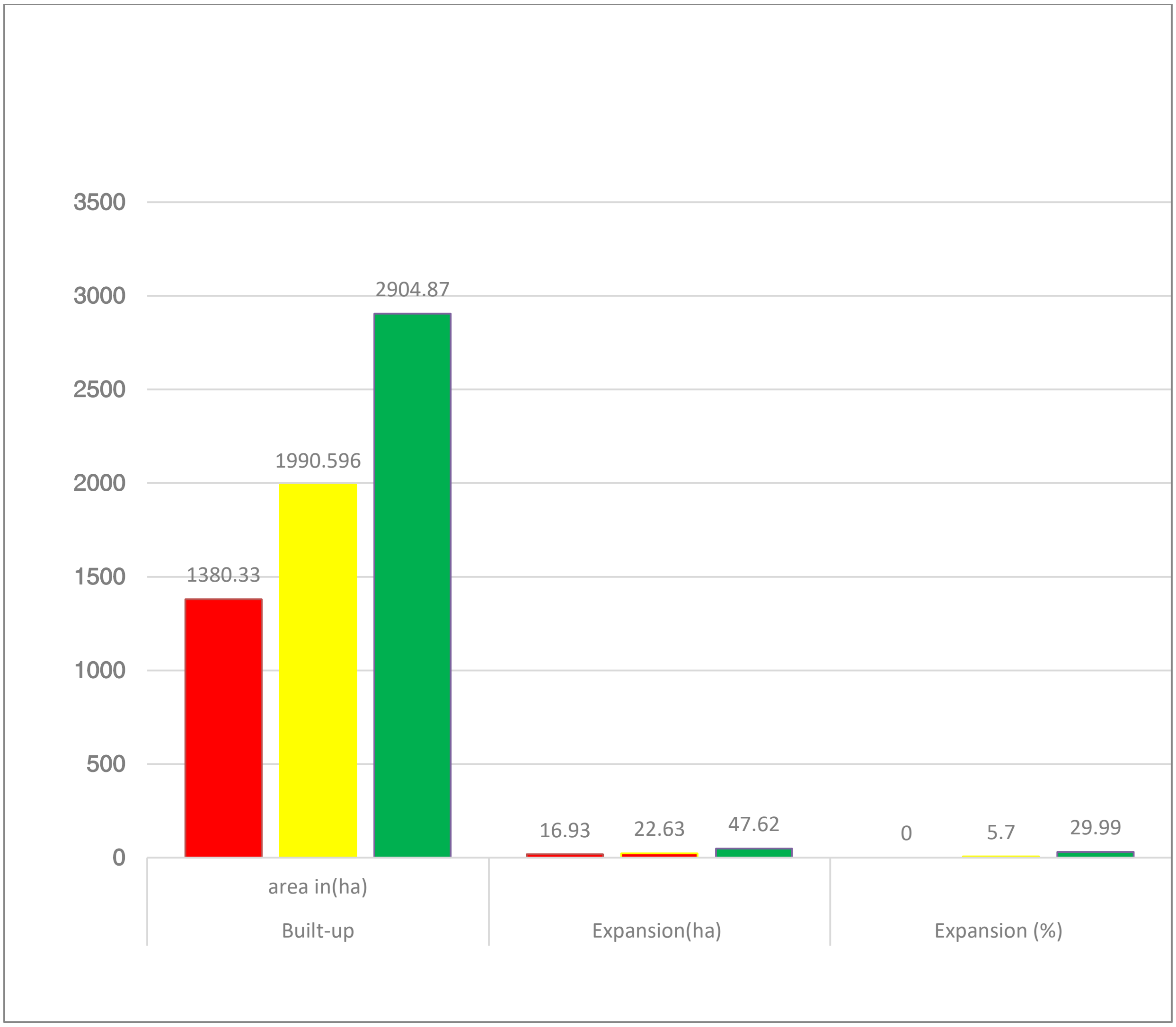

Figure 4-1 shows the built-up area over 34 years, from 1986 to 2020.

The built-up area was compared during a 34-year period, from 1986 to 2020, to determine the changes table 4.7. Between 1986 and 2020, the town's built-up area expanded by 905 hectares, representing a 159.6% expansion, with an annual growth rate of 60.33 hectares (Table 4.7). To determine the changes in the built-up area, the production from 2003 to 2020 was also compared (table 4.7). The town's built-up area increased by 2301.79 hectares between 1986 and 2020, or roughly 156.4%. The growth rate was also roughly 135.4 ha.

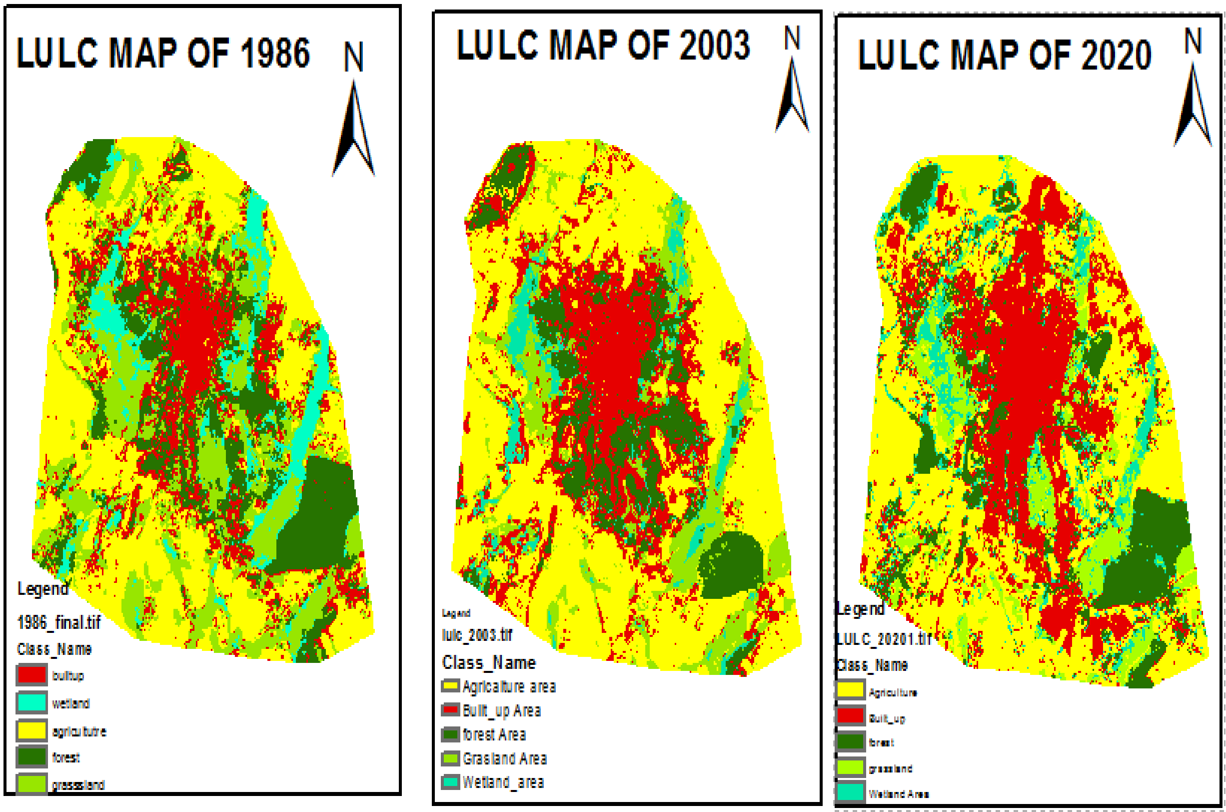

Figure 4-1 the comparison of the LULC MAP

Table 4-6 the area in hectares and the percentage change for each year (1986, 2003 and 2020) measured each LULC type

	1986		2003		2020	
Class Name	**Area (Ha)**	**Area (%)**	**Area (Ha)**	**Area (%)**	**Area (Ha)**	**Area (%)**
Agriculture area	**2538.78**	**41.62**	**1872.596**	**32.60**	**1539.37**	**25.23**
Built-up	**1380.33**	**16.93**	**1990.596**	**22.63**	**2904.87**	**47.62**
Forest Area	**910.13**	**14.92**	**880.882**	**14.44**	**582.9**	**9.55**
Grasslands Area	**775.43**	**12.71**	**659.352**	**10.81**	**676.17**	**11.08**
Wetland area	**495.43**	**8.12**	**449.1444**	**7.42**	**397.07**	**6.51**
Class Total	**6100.1**	**100**	**6100.078**	**100**	**6100.196**	**100**

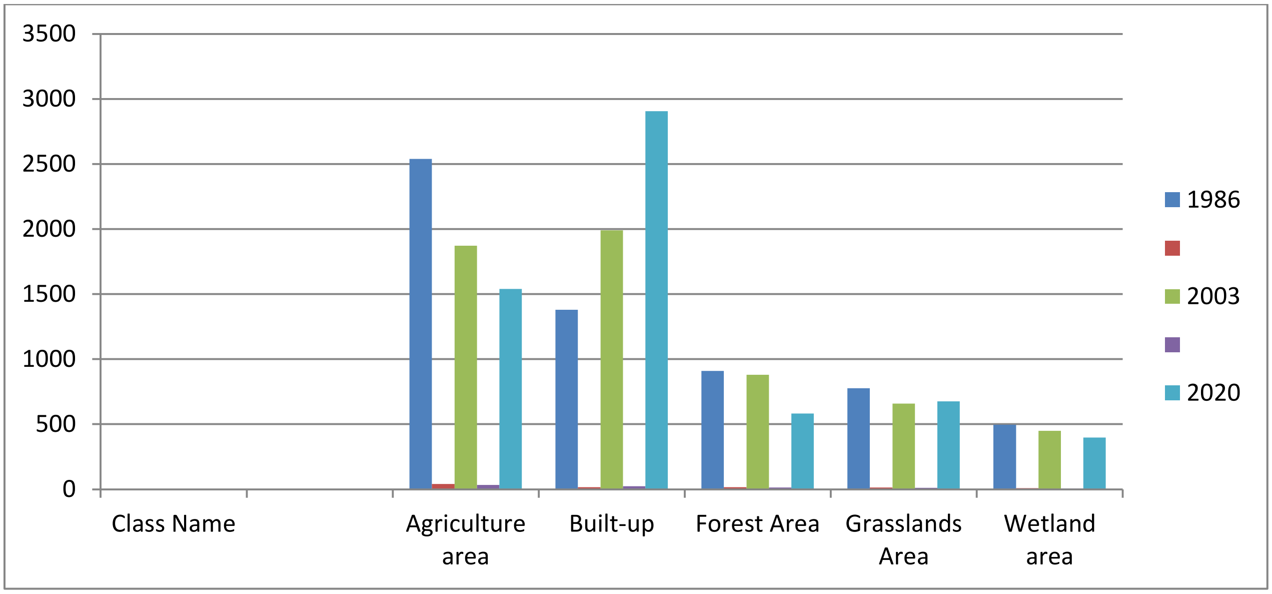

Figure 4-2 the area in hectares and the percentage change for each year (1986, 2003and 2020) measured against each LULC type

4.3 Land use land cover change in Built up area

Built-up areas contributed more to LULCC on agricultural land because of the study's goal of mapping land use, land cover change, and its impact on urban agriculture. As a result, built-up regions received more attention than other land use/land cover classifications. The aforementioned data demonstrates that between 1986 and 2020, constructed areas strictly increased. The town's horizontal growth toward agricultural areas is correlated with the increase in built-up areas. As a result, the amount of agricultural land decreased and it changed to accommodate building uses. As seen in figure 4.8 above, a reclassification was done to create land use and land cover maps of built up and none built up areas in order to investigate the characteristics and size of the built up areas. Table 4.8 makes this quite evident: in 1986, built-up areas made up 16.93% of the total study area. The proportion of built-up areas increased from 22.63% in 2003 to 47.62 % of the total area covered in 2020.

Urbanization is growing quickly in the project region year over year, as the figure (1986_2020) illustrates.Owing to the strong demand for land for various uses, including the commercial, residential, and educational sectors, as well as other factors related to the area's suitability, areas close to rivers were unsuitable for built-up habitation, which caused the expansion into agricultural lands. Land for urban agriculture is thus becoming scarce, which results in limited land utilization for urban farms. Various studies, such as Maru A. (2014), claim that free grazing destroys grasses, forest trees, and microorganisms when left unchecked. However, in the study area, some grazing areas are privately owned, which results in a lack of open space for other farmers and the conversion of some grazing areas into built-up areas.

4.4 LULC Change Detection and its Impact on the environment

The research region underwent a multi-date post-classification comparative change detection process to look into changes in land cover between 1986 and 2020. The five classes used in the post-classification change detection were built-up, forested, agricultural, grassland, and wetland areas. The categorization process was supervised. As a result, the land transition matrix was quantified using the 1986, 2003, and 2020 classifications as inputs (Tables 4.8, 4.9, and 4.10). By comparing the three thematic levels, land coverings that had changed and those that had not were distinguished. Different forms of land cover varied during the three years that were studied, but the same types of land cover did not alter.

The diagonal values (Tables 4.8, 4.9, 4.10) of the cross tabulation matrix that are colored in green correspond to land uses and land covers that remained consistent over the designated years. To find the theme change detection, each 1986 land cover categorization's area was removed from 2003. Of the 2542.184 hectares put to use for agriculture in 1986, 1872.184 hectares did not change over a 34-year period, while 366.4455 hectares did. The data indicate the degree of conversion for the built-up area, which was 368.4875 hectares out of 1990.While 268.435 hectares of the same forest land were changed to forest area, 9225 hectares of built-up area were converted to built-up areas. Out of the entire 774.967 hectares of grassland area cover, 907.075 hectares are now wetland area, 526.18 hectares are now grassland, and 249.615 hectares are now built-up. Of the 4.01 hectares of wetland total, 0.91 hectares are now built-up land, and the remaining 0.19 and 1.62 hectares are now covered by forest area and agricultural, respectively. This shows that a sizable portion of wetland bodies have been transformed for agricultural purposes by draining agriculture and overgrazing, as well as for the building of infrastructure, businesses, and residences in urban areas.

Table 4-7 Land use/Land cover transition matrix (ha) from 1985 to 2000

	2003						
		Agricultural area	Built_up area	Forest area	Grassland area	Wetland area	Grand total
1986	Agricultural area	1872.184	200	150	196	124	2542.184
	Built_up area	235.0825	1380.33	120.08	148	107..43	1990.9225
	Forest area	10.31	4.563	880.882	7.34	3.98	907.075
	Grassland area	54.076	30.51	12.98	660.352	17.049	774.967
	Wetland area	4.086	7.032	10.45	12.89	449.144	483.603
	Grand total	2175.7385	1622.435	1175.51	1024.582	701.603	6699.8685
	Total change	-366.4455	368.4875	268.435	-249.615	218.06	

Source; Landsat maps of 1986 and 2003

The cross tabulation matrix (Table 4.9) diagonal values (shaded in green) reflect land-use/land-cover that remained constant over the specified years. Of the 2502.6025 hectares of land under cultivation in 1986 and 1990, during the study period of 1986 and 2020, 1990.While 1622.435 and 368.4875 hectares were converted to built-up and bare land, respectively, presumably to make space for built-up area, 9225 hectares remained unaltered. Of the 1175.51 hectares of forest land, 907.075 hectares were converted to built-up area, while 268.435 hectares were used for agriculture. Out of the entire 3749.28 hectares, 218.06 hectares are built-up, while 1313.37 hectares are used for agricultural. The remaining area is covered by grassland. It is noteworthy that in 2020, 10.36 hectares of the 2502.6025 hectares used for agriculture were covered by vegetation.5.61 hectares that were transformed from the 98.69 hectares under wetland to 54.86 hectares of grassland space and built-up area.

Table 4-8 Land use/Land cover transition matrix (ha) from 1986 to 2020

	2020						
		Agricultural area	Built-up area	Forest area	Grassland area	Wetland area	Grand total
1986	Agricultural area	1539.37	423.31	183.655	207.8275	148.44	2502.6025
	Built-up area	290.5685	2904.870	320.08	98.12	68.43	3682.118
	Forest area	80.74	112.563	582.90	12.34	4.98	793.523
	Grassland area	15.076	38.51	35.98	676.17	10.049	775.755
	Wetland area	18.07	39.78	17.63	8.89	397.07	481.38
	Grand total	1943.8245	3519.033	1140.24	1003.347	628.969	6199.8685
	Total change	-558.778	163.085	-17.542	-126.562	-76.379	

It is evident that over the course of the study region, other land uses, primarily built-up land, have gradually displaced the space used for agriculture. Table 4.10 shows that of the 2502.6025 hectares of agricultural land in 1986, 1943.8245 hectares were converted to built-up area and 793.523 hectares to forest area, presumably for the purpose of providing forest cover for the built-up area. Table 4.10 shows that 871.3475 hectares of the total 525.969 hectares of grassland area have been converted to built-up land, whereas 1863.68 hectares of the 744.785 hectares covered by built-up were converted to built-up area. The change detection result shows that other land uses, particularly built-up land, are gradually displacing agricultural land. The A decrease in the amount of land used for agriculture is a result of these quick changes in land use.

Table 4-9 Land use/Land cover transition matrix (ha) from 2003 to 2020

	2020						
		Agricultural area	Built-up area	Forest area	Grassland area	Wetland area	Grand total
2003	Agricultural area	1539.37	183.04	63.5	51. 75	29.023	1863.68
	Built-up area	128.5685	2904.870	120.08	98.12	68.43	3320.0685
	Forest area	80.74	112.563	582.90	12.34	4.98	793.523
	Grassland area	17.076	31.51	12.98	676.17	7.049	744.785
	Wetland area	15.087	19.032	11.45	6.89	397.07	449.529
	Grand total	1780.8415	3191.288	811.065	871.3475	525.969	6199.8685
	Total change	-91.761	128.7802	-17.542	-126.562	-76.379	

CHAPTER FIVE

5. CONCULUSION AND RECOMMENDATIONS

5.1 CONCULUSION

The purpose of this study is to evaluate and examine the dynamics of urban landscapes and how they affect the agricultural land under investigation. In order to detect changes in urban land use/land cover based on Landsat satellite pictures, research has been performed with the goal of using remote sensing and GIS techniques to study the expansion of urban land and its impact on agricultural land. Through examination of LULC changes during these times, Landsat imageries from 1986, 2003, and 2020 were used to trace urban landscape developments in the studied area. The study region's LULC was occupied by agriculture, accounting for 41.62% of the total area in 1986, 32.60% in 2003, and 25.23% in 2020, according to the results. Its incline in 2020 was primarily caused by its conversion to a built-up region. The percentages of the whole study area that are made up of built-up areas, grassland, forest land, and wetland are 16.93%, 12.71%, 14.92%, and 8.12% in 1986, 22.63%, 10.81%, 14.44%, and 7.42% in 2003, and 47.62%, 11.08%,9.55 and 6.51% in 2020, respectively. Despite the fact that there have been several changes noted across LULCs between 1986 and 2020, agricultural lands have had the greatest rate of change, declining by 57.91 hectares annually while growing by 53.04 hectares per annum.

The increase of urban/built-up use is mainly at the expense of other land uses and the principal factors that contributed to the expansion of the town were: population growth, high demand for housing, urban development policy, expansion of informal settlements, etc. Urban sprawl is one of the potential threats to sustainable development therefore; identification and analysis of the sprawl patterns would help in effective land use planning and environmental management in urban areas. This study judiciously demonstrates the application of geo-informatics in studying the dynamics of urban sprawl in any town. The rate of expansion of the town, especially residential areas are threatened the existence of natural resources in the future. This strongly warns us the need of searching for an alternative solution or a wise utilization.

5.2 RECOMMENDATION

Planning is required to ensure that population expansion in cities and towns is balanced with physical urban growth. This is only feasible if the form of urban growth change, the demand from the urban population, the quality of services that can be provided, and the availability and quantity of resources for the expansion of cities and towns in the future are all understood. Town planners and urban planning authorities should consider how the town will grow in the future and comprehend the effects of uneven physical urban growth, public service delivery, and infrastructure supply.

In order to manage the supply of public services and infrastructure that will be required as a result of future urban expansion, they should be forced to rely on a GIS database and information system to govern their urban development in a sustainable manner.

Satellite remote sensing with repetitive and synoptic viewing capabilities, as well as multispectral capabilities, is a powerful tool for mapping and monitoring the ecological changes in the urban core and the peripheral land-use planning. The use of remote sensing needs to be introduced to keep an eye on developers' activity. This will lessen the loss of agricultural land that results from unplanned urban sprawl.

At the current rate of population dynamic, land-use/land-cover change is certain to increase. Therefore, the following management strategies are recommended. Instead of new housing development on agricultural land, renewal of older buildings and infill development of high-rise buildings to meet the demands and needs of the increasing number of population in the town. In addition, the construction of condominium houses is another solution.

- ❖ It is already beginning to implementation by the government and should be continuing in the future for effective urban development.
- ❖ Public participation in decision-making is also recommended. These are essential to assess the likely impacts of urban development on the surrounding ecosystems. Population growth is one of the major causes of urban expansion especially rural-urban migration to seek employment opportunities and services.

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