JIMMA UNIVERSITY

COLLEGE OF SOCIAL SCIENCE AND HUMANITIES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

LAND USE AND LAND COVER CHANGE DETECTION IN ADEA WOREDA, EAST SHOA ZONE AT OROMIA REGIONAL STATE

BY

TIRINGO MIDEKSO TULEMA

A THESIS SUBMITTED TO SCHOOL OF GRADUATE STUDIES OF JIMMA UNIVERSITY, IN PARTIAL FULFILLMENT OF THE REQUIRED FOR DEGREE OF MASTERS OF SCIENCE IN GEOGRAPHIC INFORMATION SYSTEM AND REMOTE SENSING

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APPROVED BY BOARD OF EXAMINERS SIGNATURE DATE

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Co-advisor		
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Declaration

I, the undersigned declare that this thesis is my original work and has not been presented for a degree in any other university and that all sources of material used for this thesis have been dully acknowledged.

Tiringo Midekso

Signature -----------------------

Date --------------------------

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Acronyms

AWOoLEP	Adea Woreda Office of Land and Environmental Protection.
AWOoA	Adea Woreda Office of Agriculture.
CSA	Central Statics Authority
DAs	Developmental Agents
EMA	Ethiopia Mapping Agency
ETM	Enhanced Thematic Mapper
FAO	Food And Agriculture Organization.
GIS	Geographic Information System.
GLCF	Global Landsat Cover Facility.
GLP	Global Land Project International Project Office
GPS	Global Position System
Ha	Hectare
IPMS	Improving Productivity and Market Success.
ITCZ	Inter Tropical Convergence Zone.
Kha	Kappa Coefficient
LULC	Land Use and Land Cover Change.
MASL	Meter Above Sea Level
NIR:	Near Infrared
RS	Remote Sensing.
RGB	Red Green Blue

TM	Thematic Mapper
USGS	United States Geological Survey.
UTM	Universal Transverse Mercator

Abstract

This study examine the land use and land cover dynamics in Adea woreda from 1986 to 2016 by using Geographic Information System and Remote sensing technology to detect and analyze the changes that takes place over those 30 years. To this end, the research generate and analyze spatial distribution and pattern of land use land cover on the study area, analyze land use land cover change occurred in 1986, 1996 and 2016 and produce land use land cover map. In order to achieve these, both quantitative and qualitative approaches were utilized and use both primary and secondary source of data. 16 elders, experts and managers were selected by using non-probability sampling techniques. Landsat image of 1986, 1996 and ETM of 2016 was employed using ERDAS IMAGINE 2010 and Arc GIS through Maximum Likelihood of Supervised Classification to generate land use and land cover maps. For the accuracy of classified Land Use/Land Cover maps, a confusion matrix was used to derive overall accuracy. Post classification method was employed to identify gains and losses between different Land Use Land Cover classes. The satellite image results show that Agriculture land and Built up area shows decreasing and increasing trend within the study period respectively. Therefore, it is recommended that Adea district administration, community and all concerned body should create awareness about family planning, which is major cause of problem.

Keywords: GIS, Remote Sensing, Land Use / Land Cover change, Adea *Woreda* Ethiopia

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Land is a basic source of mass and energy throughout all terrestrial ecosystems. The land cover is defined as the physical material at the surface cover on the ground whether, vegetation, urban infrastructure, bare soil, biota, topography and groundwater. Whereas land use is a description of how people use the land resources for different socio economic activities, which include urban land, agricultural land, forestland, grazing land (Lambin and Geist, 2008).Land use/cover (LULC) change is a continual process the resources through extraction and several activities that alter land resources. The main reason of land use and land cover change (LULC) is population growth, changes in consumption, urbanization expansion, and technological advancements (Wu et al., 2013).

Therefore land use and cover change (LULC) is the study of land surface change. Land use (such as agriculture, pasture, or plantation) describes human use of land, while land cover (such as forest or desert) describes the biophysical characteristics of the land surface. Land use change may affect land cover, while changing land cover may similarly affect land use. Geographically explicit feature can form a reference basis for other disciplines(Chalachew et al., 2015).

Studies of land use and land cover (LULC) change dynamics identify of respective driving forces have played an important role in research into global environmental changes(Zewdie & Csaplovics, 2015).

The International Human Dimension Programmer on Global Environmental Change (IHDP), the research community has identified three basic issues. These understood the causes of land use and land cover changes, how to quantify it and how to apply models of predicting the changes(Lambin et al.,2003).

Global land Cover database assists in global assessments by creating the best available data and information through arrangement-data. Also the different quality and standardization of various products in-line with System of Environmental Economic Accounts (SEEA).According to FAO (2014) land cover classification standard increasing compatibility and interoperability of the geospatial products, fostering community of practice and collaborations by the land cover mapping community.

In additionally to this, continuous increase of world's population and demand for food and staple production poses a major challenge for agriculture. It requires an integrated and systemic approach to face food insecurity and natural resources loss threats.

Ethiopia is the second largest populace country in Africa. 85% of the majorities of the population of the country live in rural areas and economy was dependent on agriculture with traditional farming. The urban growth increase from time to time. Because they want to lives the better life and they was encouraging land lease policy of urban.

Researches on land use and land cover change in Ethiopia involved in different regions and disciplines depending on the availability of data and tools to perform analysis. However, most of the studies have focused on deforestation, the cultivated land to land degradation, river catchments and watersheds, natural ecosystems and forests as well as the associated consequences expansion(Atalel, 2014).

In developing countries such as Ethiopia, drivers of urbanization are not only economic development, but also rapid rural population growth, poor land productivity, which often leads to rural urban migration and poorly planned urban expansion. This Processes related to urbanization, development of transport infrastructures, industrial constructions, and other built-up areas are severely influencing the environment at both global and local levels (Chalachew et al., 2015).

The study area is found in the central high land regions of Ethiopia, Oromia National Regional State and East Shewa Zone. Adea woreda is the severe of the farmer loss of agricultural land due to population growth, investment and expansion of urbanization. Besides, agricultural production become decrease from time to time. This in turn, leads to the low productivity of both crop and livestock yields.

1.2. Statement of the Problem

Land is definitely one of the most important natural resources, since life and developmental activities was based on it. Land use refers to the type of utilization to which man has put the land. It also refers to evaluation of the land with respect to various natural characteristics. However, land cover describes the vegetal attributes of land. Land use and land cover data are essential for planners, decision makers and those concerned with land resources management. Monitoring and analysis of the urban environment make use of up-to-date land use and land cover (LULC) information, for proficient and sustainable management of urban areas(Ezeomedo and Igbokwe, 2013).

LULC change has an impact on the socio-economic status of the rural population (Lambin et al.,2003). Agricultural productivity, which may determine rural income levels, wealth and education, can be affected by the consequences of LULC changes. Therefore, understanding of the complex interaction of these changes in their temporal and spatial patterns and processes is the baseline to formulate focused and targeted policy interventions in rural development and environmental management.

Adea woreda has witnessed for remarkable LULC change, mainly because of population size increase, urbanization, investment, over cultivation and over grazing that enforce the inhabitants to change their land use practice (AWOoA, 2007). this in turn results LULC change, modification and alterations in various LULC classes over time without any detailed and comprehensive attempt to evaluate changes overtime with a view to detect the LULC change.

1.3. Objective of the study

The principal objective of the study is to examine dynamics of land use and land cover change in Adea district in East Shewa Zone.

1.3.1. Specific objectives

- To generate and analyze the spatial distribution and patterns of land use land cover change in the study area
- To analyze the rate and dynamics of Land use Land cover of Adea district in 1986, 1996 and 2016
- To produce land use and land cover change maps.

1.4. Research Questions

- What are the major Land uses Land cover classes of the study area?
- How the spatial pattern of LULC class changes during the study period?
- What are the maps of study area look like?

1.5. Significance of the Study

This study may give benefit for different stakeholders; it can provide greater importance to the research community, urban planners, as well as decision makers in terms of understanding the impacts of land use land cover changes in Adea area. The results of this study provide better information about the land use and land cover change can quantify through integrated application of geography information system (GIS) and remote sensing (RS). In addition to this, it provide the opportunity to understand the trends of changes in built up areas because of driving variable and serve as input for further study.

1.6. Scope of the Study

This study has been limited in terms of space, subject and time. Geographically this study has been delimited to Adea district; East Shewa Zone and focus on the issue of land use and land cover change using GIS and RS. Temporally, the study is delimited to investigate land use land cover change occurred in 1986, 1996 and 2016.

1.7. Limitation of the study

The challenge in doing this study is from availability of the required and appropriate imagery data. Access to up to date and quality data. Lacks of secondary data were the major problem the researcher faced during this study.

1.8. Organization of the Study

This study is organized into five chapters. Chapter one constituted the introduction, which includes background of the study, statement of the problem, objectives of the study, research questions, significance of the study, scope of the study, limitation of the study. Chapter two deals with the review of related literatures. The third chapter constituted the description of the study area, the research design, sources of data, sample size and sampling techniques, methods of data collection and methods of data analysis. Chapter four presents results and discussions. The final chapter provides conclusions and recommendations.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Concept of Land Use and Land Cover

Land as a finite and a potentially productive natural resource represent our basic food production facility. However, the diversity of residents and intensive use of the resources through the increasing of population pair with economic activities and global market drive unsupported land use and land cover changes(Atalel, 2014).

The land cover is described by the situation of the earth's surface and reaction with subsurface, including biota, soil, topography, surface and groundwater, and human structures(Lambin et al., 2003). Land use has been described as for which purposes humans use the land cover. It include both biophysical attributes of the land are manipulated and the determine problem that manipulation, that is the purpose for which the land is used. Describe the classes indicate intent or purpose is: forestry, parks, livestock herding, suburbia and farmlands (Turner et al., 1995).

The main resource controlling primary productivity for earth ecosystems can be defined in terms of land the area of land available, land quality, moisture regime and soil character. Despite successful substitution of land-based resources with fossil fuels and mineral resources, land remains of prime importance(Antonio Di Gregorio and Louisa J.M. Jansen, 1998).

Land management, biophysical manipulation aspect of a land-use system; by contrast, refer to the specific ways in which humans treat vegetation, soil, and water for the purpose in question. Examples are the use of fertilizers and pesticides, irrigation for mechanized cultivation in dry lands, or the use of an introduced grass species for pasture, and the sequence of moving livestock in a ranching system (Lambin and Geist, 2006).

Program on Global Environmental Change (IHDP), the research community has identified three basic issues. These understood the causes of land use and land cover changes, how to quantify it and how to apply models of predicting the changes (Lambin et al., 2003). Conversion and modification are the two forms of land cover changes described by (Meyer and Turner, 1992) where the former is a change from one class of land cover to another. The latter is, however, a change within a land cover category. Human land use decisions play a crucial role in driving changes in the land system and the dynamic interaction between socioeconomic and biophysical drivers of change (GLP, 2010). The complexity of the coupled human-environmental system is widely acknowledged and the human land use decisions play a crucial role in driving changes in the land system and the dynamic interaction between socioeconomic and biophysical drivers of change.

Land use and cover change (LULC) is the study of land surface change. Land use such as Agriculture, pasture, plantation describes human use of land, while land covers are such as, forest or desert that describes the biophysical characteristics of the land surface. Land use change may affect land cover, while changing land cover may similarly affect land use. Research on LUCC is essentially of multidisciplinary nature, attracting scientists from a range of fields, including but not limited to economics, sociology, geography, GIS (geographic information systems) and remote sensing (RS) in particular and demography. More than twice as much land globally (over 30 million square kilometers) is in use as pasture and grasslands relative to agricultural land (Znoleff, et al., 2014).

2.4. Application of Geographic Information System (GIS)

Geographic information systems (GIS) are computer-based sets of procedures that capture, store, manipulate, edit, retrieve, analyze, model, and display data with spatial characteristics and GIS has many applications in multi decline such as resource `management, environmental impact assessment, criminology, urban planning, animal ecology, transportation planning, logistics and public health (Aronoff, 1989).

In addition, it can be described as general-purpose computer-based technologies for handling geographical data in digital form in order to capture, store, manipulate, analyze and display diverse sets of spatial or geo-referenced data. (Burrough &

Mcdonnell,1998).It also incorporate so many techniques and data types into a single analysis, making the handling of complex data sets faster, cheaper, and more effective (Aron & Patz, 2001).

2.6. Remote Sensing

Remote Sensing is the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in physical contact with the object, area, or phenomenon under investigation (Lillesand& Kiefer, 1999). For example, while reading a book, you are remotely sensing it, as you extract information from the words without touching the book in your eyes. It refers to the activities of recording (sensing) objects or events at far away (remote) places. In RS connection with GIS (Geographical Information System), remote sensing may be an useful tool for classifying land cover and the accuracy of such studies is conditioned by the amount, extent and accuracy of both satellite data and supplementary data, and also by the classification algorithms(Vinciková et al.,2010*).*

Most of the RS sensors record variations in the electromagnetic radiation are normally used as an information carrier in remote sensing attribution. In passing from the source mainly, the sun to the target and back to the sensor the energy interacts with the atmospheric constituents and the target of interest. The output of a remote sensing system is usually an image representing the scene being observed. A further step of image analysis and interpretation is required in order to extract useful information from the image. The human visual system is an example of a remote sensing system in this general sense (Lillesand& Kiefer, 1999).

The invention of Remote Sensing and GIS techniques land use/cover mapping is a useful and of a region and also application of remotely sensed data make possible to study the changes of land cover in few period of time, in low cost and with better accuracy(Bireda, 2015).

2.7. Image Classification

In order to examine and assess environmental and socioeconomic applications such as: LULC change detection and socioeconomic variables, image classification results with better accuracy are mandatory. Image classification refers to the extraction of differentiated classes or themes, usually land cover and land use categories, from raw remotely sensed digital satellite data (Weng, 2012). Image classification using remote sensing techniques has attracted the attention of research community, as the results of classification are the backbone of environmental, social and economic applications (Lu and Weng, 2007). Because image classification is generated using a remotely sensed data, there are many factors that cause difficulty to achieve a more accurate result. Some of the factors are:

- The characteristics of a study area,
- Availability of high resolution remotely sensed data,
- Ancillary and ground reference data,
- Suitable classification algorithms and the analyst's experience, and
- Time to constraint.

These factors highly determine the type of classification to be used for image classification. There are various image classification methods that can be applied to extract land cover information from remotely sensed images (Lu and Weng, 2007). However, their application depends on the methodology and type of data to be used. Some of these methods are: artificial neural networks, fuzzy-sets and expert systems. In a more specified way, image classification approaches can be categorized as supervised and unsupervised, or parametric and nonparametric, or hard and soft (fuzzy) classification, or per-pixel, sub-pixel and per-field. Some of the most commonly used image classification methods is discussed below.

2.9. Pixel-Based Image Classification Methods

Pixel-based classification methods automatically categorize all pixels in an image into land cover classes fundamentally based on spectral similarities (Qian*et al*, 2007; Weng, 2012). These types of classifiers develop a signature by summing up all pixels.

Thus, the developed signature contains the necessary things found in the training pixels but does not contain the influence of mixed pixels (Weng, 2012). According to Tadesse*et al* (2003). There are two primary types of pixel-based classification and algorithms applied to remotely sensed data: unsupervised and supervised. Unsupervised image classification algorithms are based on categorizing each pixel to unknown cluster centers and then moving from one cluster center to another in a way that the Supervised Spatial Encoder (SSE) measure of the preceding section is reduced data. Whereas in the case of supervised image classification the analyst has previous knowledge about pixels to generate, representative parameters for each land cover class of interest. The Maximum Likelihood classification, under the category of supervised classification, which is the most widely, used per-pixel method by taking in to account spectral information of land cover classes (Qian*et al.*, 2007). Although pixel based classification methods have been widely accepted and applicable, however, there are limitations in including spatial pattern during classification. This happened especially in Maximum Likelihood classification methods where they consider only spectral information by neglecting contextual and texture information(Zhou and Robson, 2001; Dean and Smith, 2003).

2.10. Post Classification Approaches

Post classification approach is based on the use of supervised classification approaches (requiring a prior knowledge of data classes), and it is based on texture features. The extraction of texture features cannot be done at pixel level, because the texture is defined on a set of pixels (Hicham*et al*., 2007). This method is the most simple and obvious change detection based on the comparison of independently classified images (Singh, 1989). Maps of changes can be logarithms by the researcher, which shows a complete matrix of changes from times t1 to time t2. Based on this matrix, if the corresponding pixels have the same category label, the pixel has not been changed, or else the pixel has been changed (Xu*et al*., 2009).

2.11. Change Detection Analysis

Change detection can be defined as the process of identifying differences in the state of object or phenomena by observing them at different times by using remote sensing techniques. Essentially, it also involves the ability to quantify temporal applications of remotely sensed data obtained from Earth-orbiting satellites (Singh, 1989). As indicated from the beginning of this chapter there are four aspects of change detection, which are important when monitoring natural resources:

i. Detecting the changes that have occurred
ii. Identifying the nature of the change
iii. Measuring the area extent of the change
iv. Assessing the spatial pattern of the change

Empirical Review of Related Literature

2.12. Application of remote sensing in land use and land Cover change

Remote sensing application gives the accurate information about land use and land cover change is therefore highly essential to many groups. To achieve this information, remotely sensed data can be used since it provides land cover information. Remote sensing refers to the science or art of acquiring information of an object or phenomena in the earth's surface without any physical contact with it and this can be done though sensing and recording of either reflected or emitted energy or the information being processed, analyzed and applied to a given problem (Campbell,2007).

2.2. Cause of Land Use/Land Cover Change and its impacts in Ethiopia

The main cause of LULC change and related impacts in Ethiopia are anthropogenic in origin even though natural processes may also contribute to change. The pressures exerted by population growth are taken as the main factor. Given the low level of economic development, exerted pressure on change in the environment by conversion of woodlands and shrub lands into the croplands that resulted in loss of natural vegetation cover (Dougallet al., 1975, Virgo & Munro, 1977). Land cover changes due to human activities change land use and hence a single class of cover could support multiple uses (forest used for combinations of timbering, slash and burn agriculture, fuel wood collection and soil protection). On the other hand, a single system of land use can maintain several covers (as certain farming systems combine cultivated land, improved pasture an settlements).

In most developing countries, population growth has been a dominant cause of land-use and land-cover change than other forces (Sege, 1994). There is a significant statistical correlation between population growth and land cover conversion (forest change) in most of African, Asian, and L/American countries(Jessie A. Vital, 2008),In addition to this the question of what factors affect land-use and land-cover change remains largely unanswered. Recently, human activities and social factors were recognized to have a very importance for understanding of land-use and land-cover change (Geist & lambin, 2002).

Land use/land cover changes shows that the dynamics determine in the socio-economic condition of a given area. Similarly, changes in the socio-economic situations cause land use/land cover changes through their influence on land management techniques used and other various aspects of the farming systems, institutional settings, environmental policy and others(Lambin et al., 2003).

Also, these two major categories of causes operate at different levels. Proximate causes operate at the local level (individual farms, householders, or communities); on the contrary, the sources of underlying causes are at regional and national levels such as districts, provinces, or countries. Underlying causes are often external and beyond the control of local communities

2.2.1. Population growth

Population has been the major cause of agricultural expansion(Foley et al., 2011). Even though the positive correlation between population growth and cropland is expected due to increasing demand for food, it is also true that people trend to settle in areas suitable for agriculture. Technological development and international trade have weakened the relationship between population and expansion as well as settlement in areas of arable land.

2.2.2. Institutional Factors

The understanding of institutional causes that is political, legal, economic, and traditional and their interaction with individual decision-making are important in explaining land use changes. Institutional causes need to be considered at micro and macro levels because the implementation of macro policies was practiced at the local level. Land-use and land-cover changes was influenced significantly, when macro policies undermine local policies in that the structure of local and national polices may determine local people's access to land, capital, technology, and information (Lambin and Geist, 2003).

Lack of well-defined policies and weak institutional enforcement may facilitate changes of land use. On the other hand, restoration of land use is possible if there are appropriate land use policies in place. In most developing countries, communal (traditional) land holding systems have been shifted to a formal (state) holding system (Lambinet al., 2003). The policy in developing countries of price control on agricultural in-put and out-put and self-sufficiency in food have all influenced land use changes (Turner et al., 1993).

2.3. Urbanization

From a broader point of view urbanization is one of the ways in which human activities altering global land cover. Although urbanization trend is global, according to the reports of the United Nations Centre for Human Settlements (Habitat, 2001), it has showed most remarked changes in developing countries associated with the migration of rural people to cities for better opportunities. Following this there had been estimated a rapid growth of population in urban areas at an average rate of 2.3% per year between 2000-2030 (United Nations, 2001).Urban growth, particularly the movement of residential and commercial land use to rural areas at the periphery of metropolitan areas, has long been considered as a sign of regional economic vitality (Yuan et al, 2005). However, its importance becomes unbalanced with impacts on ecosystem, greater economic differences and social fragmentation. It can be defined as the rate of increase in urban population. Dynamic processes due to urban change, especially the tremendous worldwide expansion of urban population and urbanized area, affect both human and natural systems at all geographic scales (Brockerhoff, 2000).

Urban areas are growing fast and increasingly occupying larger land areas. The urban population surpassed the rural population and it is expected that by 2050, the urban population will account for 70% of the total global population. However, measurements of an urban area are not well captured by current LUCC models (Grimm et al., 2008, Olson et al., 2008, Seto & Shepherd, 2009).

Ethiopia is one of the second largest populated countries in Africa with a total population of over 80 million and having an annual growth rate of 3.02%. The country is experiencing an average annual urban growth rate of 4.6%, which is a high rate by world standard (Cohen, 2004). Even though urbanization rates differ depending on the methodologies applied, Ethiopia's urbanization is low relative to other Sub-Saharan African (SSA) countries. Since the majority of the population (85%) is living in the rural areas, where agriculture is the backbone of the country's economy, it is evident that urban growth to be low. The self sufficiency of agriculture also contributed to reinforcing of the rural peasant life from their territory. According to Central Statistical Agency of Ethiopia (CSA), it is only 16% of the population lived in urban areas. Among these are in small cities and towns (Schmidt and Kedir, 2011).

There was one research conducted by Berhanu Ejigu on assessment of soil erosion and conservation practices in adea woreda,east shewa zone. However, no one conduct research on land use and land cover change by using GIS and RS technology in Adea *woreda.*

CHAPTER THREE

3. METHODOLOGY OF THE STUDY

3.1. Description of the study area

Geographically Adea *Woreda* is located in Oromia National Regional State in East Shewa Zone. Adea *Woreda* is located south East of Addis Ababa. The *Woreda* capital town Bihoftu has the distance of 47km and 52km from Addis Ababa and Adama, respectively. The four woredas, which relative location of Adea *Woreda* are,Ginbichu *Woreda* in the North, Liban-chuqala *Woreda* in the South, Lume *Woreda* in the East and Akaki woreda in the West. The absolute location of Adea *Woreda* is between $8^{0}38^{'}42^{''}$N - $8^{0}56^{'}19^{''}$N latitude and $38^{0}48^{'}21^{''}$E – $39^{0}11^{'}15^{''}$E longitude; with an elevation range between 1,700m – 2,920m.a.s.l. The Adea *Woreda* covers an area of 89,436.7 ha or 894.4 km^2 (AWOoLEP, 2013). Out of which agricultural land covers 71,9ha(80.42

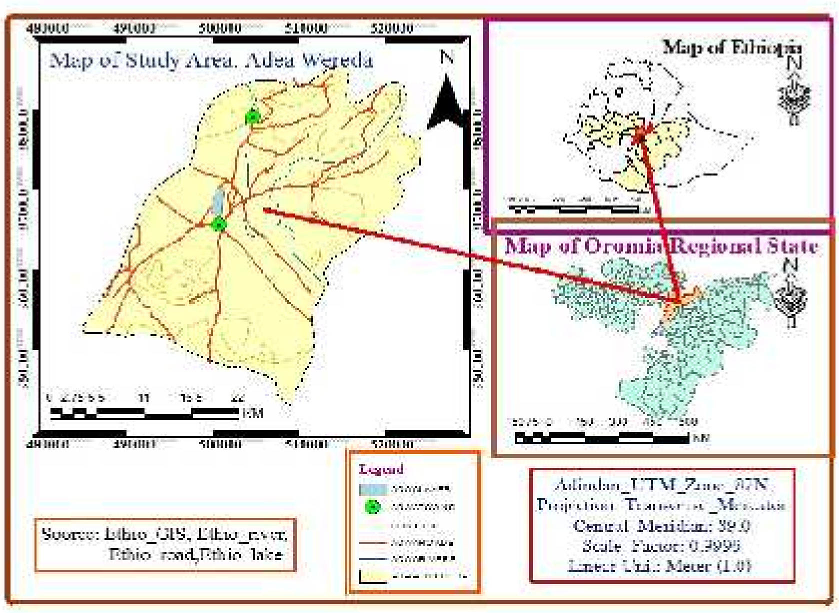


Figure 3.1 Location map of study area

3.2. Population of the study area

Adea *Woreda* has the total population of 144,289 (AWOoA, 2007). Out of which 75,478 (52.3%) were males and 68,811 (47.7%) were females; with the annual growth rate of 2.9%. Out of the total population of Adea *Woreda*, the adult population were 77,901 (54%), the young population were 63,461 (44%), and the elder population were accounts for 2,927 (2%) of the total population (CSA, 2007)

3.3. Climate

The agro-climate of the study area are sub-divided in to two zones; that is, sub-tropical (Woyina-Dega) and Temperate (Dega) zones. The Woyina-Dega constitutes 94% of the total area and *Dega* constitute 6% (AWOoA, 2013). Therefore, the agro-climate of the study area are dominantly characterized by Woyina-Dega type of climate.

The highest temperature is observed during the spring season (March, April, and May), while the lowest temperature is occurred during the months of October, November and December (IPMS, 2004). Temperature and rainfall are considered the two most important factors in the agriculture of the highland regions of Oromia, and Ethiopia at large. The average temperature in the study area is 18.5^0C.

There are two rainy seasons in the highland regions of Ethiopia denotes the "Kiremt" or "Maher", which shows the big rains. Meher rains which accounts for about 74% of the annual precipitation are the most economically important rains for crop production (Kahsay, 2004). On the other hand, "*Belg*" are known as the small rains.

The rainfall of the study area is similar to other parts of the highland regions. The rainfall pattern of the study area is bi-modal and the main rainy season (summer) extends from June to September when the ITCZ is to the North of the equator. The small wet season is usually occurs during the first two months of spring (March to

April). The annual total rainfall of the study area is 839 mm. on an average (IPMS, 2004; AWOoA, 2013).

3.4. Economic Activities of the *Woreda*

Agriculture is the major population occupation in the *Woreda*. The major farming operation is done by oxen power. The agriculture are characterized by mixed farming systems and the people are depending on both crop production and livestock production for their livelihood. The agro-ecology in the Adea *Woreda* is best suited for diverse agricultural production.

The total agricultural land in Adea *Woreda* is covers 71,923 hectares. Teff and wheat production dominates the agricultural production system. Adea *Woreda* is known as nationally level for its best qualify teff production. Chickpeas and lentil are also grown in sizeable quantities. There are also other important crops grown in the area. There are a some of rivers and lakes that are being used for irrigated agriculture, particularly for horticultural crops production. Horticultural crops, which are mainly vegetables, are produced under small-scale irrigation. Currently, there is also a huge investment on flower cultivating factories in the area and steel production, Bishoftu automotive industry and Adea pounder manufacture are the best *woreda* source of the economics activities.

3.5. Research Methodology

3.5.1. Research Design

A research design is the strategy to get the information required for the research. It is the overall plan for answering the research question. The research design incorporates sampling, data collection and analysis plan. The approach enables to know how a unit of study is affected by the item being studied through observations of the unit in its setting, and through field interaction and information or data gathered about the unit. In this study, both Qualitative and quantitative research approach was applied. Qualitative research design was used to explore the perception of local community towards the major causes of land use and land cover change whereas quantitative research design was used to quantify some numerical data obtained from sample survey (Ugochukwu,2009).

3.5.2. Sampling Techniques and Sample Size Determination

The *Woreda* has 27 *kebele* administrations, and four of them has-been selected purposively namely: kajima_Dibayu, Kurkura_dambi, Golo_ Dhertu and Godino Jitu based on the severity of problems on land use and land cover change and based on the researcher experience about the area.

3.5.3. Sources of Data

Regarding to data sources both primary and secondary sources were employed. Questionnaires, interviews, GPS and field observation used as a primary source. Whereas data from online sources, reports, books, and journals, governmental institutions like Adea *Woreda* agricultural bureau and Adea *Woreda* land administration and environmental protection bureau used as secondary sources. The data related to the socioeconomic factors that could affect the land use and land cover change has be obtained from developmental agents or experts, kebele administration leaders and focused group discussion with residents in the *kebele.* In addition to this, Landsat imagery of 1986, 1996 and 2016 obtained from United States Geological Survey earth explorer (USGS: http://glovis.usgs.gov) through path 054 and row 168 to analyze land use land cover of the study area using ERDAS IMAGINE 2010 software.

3.5.4. Data Collection Instruments

Data has been collected by combination of methods for the acquisition of the interactions that factors which will be determine the land use and land cover change expression/manifestation including; Interview, field observation, focus group discussion and GPS survey. It is also better for the household respondents in that minimizing the difficulties of ambiguity and reduces effect of biased conclusion and interpretation happened in the other methods.

3.5.4.1. Interviews

An interview has been made the investigator to get additional data to substantiate the information obtained by questionnaires. The semi-structured interview schedule was prepared. The interviews has been conducted by the researchers was targeting the key informants such as DAs working in the sites (4), *Kebeles* Managers (4) and local elders from the sample households (4) were purposively selected.

3.5.4.2. Field observation

The investigator has conducted frequent field observation by using the checklists to assess the land use and land cover change types. During field, observation the researcher has used the visual photographs to realize the actual existing realities that were raised in the questionnaires.

3.5.4.3. GPS survey

GPS has been used to locate the points for the analysis land use and land cover change methods. Training data has been collected from field works using GPS. Geographic location of each survey point has been recorded using a global positioning system (GPS) instrument.

3.5.4.4 Focus group discussion

Data has be collected used to focus group discussion. The focus group discussion has be conducted with *kebele* and *woreda* experts who have key involvement in natural resource conservation and development activities in the study area.

3.6. Method of Data Analysis

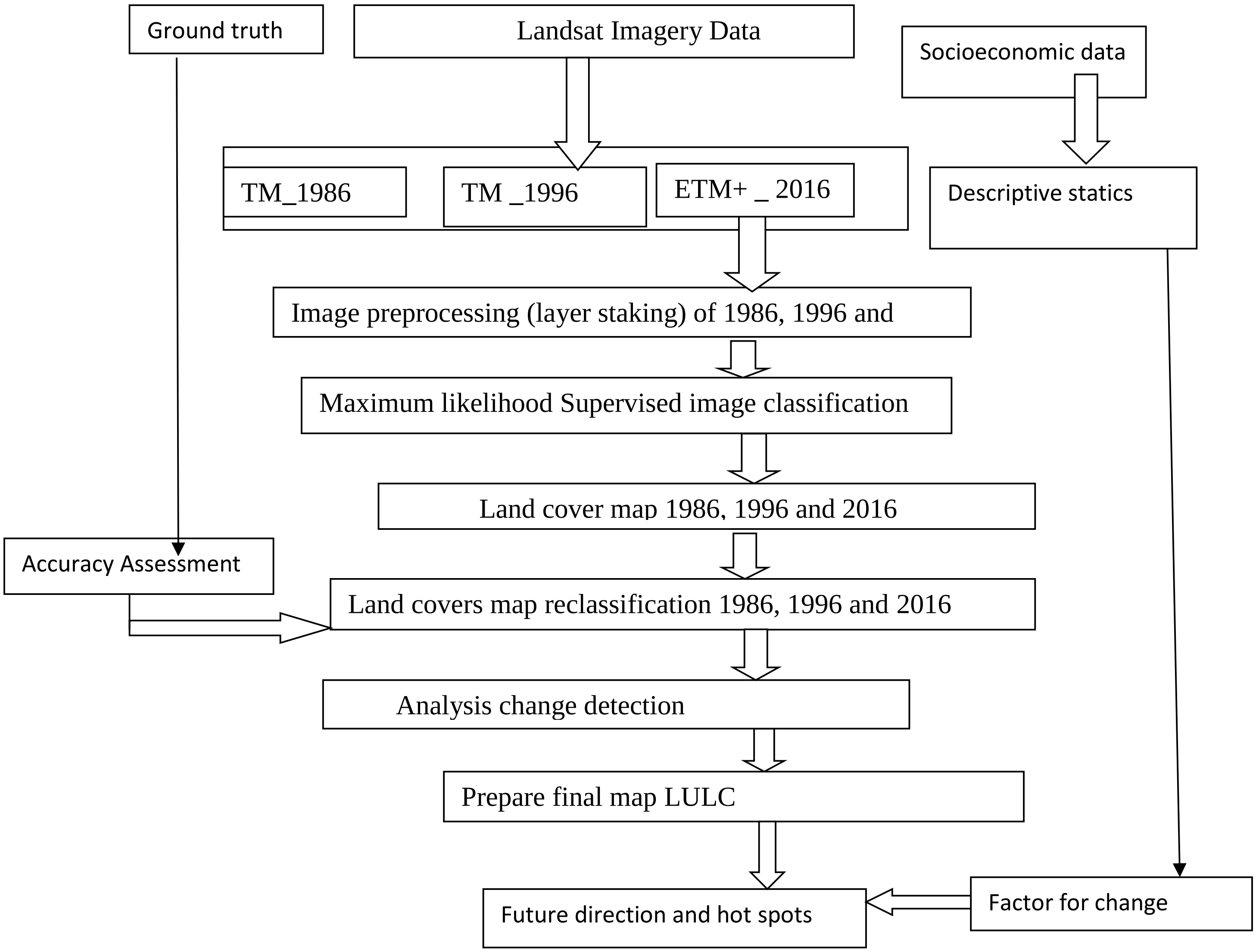
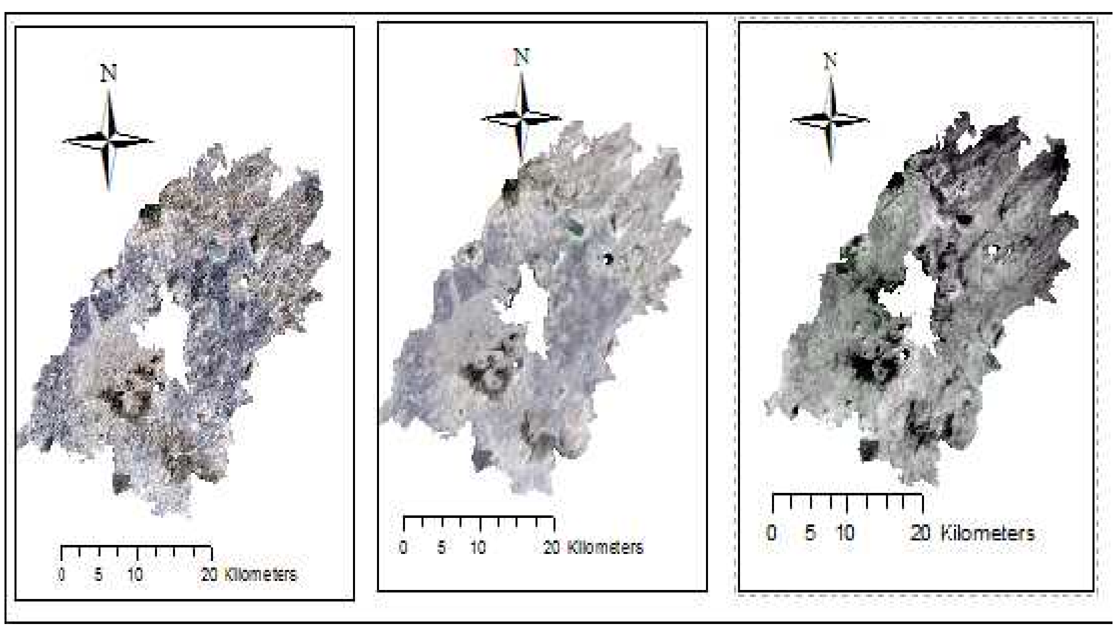


Figure 3.2 Flowchart of research methods

3.7. Data Acquisition and Source

The images were extracted to Tiff formats for processing and the detail of image properties summarized in table below. The images acquired from the period January–February, as this is a clear sky season in the region, reducing atmospheric and radiometric problems. Images were composed in different ways in order to identify surface features in the study area. True color composite usually known by RGB 321 combination where band 3 reflects red color, band 2 reflects green and band 1 reflects blue color. Another composite called "false color composite" which uses an RGB combination of 432. In this band combination band 4 represents the NIR infrared, band 3 belongs to red and band 2 to green. This combination gives better visualization in identifying vegetation, which looks red in 432 combinations. Below illustrated maps of the study area generated using the false colour combination and vegetation is seen as red and dark red, water is blue and shades of which looks red in 432 combinations.



False Color Composite of 1986 (right), 1996 (middle) and 2016(left)

The local administrative data and topographic map of the study area were obtained from CSA and Ethiopian Mapping Agency (EMA) respectively. These were brought to Universal Transverse Mercator (UTM) projection in zone 37N.

3.8. Data Source Characteristics

NO	Types of data	Sensor	Date of Acquisition	Path/Row	Spatial data Resolution	Source
1	Land sat image	TM	01/2/1986	168/54	30m by 30m	USGS
2	Land sat image	TM	16/2/1996	168/54	30m by 30m	USGS
3	Land sat image	OLI	20/2/2016	168/54	30m by 30m	USGS

Then field visits to site was carried out to obtain ground control points using etrix-30 Garmin GPS for ground truth sampling.

3.9. Development of a Classification Scheme

Based on the prior knowledge of the study area for over 30 years' and a brief reconnaissance survey with additional information from elders, a classification scheme was developed for the study area as the fallow:

3.9.1. Water bodies

Water bodies - the part of the earth's surface covered with water (such as a river or lake or ocean).

3.9.2. Agriculture

Agriculture has been the greatest force of land transformation on this planet. Nearly of the third world, surface or country was currently being used for growing crops or grazing cattle. Much of this agricultural land has been created at the expense of natural forests, grasslands, and wetlands that provide valuable habitats for species and valuable services for humankind (Millennium Ecosystem Assessment, 2003).This category includes area allotted for annual rain fed and irrigated cultivation. Lands mostly used for cereal production in subsistence farming and mixed farm.

3.9.3. Forest

Forest is usually defined by the presence of trees, under many definitions an area completely lacking trees may still be considered a forest if it grew trees in the past will grow trees in the future or was legally designated as a forest regardless of vegetation type. This unit includes densely growth trees forming closed canopy. The predominant species.

3.9.4. Grassland

Grasslands are areas where the vegetation is dominated by grasses (Phocaea), however sedge (Cyperaceae) and rush (Juncaceae) families can also be found. Area predominantly covered by small grasses with a small proportion of shrub and trees. Usually this category is use or grazing.

3.9.5. Built up areas

Area occupied by small town including market places, roads institution such as school, clinic, court and others. Built up Area It is the area of the house/apartment, which includes the balcony and walls. It is also referred to as ‘Total Area’ of the house.

3.10. Accuracy Assessment

Accuracy assessment is the comparison of a classification with ground truth data to evaluate how well the classification represents the real world. It was performed by comparing a map created by using remote sensing analysis to a reference map based on different information sources such as field survey, Google Earth and original mosaic images. An interpretation is then made of how close the newly produced map from the remotely sensed data matches the reference (source) map. Although the basic approaches to accuracy assessment seems relatively direct and easy, a variety of errors encountered when evaluating an image classification and capturing remotely 32 sensed data. Evaluation of the accuracy of a classified image was done using an error matrix sometimes called confusion matrix (Senseman*et al*, 1995; Foody, 2002). Error Matrix is a square array of numbers laid out in rows and columns that express the number of sample units assigned to a particular category relative to the actual category as verified in the field. The columns normally represent the reference data, while the rows indicate the classification generated from classified image. It also provides an excellent summary of the two types of thematic error that can occur, namely, omission and commission. Error of omission refers to pixels in the reference map that were identified as something other than their "accepted" value. Whereas error of commission, on the other hand refers to pixels that were incorrectly classified as a class in a row (Maingi*et al*, 2002). Most of the classification accuracy measurements were derived from an error matrix. However, the most popular one is the correctly allocated cases in a percentage. Based on this, user's accuracy refers to the probability that a given pixel can be found in the ground as it is in the classified image, whereas producer's accuracy refers to the percentage of a given class that is correctly identified on the map (Yesserie, 2009).

CHAPTERFOUR

4.1. RESULTS AND DISCUSSIONS

As indicated in the classification scheme Water bodies, Agriculture, Grassland, and Forest and Built up areas are the major LULC classes for the study periods. The classified images were acquired, when crop harvesting had already started, and farmlands appear bare and grasslands look relatively bright in their color. Regarding vegetation, there were relatively undisturbed areas that had been serving as a home for some wild animals with varying levels of density, ground cover and disturbance. Some of these forests have been sources of wood for house construction, household energy and farm implements.

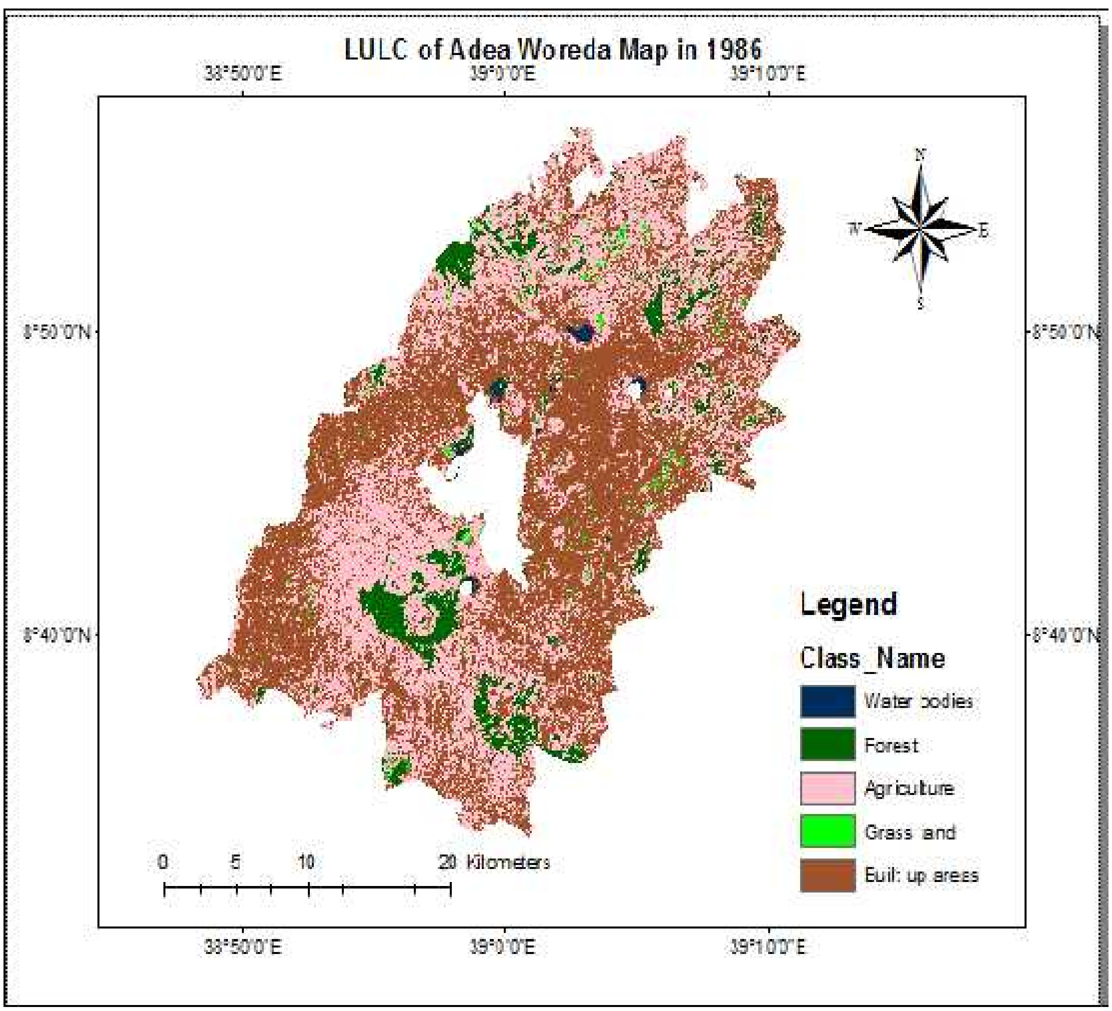


Fig.4.1 LULC of Adea Woreda in 1986

The classification result of the 1986 image revealed that Agriculture land constituted the largest proportion of land in the woreda with a value of 42.9%, followed by Built up areas, which accounts for 35.9 % .Forest and water bodies constituted 18.3% and 2.9% respectively. In Ethiopia, before 1974, the relationship between land users and owners was based on a feudal system (Lakew et al., 2000) under which the ownership of land was limited to a few individuals. Most inhabitants were only eligible to get access to farmland through sharecropping. According to the elders during this period, it was highly likely that a portion of the land was left abandoned. Human population in the woreda was relatively low with low pressure on the land and associated resources.

LULC classes	1986		1996		2016	
	Area in (ha)	%	Area(ha)	%	Area(ha)	%
Water bodies	2589	2.9	802.6	0.9	1094	1.2
Forest	16327.4	18.3	9677.4	10.8	8348.2	9.3
Agriculture	59674.2	66	38404.5	42.9	15150.5	17
Grass land	1361.3	1.5	4229	4.7	9075.4	10.1
Built up area	11249	12.6	32119.9	20.8	63812	35.9
Total	89440.5	100	89440.5	100	89440.5	100

Table: 4.1 Area statistics of the land use and land cover units from 1986-2016

The classification result of the 1986 image revealed that agriculture land constituted the largest proportion of land in the woreda with a value of 42.9 %, followed by built up areas, which accounts for 20.8 % (Figure 4.1). Forest, water bodies and grassland constituted 18.3%, 2.9% and 1.5% respectively.

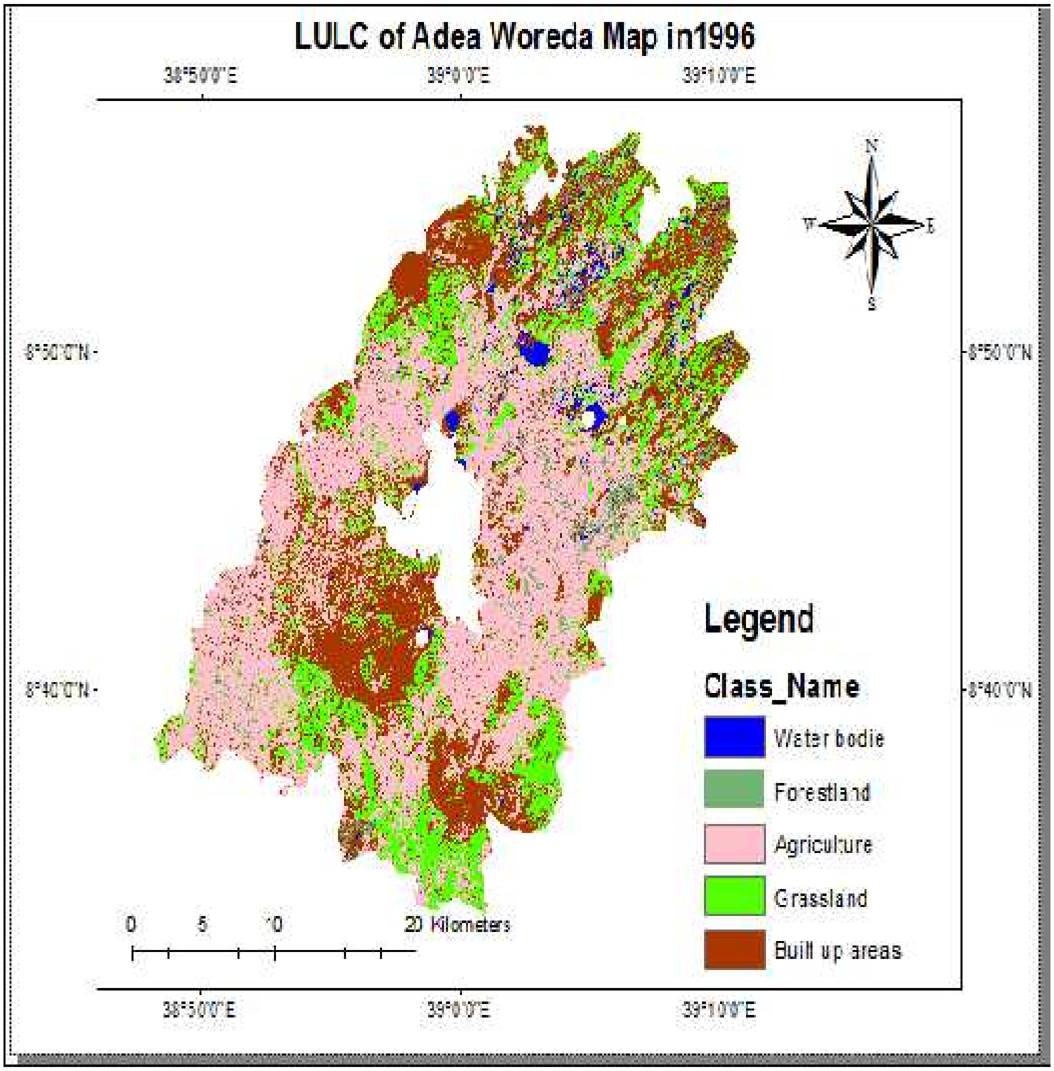


Fig.4.2 LULC map of Adea woreda in 1996

Even if there is some increment from built up areas and grassland in 35.9 % and 10.1 % the amount of 1996, the agriculture land, which covers 66 % of the landscape, is the dominant class again in 2016. Similarly, the built up areas are increase to 12.6 %. As a result, the grassland coverage was increased to 10.1% and water bodies became only 1.2 % of the woreda's coverage due to the dry up of the area as indicated on Figure.

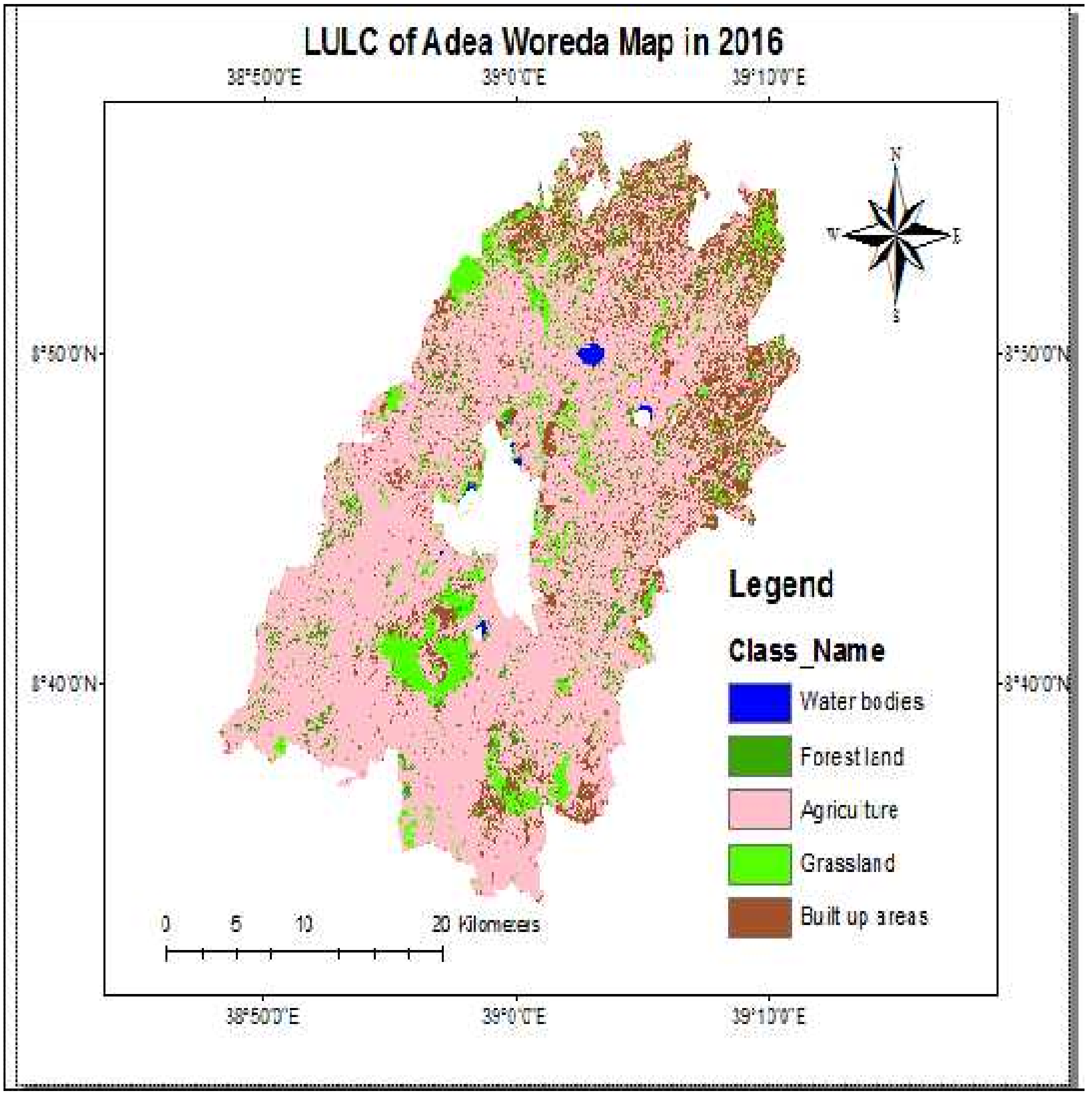


Fig.4.3 LULC map of Adea woreda in 2016.

4.2. Accuracy Assessment of the Classification

Classified LULC maps from remotely sensed images may contain various types of errors. Therefore, users applied accuracy assessment to find out those errors to make the produced LULC maps reliable and easily interpretable. Once the classified image was integrated into a GIS, accuracy assessment should be processed as it limits the classification results of a remotely sensed imagery data. To do so, the accuracy of a classified map has to be assessed and compared with a referenced data using an error matrix. The accuracy assessment in this study was made using the original images and elders who live in the study area for 1986and 1996, field observation, and Google

Earth image for the 2016 study period. Accuracy assessment is a general term for comparing the classification to geographical data that are assume to be true, in order to determine the accuracy of the classification process. The accuracy of a remotely sensed data product is important just as the information presented in the product. Without known accuracy, the product cannot be use reliably, and therefore, has limited applicability.

4.3. User's Accuracy

Users accuracy refers to the number of correctly classified pixels in each class (category) divided by the total number of pixels that were classified in that category of the classified image (row total). It represents the probability that a pixel classified into a given category actually represents that category on the ground.

Results of user's accuracy in this study showed that in 1986 the maximum class accuracy was 96%, which was forest where correctly classified and the minimum were built up areas land class with an accuracy of 75.4% as presented in table 4.2 below. In 1996, the class accuracies range from 85.7% to 92.6 % where as in the period 2016, it ranges from 84.3 % to 95.9% as indicated in tables 4.3 and 4.4 respectively. The lowest values of class accuracies were misclassified due to spectral property similarities among other land cover classes. As shown in tables 4.2 and 4.4, the user's accuracy was lowest for built up areas land as some of the grassland areas were misclassified as agriculture. Moreover, the time of image acquisition has a great role for such misclassification problems. Since the images obtained during the season where most agricultural activities were carried out in Ethiopia, other land cover classes appear as agriculture and vice versa.

4.4. Producer's Accuracy

Producer's accuracy refers to the number of correctly classified pixels in each class (category) divided by the total number of pixels in the reference data to be of that category (column total). This value represents how well its reference pixels of the ground cover type are classified. As shown in table 4.2 built up areas was largely misclassified with accuracy of 80 % and in table 4.3; this class became a low accuracy of 84.3% whereas forestlands had been relatively properly classified. The lowest values for forestland areas in table 4.2 and 4.3 were misclassified due to the similar spectral properties of different land cover classes such as built up areas**.**

Table 4.2 Confusion matrix for land use and land cover map of 1986

Classes	**Reference data**						
	Water bodies	**Forest**	**Agriculture**	**Grass land**	**Built up areas**	**Total row**	**Users accuracy**
Water bodies	**38**	1	1	1	2	43	88.4%
Forest	1	**25**	0	0	0	26	96.2%
Agriculture	2	2	**20**	1	1	26	77%
Grass land	1	1	1	**22**	0	28	89.3%
Built up areas	0	2	2	1	**12**	16	75.4%
Total column	42	30	22	25	15	**136**	
Producer accuracy	90.5%	83.3%	84.6%	89.3%	80 %		
Over all	**83.8%**						

Table 4.3 Confusion Matrix for the LULC Map of 1996

Classes	Reference data						
	Water bodies	Forest	Agriculturess	Grass land	Built up areas	Total row	User
Water bodies	**22**	0	0	1	1	24	91.7 %
Forest	0	**27**	1	1	0	29	92.6 %
Agriculture	1	2	**38**	0	3	44	86.4 %
Grass land	1	0	2	**24**	1	28	85.7 %
Built up areas	1	3	1	2	**66**	73	90.4 %
Total column	25	32	42	28	71	198	
Producer accuracy	88 %	84.3 %	90.5 %	85.7 %	92 %		
Overall	80.7%						

Table 4.4 Confusion Matrix for the LULC Map of 2016

	Reference data						
Classes	Water bodies	Forest land	Agriculture	Grass land	Built up areas	Total row	User accuracy
Water	**23**	1	0	0	1	25	92 %
Forest	0	**35**	1	2	0	38	91.1 %
Agriculture	2	2	**43**	2	2	51	84.3 %
Grass land	1	0	1	**25**	2	29	86.2 %
Built up areas	0	0	2	1	**70**	73	95.9 %
Total column	26	38	47	30	75	**216**	
Produce accuracy	88.5 %	92.1 %	91.5 %	83.3 %	95.9 %		
Overall accuracy	79.7 %						

4.5. Overall accuracy

It was computed by dividing the total number of correctly classified pixels (i.e., the sum of the elements along the major diagonal) by the total number of reference pixels. It shows an overall result of the tabular error matrix. The overall accuracy performed in the study period 1986 was 83.8% (table 4.2), in 1996 was 80.7% (table 4.3) and during 2016 it was 79.7 % (table 4.4). As mentioned by Anderson *et al*.(1976) for a reliable land cover classification, the minimum overall accuracy value computed from an error matrix should be 85%. Therefore, the overall accuracies for the study period maps were above 85% based on Anderson's criteria. The 1986 supervised classification with an overall accuracy of 83.7% was achieved with a Kappa coefficient (Khat) of 0.81. This value implies a strong agreement with good accuracy, and is often multiply by 100 to give a percentage measure of classification accuracy. Therefore, the Khat value of 0.81 represents a probable 81% better accuracy than if the classification resulted from a random assignment. Therefore, the overall accuracies for maps were above 85% based on Anderson's criteria.

4.6. Land Use/Land Cover Change: Trend, Rate and Magnitude

An important aspect of change detection is to determine what is actually changing to what i.e. which land use class is changing to which other classes. This information reveals both the changes (additions and reductions) and classes that are relatively stable overtime. This information will also serve as a vital tool in management decisions. This process involves a pixel-to-pixel comparison of the study year images through overlays.

Table4.5 Post-classification Matrix of Study Area between 1986 and 1996.

Classes	1986					
	Water bodies	Forest	Agriculture land	Grassland	Built up areas	Total
	In hectare					
Water bodies	216	151	15	18	105	416
Forest	57	5134.23	482.04	176.31	302.4	6152.22
Agriculture	491.31	12378.6	13547.97	1402.2	9207.9	23480.4
Grass land	40.68	435.06	490	181	213	1361.34
Built up areas	790.74	7614.18	25192. 26	2450. 97	8391. 87	44440
Total	596.42	25713.8	39728.25	4229.1	18130	89440.5
Change	- 180.42	- 19561.5 8	-2700.27	- 2867.76	-26310	

As the above table 4.5 seen in 1986 and 1996 the agriculture 37027.98 ha and 39728.25 ha and the change increased by 2700 ha to agriculture and the agriculture following by built up (26310 ha), forest (19561 ha), grassland (2867.76 ha) and water bodies (180.42 ha) respectively.

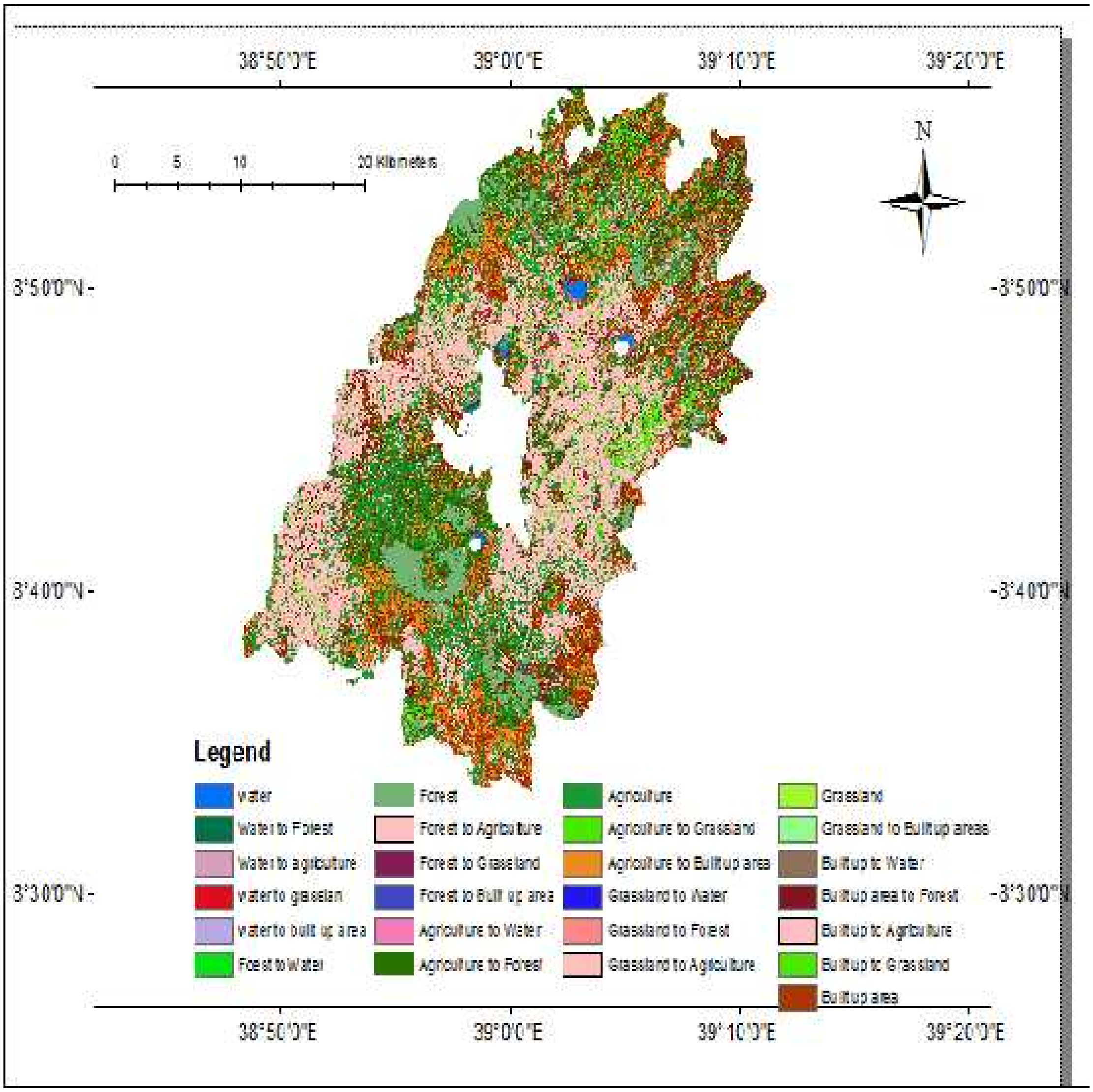


Fig. 4.5 LULC Change Map between 1986 and 1996

Table 4.6 Post-classification Matrix of Study Area between 1996 and 2016.

		1996					
2016	Classes	water	Forest	Agriculture	Grass land	Built up areas	Total
		In hectares					
	Water	226.35	94.05	839.7	192.78	286.2	1639
	Forest	40.05	4507.92	14765.58	1979.73	4360.86	47347.2
	Agriculture	10.8	1209.42	33408.18	2710.53	2380.59	39719.5
	Grass land	0.99	269.91	2842.29	481.23	634.32	4228.7
	Built up areas	9.36	491.94	13375.98	653.22	3595.86	18126.4
	Total	278.5	6573.2	65231.7	5817.5	11257.7	89440.5
	Change	1360.5	40774	-25512.2	10046.2	6868.7	

As the table of 4.6 indicated, the above change is between 1996 and 2016. In 1996 and 2016 the agriculture were (39719.5) and (65231.7) respectively. The change increased in 25512.2 ha and the agriculture was followed by forest 47347.2 ha & 6573.2 ha. so the change was increased 40774,built up areas 18126.4 to 11257.7ha the change decreased in 10046.2 ha ,grass land 4228.7 to5817.5 ha ,also the change increased in 10046.2 ha and water bodies 1639 & 278.5 ha the change decreased in 1360.5 ha respectively.

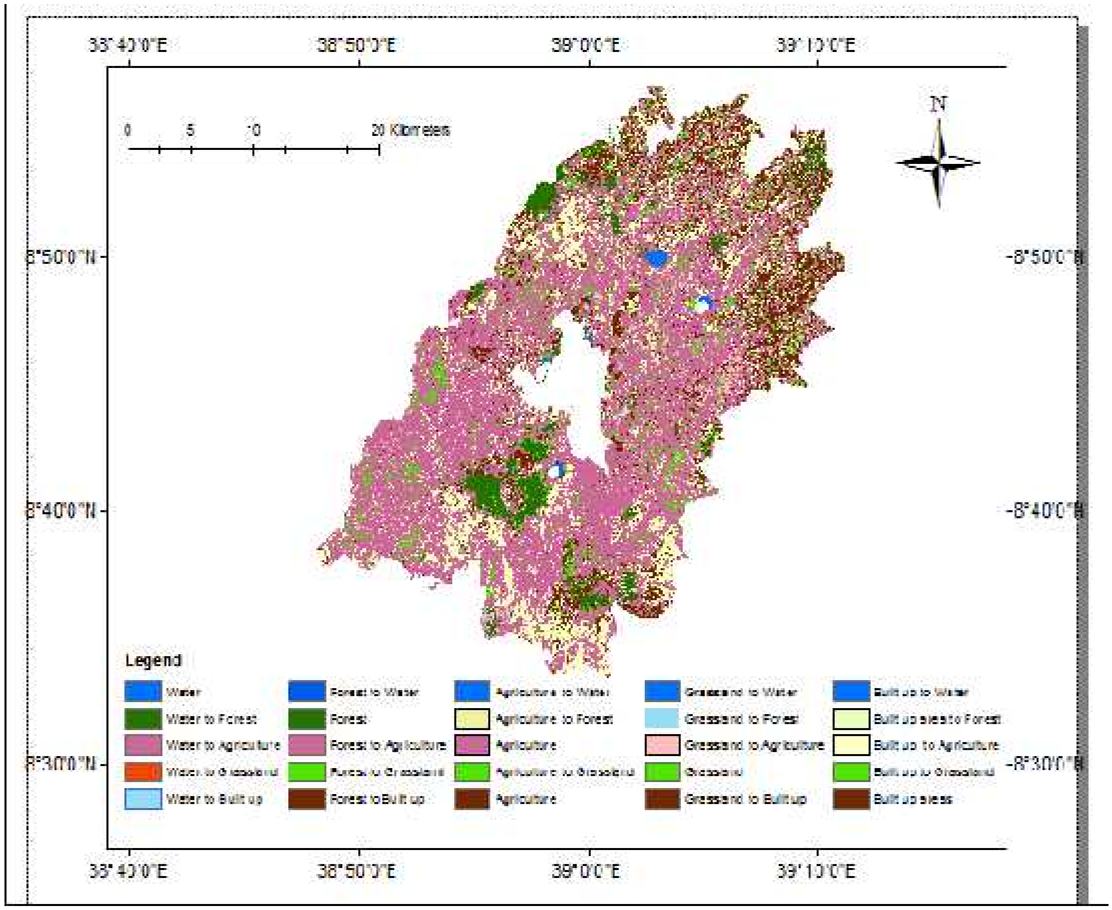


Fig. 4.11 LULC Change Map between 1996 and 2016

Table4.7 Post-classification Matrix of Study Area between 1986and 2016.

	1986						
	Classes	Water bodies	Forest land	Agriculture	Grass land	Built up areas	Total
2016	Water	200	66.69	80.78	62.1	49.41	409.61
	Forest	6.12	3148.2	1833.48	463.95	647.64	6093.39
	Agriculture	8.73	1876.53	27604.8	2045.43	5483.61	37019.1
	Grass land	0.18	115.1	886.86	152.37	206.28	1360.79
	Built up areas	72	1366.65	34825.66	3293.63	4870.89	44428.83
	Total	282	6572.94	65231.58	6017.48	60607.22	89440.5
	Change	127.6	-479.55	-28212.48	-4656.79	-16178.39	

As the table4.7seen in 1986 and 2016, the built up areas largely increased in 44428.83 and 60607.22ha. , the change were increased in 16178.18 ha and built up areas are followed by agriculture change increased in 28212.8 ha, the forestland are increased in 479.55ha are changed, grassland change was increased 4656.79 ha and water bodies was change decreased 127.6 respectively.

4.7. Cause of land use and land cover change in Adea Woreda

The LULC in Adea woreda increases time to time in the area. Due to several reasons: In previous time mostly of *woreda* land used for agriculture land, grazing, forestland. However LULC are automatically changing one to another's .The cause of LULC in *woreda* direct or indirectly related to the alarming growth of the population, expansion of urbanization and investments are a major for land use and land cover change in the *woreda*. This mean the majority of the woreda population directly interconnects to the agriculture.

According to Adea *Woreda* experts at the present a day the major problem for farmers in the study area is shortage of cultivable land and diminishing of land productivity. The current population pressure has created a high need for additional land. Currently triggered by the serious shortage of land, kebeles of the *Woreda* are giving land to landless youths from communally owned lands by organizing to small-scale enterprises.

Fig.4.4. Field observation photo (taken by researcher in 2017)

This photo show as the place in previously cover by forest and know by deforestation use this place for different purpose .This mean that exploiting different mineral like calcium carbonate and its use as row material in cement manufactory.

Fig 4.5.Photo of forest in study area (by researcher at golo_dhertu *kebele*)

This small micro enterprise groups use the gained land for different purposes such as exploiting mineral called calcium carbonate (pumice) and micro enterpriser etc. The other issue related to expansion urbanization is investments the causes the population migrate from rural to urban areas. Problem came with the investments and urbanization are the burning issue in district. This means that most of farmer are because urbanization & investments thy loose there farming land this was the major cause for diminishing of agriculture.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

LULC changes have wide range of consequences at spatial and temporal scales. Because of these effects and influences, it has become one of the major problems for environmental change as well as natural resource management. Identifying the complex interaction between changes and its drivers over space and time is important to predict future developments, set decision-making mechanisms and construct alternative scenarios.

This study has been conducted by integrating GIS and Remote Sensing. In order to detect and analyze changes in land cover classes, these techniques were implemented. In the first section, satellite data for the study periods of 1986, 1996 and 2016 and Remote Sensing techniques were applied to generate LULC maps through a maximum likelihood supervised image classification algorithm. The accuracy assessment and change detection processes has also been done. The overall accuracy of land use and land cover maps generated in this study had an acceptable value of above the minimum threshold. In the last section.

From the remote sensing of image classification result, the woreda showed significant change in the LULC over the last three decades. The changes were largely caused by increased population growth, urbanization and investments. From the observed changes expansion of forest coverage and growth of urban areas can be taken as something positive.

In the first study period, the study area was covered by five LULC categories namely water bodies, forestland, agriculture, grassland and built up areas. From the observed changes agriculture are the most converted. It covers (65231.58ha) type during the entire study period and surprisingly built up areas increased by (16178.39ha).

From the observed changes forestland are the most converted (6572.94 ha) over type during the entire study period and surprisingly decreased by 25.4% (7,378ha) the water bodies and grassland decreased (127.6 ha) and (4656.79) ha respectively.

The expansion of this LULC type is due to decrement on the productivity of agriculture land that opened the way for the introduction and expansion of urbanization. The socioeconomic condition of the study area community had largely affected by the changes on this LULC type.

5.2 Recommendations

- ❖ The results of this study have shown that Remote Sensing and GIS are important tools in LULC change studies. Therefore, based on the findings of this study, the following recommendations are forwarded for policy implications and future research directions
- ❖ There should be an appropriate land use planning and policy with impact studies and scenarios, in order to use a given land with its maximum output. In addition the farmers should be aware of their land use system.
- ❖ Population increase has played a major role on LULC there should be strong¬ family planning awareness creation campaigns with adequate health services from the zonal and woreda like health extension services (offices). To minimize the problems of landless youths, it will be imperative to create and strengthen off-farm income generating activities due to limited capacity of land to accommodate additional population.
- ❖ To make the woreda’s community more profitable the mineral and industry production system should be supported by results of modern technology.
- ❖ I recommend integration of socio-economic data, land policy scenarios, biophysical, parameters and demographic variables when predicting future LULC patterns.
- ❖ Incorporation of the above variables would improve model performance and provide accurate prediction of the future LULC patterns in the study area.

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