ADDIS ABABA UNIVERSITY
COLLEGE OF SOCIAL SCIENCES
DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

SPATIOTEMPORAL LAND USE/LAND COVER CHANGE, DRIVING FORCES AND CONSEQUENCES IN AMEYA WOREDA, CENTRAL, ETHIOPIA

BY
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ADVISOR: ASMAMAW LEGASS (DR.)

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTER OF ARTS DEGREE IN GIS, REMOTE SENSING AND DIGITAL CARTOGRAPHY

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This is to certify that the thesis prepared by Tulu Tadese entitled: spatiotemporal land use/land cover change, driving forces and consequences in Ameya woreda, central, Ethiopia and submitted to department of geography and environmental studies in partial fulfillment of the requirements for the master of arts degree in GIS, remote sensing and digital cartography complies with the regulation of the University and meets the accepted standards with respect to originality and quality.

Approved by Board of Examiners

Advisor	Signature	Date
Internal Examiner	Signature	Date
External Examiner	Signature	Date

Declaration

I, the undersigned, declare the project is my original work, not presented for any degree in any universities and that all the source used for it are duly acknowledged.

The project is original and has not been submitted for the award of any degree or diploma to any University or institution.

Tulu Tadese Megersa _____ _____

Name **Signature** **Date**

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Abbreviation and Acronyms

BoFED	Bureau of Finance and Economic development
CSA	Ethiopian Central Statistical Authority
EMA	Ethiopian Mapping Agency
ETM	Enhanced Thematic Mapper
FAO	Food and Agricultural Organization
GIS	Geographic Information System
GLCF	Global Land Cover Facility
GPS	Global Position System
IGBP	International Geosphere-Biosphere Program
IHDP	International Human Dimension Program
KIIs	Key Informal Interviews
LCI	Land Cover Institute
LUCC	Land Use/Cover Change
RS	Remote Sensing
TM	Land Management
USGS	United States Geological Survey

Abstract

Understanding of the land use/ land cover change (LULCC) has paramount importance for sustainable development and setting out the strategies of natural resource management. The present study illustrates the spatiotemporal land use/ land cover changes, driving forces and consequences taking place in Ameya Woreda, Central, Ethiopia. Qualitative data were used to investigate the causes and effects of land use/ land cover change. Landsat satellite imageries of three different periods, i.e., Landsat Thematic Mapper (TM) of 1986, 2001 and 2016 were acquired from Global Land Cover Facility Site (GLCF) and earth explorer site (USGS) and quantify the LULC changes that has taken the Ameya Woreda from 1986 to 2016 over a period of 30 years. Supervised classification methodology has been employed using maximum likelihood technique of ERDAS 2014Software. The images of the study area were categorized into five different LULCC classes namely vegetation, cultivated land, bare land, grass land and settlement. The results revealed that during the last three decades, cultivated and settlement lands have increased by 21.1% and 0.91% while vegetation, bare and grass lands have decreased by 11.9%, 2.6% and 7.4% respectively. As the study explored population growth, expansion of agricultural land, demand for fuel wood and construction materials and charcoal, and inefficiency of natural resource and land management system were the main causes of LULCC at woreda and kebele level. Whereas, forest degradation, Loss of plant's and animal's species, land degradation, hydrological impact and shortage of animal feeding were the main consequences of land use/ land cover change.

Keywords: *Land use/Land cover, driving forces, consequence, GIS, Remote sensing*

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

The land use/land cover pattern of a region is an outcome of natural and socio-economic factors. The need for agricultural land and the alarming demographic pressure are making land scarce resource. As Huimin (2009) identified, the expansion of agriculture and the need of land for a wide range of economic activities have transformed one third of our planet's land surface to be one-half in the form of forest clearance, agricultural practice and urban expansion. Land use/land cover change has profound impacts on ecosystem service, food production and environmental balance (Huimin, 2009). Therefore, land use/land cover change has become a core constituent in current strategies for managing a natural resource and monitoring environmental changes. James *et al*., (2001) classified land cover in to urban, agricultural land, range land, forest land, water, wetland, Barren land, Tundra and perennial snow or Ice. Hence, to satisfy the increasing demands for basic human needs and welfare, systematic use of land by selection, planning and implementation of land use schemes through getting and by optimal usage of information on land use/ land cover is very important. The rapid increase in human population and their effort to strive to improve standard of living has put great pressure on vegetation, soil and water. Thus, as Jeanne *et al*., (1995) indicated, the study of land use/land cover change is essential to document its rate, driving forces and its consequences for many government institutions. Specially, due to the widespread and rapid changes in the distribution and characteristics of tropical forest, LULCC in lowland tropical regions are major concern for the globe in general, and the local people, in particular.

According to FAO (2012), 4 billion hectors (31%) of the world's land surface is under forest cover. Deforestation is one of the key causes of land cover change and it is the most challenging factor in developing countries, particularly in tropical rain forests, which covers some 550 million ha of the globe, with an annual harvesting rate of over 2%. So that the forest cover of the world is declining continuously and has global environmental implications.

The worldwide impacts of deforestation are change in the way of life of local people, extinction species, destruction of genetic resources, increasing soil erosion by wind and running water, expansion of desertification, and overflow of rivers causing flooding and future erosion (James 1986).This reality availed itself in Africa mostly during and after colonial period because people of Africa have the tradition of protecting forests as sacred places especially before colonization.

> *In a few locations, deforestation in Africa increased during the colonial period, when trees were harvested and shipped to Europe. Forests were exploited to fuel steamboats and trains during the nineteenth century, opening up large areas of the continent for resource exploitation and agricultural development* (FAO, 2012:15).

Due to population growth and dependency on agriculture (agrarian society) of sub-Saharan Africa, deforestation practices have been intensified across the region. This speeds up the trajectory of land use land cover change and impacted the environment as a whole in Africa in general, and sub-Saharan Africa, in particular. In Ethiopia, for instance, deforestation for farmland and other purposes which in turn brings soil erosion and soil degradation is emanated from population pressure (Hurni, 1990). This is because of natural forests are the main sources of wood for fuel and construction materials in the country. Ethiopia is at a crossroad and needs to improve its biophysical resources in order to feed its growing population.

In short, land use changes can influence the socio-economic status of the rural population (Lambin, *et a*l., 2000). According to Muleta (2009), the most important human factors which were recognized as change agents of land use are the need to supply food for rapidly growing population. This requires something to be brought about the expansion of agricultural land and the provision of land for the landless in order to fulfill self-sufficiency. Consequently, agricultural productivity that determines rural income levels and wealth can be affected by the land use change. The land use change brings tremendous impacts in the agricultural productivity.

Nevertheless, there is no such critically investigated study carried out in and around the land-use/cover of Ameya *woreda*. Particularly, there is no study carried out related to the status of recent land use/land cover (LULCC) in the area. No attempt has been made so far to look into the spatiotemporal land use/land cover changes and the causes of a change over years.

Therefore, the study aimed to investigate the spatiotemporal analysis of land use land cover changes, its driving forces and its impacts in Ameya *woreda* from 1986-2016 by using GS and RS technology and studying at the socio-economic activities.

1.2 Statement of the Problem

As William B *et al*, (1992) cited in (FAO, 2012) Land use/land cover (LULC) changes influence climate and weather condition from local to global scales and he affirmed that they can have impacts by affecting the composition of the atmosphere and the exchange of energy between continents and the atmosphere which can lead to global warming. Change in LULC can also affect biodiversity, leads to forest fragmentation, soil erosion, alter ecosystem services, and increase flooding (Mengistie, *et al*., 2013). This calls for global attention for continuous monitoring of the land use/land cover changes and prediction. Lambin, *et al* (2003) noted that to know what changes happened, where and when they occur, their rate of occurrences and the social and physical forces that drive those changes, land use/ cover change information is needed. Specially, in continents like Africa where agricultural technologies are not fully developed, policy makers need such information than others. FAO (2012) stated that, the slow development of agricultural technology in Africa is attributed to becoming the commonplaceness of slash-and-burn cultivation that resulted in harvesting forests for fuel wood and charcoal to reply to the growing of cities, and due to population growth fallow period became shorter.

In many developing countries like Ethiopia, most of the rural populations directly live on land resource as a source of livelihood. Especially in Ameya *woreda* (in the study area) much emphasis is given to the land resource. They have a saying for this which goes in *Afaan Oromo* as "*Dhimmi lafaa dhimma lafeeti*." which literally means issues of the land is equivalent to issues of the bone in the body. This is because of they earn their life from using land. This rural population is currently growing rapidly and consequently inducing the decrease in natural vegetation cover and its conversion into other types of land use/land covers.

The increasing rate of population growth and deterioration of natural resource in Ethiopia influenced agricultural sector in the country (Mulugeta, 2004). Abate, (1994) also added that, Ethiopian agriculture is struggling with the challenge of providing food for a growth

population. One of the immediate problems facing Ethiopia today is land degradation, particularly loss of vegetation cover and soil erosion which contribute significantly to low agricultural productivity. In Ethiopia, the highlands are the centre of economic activity of the country and are characterized by enormous ecological, environmental and agricultural diversity (Kahsay, 2004).

Therefore, the quantitative information on the spatial distribution of land use types and their conditions as well as temporal changes is very important for land resource and environmental policy makers. To satisfy these needs ecologists and natural resource managers use Remote Sensing and GIS technology to get appropriate data and practical periodical change (Mengistie *et al.*, 2013). To be the part and parcel of the contributors to this timely data and research gap, this study used GIS and Remote sensing technology throughout data collection process.

Furthermore, the world we are living in is in trouble. Climate change due to different factors is worsening our life. So, the world is now asking the question what to be done? To answer this question, I believe everybody should question himself. As a geographer, I prefer to start from what I observed as a problem. I started from the problems of land use land cover change observed in my *woreda.* The courses we have taken throughout these two years initiated me to conduct this study. I have been seeing land use land cover change from my childhood up to now in my *woreda*. Specially, deforestation is the common phenomenon in Ameya *woreda*. I strongly believe that, these problems should be clearly identified and fixed through scientific approach.

Therefore, to fill the research gap on this area, this study analyzed land use/ land cover change, its major causes and the impacts it has made on the environment and the livelihood of the people in Ameya *woreda*, by using Remote Sensing and GIS tools. The underlying causes and effects were identified by qualitative data collected through in-depth interview and focus group discussion

1.3 Objectives of the Study

1.3.1. General Objective

The general objective of this study is to investigate the spatiotemporal land use/ land cover changes, driving forces and consequences taking place in Ameya *Woreda.*

1.3.2. Specific Objectives

This study is specifically aimed to:

1. assess the rate and spatiotemporal land use/ land cover change trends from 1986- 2016 in *Ameya*;
2. identify the drivers which affect land use/ land cover changes in the study area;
3. generate map of 1986, 2001and 2016 years of land use/ land cover in the study area;
4. investigate the effects of spatiotemporal land use/land cover changes over the years in `the study area.

1.4 Research Questions

In order to assess the stated problem and objectives, the study attempted to answer the following questions:

1. What are the rates and spatiotemporal land use/ land cover change trends from 1986-2016 in Amaya *woreda*?
2. What are the major drivers of land use/ land cover changes in the study area?
3. What are the map of land use /land cover in the area?
4. What are the effects of spatiotemporal land use pattern over the years in the study area?

1.5. Ethical Consideration

There are a number of key phrases that describe the system of ethical protection that the contemporary social and medical research establishments will have created to try to properly protect the rights of the research participants. The principle of voluntary participation requires that people will not be coerced to participate in research. Closely related to the notion of voluntary participation is the requirement of informed consent.

In this investigation that is related to spatiotemporal recent land use/ land cover change analysis, its major driving forces and impacts, ethical consideration needs a care since it incorporates human elements which needs special treatment. Regarding these facts, the researcher has got the consent of households and *woreda* officials while conducting focus group discussion, key informant interviews and field observations. First and foremost, the researcher had explained as the research is conducted for academic purpose and finally the results of the research will as well benefit the need of the study population. Personal information or background will be kept

secretly that will not be noticed nor given to any third person or party without their full permission in case the need arises.

1.6. Significance of the Study

This study is carried out for academic purpose and focuses only on a single *woreda* in Ethiopia-Ameya *woreda* of Oromia Regional state. But, the findings of the study will be very useful to have a detail understanding about the spatiotemporal analysis of land use land cover change patterns in general and the outlaying area in particular. It adds a lot of representation appearing on pattern of spatiotemporal analysis of land use land cover change effects in rural areas that actually occur at present. Thus, the result of this study will be essential input to the incumbent government's endeavor to address the frequent impacts of land use land cover change pattern in rural area and bring about sustainable land management.

Especially, NGOs and concerned governmental bodies at *woreda* and regional levels can make use of this research output to plan for specific rural land use planning and land use advancement plan of action intended to accomplish a specific objectives. Besides, it is crucial to estimate the time and place at which the significance of land use land cover change turns to zero or intolerable stage. It is also instrumental to go through vegetation cover dynamism along with land use land cover change to supply basic information for those who intended to design effective and timely actions on highly degradable land resources.

The study will also contribute towards the understanding of the magnitude of change from the point of view of resources degradation, economic activity dynamics and livelihoods change there by indicates directions on how smallholders could come up with these problems. Furthermore, the outcome of the study will generate relevant information that will contribute to the development plans of the *woreda* in terms of land use and sustainable land management system for its local community. The result of the study can have jurisdictions on development interventions and policy discussions related to population and environment connection.

Finally, this study could be the stepping stone for other researchers who want to embark on further research in the area. It is also the input for policy makers, planners and agricultural expertise.

1.7. Scope and Limitation of the Study

The study has spatial, temporal and analytical scopes. Spatially, this study is limited and undertaken in Ameya *woreda*, South west shoa zone of Oromia Regional State. The study is conducted only in a single *woreda*. The study is based on a cross sectional research design where data is gathered by a single contact through field observation, KII, FGDs and secondary sources to investigate the rate and trend of land use and land cover change. The study examined the change and pattern of land use over space and time, and determined the basic factors the peasants or household's access to land use planning and sustainable land management in an entire period of time.

In spite of this, this study is not free from limitation, specifically arising from data collection problems like, unwillingness of some respondents in supplying the right data. The other one is the problem of satellite image accessibility, quality and resolution power. The high quality image resolution was not used for this study because of expensiveness of the images. In fact, different data confirmation and validation methods were employed to reduce the limitations of this study to some extent. Ameya *woreda* has no arranged and written materials about the demography, population size, and Agricultural and environmental data.

1.8. Definition of Key Terms

GIS (Geographic Information System) is computer based system for collection, storage, processing and displaying geographically referenced data (Burrough, 1990).

Land is the physical resource which is the foundation for economic, social, infrastructural and other human activities (Lambin, *et al*, 2003).

Land Cover refers to the visible biophysical features and elements on earth's surface and immediate surface (Prakasam, 2010). It includes vegetation, water (surface, ground water), desert, ice, soil, relief and anthropogenic structures like mining and settlement (IGBP/IHDDP- LUCC and IGBP-DIS, 1997; Di Gregerio, 2005).

Land use is the purposeful actions and involvements of human beings to exploit land resources, everything on the land and inside it to fulfill their needs and wants. It is the modification of the land carrying varies activities and using different inputs that convert the land cover kind to produce, change or preserve the land (IGBP/IHDDP-LUCC and IGBP-DIS, 1997; Di Gregerio, 2005). As a matter of fact, there is a close interaction between land cover and man action in any

place inhabited by human beings for the recent land cover has been changed by human use from the immoral (Allen and Barnes, 1985; Turnel, *et al*.1990; Whitby, 1990 cited Turnel *et al*; 1995).

Remote Sensing is explained as a host of processes by which information concerning an object, area and any phenomenon is obtained without any physical contact with it. Moreover, the term is specifically related with measuring the interrelationship between earth surface materials and electromagnetic energy (Milla *et al*., 2005).

1.9 Origination of the Paper

The project work is organized into five chapters in which the first chapter deals with the introduction, statements of the problem, research objectives, research questions, ethical consideration, significance of the study, scope and limitation of the study and organization of the paper. The second part contains review of related literatures about overview of land, land use/ land cover change, land use land cover change in Ethiopia, driving forces of land use land cover changes and consequences of land use land cover changes are briefly pointed out. The research methods and materials, general description of the study area, research design, instruments of data sources and methods of data analysis are presented in chapter three. The fourth chapter deals with the result and discussion which contains, land use/ cover maps of 1986 to 2016, accuracy assessment of the classification, spatiotemporal land use land cover change rate, the main driving forces and consequences of land use land cover change. Finally, conclusions and recommendation of the study are presented in the fifth chapter.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.1 Overview of Land, Land use/ Land Cover Change

Land use/ land cover is a common phenomenon throughout the world. As Briassoulis (2000) and the Food and Agriculture organization (FAO, 1995) state land in a more and inclusive way defined as a place on the earth surface that embraces all elements of the biosphere including the close surface climate, the soil and landforms, water surface (shallow lakes, rivers, marshes and swamps), and related ground water reserve, the biological life, the current and past human settlement patterns and activities. The same author concludes that the explanation given for land differs among scholars due to the features that characterize the land.

Moreover, LULC is the primary cause of worldwide environmental change that has been increasing spatially and temporally at an alarming rate (Wubie, *et.al* (2016). As Ebrahim and Mohammed (2017) briefly state conversion in LULC results in multi faceted environmental side effects by hampering water provision reservoir storage capacity, agricultural potential and ecology of an area. Moreover, as Turner and Meye 1941, cited in warra *et al*, 2013 indicate human need for land resources and the advancement in technological managerial and institutional level have widely changed the vegetation, soil, and the relief of the physical environment worldwide.

Furthermore, LULC changes have a manifold and profound impact on the vegetation distribution growth (Defries *et al* 2002). Consequently, biodiversity loss, land degradation and climatic change at local and global levels are directly correlated with the change in vegetation cover in small and large areas. The most evident phenomenon in LULC analysis is deforestation. Awide range removal of forests can strongly affect the climate condition particularly rainfall distribution (Meher; 2001), which again influences the vegetation cover and distribution. LULC changes are ever changing processes in terms of their types and extent over space and time (Prakasam 2010). Turner *et al* (1995) cited in Solomon (2016) point out that the knowledge of LULC interaction is interwined with causes and effects of LULC change for the conversion in land cover leads to the change in land use (Turner *et al* 1995 cited in Solomon 2016). Land use land cover dynamics are the outcomes of a complicated interrelationship between natural, socio- cultural and economic aspects that took place on different level and intensify (Reid 2000 cited in Warra *et al* 2013).

Wubie, *et.al* (2016) confirm the case in point stating that the tie between land use and land cover change and the driving forces are complex and dynamic. It is driven by natural and socio-economic agents.

Land use /land cover are two different but closely interrelated terms. According to FAO (1995) land use is described as the function and motive for which land can be harnessed by its inhabitants; it can be explained as the human action tied with the land to get the necessary materials that sustain human life and affecting the land surface in positive and positive ways. Land use pattern and the purpose for which the land can use differ from place to place due to biophysical and socio-cultural factors.

Moreover (FAO, 1995) elaborates land use by listing various activities that are conducted on the land surface like grazing, agriculture, urban development, logging, mining and others. On the top of that Mayor and Turner II (eds) (1994) clearly distinguish between land cover and land use. Land cover portrays the physical, chemical and biological components of the earth's surface. For instance, grassland, forest, concrete and so forth. On the other hand, land use implies the purpose for a given land type can be best suited. For example, grazing land, recreation and settlement are some of it.

However, Land use is related to land cover in many ways and affects it in multi-dimensional ways. A given land use can best used for a single purpose and some land uses can be exploited for multiple functions like forest for fuel wood, recreation, timber and flash and burn agriculture. Turner II *et al*, (1993), identify the large scale social components based on their contribution in the process of land cover change into human driving forces, human mitigating forces, and proximate forces of change.

Human driving forces are basic societal causes that are very important result of population, technology, socio-cultural and economic arrangements that change the land cover. On the other hand human mitigating forces are used to reverse the adverse impacts of human driving forces like setting up formal and informal regulation mechanisms, a responsible market systems and friendly technological innovations. Mitigating forces can be applied to rehabilitate negative side effects that took place in the past related to land cover change. Proximate causes of change are socio-cultural and economic actions which have a direct effect on land cover. They are the immediate land resource allocation strategies that tend to change the original cover land and/or modify the

existing land cover types. The phrase land use/land covers are not the same technically. Therefore clear distinction between them is crucial. According to Encyclopedia of the earth broadly, the term land use and land cover change indicates all kinds of human modification of the land surface.

However, Land cover is specifically related with the biophysical cover of land surface including water, vegetation, bare soil and /manmade structures (Ellis and Pontius 2006). With regard to land cover land use has a bit complicated with various purposes the land is assigned for. Hence, social scientists and land mangers explain the term in a wider sense relating it to socio economic aspects. Others particularly, material science researchers attach the term with various human actions applied on the land, for instance farming, forestry and infrastructures. Turner II *et al*, (1993) explain land use as both the way in which the biophysical components of the land are used and the burning desire for using it. Moreover, Lambin *et al*, (2007) distinguish between land cover and land use in that land cover portrays any observable and visible thing on the land whether it is natural or manmade. On the other hand, land use indicates the practical actions that human beings apply on the land like grazing land for cattle habitable areas.

Moreover, Land cover depicts original and introduced vegetation cover, rocks, sand and other surface and human induced structure that are seen on the surface of the earth. Land use shows a multitude of activities carried by human beings with the motive of setting products and benefits from land resources like soil and vegetation cover (DeBie, *et al* (1996). It is a common understanding that land use affects land cover in different ways. Hence, land cover change is the conversion of the land surface for different purposes (Lemlem 2007). The rapid increase in population size and the booming socio economic needs create a pressure on land use and land cover. Furthermore, the pressure resulted in unplanned and uncontrolled changes in LULC (Seto, 2002).

The LULC conversion are mainly the outcome of improper use of agricultural, urban, range and forest lands that can in turn result harsh environmental problems like land degradation and flooding, etc. different land types do have various land covers for unique purpose. LULC are different but they are closely interdependent features of earth's surface. Land use includes grazing, agriculture, urban development, forestry and mining. According to Meyer (1995) the word land cover basically refers to the type and level of plant cover like forest or grass and it further stretches to human made structures like building, roads and so forth. As Riebsame *et al*, (1994) state land use affects land cover and changes in land cover affects land use. Conversion of

land cover through land use processes cannot necessarily reflect land degradation. Yet, several land use practices motivated by social reasons resulted in bringing about land cover changes that negatively affects bio diversity, water resources, climate, the atmosphere and other natural set up of the land.

2.2 Land use/ Land Cover Change in Ethiopia

Mengistie, *et al* (2013) have examined LULC change by using the object based classification of multi temporal remotely sensed data(land sat and rapid eye)from four reference years followed by post classification comparisons using the recent advancements of remote sensing and GIS technologies. The method in object based method enhances the classification accuracy. It is one of the newly applied approaches for the Ethiopian land escape with various features and rugged relief. The application has the capacity for being used in the rest part of the country with improved classification results.

Moreover, Mengistie *et al*, (2013) find out that there are some researches which are conducted in an integrated way that relate analysis to other geographic aspects of LULCC in the highlands of Ethiopia. In Ethiopia, natural resource distribution, type and management differ from place to place. For example rain fall in the country is highly variable ranging from 600mm to 2700mm per year. The variability and shortage of rain fall has a significant effect on the highlands of Ethiopia (Hussein 2009). Various studies show the forest cover in the country decreasing from time to time.

2.3. Driving Forces of Land use/land Cover Changes.

Looking at the driving forces of LULCC is very crucial in addressing the constraints. Land use/ cover change are the outcome of numerous driving forces that command certain environmental, social and economic conditions. Furthermore, the driving forces can be influenced by social out looks and practices like local culture, economic and financial elements, the state of the environment such as land quality, the topography, availability of water, current land policy and development plans. Hence, it is necessary to identify between the driving forces and the controlling variables. The driving forces can be used as a blue print for managing the land cover change. According to (Ellis and Pontius, 2006) assessing the interaction between the drivers of land use change need a good knowledge about the ways and the rest influencing factors and land policy. Land use /land cover change is most often addressed based on selected biophysical and

socio-economic elements. To easily construct simulation, the driving forces are mostly considered exogenous to the land use system (Velburg, *et.at*, 2004). The relationship between driving forces and LULCC can be distinguished by quantitative and qualitative methods.

Land use/land cover change has become a core and crucial factor that is considered for recent natural resource management and to oversee environmental changes. Land use is the outcome of the interrelationship between socio-cultural settings, the state and its physical demands and the physical potential of the land (Balak and Kolarkar, 1993).

Land use is the purposeful application of land management strategy imposed on land cover by human beings or land managers to user the land cover, reflecting human activities like industries, settlement, cultivation, grazing logging and mining (Zubair, 2006). Is the other hand, land cover is the natural and artificial features of the land surface explained by vegetation cover, water, ice, sand and gravel and the immediate sub-surface composed of living organisms, soil, relief, surface and ground water and human imprints including infrastructures and settlement(Lambin,*et.al*, 2003; Baulies and Szejwach, 1997).

Land use/cover change varies rapidly from time to time and place to place, and very important for the study of natural resources. Land use land cover change dynamics are the most crucial factors for monitoring, assessing, safeguarding and proper use of natural resources. Land use/cover changes are the critical topics and challenges for environmentally friendly and sustainable economic progress of the place. As human population increases rapidly environmental degradation like deforestation, soil erosion, biodiversity loss, water pollution and global warming are human life from time to time. Change detection in land use and land cover can be assessed on temporal scales, for instance, a decade to evaluate land cover change caused by human actions on land surface (Gibson and power, 2000).

Land use/cover change is highly affected by different natural and human activities. For promoting the economic situation of an area in a long- lasting way without keeping the environmental condition safe a wise use of natural resources is a must. This can be effectively by looking at the present and past land use and land cover change patterns of the area concerned area (Chaurasia, *et.al*, 1996). Land use land cover change is taking place at an alarming rate, wider scale and the factors of change are human and negatively affecting human beings themselves (Agrawal, *et,al, 2002*). Lambin *et, al* (2003) and Solomon (2016) summed up driving

forces behind land use land cover changes into proximate and underlying causes. Proximate (direct causes) are human activities and immediate actions that arise from the proposed land use and directly influence land cover. As Solomon (2016) further a specifies proximate causes are human actions which have a direct impact on the land use through the use of different resources on the land like wood extraction or clearing it for agriculture. On the other hand, the underlying (indirect) causes are basic elements that pave the way for the proximate causes to operate. The effect is felt from far distant areas, frequently by affecting one or more proximate causes (Lambin, *et.at,* 2003). Moreover, Solomon (2016) citing (Geist and Lambin, 2002, Vancker, *et.al* 2003) states that underlying causes basic engines that work behind the proximate causes encompassing demographic pressure, economic policy, technological advancement, institutional and cultural elements.

Most of the time, proximate causes work in small scale, local level (individual farms, households or communities). On contrary, underlying causes can emerge from large-scales, far- reaching, i.e., regional (*woreda,* provinces, country) and worldwide scales. Underlying causes are frequently strange(exogenous) to the local societies in direct attachment with the land use and beyond the controlling capacity of the community concerned stated the other way, only some local- level factors are well known by decision makers (Lambin, *et.al*, 2003; Solomon, 2016). Different scholars point out population pressure, expansion of agricultural land, Settlement and poverty in the front line as causes for land use- land cover change.

2.3.1 Population Pressure

The impact of rapid population growth on the land use- land cover change is one of the most widely accepted factors among intellectuals. For instance, Wubie, *et.al* (2016) citing Turner and Meyer (1994) fast population growth, distribution and the resultant demographic changes are taken as the key elements that are responsible for land use- land cover change. Solomon (2016) clarifies the case in point starting that when population booms the demand for farming land, pasture land, fire wood, and settlement and consequently increases. Moreover, spatial and demographic changes in Ethiopia cause a severe effect on the farm lands and land cover of an area (Kebrom, 1999 cited in Solomon on 2016). On the top that Kinfe (2011) referring Erle(2007) states that although humans have been using the land for food and non-food products, the present need and demand level and intensities of land use- land cover changes are much greater than any human history in the world highly affecting ecosystem and environmental

resources at local, regional and global scales. Furthermore, Ebrahim and Mohammed (2017) high light that population increase poses a formidable impact on land resources due to the rising need for agricultural lands, settlements, energy consumption and building materials.

2.3.2 Expansion of Agricultural Lands

Land is the base of livelihood for agricultural societies like Ethiopia. For many developing countries, agriculture is the primary and pival economic sector for it is the key source of gross domestic product (GDP), export and foreign currency earning and employment. The very key role it plays indicates that agriculture remains one of the main causes of land use- land cover change in rural environment (Muluneh, 2005). According to Warra, *et al.,* (2013) point out that agricultural and rural settlement land is the major cause of land use land cover change in the Kasso catchment area of Bale Mountain.

Moreover, as Wubie, *et.al* (2016) states that agricultural and residential land is the major factor for land use land cover change in Gumera watershed of Lake Tana Basin. Respondents in the study area identified the expansion of crop production is the leading cause of land use land cover change among others. On the top that Solomon (2016) specifies that the fast increasing population pressure on the Ethiopian highlands results in a profound changes in land use land cover change primarily driven by agricultural activities. Here, agricultural land shows steady but continuous increase at the expense of forests and grass lands through time (Gete, 2000, Kebrom and Hendland, 2000 cited in Solomon, 2016). Furthermore, as muluneh (2005) puts increase in agricultural production is the outcome of expansion of cultivated land or agricultural intensification. About 80% of agricultural growth has come from the extension of area under cultivation (Paulino, 1987 cited in Muluneh, 2005).

2.3.3 Demand for Fuel Wood and Construction Materials

Deforestation is the outcome of forest resources to a different type of land cover or when the remaining tree cover drops below a minimum threshold of 10% according to the UN- Food and Agriculture Organization (FAO) (Lambin, *et.al* 2003). The causes for forest loss vary from area to area. For instance, in Latin America, it is the high level of forest processing and pasture for grazing animals that are the main reasons, while crop production by small scale holder is the great concern in Africa. In line with this, Warra, *et.al*(2013) portray about 73.3% of sample households in Kasso catchment in Bale Mountain rely on wood for cooking, heating and light

and consequent loss of original forests and the conversion of forest lands in to crop, settlement and grass lands. A higher figure is seen in the Gumera watershed of Lake Tana basin by Wubie, *et al* (2016) staling that about 80% of the sample households depend on wood as a sorts of all energy. Both studies express that wood is the source of energy for nearby urban areas and the means of generating income for the rural households.

2.4 Consequences of Land use/ Land Cover Changes

2.4.1 Deforestation

Forest is the life bearer and conserver for flora and fauna including human beings. According to Sherem(1993) as cited in Chakravarty, Ghosh,Suresh, Dey, Shukla(2012) the forest-which covers almost one third of the land surface of earth- render various environmental advantages like soil conservation, prevention of climatic change and biodiversity and balances hydrologic cycle. However, due to economic and social changes the interaction between human and forest has changed through time in the world (FAO, 2012).

United Nations Food and Agricultural Organization further elaborated the major roles of forests and human impacts on forests that could risk our environment by saying:

> *Forests have played a major role in human history, and periodic deforestation has accompanied population growth and development for thousands of years, throughout the world. Climate, culture, technology and trade have had an important influence on speeding up or slowing down – in some cases even reversing – the pace of deforestation. (FAO, 2012: 8)*

Deforestation is the clearing of forests to make the land to be usable for other purposes or to make it bare land (FAO, 2012). It causes paramount changes on the surface of the earth. The global increment of growth rate of the human population necessitates the tragedy of global deforestation. But, the pace of global deforestation prior to 1950 and afterwards has been more rapid than the population growth (FAO, 2012).

Even though forests currently covers 23 percent of the land of Africa, between 1990 to 2010 African countries was converted 75 million hectors of forest land(ten percent of the total forest area) to other uses(FAO, 2012). Sub-Saharan African countries consist largely of agrarian societies, primarily dependent on traditional farming and animal husbandry. In this region, deforestation and population have gradually increased together, with the heaviest forest losses

coming in areas where wood is needed for fuel or where forest land is needed for growing crops. Of the sub-Saharan African countries Ethiopia is the country in which deforestation problem is highly intensified. "In the late 19th century about 40% of Ethiopia was covered with forests"(Teshome, 2012). However, due to population growth, demand for construction materials and fire wood, to generate income and expansion of farm lands forest lands coverage is mitigated in the country. According to Birhan (2007: 10)

> *Large forests have been transformed for farm and settlement developments. This shows that people have assumed that rich vegetation is a sign of the fertile soils that lie under the forest, and this has lead to rapid forest clearance for agriculture as well as timber supply.*

These deforestation activities, expansion of agriculture and unsustainable use of environmental resources especially forests and forest products have been increasing at alarming rate. The effects of such destructions in Ethiopia are soil erosion, poverty, food insecurity and recurrent draught, extinction and loss of biodiversity, and global warming and climate change (Teshome, 2012).

As cited in FAO (2012), during the deliberations of the United Nations Intergovernmental Forum on Forests (IFF, 2000), the global community agreed that the underlying causes of deforestation and forest degradation are:

> *Poverty; lack of secure land tenure patterns; inadequate recognition within national laws and jurisdiction of the rights and needs of forest-dependent indigenous and local communities; inadequate cross-sectoral policies; undervaluation of forest products and ecosystem services; lack of participation; lack of good governance; absence of a supportive economic climate that facilitates sustainable forest management; illegal trade; lack of capacity; lack of an enabling environment, at both the national and international levels; national policies that distort markets and encourage the conversion of forest land to other uses (FAO, 2012).*

All these causes are interrelated and their solutions are specific to each countries of the world.

2.4.2 Soil Degradation and Erosion

The removal of original cover of land without taking any mitigation measures results in the physical, chemical and biological loss of soil. The loss of the natural land cover the land, the steepness of the slope, and bad farming practices all together exacerbate the erosion of the soil (Wubie, *et al*, 2016). Furthermore, as Warra, *et al*, (2013) point out the removal of land cover accelerates run off and soil erosion along steep slopes, formation of gullies in many cultivated

and grass lands around the hills and water logging in plain areas. On the top that Wubie, *et al*(2016) indicate that in the lower areas of gentle slopes, the gullies get narrower and smaller in depth due to the accumulation of sediments transported from higher grounds.

Moreover, the deposition of sediments and water logging particularly in the rainy season and soil depletion due to over cultivation are the most identified agricultural difficulties in the plain areas of Gumera watershed of Lake Tana basin. According to Warra *et al* (2013), the removal of original forests to agricultural production results in reduction of soil organic nutrients, carbon and drastic change in soil structure.

2.4.3 Climate Change

Climate change is the long term or permanent transformation in a climate feature of a place. Some of the signs that indicate climate change are rise in global temperature, the prevalence of recurrent drought, floods, shortages of rain fall, decrease in glacial cover over mountains and rising sea levels (Alemayehu,2006 cited in Kinfe, 2011). Henderson, Sellers and Gortiz (1994) point out that climate and land exploitation by humans are closely interrelated. Particularly, small scale change in climate as a result of land cover change is widely observed and recorded. Moreover, Cook and sims,(1975) states that the conversion of vegetation cover can affect the climate condition on small or large scales .The changes can further stretch to grave environmental threats for human kind today like climatic change, loss of biodiversity, water, soil and air pollution.

Land use land cover are inter wined to climate and weather in subtle and complex ways. The interaction between land cover and climate change encompasses the exchange of green house gases (water vapour, carbon dioxide, methane and nitrous oxide) between land and the atmosphere. Furthermore, the amount of insolation be it solar or terrestrial has an influence on land use/ land cover and climate, thermal exchange between the ground and atmosphere, the nature of land surface and its uptake of the momentum from the atmosphere (U.S. climate change science program, 2004) cited in Kinfe (2011).

2.4.4 Biodiversity Loss

Changes in environmental conditions and natural setting of the land and its cover can greatly affect the life cycle and the survival of various plants and animals (Angelica and Richter, 2008). According to Wubie, et.al, (2016) due to rampant destruction of forest in the *Gumera* watershed

of Lake *Tana* basin original tree like Juniperous procera, Millettin ferugunea and ximenia ameriicana which were widely seen in area are now on the brink of extinction.

Currently, they are found only in sacred areas like churches and monasteries. In several sections of the watershed the original trees are replaced by exotic trees such as eucalyptus. The disappearance of forests is followed by the disappearance of various wild animals in area. Moreover, Warra et.al (2013) states that the biodiversity rich, *kasso* catchment in the Bale Mountain is greatly affected by human interference for agricultural, animal grazing, fire wood and settlement. The subsequent conversion of original vegetation cover in the area like forest, wood land, and bush land causes a remarkable change in the environmental condition and the great loss of biodiversity. Different species of plants and animals are disappeared from the area. Various trees like *Agamsa* (Carrisa Edulis), *Tulla* (Raganea Simen), *Ejersa* (Olea Africa), *Leemmana* (Arundinaria alpine) used for several purposes including medicinal values to the surrounding people are to the point of extinction.

2.4.5 Hydrological Effects

The hydrological cycle is closely interrelated with the biochemical cycles. Different researchers show that land use changes like a forestation, reforestation, change of forested to agricultural lands the conversion of grass lands by trees, drought and increasing urbanization affect surface and sub-surface hydrology of river basins at local and regional levels(Tayler,1977; Bannister, 1979) cited in Muluneh, (2005). Change in the hydrological cycle of a river basin can result in variation in the rate of flooding and its amount, reduction or increase in basin yield and ground water recharge (run off), the decrease in the water quality with increase in sediment transportation and soil erosion(Walkinson,1992) cited in Muluneh, 2005.

Moreover, Batra,*et al* (2007) state that land use land cover change highly affects the hydrological condition of the watersheds, water resources and the environment at small and large scales. Furthermore, according to Warra *et al*, (2013) human activities like deforestation and intensive cultivation can decrease the amount of water that percolate into the ground and recharges streams, springs and underground water. The same authors point out that the reduction of the volume of locally available streams and rivers through time in the kasso catchment area of Bale Mountain. The drying up of several springs and streams is reported by the authors affecting the socio-economic life of farmers in the area.

CHAPTER THREE: BACKGROUND OF THE STUDY AREA AND RESEARCH METHODS

3.1 General Description of the Study Area

The study is conducted in Ameya *woreda* which is one of the eleven rural Administrative *woreda* found in South West Shewa Zone of Oromia Regional State. The Administrative centre of Ameya *woreda*- Gindo is located about 144 kilometers south west of Addis Ababa and 30 kilometres far away from the administrative centre of south West Showa Zone-Woliso Town. Ameya *woreda* found at 8°21.5' to 8°47.5'N and 37°31' to 37°50' East. The altitude of the *woreda* ranges from 1600meters to 3200 meters above sea level. The *woreda* is bounded by Wanchi *woreda* in the East, SNNP in south, Nono *woreda* in West, Dire Inchini in the north and Toke Kutaye in North east(See Figure 1 below). The topography of the *woreda* is characterized by three land form features. These are hilly (mountainous), undulating and dominantly flat land (Ameya *woreda* Agricultural office, 2017).

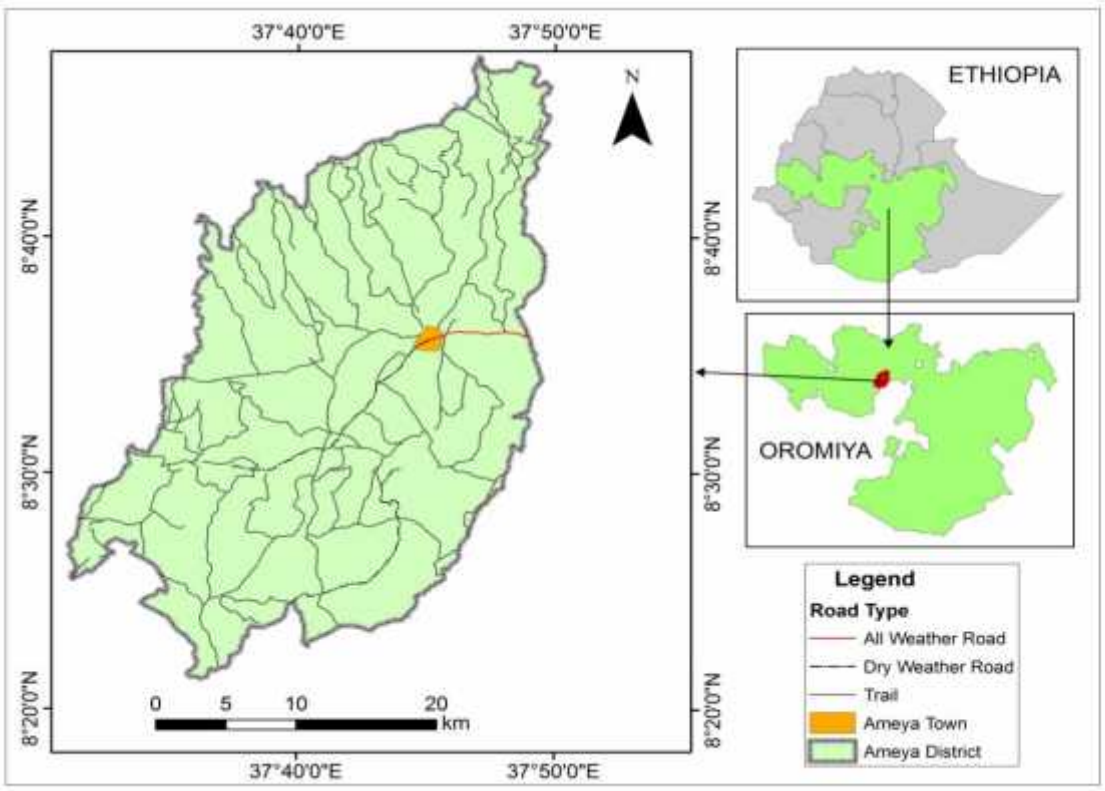

Figure1: Location Map of the study area.

Source develops from Ethio-GIS.

3.1.1 Climate and Hydrology

The *woreda* is located in central Oromia. Based on its agro-ecology, the *woreda* divided into two zones, the mid-highland (locally known as *badadare*) which lies below 2500 meter above sea level, and highland (locally called *Bada*) which is over 2500meter above sea level. The majority (64%) of the *woreda* area are covered by mid-highland agro-ecology while the remaining (36%) under highland. The mean annual temperature ranges from 12c° to 32c°. The area has a bi-modal rain fall, where the short rainy season is the period from March to the end of April (*Arfaasaa)* and main rainy season is the period from June to September (*Ganna).* The annual precipitation ranges from 900 to 1800 millimeter (See Figure 2, 3 and 4 below). Perennial rivers found in the *woreda* are *kulit Guda* (60km), *Amegna Guda* (30km), *Kulit kala* (28km), *Darge Guda (*30km), *Bura* (30km), *Weni Gnata* (32km), *Ejersa* (32km), *Nano* (35km), *Anani* (32km), *Kabana* (26km) and many tributaries which are the sources of *Abay* and *Gibe* are flowing from Ameya *woreda* (*woreda's* Agricultural office, 2017).

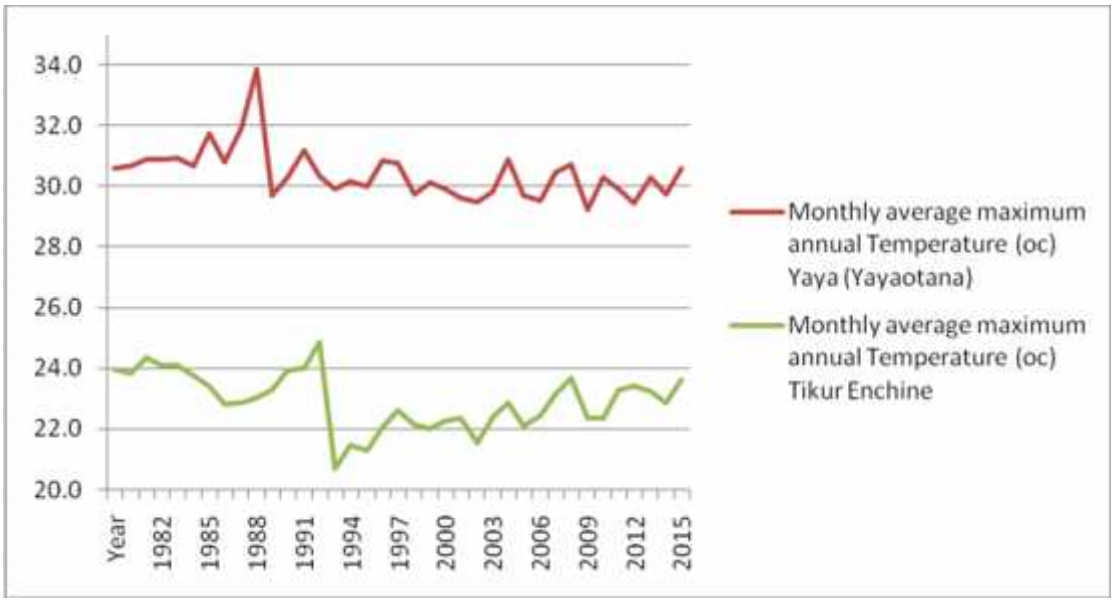

Figure 2: Monthly average maximum annual temperature (°c)

Source: Computed based on raw data from Ethiopian Metrology Agency.

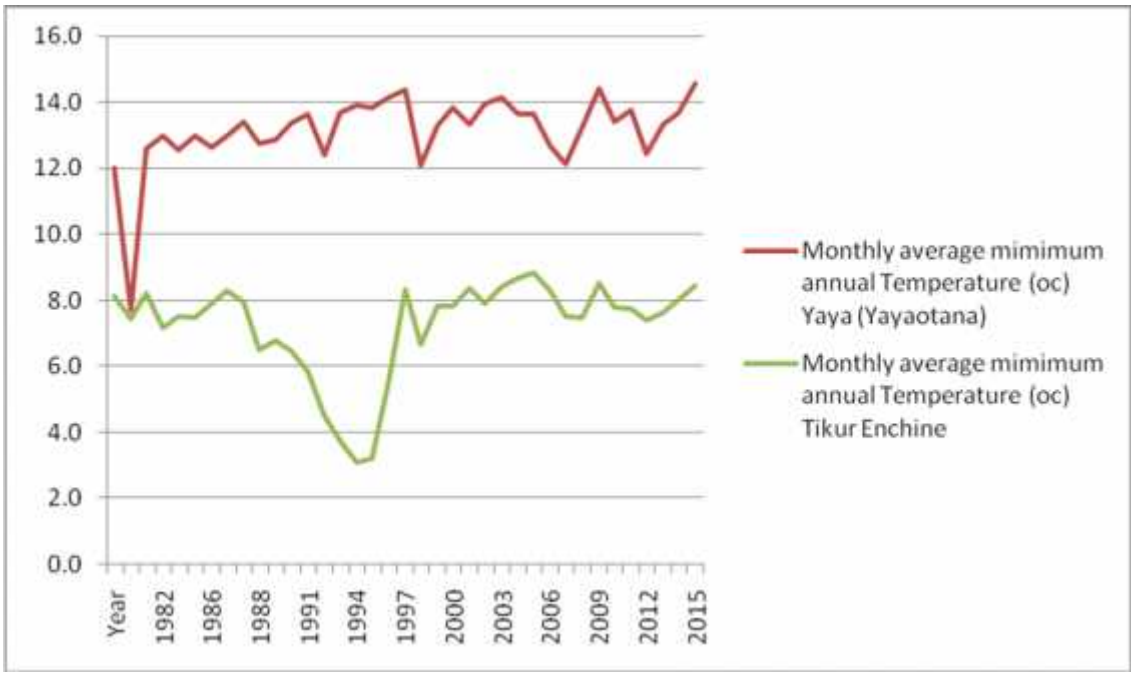

Figure 3: Monthly average minimum annual temperature (°c) Source:

Source: Computed based on raw data from Ethiopian Metrology Agency

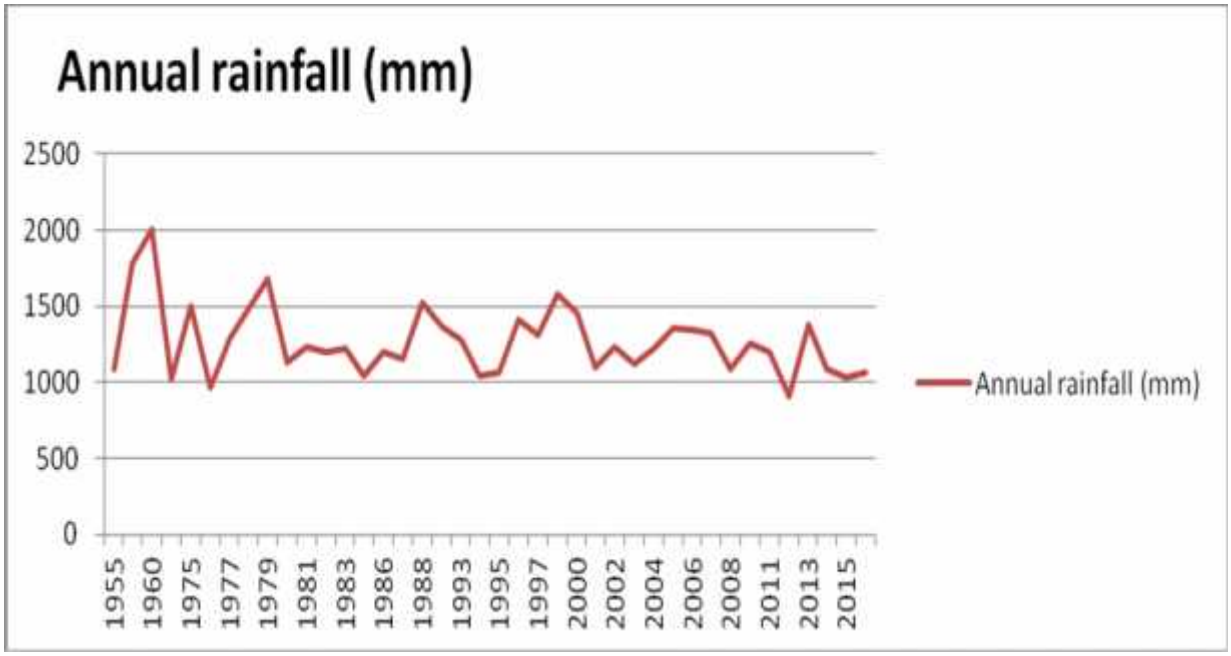

Figure 4: Annual average rainfall (mm).

Source: Computed based on raw data from Ethiopian Metrology Agency.

3.1.2 Soil

The local geology and its interaction with climate largely determine the nature and type of soil that occurs at ground surface. The geological characteristic is of principal importance in this respect including the mineralogical composition of the bedrock which determines its chemical stability under different climatic regimes. According to *woreda* Agricultural office, two major soil types dominate the study area. These are red soil (*Biyyee Diimaa*) and black soil (*Biyyee Gurraacha*). The most dominant soil in the *woreda* is verti soil (70%) and clay soil (30%) (Woreda's Agricultural office, 2017).

3.1.3 Vegetation

At present about 3970 ha is covered by forest, 627ha covered by wood and 290ha covered by shrub and bush (OBoFED). As the elders of the study area explained most of Ameya *woreda*'s land is covered with the indigenous trees such as Junniperus (*Gaattiraa*), Olea Abyssinia (*Ejersa*), sholla (*Harbuu*), Hagenia forest (*Heexoo*), podocarpus (*Birbirsa*), adulis (*Agamsa*) and cordial Africana (*Waddeessa*), (Coroton (*Bakkanniisa*) However, now a day, these species of the trees are not observed in the *woreda* except in small protected areas. Thus, vegetation coverage in the study area includes scattered trees, shrubs and Eucalyptus tree (*Baargamoo*).

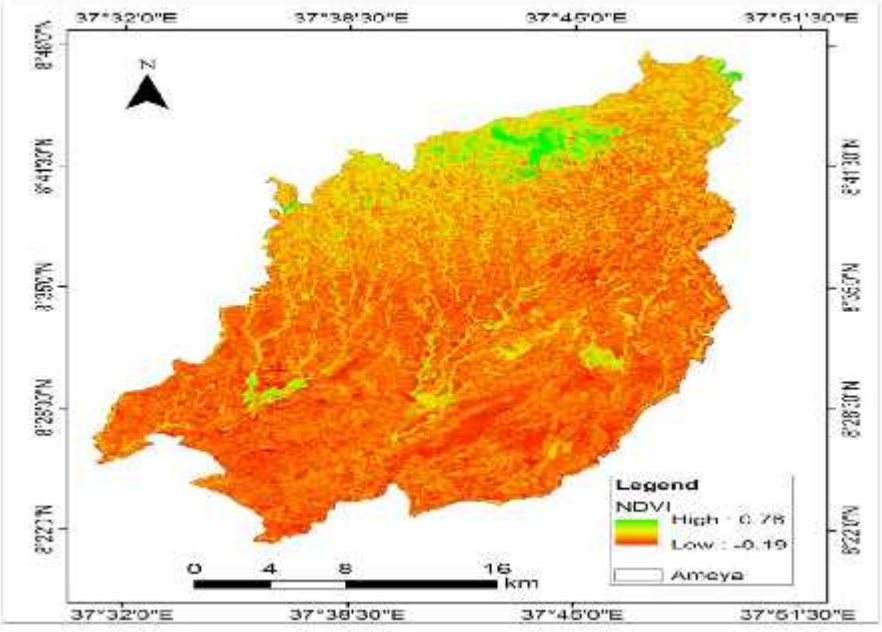

Figure 5: Vegetation patterns in the *woreda*.
Source from landsat 8 of 2016

3.1.4 Socio-economic Condition of the *Woreda*

3.1.4.1 Population

The dynamic nature of population in a given settlement area is the result of fertility, mortality and migration. The demographic process is a complex phenomenon affected by social, economic, cultural, political and psychological factors. According to July 2006 population projection, Ameya *woreda* has a total population of 147,609 (male 74,470 and female 73,139). Rural population of the *woreda* accounts for about 94.3%, while urban population is about 5.7% showing that urbanization is very low. (Oromia BoFED).

Demographic characteristics of the *woreda* shows that population aged less than four years accounts for about 12.4%, age of 4 to 6years 10.6%, age of 7 to 10years 13.8%, age of 11 to 14 years 9.3%, 15 to 16 years 4.9% and age of 17 to18years accounts for about 0.5%. Economically active population accounts for about 45.6% of the total population of the *woreda* Moreover, old age (65+) accounts for about 3%

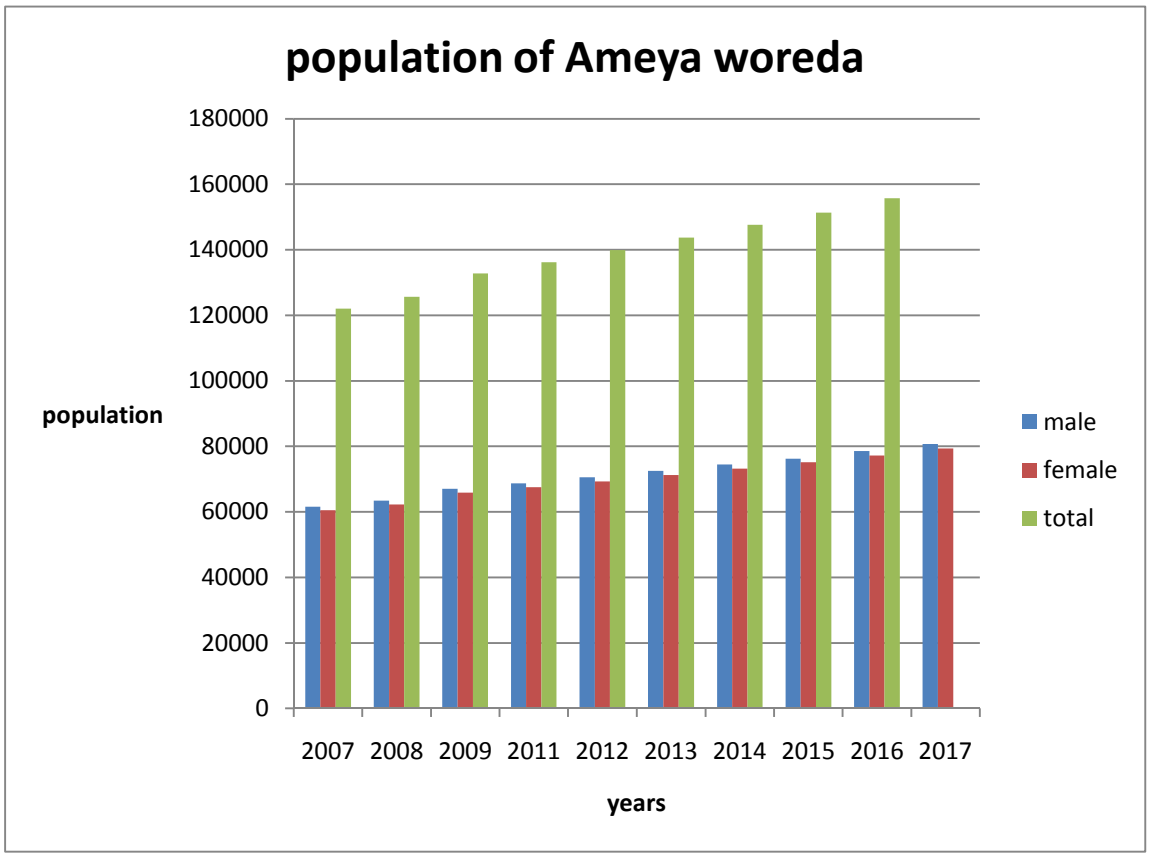

Figure 6: Population growth trends in Ameya *Woreda*.

Source: Computed based on raw data from (Oromia BoFED).

3.1.4.2 Farming Systems

Predominantly, farming system of the *woreda* is mixed farming which comprises both crop and livestock production. Farming system of the area is dominated by rain fed and irrigation. Livestock production as farming system is mainly exercised for traction power, domestic consumption of milk, meat and transportation purposes (*woreda*'s Agricultural office, 2017).

3.1.4.3 Crop Production

The economic activities of the community of the *woreda* depend on land and land resources. The main crops cultivated in this *woreda* are maize, *teff*, sorghum, pepper, *nug*, barley, wheat, pea and bean. Vegetables as potato, onion, carrot, cabbage and *enset* are grown in the area in large extent.

3.1.4.4 Livestock Production

Livestock keeping is a traditional practice in the area since long before other farming system experienced. The main types of livestock are cattle, sheep, goats, horses, mule and donkeys. Cows are the only animals that are milked. Livestock products, such as, butter, skin and eggs are also sold .Oxen and milking cows are mostly replaced from within the herd. Sheep and goats are also slaughtered during holy days. The common livestock feed is grass and crop residue. The sources of water for livestock in the wet season are unprotected springs, minor rivers, and seasonal ponds and major rivers in the dry season. Generally, crop production and livestock husbandry are widely practiced in the *woreda* but still the value is too low because it is handled in traditional ways with little technological inputs (*woreda's* Agricultural office, 2017).

3.2 Research Design

The research is based on mixed concurrent (dominant states of quantitative) method which encompasses technical quantitative and qualitative methods of research design. As pointed out in Creswell (2009), mixed method enables to better understand the problem more comprehensively and it is the most popular application method in conducting research. Quantitative and qualitative methods are combined and integrated to add value to the arguments from different perspectives, and enable to answer research questions more deeply.

It is obvious that the land use/land cover change study can encompass observational and experimental or mixed research methods to generate the required data for the research.

The research has carried out using the observation through exploratory, descriptive or analytical methods. To carry out exploratory study, it needs small scale study of relatively short duration, which was conducted when little has known about the problem. In the case of descriptive study, the researcher simply described the distribution of spatiotemporal land use/ land cover change of the study area. Lastly, the study has attempted to investigate the correlation possible causes and effect of land use /land cover change.

In the same way, experimental or intervention study also followed to assess spatiotemporal analysis of land use/ land cover change. Through this study, the researcher has investigated the effect of an intervention that has taken place in the study area. Some of experimental or intervention study was both controlled and uncontrolled through technical activity. Generally the researcher's study design follows quantitative and qualitative research type based on types of data.

3.3 Data Collection Instruments

The data used for this study was collected from both primary and secondary sources. Majority of the primary data was collected through key informant interviews and focus group discussions with the household heads and *woreda*'s experts like land management officers, agricultural experts, natural resources and forest protection office experts, officers at *kebel*e and *woreda* levels, and rural development agents. Health extension professionals and elders have provided essential information for the study.

Secondary data source are the sources that are very useful for the study and obtained from *woreda* agricultural office, central statistical authority, national meteorological agency, EMA and different offices in Ameya *woreda*. Both primary and secondary data have been used in this study. In addition, secondary data sources, such as, landsat satellite images, published and unpublished documents and reports from different offices in Ameya *woreda*, as well as books, scientific journals and proceedings were used to substantiate and explain the findings of the study.

3.3.1 Primary Data Collection

The primary data sources were generated by the researcher in order to measure the independent variables. Data was collected through field observation, key informant interview, focus group discussion and digital camera in order to check the current feature of the study area.

3.3.1.1 Key Informant Interview

In addition to the remotely sensed data, thirty key informant interviews were conducted with individuals who have lived for long time in the study area and had detail information about the past and present land use/land cover types. Elderly people, the former Administers of the *kebele*, who had served during *Derg* regime and development agents (DAs), were selected for key informant interview. Purposive types of questions were asked to get relevant information about the causes, impacts and types of land use/ land cover change of the study area. Such information has been to triangulate information generated from remote sensed data.

3.3.1.2 Focus Group Discussion (FGD)

The Focus group discussion creates the opportunity to participants to feel at home and express their behaviors, attitudes and opinions freely (*Berg, 2001).* The focus group discussion was carried out with representatives taken from different offices of the *woreda* namely from the Natural resource and forest protection office, Land management office and agricultural and rural development office. This technique was used to extract information in a participatory manner, so that both the community's perceptions and views have been captured and interpreted. Suitable conditions were settled for the discussions so that they would be able to describe the issues under investigation precisely in their own language.

Therefore, to investigate the causes and effects of land use land cover change in Ameya *woreda*, a researcher selected purposively a maximum of thirty (30) key informants for interview from household heads, Developmental Agents, Former and current Kebele officials and elders of the study area. The researcher's role was just facilitating and moderating the discussion. The researcher was also employed two FGD each with six members. The participants were from experts of rural land management, natural resources and forest protection of the *woreda*. In this key informant and focus group discussion; the present and former *kebele* chairman, developmental agent (DAs), elders, rural land management and environmental protection experts and matured youth was selected purposively to acquire their deep and fertile views regarding the issues of land use land cover change with a few relevant interviews.

3.3.2 Secondary Data Collection

Tools of data collection for qualitative and quantitative research design (secondary data source) obtained from the office of the Ameya *woreda* rural land management and environmental protection, Ethiopia Mapping Agency (EMA), National Meteorological Agency of Ethiopia, satellite image website, development bureau.

In general, remote sensing and socio-economic survey techniques were employed to quantify land use change and to assess the impact of this change in the study area. GPS and photo camera transect walk, focus group discussions and key informant interviews were used. In addition to socio-economic data, remote sensed data was collected and processed as well. The researcher conducted the research in the frame of modeling land use and land cover change focusing on LANDSAT (Earth observing system image series).

This section also described the data and methods that were applied in data acquisition, pre-processing (geo-reference and geometric correction), processing, presentation and analysis of data with a view to achieve the designed objectives and the research questions posed. This helps for the analysis of change and to draw conclusion on the spatiotemporal land use land cover changes in the *woreda*.

3.3.2.1 Landsat Data

The data that has been used for studying the *woreda* level spatiotemporal analysis of recent Land use/land cover change including three historical land sat satellite images covering the *woreda* for the past 30years (1986 to 2016). The image included three 30m resolution land sat TM images from 1986 to 2016(Table 1). These satellite images with path 169 and raw 54 were obtained from the global land cover facility (GLCF) and USGS (United State Geological survey).

Table 1: Land sat images data reference

Reference years	Path/row	Sensor	Resolution	Date of acquisition
1986	169/54	Landsat TM	30m	Nov/22/1986
2001	169/54	Landsat TM	30m	Nov/26/2001
2016	169/54	Landsat 8	30m	Dec/28/2016

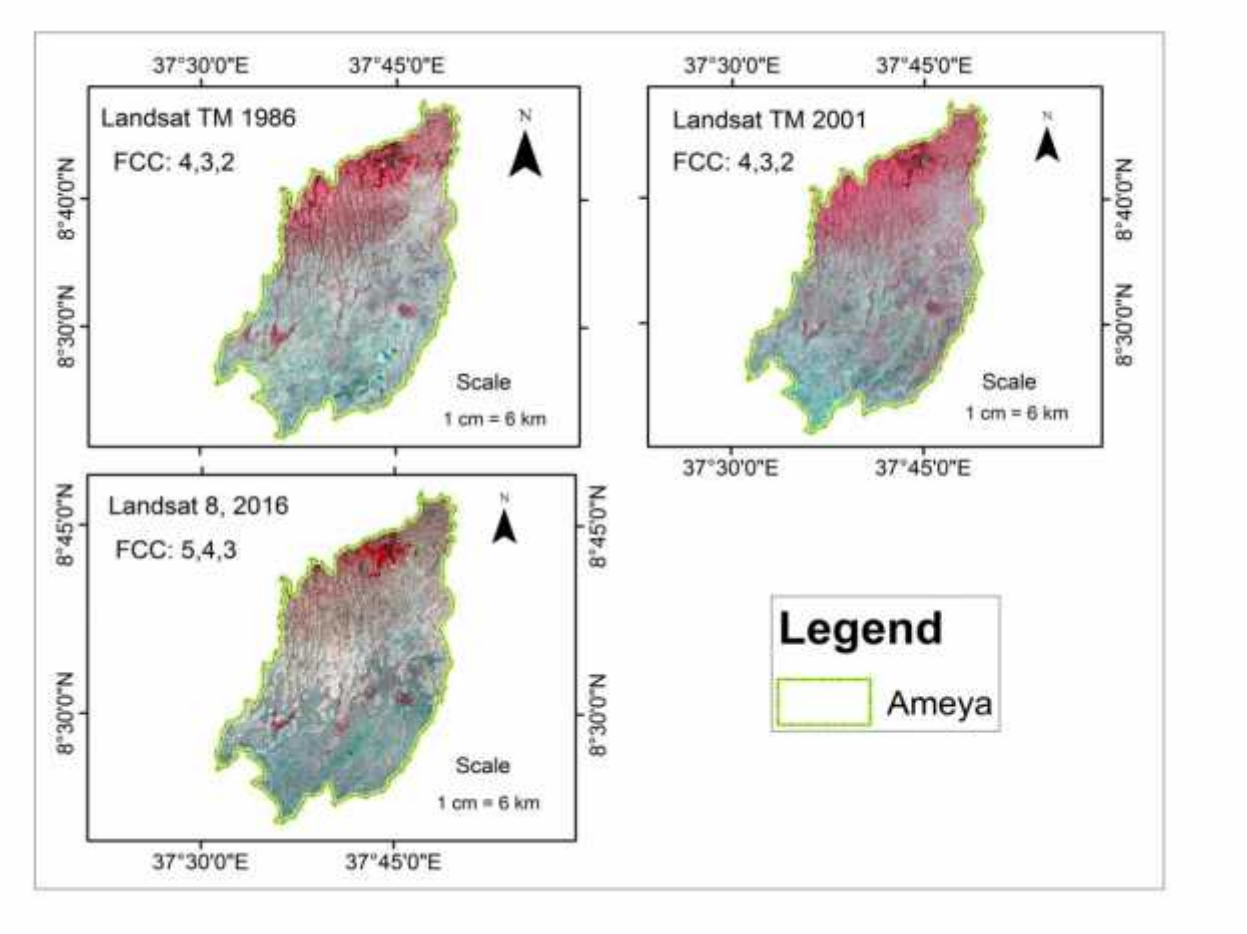

Figure7: False color composite of landsat image

3.3.2.2 Image Processing

Digital Image processing refers to the manipulation and interpretation of digital images, by a computer system, to prepare an image for display, interpretation and to extract useful information from the image. The possible forms of digital image manipulation are literally infinite. Digital image processing is largely concerned with four basic operations: image rectification and restoration, image transformation, image enhancement and image classification (Lillesand, T. and R. Kiefer (1987). Therefore, in this study the researcher was used image processing to enhance the quality of the study.

3.3.2.3 Pre- processing

Raw satellite image is full of errors and was not directly utilized for feature identifications and any applications. It needs some correction. Pre-processing was done before the main data analysis and extraction of information. Pre-processing involves two major processes: geometric correction and radiometric correction.

3.3.2.4 Image Enhancement

Image enhancement is used to increase the details of the image by assigning the image maximum and minimum brightness values to maximum minimum display values, and it is done on pixel values, and this makes visual interpretation easier by increasing the visual discrimination between features in a scene and assists the human analyst: False colour composite (FCC), spatial re-sampling, etc.

3.3.2.5 Image Transformation

According to Richards, (1999), image transformation refers to the derivation of new imagery as a result of some mathematical treatment of the raw image bands. Image transformation involves processes that are similar in concept to those processes in image enhancement, but unlike image enhancement these processes that are similar in concept to those processes in image enhancement, but unlike image enhancement these process are normally applied on multi-channel (band) images.

3.3.2.6 Image Classification

Image classification is the process of creating thematic maps from satellite imagery. A thematic map is an informational representation of images from remote sensors is known as a quantitative analysis due to its ability to identify pixels based on the numerical properties. Present and past information on land cover and land use change for the study area was generated from remotely sensed data. Satellite image from land sat TM and Landsat 8, number 169/054 was obtained. Both resources were used to analyze land cover and land use changes over the years for the study area. Detailed digital image processing and visual interpretation of satellite images were made. It is believed that the time gap of about recent years of the satellite imagery is wide enough to show changes and trends in land use and land cover in the study area. Image classification is the extraction of differentiated classes of land cover and land use categories from remotely sensed data. For the satellite image, pre-field image processing was done using color composite of bands 4, 3and 2 in RGB transformation. Geo-referencing of the image is used to establish relationship between row and column numbers with actual coordinates using the satellite images.

3.4. Summary of Research Approach

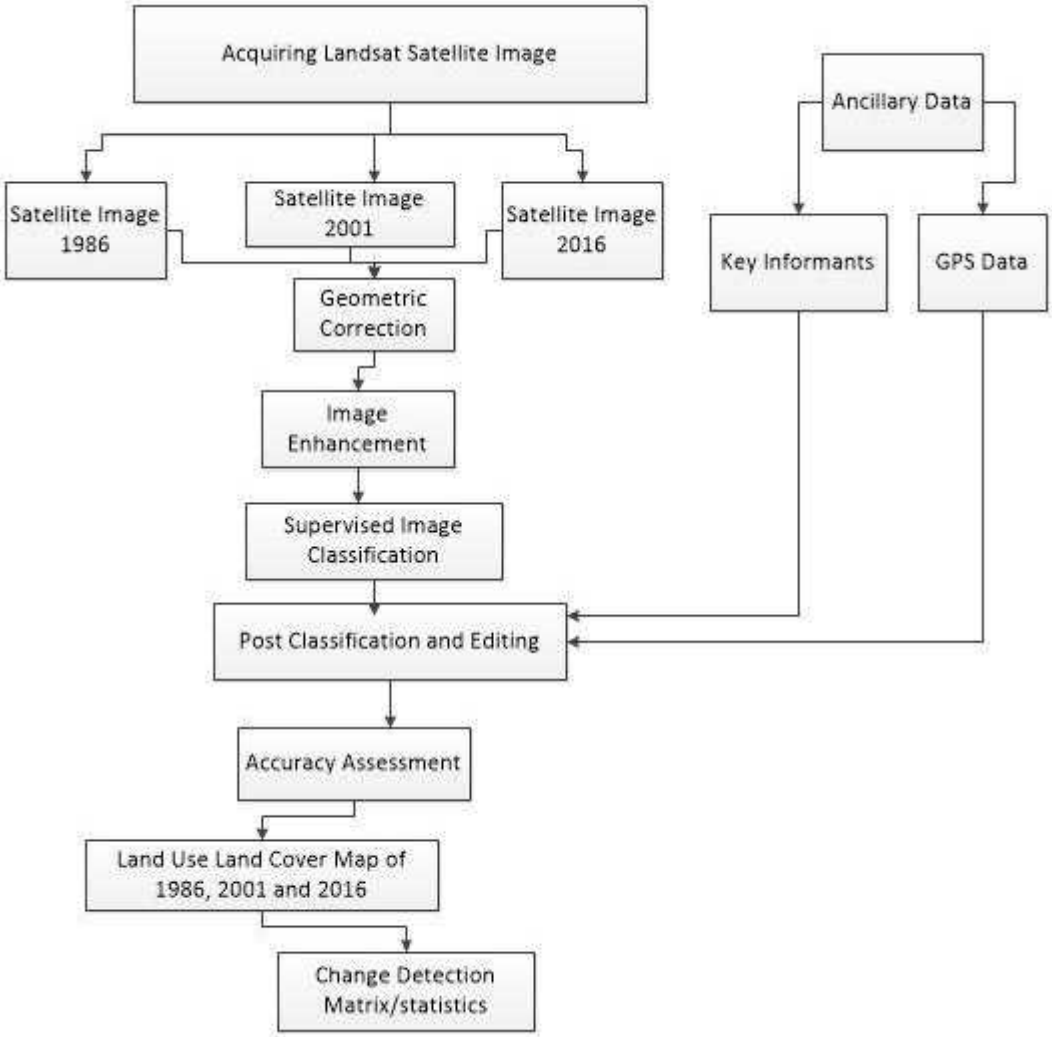

Figure 8: Flow chart of research methods of the study

3.5 Methods of Data Analysis

To assess the social and environmental impact of the change, data concerning socio-economic was gathered from the selected area. The assessment was done by interviewing households from high LULC change area, their development agents and elders of the community. Agriculture and rural development officers, natural resource and forest protection experts and rural land management officers from the *woreda* were included in the focus group discussion.

The socio-economic data obtained from the KII and FGD was explained qualitatively in the form of statement. GIS and remote sensing method allows spatial monitoring and analyses where the knowledge of the stakeholders can be integrated. As a result, to analyze and quantify the spatial

temporal land use and land cover dynamics, the GIS and remote sensing technologies were used. Data from landsat imageries were processed by ERDAS software and spatial analysis, interpolation and other calculations by Arc GIS. For classification, the ERDAS software was utilized and MS office and Excel was used to create charts and graphs. Supervised digital image classification technique was employed and completed with field surveys that provide on-the-ground information about the types of land use and land-cover classes.

The methods for land use and land cover dynamics analysis with spatiotemporal changes were monitored by analyzing multi-temporal remotely sensed images of three dates of landsat satellite imageries. A combination of steps and procedures were developed to interpret, analyze, map, and quantify the available, determination of relationships between variables, and identification of important variables.

CHAPTER FOUR: SPATIOTEMPORAL LAND USE/LAND COVER CHANGES, DRIVING FORCES AND CONSEQUENCES

In this chapter, the researcher present the analysis and discussion of collected data about the Land use land cover change, its main driving forces and the impact it brought on land cover in Ameya *woreda*. In this study, the researcher used both quantitative (remote sensing and GIS data) and qualitative methodology. The data were collected through In-depth interview with the administrative personnel of the *woreda*, experts, farmers and residents of the *woreda's*. Satellite images at different time interval of 1986, 2001 and 2016 was also interpreted and analyzed. Participatory observation was conducted to get in-depth understanding of the impacts of land use land cover change of the *woreda*. The analyzed and interpreted data by theme and comparing with GIS and Remote sensing Data are presented under the following sub-topics.

4.1. Land use/land Covers Maps and Rate Changes in Ameya Woreda

Rapid land use and land cover change is dynamic, wide spread and an accelerating process, mainly driven by natural phenomena and anthropogenic activities, which in turn derive changes that impact on natural resources and socio-economic activities of human being. Adequate information was obtained on land use and land cover changes by interpreting satellite images of the years 1986, 2001 and 2016.The year 1986 was taken as a base year in the analysis of the land use and land cover change in the study area. In a nut shell this section presents the land cover maps resulting from classification of satellite images, assessment of map accuracy analysis of the trend, rate and nature of the land cover change. The identified land use and land cover types of the study *woreda* results of each LULCC are presented below.

4.1.1 Land use/ Land Cover of the Study Area from 1986 to 2016

Table 2 and figure 9 below show that land use/ land cover (LULC) of the study area in quantity and thematic map respectively. In this *woreda* cultivation land and vegetation land cover were the highest coverage of the total area of the study area through the study period. Based on the LULC classification, the major parts of the area was covered by cultivated and vegetation land.In1986, cultivated land, vegetation land, grass land, barren land and settlement area covered by 71.96%,

16.6%, 8.19%, 3.16% and 0.05% of the total area respectively. In 2001 the same as the *woreda* were covered cultivated land (81.87%), vegetation land (14.73%), grass land (3.12%), barren land (0.22%) and settlement area (0.06%) respectively. Lastly, the last period of the study in 2016 the area has been covered (93.06%) cultivated land, 4.87%) vegetation, (0.96%) settlement, (0.55%) grass land and barren land respectively. In 2016 cultivated land had the largest areal coverage (93.06%) and whereas, (6.94%) was the share of others LULC classes. In this section, three LULC classification maps were produced (Figure 10, 11and 12).

Table 2: Land use/land cover of Ameya *woreda* from 1986 to 2016.

No	LULCs	Land Use Land Cover (km^2)						Land Use Land Cover Change (km^2		
		1986	%	2001	%	2016	%	1986 to 2001	2001 to 2016	1986 to 2016
1	Vegetation	154.01	16.6	136.43	14.73	45.12	4.87	-17.58	-91.31	-108.89
2	Cultivation	666.34	71.96	758.08	81.87	861.81	93.06	91.74	103.73	195.47
3	Grass Land	75.91	8.19	28.85	3.12	5.06	0.55	-47.06	-23.79	-70.85
4	Settlement	0.49	0.05	0.56	0.06	8.93	0.96	0.07	8.37	8.44
5	Bare Land	29.26	3.16	2.07	0.22	5.07	0.55	-27.19	3	-24.19
	Total	926.00	100.00	926.00	100.00	926.00	100.00			

Source: from satellite image interpretation

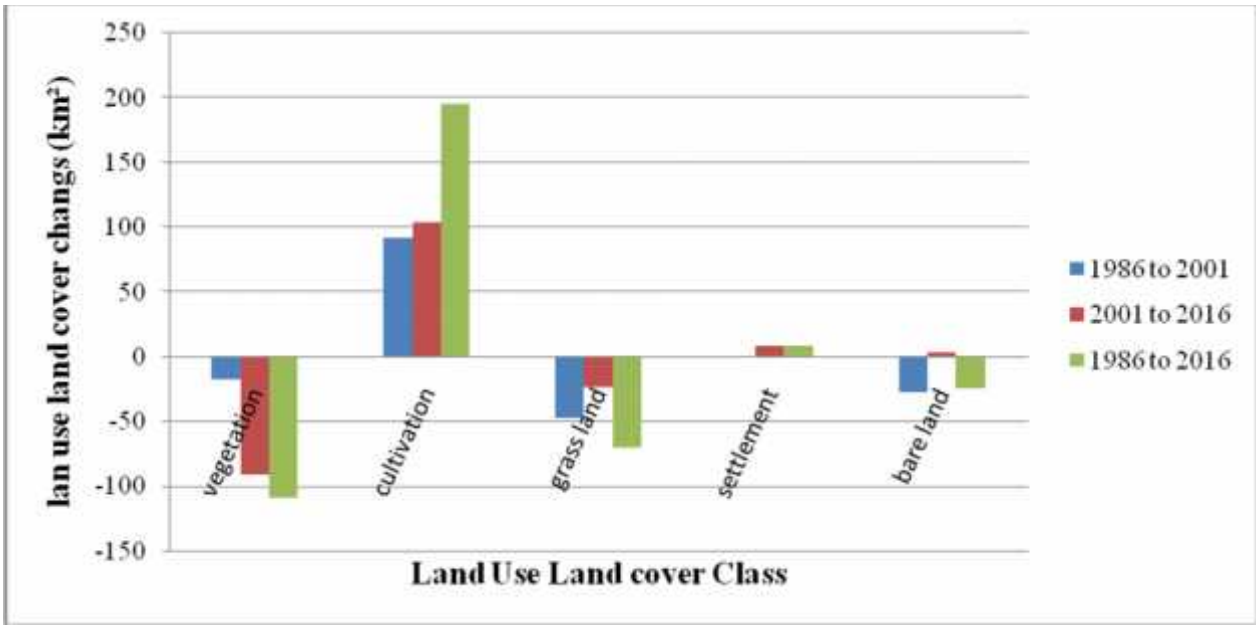

Figure 9: Land use/ Land cover changes graph

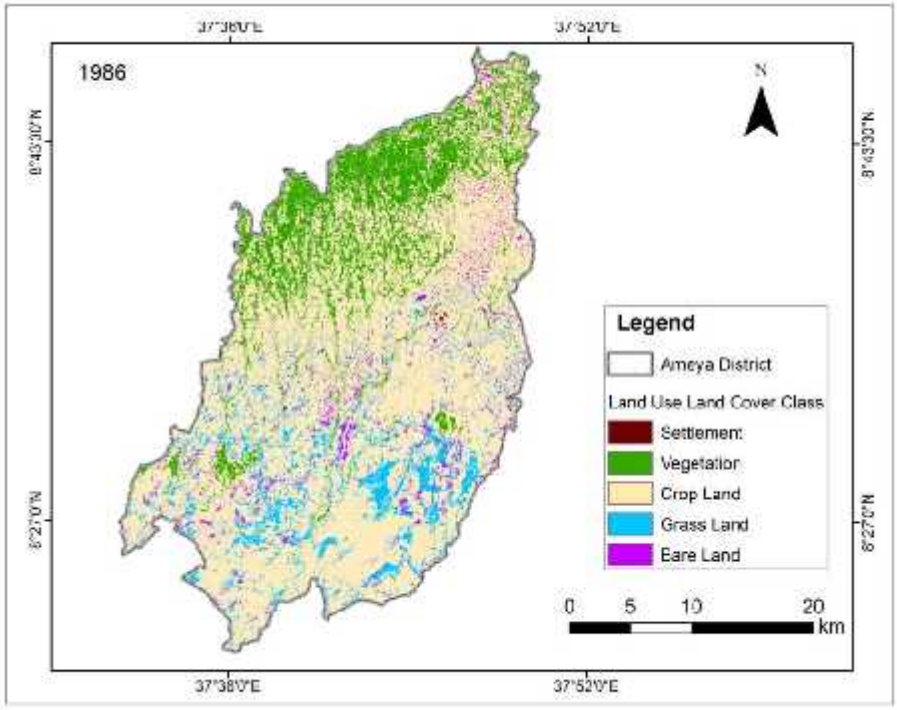

Figure 10: Land use/ Land Cover Map of the study area in 1986.

Source: 1986 Image interpretation

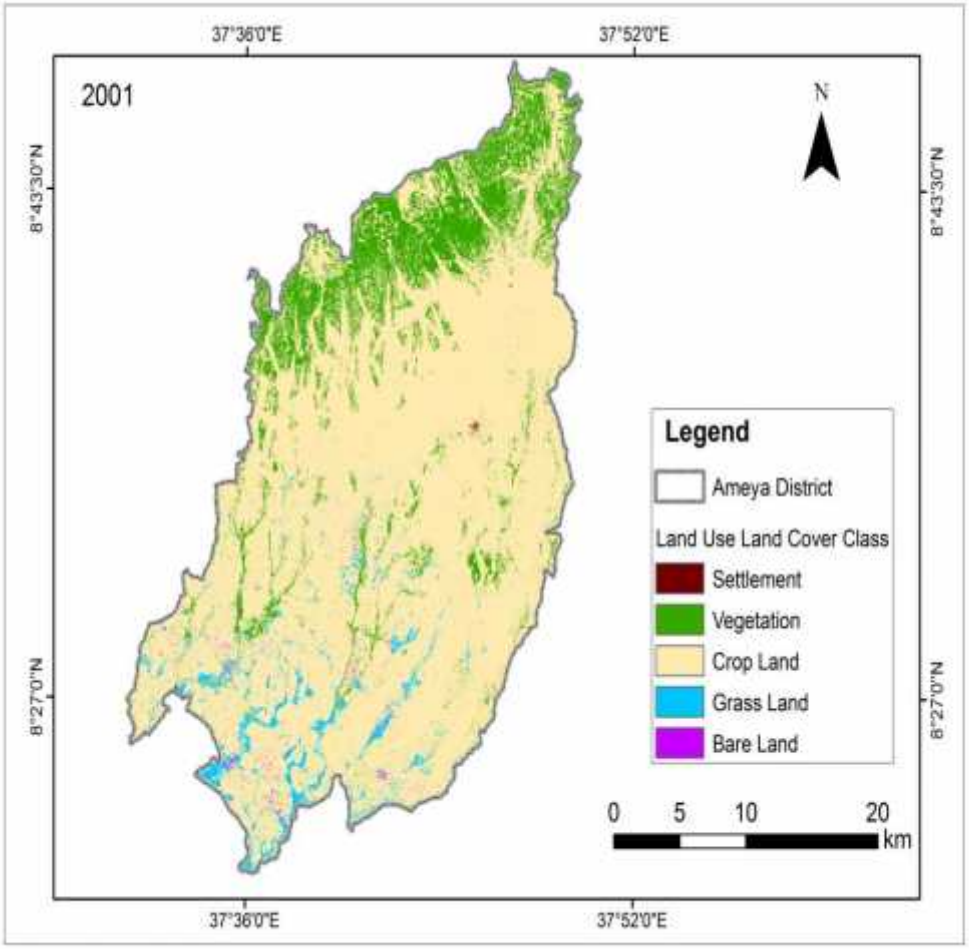

Figure11: Land use Land Cover Map of the study area in 2001

Source: 2001 image interpretation

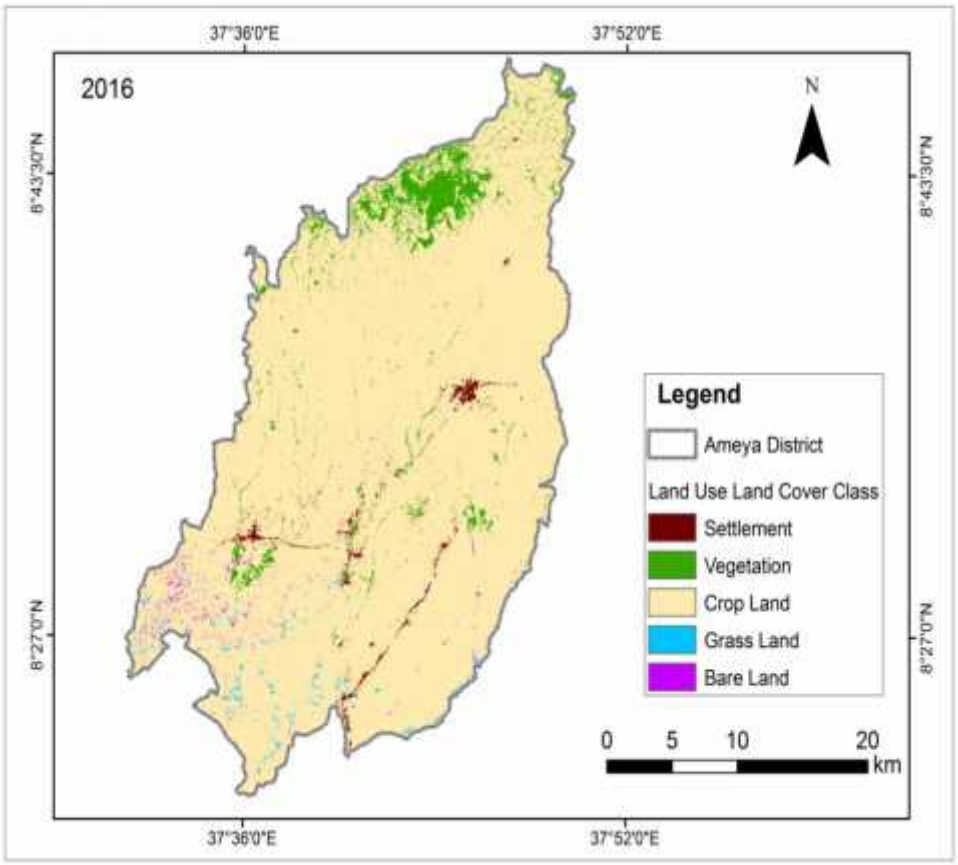

Figure 12: land use/cover map of the study area in 2016

Source: 2016 image interpretation.

4.1.2 Accuracy Assessment of the Classification

Accuracy assessment refers to a process that employed to estimate the accuracy of image classification by comparing classified map with a reference map and LULC change statistics was performed using relative change detection mechanisms. The technique is important to evaluate trends of area and percentage change of one land use/land cover to others, to determine their spatial increase or decrease through time interval because of natural and manmade factors. For example, accuracy assessment is an integral part of any image classification process due to the fact that image classification using different classification algorithms could classify pixels or group of pixels to wrong classes. As classified LULC maps from remote sensed imageries may contain some errors, accuracy assessment was employed to find out those errors so as to ensure reliability of the produced LULC maps. Therefore, the classified maps were assessed and compared with a referenced data and ground truth using an error matrix. The

overall accuracies for the three reference years: 1986, 2001 and 2016 are 89.2%, 90% and 88% with the Kappa statistics of 0.865, 0.875 and 0.85 respectively (Table 3). The Kappa statistics value greater than 0.80 (80%) represents a strong agreement and a value between 0.60 and 0.80 represents a substantial agreement (Landis and Koch, 1977). Hence, the maps met the accuracy requirements for change detection analysis (Anderson *et al.*, 1976), and there is a positive correlation between the remotely sensed classified samples and the reference data. Results of user's accuracy in this study showed that in 1986 the maximum class accuracy was for cultivated land (96%) and the minimum was for settlement and grass land (86%). In 2001, user's accuracy ranges from lowest accuracy (80%, bare land) to relatively correctly classified (94%, settlement area) whereas in the period 2016, it was ranges from 84% bare land, 86% (grassland and cultivated land) to 92% (vegetation and settlement land). Results of producer's accuracy showed that vegetation, bare land, and settlement area relatively correctly classified:

93.88%, 95.4% and 97.87% in 1986, 2001and 2016 respectively. The lowest accuracy was cultivated land (82.76%), grass land (83.6%) and bare land (81%) in 1986, 2001 and 2016 respectively.

Table 3: Accuracy assessment of the classification

lulc 1986	Vegetation	Cultivation	Settlement	Grass Land	Bare Land	Producer Accuracy (%)		
Vegetation	45	4	0	**0**	0	93.88		
Cultivation	1	48	0	**0**	1	82.76	Over all accuracy	89.20%
Settlement	1	0	43	3	3	93.48	Kappa Statistics	0.865
Grass Land	1	0	0	43	0	86		
Bare Land	0	0	3	4	43	86		
User Accuracy (%)	**92**	**96**	**86**	**86**	**91.49**			

lulc 2001	Settlement	Vegetation	Crop Land	Grass Land	Bare Land	Producers Accuracy (%)		
Settlement	47	1	0	1	1	94		
Vegetation	0	46	2	2	0	93.88	Overall accuracy	90%
Cultivation	0	1	46	3	0	85.19	Kappa Statistics	0.875
Grass Land	0	1	2	46	1	83.64		
Bare Land	3	0	4	3	40	95.24		
User Accuracy (%)	94	92	92	92	80			

lulc 2016	Vegetation	Cultivation	Settlement	Grass Land	Bare Land	Producer Accuracy (%)		
Vegetation	46	1	0	2	1	95.83		
Cultivation	0	43	0	4	3	82.69		
Settlement	1	1	46	1	1	97.87	Over all accuracy	88.00%
Grass Land	0	4	0	43	0	81.13	Kappa Statistics	0.85
Bare Land	1	3	1	3	42	84		
User Accuracy (%)	**92**	**86**	**92**	**86**	**84**			

4.2. Rate of Land use/ land Cover Changes

According to Berhan (2007), to compute the rate of land use/land cover changes; the following equation was performed for computing rate of change.

$$R = Q2 - Q1/T \quad \text{……Equation2}$$

Where, R=rate of change

Q2=recent year of LULC in sq.km

Q1= Initial year of LULC in sq.km

T= Interval year between initial and recent year

The result is presented in table 4

4.2.1. Land use/Land Covers Class and Change Rate (1986-2016)

In the year of 1986-2001 the land cover of grassland, bare land and vegetation land cover decreased to -3.1, -1.8 and -1.17 respectively (table 4). While the cultivation land and settlement areas increased at the rate of 6.1 and 0.01 in that order. Furthermore, in between 2001-2016 the land cover of vegetation and grass land cover radically decline by the rate of -6.09 and -1.59 respectively. Whereas, the cultivation land cover of the study area's was fundamentally increased at 6.92 the rate. Generally, in the year 1986-2016 the land cover areas of the *woreda* converted to other land use land cover classes like -3.63 vegetation, -2.36 grasses and -0.8 bare land.

Table 4: Land use land covers dynamics (1986-2016) in (km^2) and their rate of changes

No.	**LULCs**	**Land Use Land Cover (km^2)**			**Rate of Change (km^2)/year)**		
		1986	2001	2016	1986 to 2001	2001 to 2016	1986 to 2016
1	Vegetation	154.01	136.43	45.12	-1.17	-6.09	-3.63
2	Cultivation	666.34	758.08	861.81	6.1	6.92	6.52
3	Grass Land	75.91	28.85	5.06	-3.1	-1.59	-2.36
4	Settlement	0.49	0.56	8.93	0.01	0.56	0.28
5	Bare Land	29.26	2.07	5.07	-1.8	0.20	-0.81
	Total	926.00	926.00	926.00			

Source: Calculated from table 2

(Table5). The vegetation, grass land and bare land cover has been declining since the year 1986 to 2016 in the order of 16.63%, 8.2%, 3.16% for 1986, 14.7%, 3.1%, 0.22%for 2001 and 4.87% vegetation and 0.55% grass land diminished respectively in 2016. For instance, the vegetation and Grass land cover types in the *woreda* were highly converted throughout the study period. From 1986-2016 Vegetation land, grass land and bare land shrunk at annual rates of -0.4, -0.25 and -0.1 with corresponding change. Whereas, cultivated land and settlement areas highly expanded at annual rate of 0.7 and 0.03 changes respectively.

Table 5: Land Use/Land Cover change (1986 to 2016) area and their rate of changes in %

No	LULCs	Area in %			Change in %			Rate of change in%/year		
		1986	2001	2016	1986 to 2001	2001 to 2016	1986 to 2016	1986 to 2001	2001 to 2016	1986 to 2016
1	Vegetation	16.63	14.73	4.87	-1.9	-9.86	-11.76	-0.1	-0.66	-0.4
2	Crop Land	71.96	81.87	93.07	9.91	11.2	21.1	0.66	0.75	0.7
3	Grass Land	8.2	3.12	0.55	-5.08	-2.57	-7.65	-0.34	-0.17	-0.25
4	Settlement	0.05	0.06	0.96	0.01	0.9	0.91	0.001	0.06	0.03
5	Bare Land	3.16	0.22	0.55	-2.94	0.33	-2.61	-0.196	0.02	-0.1
Total		100	100	100						

Source: Calculated from table 2

Moreover, to have a clear understanding about the land cover change and its patterns in the study area, the land cover and land use change matrix had been generated based on the 1986, 2001 and 2016 satellite image interpretations and presented in table 6 and 7. These tables are showing an area distribution of land cover and land use classes and also provides information about what proportion of each cover and use types changed into other cover classes in the forthcoming time reflection. To analyze and extract information from these land cover/land use change matrix, the following points should be taken in to considerations: first the land cover and land use value is presented in square kilometers. The second one is each column gives the cover and use type in the recent years and the thirds each row values indicate the cover and use types for the previous years. Finally, in the change matrix the value above and below the diagonal lines represent change in land cover and land use. On contrary, as the value along the diagonal line represent where no change as occurred.

Table 6: Matrix of Land Cover/Land Use Changes between 1986 and 2001 at Ameya *woreda*

	LULC Class 2001					
LULC Class 1986	1986 to 2001	Vegetation	Crop Land	Grass Land	Settlement	Bare Land	Total
	Vegetation	80.01	73.11	0.21	0.20	0.48	154.01
	Crop Land	54.68	590.46	20.11	0.01	1.08	666.34
	Grass Land	0.51	67.93	7.24	0.01	0.22	75.91
	Settlement	0.00	0.00	0.00	0.30	0.19	0.49
	Bare Land	1.23	26.58	1.29	0.04	0.10	29.24
	Total	136.43	758.08	28.85	0.56	2.07	925.99

Source: Land use/cover classification maps of 1986 and 2001

As table 6 shows that the land use/ land cover matrix for the years of 1986 to 2001 change in the study area was by enlarge attributed to expansion of cultivation land area. This class has expanded at the negative of vegetation land (73.11 sq. km), grass land (67.93 sq.km) and bare land (26.58 sq. km) classes. In a nutshell, grass land, vegetation land and bare land classes converted to cultivation land

Table 7: Matrix of Land Cover/Land Use Changes between 2001 and 2016 at Ameya *woreda*

	LULC class 2016					
LULC Class 2001	2001 to 2016	Vegetation	Crop Land	Grass Land	Settlement	Bare Land	Total
	Vegetation	30.52	105.55	0.06	0.15	0.15	136.43
	Crop Land	14.58	728.78	3.13	7.63	3.96	758.08
	Grass Land	0.00	25.57	1.84	0.50	0.94	28.85
	Settlement	0.00	0.00	0.00	0.56	0.00	0.56
	Bare Land	0.02	1.91	0.04	0.09	0.02	2.08
	Total	45.12	861.81	5.06	8.93	5.07	925.99

Source: Land use/cover classification maps of 2001 and 2016

According to table 7 conversion matrix for the year 2001 to 2016 the change in the land use/land cover in the Ameya *woreda* was converted to crop land areas. This class has long-drawn-out at the expense of vegetation land (105.6 sq. km) and grass land (25.57 sq. km). There were also significant changes of cultivation land to vegetation land (14.58sq.km), settlement area (7.63 sq. km), bare land (3.96 sq. km) and grass land (3.13 sq. km). General cultivation land covers class increase in this period.

4.3. Socio-Economic Study

A socio economic survey was conducted in the first two weeks of march 2017 and it involved key informant interview, FGD and observation with selected elders, agricultural officers, land management, natural resource and environmental protection of the *woreda*, health office and *woreda* communication bureau to generate information on land use/ land cover changes. the causes and effects of land use land cover change was also accessed to get insight on various political, social and environmental factors that influence decision on land use/land cover in Ameya *woreda*. The time horizon considered for the trend analyses using the socio economic study corresponding with the time bounded considered above (for thirty years) were for the remote sensing analysis.

Generally, the data collected through observation, key informant interview and FGD with individual elder households and different *woreda* officers from different offices helped the researcher to identify the history of land use in the *woreda*, LULCC classes such as cultivated, forest, settlement, grassland and bare land. Again the main driving forces of land use land cover change were also identified as; population pressure, expansion of agricultural land, need for fuel wood and construction materials, and absence of natural resource tenure policy enforcement body. Another point that the research uncovered was the effect of land use land cover change in the *woreda*. These effects, according to the informants, are deforestation, land degradation, Loss of plant's and animal's species, hydrological impact and animal feed shortage.

4.3.1 History of Land Use and Land Ownership in Ameya *Woreda*

Land is the basic resource that can be viewed as physical reality, economic value, legal and cultural entity **(**Belay, 2016). It is the foundation for human society to earn their life. Especially, in developing countries like Ethiopia, land is the most important resource through which one can ensure his/her living. More than 90 million people of Ethiopia's well being are dependent of natural resources like land and water. According to USAID (2015), they use it to produce crops and for the rearing of animals which contribute to the country's more than 40% of GDP. However, the land ownership history of the country was not at the favor of the people of the country. The owners are the emperors, the land lords, military officers and the church (the Ethiopian Orthodox church). Emperor Menelik II and Emperor H/Sillassie are used to allocate the land for their regime organs like nobles, royal family, solders and the Ethiopian Orthodox

Church. The other citizens have been serfs and considered as the second citizens of the country.

This has been practiced across the country including the study area (Ameya *woreda*). Ameya *woreda* was seriously victimized by the land ownership system of these two emperors. The land of the *woreda* had classified in to three ownership style. *Gult, rist* and *Samon* lands. These names are still there as the name of *Keble's* to manifest the legacy of these regimes.

As hoben, (1993) cited in Yigremew, (2002) *gult* is the rights given to the royal families and religious institution over land for the reward of their loyal services to their land lords and to the church. The *gult* land owner, be it individual or institution, has the right to collect taxes from the tiller. The other one is *rist* land. *Rist* is the right given to the ancestral and historical kinship of the first *rist* holder to claim the share (Yigremew, 2002). This is the right to use the land. But it was impossible to own or alienate it. The third land ownership and usage system in Ameya *woreda* prior to the 1974 revolution was known as *semon*. Yigremew pointed out that "*Semon* land was held by the church, by individuals obligated to provide clerical services for the community or by peasants who paid tribute to the church rather than taxes to the state".

The educated elite's revolution of 1960s and 70s in the country had brought the relief for the farmers. They had realized their slogan of land to the tiller by over throwing Emperor H/Sillassie. However, the military junta (derg) had upsurge the power and appointed themselves as the governors of the country in 1974. On 4 March 1975, the "Provisional Military Administrative Council" also known as the derg (the council) announced an agrarian reform program known as Proclamation No. 31/1975 "Proclamation to provide for the Public Ownership of Rural Lands." This proclamation declared all rural land to be the property of the state [Article 3] – without any compensation to previous rights holders and prohibited all tenancy relations [Article 4.5]. The Proclamation provided the legal basis for the distribution of usufruct rights to a large number of rural families who had been working under exploitative tenancy contracts for a small group of landlords. The reform hence implemented the "land to the tiller" approach that was popular in the 1970s (Getnet, 2012). On practice the derg used villagization and collectivization policy to distribute the land among farmers.

In Ameya *woreda* for instance, by the name of villagization and collectivization a lot of immigrants were flooded to the area. As key informants stated conflict has been recurrently out breaking among the home-grown and the immigrants on land use. As of today, this conflict is often availing itself in the area. As Demesa pinpointed, a lot of people were lost their life and others were fled to the north part because of the conflict over land and other natural resources (Personal interview, March 2017).

According to the Federal Democratic Republic of Ethiopian Constitution (FDRE Constitution), all urban and rural land is the property of the state and the Ethiopian people. Accordingly, sale, exchange and mortgage of land are prohibited. This FDRE Constitution of 1995 Article 40(3), granted ownership of land for the state and the people. Based on this legal ground, the land and it's there in was allocated for the nine Regional governments of the country, and then to the local governments of *woreda* s and *kebeles*.

In Ameya *woreda* of Oromia Regional state, the land ownership certificate was issued for the farmers who had been using the land of any kind. Additionally, warfront returnee solders of Derg were also given the land on the beginning of the EPDRF reign (personal interview of Lemma, Taddesse and Taressa, March 2017). Later, to minimize the population density and to empower unemployed youth uncultivated lands of the *woreda* like bare land, forest land and the grassland was reallocated for the landless part of the society and for the youths in 2006. But, the distribution process was explicitly full of corruption, nepotism and embezzlement (Lemma Endale, personal interview, March 2017). Because of this corruption and ineffective natural resource and land management, the land use land coverage in the *woreda* was brought negative impact on the lively hood of the society.

To conclude that, land ownership and usage of Ameya *woreda* has been disastrous to the environment and to the socio-economic life of the society. In other words, starting from the emperors‟ era to the present, the allocation and administration of land was unfair and biased, natural resources were depleted, and land usage was not effectively and properly managed.

4.3.2 Land use/ Land Cover Change

Land use land cover change is the core concept in setting strategies for natural resource management and to pinpoint the impact of environmental change. As James *et al*., (2001) stated that land cover can be generally classified in to urban, agricultural land, range land, forest land, water; wetland, Barren land, Tundra and perennial snow or Ice. These types of land cover can be changed from one to another due to the human activities and natural phenomenon. The land cover in Ameya *woreda* is evolved from one land cover to the other by the impact from human activities. The study identified five major land use land cover change which were influenced by the people in the *woreda*. These classified land use land cover change are: Cultivated land, forest land, grassland, settlement land and bare land. The status of these land use/land cover change is discussed below by comparing and contrasting the past with the present based on the collected data from the key informants interview and focus group discussion.

4.3.2.1 Cultivated Land

As population size increased from time to time in Amaya *woreda*, the need for agricultural land was also increased due to the majority of *woreda*'s populations are earning their life through agriculture. According to the key informants Oli Simbo, Getachew Megersa and Teressa Regassa; three decades ago, there was enough cultivated land because the population growth at that time was not as much rapid rather it was a normal growth (Personal interview, March 2017). However, nowadays, due to rapid population growth and immigrants from different parts of the country to *Ameya woreda*, there is acute shortage of farming land (Agricultural and rural development office, 2017).

Rapid population growth in the study area resulted in the rising in the need for materials which are significant for the livelihood of local people. The life of people in the *woreda* is dependent on agriculture and its products and the awareness of people on economizing land (using little land for greater productivity) is very low. This caused the forest land, grassland and even bare lands to be used for cultivation land. Key informants witnessed these changes in their respective *kebeles.* For instance, Kumela Taddele said: "there was a grass land in our area. It is no more there. The reason is that, it is converted to cultivated land (Personal interview, March 2017)."

Because of shortage of agricultural land, soil infertility and low productivity; agriculture failed to satisfy the interest of people in the study area. According to FGD and key informants; before

thirty years, most parts of Ameya *woreda* was covered by grazing land and forest land, particularly northern part which is highland, than cultivated land. Whereas, the lowland part of the study area was covered by grassland. The northern part of the *woreda*, *Ajo, Gute Eteya* and *Rogge* Mountains, were changed to cultivated land from forest lands. Likewise, the lower part of the *woreda* which was largely grasslands and bare lands is occupied by immigrants from northern Ethiopia (FGD, March 2017).

At the present, most part of these lands in the study area is shifted to cultivated lands. Generally, as a result of rapid population growth in Ameya *woreda*, grazing land, bare land and forest lands are shifted to cultivated land.

4.3.2.2 Forest Land

Forest has crucial role in natural environment protection (ecosystem preservation) and enhancing socio-economic activities of the world in many ways. Marcovic (2010), as cited in Teshome, stated that Forest and forest lands are:

> *important producers of biomass, sources of healthy and high quality forest fruits, medical herbs and mushrooms, an important habitat for wild plant and animal species, the main factor for the maintenance and regulation of hydrological regime, provide protection from landslides and erosion, absorb significant volumes of carbon and represent the main air-purifying system.(Marcovic, 2010 as cited in Teshome, 2012.p.16)*

However, a result of population pressure, the quantity and the quality of the forest decreasing from year to year throughout the world including our country Ethiopia. The study area (*Ameya woreda*) forest coverage is varies from decade to decade due to anthropogenic activities. According to the focus group discussion respondents and 90% of key informants, most parts of the *woreda* land have been covered by forests three decades ago. Especially the northern and western tips parts of the *woreda* have been covered with various tree species.

However, recently the forest coverage in the study area when compared with the past three decades, changed to agricultural land and settlement area. This is due to the change of different socio-economic practices in the *woreda* such as, expansion of agricultural and settlement land, deforestation, need for fire wood, demand for construction materials, expansion of land holding size among farmers, land tuners, and poor land and natural resources management in the *woreda* (FGD, March 2017).

In a nut shell, the rapid increasing rate of population in the *woreda* is the major factor contributed to the fast growing rate of deforestation in the area. The forest land was converted to cultivation and settlement land within the last thirty years.

4.3.2.3 Settlement

Built up houses and roads constructed at the places in the *woreda* could be included in settlement land. Data obtained from FGD and key informants revealed that settlement areas increased from time to time due to fast rate of population growth in the study area and an increasing rate of unemployment in the *woreda*. There is, for instance, twenty children in Mohammed's house hold. Most of them were 10^{th} grade complete. Due to lack of other job opportunities, all of them become farmers and living together with their parents (Mohammed Ahmed, Personal Interview, March 2017).

This in turn, necessitated the increment for the needs of housing and infrastructures in the *woreda*. Even the built houses sizes are large and homesteads were constructed in large number with in the last thirty years (Oli simbo, personal interview, March 2017). The current status of settlement land of the area is alarmingly increased by diminishing the forest, grass and bare lands.

4.3.2.4 Grassland

As agriculture is the main economic activity of the people of Ameya *woreda,* they widely engaged in livestock rearing next to farming of land for a long period of time. Before 30 years, there was no shortage of grazing land in Ameya *woreda* according to key informant.

Because there was enough grazing land especially in low land areas of the study area. One of the informants Mr. Demesa told the researcher that that three or four decades ago the grazing land was plenty. Majority of local farmers send their cattle to the field and the livestock were used to graze without any limitation and managed to come back home without the assistance of shepherd at the night (Demesa Oli, personal interview, March 2017).

This implies that there was abundant grassland in the study area and people of Ameya *woreda* were highly participated in rearing of animals in addition to farming of land. The Key informants compared and contrasted the number of cattle each and every household owns. According to Oli Simbo- 65- said, before 30 years, one household owns 20-50 cattle in the average while the

average number of cattle one household owns today is 10 and the reason behind this include land conversion in which grazing land in low land and highland area was changed to cultivated land, shortage of drinking water for livestock (Oli, personal interview, 18 march 2017). As a result of conversion of grassland to cultivated land, rearing of animals in Ameya *woreda* decreased as these key informants explained. In order to feed their livestock, farmers in the study area are using chaff, hay and leaf of *enset* as food for their livestock.

The expansion of investment in the *woreda* on agriculture by itself reduced the amount of grass lands in the *worada*. According to Ameya *woreda* land management office, more than 14 investors have been investing on agriculture. These investors converted 821.02 hectors of grassland to cultivated land (Ameya *woreda* LM office, 2008 E.C). Generally, the situation of rearing of animals decreased from time to time due to increasing in number of population which resulted in shift of grazing land to cultivated land and local farmers are also use traditional way of livestock production.

4.3.2.4 Bare Land

Bare land is one of the land cover classes which have no grasses or forests. But, in some places it is found on plateau and covered by shrubs and stones. In Ameya *woreda* there were bare lands that have been considered as a communal property among the people of different *kebeles*. But, no one has used it for cultivation, for forestation or for settlement in the *woreda*. Now days, the situation was already changed. As key informants observed, the bare land is converted to cultivation land due to population growth. However, these lands were occupied by individuals by their own initiation `without getting any permission from legally authorized body.

In a nutshell, the intensity of population growth in the *woreda*, forced the society to convert bare land to cultivation land even though it has infertile soil.

4.3.3. Driving Force of land Use land Cover Change in Ameya *Woreda*

Land use is anthropogenic activities and the varied uses which are carried on land and land cover refers to natural vegetation, water bodies, soil, artificial cover and others on land (NRSA, 1989 cited in Esubalew 2014). Land cover is refers to combination of living and non living things on surface of the earth which is the most significant properties of earth system. Land cover is the things which are natural and manmade features that covers surface of the earth while land use

describes how the land cover is modified (Esubalew, 2014). Land use/land cover change is a dynamic process taking place on the biophysical surface that have taken place over a period of time and space is of enormous importance in natural resource study. LULCC is the major challenges for ecologic friendly and sustainable development for economic growth. Land use/land cover change caused by multiple driving forces that control some environmental, social and economic variables. The variety of LULC is as a result of different driving forces which may be occurred naturally or by human activities. As land use land cover change is observed in different parts of the world, there is also land use land cover change in our country specifically in the study area. According to socio- economic study, the main causes of LULCC in *Ameya woreda* are population pressure, expansion of agricultural land, demand for fuel wood and construction materials and absence of natural resource tenure policy enforcement.

4.3.3.1 Population Pressure

Population growth is the increase in the number of individuals in a population. Global human population growth amounts to around 75 million annually or 1.1% per year. The global population has grown from 1 billion in 1800 to 7 billion in 2012 and it is expected to 8.4 billion by mid-2030 and 9.6 billion by mid-2050. Many nations with rapid economic growth have low standard of living whereas many nations with low rate of population growth have high standard of living (World population factsheet, 2013). Population pressure disturbs the traditional systems of land use in a given area and this negatively affects local population and their environment. Population growth increases demand for land and therefore, contributes to farming on marginal lands (steep lands, fragile soils) leading to soil erosion. It also increases the demand for biomass as a source of fuel, leading to deforestation and increased burning of dung and crop residues, thus increase the problems of erosion and nutrient depletion.

Population growth also increases the demand for livestock products and therefore leads to increased livestock numbers, causing overgrazing and consumption for crop residues by animals. As the number of population increase from time to time globally and locally, there is rapid population growth in Ameya *woreda* due to fertility and ingoing immigrants from other parts of the country. According to the *woreda* health office, family planning is not properly implemented and due to lack of awareness majority of people of the *woreda* are not in a right track to use long family planning (Alemu Berecha, personal interview, March 2017). This is, according to Alemu, because of local people refusal to use long family planning instead they prefer the short

one. Ameya *woreda* health experts explain that the short family planning is not effective to balance the number of population with plan of *woreda* health office which was planned to control the rapid population growth in the study area. However, as a result of continuous and rapid flooding of immigrants into the *woreda* especially in the lower part of the *woreda*, the *woreda* health office was failed to reduce the number of population. Generally, rapid population growth in the study area is the main driving force of LULCC. Population growth in the *woreda* resulted in shortage of farming and grazing land, forest degradation, decline in agricultural productivity, shortage of fuel wood and construction materials, climate change, drying up of source of river, decrease in number of livestock due to lack of grazing land and conflict on land.

4.3.3.2 Expansion of Agricultural Land

Agriculture is systematic rising of useful plants and livestock under the management of man. Agriculture is deliberately the effort to modify a portion of earth's surface through cultivation of crops and the raising of livestock for sustenance or economic gain (Rubenstein, 2003). Agriculture contributes a lot in economic development of a country.

Agriculture makes its contribution to economic development in many ways through; by providing food and materials to nonagricultural sector of the economy, creating demand for goods in non agricultural sector by rural people on the strength of purchasing power, earned by them on selling the marketable products. Even if agriculture is back bone of economic development of a nation, unsustainable agriculture and its practices affect LULC and natural environment in Ameya *woreda*. According to key informants of the study expansion of agricultural land, one of the main causes of LULCC in the study area is mainly caused by rapid population growth, lack of job opportunity in nonagricultural sector, lack of modern agricultural practices, problem on natural resource management, and lack of interest of *woreda* officials to support farmers (Getachew, Tefera, Lemma, Guteta, Desta and et.al, personal interview, 21March 2017).

In a nutshell, expansion of agricultural practices in the *woreda* negatively affects natural environment in many ways such as land conversion (forest to cultivated land through deforestation(See figure 13), grassland to cultivated land and bare land to cultivated land), deforestation, soil erosion, and climatic change, decrease the volume of water, soil infertility, extinction of wild animals and natural forest.

Figure 13: Expansion of agricultural land at Kura Bola *kebele*, Ameya *woreda* (photo by Author)

4.3.3.3 The Demand for Fuel Wood and Construction Materials

Fuel wood is the sources of energy for coo*k*ing, light and serves as source of income for people, especially in developing countries. The need for construction materials people in rural as well as in urban exploit natural forests and planted trees (FAO, 2012). According to the response of key informants and the FGD respondents, the main source of energy in Ameya *woreda* is fuel wood - fire wood and charcoal- which is the leading cause for deforestation next to agricultural expansion in the *woreda*. . As Tesfaye (one of the informant) explained people cut the old trees for agricultural land expansion, to use it as a fire wood, for illegal wood trading, for charcoal, to produce timber, for fence and house construction (Tesfaye Negera, March 2017).

In addition to this, many people in the *woreda* use fire wood and charcoal as a source of income they sell it out to their neighbors in the rural areas and for urban dwellers including Addis Ababa (See figure 14). As the number of people has been increasing from time to time, the need for shelter was increased; the demand for construction materials was also increased and this resulted in deforestation in the study area (FGD2, March 2017). Generally, the people of Ameya *woreda* are using forest and its products as a source of income and energy by cutting trees and selling it to both in rural and urban areas.

Figure 14: Wood prepared for sale at Kechema Jiren *Kebele,* Ameya *woreda* (photo by Author)

4.3.3.4 Absence of Natural Resource Tenure Policy Enforcement

Land term "land tenure" is concerned with the complex relationships that exist between categories of individuals and groups in reference to land and other natural resource (Ambaye, 2015). These relationships of individuals and groups with issues related to natural resources and land acquisition, conservation, exploitation and transfer can be examined based on the right and obligation these categories of people ought to hold.

Conservation and wise use of land and other natural resources is important to bring sustainable development. In Ethiopia, lands is owned by both government and people, but previously land lords, church and kings and government alone controlled land and its production by excluding the tillers.

However, land the *derg* breaks the ice and the tillers got the land to plough. From that time onwards, the ownership of land is in the hands of Ethiopian government and its people. As ownership of land belongs to both government and people, they should protect land cooperatively. Therefore, the study explored the weakness and strength of land use and management in Ameya *woreda* of Oromia regional state. In Ameya *woreda*, after land lords loose land ownership right, land was allocated for local people in different times and space. Immediately after it came to power in 1974, Derg nationalized the land. The Ethiopian People's Democratic Front (EPRDF) constitution Article 40(3) ensured the people's profitability from the

usage of land and natural resources, and even the government allocated the land for solders of the previous regime. According to informants, In 1986 E.C the land which previously was communal and grazing land (lafa loonii) is reallocated for solders returned from the war front. Due to land distributed for Micro enterprise and for immigrants, currently, no piece of land left for livestock to graze and the forest land that has been abundant at some part of the lowland and the highland are diminishing (Teressa Regassa, FGD, and March 2017).

Land was distributed for the unemployed youths in 2006 in *Ameya woreda* according the respondents. The main reason was to respond to the rapid population growth and youth unemployment in the *woreda*. Land was distributed for the unemployed youths in 2006 in Ameya *woreda* according to the respondents. The main reason was to respond to the rapid population growth and youth unemployment in the *woreda*. Mr. Taddesse explained that, the governments loss of election at the area in 2005 enforced the government to attract the attention of unemployed youths and other landless farmers by providing them land (Taddesse Magersa, personal interview, March 2017).

After many people owned land in different times in Ameya *woreda*, they continuously engaged in unwise use of natural resources by transforming or changing forest land and grassland to agricultural land and built up houses. Consequently, LULCC in the *woreda* has happened. In Ameya *woreda*, mismanagement and unwise use of natural resources has impact on land.

Lack of awareness and law on forest resources, the complicated certifying of farmers on land ownership, low supervision on migrants' forest resource use and lack of demarcating of forest land facilitated deforestation in addition to population density (FGD2, March, 2017).

Generally, there is no any government body and other concerned bodies who take responsibility of preservation of natural resources in the study area and people of the *woreda* are in great worries about their futurity.

4.3.4 Effects of Land use/Land Cover Change in Ameya *Woreda*

The change in LULC has negative impact on natural environment and cultural landscape such as Loss of plant's and animal's species, local climatic change, deforestation, land degradation, hydrological impact, surface runoff, and poverty and socio economic conflict among local communities. These can affect significantly food security and rural livelihood system in

Ameya woreda. The major potential environmental effects of LULCC in the study area are as follows.

4.3.4.1 Forest Degradation

One of the most important resources on earth, forest- is the main reason for the life of human being. People depend on the forest resources, mainly for their economic, environmental and enjoyment purposes. Forest is important in many ways. For instance, wood from forest trees provides lumber, to make furniture and various hand tools, serve as the chief source of fuel for cooking and heating, for construction purposes (Birhan, 2007).

Even though, forest and its products are keys for human survival, many research findings explained that various indigenous forests are cleared in Ethiopia. Similarly, FGD and key informants revealed that there is widespread forest degradation in Ameya *woreda* and become serious problems. According to discussion with key informants and FGD, the main causes for forest degradation in the *woreda* are; expansion of cultivated land, illegal seizure of land, fire wood and charcoal production, population pressure, increasing need for construction materials, settlement expansion and source of income . People's clearing of forests for agricultural purposes brought deficiency of big trees for building of houses and shadow for humans and livestock, and finding wood for fire become worsening in the *woreda* (Lomitu Dandena, personal interview, March 2017).

The other informants described about large forests which are diminishing from time to time in the woreda. These are *Rogge, Gango, Gafersa, Asasa, Lencha, Manjuje* and others (FGD2, March, 2017). They were cleared out by the people of the *woreda* for searching of cultivation, timber, grazing of their cattle, for fire wood and for construction. According to Tammirat Gutesa, the former Developmental Agent of the *woreda*, "forestlands were cleared and changed to cultivated land. Steep slopes were swept by runoff and landslide has happened to Rogge forest, specially recurring at a place called Danse" (FGD2, March, 2017).

To sum up, According to FGD and key informant especially *woreda* experts, forest degradation affect natural environment and local people in the study area. the main effects of forest degradation in Ameya *woreda* are; soil erosion, flooding particularly in the highland part of the *woreda*, drying up of water source, extinction of indigenous tree and wild animals, climatic change, land slide, shortage of fire wood and construction materials and others.

Figure 15: Deforestation at Kura Bola *Kebele,* Ameya *woreda*.(photo by Author)

4.3.4.2. Land Degradation

Land degradation is the process in which the value of biophysical environment is affected by a combination of human induced processes acting up on the land. It refers to any change or disturbance to the land and is the removal of loose surface materials and nutrient content by different agents mainly water and wind (Warra, et al, 2013). In the study area, FGD and key informant explain that the main causes of land degradation are; rapid population growth, deforestation, over cultivation, overgrazing, natural resource management, backward farming system. Due to population pressure land degradation in forms of soil erosion is common in the highland area of the *woreda* as a result, there is decline in agricultural productivity and people in local area are not food self sufficient. From the first focus group member an expert from Agricultural and Rural development office- explained that soil erosion that has happened by runoff and gully erosion is the consequence of deforestation. This in turn, affected the soil fertility and productivity of the woreda. Furthermore, "In order to replace or afforest the area, people are planting trees of foreign origin like *tid* and *behar zef*. These plants that has long root have the capacity to deplete the soil fertility" (FGD1, March, 2017).

Hence, the *woreda's* land cover has been affected by different human activities. Lack of awareness about the natural resource conservation, deforestation, over grazing and population growths are the major factors that brought land degradation in the area (See figure 16 and 17).

Dalliance of introduction and ineffective implementation of new mechanized technologies on farming in the *woreda*, paved the way for soil degradation and infertility.

Figure 16: Gully Erosion at *gombore kebele* in Ameya *woreda* (photo by Author)

Figure 17: Gully Erosion at Gulti *Bola kebele* in Ameya *woreda* (photo by Author)

4.3.4.3 Loss of Plant's and Animal's Species

The research has shown that the area under natural vegetation and forest has declined over the past three decades. This indicates the loss of biodiversity in both plant and animals. As Gadisa-key informant- revealed, the *woreda*'s biggest forests like Rogge, Gango, robai and Asasa were where a lot of different indigenous trees species were found. But, currently they are depleted in anthropogenic way (Personal interview, March 2017). According to FGD and key informant almost all indigenous tree species and animals were disappeared and the remaining few plants and animals are in danger. They explain that, the main cause of Loss of plant's and animal's species in the study area is deforestation. One of my informants explained the situation as *biodiversity* were lost because of forest destruction; plant species like *Ejersa* (olive oil), *Heexoo* (hygenia abyssinica), *Gaattiraa* (Juniper procera), *bakkanisa* (coroton), *Eebicha* (vernoria), *wadeessa* (Cordia Africana) and *agamsa* (Idulis) were lost. The animal species like *Jaldeessa* (olive baboon), *qamalee* (vervet monkey), *Qeerransa* (leopard), *waraabeessa* (hyena), *sardiidaa* (Fox), *booyyee* (pig) and etc were also disappeared and only *Qamalee* (vervet monkey) and (*Jaldeessa*) olive baboon often found throughout the Woreda's *kebeles* (Bayera, personal Interview, March 2017).

As a result of deforestation, many wild animals disappeared and fled the area due to shortage or lack of food and water. As forest and its area are serving as home for wild animals, the cutting of trees for different purposes makes life difficult for wild animals and they remain homeless. Hunting of wild animals was also the main cause for the disappearance of wild animals in the study *woreda*.

4.3.4.4 Hydrological Impact

Warra *et al*, (2013) inferred that human activities like deforestation and intensive cultivation can decrease the amount of water that percolate into the ground and recharges streams, springs and underground water. According to Mengistu(2009), cited in Alemayehu, Land use land cover change which is precipitated by vegetation removal has the capacity to impact the hydrological cycle of certain area by preventing the rainfall, speeding up of evaporation and paving the way for runoff(Alemayehu, 2010).

As the informants of this sample data, hydrological impact is one of the main effects of LULCC in Ameya *woreda*, which was mainly resulted from deforestation and expansion of agricultural land. The *woreda* agricultural experts, residents and different stakeholders exposed

that the weather condition has changed, and due to the shortage of water, watering of cattle and animals became worse. Due to weather change, according to one of the informant, the area seems to its residents "strange land". "I feel as if I am in strangers land. Because, day time we are experiencing unusual high temperature and during the night time we feel extreme coldness (Taddesse, personal interview, March 2017)."

According to the respondents in Ameya *woreda* hydrological change is greatly observable. Water volume and quality, drying up of steams and weather conditions (Lomitu, Lemma, Guteta, Teressa and Tsigu, Personal interview and FGD, March 2017). They inferred that this has happened because of lack of awareness about the natural resource conservation among the people of the *woreda* and deforestation. Among the rivers of the *woreda* like *Kulit*, *Amengna*, *kulu* and *kechema* are the tributaries of Abay and Ghibe-the country's biggest rivers. Hydrological impact on these rivers could have the great impact on the country's socio-economic and political development.

To sum up, the hydrological impact that has happened to the *woreda* was emanated from misuse of natural resources, intensive cultivation and deforestation. As a result, the number, volume and quality of water bodies of the *woreda* were decreased. Consequently, weather condition change-inconsistency of annual rainfall and an increment of temperature- have happened.

4.3.4.5. Shortages of Animal Feed

The life of people in the Ameya *woreda* is depending on farming and livestock rearing. However, the study identified that there is shortage of grazing land in the area. This has happened because of anthropogenic activities like agricultural land expansion, settlement and deforestation due to rapid population growth in the *woreda*. As key informants revealed, 30 years ago on average one household owns more than 20 livestock, but, nowadays the number of livestock one household owns is 1-4 on average(Gelana, Taddesse, Oluma, Oli, Mohammed, Getachew, Tedele, et al. Personal interview, march 2017). This was the result of lack of grazing land, decrease in the volume of water, and clearance of big trees which has been used as a shadow for livestock. Consequently, different socio- economic problems such as decrease in quantity and quality of livestock including decline of milk and milk products, meat, hide and skin, lack of animal manure to increase soil fertility, and reduction of household income from the sale of live animals.

Generally, animal feeding shortage is one of the main challenges of local people in the study area. Poverty reduction, ensuring food security and improving the living standards of rural community in the *woreda* are the thing that needs special consideration.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

Understanding of land use land cover change has paramount importance for bringing of sustainable development and to set out the strategies of natural resource management. To contribute to the country's development by identifying the major problems of land use land cover change, this study was conducted on Ameya *woreda*. The results of this study revealed the existence of significant land use and land cover changes in the last 30 years. Especially the expansion of cultivation land and settlement at the expense of forest land and grass land.

The LU/LC pattern of change observed on the five classes of land use land cover has showed different trends and magnitude in three different periods of times. From, 1986 to 2001 and from 2001 to 2016 comparison had been made to understand the land use land cover change. Accordingly, Settlement land was expanded and cultivation land was increased throughout the three periods with different pattern, trend and magnitude. Grass land, bare land and forest land were alarmingly decreased throughout the three consecutive periods.

The main driving forces of land use land cover change in Ameya *woreda* are population growth, expansion of agricultural land, need for fuel wood and construction materials and charcoal, and inefficiency of natural resource and land management system at *woreda* and kebele level.

Population pressure is among the main driving force of land use land cover change. This was emanated from uncontrolled birth and consistence of immigrants flooding to the *woreda* from different parts of the country. Consequently, population growth brought land cover conversion especially forest land and grass lands were converted to agricultural lands. Agricultural land was expanded in the *woreda* in the expenses of other land cover classes, because agriculture is the major source of livelihood for the peoples of the *woreda*.

Furthermore, Inefficient natural resources and land management policy enforcement in the *woreda* has been contributing to the land use land cover change. Land distribution among the youth and landless part of the society was corrupted. There is no awareness creation for farmers about natural resources conservation. The forests are not well demarcated and conserved by

Woreda's and *kebele's* officials. No cooperation and integration among *woreda*'s a sector office working on natural resources directly or indirectly. The people of the *woreda's* are also contributed to the land use land cover change by degrading forests for search of fuel wood, construction materials and charcoal.

Moreover, the effects of land use land cover change in Ameya *woreda* are forest degradation, loss of bio diversity, land degradation, hydrological impact and shortage of animal feeding. These effects were affected the life of the people of the *woreda* by minimizing the number of their livestock, infertility of soil, changing the weather condition and temperature of the area, and soil eroding. Even its magnitude is further extended to minimize and extinct flora and fauna (bio diversity) in the *woreda*.

Generally, land use land cover change in Ameya were mostly accelerated by population growth and resulted in deforestation which have the capacity to affect human, plants and animals life. It is also a hindrance for positive socio-economic change in the *woreda* as well as at the country level.

5.2 Recommendations

The finding of this study may not fully pinpoint the main causes, factors, impacts, patterns and magnitude of land use land cover change in the *woreda*. But, if they are considered and implemented properly, the study's findings are important tool to bring sustainable solutions for land use land cover change in the *woreda*. Therefore, hereby I recommended the following to minimize, if possible to alleviate, land use land cover change in Ameya *woreda*:

1. As can be observed from this study, due to the expansion of cultivated land, other natural resources were damaged. Therefore, the woreda's Forest and Natural Resource Conservation Office and woreda's Agriculture and Rural Development Office should aware and initiate the farmers about natural resources use and conservation.
2. The *woreda* is demarcated and covered by forests in different direction. But, deforestation is very intense in the area. To avoid the impact of deforestation, which has the high potential to affect the *woreda's* and the country's socio-economic profile, different stakeholders should take an initiative to protect forests.

   Oromia Regional state, south west shoa zone and Ameya *woreda* administrations should take the responsibility to implement land and natural resources conservation tenure policy and demarcate unprotected forest lands.

3. The livelihood of the people of the *woreda* is dependent on agriculture. But, the number of population is very high and shortage of farming land became high. So, to balance the gap between population growth and land use, the *woreda* should device alternative options. Like, for instance, introducing modern farming technologies and providing necessary assistance for farmers by *woreda*'s agricultural expertise so that the farmers can get large productivity from small plot of land.
4. Due to the population growth in the *woreda*, land use land cover change was occurred. The population growth has happed because of uncontrolled birth and an increment of immigrants from time to time. So, Oromia regional state government must to educate the society about family planning, and planning and implementing how to control illegal immigration.
5. To ensure the sustainability of natural resources of this *woreda*, further investigation is needed on every class of natural resources. In other words, issues of forest land, grass land, farming land, bare land, and population pressure have to research separately and thoroughly. So, hereby I call up on researchers to study these issues to bring sustainable solution on socio-economy of the society of the *woreda*.
6. Different offices at Ameya *woreda* are working on natural resources use, conservation and management in the *woreda*. They plan differently. They work separately on the same issues. They have no cooperation and coordination. Therefore, these stakeholders should cooperate and integrate their plans and works on natural recourses to do a fruitful job.

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APPENDIX I

KEY INFORMANT INTERVIEW GUIDE FOR HOUSE HOLD SURVEY

1. Age of the respondent: _____ Sex: _____Marital Status_____
2. What is your level of education? _____
3. Number of your Family _____
4. How is the land history and distribution system of your *woreda*?
5. How was the land usage looks like in your areas over the past of 30years?
6. Do you feel (think) that land is becoming scarce or it is still abundant in your community?
7. If your answer for question no. 6 is becoming scarce, what are your reasons?
8. If your answer for question no. 6 is still abundant, what are your justifications? Please, specify it briefly.
9. Have you noticed any change in the land use/land cover in your area over the past 30 years?
10. Is there any change observed in your area with regard to vegetation cover, settlement areas, cultivation land, bare land and land use pattern over the past 30 years?
11. Did the changes also modify the land cover types in any ways?
12. What are the driving forces of land use/land cover changes in your area?

    Example, a. Lack of proper management c. Increasing demand for farming Technology

    b. population growth d. Advancement of technology e.To expand farming land
13. Has the quality of the forest, grazing and crop land changed over the last 30 years?
14. Do you have an awareness of proper land use and management? Please, discuss it.
15. What are the new skills that you obtained from the woreda rural land management experts?
16. What are effects of land use/land cover change in the areas? Example:

    A. soil erosion /land degradation b. Deforestation c. decreasing of crop yields.

    d. migration and extinction of wild animals. e. Weather condition change

FOCUS GROUP DISCUSSION CHECK LIST

1. Age of the respondent: _____ Sex: _____Marital status ____

2. What is your level of education? _____

3. Role of expert in the office _____

4. Do you feel (Think) any change of land use/land cover changes over time and space in your *woreda*?

5. Is there any investment or investor on land improvement measures? Yes/no

If yes, what type of improvement measures exist?

6. Can you mention the consequences of land cover changes from one type to another?

7. How local people‟s occupation of land changed over the past 30 years, because of population increment?

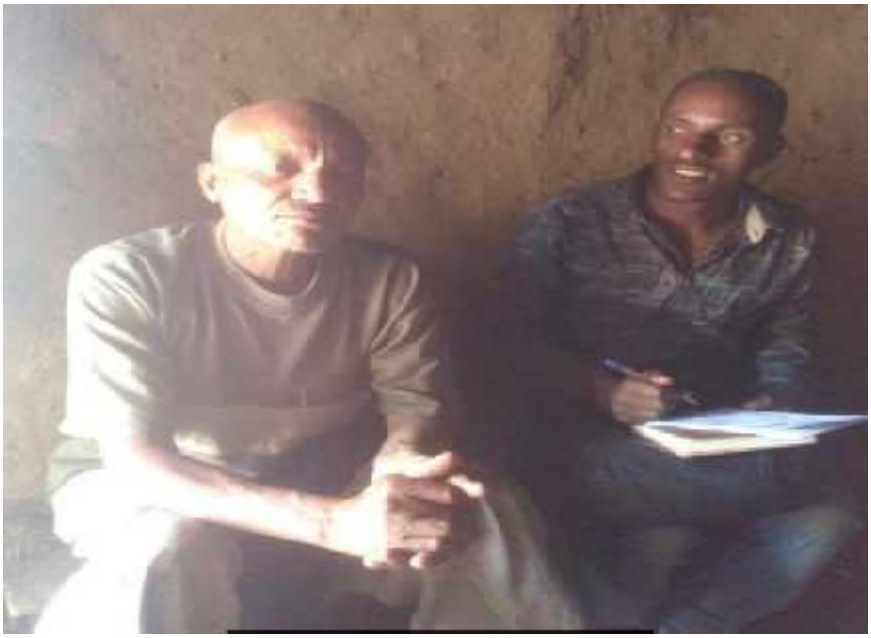
8. Do the individuals or the community actively participating in the conservation activities?

9. Do you believe that human activities have prompt impact on land use/cover change? If your answer is “Yes”, explain it in detail!

10. What new skills you thought the rural population in relation to land use management?

11. Do you think that the rural land management and Environmental protection sector has helped the rural population to conserve their own natural resources? Explain in detail.

APPENDIX II: Sample pictures from field



Participants of KII

Participants of FGD one

Participants of FGD two

Cultivation area

APPENDIX: III

No.	Year	Annual rainfall (mm)	No.	Year	Annual rainfall (mm)
1	1955	1084.8	21	1995	1066.8
2	1956	1781.5	22	1996	1409.9
3	1960	2008.5	23	1997	1314.6
4	1974	1025.1	24	1998	1580.5
5	1975	1502.5	25	2000	1452.5
6	1976	968.1	26	2001	1102.4
7	1977	1288.3	27	2002	1227.4
8	1978	1481.1	28	2003	1118.2
9	1979	1684	29	2004	1220
10	1980	1128.3	30	2005	1355.9
11	1981	1233	31	2006	1339.1
12	1982	1203	32	2007	1322.3
13	1983	1220.3	33	2008	1082.4
14	1985	1037.6	34	2010	1251.6
15	1986	1193.5	35	2011	1201.5
16	1987	1149.7	36	2012	904.3
17	1988	1527.1	37	2013	1373.1
18	1990	1371.6	38	2014	1081.7
19	1993	1280	39	2015	1031.5
20	1994	1039.5	40	2016	1067.1

Monthly average maximum annual Temperature (^{o}c)			Monthly average minimum annual Temperature ((oc)	
Year	Yaya (Yayaotana)	Tikur Enchine	Yaya (Yayaotana)	Tikur Enchine
1980	30.6	24.0	12.0	8.1
1981	30.7	23.9	7.7	7.4
1982	30.9	24.3	12.6	8.2
1983	30.9	24.1	13.0	7.2
1984	31.0	24.1	12.6	7.5
1985	30.7	23.8	13.0	7.5
1986	31.7	23.4	12.6	7.9
1987	30.8	22.8	13.0	8.3
1988	31.9	22.9	13.4	8.0
1989	33.9	23.0	12.8	6.5
1990	29.7	23.3	12.9	6.8
1991	30.3	23.9	13.4	6.5
1992	31.2	24.0	13.6	5.9
1993	30.4	24.9	12.4	4.5
1994	29.9	20.7	13.7	3.8
1995	30.2	21.5	13.9	3.1
1996	30.0	21.3	13.8	3.2
1997	30.8	22.1	14.1	5.5
1998	30.8	22.6	14.4	8.3
1999	29.7	22.2	12.1	6.7
2000	30.1	22.0	13.3	7.8
2001	29.9	22.3	13.8	7.8
2002	29.6	22.3	13.3	8.4
2003	29.5	21.6	14.0	7.9
2004	29.8	22.4	14.2	8.4
2005	30.9	22.9	13.6	8.7
2006	29.7	22.1	13.6	8.8
2007	29.5	22.5	12.7	8.3
2008	30.4	23.1	12.1	7.5
2009	30.7	23.7	13.3	7.5
2010	29.2	22.4	14.4	8.5
2011	30.3	22.3	13.4	7.8
2012	29.9	23.3	13.8	7.8
2013	29.4	23.4	12.4	7.4
2014	30.3	23.2	13.3	7.6
2015	29.7	22.8	13.7	8.0
2016	30.6	23.6	14.6	8.5