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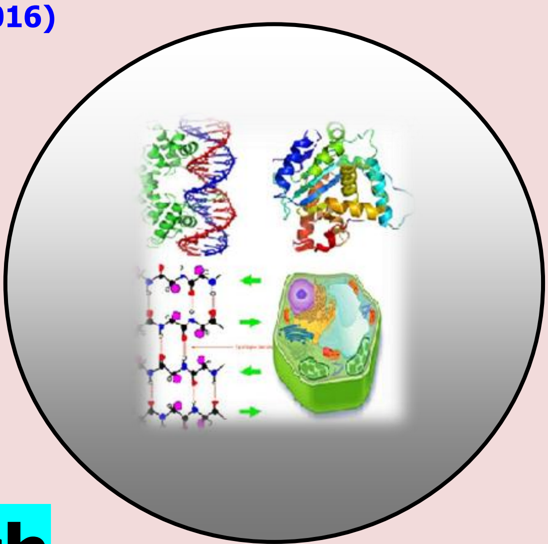

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RESEARCH PAPER

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Analysis of Land use and Land Cover Change, Drivers and Impact on Agricultural Productivity in Esera Woreda, Dawro Zone, Southwest Ethipoia

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ABSTRACT

Land use and land cover (LULC) change is one of the challenges which strongly influence the process of agricultural development in the study area. Change in land use can negatively affect the potential use of an area and ultimately lead to soil and vegetation degradation that have an impact for loss of agricultural productivity. Land use land cover change analysis was conducted in Esera woreda, Southwest Ethiopia between 1986 - 2014, on an area that covers 106021.26 hectares using Remote Sensing satellite image and Geographic Information System with field verifications. Hence, this study was conducted to examine land use change, its drivers and impacts in agricultural productivity in Esera woreda .In the study, land use/land cover maps of 1986, 2000 and 2014, and change maps of 1986-2000 and 2000-2014 were produced. Results from land use and land cover change analysis shown an increase in agricultural land from 33.3 % in 1986 to 63.03 % in 2014. The increase of agricultural land was mainly at the expense of forest cover change. Forest cover decreased from 61.89 % in 1986 to 22.41 in 2014. Built up area was 3.83 % in 1986 that increased to 13.52% in 2014 and water body which was 0.96% in 1986 increased to 1.03 % in 2014. The study also found that the main causes of land use and land cover changes were mainly, demand for agricultural land, increased demands for forest products such firewood and charcoal. Thus, it is highly recommendable for all concerned bodies to introduce modern farming system that allows farmers to get more agricultural products from small farming land plot and to use alternative fuel sources to reduce the dependence of rural community on forest products.
Keywords: Land use, Land covers change, Agricultural productivity, GIS and Remote sensing.

INTRODUCTION

Background of the study

Land is delineable area of the earth's terrestrial surface, embracing all attributes of the biosphere immediately above or below this surface, including the plant and animal populations, the human settlement pattern and physical results of past and present human activity (terracing, water storage or drainage structures, roads, buildings, etc.) (IDWG-LUP at FAO in 1994).The term land cover originally referred to the kind and state of vegetation, such as forest or grass cover but it has broadened in subsequent usage to include other things such as manmade structures like building, soil type, biodiversity, surface and ground water(Meyer, 1995). Land use refers to a series of operations on land, carried out by humans, with the intention to obtain products and benefit through using land resources including soil resources and vegetation resources which is part of land cover (DeBie *et al*, 1996).

Globally land cover and land use change today is altered principally by direct human use, by agriculture and livestock rising, forest clearing and mismanagement and urban and suburban construction and development. A serious problem the world is facing at present is the deterioration of both the natural environment and natural resources. Human activities generate environmental pressure in different ways. Among them is overexploitation of renewable resources such as forests, and degradation of basic resources such as land and water .Hence, in order to use land optimally, it is not only necessary to have the information on existing land use and land cover but also the capability to monitor the dynamics of land use resulting out of both changing demands of increasing population and forces of nature acting to shape the landscape (Meyer, 1995). The spatial and temporal distribution of land use and land cover is very important in understanding a wide variety of global change phenomenon. The development of mankind over the past decades has gone through number of historical stages. Man is the most progressive creature on the earth. For his progress he has made many changes on the earth surface such as industrialization, urbanization, farming and construction activities. Land use-land cover change over time is an inevitable phenomenon occurring globally due to both temporary and or permanent interest of the inhabitants in a particular area. The phenomenon could be revealed either in a small or large scale but the most interesting and fundamental observation is that change occurs over time in a particular place. Land-cover is the biophysical state of the earth’s surface and immediate subsurface is the source and sink for most of the material and energy movements and interactions between the geo-sphere and biosphere. Changes in land-cover include changes in biotic diversity, actual and potential primary productivity, and soil quality and sedimentation rates and cannot be well understood without the knowledge of land use change that drives them. Therefore, land use and land cover changes have environmental implications at local and regional levels, and perhaps are linked to the global environmental process (Bello *et.al*, 2014).

The land use and land cover pattern of a region is an outcome of natural and socio economic factors and their utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressure. Hence, information on land use / land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. This information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population. Land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental changes. Several regions around the world are currently undergoing rapid, wide-ranging changes in land cover (Mas, 1999).

Currently in Ethiopia land cover and land use change concerns of energy, food security and environment with regard to land degradation due to erosion and deforestation and pollution of air due to the emission of harmful gasses from the use of fossil fuel are becoming very important issues. The advancement in the concept of vegetation mapping has greatly increased research on land use land cover change thus providing an accurate evaluation of the spread and health of the study area forest, grassland, and agricultural resources has become an important priority. Agriculture in Ethiopia is increasing, but it confronted with the pressure from a rapidly growing population and diminishing natural resources (Mulugeta, 2004). Ethiopian agriculture faces the challenge of providing food for a growing population (Abate, 2010). One of the immediate problems facing Ethiopia today is land degradation, particularly loss of vegetation cover and soil erosion contribute significantly to low agricultural productivity.

Consequently, agricultural productivity that determines rural income levels and wealth can be affected by the land use and land cover change brings tremendous impacts in the agricultural productivity in the study area. Viewing the Earth from space is now crucial to the understanding of the influence of man's activities on his natural resource base over time. In situations of rapid and often unrecorded land use change, observations of the earth from space provide objective information of human utilization of the landscape. Remote Sensing (RS) and Geographic Information System (GIS) are now providing new tools for advanced ecosystem management. Over the past years, data from Earth sensing satellites has become vital in mapping the Earth's features and infrastructures, managing natural resources and studying environmental change.

Statement of the Problem

The awareness about the importance of LULC change study among global issues has risen for its nexus on global human security and quality of the environment. Furthermore, LULC change is a critical issue due to its great influence on land degradation, biodiversity loss, water quality, effects, and human life. Analyzing the land cover changes and understanding the subsequent trends of change contribute to present complex dynamics of LULC and are important for planning and policy making and sustainable management of resources (Rachmad and Nobukazu**,** 2013)**.** Land use and cover changes could lead to a decreased availability of different products and services for human, livestock, agricultural production and damage to the environment as well (Agarwal *et al,* 2002).

In Ethiopia, the causes of land cover change particularly natural forest destruction were agricultural expansion, both through shifting cultivation and the spread of sedentary agriculture; the demand for increasing amounts of construction material, fuel wood and charcoal. Charcoal production is common place in the arid, semi-arid and dry sub humid parts of the country. Using fire to fumigate bees and to facilitate hunting is also very common, which results forest fire and destructs natural forests (Kahsay cited in Netsanet, 2007).

According to Barry and Ejigu (2005) the main causes of land use land cover change and fertility decline in southwestern Ethiopia are deforestation, removal of crop residues from fields, land fragmentation, reduction of fallowing periods, overgrazing, low fertilizer inputs, inadequate soil and water conservation practices and cropping of marginal lands. These have resulted in lowering of agricultural production, leading to food insecurity and increased poverty.

Esera woreda is part of south west Ethiopia which is exposed to high land degradation as per the previous observation of the researcher in many ways. The reasons for land use and land cover change drivers and its impact on agricultural productivity in the study area may include rapid population growth, resettlement and land shortage which forced farming families to increase their agricultural fields in to natural forests. In addition, local vegetation cover changed by biophysical and socio-economic drivers, especially forest cover change by animal feed/grazing, construction materials and charcoal production/fuel wood has significant and cumulative impact on the study area. These factors also would cause seasonal flooding of farmlands in the bottomlands, which might affect several farming families and agricultural productivity. Furthermore, rising and falling topography which makes it vulnerable for soil fertility decline, deforestation and causing soil erosion. However, none of these situations of the study area have been systematically investigated by previous studies.

Therefore, this research has vital contribution in addressing the main drivers of land use and land cover change and its impact on agricultural productivity in relation to the socio-economic set up of the study area by using GIS and RS. It also attempted to provide recommendations which would help to ensure the sustainability of environments and improvement of agricultural productivity that enhance the livelihoods of farming communities.

Objective of the study

General Objective

The study aims to analyze land use and land cover changes, driver and impact on agricultural productivity in *Esera woreda* from1986 to 2014.

Specific Objectives

This study encompasses the following specific research objectives:

- To map land use and land cover change of the study area of 1986, 2000, and 2014.
- To identify major drivers of land use and land cover change in the study area.
- To assess impact of land use land cover change on the agricultural productivity in the study area.

Research Question

This study tried to answer the following research questions:

- What are the major cause of land use and land cover change in the study area?
- What are the fundamental forces behind forest and other land use and land cover change?
- How does land use and land cover change affect agricultural productivity in Esera woreda?

Significance of the Study

Spatiotemporal Analysis of land use and land cover changes is one of the most detailed techniques to recognize how land was used in the past, what types of changes are expected in the future, the forces and processes behind the changes and its implications on agricultural productivity, livelihoods; environmental degradation, and land cover and land use. Therefore, this study will be helpful to improve the existing methods and techniques in the analysis of remotely sensed data so as to apply it in land use and land cover dynamics, and environmental degradation. The output of this research is also crucial for natural resources administrators, development agents, fund providers, socio-economic development planners and ecologists in order to have suitable environmental protection and development interventions. Particularly, *Esera Woreda* local community will be most beneficial as this study may bring development interventions and works by governmental and non-governmental organizations in the study area.

Scope and Limitations of the Study

The spatial scope of study was in *Esera* Woreda located in, Dawro Zone, Southern Nations Nationality and Peoples' Regional State, Southwestern Ethiopian land use and land cover changes; drivers and its impact on agricultural productivity, and Temporal scope of the study from 1986 to 2014.

The limitation of the research is lack of organized and adequate historical data of agricultural productivity at the district level was one of the limited factors in this study. The other limitation was that the socio-economic survey could not include all household heads in the study area mainly due to shortage of finance. The sample size for the survey was 116 household heads, around 6% of the total number of households in the study area, which might make generalizations a little difficult.

Organization of the paper

The research paper would have five major chapters. The first chapter is an introductory part Comprises, statement of the problem, objectives of the study, research questions, significance, scope and limitation of the study and organization of the report. Related literature reviews in the second chapter. Chapter three gives a brief description of a study area and the overall method and materials which the study were utilized. Analysis of results discussions were dealt in fourth chapter. At chapter five conclusion and scientific recommendations were given.

RELATED LITERATURE REVIEW

The Concept of Land, Land Use and Land Cover change

According to Interdepartmental Working Group on Land Use Planning (IDWG-LUP) at FAO proposed in 1994 land is "A delineable area of the earth's terrestrial surface, embracing all attributes of the biosphere immediately above or below this surface, including those of the near surface climate, the soil and terrain forms, the surface hydrology including shallow lakes, rivers, marshes and swamps, the near-surface sedimentary layers and associated groundwater reserves, the plant and animal populations, the human settlement pattern and physical results of past and present human activity (terracing, water storage or drainage structures, roads, buildings, etc.)".

Land cover refers to the actual surface cover for a given location covered by vegetation type, anthropogenic structure ,water, bare, rock sand and etc. occur on the earth's surface. Remote-sensing data have a long history of being used for deriving land-cover maps, even before the launch of the first Landsat platform in 1972. Aerial photography served as a primary source of information on land cover before the availability of satellite imagery, and it remains an important source of land-cover information even today(Sohl and Sleeter, 2012). The Global Land Cover Network (GLCN, 2006) defines land cover as the observed bio physical cover, as seen from the ground or through remote sensing, including vegetation (natural or planted) and human construction (buildings, roads, etc.) which cover the earth's surface. Water, ice, bare rock or sand surfaces also count as land cover. Every parcel of land on the earth's surface is unique in the cover it possesses.

According to Meyer (1995), the term land cover originally referred to the kind and state of vegetation, such as forest or grass cover but it has broadened in subsequent usage to include other things such as manmade structures like building, soil type, biodiversity, surface and ground water. Ground cover exerts a strong moderating impact on dissipating the energy supplied by agents of soil erosion especially rain drop. Soil erosion potential is increased if the soil has no or very little vegetative cover of plants and crop residues. Plant and residue cover protects the soil from raindrop impact and splash, tends to slow down the movement of surface runoff and allows excess surface water to infiltrate. The erosion reducing effectiveness of plant and/or residue covers depends on the type, extent and quantity of cover. Vegetation and residue combinations that completely cover the soil, and which intercept all falling raindrops at and close to the surface are the most efficient in controlling soil erosion(Morgan 2005).

Land use refers to a series of operations on land, carried out by humans, with the intention to obtain products and benefit through using land resources including soil resources and vegetation resources which is part of land cover (DeBie. *et al*. 1996). Land use is the intended employment and management strategy placed on the land cover by human agents, or land managers to exploit the land cover and reflects human activities such as industrial zones, residential zones, agricultural fields, grazing, logging, and mining among many others (Zubair, 2006) Land use activities, primarily for agricultural expansion and economic growth, have transformed one third to one-half of our planet's land surface in the form of forest clearance, agricultural practice and urban expansion, which made profound impacts on ecosystem service, food production and environment (Huimin Yan, 2009). The rapid increase in human population and strive for growth in the standard of living has put great pressure on natural resources such as vegetation, soil and water. Through conversion and intensification of land use human have caused huge changes in the balance of natural ecosystems (Fenglei *et al,* 2007). Land use change is driven by natural phenomena and anthropogenic activities, which in turn drives changes that would impact the ecosystem (Gol *et al.,* 2010; Rahdary *et al*., 2008). Crop land and pastures are now among the dominant ecosystems on the planet, occupying more than 35% of the world's land surface (Paul and Lisa, 2011).

Land use and land cover are often used interchangeably. However, they are actually quite different. Land use and land cover are distinct yet closely linked characteristics of the Earth's surface.

The use to which we put land could be grazing, agriculture, urban development, logging, and mining among many others. While land cover categories could be cropland, forest, wetland, pasture, roads, urban areas among others. A given land use may take place on one, or more than one, pieces of land and several land uses may occur on the same piece of land. Therefore, matching of existing land cover/use with topographic and soil characteristics to evaluate land suitability for irrigation with land suitability classes, present possible lands for new agricultural production (Jaruntorn *et al,2004).*
Land use land cover change in the above context land use and land cover change defined as an alteration in the surface component of the landscape and two successive occasions (Lemlem, 2007). Land use and land cover classes represent analytical units, which allow establishing a first quantitative link between human activities, environmental impacts and its geographical (spatial) dimension. Information on land cover and/or land use change is of special value integrating the temporal dimension. This is of overall interest for both politicians for the evaluation of land related policy measures and for the research community discovering the underlying causes and consequences. Land cover and land use change is commonly divided into two broad categories: conversion and modification (Stott, & Young, 1996):
Conversion refers to a change from one cover or use category to another (e.g. from forest to grass land or from crop land to settlement.
Modification represents a change within one land use or land cover category (e.g. from rain fed cultivated area to irrigated cultivated area) due to changes in its physical or functional attributes.
The pure land cover and land use information gains a significant added value through the analysis, identification and description of ongoing processes. Based on land cover and land use change information, certain processes can be retrieved, which might also serve as simple indicators. The growing population and increasing socio-economic necessities creates a pressure on land use/land cover. This pressure results in unplanned and uncontrolled changes in land use land cover change. The land use land cover change alterations are generally caused by mismanagement of agricultural, urban, range forest covers and grazing lands which lead to severe environmental problems such as landslides, floods etc.

Driving Factors of land use land cover change
The driving forces or factors of land use and land cover change are many faceted. One of the fundamental theories in land change study is the force that observes land change usually called "driving force". It is generally accepted that there are two main driving forces of land change namely biophysical forces and socioeconomic or anthropogenic drivers. Some studies disclosed that the relationship between land change and its causative factors is complex and dynamic, strongly related to socioeconomic factors, and may occur at various temporal and spatial scales. As a consequence of complex interactions between biophysical and socioeconomic conditions, it constantly changes in response to the dynamic interaction between underlying drivers (indirect or root) and proximate causes (direct), (Rachmad and Nobukazu, 2013)**.** They may change in relative influence over time, and their impact will vary as the local context changes. Analysis of land use land cover change at multiple scales demands conceptual frameworks and analytical methods that are both comprehensive enough to capture the dynamics of society–environment interactions at different scales, and flexible enough to accommodate the temporal dynamics of these processes (Campbell, 1998). According to Turner *et al*, (2004) it is essential that analyses of land use land cover change processes be carried out in reference to the complexity of the human-environment systems within the study area. In land-use studies, the main goals include finding the biophysical and socio-economic drivers of land-use and land-cover change, and understanding how they affect the structure and function of terrestrial systems. Drivers of land use change are defined as proximate and underlying factors (Geist and Lambin, 2002).

Proximate and underlying causes of land use land cover change

Proximate Causes

Proximate or direct causes of land-use change constitute human activities or immediate actions that originate from intended land use and directly affect land cover (Ojima, 1994). They involve a physical action on land cover. Proximate causes of deforestation are human activities that directly affect environment (Turner *et al,* 1990, 1993). Different from structural, systemic or initial conditions, they can be interpreted as the more immediate, direct factors which originate from land-use and directly impact upon forest cover (Ojima et al. 1994). In terms of scale, proximate causes are seen to operate at the local level or sites of the respective study area.

According to Kaimowitz and Angelsen, 1998; Contreras-Hermosilla, 2000), proximate causes are commonly grouped into three broad categories: expansion of crop land and pasture (agricultural expansion), harvesting or extraction of wood (wood extraction), and expansion of infrastructure. In the cases analyzed, these broad groups were found to be further composed of specific variables (activities): for example, forest to pasture conversion for large-scale cattle ranching, clear-cutting of trees for food (subsistence) farming, or forest removal due to the establishment of agro-industrial plantations. However, some activities as drawn from case studies still remain broad, aggregate entities, since authors occasionally specified cattle ranching or commercial wood extraction, for example, as proximate causes, but gave no mention of specific actors or agents behind these activities.

In Ethiopia, the proximate causes of land cover change particularly natural forest destruction are agricultural expansion, both through shifting cultivation and the spread of sedentary agriculture; the demand for increasing amounts of construction material, fuel wood and charcoal. Charcoal production is common place in the arid, semi-arid and dry sub humid parts of the country. Using fire to fumigate bees and to facilitate hunting is also very common, which results forest fire and destructs natural forests. In addition population pressure is inducing, the clearing of forests for agriculture and other purposes, and the attendant accelerated soil erosion, is gradually destroying the soil resource (Kahsay, 2004).

Underlying causes

Underlying or indirect causes are fundamental forces that support the more proximate causes of land cover change. They operate more diffusely (i.e., from a distance), often by altering one or more proximate causes (Leemans, 2003). Underlying causes are formed by a complex of social, political, economic, demographic, technological, cultural, and biophysical variables that constitute initial conditions in the human-environment relations and are structural (or systemic) in nature (Ledec, 1985). In terms of spatial scale, underlying drivers may operate directly at the local level, or indirectly from the national or even global level. Kaimowitz and Angelsen ,1998) point out that it is more difficult to establish clear links between underlying factors and deforestation than between immediate causes and deforestation since the causal relationships are less direct". Fundamental explanations, as taken from deforestation literature (Ledec 1985; Lambin 1994 and Contreras-Hermosilla 2000), are broadly grouped here into five categories. These are demographic factors (human population dynamics, sometimes referred to as population "pressure"), economic factors (commercialization, development, economic growth or change), technological factors (technological change or progress), policy and institutional factors (change or impact of political-economic institutions, institutional change), and a complex of socio-political or cultural factors (values, public attitudes, beliefs, and individual or household behavior).

These broad groups are composed of specific forces or human activities. This is because natural forests are the main sources of wood for fuel, construction and industry, even though plantation forestry is also increasingly becoming.

In Ethiopia forests may have existed long before history was recorded, but the present day forest cover does not correlate with human population in recorded history, even though environmental problems such as droughts may have also contributed to this phenomenon. The annual loss of natural forest cover has been estimated to be 150,000 to 200,000 ha/year and in 1989 forest cover was estimated at only 2.7% of the Ethiopian land mass (EFAP, 1993).

Generally, deforestation can result in the loss of biodiversity; which in turn results in declines in ecosystem integrity, and also genetic losses that may impede future scientific advances in agriculture and pharmaceutics. The consequences of deforestation will therefore be felt by the many poor because of lack of cash to buy modern medicine. In addition, deforestation can also impact hydrological processes, leading to localized declines in rainfall, and more rapid runoff of precipitation, causing flooding and soil erosion, a common phenomenon in the study area and areas close to it (Dagnachew *et al*, 2003). Land use affects land cover and changes in land cover affect land use. A change in either however is not necessarily the product of the other. Changes in land cover by land use do not necessarily imply degradation of the land. However, many shifting land use patterns driven by a variety of social causes, result in land cover changes that affects biodiversity, water and radiation budgets, trace gas emissions and other processes that come together to affect climate and biosphere (Riebsame *et.al,* 1994).

Land use land cover change impact on agricultural productivity

A serious problem the world is facing at present is the deterioration of both the natural environment and natural resources. Human activities generate environmental pressure indifferent ways. Notable among them are overexploitation of renewable resources such as forests, and degradation of basic resources such as land and water. Agricultural growth depends on productivity promotion through proper resource management, development of adequate infrastructure, application of appropriate technology, new farming methods, and farm management improvement. In recent years countries with traditional agricultural practices have developed fragmented, non-geometric small plots of different household's farmland and created some difficulties for agricultural development, especially the limitation for agricultural mechanization. This, in turn, leads to low productivity **(**Najafi.2003). Agricultural systems are dynamic in the sense that they are in a continual state of change and evolution; whereby, events, which occur at the present time, affect its performance both financially and biologically in the future, which, in turn influence the biological and economic efficiency of the system.

Agriculture is practiced in the form of production systems, enterprises, or farming systems. Their economic viability generally is an important evaluation criterion, although it is not the only one. Agricultural systems are ideally analyzed from economic, social, and environmental points of view, but common analyses mostly concentrate only on the economic views. FAO (1999) has suggested four functions for agricultural activities and land use: food security, environmental, economical, and social, all of which are defended by different stakeholders. Land degradation has significant costs, particularly in developing countries (Rosegrant and Ringler, 1997). It not only reduces farm productivity affecting livelihood and regional economies, it also leads to reduced biodiversity and stream sedimentation affecting water quality, storage and marine resources. Land degradation in most developing countries is becoming a major constraint to future growth and development (Raina *et.al,* 1991). About 40-75% of the world's agricultural land's productivity is reduced due to land degradation (IFPRI, 2000). Ethiopia is reported to have the highest rates of soil nutrient depletion in sub-Saharan Africa, with soil erosion estimated to average 42 tons per hectare per year on cultivated land (Stoorvogel and Smaling, 1990; and Pender,etal. 2001). This land degradation has many causes. Ethiopia has a long history of drought, which greatly contributed to land degradation. In addition to this, the combined effects of deforestation, overgrazing, expansion of cropland and unsustainable use of natural resources has contributed to land degradation (Descheemaeker, *et.al*, 2011).

These soil-depleting activities have been exacerbated by the historical and changing patterns of land ownership relating to ethnic groups (Berry, 2009).

Agriculture is the mainstay of the Ethiopian economy and underpins its development process. It is a sector with great potential for stimulating growth and employment and eradicating poverty. Because of its importance to national food security and poverty reduction, the government has, within the Growth and Transformation Plan (GTP), articulated a clear vision for the sector, placing it at the center aim to stimulate investment and productivity of the sector to promote household and national food security and to really development partners to deliver effective development aid to the sector. production and productivity by among others promoting domestic and foreign investment through agricultural commercialization, increasing public investment in agricultural infrastructure, promoting technology transfer and adoption, ensuring efficient use of land, labor, technology and other inputs, and specifically raising the productivity of smallholder farmers. But for long, Ethiopia had been losing its natural forests and woodlands for fuel wood, construction and expansion of agriculture etc. These led to land degradation manifested by increased soil acidity and alkalinity as well as losses of biodiversity (NAMA,2011). The agricultural sector in Ethiopia is increasingly being confronted with the pressure from a rapidly growing population and diminishing natural resources (Mulugeta, 2004).

Ethiopian agriculture faces the challenge of providing food for a growing population (Abate, 2010). One of the immediate problems facing Ethiopia today is land degradation, particularly loss of vegetation cover and soil erosion contribute significantly to low agricultural productivity. In Ethiopia the highlands are the center of economic activity of the country and are characterized by enormous ecological, environmental and agricultural diversity (Kahsay, 2004). Generally, land use changes can affect the socio-economic status of the rural population (Lambin *et al,* 2000). According to Muleta (2009), the most important human factors recognized as change agents of land use are the need to provide food for rapidly growing population this necessitates the expansion of agricultural land and the provision of land for the landless in order of self-sufficiency. Consequently, agricultural productivity that determines rural income levels and wealth can be affected by the land use change. According to Mesfin (1998) another challenges of soil fertility decline in Ethiopia are related to cultural practices like traditional cultivation, removal of vegetative cover (such as straw or stubble) or burning plant residues as practiced under the traditional system of crop production or the annual burning of vegetation on grazing lands. These are the major contributors to the loss of nutrients. The land use change brings tremendous impacts in the agricultural productivity. Therefore, this particular study focused on the land use change and its impacts in southwestern part of the country. Therefore, the objective of the study will investigate the analysis of land use land cover change, drives and its impact on agricultural productivity in *Esera Woreda* South West of Ethiopia.

Applying remote sensing for land use and land cover change

Remote sensing provides a viable source of data from which updated land cover information can be extracted efficiently and cheaply in order to inventory and monitor these changes effectively. Thus change detection has become a major application of remotely sensed data because of repetitive coverage at short intervals and consistent image quality (Mas, 1999). There is significant variation between various sensor instruments' capability and wealth of information captured and also the applicability depends on the objective of the intended study. There is also clear variation in the spatial and spectral properties of satellite images acquired by different versions of a particular sensor instrument. Landsat instruments can be taken as a good example of showing continuous improvement in radiometric and spectral property of images enabling better understanding of land resources (Hussein, 2009). Landsat satellites have provided repetitive global coverage of medium-resolution multispectral imagery and reliability have made them a popular source for documenting changes in land cover and use over time (Turner *et al*, 2003).

Multispectral Scanner (MSS) data from the U.S. Geological Survey's (USGS). There are numerous approaches to characterizing land cover change. Each one of it has a set of strengths and weaknesses and as a result no single approach is optimal for all types of landscapes and land cover features (EPA, 1999). There are two major approaches of classification of remotely sensed images for various applications. In a supervised classification, the software is “trained" to recognize that certain types of pixels represent specific land cover types. Knowledge of the area and information collected during field work are important inputs, which are used by the software to classify the pixels into similar groups based on sample signatures specified. In an unsupervised classification, or "clustering", the desired number of groups, or "clusters", will be inputs to the software (Globe toolkit, 2003). The software then groups the pixels according to similar spectral characteristics.

Image classification

Classification of a satellite image can be achieved by supervised or unsupervised procedures. A supervised approach relies on the prior specification of training areas, in which major land cover types are delimited manually as a key for electronically classifying the image. In contrast, no such visual interpretation is involved in an unsupervised method. It uses automated methods to cluster reflectance values in order to derive a required number of land classes and their associated spectral signatures (Tudor, *et al*. 1998). Land use land cover change detection by using remote sensing techniques can be broadly classified as either pre- or post-classification change methods. A pre-classification process refers to operations carried out to bring satellite images to the desirable geometric and spectral standard by correcting errors, and it is performed prior to image classification. Whereas, post-classification methods refers to activities done after classification of images like computation of class statistics, accuracy assessment, and map preparation.

Land use and land cover change detection

Land use land cover change detection is comparative analysis of independently produced classifications, and simultaneous analysis of multi temporal data. Following image classification as part of the change detection process, accuracy needs to be assessed to evaluate the degree of acceptability of the classification process. A standard accuracy assessment procedure for baseline land cover products involves the use of the error matrix and the standard procedure for one-point-in-time land cover products can be extremely difficult to apply to multi-temporal change analysis products (EPA, 1999). Accordingly, accuracy assessments are usually limited to the very recent image that serves as a reference using ground control points (GCPs) collected as part of the data required for the change detection.

MATERIALS AND METHODS

Study area

The study was conducted in Southern Nations, Nationalities and Peoples Regional State (SNNPRS) of Ethiopia in the *Esera woreda* of Dawro zone, southwestern Ethiopia .The capital of *Esera* is Bale. It is situated in the omo basin located 323 km and 670 km far from Hawassa and Addis Ababa which are capital cities of the Southern Peoples Region and Ethiopia, respectively. The *woreda* shares boundary with *Mareka woreda* in the east, *Tocha* woreda in north, *Konta* special *woreda* in the west, *Loma woreda* south east and Gamu gofa zone in the south. According to 2007 population and housing census population of the district had an estimated population of 82,218 of which 41,762 male and 40,456 female. The district has 29 *kebeles*. The area is topographically rugged. The Woreda covers total area of 106021.26 hectares and lies between 6º38′00″-7º6′00″ degree north latitude and 36º38′00″ to 37º13′00″ degree east longitudes, with an elevation ranging 501-2500m. Regarding the Agro-Ecology, 47% was tropical, 32% was Subtropical and 21% was temperate. The annual mean temperature ranges between 15.1 to 27.5^{o}c.

The rainfall was a bimodal type, the short rainy season was between (February to March) and the long between (May to September). The average annual rainfall ranges from 1201 to 1800mm. According to the land utilization data of the area, 38.4% is cultivated land, 13.39% grazing land, 16.81% forest bushes and shrub land, 17.09 % cultivable and 14.31 is covered by others. The livestock resource of the woreda was estimated to be 313,094 cattle, 113,554 sheep, 45,703 goats, 7,081 horses, 1,934 mules, 5,064 donkey, and 157,996 chicken and 28,557 traditional hives (CSA, 2006).

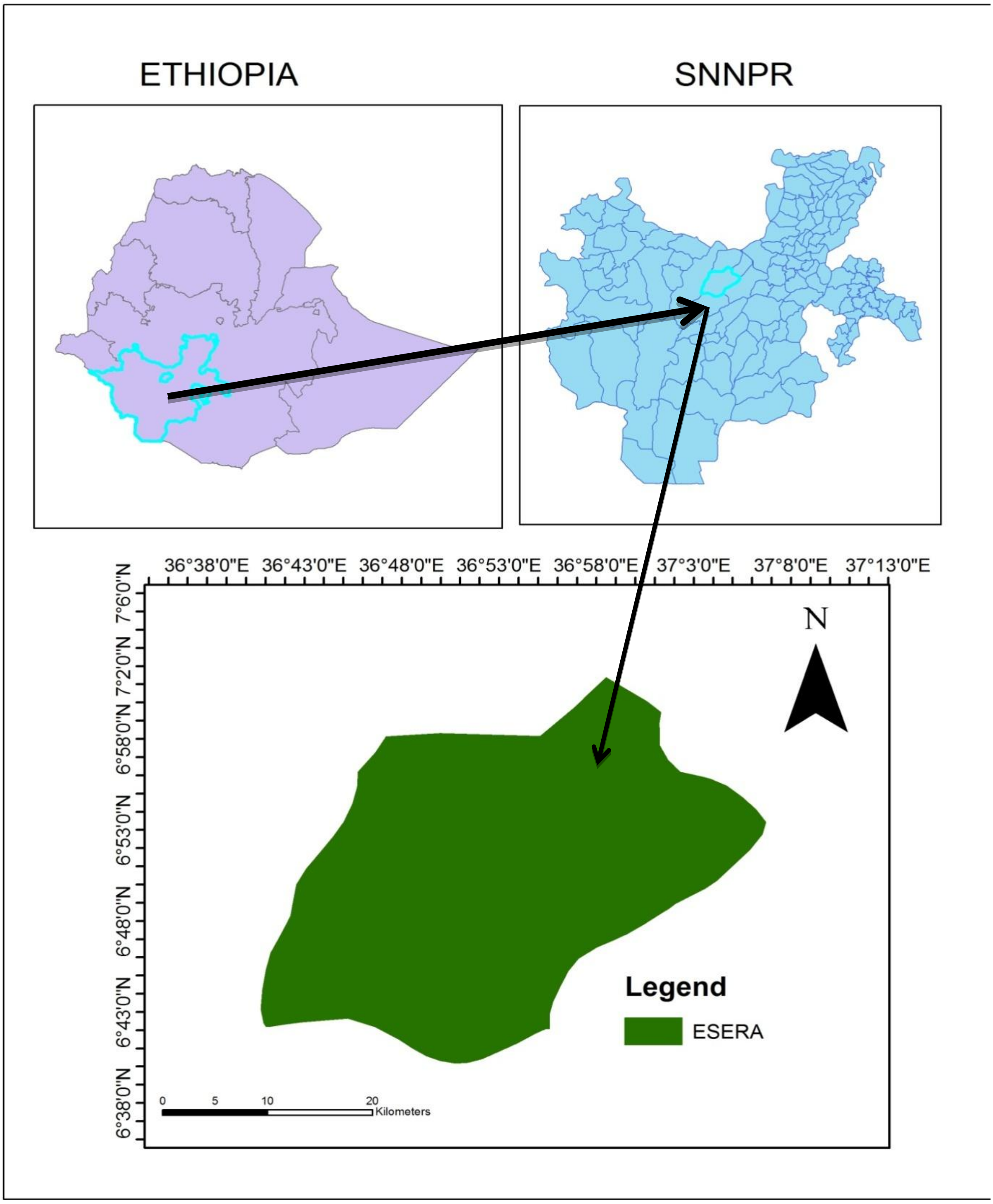


Figure 3. Map of the study area.

Types and sources of data

Spatial data

In order to address the objective of the study both quantitative and qualitative research method and primary and secondary data sources were employed. A satellite images were the main source of spatial data used for the study. Landsat TM 1986, ETM+ 2000 and landsat 8, 2014 with path and row 169 and 055 respectively and spatial resolution of 30mx30m were obtained from Global Land Cover Facilities (GLCF) and United States Geological Survey (USGS). The three satellite images were acquired in the same season. The satellite images were used to evaluate land cover and land use changes of the past twenty eight years. It is believed that the time gap of between the three satellite imagery is wide enough to show changes and trends in land use and land cover in the study area. Tools of data collection for spatial one were by using internet and Global Positioning System.

Table 3. Satellite images used for the study.

Satellite image	Year	Acquisition date	Path and raw	Source	Resolution
Landsat TM	1986	1986-01-28	169/055	GLCF	30mx30m
Landsat ETM+	2000	2000-01-27	169/055	GLCF	30mx30m
Landsat 8	2014	2014-02-28	169/055	USGS	30mx30m

Socio-economic data

Socio-economic data for the study was obtained from primary and secondary sources. The primary sources of data obtained through questionnaires, interview and observation. Secondary sources of data was collected from published and unpublished materials such as office records and reports, journals, books; data was also collected from Agriculture office and finance and economic development office of *Esera Woreda*, Ethiopia Meteorological Agency(EMA). Socio economic data was collected by using direct field observation, Digital Camera, Key Informant Interview, structured and open-ended questionnaire were prepared to gather information about the process and reasons of land use and land cover change its drivers and impacts on agricultural productivity in the past and present. Hence, a household survey was conducted to acquire data relating to the socio-economic, drivers of land use and land cover change and demographic conditions of households which were explained the changes observed in the land use and land cover.

Sampling technique

Two stage (multi-stage) sampling methods was employed to select sample from population. First, four *kebeles* were selected purposively out of 29 *kebeles* existing in *Esera woreda*: *Neda*, *Sengeti, Yinbira* and *Oki* and these *kebeles* were selected because of high destruction of forest cover in the area and most part of these *kebeles* occupied by resettlement program relatively with the other *kebeles* in the *woreda.* Next sample households were selected from each sample *kebele* by using systematic random sampling method from list of *kebele* households. The total number of registered households in selected *Kebeles* is 2016 (*Esera woreda* finance office, 2016). According to Yemane (1967), simplified formula was used to determine sample sizes. The formula assumes a 95% confidence level and the maximum variance (p = 0.5):

$$n = \frac{N}{1+N(e)^2}$$

Where

n -is the sample size

N -is the population size

e -specifies the desired level of precision, where e = 1− precision (0.05 limit of tolerable error) level of precision= 9% (0.091 = a theoretical or statistical constant.

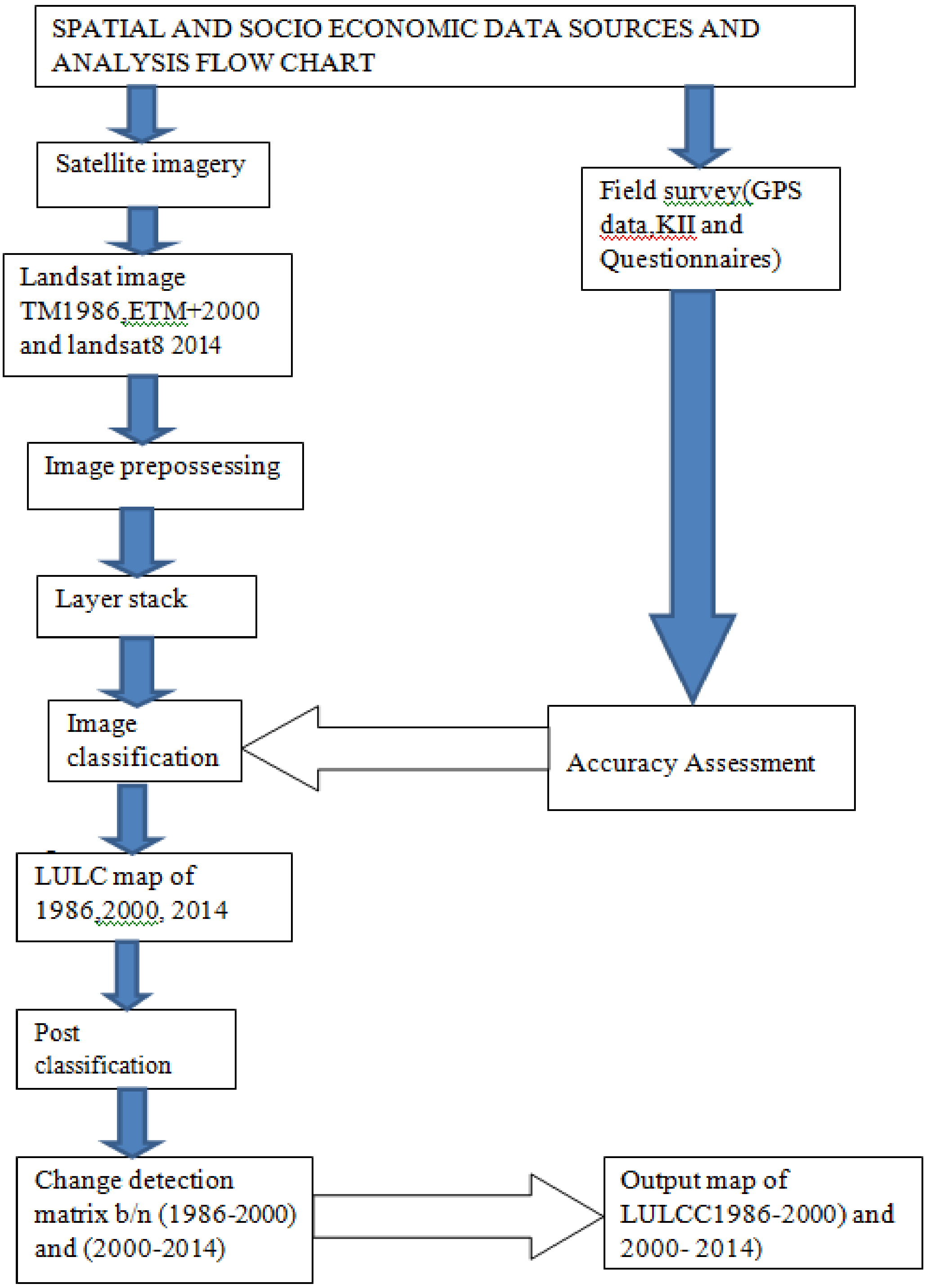


Figure 3. Spatial and socio-economic data source and analysis flow chart.

A agricultural productivity in the livelihoods of the study area. By applying the above formula, 116 sample household heads were selected from the four *kebeles*. Sample size was proportionately distributed based on household size of the respective *kebeles*.

The total households of *Neda kebele*, *Sengeti kebele, Yinbira kebele* and *Oki kebele* were 660, 500, 410 and 446 respectively and the sample size of *Neda kebele, Sengeti kebele, Yinbira kebele* and *Oki kebele* were 38, 29, 23 and 26 respectively. However, after the sample size determined, close and open-ended questions were administered to the total sample size of 116. Data collectors requested sample household heads and fill in the questionnaire under a close supervision of the researcher. Moreover, 12 key informants were purposely selected from the four *kebeles.* The selected key informants include 3elders from each sampled *kebele* including chairman of the respective *kebeles* and 3experts of *woreda* agricultural office. The questionnaires were initially prepared in English and translated to the local language (*Dawrogna*) for simplicity and precision purposes. Prior to the beginning of the actual survey and interview processes, a consent was presented of each respondent to request their willingness to participate in the final interview

Data analysis

Spatial data analysis was performed to get important information from the acquired landsat TM and ETM+ satellite image of the years 1986, 2000 and 2014. In order to generate images ENVI 4.7 software was used at different stages. The image pre-processing technique used in the study. Image classification and analysis procedures were used to digitally identify and classify pixels in the data. Classification implemented on multispectral data sets and the process assigns each pixel in an image to a particular class or theme based on spectral characteristics of the pixel reflectance values. Four land use and land cover classes were used in this study: agricultural land, forest cover, built up area and water body. Finally, supervised classification method and maximum likelihood technique was carried out using training areas and test data for accuracy assessment in order to compare the changes on the spatial trends of land use and land cover. The classified land use and land cover was cross-checked with ground truth using global positioning system. Land use and land cover classification accuracy was assessed in order to examine whether the classification result reflects the reality on the ground. The classified images were exported to ArcGIS 10.3 and land use and land cover maps of the year 1986, 2000 and 2014 were produced. Moreover, the classified land use and land cover maps were used to detect or analyze change that occurred over the past 28 years. This helped to detect and examine the extent and direction of the land use and land cover changes in the study area. Analyses of socio-economic data were done after checking completeness of quantitative data, descriptive measures like frequency and percent were generated. The qualitative data obtained through interviews conducted with key informant interview, and experts in *woreda* agricultural offices, together with the descriptive statistics of the qualitative household data, was used to identify the causes of land use and land cover change and to assess the impact of the changes on

Data Validity and Reliability of the study

The research instruments were addressed research objectives and research questions. Therefore, as a principle, in order to assure the validity of the research, the researcher tried to review quite adequate conceptual literatures related to the problem under investigation. This allows the researcher integrates major themes in data generating instruments so as to investigate the problem in all implementation way. In case of qualitative data collection researcher was friendly and good interpersonal relation with research subjects to extract reliable data.

Ethical Consideration

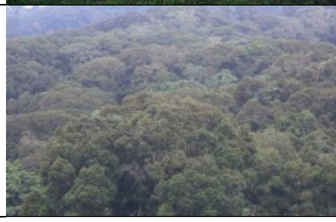
The main concern of research was incorporate human subjects in the study is ethical considerations for the research subjects. Researcher informed about the research process to the household respondents and key informants duties of data collectors to implement the fundamental principles of research ethics was also presented. The information obtained from the respondents was kept utmost confidential level. Beyond the ethics on human subjects, the researcher recognized the works of other has acknowledged all the sources cited in the body of the paper.

RESULTS AND DISCUSSION

Spatial data analysis of land use and land cover types in *Esera Woreda*

By using the application of image classification methods, four major land uses and land cover types were identified in *Esera* district. These include agricultural land, forest cover, built up area and water body, based on the characteristics of landsat satellite images of the year 1986, 2000, and 2014.

Table 4.1 Major land use land cover type in the study area.

LU/LC classes	Description of each land use class	Plates of each land use and land cover type
Agricultural land	Areas assigned to crop cultivation both annuals and perennials, mostly of cereals in subsistence farming and the scattered rural settlements included within the cultivated fields.	
Forest cover	Areas covered by trees forming closed or nearly closed canopies and cover more than 0.5 hectare and higher than 5 meter.	
Built up area	Areas that have been populated with residential, commercial, industrial, transportation facilities.	
Water body	Areas covered with water such as rivers and lakes	

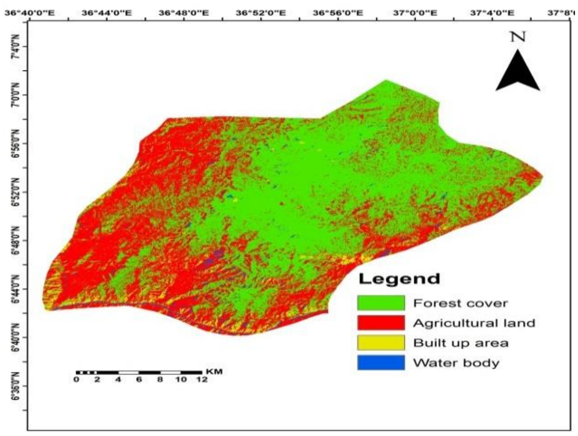
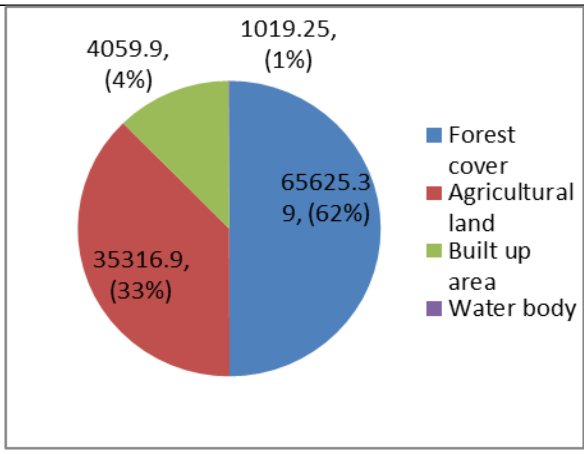
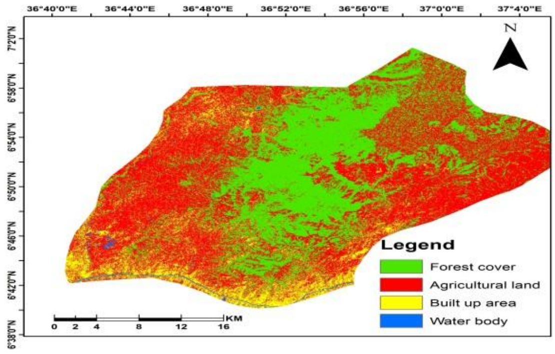


Figure 4.1a 1986





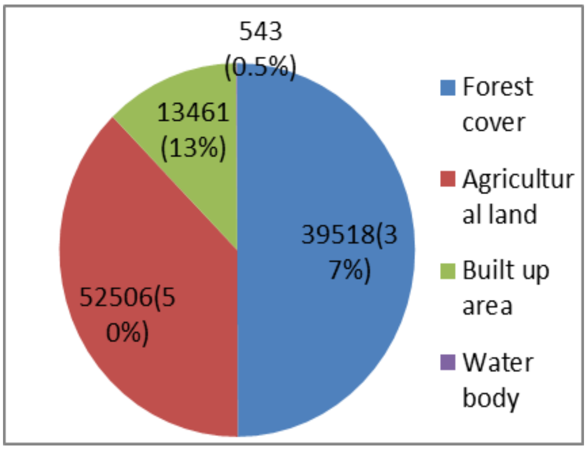
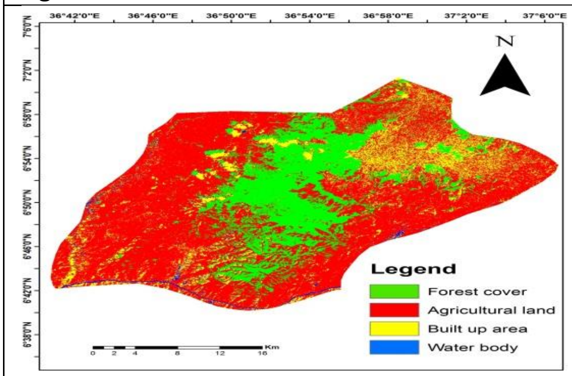


Figure4.1b 2000



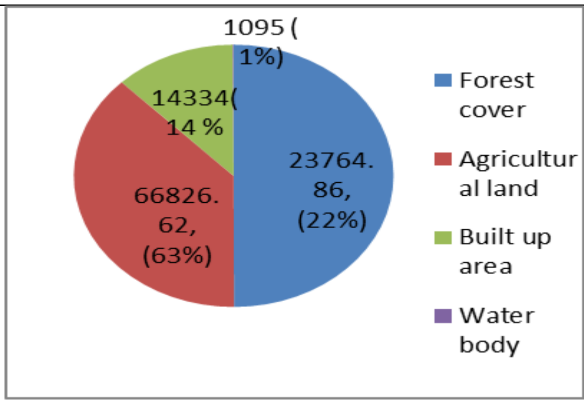


Figure4.1c 2014

Figure4.1: Spatial distribution of the different land use and land cover types (left) and spatial extent of classified land use and land cover types (right) for the year 1986, 2000 and 2014.

Land use and land cover classification

Land use and land cover classification for 1986 from TM satellite image in (Figure4.1a) showed that majority of the study area was under forest cover and agricultural land accounting for 65625.39ha (61.89%) and 35316.9 ha (33.3%) respectively. While, built up area and water body amounted to be about 4059.9 ha (3.83%), 1019.25ha (0.96%) respectively. The land use land cover classification for 2000 from ETM+ satellite image (in figure 4.1b) showed that forest cover and agricultural land accounting for 39518.82ha (37.27%) and 52506.45ha (49.52%) respectively. But forest cover is decreasing from 61.89 percent in 1986 to 37.27 percent in the year 2000 and agricultural land increased from 33.3% in 1986 to 49.52% in the year 2000, while built up area and water body amounted to about 13461.93 ha (12.69%), 534.06ha (0.503%), respectively. The land use and land cover classification for 2014 from Landsat8 satellite image on (figure 4.1c) showed that forest cover and agricultural land are dominant classes. Forest cover accounting for 23764.86ha (22.41%) and agricultural land accounts for 66826.62ha (63.03%) respectively, forest cover was still decreasing from 65625.39 hectares to 23764.86 hectares in this time and built up area and water body amounted to about 14334.12ha (13.52%), 1095.66ha (1.03%) respectively. According to above satellite image classification in figure 4.1a, more than half of land use and land cover classification covered by forest compare to other classes. In the year 2000, most portion of the land use land cover class was agricultural land.

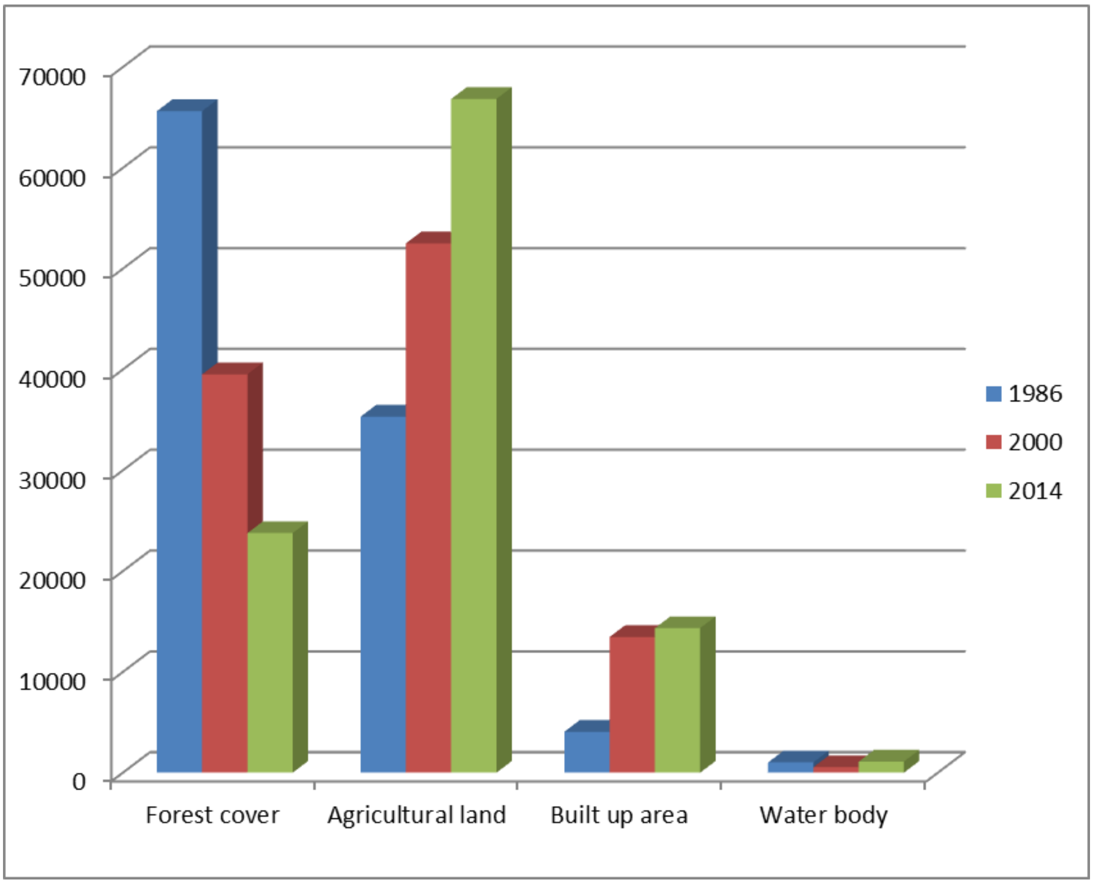


Figure 4. Land use land cover types in different years.

Table 4.2 Accuracy assessment report of landsat image of 1986.

Class name	Forest cover	Agricultural land	Built up area	Water body	Total	User accuracy	Producer accuracy
Forest cove	84.24	0.12	0.00	0.34	35.15	99.69	84.24
Agricultural land	15.5	95.36	2.56	0.85	35.65	80.91	95.36
Built up area	0.26	4.52	97.44	0.00	8.32	82.25	97.44
Water bod	0.00	0.00	0.00	98.81	20.89	100	98.81
Total	100	100	100	100	100		
Over all accuracy= 91.6097% Kaffa coefficient= 0.8794							

The increment of agricultural land and built up area was because of large number of population or resettles came from different zones of the region settled in the study *woreda*. In figure 4.1c water body also showed slight increment than previous period by applying soil water conservation methods. Most portion of the land use land cover class was agricultural land during this period. Generally, agricultural land and built up area also shows increment through 1986 to 2014 indicates population pressure in the district. But forest cover shows continuous decrease in the above time interval. The following graph also shows the spatial distribution of land use land cover types in the study

Accuracy Assessment

Classification accuracy could be affected by lack of high resolution of images used and lack of previous knowledge of the area, always error expected accordingly. To assess the classification accuracy, confusion matrix was used. Confusion matrix indicates the nature of the classification error. As it is shown (Table4.2) for 1986 the overall accuracy and kappa coefficient is 91.6% and 0.8794 respectively. This shows 91.6% of the land use and land cover classes are correctly classified. Based on assessment made, producer accuracy of forest was found to be 84.24% and user accuracy is found to be 99.69%.respectively.

In table 4.3. Accuracy assessment report of 2000 classification based on assessment made, producer accuracy of agricultural land is found to be 93.37% and user accuracy was found to be 91.61. Generally, overall classification accuracy is 93.578% and kaffa coefficient found to be 0.9071.This shows that land use land cover classes were almost correctly classified.

Table 4.3. Accuracy assessment report of landsat image of 2000.

Class name	Forest cover	Agricultural land	Built up area	Water body	Total	User accuracy	Producer accuracy
Forest cove	99.45	2.17	2.36	0	36.21	96.67	99.45
Agricultural land	0.55	93.37	16.81	2.74	38.58	91.61	93.37
Built up area	0.00	4.46	80.83	2.74	15.21	86.98	80.83
Water body	0.00	0.00	0	94.52	10	100.00	94.52
Total	100.00	100.00	100	0	100		
Over all accuracy= 93.5780% Kaffa coefficient= 0.9071							

In the same way, accuracy assessment of 2014 shows that user accuracy of agricultural land was 97.14 and producer accuracy was found to be 98.35. Over all accuracy of the classification was 99.00 and kaffa coefficient was 0.9829.

Table 4.4. Accuracy assessment report of land sat image of 2014.

Class name	Forest cover	Agricultural land	Built up area	Water body	Total	User accuracy	Producer accuracy
Forest cove	99.10	0.41	0.00	0.00	59.62	99.87	99.10
Agricultural land	0.90	98.35	0.00	0.00	18.85	97.14	98.35
Built up area	0.00	1.24	100.00	1.25	9.38	95.90	100.00
Water bod	0.00	0.00	0.00	98.75	12.15	100.00	98.75
Tota1	100.00	100.00	100.00	100.00	100.0		
Over all accuracy= 99.00% Kaffa coefficient= 0.9829							

To summarize accuracy assessment of all the three classified imageries of the district was conducted in the following ways. In table 4.5 for all the above maps, the producer's, user's and overall accuracy and the Kappa coefficient were computed in the year 1986, 2000 and 2014.

Table 4.5. Land use land cover classes and accuracy assessment of the classified images of the study area.

Class name	Accuracy (%)					
	1986		2000		2014	
	Producer's	User's	Producer's	User's	Producer's	User's
Forest cover	84.24	99.69	99.45	96.67	99.10	99.87
Agricultural land	95.36	80.91	93.37	91.61	98.35	97.14
Built up area	97.44	82.25	80.83	86.98	100.00	95.90
Water body	98.81	100	94.52	100.00	98.75	100.00
Overall accuracy	91.6097		93.5780		99.00	
Kappa coefficient	0.8794		0.9071		0.9829	

Table 4.6. Pattern of LULC classes, their corresponding areas and change for 1986 and 2000.

Land use land Cover type	1986 Area in hectares	1986 Land Cover in (%)	2000 Area in (ha)	2000 Land Cover in (%)	Changebetween1986 and 2000	
					Hectare	%
Forest cover	65625.3	61.89	39518.82	37.27	-26106.57	-24.62
Agricultural land	35316.9	33.3	52506.45	49.52	+17189.55	+16.21
Built up area	4059.9	3.83	13461.93	12.69	+9402.02	+8.87
Water body	1019.25	0.96	543.06	0.503	-476.19	-0.45
Total	106021.26	100	106021.26	100		

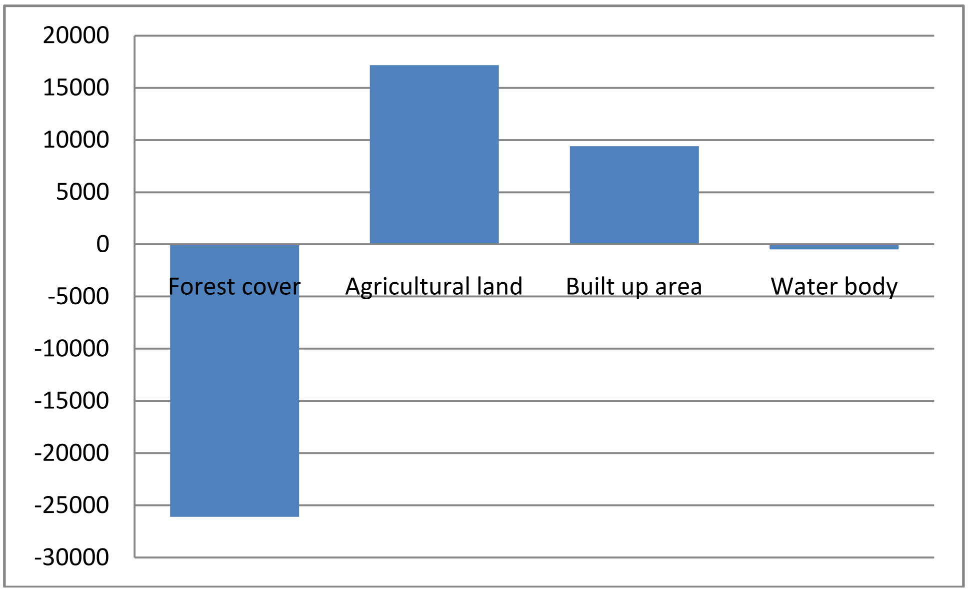


Figure 4. Land use land cover change difference from 1986 to 2000.

Pattern of land use and land cover change

Table 4.6 shows below the pattern of changes in land use land cover between 1986 and 2000. Land cover classified as agricultural land and built up area increased by 17189ha, and 9402ha respectively in last 14 years period. In contrast, forest cover showed a reverse trend, reducing by 26106ha during the same period of time. Water body showed a similar pattern of change and decreased by 476ha in this period. Land cover of forest and water body also showed a decline, which may have been due to encroachment by agricultural land in to forest. In general, the pattern showed a tendency towards more land being brought under agricultural land.

Table 4.7. shows below the pattern of changes in land use land cover between 2000 and 2014. Agricultural land, built up area and water body increased by 14320ha, 872ha and 552ha respectively. On the other hand, forest cover reducing by 15753ha during the same period of time. During this time interval except forest cover the remaining three classes showed increment and indicated in table 4. below.

Table 4.7. Pattern of Land covers classes, their corresponding areas and change for 2000 & 2014.

Land Cover Type	Area in 2000(ha)	(%) Land Cover in 2000	Area in 2014 (ha)	(%) Land Cover in 2014	Change between 2000 and 2014	
					Hectare	%
Forest cover	39518.82	37.27	23764.86	22.41	-15753.96	-14.86
Agricultural land	52506.45	49.52	66826.62	63.03	+14320.17	+13.51
Built up area	13461.93	12.69	14334.12	13.52	+872.19	+0.82
Water body	543.06	0.503	1095.66	1.03	+552.6	+0.52
Total	106021.26	100	106021.26	100	-	-

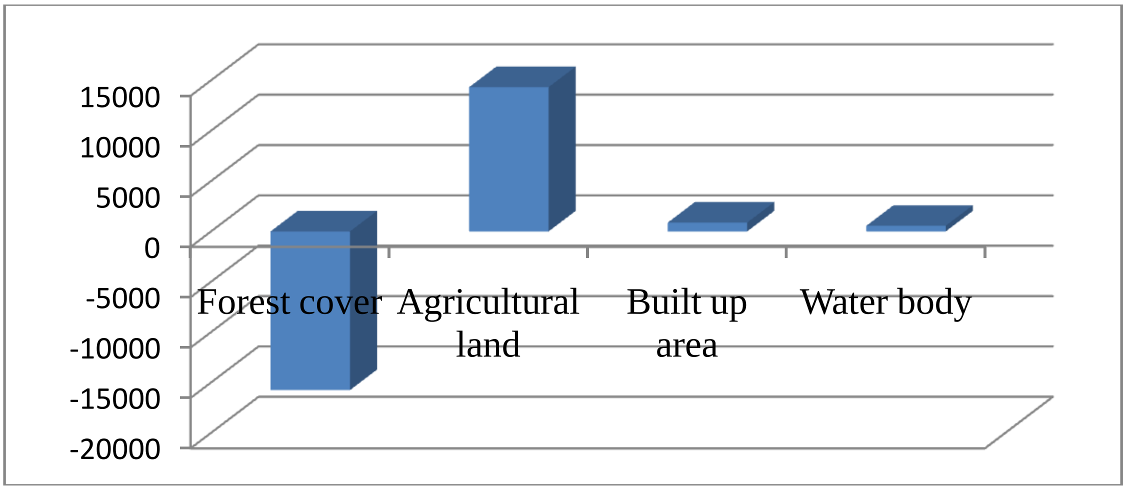


Figure 4. Land use and land cover change difference from 2000 to 2014.

Table 4.8 shows the pattern of changes in land use land cover between 1986 and 2014. Land used for agricultural land increased by 66826ha compared with the previous amount of cover and accounted for 35316ha of the total area and it showed dramatic change of increment accounted about 31571ha.

Built up area and water body showed similar patterns of change, with increases of 10274ha and 76ha respectively within 28-years period. In contrast, forest cover showed very high deforestation trend, reduced by 41860ha. Continues decline of forest cover mostly correlate with the expansion of agricultural land in the study area.

Table 4.8. Land covers classes, their corresponding areas and change for 1986 to 2014.

Land Cover Type	Area in 1986(ha)	(%) Land Cover in 1986	Area in 2014 (ha)	(%) Land Cover in 2014	Change between 1986 to 2014	
					Hectare	%
Forest cover	65625.39	61.89	23764.86	22.41	-41860.53	-39.48
Agricultural land	35316.9	33.3	66826.62	63.03	+31571.1	+29.79
Built up area	4059.9	3.83	14334.12	13.52	+10274.22	+9.7
Water body	1019.25	0.96	1095.66	1.03	+76.41	+0.07
Total	106021.26	100	106021.26	100		

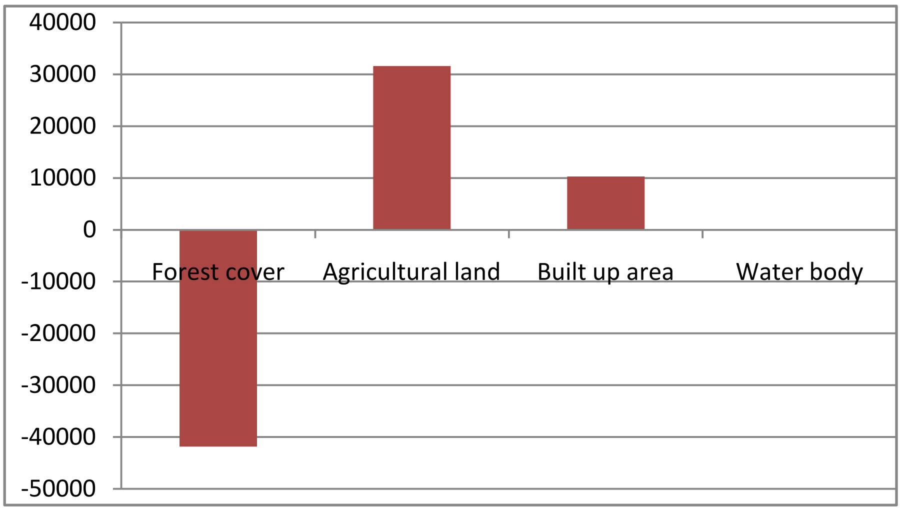


Figure 4. Land use and land cover change difference from 1986 to 2014.

Rate of land use and land cover changes in the study area

In table 4.9, between the year 1986 and 2000, agricultural land and built up area increased with 4.35 and 2.38 percent per a year respectively. The expansion of agricultural land was by clearing of forest cover it is explained in the land use land cover change pattern of table 6&7 for 1986 and 2000; 34072.05ha and 15437.24ha of forest cover had been changed to agricultural land. Between2000 to 2014 the rate of agricultural land also increased by 3.25 percent per year. This shows that there was rapid expansion of agricultural land within the specified time period because of population pressure lead to encroachment of agricultural field into natural forest. According to *Esera woreda* finance and economic development office in1986, the total population of the district was 50918, in 2000 and 2014 the total population of the district was 65751 and 85645 respectively. Forest land and water body had decreased from 1986 to 2000 with 0.47 and 0.12 percent per year rate of change and forest cover further decreased in 2014 with rate of 3.57 percent per year.

The change was induced by the transfer of forest land to agricultural land. The massive reduction of vegetation particularly in between 1986 to 2000 was because of resettlement program resettles came from different *woreda* with in zone and other zones from Southern Nation, Nationality and Peoples Regional Government. Similarly, water body was reduced in size between 1986 and 2000 with a rate of 0.12 percent per year. But it increased between 2000 and 2014 with a rate of 0.125 percent per year. This is because of between 1986 and 2000 there is no soil and water conservation practice applied. But between 2000 and 2014 by applying soil water conservation method practice in the *woreda*. Whereas built up area was continuously increased between 1986 and 2000 with a rate of 2.38 percent per year and then further increased in 2014 with a rate of 0.197 percent per year. The rate of expansion was very high between 1986 and 2000 because of the new emerging towns and additional population from the other zones.

Table 4.9. Land use land cover classes and rate of change between 1986 through 2014.

Land use land cover	Years			Rate of change					
	1986	2000	2014	1986to 2000 (ha/yr)	%	2000 to 2014 (h/yr)	%	1986 to 2014 (h/yr)	%
Forest cover	65625.3	39518. 82	23764.86	-1864.75	-0.47	-1125.28	-3.57	-1495.015	- 1.78
Agricultural land	35316.9	52545	66826.2	17189.55	4.35	1022.86	3.25	1125.35	1.34
Built up area	4059.9	13461. 93	14334.12	9402.03	2.38	62.29	0.197	366.93	0.44
Water body	1019.25	543.06	1095.66	-476.19	-0.12	39.47	0.125	2.72	0.00 3
Total	106021. 26	106021 .26	106021.2 6	28232.79	7.32	2249.9	7.14	2990.015	3.56

Table: 4.10. Change detection matrixes of 1986 to 2000.

2000(final year) in hectare and	1986 (initial year) in hectare						
	LU/LC type	Forest cover	Agricultural land	Built up area	Water body	Row Total	Class Total
		Area(ha)	Area(ha)	Area(ha)	Area(ha)		
	Forest cover	26477.06	3567	175.1	57.31	100	100
	Agricultural land	34072.05	25178.1	1967.83	151.74	100	100
	Built up area	5011.15	6342.6	1911.03	763.06	100	100
	Water body	64.31	228.85	5.64	47.14	100	100
	Class Total	65624.57	35316.55	100	100	0	0
	Class Changes	39147.51	10138.45	4059.6	-95.375	0	0
	Image Difference	-14610.2	17354.37	4413.35	-965.23		

Change Detection Matrix

To analyze the change from one land use and land cover type to the other, each land use land cover type from 1986 was compared with the corresponding land use and land cover type in the 2000 and 2000 with 2014.This procedure showing the initial value of each count of 1986 and the final value of each count of 2000 for the first period. Similarly for the second period the initial value is the 2000 count value and final value is the 2014 count value (Table 4.10 and 4.11).

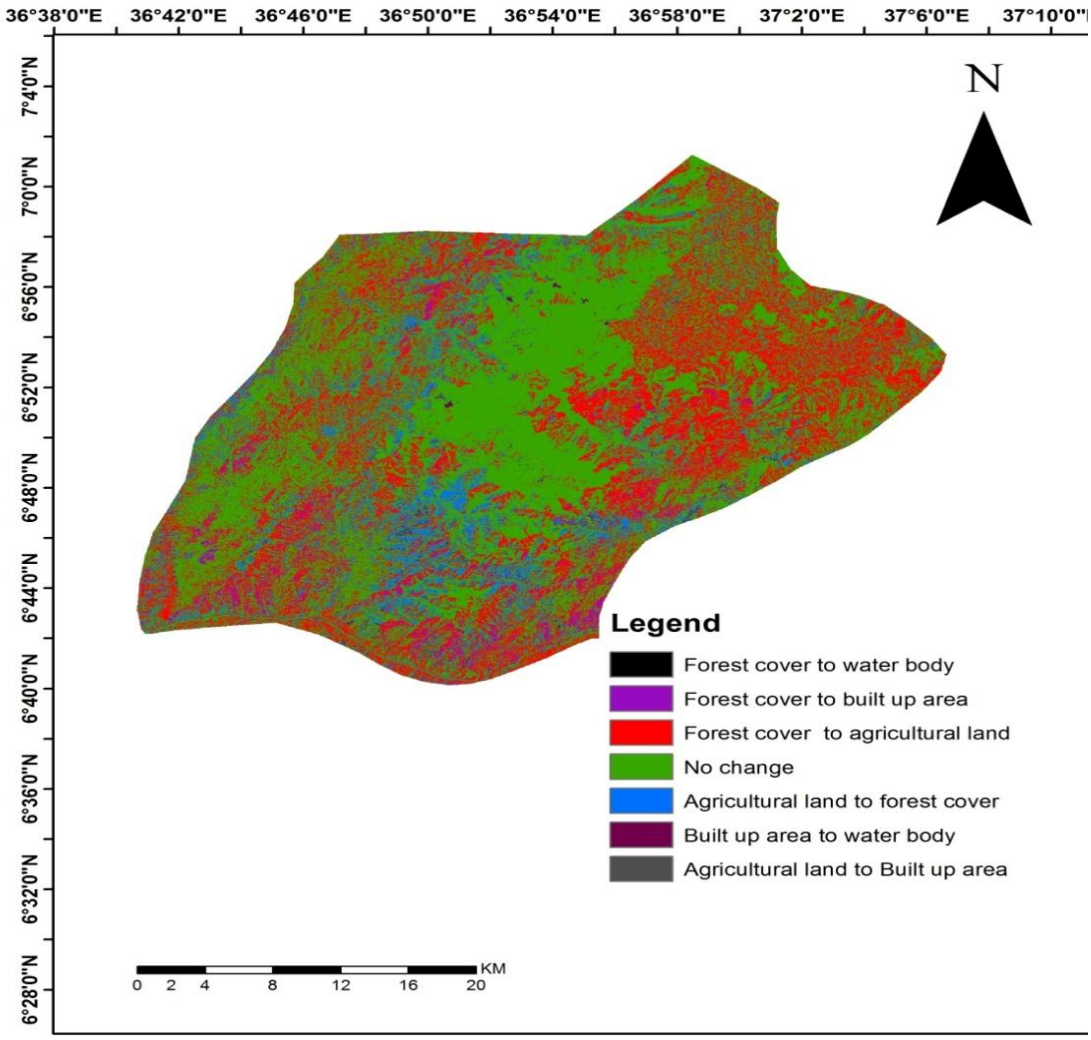


Figure 4. Map of land use land cover change between 1986 and 2000.

Also a change matrix with initial year data in the rows and the final year data in the columns was created for the two periods (1986 -2000) and (2000 -2014). According to table 4.10 above, the values on the diagonal are the areas that had not changed during the last fourteen years. Therefore, the image difference indicated forest cover and water body decreased by 14610 ha and 965ha respectively. Agricultural land and built up area showed an increase of 17354ha and 4413ha respectively. Forest cover in 1986, almost half of it 26477ha has not changed. About more than half 34072ha of the total transformation of forest cover had occurred agricultural land and about 5011ha and 64ha area was converted to build up area and water bodies from forest cover. The other changing land use and land cover type was agricultural land, it is clearly observed from the result that the extent at which agricultural land is being converted to build up area, forest cover and water body was about 6342ha, 3567ha and 228 ha respectively and 25178 ha remained unchanged during the first fourteen years. Regarding built up area, from the total area1967 have been transformed to agricultural land and 175ha was transformed to forest and 5.64ha transformed to water body. Of the total area of buildup area, 1911ha remained unchanged. Though the area coverage of water body relatively insignificant, it also showed transformation to different land cover types and the largest change was to built up area 763 ha , agricultural land 151ha and to forest cover 57ha. From the total area of water body 47 ha remained unchanged. In the above table water body transformed to forest cover is because of some wet lands transformed nearby forests, and the transformation of water body to agricultural land and built up area in the above specified period is because of most of wet lands occupied by resettlement program in the area.

Table 4.11. Change detection matrix of 2000 to 2014.

	2000(initial year) in hectares						
2014(final year) in hectares	Land use land cover Types	Forest cover	Agricultural land	built up area	Water body	Row Total	Class Total
		Area ha.	Area in ha.	Area in ha.	Area in ha.		
	Forest cover	11733.53	772.37	165.58	8.52	100	100
	Agricultural land	15437.24	30258.94	2746.5	16.08	100	100
	Built up area	11837.86	20792.9	10402.2	111.53	100	100
	Water body	510.19	682.05	148.35	406.92	100	100
	Class Total	39518.817	52506.27	13462.63	543.05	0	0
	Class Changes	27785.29	22247.33	3060.43	136.13	0	0
	Image Difference	-23648.07	-4588.01	2840.6	238.31		

The above table shows the transformation of land use land cover types between the year 2000 and 2014, the values on the diagonal were the areas that had not changed during the second fourteen years. Therefore, the image difference indicated forest cover and agricultural land decreased by 23648 and 4588 hectare respectively. Built up area and water body showed an increase of 2840ha and 238ha respectively. From the total forest cover in 2000, 11733have not changed. The total transformation of forest cover had occurred agricultural land, built up area and water bodies from forest cover accounts 15437ha, 11837ha and 510ha respectively. The other changing land use land cover type was agricultural land, it is clearly observed from the result that the extent at which agricultural land is being converted to build up area, forest cover and water body was also 20792ha, 772ha and 682ha respectively and 30258ha remained unchanged during the second fourteen years. Regarding built up area, from the total area of 2746ha have been transformed to agricultural land and 165ha was transformed to forest. From the total buildup area 10402ha remained unchanged. The last but not the least water body coverage relatively significant than the first fourteen years. It also showed transformation to different land cover types and the largest transformation was to build up area, agricultural land and forest cover accounts 111, 16 and 8 hectares respectively. From the total area of water body 406ha remained unchanged.

Results from socio-economic survey

General characteristics of households

A socio-economic survey was conducted and it involved interview of selected households and key informant to generate information on household level change in land use and land cover change, drivers and its implication on agricultural productivity and to get insight into various economic, social, and environmental factors that influence decision on land use and land cover at household and district level. A total of 116 household heads and 12 key informants were interviewed and response was obtained from all households from whom data were collected making a response rate of 100%. The general characteristics of study subjects were summarized as, majority of respondents (66.4%) households age group fall within age above 40 years. Concerning sex of respondents, 94% of the households were male-headed and remaining 6% were female-headed. Regarding family size of respondents only 13.8% the family size less than four members per household and the remains 86.2% of sampled household size was greater than four members per household. This indicates population pressure in the district. The *Dawuro* ethnic group covers the large proportion of study subjects 81(69.8%) followed by *Kambata* ,*Wolayta* and *Hadiya* ethnicities accounting for 16(13.8%) and 13(11.2%) and 6(5.2%) respectively.

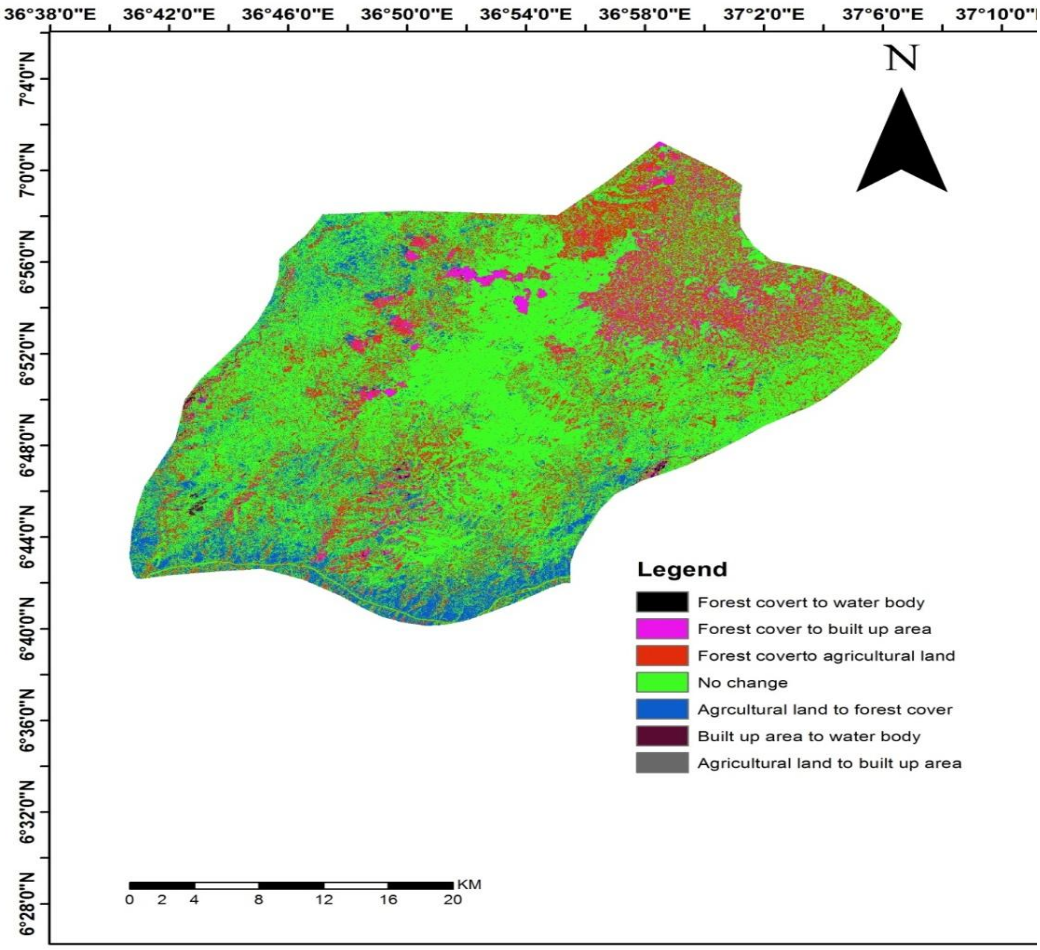


Figure 4. Map of land use land cover change between 2000 and 2014.

Majority of the households 110 (94.8%) were farmers and the remaining 5.2% were merchants. Most of the respondents married household heads and constituted 99(85.3%) followed by single 7(6%) respectively. Widowed and divorced sampled household heads constituted less than 10% of the study subjects. The assessment of educational status of sampled household heads involved in the survey showed that majority were illiterates, that means 45(38.8%), 40(34.5%) were primary education and the remaining's were secondary education. Regarding total land owned by sampled household heads,1-2 hectares were 85(73.28%) followed 2-3 hectares 32(10.34%) and 11(9.5%) of the respondent their land size was less than one hectare. Concerning means of land acquisition majority of the respondents about 53(45.7%) owned by first distribution, 39(33.6%) by resettlement and 22(19%) by gift. The resettles are not only from *Dawro Zone* but also they came from *Wolayta Zone, Hadiya Zone,Kambata and Tambaro Zones*.(Table 1presents general characteristics of the households).

Table 4.12. General characteristics of the households.

Characteristics		Frequency	Percentage
Age in years of respondents	20-30	1	0.9
	31-40	38	32.8
	>40	77	66.4
Family Size of respondents	Less than 4	16	13.8
	Greater than 4	100	86.2
Occupation of respondents	Farmer	1010	94.8
	Merchant	6	5.2
	Government employee	-	-
Total land owned	<1ha	11	9.5
	1-2ha	85	73.28
	2-3ha	12	10.34
	>4ha	4	3.4
Means of land acquisition	First distribution	53	45.7
	Resettlement	39	33.6
	Gift	22	19
	Share Cropping	2	1.7
Educational Status	Illiterate	45	38.8
	Primary education	40	34.5
	Secondary education	31	26.7
Ethnic Group	Dawro	88	69.8
	Hadya	6	5.2
	Wolayta	13	11.2
	Kambata	16	13.8

Source: Field survey, 2016

Next to general characteristics of the study subjects, years of experience living in the district households more than 66.4% of respondents lived for more than 40 years and above in the study area. But only 0.9% was lived for less than 20 years and 32.8% of respondents lived in the area 31 to 40 years. Majority about 98.3% responded that land use land cover change is a problem in their locality. From respondents 37.9% the main case of land cover land use change was over cultivation,19.8% resettlement,17.2% illegal cutting of tree,13.8% need of crop land and 11.2% over grazing was the case of land cover change. This is emanated from different reasons.

Among them mostly 69.8% said due to vegetation decline followed by 31.2% it is due to soil fertility decline. According to remote sensing data in table 7 and 8 confirms this idea. The forest coverage of *Esera woreda* in 1986 accounts 65625.39 hectares and 61.89% of the total area covered by forest. In the year 2000 forest coverage of the district surprisingly reduced to 39518 hectares which means 37.27% forest coverage in the area and finally, in the year 2014 the total coverage of forest also decreased to 23764.89 hectares which is in percentage 22.41% of the total area of the *Woreda*. This indicates that the main cause of land use land cover change in the study area was forest deforestation for socio-economic purposes.

Generally, remote sensing data and socio-economic data of the study area were shows land use land cover change is a challenging problem in the district and the main cases for the changes were over cultivation, resettlement, illegal cutting of forest for different purposes and over grazing were driving factors for land use and land cover change in the study area .

Driving forces of land use and land cover change in the study area

Driving forces are the direct agents that promote change resulting in a given state of land use and land cover. Causes are the direct pressures exerted on land resources. The driving forces in the study area include population pressure, demand for agricultural land, over cultivation, resettlement, increased demands for forest products such fire wood and charcoal, less soil and water conservation practices, overgrazing, deforestation, declining crop productivity and agricultural encroachment in to marginal areas. According to Central Statistical Authority the total population of the study Woreda was 65751in 1994 Central Statistical Authority (CSA, 1994) and it increased up to 82,218 in 2007 (CSA, 2007) and the data obtained from *Esera woreda* finance and economic development office, the total population of the *woreda* in the year 2015/16 is about 85645. Fast population growth and the consequent high pressure on resources are expected to have an adverse effect on the existing natural resources of the area. Such rapid population growth in the area has already exerted pressure on the existing land resources through increasing the demand for food, wood for fuel and construction purposes, and other necessities. The expansion of agricultural lands toward forest and marginal lands, including continuous and over cultivation, has resulted in deforestation and soil degradation. Similarly, increased demands for fuel wood in the absence of alternative sources of energy have led to the destruction of forests. According to socio-economic survey and key informant interview responses the major driving forces for land use land cover change in the *woreda* were over cultivation, illegal cutting of tree, resettlement ,need of crop land and over grazing accounts 37.9% , 17.2%, 19.8%, 13.8% and 11..2% respectively. Fuel wood have been the most important energy sources in rural Ethiopia in general and in the *Esera Woreda* in particular; 99(85.3%) of the respondents confirmed that fuel wood was most important, while 16(13.8%) confirmed that charcoal was most important for cooking and heating. A few respondents (0,9%) told that they used crop residues as energy sources..

Impact of land use and land cover change on agricultural productivity

Crop productivity

Land use and land cover changes degrade the land's capacity for sustained use and regaining its natural cover. Specifically, changes in land use and land cover have a significant influence on soil resources and biodiversity. Its cumulative change has impact on reducing agricultural productivity. The major crop types grown in the study area were maize, teff and beans. According to *Esera woreda* agricultural office and sampled households maize is the dominant crop in the *woreda* and more than 60.3% of respondent produce maize and 22.4% of respondents produce teff. Concerning crop productivity in the study area before 30 years, sampled households obtained from one hectare greater than 25quintals accounts 81% of respondents, 12.1% of respondents got 15-25quintals and 6.9% of respondents got 11-15 quintals per hectare.

Table: 4.13. Response of household heads on crop productivity.

Characteristics		Frequency			Percent	
Main crops grown in the area	Maize	70			60.3	
	Teff	26			22.4	
	Wheat	3			2.6	
	Beans	17			14.7	
	Total	116			100.0	
Crop productivity per hectare in quintals	Before 30years		Before15 years		Current time	
	Freq.	%	Freq.	%	Freq.	%
<5 quintals	-	0	3	2.6	21	18.1
6-10 quintals	-	0	28	24.1	52	44.83
11-15 quintals	8	6.9	31	26.7	27	23.3
15-25 quintals	14	12.1	40	34.5	16	13.8
>25 quintals	94	81.03	14	12.1	-	-
Total	116	100	116	100	116	100
Causes of crop yield reduction						
Soil degradation	78			67.3		
Lack of enough crop land	10			8.6		
Climate change	28			24.1		
Total	116			100		

Source: Field survey, 2016

Before 15 years ago, sampled households obtained from one hectare 15-25quintals accounts 34.5% of respondents followed by 11-15 quintals 26.7% of respondents, 6-10 quintals per hectare and below 5 quintals and above 25 quintal is only 2.6% and 12% respectively. However, currently there is reduction in crop production as they replied. Majority or 44.83% of respondent got 6-10 quintals per hectare, 23.3%, of respondents got 11-15 quintals from one hectare, 15-25quintals were 13.8% and below five quintals per hectare accounts more than 18%of respondents. From the discussion, it is possible to understand the decline of agricultural productivity per individual household head though the results of remote sensing data on land use change showed an increasing trend of agricultural land in the study woreda. The total agricultural land was increased in the past 28 years, but the agricultural productivity per hectare decreased.

The major causes for crop yield reduction per hectare in the study area were soil degradation, climate change and small farmland size per household as replied by 67.3%, 24.1% and 8.6% of the respondents respectively (Table 4.13). From this it is possible to realize that the degradation of agricultural land is highly accountable for the reduction of crop yield in the study area.

They also reported high variability of rainy season recently as compared to before two decades ago. In addition, the data obtained from Ethiopia Meteorological Agency indicates that the mean annual temperature of the study area was increased from 20.4625°c in the year 2006 to 22.24 °c in the year 2014. In the same way, mean annual rain fall of the district decreased from 149.6mm to 131.71mm in the above years. Thus, these climate changes also contribute to less agricultural productivity since the farming system of the study area is highly dependent on rainfall.
Moreover, key informants and survey respondents reported that after the year 2000, agricultural practice changed from shifting cultivation to sedentary agriculture because of the introduction of resettlement program in the area that reduced the possibility of shifting cultivation. This led to over cultivation of the land which has resulted in declining of soil fertility and a drop in agricultural productivity. From all these, it is possible to confirm that the decline of agricultural productivity is due to change in land use and land cover. Regarding the productivity of major crops in the study area, Table 4.13 indicated below the responses of participant household heads.

Source: Field survey, 2016

In socio-economic data collection Key Informant Interview in (left) and household survey (right)

Livestock productivity
Esera Woreda, as in most other parts of the country, livestock is an important part of the agricultural system in the area. The majority of respondents owned cow, accounted for 68.9%, oxen 16.4%, sheep and goats for 16.4%. Concerning the trend of the livestock in terms of their number and productivity over the past 28 years or from 1986 to 2014, as many as 94% of the respondents reported that livestock numbers and productivity had decreased in the area, while only 6% of the sample households reported an increase in numbers. The total number and productivity of livestock of the sampled households was decreasing from past to present. The main reason for reduction of livestock number and productivity, about 76 (65.5%) of respondents indicated that the main reason for the decrease in productivity and numbers of livestock per households had been shortage of grazing land and the remaining rate is due to lack of fodder.

With regard to the respondents the main factor behind the shortage of livestock feed was expansion of agricultural land towards grazing land and forest. According to interview with respondents the source of livestock feed were 45(38.8%) forest, 44(37.9%) grazing land and the remaining the crop residue accounts 27(23.3%). The land use change data shows that, highly declining of forest land that affects the availability of feed resources for the livestock. According to the socio-economic survey data obtained from key informant interview and sampled house hold heads response, the trends of livestock number and productivity shows declining to the same as crop production from past to present. The reasons for the declining of livestock number and productivity are many. Among this the major reasons are most of the respondents recognized that grazing area had declined, due to conversion to agricultural land, decrease productivity of grazing land, conversion of forest area to cultivated land, expansion of settlements. Based on the study, 100% of interviewed households depend on agriculture (both crop production and livestock production). However, results of socio-economic survey showed that soil fertility crop yield decline and the reduction in livestock productivity were mainly due to removal of vegetation cover and increasing demand of agricultural land and forest products induced by population pressure in the study area.

Table 4.14 Response of household heads on livestock productivity.

Characteristics		No. of respondent	%
Types and number of livestock you own	Cow	81	69.8
	Ox	19	16.4
	Goat	6	5.2
	Sheep	10	8.6
	Total	116	100.0
Trends of the livestock in terms of their number and productivity over the past 30 years to present	Increase	7	6
	Decrease	109	94
	Total	116	100
Reasons for the above trend	Lack of fodder	40	34.5
	Shortage of grazing land	76	65.5
	Total	116	100
Major source of fodder for animals	Crop residues	27	23.3
	Forest	45	38.8
	Grazing land	44	37.9
	Total	116	100.0

Source: Field survey, 2016

CONCLUSION AND RECOMMENDATIONS

Conclusion

Land use land cover change analysis of the study has applied that the newly emerging Geo-spatial technology or Remote Sensing and Geographic Information System to provide powerful information to analyze land use and land cover changes in the study area. The study used an integrated approach to understand past and the present conditions of the study area by using satellite images provided necessary data for study area. Using these advanced technologies, changes in land use and land cover were calculated for the *Esera woreda* between 1986 to 2014. In this regard, four land use and land cover classes were determined and include forest cover, agricultural land, built up area and water body. Based on the findings, analysis of land use and land cover classification for the study periods shown that there is rapid increase in agricultural land and built up area, while there is a decreasing trend in forest cover.

Generally, the results also show that the extent of agricultural land and built up area has increased the whole periods at the expense of deforestation or forest cover change. The general trend observed was a decrease in forest cover at a rate of 1495 hectares per year. A corresponding increase was observed in agricultural land of 1125.35 hectares per yea, built up areas with 366.93hectares per year, and water body with 2.72 hectares per year. The decrease in forest cover particularly reflects the considerable expansion of agricultural land, resettlement and illegal cutting of trees in the area. In the study area, the vegetation cover was converted to cultivated land and built up area. As a result, land degradation occurs and productivity is decreasing; consequently, the current crop yield per unit area is gradually declined. Similarly, the number of livestock productivity per household also declined due to the low availability of livestock feed. Land use and land cover changes also related with the livelihoods of the local population, i.e. socio-economic conditions and access to agricultural land and population growth. The area is one of densely populated areas of the country more than 86.2% of sampled house hold heads replied that their family size greater than four members per household and land use and land cover change may affect natural resources and reduce agricultural productivity on which the livelihood of the local community mainly relied on.

Recommendations

From the result obtained from satellite image and actual field observations made during the study, the following recommendations are forwarded:

- This study showed the trend of shifting forest cover to agricultural land is increasing in the last 28 years in the study area. Rapid destruction of forest cover which might be due to lack of careful management practice on farming system and clearing of vegetation. Therefore, it needs participatory forest management and the local people must be involved in reforestation and all development activities and forest conservation in order to ensure sustainability of forest management
- Population pressure is increasing from time to time in the Southern Nation Nationalities and People's Regional Government. This leads to resettlement program in the study area from different zones of the region .The inhabitants and related socio-economic activities are the major cause for forest cover (vegetation) change on the study area. As a result of these activities, the forest cover and biodiversity of the area was highly affected. Therefore, intensive study should be done to identify the potential area that would not close to forest areas before resettlement program execution.
- In the face of the growing household size, land shortage and growing number of landless youths, rather than agricultural activities, other fields of job like manufacturing and service provision and related activities should be created at the local level. For this purpose, the *woreda* government should play an important role through facilitating infrastructure to attract private sectors to invest on manufacturing and service sectors for tourists to explore the advantage of chebera churchura national park which is located in this *woreda* which is rich in natural biodiversity.
- In order to improve agricultural productivity the small landholding size of the area necessitated the intensification of agriculture through specialization and diversification with the use of special seeds, chemical and natural fertilizers are very important with continuous supporting of Development Agent (DA) at the *kebele* level in order to improve agricultural productivity.
- Agriculture and rural development office of *Esera woreda* and other governmental and non-governmental organizations should take their own share of responsibilities in solving the challenges related to crop productivity, livestock productivity and natural resources management especially forest and land management in the study area.

- This research can help as an initial point. However, further research in the area is highly recommendable in order to demonstrate radical conversion of one land cover type to the other and to take conservation and rehabilitation action. Furthermore, application of remote sensing and geographic information system was found helpful in assessing land use land cover change in this study. It is hoped that future land use and land cover development activities will exploit these resources more than the present study for better assessment of land resources in the study area.

Therefore, the current trends in land use and land cover must be improved towards the resources management and conserving of the existing natural resources in the study area through community participation and using sustainable land resources management plan so that agricultural productivity can be improved.

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