IMPACT OF RESETTLEMENT SCHEMES ON LAND USE LAND COVER, WOODY SPECIES DIVERSITY AND SELECTED SOIL PROPERTIES UNDER DIFFERENT LAND USE: THE CASE OF BORECHA DISTRICT, SOUTH WEST ETHIOPIA

MSc. THESIS

TEMESGEN TESHOME DINSA

November, 2019

JIMMA, ETHIOPIA

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Temesgen Teshome Dinsa

MSc. Thesis

Submitted to the School of Graduated Studies of Jimma University College of Agriculture and Veterinary Medicine Department of Natural Resources Management in Partial Fulfillment of the Requirements for the Degree of Masters of science in Natural Resource Management by Specialization Forest and Nature Management

Major Advisor: Zerihun Kebebew (Ass. Prof, PhD Candidate)

Co –Advisor: Gudina Legese (PhD)

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I have completed my thesis research works as per the approved proposal and it has been evaluated and accepted by my advisors. Hence I hereby kindly request the department to allow me to present the findings of my work and submit the thesis.

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We, the thesis advisor has evaluated the contents of the thesis and found it to be satisfactory, executed according to the approved proposal, written according to the standards and formats of the University and is ready to be submitted. Hence, we recommended the thesis to be submitted for external defense.

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Decision/suggestion of Department Graduate Council (DGC)

____

Chairperson, DGC ____________________ _______________

Signature Date

Chairperson, CGS ______________________ ________________

Signature Date

DEDICATION

This thesis is especially dedicated to my father, Teshome Dinsa and to all my family members, for their love and devoted partnership in the success of my life.

STATEMENT OF THE AUTHOR

First, I declare that this thesis work is my bonafide work and all the sources of materials used for this thesis have been properly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for MSc. degree at the Jimma University and deposited at the University library to be made available to borrower sunder rules of the library. Brief quotations from this thesis are allowed without special permission provided that accurate acknowledgement of the source is being made. Requests for permission for extended the quotation or reproduction of this manuscript in whole or in part may be granted by the head of the department of Natural Resource Management or the Dean of the post School of Graduate Studies when in his or her judgment the proposed use of the material is in the interest of scholarship. In all other instances, however, permissions must be obtained from the author.

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Date of submission: 02/10/2019

BIOGRAPHICAL SKETCH

The author was born on January 25, 1987 in Oromia regional state, Buno Bedele zone, Bedele town, some 480 kilometer west of Addis Ababa. The author was born from his father Teshome Dinsa and his mother Tujube Diga. He attended his Elementary education (1-8): From (1994-2002G.C), at Dabo Hana Elementary School and High school (9-10): From (2002-2004G.C), Bedele Senior Secondary School. Then he joined Gambella ATVET College in 2005 and graduated 2007 with diploma in Natural Resource Management. The author was employed and worked at Mako Woreda Agricultural and Natural Resource Office, for 3 years as expert of forest development and he again joined Jimma University in 2012 and graduated with B.Sc. degree in Natural Resource Management in July 2014. After his graduation, he was served from since to 2014 to 2017 at different position in Meko District. He has been working in Buno Bedele Zonal Agricultural and Natural Resource Office and Hunde Oromo Grass root development Initiative on the position of Natural Resource management Advisor, until he got the chance to rejoin Jimma University in October 2018 to pursue his MSc. study in Natural Resource Management by specialization of Forest and nature management.

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LIST OF ABBREVIATION AND ACRONYMS

ANOVA	Analysis of Variance
BANO	Borecha Agriculture and Natural Resource Office
BD	Bulk Density
BLAO	Borecha Land Administration Office
CSA	Central Statistical Agency
ERDAS	Earth Resource Data Analysis System
ETM+	Enhanced Thematic Mapper Plus
FDRE	Federal Democratic Republic of Ethiopia.
FGD	Focus Group Discussion
FAO	Food and Agriculture Organization of United Nations
GCP	Ground Control Point
GIS	Geographic Information System
GPS	Global Positioning System
Ha	Hectare
IPCC	Intergovernmental Panel for Climate Change
IVI	Importance Value Index
KI	Key Informant Interview
LULCC	Land Use Land Cover Change
LULC	Land Use Land Cover
Mg	Mega gram
MLC	Maximum Likelihood Classification
MSS	Multi Spectral Sensor
OLI	Operational Land Images
SOC	Soil Organic Carbon
SAS	Statistical Analysis Software
SPSS	Statistical Package for Social Science
TM	Thematic Mapper

ABSTRACT

*Ethiopian government sponsored resettlement programs that were carried out during 1984/85. Ressettlement is caused to damage the environment by clearing large areas of forest. To build homesteads, to acquire farmland, and to construct access roads. Lack of current knowledge of the extent and magnitude of land use and land cover change due to resettlement to promote sustainable land management encouraged the production of this research. Therefore the, aim of this study is to assess the impact of resettlement schemes on land use land cover, woody species diversity and soil carbon under different land use in Borecha district, south west Ethiopia. A satellite image from land sat of 1986 TM, 2002 ETM+ and OLI, 2018 was used to generate land cover map. To generate information focus group discussion, key informant interview were used. For land USE land cover analyses ERDAS imagine software 2015 version was used. The SPSS version 20 was used for Shannon diversity index data analysis. Transact lines of 200m apart were used along which 20m*20m plots at 100m interval were taken to identify tree species composition and diversity. Soil laboratory analysis and statical analysis used for selected soil properties under different land use. The results of the study were shows that between 1986 to 2018 forest in the study area decreased from, 2936ha (16.3%) to 1557 ha (8.61%) with rate change of -43. 8ha /year. From 1986 to 2018 the forest was lost by net change of -1379ha (-11.9%) for indicated period in study area.The Cultivated increased from 6584ha (36.4%) to 12, 227ha (67.64%).Cultivated land increased by net change of 5,640ha with annual expansion rate of 47.7% in the study area. The result shows that Shannon diversity index woody vegetation for forest 3.38 and evenness 0.53, agroforestery 2.69 evenness 0.42, cultivated land 1.93 evenness 0.33 and grazing land 2.12 and evenness 0.39 respectively. The highest result of soil organic carbon was found in forest and while, the highest soil bulk density values was observed in crop land. Conservation management was need for some species such as Cordia africana, Prunus africana and Ekebegia capensis which endangered because they have been extracted for timber and other purposes by the resettlers. The future prospect of this study should be Government and NGOs important to minimize forest burdens by expansion of electricity, biogas and encourage the modern stove for resident community for energy sources.*

Key Words:-Land Use, Land Cover, Woody Species Diversity, Resettlement, Selected soil properties.

1. INTRODUCTION

1.1. Background

Land use land cover change has currently been a hot research topic for a variety of applications on world (Lambin *et al*., 2011). Land use land cover change has been regarded as an important factor influencing climate change and environmental conditions (Dengsheng *et al*., 2014), and has close relationship to human population resettlement and economic conditions (Dengsheng *et al*., 2014). Land use land cover change refers to human modification of the terrestrial surface of the earth (WRI, 2001). The negative impact of LULCC associated to ressetlement globally on biodiversity, climate, water, soil, and air, in particularly on ecosystem services in general, has been recognized as one of the greatest environmental concerns for human populations today (GEF, 2012). Globally, agriculture and ressettlement associated land use land cover changes have been the principal drivers of deforestation and were responsible for 24% of global greenhouse gas (GHG) emissions in 2010(FAO, 2015). From 1970 to 2011, CO_2 emissions increased by about 90%, from agriculture sector deforestation and other land use changes have been the second largest sources of global carbon emissions, next to the use of fossil fuels (FAO, 2015). Much of the increase LULCC in agriculture-related emissions was took place in Asia, Latin America and Africa due to their economic development depends more on agriculture (Meyfroidt *et al*., 2014). The changes inland use/land cover systems have great impact on agro-biodiversity, soil degradation and sustainability of agricultural production (Lambin *et al*., 2003).

Land degradation and declining soil fertility has a severe impact in Ethiopia, much of the direct change is a consequence of land use, and today about 40% of the land surface is used for agriculture (crops and pasture) (Lawler, *et al*., 2014). The total of 340 million hectare of woody vegetation in dryland zones of Africa (including Ethiopia) have become degraded (USEPACC, 2016). For example, in Ethiopia, the estimated forest area in 1955 was 17 million ha, but it dropped dramatically to 3.4 million ha in 1979 (FAO, 2015). Due to agriculture expansion and related ressettlement the land use/land cover change controlling of CO_2 emissions in sub-Saharan Africa particularly in Ethiopia more critical than in other regions and have been discovered to be an uncertain component in global carbon cycle for the continent (Grieco *et al*., 2012).

Degradation and deforestation by resettlement have impacted negatively on both vegetation and soil carbon stock which estimated that about 33% of carbon lost in Africa and particularly in Ethiopia soils within this period was attributed to land degradation and soil erosion (Grieco *et al*., 2012). Because of land use land cover induced degradation, the government of Ethiopia had been considering resettlement program as potential solution for food security through resettling peoples from densely populated and highly degraded area into sparsely populated and less degraded area(Bahilu,2010). The impact of resettlement in Kafa Zone, demonstrated that the general land use/land cover change patterns decreased dramatically in vegetation cover (especially the natural forest and the wooded grassland),while area cover of cultivated land and settlements have progressively increased between 1967 and 1987 (Mekuria 2005). The 1984/85 famine placed most affected and the government responded to the famine by launching large scale resettlement program (Dessalegn, 2003b). Accordingly, it was initially intended to resettle 1.5 million people to address the problem of recurrent food insecurity in risk-prone areas and some 600,000 people were resettled in the southwestern and southern of Ethiopia (Dessalegn, 2003).

Moreover, the EPRDF government appears to be increasingly enthusiastic and in favor of launching planned resettlement schemes during 2002/03 the plan envisages relocating over 2 million people in 3 years. Like other regions, chronic and frequent food shortage of varying degree is becoming prevalent at different times and provoked large-scale state-organized resettlements programs. Among the zones in Borena, Bale, East and West Hararge, Arsi, some parts of North Shewa and some pocket areas of Rift valley of Eastern Shewa are affected by food insecurity problems and 44 Woredas found in these areas were identified as severely food insecure areas and nominated for various development interventions, resettlement among others, as part of Regional Food Security Program (ONRG, 2001). The pre-settlement feasibility study identified Illubabor and Wollega zones of Oromia Regional State as potential areas for resettlement. The zones have eight potential resettlement sites with total of 23,700 ha. According to official reports of MORD, (2003) about 100,000 people were planned to be resettled in the Region to areas where population density is relatively low and unutilized land is available and Borecha district was preressettlement during Derg regimes and FDRE government many ressettlement was took place in the study area. In this case investigator interested on impacts of resettlement on land use and land cover changes in Borecha district of study area. Due to the area was highly influenced by the government resettlement program land use and land cover changes are accelerating from time to time as a result of resettlement. In Borecha resettlement, the demands for meeting local food production caused agricultural land expansions, as well as increased deforestation, poor farm management practices and massive ressettlement was took place and limited study was done in the study area.

1.2. Statement of the Problem

Since 1984/1985's the government of Ethiopia had been running resettlement programs in different parts of the country including southwest to overcome the problems of food insecurity and drought (Dessalegn, 2003). The resettlement program is designed to relocate thousands of peoples from areas affected with land degradation, scarcity of fertile crop land, highly populated and drought affected areas into another area where known for high forest cover, sparsely populated and fertile agricultural lands (ONRG, 2001). In other words areas commonly used for resettlement programs are good in terms of biodiversity conservation (because of high forest cover), and provides ecosystem services (because of the presence of good forest coverage, there is minimum soil erosion, high carbon sequestration both in soil and biomass, microclimate modification) for the local, national, regional and the global community. Due to the ever-growing impact of human activities, the biodiversity of natural habitats is rapidly being eroded at an alarming rate. The major challenge is to achieve a significant reduction of the current rate of biodiversity loss at the global, regional and national level (Guyassa and Raj, 2013).

The settlers from northern and central part of the country have introduced a new farming system, which is not adapted to the area. The settlers from northern, central and other parts of the country to resettle in study area, resettlement entailed a shift from an intensive agro based livelihood to forest based system of which they had no experience and were not prepared to manage. Rather, an extensive cereal based farming system was established at the expense of large tracks of forest in the study area due to ressettlement was degraded. In ressettlement study area forests are burnt, trees are felled and even the largest of them are killed by debarking and in case of protected trees, illegal underground cutting of their roots, this led to the rapid expansion of cropland. Further, indigenous people are dynamically changing their agricultural system mimicking the resettlers' cultures. The increasing of population as a result of resettlement in the study area increased the demand for land, fuel wood and construction wood, which further aggravated deforestation in the study area. Furthermore, the 2 ha of land given to new settlers upon arrival are frequently expanded through different mechanisms, i.e. by illegal clearing of the forestland is the serious problem in Borecha study area.

In the study area, 21,300 peoples were relocated from north part of the country and central and east part of oromia region in 2002/2003(BANO, 2019).These settlers are settled in natural forest area due to these they are cleared forests for crop land expansion, for house construction, using different trees for timber and charcoal preparation, for domestic energy by ressettlers impact on the woody vegetation and soil organic carbon in study area.

In Borecha resettlement, the demands for meeting local food production caused agricultural land expansions increased deforestation and poor farm management practices in the study area. Lack of current knowledge of the extent and magnitude of land use land cover change due to resettlement to promote sustainable land management encouraged the production of this research. The lack of rational planning of land use is the other problem to be addressed in this study. Therefore, land use/land cover change and promotion of sustainable land management due to resettlement remain the main problem of the interest of the research. At national and regional levels, land use and its status selected soil properties under different land use are important knowledge gaps that need to be addressed for making appropriate policy decisions. Studying the extent and dynamics of Borecha district land use and land cover change and its impacts is an urgent need. Moreover, it helps to evaluate expansion of resettlement patterns and land use and land cover changes in Borecha district and to analyze the impact of such change on the environment and through conversion of natural forest impact on climate change. Abound with the effects of these activities (settlement program) on biodiversity and ecosystem services were degraded in the study area.

Therefore, the current study was intended the information gap regarding impacts of resettlement program conducted in the study area on woody vegetation composition and diversity and soil carbon status. The information on the impacts of resettlement program on land use land cover, woody vegetation composition and diversity and soil carbon status can help policy makers, land managers to assist for future plan for rational land use, policy decision to design proper resettlement programs and land management. Because there is massive ressetlement in study area during the different period of time and still little study was conducted. Because of these reasons this study aimed is to fill the gaps in study area to generate information that could help in tackling some of the problems that accompanied rapid impact of resettlement on land use and land cover change, woody vegetation composition and diversity and soil carbon status under different land use in Borecha study area.

1.3. Objectives of the Study

1.3.1. General objective

The general objective of this study was to assess impact of resettlement schemes on land use land cover, woody species diversity and selected soil properties under different land use in Borecha District of study area.

1.3.2. Specific objectives

The specific objectives of this study were:

- To examine the land use land cover dynamics over in the past three decades of the study area.
- To determine the woody species composition and diversity under different land use of study area.
- To asses selected soil properties under different land use types in study area.

1.4. Research question

- ❖ What are the major land use/cover change have that occurred over the past three decades in study area?
- ❖ What are the woody species composition and diversity found under different land use in study area?
- ❖ What are the selected soil properties under different land use in study area?

2. LITERATURE REVIEW

2.1. Conceptualizations

2.1.1. Resettlement in Ethiopia

The last three governments of Ethiopia have all carried out resettlement projects with different objectives and with varying intensity but, broadly speaking, the premises on which each justified the need for resettlement were similar, at least in theory (Asrat, 2006). In the 1960s and 1970s, under the imperial regime, state-sponsored-resettlement was largely undertaken to promote two objectives. The first of these was to rationalize land use on government owned land and thus raise state revenue. The second was to provide additional resources for the hard pressed northern peasantry by relocating them to the southern regions (where most government land was located) and which was mainly inhabited by subordinate populations (Desalegne, 2003).During the mid-1980s, the Ethiopian government relocated about 600,000 people from drought-affected and over-populated regions to different resettlement sites, namely, Metekel, Metema, Assosa, Gambella, and Kafa, located in the western and southwestern parts.

The official objective of the resettlement was to prevent famine (or attain food security) by moving people from drought-prone and overly crowded areas to sparsely populated regions and unoccupied virgin lands. In the mid-1980s, the Ethiopian government portrayed the resettlement program as a lasting solution to the famine problem. Given the slow reaction of the international community in terms of providing food aid due to ideological reasons, resettlement was seen as a way out of a frustrating problem and humiliating dependency on food aid (Yntiso, 2002).The current government has launched what it calls ‘intra-regional voluntary settlement schemes’ where farming households are moved within the existing administrative regions (Alemneh, 2004). Resettlement has been resurrected as part of lasting solutions to the continual impoverishment and destitution of Ethiopian rural communities. The voluntary resettlement program is one of the most important food security strategies of the Federal Government of Ethiopia under the general coordination of the Ministry of Rural Development (Abraham, 2003).

2.1.2. Land use/land cover Dynamics

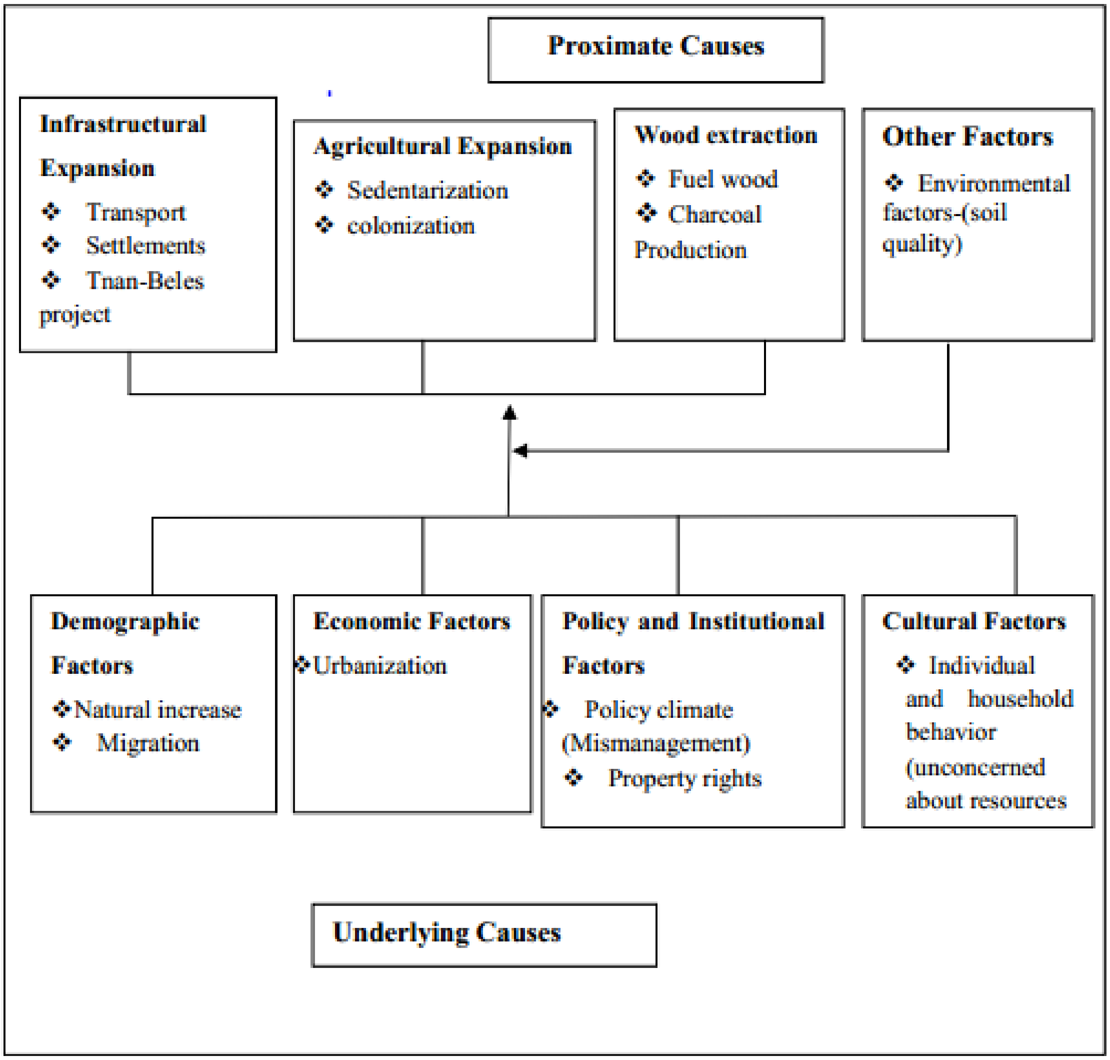
Land is the major natural resource that economic, social, infrastructure and other human activities are undertaken on. Thus, changes in land-use have occurred at all times in the past, are presently ongoing, and are likely to continue in the future (Lambin *et al*., 2003). These changes have beneficial or detrimental impacts, the latter being the principal causes of global concern as they impact on human well-being and safety. For instance, deforestation and agricultural intensification are so pervasive when they aggregate globally and significantly affect key aspects of Earth Systems (Lewis, 2006; Zhao *et al*., 2006). Land cover is a biophysical characteristic which refers to the cover of the surface of the earth, whereas land use is the way in which humans exploit the land cover. LULC changes are caused by natural and human drivers, such as construction of human settlements, government policies, climate change or other biophysical drivers (Riebsame *et al*., 1994; Lambin *et al*., 2003 as cited on Kiros, 2008). In response to the increasing demands for food production, agricultural lands are expanding at the expense of natural vegetation and grasslands (Lambin *et al*., 2000).

These changes inland use/land cover systems have great impact, among others, on agro-biodiversity, soil degradation and sustainability of agricultural production (Lambin *et al*., 2003).Throughout the world processes related to urbanization, development of transport infrastructures, industrial constructions, and other built-up areas, are severely influencing the environment, and are often modifying the landscape in an unsustainable way (McCormick *et al*.,2004).In many cases land-use activities go hand in hand with substantial modifications of the physical and biological cover of the Earth’s surface, resulting in direct effects on energy and matter fluxes between terrestrial ecosystems and the atmosphere. For instance, the conversion of forest to cropland is changing climate relevant surface parameters (e.g. albedo) as well as evapotranspiration processes and carbon flows. In turn, human land-use decisions are also influenced by environmental processes. Changing temperature and precipitation patterns for example are important determinants for location and intensity of agriculture. Due to these close linkages, processes of land-use and related land-cover change should be considered as important components in the construction of Earth System models *(*Schaldach *et al.,* 2009*)*.The landscape concept used to map and assess LUCC allows us to explain relationships between land-use practices and land-cover patterns, and considers land-cover change as driven largely by land-use types. For different-scale LUCC investigations, the landscape methodology is used on the base of remote sensing data of different spatial and temporal resolution, as well as conventional thematic maps and in-field data, to explain relationships between current land-use practices and land-Cover patterns (Milanova *et al*., 2007). Present-day landscapes are territorially defined units of land surface, characterized by a structurally organized combination of natural and economic components whose close interactions give birth to the present-day landscape territorial system. Such an approach provides a base for the perception of the world as a system of interrelated territorial samples with different environmental situations. In response to this issue, a hierarchical landscape classification scheme is proposed for scale-dependent land scape applications (ibid).

2.1.3. Land Use/cover Changes and the Causes

Different researchers have put the reasons for land use/cover changes in two broad categories as proximate or direct and underlying or indirect / root causes (Geist and Lambin, 2002; Liver man and Cuesta, 2008). According to Lambin *et al*. (2003) further contend that proximate factors occur at local or household/farm level whereas underlying factors emanate from regional, country or even global level. As a consequence, proximate variables are context and region specific while the root causes on the other hand are the result of complex political, economic and social conditions occurring at a distance. Farm level analysis allows to address proximate causes and to interpret them in reference to underlying causes (Mottet *et al*., 2006). According to Long *et al*.(2007) industrialization, urbanization, population growth, and China’s economic reforms as major factors that identified land use changes in Kunshan. Another study in Zimbabwe also recognized that pressure for agricultural land, building materials and fuel wood triggered land use/cover changes (Mapedza *et al*., 2003). Study by (Brink and Eva, 2009) also reveals that there is a significant degree of land use/cover change in Sub-Saharan Africa. These changes have resulted due to manmade and natural drivers related to high rate of population increase, economic development and globalization on one hand and natural hazards such as floods, landslides, drought and climate change on the other end of the spectrum. The study in landscape change in Tahuladare Warada ,Wello by(Crummey ,1998)indicates the existence of fast population increase but little expansion of cultivated land and an increase in woody vegetation (mainly eucalyptus trees). A similar trend has been identified by (Bewket, 2013) in Chemoga watershed case study where it appears that population has increased but woodland recovery was high in 1998 due to eucalyptus tree plantation. According to Nyssen *et al*. (2009) observe land use/cover dynamics for the last four decades in Bela-Welleh catchment, Wag, Northern Ethiopian Highlands, due to population pressure. According to Gebreyohannis *et al*. (2013) in forest cover change study in the Blue Nile basin has observed forest cover increase particularly in Gilglel Abay or little Abay watershed due to eucalyptus tree expansion. A study conducted in Afar, Ethiopia identified more than fifteen factors as the cause for land use/cover changes (Tsegaye *et al*., 2010). The driving forces documented in the study include migration from nearby highlands triggered by drought, land tenure and government policy changes only to mention some (Tsegaye *et al*., 2010). Another study in the Central Rift Valley of Ethiopia reveals that population growth, decline in agricultural productivity, land tenure change and erratic rainfall have the major drivers of land use/cover in the area (Efrem *et al*., 2009).

The land use/cover dynamics study in the northwestern Ethiopia reports that population dynamics, exiting land tenure, institutional and socioeconomic conditions should be critically examined too put in place any land related policy (Gete and Hurni, 2001). On top of that, another study in Ethiopia contends that one of the reasons for land use and cover changes in Derek Olli catchment is change in population size in the surrounding urban centers whose charcoal and fuel wood consumption has equally increased (Tegene, 2002). More Over according to Temesgen *et al*. (2013) also observed that in main Ethiopian rift valley, one of the reasons for net reduction in woodland between 1986 and 2000 was due to institutional weakness observed during the transition period, i.e. Military government to the present regime. In sum, the factors that affect land use/cover changes are complex and at times interrelated. Thus, the study of land use/cover changes demands a careful investigation of these complex and interrelated factors at local, national and global levels.



(Source: Geist and Lambin, 2002)

Figure. 1. Proximate and Underlying Causes of Land Use/Cover changes

In the semi- arid areas of the central Rift Valley, in Keraru and Gubeta, Arjo, Western Wolega, Oromia region during the period 1973 ,2000 cropland coverage has increased and woodland cover lost (Efrem, 2010)Because of the ever-increasing population pressure and the widespread poverty, land use and land cover are changing dramatically.

2.1.4. Impact of LULC Changes on the Forest Resources

The growing population and increasing socio-economic necessities creates a pressure on LULC. This pressure results in unplanned and uncontrolled changes in LULC. The LULC alterations are generally caused by mismanagement of agricultural, urban, range and forest lands which lead to severe environmental problems such as landslides, floods (Seto *et al.*, 2002). LULC is increasingly recognized as an important driver of environmental change on all spatial and temporal scales. LULC contributes significantly to earth atmosphere interactions, forest fragmentation, and biodiversity loss. It has become one of the major issues for environmental change monitoring and natural resource management. LULC and its impacts on terrestrial ecosystems including forestry, agriculture, and biodiversity have been identified as high priority issues in global, national, and regional levels (Fuchs, 1996 cited on Zhang *et al*., 2009). According to Houghton (1995); Thenkabail (1999); (Helmer *et al*.,2000) as cited on (Boakye *et al*.,2008), LULC leads to degradation of forest or woodland and these have impact on catchment processes and biochemical cycles and leads to soil erosion and water shortage not only in the regions immediately affected by deforestation, but also in reasonably distant areas.

There are also incidental impacts on environment due to land use change from other human activities such as forest and lakes damaged by acid rain from fossil fuel combustion and crops near cities damaged by troposphere ozone resulting from automobile exhaust. 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. Loss of biodiversity, soil degradation, and environmental deterioration are largely results of LULC change. An example of the negative effects of LULC change is that land productivity declines under continuous cultivation, overgrazing and soil erosion (Muluneh, 2003). The other obvious consequence of LULC change, particularly of deforestation is the shortage of fuel wood. As population increases household energy consumption also increases. Of the total population of the world, 30 to 40 percent largely depends on fuel wood and charcoal. For the poor in rural areas, it is not only a source of energy but a means of income generation too. "In many parts of the developing world, fuel is scarcer and more expensive than the food that is eaten." (Girma *et al*., 2002). In

Ethiopia, 85 percent of domestic energy consumption is derived from forest products and this clearing land without selection to expand agricultural lands is the main cause of loss of biodiversity (Girma *et al*., 2002) or forest degradation.

2.2. Empirical Evidences of the Literature Related to the study

2.2.1. Land use/Land cover Studies in Ethiopia

Land in Ethiopia is being used to grow crops, trees, and animals for food, as building sites for houses and roads, or for recreational purposes. Most of the land is being used by smallholders who farm for subsistence. With rapid population growth and in the absence of agricultural intensification, smallholders require more land to grow crops and earn a living; it results in deforestation and land use conversions from other types of land cover to cropland. Research conducted in Ethiopia has shown that there were considerable LULC changes in the countries during the second half of the 20th century. Most of these studies indicated that deforestation and encroachment of cultivation into marginal areas were the major causes of land degradation, particularly in the highland part of the country (Daniel, 2008).For instance, over the past 41 years, agricultural land areas increased significantly at the cost of the surface area for natural vegetation (woodland and shrub land) and in recent decades reductions in woodland and expansion and intensification of agriculture were associated with road construction, settlement expansions and population pressure in the highlands ofTigray, northern Ethiopia(Kiros 2008).

Kibrom and Hedlund (2000) who studied the highlands of Kalu District, Ethiopia observed a decrease in coverage by shrub lands, riverine vegetation, and forests and areas under cultivation remained more or less unchanged. They concluded that land cover changes were the result of clearing of vegetation for fuel wood and grazing. Gete (2001) and (Belay, 2010), as cited on (Daniel ,2008), reported a serious trend in land degradation resulting from the expansion of cultivated land at the expense of forestlands in Dembecha in north-western Ethiopia and in the Derekoli watershed in South Wollo. In contrast, (Muluneh, 2003) and (Bewket, 2002) have reported an increase in wood lots (eucalyptus tree plantations) and cultivated land at the expense of grazing land in both Sebat-bet Gurage land in south-central

Ethiopia, and in the Chemoga River watershed in north-western Ethiopia. Land use/ Land cover changes that occurred from 1971/72 to 2000 in Yerer Mountain and its surroundings results an increase in cultivated land at the expense of the grass lands (Kassa, 2004).

2.2.2. Environmental Impacts of Resettlement in Ethiopia

The 1984/85 resettlement program engender massive destruction of the country's forest resources and introduced intensive highland agricultural techniques in areas which have delicate soils calling for low population densities and the practice of shifting agriculture. In this connection, it is interesting to note that the government's effort to tackle the problems of land scarcity, famine, and ecological degradation in the highlands has resulted in the spread of these problems to regions which were previously unaffected (Kassa, 2004). According to Mekuria (2005), who studied Shomba and Michity resettlement areas in Kafa Zone, demonstrated that the general land use/land cover change patterns decreased dramatically in vegetation cover (especially the natural forest and the wooded grassland),while area cover of cultivated land and settlements have progressively increased between 1967 and 1987 in both areas. This shows that some major socioeconomic changes had taken place between 1967 and 1987 that altered the LULC of the in this areas.

Spontaneous resettlement/migration of people from drought-hit areas of Hararghe and Arsi zones to Bale zone of Oromia Regional State have also caused environmental damage to the resettlement areas in recent years. The resettles were relocated in Mana Hangatu, Berbere and Gololcha woredas of Bale Zone in which some parts of fall in Bale mountains National Park and the impact on the wildlife and their habitat was also considerable (Dechassa,2002).The current resettlement programs launched during 2002/03 were suspected of environmental damages. The resettlement was experiencing extensive destruction of wood plants by smallholder farmers for house construction and agriculture, consumption and selling of fuel woods ((Dechassa, 2002). According to Berhanu(2007), also investigated that ,the recent resettlement programs conducted in different parts of the country may have involved environmental damages despite differences in scale which includes huge loss of natural forests with great impact on sustainability of the environment contrary to what has been set out in the implementation manual of the scheme. Similarly, the resettlement program has resulted in large damage to the natural forest of their settlement areas as well as the killing and fleeing of wild animals. According to (Ahmed, 2005) about 5613.7 hectares of forestland in Haro Tatessa resettlement site was removed due to the resettlement program. The study also states that some of the damages caused on forest and wild animals are not easily reversible, even may lead to extinction of some species (Ahmed, 2005) .The Woodland in Chewaka resettlement area in Bedele Woreda of Illubabor zone has shrunk by 42.4 percent after the resettlement of people (Berhanu, 2007)

2.2.3. Remote Sensing as a Tool for Land use/land cover Study

Remote sensing and Geographic Information Systems (GIS) are providing new tools for advanced ecosystem management. The collection of remotely sensed data facilitates the synoptic analyses of earth-system function, patterning, and change at local, regional, and global scales over time. Such data also provide a vital link between intensive, localized ecological research and the regional, national, and international conservation and management of biological diversity (Ernani and Gabriels, 2006) Remote Sensing is the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with object, area, or phenomenon under investigation (Lillesand and Kiefer, 2004). It provides large variety and amount of data about the earth surface for detailed analysis and change detection with the help of various space borne and airborne sensors.

It presents powerful capabilities for understanding and managing earth resources. Remote Sensing have been proven to be a very useful tool for LULC change detection. Change detection and monitoring involve the use of several multi-date images to evaluate the differences in LULC due to various environmental conditions and human actions between the acquisition dates of images. Successful use of satellite Remote Sensing for LULC change detection depends upon an adequate understanding of landscape features, imaging systems, and methodology employed in relation to the aim of the analysis (Yang & Lo, 2002).With the availability of historical Remote Sensing data, the reduction in data cost and increased resolution from satellite platforms, Remote Sensing technology appears poised to make an even greater impact on monitoring land-cover and land-use change (Rogan &Chen, 2004). In general, change detection of LULC involves the interpretation and analysis of multi-temporal and multi-source satellite images to identify temporal phenomenon or changes through a certain period of time. Remote Sensing data are the primary source for change detection in recent decades and have made a greater impact for different planning agencies and land management initiatives (Yang and Lo, 2002).

2.2.4. Image Classification

Multispectral classification is the process of sorting pixels into a finite number of individual classes, or categories of data, based on their data file values. If a pixel satisfies a certain setoff criteria, the pixel is assigned to the class that corresponds to that criterion. This process is also referred to as image segmentation. Depending on the type of information you want to extract from the original data, classes may be associated with known features on the ground or may simply represent areas that look different to the computer. An example of a classified image is a land cover map, showing vegetation, bare land, pasture, settlements (ErdasField Guide, 1999) A land use and land cover classification system which can effectively employ orbital and high-altitude remote sensor data should meet the following criteria (Anderson, 1976): The minimum level of interpretation accuracy in the identification of land use and land cover categories from remote sensor data should be at least 85 percent.

2.2.5. Pre-processing of Satellite Data

Raw digital images usually have some geometric distortions as a result of variations in the altitude, attitude, Earth curvature, atmospheric refraction, relief displacement, and nonlinearities in the sweep of a sensor's IFOV (Lillesand *et al*., 2004).These errors should be corrected to ensure accuracy of the final results. Generally, there are two types of data correction: radiometric and geometric. Radiometric correction addresses variations in the pixel intensities (DNs) that are not caused by the object or scene being scanned. These variations include: differing sensitivities or malfunctioning of the detectors, topographic effects and atmospheric effects. Geometric correction addresses errors in the relative positions of pixels. These errors are induced by: sensor viewing geometry and terrain variations (Erdas Field Guide, 1999).

2.2.6. Types of Image Classification

Land cover maps are commonly created from remotely sensed data through unsupervised or supervised classification techniques (Jensen, 2003). Unsupervised Classification the unsupervised classification approach is an automated classification method that creates thematic raster layer from a remotely sensed image by letting the software identifies statistical patterns in the data without using any ground truth data (Lillesand *et al*., 2004).The spectral classes obtained from the unsupervised classification are based solely on natural groupings in the image values. The Unsupervised approach does have its advantages. Since there is no reliance on user provided training samples (which might not represent "pure" examples of the class / feature desired and which would therefore bias the results), the algorithmic grouping of pixels is often more likely to produce statistically valid results. Consequently, many users of remotely sensed data have switched to allowing software to produce homogenous groupings via unsupervised classification techniques and then use the locations of training data to help label the groups (Erdas Field Guide, 1999).

Supervised Classification, here the image analyst supervises the pixel categorization process by specifying, to the computer algorithm, numerical descriptors of various land cover types present in the image. Training samples that describes the typical spectral pattern of land cover classes are defined. Pixels in the image are compared numerically to the training samples and are labeled to land cover classes that have similar characteristics. All the classification techniques like the maximum likelihood classification (MLC), parallelepiped and minimum distance to mean classification may be applied to get the best classification technique (Golmehr,2009).In a supervised classification, the identity and location of certain representative patches of the land cover types present in a landscape need to be identified prior to classification. Initial field input is normally required for adequate map accuracy.

2.2.7. Change Detection Methods

Digital change detection encompasses the quantification of temporal phenomena from multi date imagery that is most commonly acquired by satellite-based multi-spectral sensors. In general, change detection involves the application of multi-temporal datasets to quantitatively analyze the temporal effects of the phenomena (Lu *et al*., 2007).Change detection methods have been grouped generally into image algebra, transformation and classification. Classification category includes post-classification comparison, spectral temporal combined analysis, expectation-maximization algorithm change detection, unsupervised change detection, and hybrid change detection and ANN (Lu, *et al*., 2007).

This category has the advantage of showing both change no change as well as ‘from to ‘information. Post Classification Change Detection. This method compares two independently produced classified land use/cover maps of two different dates. Therefore, it minimizes the problem of normalizing for atmospheric and sensor differences between two dates, and can indicate the nature of change. It was found to be an accurate procedure for land use/cover change detection provided that the two land use/cover maps have been accurately produced (Jensen, 2002).Post classification analysis is involves independently produced spectral classification results from each end of the time interval of interest, followed by a pixel by pixel or segment by segment comparison to detect changes in cover type. In addition to the algorithms which are applied on the classified images to determine those pixels with a change between the two dates, statistics can be compiled to express the specific nature of changes between the two images (Lillesand *et al*., 2004).

2.2.8. Accuracy Assessment

In thematic mapping from remotely sensed data, the term accuracy is used typically to express the degree of ‘correctness’ of a map or classification (Foody, 2001). A thematic map derived with a classification may be considered accurate if it provides an unbiased representation of the land cover of the region it portrays. In essence, therefore, classification accuracy is typically taken to mean the degree to which the derived image classification agrees with reality or conforms to the ‘truth’. A set of reference pixels representing geographic points on the classified image is required for the accuracy assessment. Randomly selected reference pixels lessen or eliminate the possibility of bias (Congalton, 1991). According to Congalton & Green (1991), if information derived from remote sensing data is to be used in some decision-making process, then it is critical that some measure of its quality be known. The most common accuracy assessment elements include overall accuracy, producer's accuracy, user's accuracy and kappa coefficient (Lu *et al*., 2007).

2.3. Soil Organic Carbon

Soil organic carbon has tremendous effect on the physical, chemical, thermal properties and on biological activity of the soil. It thus sustains soil productivity and biodiversity. These aspects may be seen as an 'added-benefit' over direct carbon mitigation techniques that would only physically store carbon in the deeper subsoil for instance: old gas fields, mines and aquifers (Lal, 2004). As some studies indicated, the overall land-use systems can be ranked in terms of their SOC content in the order: forests, agro forests, tree plantations and arable crops (Nair *et al.,* 2009). Carbon sequestration occurs in plants as they photosynthesize atmospheric CO_2 into plant biomass which is transferred to the soil when plant biomass components drop on and into the soil. There is a great variation in the amount of organic matter in temperate, tropical and subtropical soils. SOC in the top one meter of the world soil comprises about three over four of the earth's terrestrial carbon and there is also tremendous potential to sequester additional carbon in soil (Albrecht and Kandji, 2003). SOC is encapsulated in stable micro-aggregates so that C is protected from microbial processes or as recalcitrant C with long turnover time (Lal *et al*., 2004). Soil C sequestration helps off set emissions from fossil fuel combustion and other carbon-emitting activities while enhancing soil quality and long-term plant productivity (Bangroo *et al*., 2011). Management systems that add high amounts of biomass to the soil, causes minimal soil disturbance, improve soil structure, and enhance soil fauna activity (Lal *et al*., 2004). The environment could benefit from increasing organic carbon content of soils through carbon sequestration (Nair *et al.,* 2009). Use of soil to sequester carbon will require changes in management, either through reducing carbon emissions associated with decomposition or by adding extra organic material.

2.3.1. Natural Forests and Carbon

Forests comprise the largest C pool of all terrestrial ecosystems and the annual gross exchange of CO_2 between forests and the atmosphere exceeds the anthropogenic release of CO_2 due to combustion of fossil fuels more than seven times (Robert, 2007). Obviously, forest C dynamics cannot be ignored when ways to mitigate climate change are sought. The main carbon pools in tropical forest ecosystems are the living biomass of trees and understory vegetation and the litter, woody debris and soil organic matter (Baldock, 2007). The carbon stored in the aboveground living biomass of trees is typically the largest pool and the most directly impacted by deforestation and degradation (Holly *et al.*, 2007). Deforestation can release large quantities of C, and afforestation can fix CO_2 in new biomass and dead organic matter. These changes in land use are regionally of different relevance. Deforestation is ongoing at high rates mostly in tropical regions, where forests are converted to agricultural land (Baldock, 2007).

Afforestation is commonly dominant in regions where incentives for agriculture are weak and where land owners resort to the less intensive forestry (Bekele, 2006). In order to be relevant for the mitigation of climatic change, the C pool of the land and in forest products needs to be increased sustainably and the change in the C pool needs to be verifiable. As most definitions of "forest" depend on a threshold land cover fraction by woody perennials, the derived systems such as coffee plantations with or without shade trees may fall under the definition (Robert, 2007). The variation in C stocks within the forest category, whatever operational definition one chooses, is considerable and most of the changes due to a gradual degradation or aggregation of C stocks can remain unnoticed if one uses only two land cover classes (van Noordwijk *et al.*, 2002).

2.3.2. Agroforestry and carbon

Agroforestry is defined by the World Agroforestry Centre as: a collective name for land use systems and technologies where a woody perennials tree, shrubs, palms and bamboos. Agroforestery is deliberately used on the same land management units such as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence (Young, 1989). The agroforestry sector has received recent attention for it is believed to have potential to sequester carbon and mitigate the greenhouse effect (Kumar *et al.*, 2009). Tree-based systems are a convenient way of sequestering carbon from the atmosphere to reduce net emissions. Agroforestry systems have the potential to sequester atmospheric carbon (C) in vegetation and soil while maintaining sustainable productivity. It is also one of the promising management practices to reduce soil degradation (Lal, 2004). Agroforestry has a particular role to play in mitigation of atmospheric accumulation of carbon dioxide for instance, as reported by different scholars Land-use Change and Forestry report of the IPCC, agroforestry offered the highest potential for carbon sequestration (Nair *et al.*, 2009). Agroforestry offers a compromise solution because it increases the storage of carbon on land and, at the same time, may enhance agricultural production rather than compete with it (Oscar *et al*., 2003).

Agroforestry do not only accumulate carbon on site but conserve carbon in existing forests by reducing the need for fuel and agricultural land normally obtained from neighboring forests (Baldock, 2007). Two aspects of agroforestry are important in reducing losses of carbon from neighboring forests (Robert, 2007). First, agroforestry adds to the permanence of agriculture; second, it reduces the area required for agriculture. The additional food production and income generated by agroforestry trees reduces the reasons for abandoning land and moving on to cut new fields from forest. Trees also provide various service functions, such as increasing soil organic matter and nutrient levels and reducing runoff and soil loss, and these increase the productivity of fields beyond what occurs in fields without trees. More importantly, the secondary effects of agroforestry in reducing deforestation might largely eliminate these emissions altogether. Whether agroforestry can work in the long term, however, depends on the demands placed upon it by increases in the number of people seeking food and fuel and by changes in climate (Baldock, 2007).

2.3.3. Agriculture and Carbon

Agricultural activities serve as both sources and sinks for greenhouse gases. Globally, land use changes and agricultural activities have released a historic 66 to 90 Pg of soil organic carbon (SOC) and may be currently releasing as much as 1.6 to 2.6 Pg of SOC per year (Lal, 2004). The primary sources of greenhouse gases in agriculture are the production of nitrogen based fertilizers; the combustion of fossil fuels such as coal, gasoline, diesel fuel and natural gas and waste management. The increase in aeration of the soil and the intense disturbance are the main factors stimulating the mineralization of organic matter by the soil microorganisms (Baldock, 2007). Tillage practices have been causing the general decrease in OM of intensively cultivated soils, and the important CO_2 emissions linked to agriculture in the past. Land misuse and soil mismanagement has caused depletion of SOC with an attendant emission of CO_2 and other GHGs in to the atmosphere (Melillo, 2002). Carbon is lost from the soil through leaching of dissolved carbon, erosion, and conversion of carbon to carbon dioxide through mineralization (Baldock, 2007).Carbon sequestration in the agriculture sector refers to the capacity of agricultural lands to remove carbon dioxide from the atmosphere.

The ability of agricultural lands to store or sequester carbon depends on several factors, including climate, soil type, type of crop or vegetation cover and management practices (Jeff and Holly, 2008). At national and regional levels, land use and its impact on the SOC pool and its dynamics are important knowledge gaps that need to be addressed for making appropriate policy decisions. Soil and crop management can greatly improve the residence time and new C storage in soil. Different land uses and agronomic practices were evaluated with respect to their effect on carbon sequestration or release (Lal, 2004). Conservation tillage, organic production, covers cropping and crop rotations can drastically increase the amount of carbon stored in soils (Jeff and Holly, 2008). Traditional agriculture is intensively cultivated and is dominated by annual crops in contrast to the primarily perennial grasses and forested systems. The annual cropping systems are often bare, or nearly so, for extended periods of time where there is substantial solar radiation (Baker and Griffis, 2005).

3. MATERIALS AND METHODS

3.1. Description of Study Area

3.1.1. Location of Borecha district

The study was conducted in Borecha District Buno Bedelle Zone, in Oromia Regional State, south west part of Ethiopia. The District is located 496 Km far from Addis Ababa south west direction and Northeast of the Buno Bedele zone and 51 km far from Bedele town. The District has 32 *kebeles*. Out of these one is urban area and others 31 are rural villages. Its total area is around 96,525.1 hectares. It is surrounded by four neighboring Districts. It bordered in north Nunu Qumba District, west of Gechi District and east of Limu Seka, south of Didesa District (BANO and B LA Office, 2019). The absolute location of Borecha District, it lies between $7^{0}24'$N and 7^{0} $48'$N latitude and 37^{0} $53'$E and $37^{0}68'$E longitude.

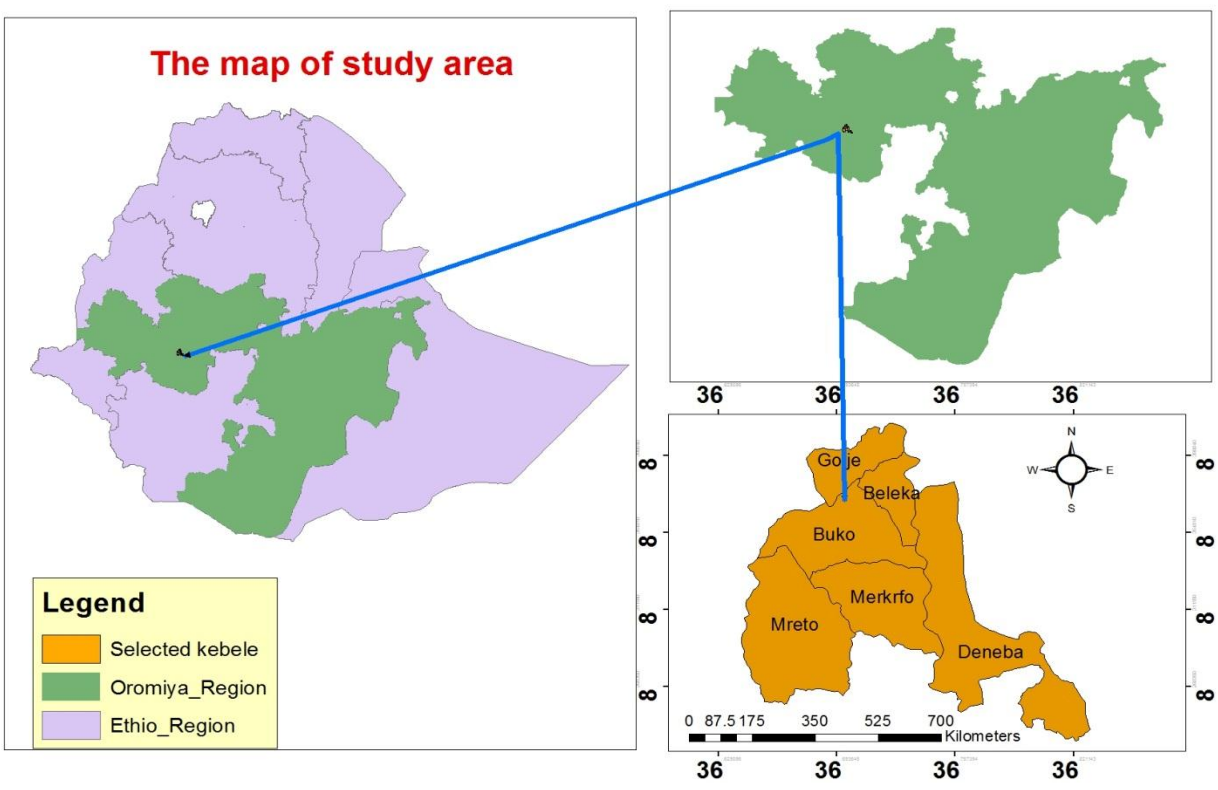


Figure 2. The location study area map

(Source: Ethio-GIS)

3.1.2. Population and socio economic characteristics of the study area

Population number of the study area is 87,262. Out of this, 43,450 are males and 43,812 are females. The population distribution was 69,130 peoples are settled in rural area and 18,132 peoples are settled in urban area. The total households heads of the district were 13,445 from these males are house hold heads are 12,838 and females households are 607, settled in rural area. Therefore in urban total households were male households 1007 and female households are 57 the total households heads in urban area was 1064. The main ways of life of peoples in the study area is agriculture and service sector. More than 90% of peoples of the study area engage their life based on agriculture like crop cultivation and animal rearing. Less than 10% of peoples of the study area engage their life based on shopping, government employment, wood work and other service sectors. And its agriculture is mainly dependent on rainfall and traditional irrigation farming system. Cereal crops such as teff, maize and Sorghum are the commonly cultivated crops in the study area (BANO, 2019). The religion in study area was Muslim, 94.96% and Orthodox 3.45% and 1.59% protestant (CSA, 2007).

3.1.3. Climate

According to BANO (2019), agro ecologically, the woreda is divided into three ecological zones namely, highland 4.7%, and it covers 4,506.25hectares of its total area mid-altitude 66.4%, and it covers 64,118.85 hectares of its total area and low-land 28.9%, this covers 27,900 hectares of its total area (BANO, 2019). Its rainfall ranges from 1184 mm to 2214 mm and the average annual rain fall is 1699 mm (fig.3). The study area has the mountain, plain and valley land structure. Its altitude range from 1350 meter above mean sea level to 2450 meter above mean sea level. The average altitude is 1900 meters above sea level. The study area has experienced both cold and hot temperature. Its temperature ranges from 11^0c at minimum to 32^0c at the maximum. The average annual temperature is 21.5ºc (BANO, 2019) (fig.3).

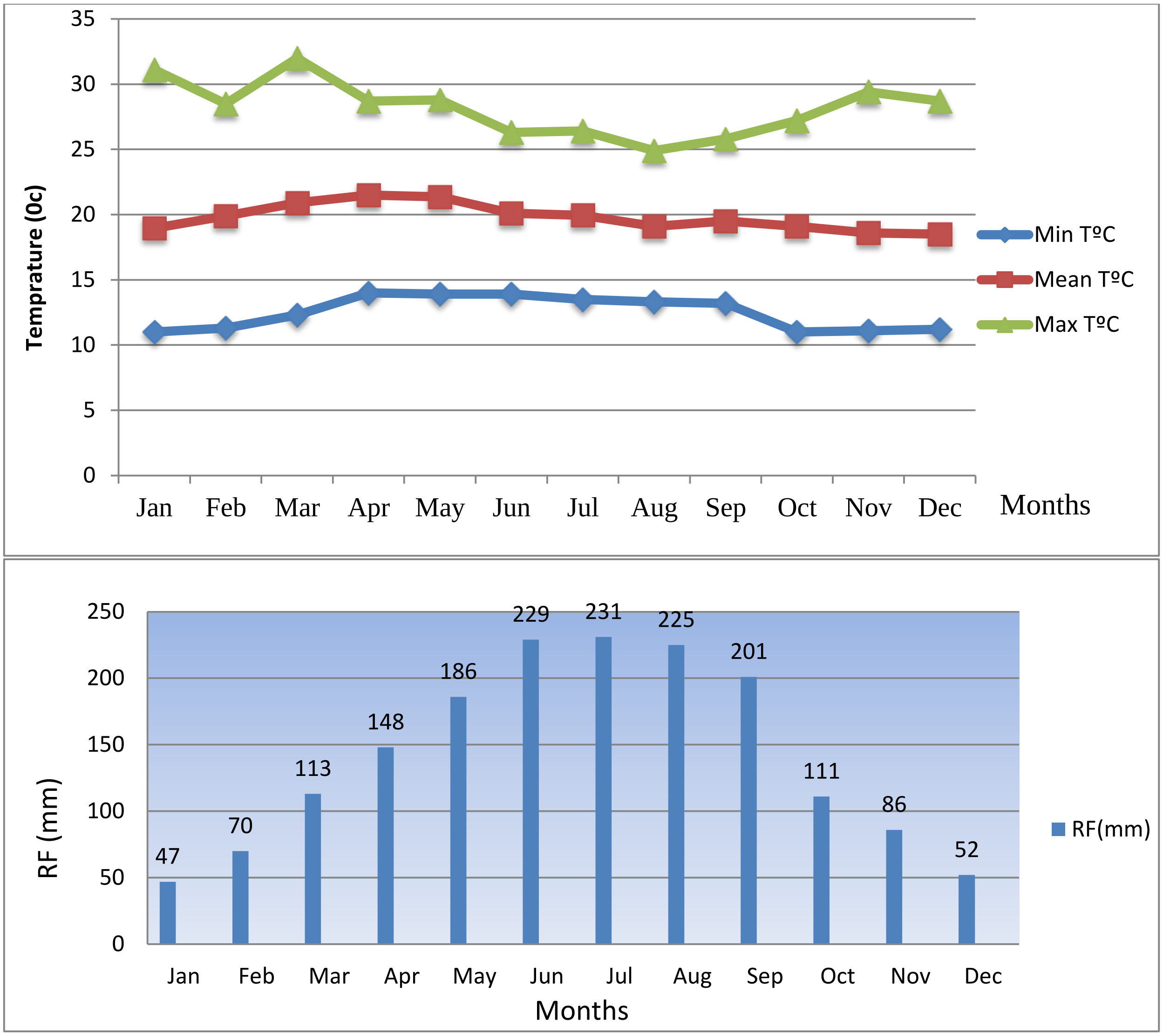


Figure. 3 .The mean climate of the study area.

(Source: NMA, 2019)

3.1.4. Land use and vegetation

The land use pattern of the study area is similar to the other areas of Buno Bedele Zone, whereby farmers divide their lands into several plots for different purposes such as settlement and avenues, growing coffee, khat and other cereals, grazing, and tree plantations. Homestead plots are used for growing the most important crops such as; coffee, enset, khat and vegetables. Plot farms are used for growing annual crops such as, teff, maize, sorghum, and beans (BANO, 2019).The land use pattern, around 65,654.85 hectares (68.09 %) is potential for farming land. Out of this, 61,437.25 hectares are cultivated land. Forest land coverage 11,248.18 hectares (11.64%). Out of this natural forest cover is account 9,812.18 and plantation 1,436 spontaneously; Grazing land covers 8011 hectares (8.29%) of its total area. And 5,206.65 (5.39%) hectares are covered by wetland. Out of this, 4,249.65 hectares are potentially cultivated wetland but only 81.61% hectares are cultivated and uncultivated 957(18.38%) hectares (BANO, 2019) land covered by coffee 417(0.43%) , land covered by khat 1926 hectares (1.99%) potential for the perennial crop, 1,211.07ha and the others 2,850.5 hectares. (BANO, 2019).Vegetation is the most important for soil conservation and also for fuels formation as well as for bee forage. In Borecha District the distribution of vegetation consists of more or fewer bushes and shrubs, forest these vegetation's cover most of the steep mountains of re settlement area. However, indigenous trees like *Juniperus procepa, cordia africana, Croton macrostachyus, Premna schimperi, Foneix reclinata, Strychnos spinosa, Acacia sieberiana, and Eckebergirueppeliana* are found in the part of the study area, the area where the springs are found. Eucalyptus trees are found in the settlement areas.

3.1.5. Soils

The soils of southwestern Ethiopia are in general classified as Nitosols according to the soil classification systems (Mesfin, 1998) and soil around Bedele classified as Nitsoils according to the soil classification and soil characterization systems by (Abera &Kefyalew, 2017).More over the soil of Didessa district was classified as Nitosols and Cambisols according to the soil classification and soil characterization by (Alemayehu, 2015**)**,this is the nearest district which is surrounded by the study area of Borecha district.

3.2. Methodology of the Study

In this study, different types of data and methods of data analysis were employed. This section shows the general methods implemented, applied techniques and the data inputs used throughout this study.

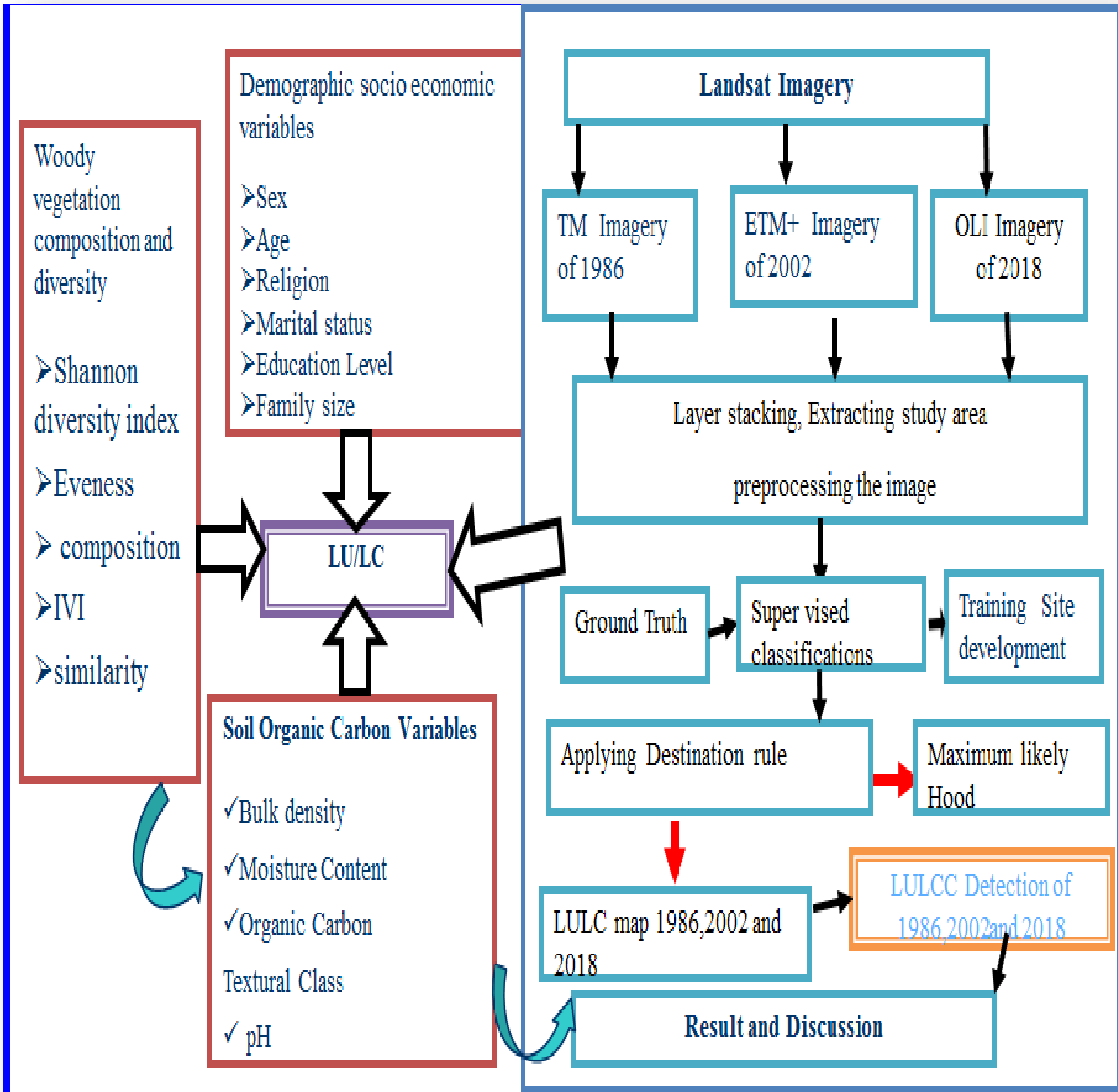


Figure.4. Flow chart showing general methodologies employed

Source: Own sketch

As shown in the above figure, the first section of the methodology involved on preprocessing of data, remote sensing image classification, change detection analysis and wood vegetation composition and diversity data collection and analysis soil organic carbon data collection and analysis and socioeconomic data collection and analysis.

3.2.1. Research Design

The design used for the current study was cross sectional research design. The concurrent mixed approaches enable to gather quantitative and qualitative data, and are gathered at the same time (Creswell, *et al*., 2003). The purpose of mixed method is to collect data from different sources and applied triangulation method to enhance and improve the quality of the data during the analysis and interpretation.

3.2.2. Types of data and sources

For this study both qualitative and quantitative data were used. These data were obtained from primary and secondary data sources. The primary data sources were households, field survey, GPS measurement and satellite image, whereas secondary data used include; relevant publications such as unpublished reports and other data from district land administration offices and censuses results.

3.2.2.1. Satellite data and processing

There are different methods and techniques in order to use an input data to reach in success of a desired goal. However, it highly depends on the availability of input data and quality of information. The data sets used in this study were satellite images and ground truth data. Satellite images of the 1986, 2002, and 2018 were used for this study. For this study Satellite images were downloaded freely from USGS website http://www.earthexplorer.usgs.gov and acquired from the land sat of 1986 TM, 2002 was obtained from ETM+ and 2018 was obtained from OLI. The year 1986 was taken due to government organized resettlement program during the Derg regime has taken place, images from the year 2002 selected as resettlement program organized by the current EPRDF government was implemented. Therefore, it can be assumed that these years indicate important points in the dynamics of LULC in the area. In January and February during a dry seasons were selected not only suitable for obtaining cloud free images but also assumed that confusion in spectral contrast between forest and non-forest green vegetation such as agricultural and grass land s could be minimized during dry seasons. For quality of image classification ground truth was taken from field study of all land use (forest, grazing land, cultivated land and settlement). The ground truth data were collected during field work by reading GPS Garmin 72H and used for land use land cover classification of 2018 and in addition Google earth and preprocessed imagery were used for accuracy assessment.

Table 1. The characteristics of the satellite images used for the study:

Index(Year of acquisition)	Sensor	Acquisition Date	Sensor	Spatial resolution	Path/row	Producer
1986	Landsat TM	6/01/1986	TM	30x30m	175/055	USGS
2002	LandsatETM$^+$	24/02/2002	ETM+	30x30m	175/055	USGS
2018	Landsat OLI	30/01/2018	OLI	30x30m	175/055	USGS

Source: Own computation, 2019

3.2.2.2. Image Enhancement and layer stacking

To increase interpretability of the image by removing cloud cover on some portion of the image of land sat TM 1986 haze reduction technique were employed and during layer stacking, all seven bands of TM and ETM+2002, excluding the thermal band were considered for layers stacking.

3.3. Sample size and sampling techniques

During selection of the study area, multistage random sampling was conducted. At the first stage, Woreda was chosen and secondly peasant associations (PAs) or kebeles was identified. For this study six kebeles purposively selected based on the year they settled and geographically embedded and this is because while it clipped it need different satellite image and depending on this three kebeles were selected from resettlers of 1986 and three kebeles were selected from resettlers settled in 2002. The required biophysical and socioeconomic data was collected through detailed socioeconomic assessment which was conducted by Household Survey. At the third stage 184 sample households for each sample kebele were determined by probability proportionally sample among the total samples of households of the six kebeles.

To determine the sample size researcher used the following formula developed by Cochran (1977), which is written as follows for infinite population:

$$no = \frac{Z^2 Pq}{e^2} \text{...equation[1]}$$

Where, “no” is the desired sample size for the study, z is the selected critical value of desired confidence level, p is the estimated proportion of an attribute that is present in the population, q =1−p and “e” is the desired level of precision. As the variability in the population was not known before hand, the maximum variability (50%) was taken in the current study. Often, an acceptable margin of error used by survey researchers falls between 4% and 8% at the 95% confidence level (Data Star, 2008). So a margin of error of 7% (0.07) was taken for this study. To obtain the actual sample from which the desired data is collected, Cochran’s formula for finite population was used. Cochran (1977) pointed out that if the population is finite, then the sample size can be reduced slightly. He proposed a correction formula to calculate the final sample size in this case; which is given below:

$$\text{Where;} \quad n = \frac{no}{1+(no-1)/N} \text{..equation[2]}$$

Where, “N” is the total number of population house hold in the selected kebeles 3026. Hence: $(1.96)^2$ (0.5) (0.5) ÷ $(0.07)^2$ =196. As our population (N) is known, i.e., 3026 (total number of population house hold in the six kebeles), the following formula gives us the actual sample size for data collection. Thus:

$$n = \quad 1 + \frac{\frac{196}{(196-1)}}{3026} = \quad 184 \text{, respondents.}$$

So sample size of the study area 184. When sample confidence interval at 95 % and error at 0.05%. Numbers of sample households for each sample kebele were determined probability proportionally sample among the total sample households of the six kebeles. Total households 184 of households selected are shown below in (table 3). The survey was conducted through direct interview with household members using structured and semi-structured questionnaire. Interview was conducted with family heads (Family House hold) it was made with appropriate representative and knowledgeable member of the household.

Table 2. Sample Distribution of Six Kebeles Population:

Kebele	Total number of Households			Sampled Households
	Male	Female	Total	
Golja	347	7	354	22
Beleka	259	12	271	16
Buko	289	14	303	18
Merkafo	513	28	541	33
Gosu/Mereto	450	12	462	28
Deneba	1037	58	1095	67
Total	2895	131	3026	184

Source: Own computation, 2019

3.3.1. Vegetation sampling

To determine the species composition and diversity of woody vegetation of the Borecha district study area, sixteen transect lines (from each land use 4 transact lines) were laid down starting from the top of ridge to bottom of the valley in all land use (forest, agroforestery, crop land and grazing land. All trees and shrubs (20m*20m) , 1m x 1m (Herbaceous layer and herbs) were laid down were identified in the plots, Each quadrat, for all plants having diameter at breast height (DBH) ≥ 2.5 cm, the circumference measurements were made at breast height (around 1.3 m) by using measuring tape by following the methods described Martin(1995) since stems born from the same root were considered as a single plant during the census woody vegetation and for perennial plants, the diameter of stems at the breast height was measured separately for each branch and summed. The sample quadrats were laid down along transects at a distance of 100m from each other using measuring tape meter and 200m interval between transact. Hence seventy-two total samples plot were taken from all land use (forest, agroforestry, crop land and grazing land) from each land use or stratum three replications were taken in six study kebeles. The total area in all land use were sample quadrats (2.88 hectares) were sampled.

3.3.2. Soil sampling

Soil samples were collected by stratified sampling as it was determined by FAO (2018).The composite soil samples were collected from the four land use types (crop land, grazing land, forest and agroforestery) from each land use or from each stratum with three replications of soil sample were collected from all land used discussed above and in all six study kebeles seventy-two soil sample ware taken. Both undisturbed and disturbed soil samples were taken. Undisturbed soil samples were taken by core sampler to measure the soil bulk density and moisture content whereas the disturbed soil samples were taken by using an auger to measure the rest selected soil properties such as soil organic carbon, soil texture and soil pH. A composite of represented sample soil 1 Kg from each plot was sampled and all sampled were placed in paper bags with appropriate labels. After the composite soil samples were taken and packed, it was air dried and oven dried finally ground and sieved by 2 mm sieve to the analysis of bulk density, moisture content, soil organic carbon, soil texture and pH of soil. The depth sampled followed the methods described by IPCC (2003) at depth of 30cm. Besides that in all land use and in all study kebeles soil samples were taken at depth of 30cm by using soil auger.

3.4. Materials

The materials were used for this study was described as:- GPS Garmin72H, Digital Camera, auger,Tape meter, Hammer, soil sample dish, beakers, plastic bags, spatula ,soil sample coarser and Computer Hard ware and software.

3.5. Methods of data collection

3.5.1. Questionnaire

Questionnaire method was the most important approach through which the primary data in the study was collected. The content of the questionnaire includes structured and semi-structured questions. The reason to use both structured and semi-structured questions was to get more qualitative data and quantitative data to achieve the intended socio-economic objective. The households' data were collected using structured question. The Agriculture and Natural Resource District office and two development agents and environmental protection officers were involved to facilitate the data collection. In case where the respondent cannot understand the language and translated into local language (Afaan Oromoo and amaric) questionnaires covered socio economic and demographic information such as age, Sex, education, Source of income, land size and house hold size.

3.5.2. Woody vegetation data collection

The vegetation data all trees, shrubs and herbs including vascular epiphytes were recorded from the systematically established quadrats along each transect in all land use. Species which were readily identifiable were recorded in the field. For species which were difficult to identify in the field, local people especially two elders were selected that more likely to know plant local name was interviewed and their local name were recorded as well as later scientific name was identified using plant identification by referring the publication with the help of Flora of Ethiopia and Eritrea (Hedberg *et al*., 2006) and "Useful Trees and Shrubs for Ethiopia" (Azene, 2007). In each quadrant, number and diameter at breast height (DBH at 1.3m) were measured for trees and shrubs by tape meter respectively. The starting point of the first transect line was located randomly. To avoid the edges effects, all the sample plots were established at least 50 m from the forest edges or roads inside the forest (Feyera & Demal, 2001).

3.5.3. Soil data collection

During the collection of soil samples, gravel materials, dead plants, old manures, areas near trees and compost pits were excluded. This is to minimize the differences variation, which may arise because of the dilution of soil OM due to mixing through cultivation and other factors. After these materials and areas were separated, seventy-two composite soil samples were collected from representative land use types (forest land, cropland, agroforestery and grazing land). Then after, about one kilogram of the soil samples from seventy-two composite soil samples was collected, coded and packed by plastic bags.

3.6. Method of Data Analysis

3.6.1. Land use land cover classification

3.6.1.1. Nomenclatures of land cover classes

In almost any classification process, it is rare to find clearly defined classes that one would like. Before collecting training samples, the land cover classes should be known so as to make the classification easier (Bekalo, 2009). The classification nomenclature derived from Anderson *et al.* (1976) land cover classification for remote sensing were used and is modified based on detailed physiographical knowledge of the researcher about the study area. Generally, four LULC types in 1986, 2002 and 2018 were identified. The major LULC in the study area includes: cultivated land, forestland, Grazing land and settlement. The detail types of LULC are presented as in the table blow.

Table 3 . Land Use/Cover Type and their Respective Definition: (FAO, 2010)

Land use/Land cover classes	Description
Cultivated land	Land used for cultivation of crops, the total of areas under Arable land and Permanent crops actually land under irrigated and rain fall and land under temporary meadows or fallow and chat plantations in the farmland, trees and rural homesteads but dominated by farmland.
Forest land	Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 per cent, or trees able to reach these thresholds in situ and including a rage of plantation forest types with one common feature and dominated by, *Eucalyptus spp*, *Gravilia robusta*, *cupreses lusitanica*, etc plantations.
Grazing land	Land covered by grasses, used for grazing either communal or individual and small shrubs dominated by grass.
Settlement	Is a place where people have come to live and have built homes or small rural communities and other man-made structures.

Figure 5. Image of land use of the study area

Source: own field survey

Satellite imageries of 1986, 2002, and 2018 were downloaded from USGS. To increase the quality of the image cloud cover were removed from the satellite image of TM, 1986 and haze reduction technique was employed on some portion of the image land sat of 1986. Multi temporal raw satellite image data was imported to Erdas Imagine 2015 processing software. Then, these images were layer stacked, geo referenced to their corresponding latitude and longitude by using a geo referenced the digital map of the study area, and projected to WGS 1984_ UTM_ zone_37North. The layer staking and extracting the study area of TM, 1986, ETM+2002 and OLI, 2018, land sat images were employed during image processing. Then supervised classification methods were applied on ERDAS imagine version of 2015 software. Among different classification algorithms, maximum likelihood algorithm was used for supervised classification. However, the training data there are some useful suggestions, by Congalton and Green (1999) to use 50 testing samples as minimum for each LULC-category. If the study area is larger than 1,000,000 ha, or if there are more than 12 classified categories, then there should be 75-100 samples for each LULC-category.

This suggested approach samples small areas thoroughly, while large areas might be under-sampled. For this study the accuracy assessment of land cover maps extracted from satellite images, stratified random method was used to represent different land cover classes of the area (forestland, cultivated land, Grazing land and settlement). The accuracy was assessed by using 100 points, based on ground truth data and visual interpretation. For classification accuracy assessment from Original mosaic image of land sat TM, 100 samples were taken for 2002 from Google earth pro 100 samples were taken and 100 points or samples for 2018 from field survey were collected based on the researcher's personal experience and physiographical knowledge of the study area (See annex).

3.6.2. Accuracy assessment analysis

Error matrices were designed to assess the quality of the classification accuracy. Then, the overall accuracy, Kappa coefficient, producer’s accuracy and user’s accuracy were calculated from the error matrix as determined by Fan *et al*. (2007); Congalton and Green (2009). The overall classification accuracy was computed by dividing the number of correct values in the diagonals of the matrix to total number of values taken as a reference point; producer’s accuracy was derived by dividing the number of correct pixels in one class divided by the total number of pixels as derived from reference data; user's accuracy was calculated by dividing correct classified pixels by the total number of pixels and Kappa coefficient, which measures the agreement between the classification map and the reference data. The Kappa coefficient was also used to assess the classification accuracy. The Kappa statistics calculated by using formula as follows:

Kappa (K ˆ): It reflects the difference between actual agreement and the agreement expected by chance and estimated as:

$$\text{Kappa } (K\hat{}) = \frac{Po - Pe}{1 - Pe} \text{……………………………………………………………equation [3]}$$

Where, Po=proportion of correctly classified pixels and determined by the diagonal in error matrix; Pe=proportion of correctly classified pixels expected by chance and incorporates off-diagonal. Accordingly, overall accuracy for the three-year land use/land cover classification of this study was analyzed for the respectively of the three years of 1986, 2002 and 2018 with kappa coefficient or statistics. Due to these the values of kappa coefficient were being allowable range denotes strong agreement and further analyses undertook.

3.6.3. Change detection analysis

To examine the land use/land cover change detection and the rate of its changes, post classification comparison change detection method was being employed. This kind of change detection method identifies where and how much change was being occurred. Then the whole study period (1986–2018) was classified into three sub-periods (1986 to 2002; 2002 to 2018 and 1986–2018) which includes, the entire 32 years of study periods. Then, the paired overlay was performed through spatial analysis in GIS in order to detect, compare, and analyze patterns and directions of changes and to quantify the rate of change, gains, losses, total change and net change of LULC occurred during the time period considered in the study area as determined by Pontius *et al*.(2004). To determine the magnitude, trend and rate of land use/land cover changes in the ressetlement, the area comparison analysis was made by subtracting the total area of each classes of 1986 from 2002, 2002 from 2018 and 1986 from 2018 in which the result could be positive (increasing) or negative (decreasing). The percent and rate of land use/land cover change were computed by the following formula as described by Demissie *et al*. (2017)

$Percent\ of\ change = (A - B)/B$

$Rate\ of\ change = (A - B)/C$..equation [4]

Where A is area of LULC (ha) in time 2, B is area of LULC (ha) in time 1; C is Time interval between A and B in years. Pearson's correlation was used to analyses the relationship between population and land use land cover of 1986 to 2018.

3.6.4. Woody species composition and diversity analysis

Species richness was determined from the total number of woody plant species recorded in each of the four land use types. The diversity of woody plant species in each of the land use types was analyzed. The Shannon Diversity index takes account into the species richness and their proportion of each species in all sampled plots of each land use type as described by Spellerberg and Fedor (2003).The Shannon diversity index accounts for both the diversity and evenness of woody species in the forest, agroforestery, crop land and grazing land. It was computed vegetation species diversity and vegetation species evenness by computing formula: Shannon diversity (H') and evenness (E') indices are also calculated as a measure to incorporate both species diversity and species evenness. Shannon diversity index was calculated as described by (Nolan and Callahan, 2006):

$H' = -\sum_{s}^{n} pi * lnpi$ .... equation[5]

Pi = is the proportion of individuals found in thei^{th} species (ranges 0 to 1); and

(Pi=n/N=n = number of individuals of a given species; N = total number of individuals

H' = species diversity index.

The Shannon evenness or equitability was calculated as

E=$\frac{H\prime}{lnS}$ o r E=$\frac{H\prime}{Hmax}$ equation..[6]

Where: H' = species diversity index; ln = natural logarithm.

The value index usually lies between 1.5 and 3.5 although in exceptional cases the value exceeds 4.5 (Kent and Coker, 1992). In this case excel was used to run the analysis. Measurement of similarity: similarity indices measure the degree to which the species composition of quadrants or samples matches is alike many measures exist for the assessment of similarity or dissimilarity between vegetation samples or land uses the Sorensen similarity coefficient were used. Sorensen similarity coefficient is applied to qualitative data and is widely used because it gives more weight to the species that are common to the samples rather than to those that only occur in either sample (Kent and Coker, 1992). The Sorensen coefficient of similarity (Ss) is given by the formula: the coefficient of the community of total species that in all land use communities have in common and Sorensen coefficient similarity (Ss) is given by formula:

$$Ss = \frac{2a}{2a+b+c}$$ ……………………………………………………………........ equation,[7]

Where Ss=Sorensen similarity coefficient a=number of species common in all land use b=number of species recorded in first community c=number of species recorded in second communities. The coefficient is multiplied by 100 to give a percentage. Species composition was compared among land use types using a Sorensen similarity coefficient (Brower *et al*., 1997; Krebs 1999) from the base of the tree and focused on the highest point of the tree (Negasi *et al*., 2016).

The density of the woody plant species was calculated by converting the total number of individuals of each woody species encountered in all the sample plots to equivalent number per hectare. Relative density was also the number of individuals of a species per ha to the total number of individuals per ha multiplied by 100. Relative frequency of a species was computed as the ratio of the frequency of the species to the sum total of the frequency of all species at each study site. Dominance of the woody species was determined by its basal area. The total basal area of each woody species was converted to equivalent basal area per hectare. Relative dominance was calculated as the percentage of the total basal area of a species out of the total basal areas of all species at each study site. According to Froumsia *et al*. (2012) and Guyassa and Raj (2013), importance value index (IVI) for each woody species is analyzed by summing up relative density, relative dominance, and relative frequency for each of the land use types (Forest , agroforestry , cultivated land and grazing land). Therefore, the importance value index was estimated individually to evaluate the importance of woody species found in Forest, agroforestry, cultivated land and grazing land.

3.6.5. Soil laboratory analysis.

The selected soil parameters under different land use were taken due to from the, were thoroughly mixed together to get composite samples for the determination of SOC, pH, particle size analysis, while the BD, and moisture content due to related Organic matter or SOC and were the pH was taken due to affect plant nutrient uptake, this was recommended by (WBI, 2014), World Bank Electronic Institute for Clean Development Mechanism (CDM) project.

Soil texture was analyzed by the Bouyoucous hydrometer method (Bouyoucous, 1962) .After the particle size distributions were determined in percent, the textural class of the soil was obtained by using USDA soil textural triangle classification system (USDA, 2008). The bulk density (BD) of the soil was measured from undisturbed soil samples collected using a core sampler after drying the core samples in an oven at 105 °C for 24 hours (Black, 1965). Calculation of Bulk Density by the following equation by (Pearson *et al*., 2005). BD sample= ODW- RF/CV ……………………………………………………………………equation [8]

Where: BD sample= Bulk density (g/cm3) ODW = Oven dry mass, total sample in grams CV = Core volume in cm^3 RF = Mass of coarse fragments (> 2 mm). Moisture content was calculated using gravimetric method in which wet soil was oven-dried at 105^oC for 24 hours. It was expressed as a percentage of oven dry soil. The pH of the soil was measured potentiometerically using glass electrode pH meter in the suspension in a 1:2.5(soil: water) by pH meter. SOC was analysed according to Walkley-Black method (Walkley and Black, 1934). Total SOC stock per hectare (Mg/ha) was calculated by the following equation soil organic carbon stock pools were calculated using the formula determined (Pearson *et al*., 2005) SOC=C%*D (cm)*BD (g/cm3 ………..equation [9]

Where, SOC = Soil Organic Carbon (Mg $ha-^1$) BD = Bulk Density (g/cm3) D = Depth of the Soil Sample (cm)

3.6.5.1. Statistical analysis

The data was organized and entered into the Statistical Package for Social Sciences (SPSS) software version 20 for windows. Data distributions checked for normality. Using SAS 9.3 version statistical software and a one-way Analysis of variance ratio (ANOVA)using the

General Linear Model(GLM) procedure and Least significant difference (LSD). The Least Significant difference is used to compare means of different treatments that have an equal number of replications. The mean comparisons made using the THSD/ Tukey Honest Significant Difference and used to test for significant differences between the land use and soil organic carbon as well as selected soil parameters varied significantly with each treatment for statistically different parameters at probability 5% ($p \leq 0.05$), (Brejda *et al*., 2000a). Pearson's correlation was used to analyses the relationship between soil organic carbon and related soil parameter with land use.

3.6.6. Socioeconomic analysis

The data collected through structured questioners, were analyzed using the statistical package for social science (SPSS) version 20 and in addition Microsoft office excel 2003 was used for analysis of some statistical measurement. The result of interviews was the descriptive statistics like; percentage and frequencies were being analyzed and presented in the form of tables and figures.

4. RESULT AND DISCUSSION

4.1. Socio Economic Characteristics of Respondents

4.1.1. Sex and Age structure of respondents

Based on all valid survey responses, the respondents out of 184 household heads, 177 were males and 7 were females. As the table (4) indicated that about 16 (8.69%) respondents were under 30 years old, these shows that the young house hold their age twenty five and above but blow 30 years old. Whereas 120 (65.2%) and 48(26%) of respondents were grouped into between 30 and 64 years old and above 64 years old age group respectively. Most of the respondents have 30 up to 64 years old.

4.1.2. Marital status of the respondents

The marital statuses of the respondents indicated as in (table 4) 168(91.3) respondents were married, six (3.2%) respondents were divorced, seven (3.8%) respondents were a widower and widowed and three (1.7) respondents were single. So most of the respondents in this study were married household heads. The Marital status also impacts on land use land cover.

4.1.3. Household size of the respondent

As indicated blow (table 4) about 26(14.13%) respondents have one up to three household sizes and about 107 (58.16%) respondents have four up to six household sizes. The remaining 51(27.71) respondents have seven up to nine family sizes. More than 158 (85.9 %) of respondents have more than four house hold size. As individuals reach adulthood and seek their own incomes, they need more land for subsistent crop production.

Table 4. The demographic and socio economic of respondents of the study

Variable	Golja		Beleka		Buko		Mereto		Merkefo		Deneba		Total	
	Name of kebales													
Age	No	%	NO	%	NO	%	NO	%	NO	%	NO	%	Tot.	%
<30			1	5.9	2	11.8	4	23.5	3	17.7	6	41.2	16	8.69
30-64	17	14.3	12	10	12	10	13	10.9	21	17.7	45	37	120	65.2
>64	5	10.4	3	6.3	4	8.3	11	22.9	9	18.8	16	33	48	26.1
Total	22	12	16	8.7	18	9.8	28	15.2	33	17.9	67	36.4	184	100
Education														
0 class	9	9.9	7	7.7	9	9.9	13	14.28	18	19.8	35	38.5	91	49.5
1-8 class	12	14.6	6	7.3	7	7.7	15	18.29	13	15.9	29	35.4	82	44.6
>9	1	9	3	27.3	2	18.2			2	18.2	3	27.3	11	5.9
Total	22	12	16	8.7	18	9.8	28	15.2	33	17.9	67	36.4	184	100
Land size														
0.5-2ha	11	10	10	9	12	10.9	14	12.7	20	18.2	43	39.1	110	59.83
2LHS4	10	14.75	5	8.2	5	8.2	13	21.3	11	18	18	29.5	62	33.2
4LHS6	1	11.1			2	22.2	2	22.2	1	1.1	3	4.9	9	4.9
6LHS8									1	25	2	50	3	1.6
Total	22	11.95	16	8.7	18	9.8	28	15.21	33	17.9	67	36.4	184	100
House hold size														
1-3	3	11.5	2	7.7	2	7.7	3	11.5	6	23.1	10	38.5	26	14.1
4-6	13	12.4	9	8.4	11	10.3	16	15	19	17.8	39	36.4	107	58.2
7-9	6	11.8	5	9.8	5	9.8	9	17.6	8	19.6	18	35.3	51	27.7
Total	22	12	16	8.6	18	9.78	28	15.2	33	17.9	67	36.4	184	100
MaritalStatus														
Married	19	11.3	15	8.9	17	10.11	26	15.47	30	17.8	61	36.3	168	91.3
widower/ed	1	14.28	1	28.5			1	14.3	1	14.3	3	42.8	7	3.8
Single					1	33.3	1	33.3	1	33.3			3	1.7
Divorced	2	33.3						33.33	1		3	50	6	3.2
Total	22	11.95	16	8.6	18	9.7	28	15.21	33	17.9	67	36.4	184	100

Source: Own computation, 2019

4.1.4. Land holding size of the respondent

As in the table 4 about 110 (59.8%) of respondents have 0.5-2 hectare land holding size , about 61(33.2%) respondents have more than 2 and less than 4 hectare land , about 9 (4.9%) respondents have more than 4 and less than 6 hectare land, 4(2.2%) respondents have more than 6 and less than 8 hectare of land. More than 92.9% of the respondents have 0.5 and less than four hectare land. More of the respondents of house hold, even around 110 of respondents have 0.5-2 hectare land and them sharing land from indigenous people or the farmer around the edge to vicinity of forest is clearing or converts a forest in form of expanding agricultural land because there is land scarcity. This is consistent with Bogale *et al*. (2006) who reported that the scarcity of cultivated land, which can support a family of rural households, provokes for action by deforestation and expansion of agricultural land is their interest of resettlers to acquire enough cultivated land. This situation was made farm land conflict between settlers and native community. This finding is agree with the study of Deininger and Castagnini (2004) in Uganda who showed that farm land conflict has a negative impact on the productivity of farmers and land use land cover through consuming more time to attempt resolving the land conflict and they local elders negotiated by sharing half cleared forests as agricultural lands between two bodies and they made agreement and demarcation.

4.1.5. Education status of the respondents

According to household head survey most of household heads are illiterate. The education status of the respondent could be grouped in to, 0-classes, elementary and secondary and above. As in the (table 4) indicated that most of respondent were illiterate (0 class) which shares 91 (49.5%) of the respondents. The remaining (82)45.1% and 11 (5.97 %) of respondents were stopped education in elementary and secondary school level respectively. More of respondent of the study area is an illiterate.

4.1.6. Ethnicity and religious affiliation

The Oromo are numerically the largest ethnic groups and Amara are least ethnic groups in the study area. These ethnic groups account for about Oromo 157 (85.32% and Amara 27 (14.7%) of the total household's survey respectively. Information regarding religious affiliation of sample households reveals that 164(89.1%) are Muslims, Orthodox Christians, 15(8.2 %) and 5 (2.7%) are Protestants.

4.2. Population size and growth

Ethiopia has made three national population and housing surveys in 1984, 1994 and 2007. The population size of study area was 2003 in 1986, 4621 in 1994, and 13, 147 in 2007 (CSA, 2007) .Assuming between the two periods of 1986 and 1994, the estimated population size for the study area was about 6624. This means, on average, 828 people were added to the study area in each year. Between 1986 and 2007, the estimated population size for the study area was 19,771 on average, 859 people were added each year, reaching 19,771 in 2007. The overall trends were showed that continuing population increase in the study area. During 1986 and 2002 the population increased because of new resettlements. The increment of the population in study area was impacted on land use land cover because of resettlement to acquire land for house construction and agricultural land expansion, the problem is escalating with high population dynamics. During discussion with key informant interview they mentioned mass of forest was cleared because of resettlement and wild life was attacked and was migrated. The settlers had no or low awareness about family plan and because of this problem the population was increased. Correlation of the population related to the different land uses were evaluated based on the correlation coefficient as below table.

Table 5. Pearson correlation between land use land cover and Population growth 1986 to 2018

Land use/population	Settlement	Grazing land	Crop land	Forest	Population
Settlement	1				
Grazing land	-.98**	1			
Crop Land	.97**	-99**	1		
Forest	-.90**	-.67**	-.74**	1	
Population	.88**	-52**	.93**	-.53**	1

** Correlation is significant at the 0.01 level (2-tailed).

Source: CSA Jimma Branch (1996, 2008) and BANO (2019) and data computed from remote sense and $p=po*e^{rt}$, where e=Euler number, 2.718228 p=total population t=time in years r=rate of growth.

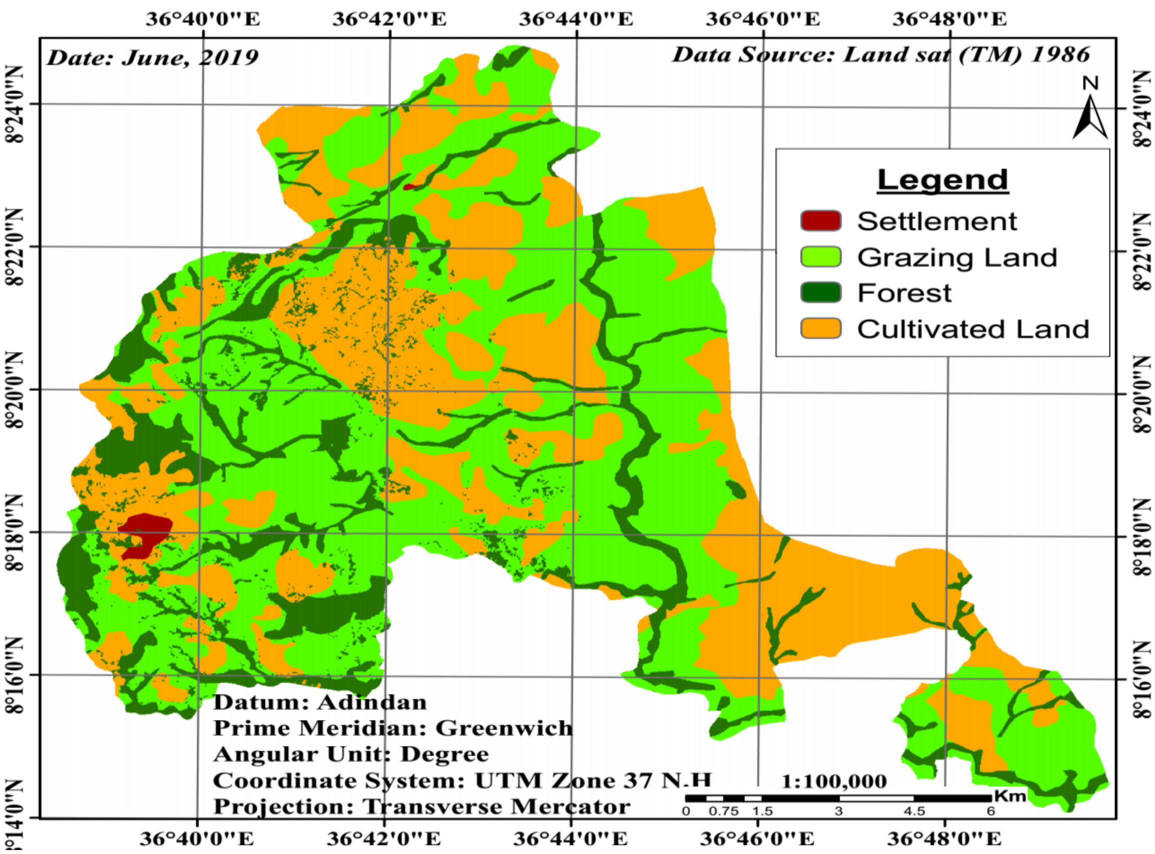
As above table (5) the result was revealed that settlement is negatively correlated with the grazing land(r=-.98**). The possible explanation for this settlement in study area is the negative impact on grazing land. This could be during ressettlement for acquiring agriculture land and house construction grazing land use changed to agricultural land and other land use. The positive correlation was found between Cultivated /crop land and settlement (r=0.97**) this implies that as settlement increases, crop land also increases because the acquiring to cultivated land and demand for food was increased in study area. Population growth increase demand for food and corresponding need to convert forests to agricultural land is increasing and to satisfy the need of large family size large amount of resources are necessary. This study agree with, Geist and Lambin (2002) who reported that the population growth leads to great impact on some natural resources like forest and evidence shows that as household size increases, the demand for new agricultural land outside the farm grows, causes an increase in deforestation. More-over the forest and settlement was negatively highly correlated (r= -0.90**). This suggests that as settlement increase area covered by forest was decrease, this is due to the land expansion for agriculture and deforestation of forest for construction, charcoal preparation and domestic energy use the forest of the study area was decreased. Moreover individuals in study area reach adulthood and they seek their own incomes, they need more land for subsistence crop production. This study finding is consistent with (Car, 2009),who reported that most of these families have moved to the edges of large, relatively intact and undisturbed natural forest, as a result of increasing population densities pushing them out of their former neighborhoods. Besides settlement and population were positively and highly correlated (0.88**).These was showed that as population growth of the study area increase settlement was increased. The result revealed that population of the study area was increased and shortage of land occurred due to population growth. The result was revealed that cropland negatively correlated with grazing land and forests (-0.99**and-0.74**) respectively.

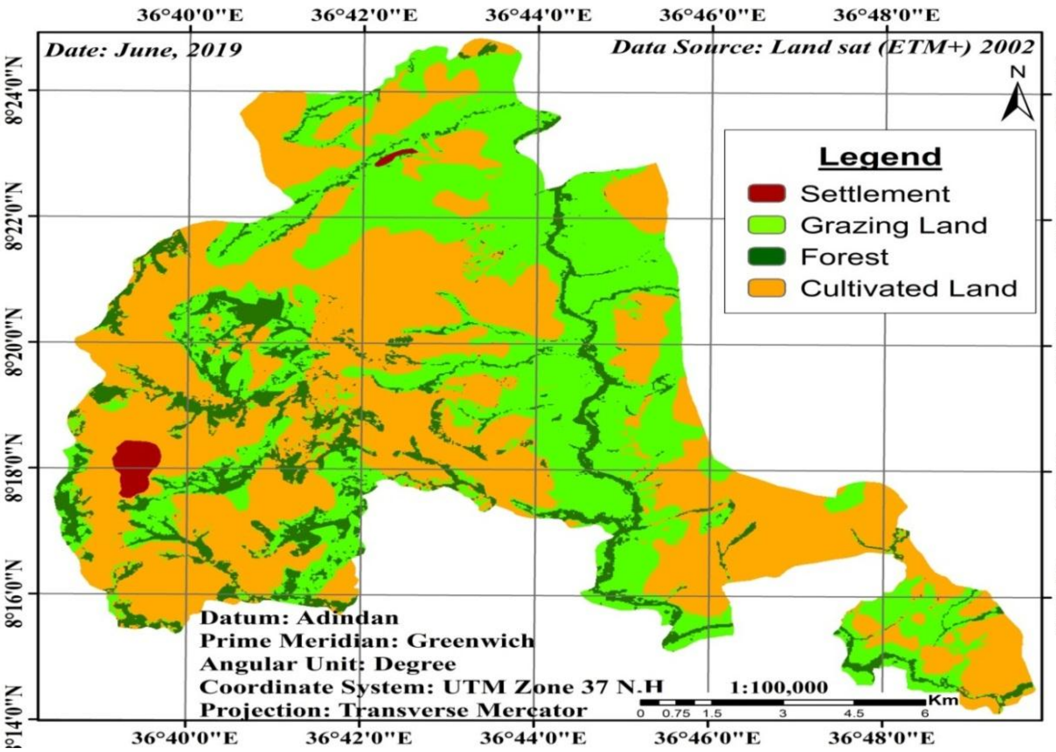
The results were showed that because of agricultural land expansion by resettler's resulted decrement of the forest and grazing land of the study area. This finding is agree with the study of (Geist and Lambin 2001) who confirmed that expansion of cropland accounted for 96% of the cases causing deforestation and decreasing of pasture (grazing land). The result of the study area revealed that population was positively correlated with crop land expansion (0.93**). The result was showed that as population growth increases the need for food also increases and to feed this population increasing production by expanding agriculture land is common in study area. Generally the results was showed that population was negatively correlated with forest and grazing land (-0.525**and -0.531**) respectively. As population increases the forest cover decreased for different demand of using forest for different purpose and expansion of agricultural land and the grazing land also decreased because of population growth. This study was consistent with the study of Geist and Lambin (2003) who reported that 61% of deforestation and decreasing of grazing land was related to human population dynamics.

4.3. Land Use and Land Cover Change of 1986, 2002 and 2018

4.3.1. Land use land cover classification of the study area (1986, 2002 and 2018)

The result of the supervised classification of land use land cover using land sat images was presented and four land use land cover categories, which were forest land, cultivated land, grazing land and settlement was identified as a major land use land cover of the study area. Thus land use land cover classification map for 1986, 2002 and 2018 are shown as blow (Fig.6).





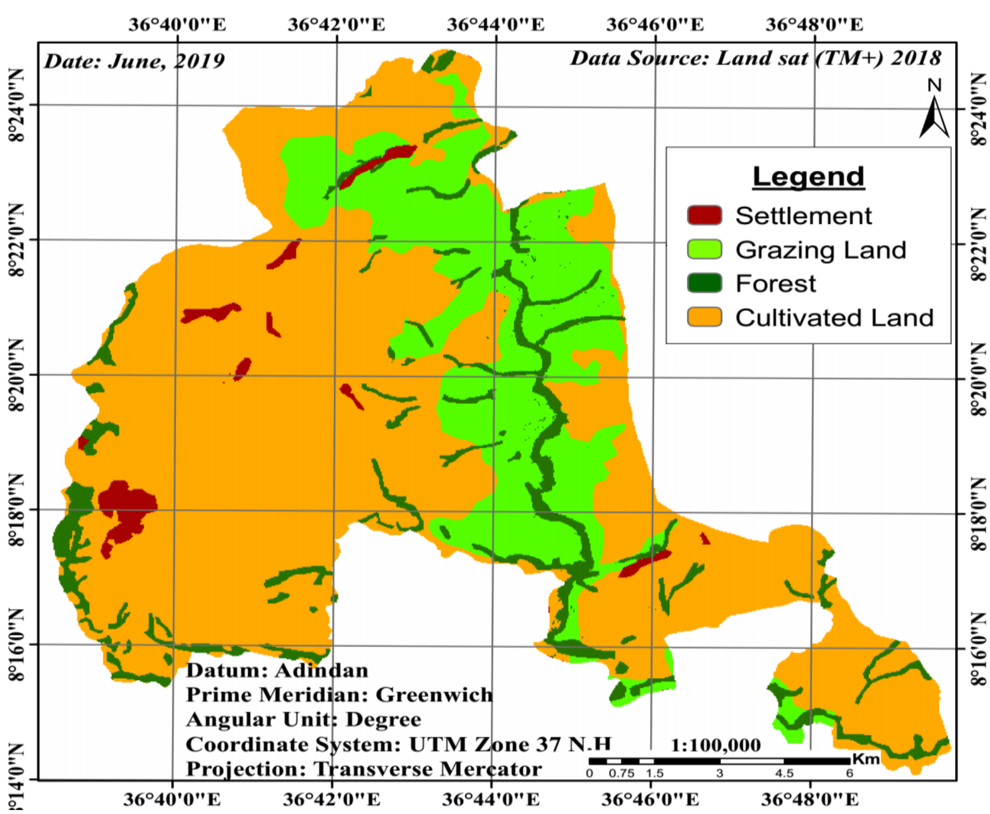


Figure 6. Map LULC of the study area of years 1986, 2002 and 2018

Source: computed from classification of land sat 1986-2018

The study reveals that the overall accuracy for over the period of 1986, 2002 and 2018 were 89.00%, 88.00% and 91.00% respectively and the LULC accuracy of all period of year's averages were 1986, 2002 and 2018, was above 85% .This study agree with Adubofour,(2011) who reported that the minimum level of interpretation accuracy in the identification of land use and land cover categories from remote sensor data should be at least 85 percent. With the kappa coefficient 1986, 2002 and 2018, was 0.84, 0.826 and 0.86 respectively. This kappa coefficient values greater than 0.8 and the result was revealed that denotes a strong agreement. This study finding consistent with study of Anthony *et al*.(2005) who reported that the kappa coefficient value has a characteristics is values greater than 0.8 denotes a strong agreement, value between 0.4 and 0.8 denotes a moderate agreement and value less than 0.4 represent poor agreements. The accuracy assessment of the LULC mapping of 1986, 2002 and 2018 were discussed as in blow table.

Table 6 . The accuracy assessment for LULC mapping of 1986, 2002 and 2018.

Lu /lc types	1986		2002		2018	
	Prod Acc.	User's Acc.	Prod. Acc.	Users Acc.	Pro. Acc.	Users Acc.
Forest land	88.89%	94.12%	87.5%	77.78%	86.67%	81.2545
Grazing land	90.635%	87.88%	90.24%	90.24%	95.12%	95.12%
Cultivated land	90%	90%	87.88%	93.55%	93.75%	90.91%
Settlement	80%	80%	80%	80%	75%	90%
Ovaer.acc.		89%		88%		91%
Kappa.cof.		0.84		0.82		0.86

Source: computed from classification of land sat 1986-2018

4.3.2. Land covers class of 1986, 2002 and 2018

An area in hectares and the percentage over each land use land cover classes of all years described in Table 7 the classification indicated that land use land cover of the study areas showed dynamics both spatially and temporally through the period of 1986, 2002 and 2018. In 1986 forest accounts 2936ha (16.24%), cultivated land 6584ha (36.42%), grazing land 8486ha (46.94) and settlement 77ha (0.43%).Therefore in the case of the year 1986 the land use land cover classes the highest is grazing land and the lowest is resettlement respectively. In 2002 the land use land cover forest 2024ha (11.20%), cultivated land 9169ha (50.72%), grazing land 6749ha (37.33%).During this significant land use land cover changes the forest is declined from 2936ha (16.24%) to 2024ha (11.20%) in 2002 period. And cultivated land shares large amount during this period by a positive increment in 1986 to 2002 from 6584ha (36.42%) to 9169ha (50.72%) was observed while Grazing land decrease from a period of 1986 to 2002, 8486ha (46.91%) to 6749ha (37.33%) during this period. On the other hand settlement increase from 77ha (0.43%) to 135ha (0.75) respectively.

Table 7 : The land use land cover from 1986 to 2018 period of years:

Land Cover Classes	Year					
	1986		2002		2018	
	Area(ha)	%	Area in(Ha)	%	Area i(Ha)	%
Forest land	2,936.00	16.24	2,024.00	11.2	1,557	8.61
Grazingland	8480.00	46.91	6749.00	37.33	3,963	21.92
Cultivated land	6584.00	36.42	9169.00	50.72	12,227	67.64
Settlement	77	0.43	135	0.75	330	1.83
Total	18,077.00	100	18,077.00	100	18,077.00	100

Source: computed from classification of land sat 1986-2018

4.3.3. Land use land cover change detection of 1986-2002

The land cover change of 1986-2002 was quantified by using differences from the beginning period. The result of change analysis of sixteen years land cover maps of the study area showed that there is change in all land cover classes. Therefore negative net change expresses a certain land use and land cover in a state of deduction, while positive sign explains an increment each period. The land use land cover was changed by disturbance of human being and nature, land use land cover is not static and there was a change of land use land cover significantly. In the beginning period of the study (1986-2002) the forest land was decrease from 2936ha (16.4%) to 2,024ha (11.2%) by a net change (-912ha) (17.253%) and rate of change (-57ha/year) this showed that there forest conversion into agriculture and other land uses.

Similarly, between periods of 1986-2002, the grazing land showed that maximum significant change from 8480ha (46.91%) changed to 6,749ha and (37.33%) the net change was (-1731ha) in percentage (32.74%) while rates of change (-108.2ha/year). This might be increase of population size in need additional land for cultivation. This study consistent with (Abate, 2011; Rachmad and Nobukazu 2013) who reported that population growth is greatest driving force for conversion of grazing land to cultivated land. On the other hand both cultivated land and settlement gains from other land was increased cultivated land increased from 6584ha (36.42%) to 9169ha (50.72%) with increased by net change (+2585ha) (48.9%) from 1986 to 2002 where rate of change (+161.6ha/year).Similarly the settlement increased from 77ha (0.43%) to 135ha (0.75%) by net change (+58ha) (1.11%) and rate of change 3.63ha/year. More over the LULC classes of change detection from the period of 1986 to 2002 was discussed as in the blow table.

Table 8. The land use land cover classes change detection from 1986-2002.

land use land cover	Year						
	1986		2002		Netchange	Rate of Change	
	Area(ha)	(%)	Area(ha)	%	Area(ha)	%	Ha/year
Forest land	2,936.00	16.24	2,024.00	11.2	-912	-17.25	-57
Cultivated land	6,584.00	36.42	9,169.00	50.72	2,585	48.9	161.56
Grazing land	8,480.00	46.91	6,749.00	37.33	-1,731	-32.75	-108.19
Settlement	77	0.43	135	0.75	58	1.1	3.63
Total	18,077.00		18,077.00		5,286.00		

Source: computed from classification of land sat 1986-2002

Table 9 : The change detection of Land use land cover of 1986-2002

	Landuse/Cover Categories	Land Use Land Cover in 1986				
		Forest land	Cultivated land	Grazing land	Settlement	Row Total
Land Use Land Cover in 2002	Forest land	**1,283.00**	124.00	617.00	0.00	2,024
	Cultivated land	914.00	**4,947.00**	3,301.00	7.00	9,169
	Grazing land	731.00	1,459.00	**4,559.00**	0.00	6,749
	Settlement	8.00	54.00	3.00	**70.00**	135
	Class Total	2,936.00	6,584.00	8,480.00	77.00	**18,077.00**
	Class Changes	**1,653.00**	**1,637.00**	**3,921.00**	**7.00**	
	Image Difference	**-912.00**	**2585.00**	**-1,731.00**	**58.00**	

Source: computed from classification of land sat 1986-2002

Table 10. Land use land covers change detection of 1986 to 2002.

Land us land cover	conversion to	1986-2002	
		Area(ha)	%
Cultivated land	Cultivated land to settlement	54	0.3
	Cultivated land to grazing Land	1,459	8.07
	No change in cultivated land	4,947.00	27.37
	Cultivated land to forest land	124	0.6
Forest land	Forest land to settlement	8	0.04
	Forest land to grazing Land	731	4.04
	No change in forest land	1,283	7.1
	Forest land to cultivated land	914	5.06
Grazing land	Grazing land to settlement	3	0.02
	No change in grazing land	4,559	25.22
	Grazing land to forest land	617	3.41
	Grazing land to cultivated land	3,301.00	18.26
Settlement	No change in Settlement	70	0.39
	Settlement to grazing Land	0	0
	Settlement to forest Land	0	0
	Settlement to Cultivated land	7	0
Total		18,077.00	100

Source: computed from classification of land sat 1986-2002.

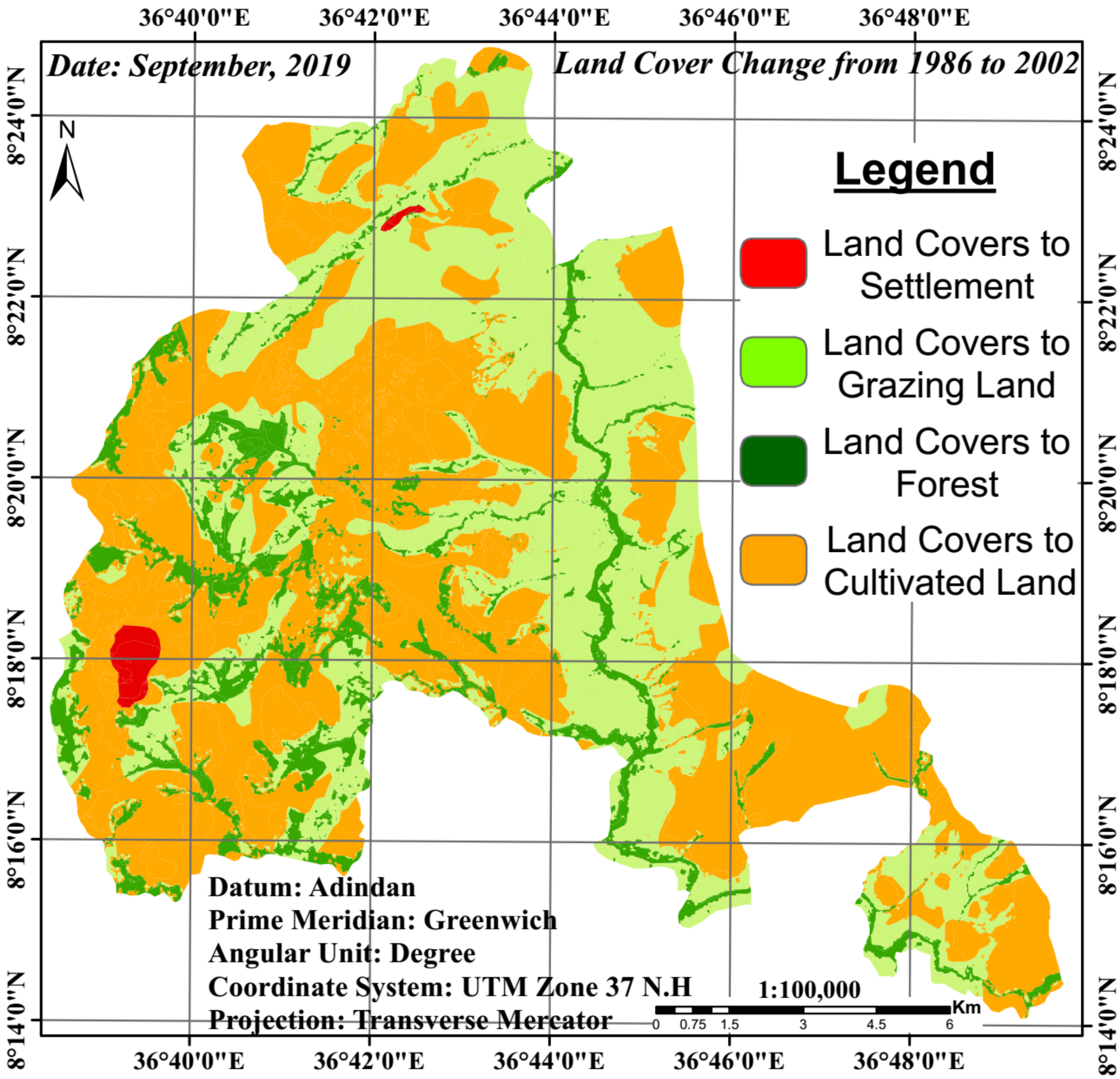


Figure 7. Map of change detection land use land cover of study area 1986-2002

Source: computed from classification of land sat 1986-2002

4.3.4. Land use land cover change detection of 2002-2018

The change detection analyses showed that between 2002 - 2018 forest lands was decreased from 2024ha (11.2%) in 2002 to 1557ha (8.61%) 2018. This means the average net of change (-467ha) and (-7.18%) with a rate of change during these sixteen years (-29.2ha/year). This implies that forest decrease because of resettlement and expansion of agricultural land expansion. However land use land cover map results showed that elsewhere like a forest, grazing land was decreased during 2002 to 2018, from hectares of 6749 (37.33%) to

3963ha(21.92%) the net change of grazing land from 2002 to 2018 was (-2786ha) (42.8%) with the rate of change(-174.13ha/year). Moreover both cultivated land and settlement results showed that between 2002 to 2018 positive increment was observed and gained from other land use land covers, while forest land and grazing land of the study area were decreased and changed to other land use. The farmland expansion was huge, and it is the largest land use type that gained the largest proportion of land from other land use/cover types, was increased from 9169ha (50.2%) to 12, 227ha (67.64%) by mean net change 3058ha (47%) and the rate of change was 191.13ha/year between 2002 to 2018 in Borecha district of study area.

Table 11. The land use land covers change detection of 2002-2018.

Land Cover Classes	Land use Land Cover Change in Hectare and Percentage from 2002 to 2018						
	2002		2018		Net Change		Rate of Change
	Hectare	%	Hectare	%	Hectare	%	Hectare/Year
Forest	2,024.00	11.2	1,557	8.61	-467	-7.18	-29.19
Grazing land	6,749.00	37.33	3,963	21.92	-2,786	-42.8	-174.13
Cultivated land	9,169.00	50.72	12,227	67.64	3,058.00	47	191.13
Settlement	135	0.75	330	1.83	195	3	12.19
Total	18,077.0		18,077.00		6,506.00	100	

Source: computed from classification of land sat 2002-2018.

Table 12. The Land use land covers change detection of 2002-2018

	Land Cover Categories	Land Use Land Cover in 2002				
		Forest	Grazing land	Cultivated land	Settlement	*Row Total*
Land Use Land Cover in 2018	Forest land	**763**	478	316	0.00	1,557
	Grazing land	96	**2,847**	1,020	0.00	3,963
	Cultivated land	1,156	3,367	**7,687**	17	12,227
	Settlement	9	57	156	**108**	330
	Class Total	2,024.00	6,749.00	9,169.00	135.00	**18,077.00**
	Class Changes	**1,261.00**	**3,902.00**	**1,482.00**	**27.00**	
	Image Difference	***-467.00***	***-2,786.00***	***3,058.00***	***195.00***	

Source: computed from classification of land sat 2002-2018 .

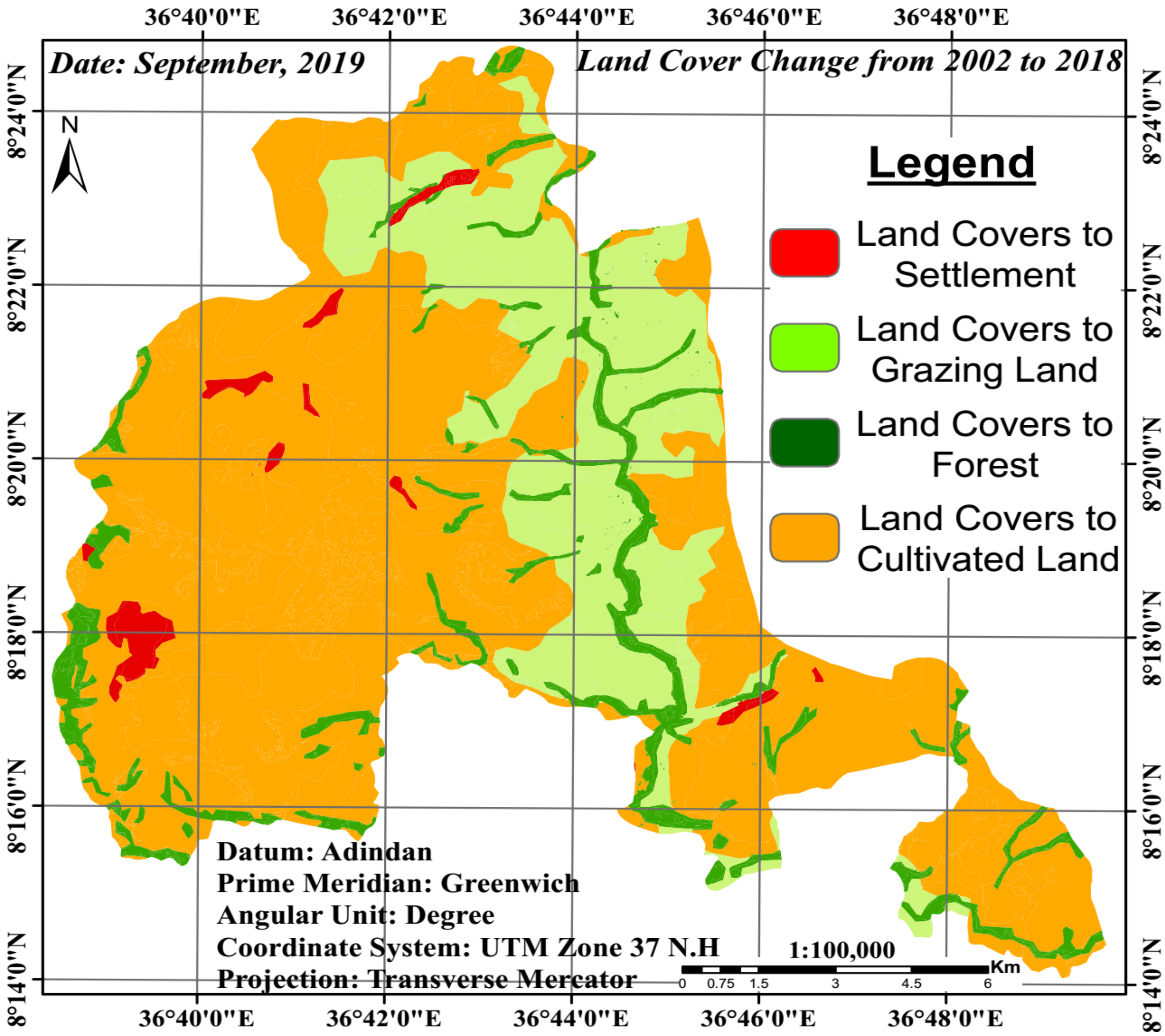


Figure 8. Map of the Land use land cover change detection of 2002-2018

Source: computed from classification of land sat 2002-2018

4.3.5. Land use land cover change detection of 1986 to 2018

Significantly land use land cover changes was observed between 1986 to 2018 .In this period forest land decreased, from 2936ha (16.35%) to 1557ha (8.61%) with net of (-1379ha) ,(11.7%) forest cover was lost and converted to other land use by rate of change (-43.09ha/year). The other land use has been grazing land since 1986 it was changes from 8486ha (46.95) to 2018, 3963ha (21.92%) by the net change between two periods was (-4517ha) (-38.3 %) and by the rate of change (-141.15ha/year).This study corroborated with study of Abate and Angassa (2016) indicates that the range land or grazing land of southern part of Ethiopia is adversely affected by increased human population pressure. Especially because of acquiring agricultural land and food demand in Borecha study area cultivated land expansion was observed in 1986 to 2018. The farmland expansion was huge, and it is the largest land use type that gained the largest proportion of land from other land use/cover types from 1986, 6,584 ha (36.44%) to 2018, 12,227ha (67.64%), by net change between 5,643ha (47.8%) this means between 1986 and 2018, a total of (+5,643 ha) of land have been converted to farmland by rate of Change (+176.34ha/year) for above mentioned period.

The land that has been brought under cultivation is significantly high. It is also evident that to increase production to fed population growth in study area each year was obtained at the expense of bringing more land under cultivation. Subsistent agriculture is inherently ineffective and, therefore, large areas of land are needed to meet the needs of rural households. This finding agree with the study of Lambin *et al*. (2003) who stated that in Africa large-scale forest conversion for cropland expansion by smallholders dominates. Besides settlement was increased significantly between 1986 - 2018 year from 77ha (0.43%) in 1986 330ha (1.83%) in 2018 by net change +253ha (2.14%) as well as by rate of change in 32 years 7.91ha/year. This finding is in line with Mekuria (2005) who reported that such progressive expansions in cultivated land and settlements are apparent indicators of a continuous increment in population density.

Table 13 . The land use land cover change detection analysis 1986 to 2018.

	Land use Land Cover Change in Hectare and Percentage from 1986 to 2018						
Land Cover Classes	1986		2018		Net Change		Rate of Change in 32 Years
	Hectare	%	Hectare	%	Hectare	%	Hectare/Year
Forest land	2,936.0	16.3	1,557	8.61	-1379	-11.7	-43.09
Grazing land	8,480.0	46.9	3,963	21.92	4,517.00	-38.3	-141.15
Cultivated land	6,584.00	36.4	12,227	67.64	5,643.00	47.8	176.34
Settlement	77	0.4	330	1.83	253	2.14	7.91
Total	18,077.	100	18,077.	100	11,792.	100	

Source computed from classification of land sat 1986-2018.

Table 14. The land use land cover change detection Matrix between periods of 1986 to 2018

Land Cover Categories **2018**	Land Use Land Cover in 1986				
	Forest	Grazing Land	Cultivated Land	Settlement	Row Total
Forest	**1,101**	347	109	0	1,557
Grazing Land	120	**2,752**	1,089	2	3,963
Cultivated Land	1,691	5,278	**5,256**	2	12,227
Settlement	24	103	130	**73**	330
Class Total	2,936.00	8,480.00	6,584.00	77.00	**18,077.00**
Class Changes	**1,835.00**	**5,728.00**	**1,328.00**	**4.00**	

Source computed from classification of land sat 2002-2018.

Table 15. The land use land covers change detection of 1986 to 2108

Land us land cover	Conversion to	1986-2018	
		Area(ha)	%
Cultivated land	Cultivated land to settlement	130	0.72
	Cultivated land to grazing Land	1,089	6.02
	No Change in cultivated land	5,256	29.08
	Cultivated land to forest	109	0.6
Forest land	Forest in settlement	24	0.13
	Forest to grazing land	120	0.66
	Forest to cultivated land	1,691	9.35
	No Change in forest	1,101	6.09
Grazing land	Grazing land in settlement	103	0.57
	No Change in grazing land	2,752	15.22
	Grazing land to cultivated land	5,278	29.2
	Grazing land to forest	347	1.92
Settlement	No Change in settlement	73	0.4
	Settlement to grazing Land	2	0.01
	Settlement to cultivated Land	2	0.01
	Settlement to forest	0	0
Total		18,077.00	100

Source computed from classification of land sat 1986-2018.

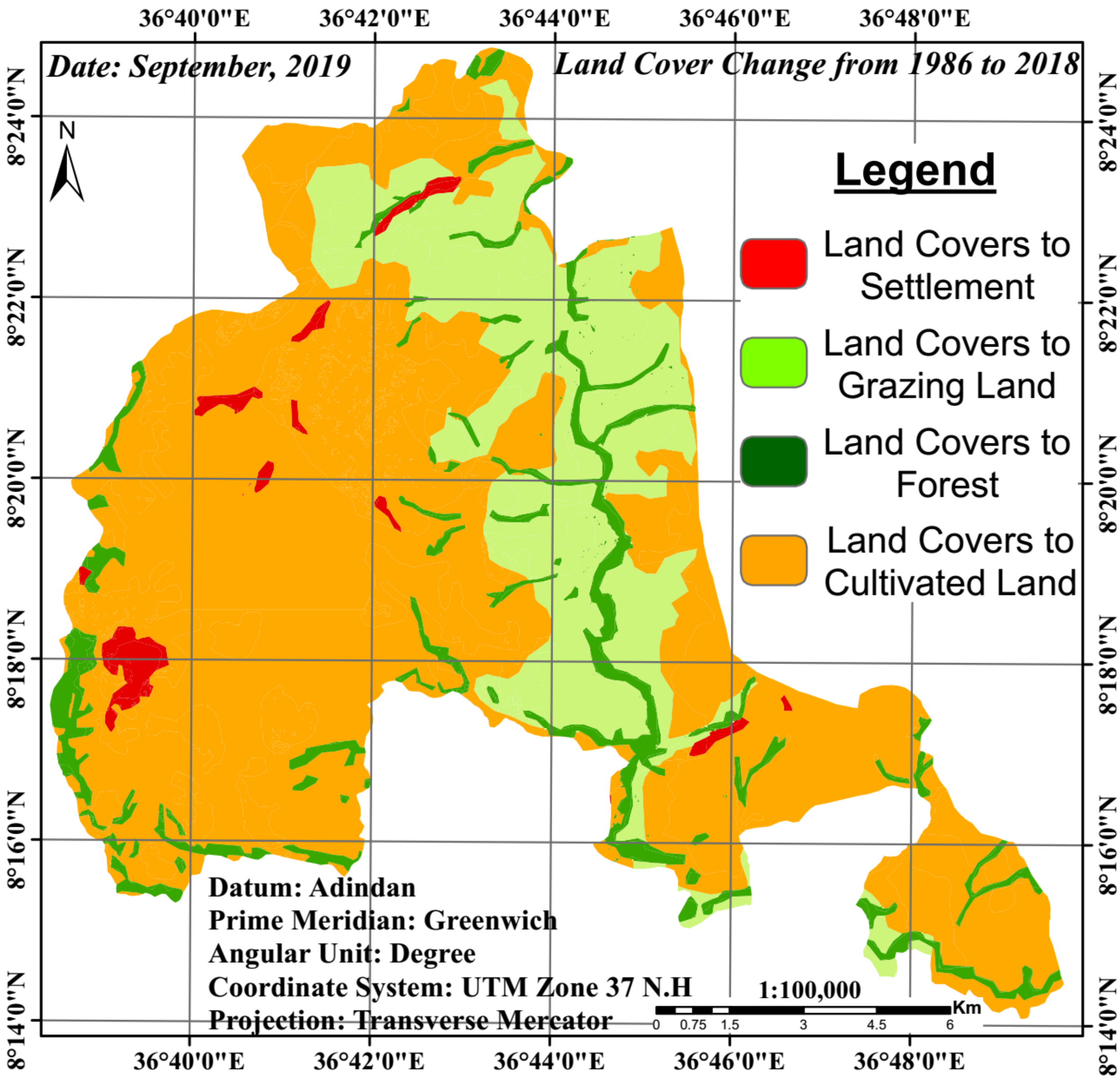


Figure 9. Map of the land use land covers change detection from 1986 to 2018

Source: computed from classification of land sat 1986-2018

4.4. The Woody Species Composition and Diversity of Different Land Use Types

A total of 90 woody species were recorded, and 32 families were identified in each four land uses (forest, agroforestry, farm land and Grazing land,) (appendix 1). Across land use of natural forest had more woody species (41 from 25 families) than agroforestry (25 from 16 families) or grazing land (13 from six families) and farm land 11 from six families).This might be forest had small disturbance by human than other land use. The results agree with those from Sultan *et al*. (2013), who reported that forest had more woody species than agroforestry, grazing land and farm land because of forest is some human interference rather than other land use. In farm land lowest woody species diversity rather than other land use. This due to the people manages their farmland to reduce shading effect and competition with their crop. Myrtaceae is the most dominant family with 11(12.2%) Fabaceae family 10 with (11.1 %) species followed by Euphorbiaceae with 5(5.5%) species Moraceae with 7 (7.7%), Rutaceae 6 with (6.6%), Boraginaceae with 4 (4.4%) the Meliaceae with 3(3.3%), Olaceae 3 with (3.3%), celasteraceae with 3(3.3%). Rubiaceae and Musaceae 9(10%), Araliaceae, Rosacea, Astraceae, Drracenaceae and six families with 2 species each together contributed to about 12 families (13.3%) of the total species. Flacaurtiaceae, Bignoniaceae, Melianthaceae, Flacaurtiaceae, Melianthaceae, Arecaceae, Simarawblecae, Sapindaceae, Icalinaceae, Acanthaseae, Polygalaceae, Lauraceae, Proteceae, Carcarceae, Anacardiceae, Tiliaceae and urtcaceaeeach seventeen species was represented and contributed 1 species each (19%).

In the study, the most represented woody species family was Fabaceae with (11.2%), Moraceae with (11.1%), Rutaceae with (6.98%) of the total numbers of woody species, and all the other families were represented by only one or two woody species in the forest. Likewise, the highest Rutaceae, with 15% and myrtaceae withy 15% of the total number of woody species followed by Fabaceae, musaceae and Euphorbiaceae with 10% each in the total numbers of wood species and all the other families were represented by only two or one woody species in the agroforestry. In the farm land Myrtaceae, was the most dominant family representing 27.27% and all the other families were represented by only two or one the woody species in farm land. In grazing land 38.46% myrtaceae and 15.3% fabaceae dominant family and all the other families were represented by only two or one the woody species in grazing land. The three land use types (forest land, agroforestry and Grazing land) shared only six woody plant species in common and farm land shares only three woody plant species. The species in all forest, agroforestry and grazing land was Syzygiumguineense ssp. guineense (Willd) D.C., Ficussycomorus, Albiziagummifera, Vernoniaouriculifera, Eucalyptus camaldulensis and Cordiaafricana while farm land shared Syzygiumguineense ssp. guineense (Willd) D.C., Albiziagummifera and Eucalyptus spps. The coefficients of similarity of forest with and with agroforestry, with grazing land and with farm land were 80%, 60%, 52% and 36% respectively. This finding is consistent with the study of (Melkamu and Abdela, 2019) the extent of species similarity and difference in between the land uses might be related to the level of disturbance in the composition of species between the land uses.

4.4.1. Species diversity, richness and eveness of woody species of the study area.

The overall Shannon diversity indices of woody species of the study area, forest was 3.38 and evenness values (J) was 0.53, diversity of woody species in agroforestry was 2.69 and evenness values (J) was 0.42, diversity of woody species of the farmland was 1.93 and evenness values (J) 0.33 and diversity of woody species in grazing land was 2.12 and evenness values (J) 0.39 respectively. This was indicating that the diversity and evenness of woody species in the forest are relatively highest, and the lowest diversity of woody species was recorded in the farm land. This is because of the high evenness value of the woody species in the natural forest and the low evenness value in agricultural land. The Shannon diversity indices of woody species of the study area forest was 3.38 and evenness values (J) was 0.53.This finding is agree with study of (Kent and Coker, 1992) they reported that the value index usually lies between 1.5 and 3.5 although in exceptional cases the value exceeds 4.5.

However the results of Shannon diversity indices agroforestry were 2.69 and evenness was (0.42).This finding is consistent with study of O'Neill *et al*.(2001) who reported that the findings the agroforestry of Thailand, which ranges from 1.9 to 2.7 for Shannon index and this finding consistent with another study by (Buchura *et al*.(2019) who reported that in agroforestry practice the species Shannon diversity of agroforestry practice in Merewa (H'= 2.58) , Mazoria (H'=2.32) and Waro Kolobo (H'= 2.48) in the agroforestry of study sites of around Jimma town. In crop land use that the occurrences of the species in study area were variable, diversity of woody species of the farmland was 1.93 and evenness values (J) 0.33.This study result is higher than Buchura *et al*. (2019.) who reported in Merewa study site of around Jimma town (H'=1.819) and lower than the results reported by Motuma *et al*. (2008) in South-Central Ethiopia (H'= 2.22, E= 0.64).

From all the species identified in seventy-two quadrants, the growth form composition of the woody species was 54 (60%) trees and, 32 (35.55 %) shrubs 3 (3.33%) herbs and climbers

1(1.12%) This study agrees with the study of Buchura et *al*.(2019) who reported that in all land use woody species were dominated by trees. In forest the composition 26(63.4%) tree, were shrub 15(36.5). This study in line with Buchura *et al*.(2019) who reported that the all identified was woody species was dominated by trees. The agroforestry, the composition was 17(68%) agroforestry fruit trees and multipurpose trees and other 8 (32%) shrub. In cultivated land 9(81.81%) tree and 2(18.18%) species were shrubs and in grazing land 8(61.5%) was tree, 4 (30.7%) was shrubs and 1 species (7.6) were epiphytes. This study indicated that the largest proportion of identified woody species were trees followed by shrubs in study area. This study is consistent with the study of Buchura *et al*.(2019) who reported that the identified woody species were dominated by trees.

Table 16. The diversity indices of woody vegetation species of the different land use and community similarity

Landuse type	Shannon index	species richness	Species Evenness	Species density (No.ha_^{1})	SorensenCoefficient of similarity
Forest	3.38	41	0.52	1044	80%
Farm land	1.93	11	0.33	423	36%
Agroforestry	2.69	25	0.42	831	67%
Grazingland	2.12	13	0.39	581	52%

Source: Own computation, 2019

As indicated in table 16 the variation in woody species richness could be due to site characteristics, management strategy and socioeconomic factors and farmers' preferences for tree species and functions in different localities. For example, farmers maintained many trees and shrub species for environmental services like soil and water conservation, edible fruit trees, medicinal value plants and for wind breaks. The distribution frequency of tree species on farms in this study was variable. As one would expect, tree species with a greater economic or ecological value or both were found to be frequently distributed across the farms. Eucalyptus species, F.sycomorus, Albizia gummifera and Mangifera indica and Persia Americana and Cordia africana were the most frequent species occurring in 65% of the sampled farms. The low abundance species could indicate that the population size might be too low to sustain these species within the agroecosystems unless their abundance is increased, as reported by O'Neill *et al*. (2001) who reported that the Shannon diversity index of the agroforestry, which ranges from 1.9 to 2.7.Species density in forest is higher than agroforestry, farm land and grazing land this result showed that forest was diversified than other land use. The species density result of agroforestry was more diversified followed by grazing land and farm land. This study result is consistent with study of Buchura *et al. (*2019) who reported that agroforestry were more diversified followed by grazing land and farm land. As indicated in table 16 the common woody species in natural forest and agroforestery and similarly in natural forest and grazing land were highest while lowest values were recorded in farm land and forest. However, the Sorensen coefficient similarities were estimated for forest was greater as compared to with others. This can be explained by the presence of more woody species in the natural forest and agroforestery, grazing land than farm land.

4.4.2. Importance value Index (IVI)

Values of IVI are important parameters that reveal the ecological significance of species in a particular ecosystem. Moreover, species with the highest IVI values are the most dominant of the particular vegetation as reported by (Simon. S and Girma B.2004).The importance value index for each species in the forest was study revealed that the V.amygddalinadeli 31.49 %, V.auriculifera 30.12%,V.nobilis (22.85%), T.nobilis, C.anisata (13.5%), F.sycomorus (9.81%), O. capensis species macrocarpa (16.74%) , Ficus sur Forssk (13.7%), A.gummifera (10.8%), Stnychnosspinosa (10.25%) and C.aurea. (A. abyssinicus, 10.88%) was recorded and those most dominant individual woody species having the highest IVI values because of was due to its high values of relative frequency, relative dominance and relative density. Important value indices are good indicators for prioritization of species conservation. The lowest IVI value where recorded was S.longipendunculata (1.5%) this was being represented by a single species. The importance value index of agroforestry was E.ventricosum (81.68%), P. Americana (15.1%), M.sapientum (23.68 %), C.papaya (10.64%), M.indica (10.35%) and R.Communis (8.8%) were the lowest IVI recorded in agroforestry G.rubusta (1.07%).In cultivated land were (45.5%) E.camaldulensis, F. sycomorus (30.93%) and Albizia gummifera (19.64) was highest IVI respectively and the lowest D. afromontana (1.06 %). In the grazing land were F. sycomore (87.3%) and S. guineense (Willd.) DC (50.3%) is highest IVI and lowest IVI in grazing land A. gummifera (2.5%) were identified.

4.5. The Selected Soil Properties under Different Land Use

Table 17 presents the means (± SD) presents a summary of ANOVA for selected soil properties like BD, SOC, textural distribution, MC and pH of soil surface layer (0–30 cm) across different LU systems. The results for the individual soil discussed in the blow table include:

Table 17. The descriptive statistical summary of selected soil properties and ANOVA

Land use / soil property		Mean	Fvalue	Pr > F	LSD	CV
Forest	BD	0.557 ± 0.0643^{c}	90.8	<.0001	0.139	6.513
Agroforestry		0.613 ± 0.1096^{c}				
Crop land		1.18 ± 0.1003^{a}				
Grazing land		1.02667 ± 0.0809^{b}				
Forest	OC	3.62 ± 0.346^{a}	32.6	<.0004	0.49877	9.59
Agroforestry		2.8 ± 0.3808^{b}				
Crop land		1.7 ± 0.313^{d}				
Grazing land		2.2 ± 0.588^{c}				
Forest	MC	25.6 ± 7.35599^{a}	53.4	<.0001	3.943	10.4
Agroforestry		24.41 ± 3.64028^{ab}				
Crop land		20.95 ± 6.20734^{d}				
Grazing land		23.03 ± 8.90429^{c}				
Forest	pH	6.59 ± 0.169^{a}	18.11	0.0021	0.407	3.3594
Agroforestry		6.3 ± 0.19^{ab}				
Crop land		5.43 ± 0.156^{c}				
Grazing land		5.94 ± 0.321^{b}				

Means separation followed by the same letter within a column are not significant at p<0.05 LSD=List of significant difference=CV=coefficient of variance BD=Bulk Density=MC=Moisture Content =OC Organic Carbon

Source: Own computation, 2019

4.5.1. Bulk density

The results showed that soil bulk density was significantly varied ($P < 0.01$) with land use types, the highest bulk density was observed at crop land and the lowest in forest was observed. The increase of bulk density was observed in crop land as compared to the forest, agroforestry and grazing land. The result of bulk density in crop land was 1.18 in study area. This finding is in line with study of (Alemayehu, 2015) who reported that the bulk density of all the studied soil in Bedele woreda is found to be less than 1.44, which is common in cultivated soils. Significant changes of soil bulk density on crop land areas might be due to the agricultural practices applied, compaction of topsoil layer due to intensive cultivation. Mean bulk density in forest and agroforestry areas was significantly lower compared to crop lands. This finding is in line with the study of (Abad *et al*., 2014) who suggested that the bulk density of cultivated land was higher than grazing land and forest lands at soil depth of 0-30 cm. Moreover (Abera & Keyfyalew, 2017) who reported that the lowest bulk density was recorded under the forest land whilst the highest was recorded under the cultivated field than grazing land in Bedele area. The presence of low soil bulk density in forest and agroforestry may be due to the higher organic matter content. The dead fine roots and mycorrhizal fungi constitute a primary supplement of the surface soil's organic matter in forest and agroforestry; soil with a larger organic matter has a low bulk density because of the low particle density of the organic matter and soil aggregate formation.

Tree roots contribute to a larger extent to a soil organic matter accumulation, up to the tree root senescence and root litter decomposition, which in turn decrease the soil bulk density. This finding agrees with the study of Lechissa *et al. (*2015) and Fantaw and Abdu (2011). They reported that the lower bulk density in the soil under forest and agroforestry the higher bulk density in soils under crop land were attributed to the differences in soil organic matter and less disturbances under forest land use than in the crop land. On the other hand, higher bulk density in crop land could be attributed to the impact of repeated cultivation which disturbs the soil structure, causing a compacted surface soil layer. This is in agreement with Kizilkaya and Dengiz (2010) in that loss of organic matter by conversion of natural forest into cultivated land has resulted in a higher bulk density. Similar results were reported by Islam and Weil (2000) that continuous tillage practice has result an increase in soil bulk density. This study in line with another study by Shisanya *et al*.(2008)& Murage *et al*.(2000), who reported that the frequent or intense cultivation of farmlands due to land shortage is another factor for the soil bulk density increasing and diminishing quality of the farmlands as the crops remove substantial amount of nutrients and grazing crop residues after harvesting increasing bulk density in crop land than other land use.

4.5.2. Soil moisture content (MC)

The results showed that soil moisture content (%) significantly varied($P < 0.01$) with the different land use types, at the depth (0–30 cm) between the mean separation soil MC (%) differed significantly ($P < 0.01$) or statically significantly influenced between cultivated land ,grazing land, homestead agroforestry and natural forest. Generally, the soil under natural forest had the highest moisture content (%) homestead agroforestry follow to forest compared to the other land use, while soil under farmland and grazing land had a lower Moisture content. This might be due to that forest and agroforestry had high moisture content respectively because of tree help to improve the porosity of the soil there by retaining moisture and tree is reduce evapotranspiration. The grazing land and cultivated land had lowest moisture content this might be conversion of forest to other land or deforestation affects the moisture content of the soil by exposing the soil to high solar radiation, which increases the rate of evaporation. The physical properties soil moisture content considered are found to have responded differently to various human induced differential managements following conversion from natural forests. This finding study is consistent with Fikadu *et al*. (2012) who reported that the inverse relationship between soil bulk density and infiltration capacity of these land uses/land covers. The another study agree with this study according to Dai *et al*. (2006) reported that land use was the main factor that affected water balance and evapotranspiration was the largest expenditure in land water balance. Moreover, this study in line with the study of (Kang *et al*., 2008) who reported that the comparison (from low to high) of the evapotranspiration in different land uses was cropland, grass-land, agroforestery and forest.

4.5.3. Soil pH

The results revealed that soil pH statically highly significant varied with land use types ($P < 0.01$). The crop land had lowest pH values followed by grazing land. Forest and agroforestry had highest pH value respectively. However, all the pH values fall under acidic soil which might be the due to high rainfall in the area. The lowest pH (5.43) value was obtained in crop land and the highest pH value (6.59) was in forest (Table 17).t. This finding is consistent with study of Anyyanwu. *et al*. (2015) who reported that the result of the soil pH of farmlands was significantly lower than soil in forests, because destruction of forest cover exposes the soil to erosion and contributes to soil acidification. And another similar study consistent with Abegaz and Adugna (2015) can conclude that the presence of lower topsoil pH in cropland can be related to the decrease in base forming cations (Ca_2+, K+, Mg_2+ and Na+) through a continuous nutrient cation uptake by plants during repeated cultivation and leaching and soil erosion loss.

4.5.4. Soil Organic carbon

The results showed that SOC significantly varied with land use types($p<0.01$) and between the mean separation SOC differed significantly ($P < 0.01$) the total soil carbon content (SOC) of land use forest, agroforestry, crop land and grazing land mean in Mega gram per hectare of SOC 3.62 Mg/ha^{-1}, 2.8Mg/ha^{-1}, 1.7Mg/ha^{-1} and 2.2Mg/ha^{-1} respectively(Table 17). The lowest soil organic carbon was observed in crop land. This study is consistent with the study of (Alemayehu, 2015) who reported that the organic carbon content in all studied soil samples is found to be very low and very low organic carbon content attributed due to intensive agricultural practices that aggravate organic carbon oxidation.

The results showed that over all mean soil organic carbon stock was follow in order of Forest>Agroforestry>Grazing land>cropland respectively. Forest land higher carbon compared to with other land use this implies that soil samples from the forests were richer in organic matter due to greater inputs of vegetation and increase decomposition of organic matter. On the other hand, the lowest soil organic carbon stock under crop land could be due to decline inputs of organic matter and removal of crop residues after harvesting crop plants and use of manure as an energy source for cooking. This finding is corroborated with Grieco *et al*. (2012) who reported that the dominant type of land use change is the conversion of forest to agricultural systems with continuously high rates of 13 million hectare being deforested per year and soil organic carbon decreased in crop lands as compared to forest lands. Other study conducted in Southern Tigray Ethiopia by Corral–Nunez *et al*. (2014), shows declining level of soil organic carbon in crop land soils under current agricultural practices due to the removal crop residues for cooking energy and free grazing of crop residues after harvesting crop plants.

4.5.5. The soil particle size distribution under different land use

Although the result reveals that soil particle size distribution is no significant difference (P > 0.05) means for sand, silt, clay the results show that particle size distribution varied with land use systems and mean separation showed no significant difference (P > 0.05). This suggests that not all the soil properties were affected by the land use. Table 18 presents the summery of ANOVA for soil particle distribution of soil surface layer (0-30cm) across the different land use discussed as blow table.

Table 18 :- Shows mean of Particle size distribution with land use

Land use/ soil particle Distribution		Mean	LSD	CV	F value	Pr>F
	Sand					
Forest		44.55±4.4[a]	7.43	9.188	3.46	0.0912
Agroforestry		35.667±4.9[b]				
crop land		38.72±4.37[b]				
Grazing land		42.778±4.9[ab]				
Forest	Clay	25.23±4.1[b]	11.1	20.2	2.11	0.2005
Agroforestry		33.88±7.1[ab]				
Cropland		35.45±3.1[a]				
Grazing land		27.88±3.9[ab]				
Forest	Silt	30.22±4.1[a]	10.49	17.19	0.29	0.8329
Agroforestry		30.453±3.01[a]				
Crop land		25.83±9.6[ab]				
Grazing land		29.342±4.4[a]				

Means separation followed by the same letter within a column are not significant at $p<0.05$ LSD=List of significant difference=CV=coefficient of variance

Source: Own computation, 2019

The soils under both forest (44.5%) and grazing (42.77%) land use systems had the highest percentage of sand content. These findings consistent with the study of (Gebrelibanos and Assen, 2013) reported that higher sand and low clay content was found at the surface (0-30cm) layer in forest and grazing land than agroforestry and crop land. More over those under agroforestry and crop land and had the lowest (35.667% and 38.72%).However, at this, mean percentage of sand content at the surface (0–30 cm) layer showed no significant difference ($P > 0.05$) between the soils under all the land use/land cover systems. Moreover , the variation of soil texture amongst land use types is implies that the effects of land use types on soil properties which triggered from different utilization and management system of land use types (Abbasi *et al*., 2007). The textural soil class was identified in each land use in the study area discussed as blow table.

Table 19 . The textural soil class identified each land use in study area

land use	Type of soil particle distribution	Mean	Type of soil identified
Forest	Sand	44.55	Loam
	Clay	25.23	
	Silt	30.22	
Agroforestery	Sand	35.667	clay loam
	Clay	33.88	
	Silt	30.453	
Crop land	Sand	38.72	clay loam
	Clay	35.45	
	Silt	25.83	
Grazing land	Sand	42.778	clay loam
	Clay	27.88	
	Silt	29.342	

Source: own computation 2019.

4.5.6. Pearson correlation between land use and selected soil properties

Correlation of the soil physiochemical soil properties related to the different land uses were evaluated based on the correlation coefficient and the corresponding significance level as blow table.

Table 20 . Pearson correlation between land use land cover and selected soil properties

	pHv	BDV	SOC	SAND	CLAY	SILT	MC
pHv							
BDv	-.813**						
	0.007						
SOC	-.857**	-.753**					
	0.0043.	0.001					
SAND	0.16	0.054	0.101				
	0.456	0.803	0.639				
CLAY	-0.087	-0.053	-0.147	-.618**			
	0.686	0.804	0.492	0.001			
SILT	0.096	-0.065	0.079	-.417*	-0.328		
	0.655	0.764	0.713	0.042	0.117		
MC	.890**	-.847**	.817**	0.099	-0.085	0.157	
	0.0028	0. 0001	0.0001	0.644	0.693	0.465	

BDV=Bulk Density Value=SOC=soil Organic Carbon=MC=Moisture Content

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

The result of SOC and Bulk density negative correlation(r= -0.753**) highly significant. This finding consistent with study Yuncong, & Carlos,(2015)who reported that the results also indicated that a change in bulk density is negatively associated with the changes in soil OM in the studied land use (r = −0.77, for agricultural, agroforestry, and grassland, respectively), which is required for proper growth of plants. This finding is consistent with the study of Addis *et al*. (2016) these findings follow the general principle that bulk density mostly increases with decreasing soil SOC and the negative correlation was found between pH and SOC and highly significant(r= -0.857**), this finding corroborated with (Dlapa *et al.,* 2011), stated that soil pH has a close relationship with soil organic carbon, as pH is commonly decreased with increasing SOC.

The positive correlation was found between sand and bulk density(r =0.054) and negative correlation was observed between clay and bulk density (r =-0.053) and silt content (r=-0.065) is observed. Results indicated that sand had more effect on bulk density than the other texture content. This finding corroborated with (Bindu *et al.,* 2017). He revealed the impact of texture on bulk density was due to organic carbon and soil texture specific test required to determine the organic matter level to judge the bulk density to get off the problem of compaction. The result of Moisture content and Bulk density negatively correlated(r= -0.847**) highly significant. This finding consistent with the current study of, (Bindu *et al.*, 2017)an equivalent increase in soil moisture contents and infiltration capacities and reduction of the soil bulk densities and also the result of pH and moisture content had positive correlation(r=0.890**) highly significant. The result of Moisture content and Soil organic carbon positively correlation(r= 0.817**) highly significant.

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

The study demonstrated on impact of resettlement on land use land cover, woody vegetation diversity and selected soil properties under different land use. The result of land use land cover change of the three decades show that agricultural land expansion and settlement was increased because of interest to meet feed for food and population growth. The forest and grazing land in study area was decreased. It could be were due to settlers heavily depend on natural resources for fuel wood and construction materials as well as production of charcoal and fuel wood as additional sources of income facilitates the depletion of the forest, while because of ressettlement grazing land was converted more into agricultural land. Some species such as Cordia africana, Prunus africana and Ekebegia capensis are endangered and the importance value index is low because of the settlers used for timber and for other purposes. This implies that overexploitation of natural resources on behalf of agriculture and settlements. This is confirmed by the decreasing areas of forest and also coincides with the overall vegetation cover decrease in the study areas. This dangerous trend probably is a result of the pressure poised by population growth and the changing functionality of the ecosystem of the area. Enhancing the agroforestry expansion in study areas was to minimize the pressure on the forests, and it has change the lively hood of people of the study area.

Land use land cover effect on soil properties has influenced the selected soil property of study area .Accordingly, the soil organic carbon under different land use in forest and agroforestery high due to organic matter accumulation and soil organic carbon under grazing land and crop land is low which could be due to decrease of organic matter under this land use in study area. More over land use land cover had impact on soil bulk density and moisture content and soil pH of the study area. Accordingly the high bulk density was recorded in cropland than other land use which could be due to compaction of cropland during frequent tillage, grazing cropland after harvesting crop residues is mainly cause compaction. The type of land use determines the composition and diversity of woody species. Comparatively, the highest diversity was recorded in the forest land followed by agroforestery in the overall study sites; and lowest species richness and diversity were recorded in crop land.

5.2. Recommendation

Based on the above conclusions the following recommendation were forwarded

- Impact assessment is crucial to take necessary measures in the study area and other similar resettlement sites and optimizing land use plan and synergy should be important to sustainable management of environment by Government and NGOs.
- The Government and NGOs should play important role to minimize forest clearance burdens by expansion of electricity, Biogas and encourage the modern stove for resident community for the energy sources.
- It should be important to use compost, crop rotation and using agroforestry to improve soil organic matter and soil structure.
- Conservation Management is needed for some species such as Cordia africana, Prunus africana and Ekebegia capensis which are endangered due to settlers consumption used for timber and for other purposes.
- The RS and GIS important tool or technology to understood and used to continuously evaluating and monitoring the trend of land use land cover change status by ressettlement and data sets at regional and national level inform policy decision.
- In general, resettlement may not be taken as the best way to minimize drought and famine or ensure food security. To guarantee effective food security diversified lively hood strategy by integrating agricultures to produce on small land size to increase production and productivity should be well needed to reduce farm land expansion and demand for food by enhancing forest conservation and increase carbon is essential.

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7. APPENDICES

7.1. Survey questioners

ANNEX 1. HOUSEHOLD QUESTIONNAIRE

1.Kebele name /Village Name____________________________

2.Name of the person who filled the questionnaire: ______________________________

3. Date on which the questionnaire was filled: __________/_________/2011 E.C.

HOUSEHOLD QUESTIONNAIRE FOR LAND USE AND LAND COVER CHANGE STUDY BASIC HOUSEHOLD INFORMATION (Fill appropriate information or tick by putting ("√")

1. Occupation: _________________________
2. Age: __________
3. Sex: 1. Male ______ 2. Female_______________
4. Marital Status: 1. Married_____ 2. Unmarried______ 3. Divorced ______
5. Windowed or er ____________ 5. Other (specify) _________________________

Total family size by age group and gender:

Age group	Male	Female	Total
0-14			
15-30			
>64+			

6. Religion: 1. Orthodox Christian______ 2. Indigenous faith ______ 3. Muslim _____
   4. Protestant _____________ 5. Other (Specify) _____________________
7. To what Ethnic group do you belong? 1. Oromo____ 2. Amhara_____
   3. Other (specify) _________________
8. Educational status:

(1-8) ____ 4. Secondary (9-12) ____ 5. Tertiary (12+) _______ diploma/Dig;_______

9. Status in the kebele: 1. Migrant__________ 2. Non-Migrant_________
10. If you answered "Migrant" to question No. 9: how long have you been here? _____
11. If you answered "settlers" to question No. 9 where did you live before? ___________

Land use/cover change

12. How do you perceive the change in the following land use/cover in the last 32 years or between 1986-2018 and now? (Years in E.C.).

1. Increased 2. Decreased 3. No change 4. Don't know

Land use/cover types	2018	2002	1986	Comment, if any
Forest land				
Grazing land				
Resettlement				
Cultivated land				

13. If you perceive an increase in land use/cover change in the last thirty two years, what factor or factors do you think might have caused it? (You may give multiple answers)

1. Population increase
2. Expansion of agricultural land
3. Introduction of new development projects
4. Deforestation
5. Other, specify ____

14. List the problems you are personally faced with due to increases in land use/cover change. List them in order of importance).

____

____

Land holding and property ownership

15. Total land holding in hectare. 1. Now ____ 2. 10 years ago____ 3. 20 years ago ___

16. Is it common to have more children in order to obtain more land?

1. Yes 2.No 3. Don't know

17. How do you use your farm land currently?

1. Once in a year 3. Always

2. Twice a year 4. Other, Specify___________________

18. Do you think that land is becoming scarce in your kebele?

1. Yes, it is becoming scarce ____ 2. No, it is abundant _____ 3. No Change____

19. If your answer for question 21 is yes, why is land become scarce (You may give multiple answers)?

1. Because of population increase
2. Because the proportion of fertile land is diminishing
3. Land has fallen in fewer hands
4. Land has been converted to non-agricultural uses
5. Land has been given to developers
6. Other, Specify____

20. How do you rate your crop production from your plot(s) over the last 20 years?

1. Increasing 2. Decreasing 3. No change

Environmental Issues

21. Say YES (1) or NO (2) if the following are major environmental problems in the area? (Multiple answers are possible)

1. Deforestation_____________ 3. Soil erosion_____________

2. Deterioration of water points_________ 4. Inadequate rainfall_______

5. Other, specify_____________

22. If deforestation is one of your answers for No. 21, what might have caused this problem? Be circling it.

1. An increasing demand for firewood_______________
2. Expansion of agricultural land______________
3. Cutting of trees for construction_______________
4. Cutting of trees to generate income________________
5. Other, specify____

23. Are there forest use and management strategies normally adopted by the local communities yet?

What are the major forest species and their use categories commonly known among the communities?

ANNEX 2. CHECKLIST FOR FOCUS GROUP DISCUSSION AND IN-DEPTH INTERVIEW Elderly

1. How do you see the population and LULCC changes since the 3 decades?
2. What effect does this result on the ecology, population?
3. What are the major land use and land cover types some 30 years ago and now?

4. Is there land use and land cover change in the kebele?
5. Would you explain the extent of the change?
6. Which resources are more affected due to land use and land cover change?
7. In your opinion what are the factors /reasons for these significant changes?
8. How did you rate population change in the kebele?
9. Why many people are coming to this area to resettlement?
10. From the three regimes, when did population grow fast? Why?
11. What were the most important economic activities 30 years ago?
12. Explain the current economic activities in the kebele?
13. What effects they bear on you (if any)?
14. What are the vegetation composition, species, and diversity? is it decrease or increase?
15. Is there timber production in your kebele? For what purpose?

Experts

1. How do you rate population dynamics in the PA (for the last 30 years or so)?
2. What effect(s) did population dynamics impose on the PA?
3. How do you rate the extent of land use/cover change in the PA
4. Would you please explain the pattern of change in land use/cover in the PA?
5. Which factors did you expect play a prominent role?
6. How do you explain the livelihood changes occurred in the PA?
7. In which one of the three regimes that land use/cover change was high? Why?
8. Would you list down the major land use land cover in the PA?

10**.** What are the major forest resources (timber and non- timber products) commonly used by the local communities? (Please, list the major forest products in order of importance)

Appendix 4: Woody plant species diversity assessment data collection sheet
Study site: Region: Oromia Zone: Buno Bedele District: 6 Kebele: ___________________
Name of data Collector: _________________Date (day/month/year) ____/___/2019
Line/Transect: _____ Plot No: ______ GPS reading; Longitude (X): __________ Latitude (Y): ___________________ Altitude/ Elevation: __________

No	Local name	Scientific name	Family Name	DBH	Growth form

* Growth form: T= Trees, S= Shrubs, T/S = Tree/Shrub.

7.2. Accuracy Assessment Result from 1986 to 2018

ACCURACY TOTALS 1986

ERROR MATRIX

Classified Data	Reference Data: Forest	Grazing Land	Cultivated	Settlement
Forest	16	0	1	0
Grazing Land	1	29	2	1
Cultivated Land	1	2	36	1
Settlement	0	1	1	8
Column Total	18	32	40	10

ACCURACY TOTALS

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Forest	18	17	16	88.89%	94.12%
Grazing Land	32	33	29	90.63%	87.88%
Cultivated Land	40	40	36	90.00%	90.00%
Settlement	10	10	8	80.00%	80.00%
Totals	100	100	89		

Overall Classification Accuracy = 89.00%

----- End of Accuracy Totals ---

KAPPA (K^) STATISTICS

Overall Kappa Statistics = 0.8415

Conditional Kappa for each Category.

Class Name	Kappa
Forest	0.9283
Grazing Land	0.8217
Cultivated Land	0.8333
Settlement	0.7778

----- End of Kappa Statistics -----

TOTALS 2002

ERROR MATRIX

Classified Data	Reference Data: Forest	Grazing Land	Cultivated	Settlement	Total

Forest	14	2	2	0	18
Grazing Land	2	37	1	1	41
Cultivated Land	0	1	29	1	31
Settlement	0	1	1	8	10
Column Total	16	41	33	10	

----- End of Error Matrix -----

ACCURACY TOTALS

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Forest	16	18	14	87.50%	77.78%
Grazing Land	41	41	37	90.24%	90.24%
Cultivated Land	33	31	29	87.88%	93.55%
Settlement	10	10	8	80.00%	80.00%
Totals	100	100	88		

Overall Classification Accuracy = 88.00%

----- End of Accuracy Totals -----

KAPPA (K^) STATISTICS

Overall Kappa Statistics = 0.8263

Conditional Kappa for each Category.

Class Name	Kappa
Unclassified	0.0000
Forest	0.7354
Grazing Land	0.8346
Cultivated Land	0.9037
Settlement	0.7778

----- End of Kappa Statistics -----

ACCURACY TOTALS 2018

ERROR MATRIX

Reference Data

Classified Data	Forest	Cultivated	Grazing La	Settlement
Forest	13	1	1	1
Cultivated Land	1	39	0	1
Grazing Land	1	1	30	1
Settlement	0	0	1	9
Column Total	15	41	32	12

----- End of Error Matrix -----

ACCURACY TOTALS

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Forest	15	16	13	86.67%	81.25%

```
Cultivated Land     41          41         39    95.12%   95.12%
   Grazing Land     32          33         30    93.75%   90.91%
     Settlement     12          10          9    75.00%   90.00%
          Totals      100           100      91
Overall Classification Accuracy =     91.00%
           ----- End of Accuracy Totals -----

KAPPA (K^) STATISTICS
---------------------
Overall Kappa Statistics = 0.8696
Conditional Kappa for each Category.
------------------------------------
       Class Name              Kappa
       ----------              -----
     Unclassified             0.0000
           Forest             0.7794
  Cultivated Land             0.9173
     Grazing Land             0.8663
       Settlement             0.8864
           ----- End of Kappa Statistics -----
```

	Source	DF	Type IIISS	Mean square	Fvalue	pr>F	R-square	Vriable
1	Lulc		2.257133	0.752378	18.11	0.0021	0.902789	pH
2	Lulc		0.823492	0.274497	90.08	<.0001	0.979531	BDV
3	Lulc		6.096092	2.032031	32.61	0.0004	0.942633	SOC
4	Lulc		143.8519	47.95062	3.46	0.0912	0.708831	Sand
5	Lulc		195.666	65.222	2.11	0.2005	0.662285	Clay
6	Lulc		23.818	7.950618	0.29	0.8329	0,354587	Silt
7	Lulc		486.0856	162.0285	79.48	0.0001	0.982493	Mc
	Model	6						
	error	6						
	corrected	12						

Woody species identified in forest		
Local nam	**scientific name**	**Family**
Akukkuu	Flacourtiaindica	Flacourtiaceae
Anbabees	Albizia gummifera	Fabaceae
Anunuu	Spaathodo campanu	Bignoniaceae
Askira /so	Millettia ferrugina	Fabaceae
Badeessaa	Syzygiumguineense	Myrtaceae
Bakkannis	Croton macrostachyu	Euphorbiaceae
Bayaa	Olea welwitschii	Oleaceae
Bosoqaa	Sapim ellipticum	Euphorbiaceae
Bottoo	schefflera abyssinica	Araliaceae
Ca'ii	vepris nobilis	Rutaceae
Ceekaa	Calpurina aurea	Fabaceae
Dembi	Ficus thoningi	Moraceae
Gursadee	Lepidotrichilia volke	Meliaceae
Hadheess	Teclea nobilis	Rutaceae
Harbuu	Ficus sycomorus	Moraceae
Kombolch	Mytenus arbutiolia	Celasteraceae
Lolchiisaa	Bersema abyssinica	Melianthaceae
Meexxii	Phoenix reclinata	Arecaceae
Mixoo	Rytigyinia	Rubiaceae
Oomii	Prunus africana	Rosaceae
Odaa	Ficus sycomorus	Moraceae
Qomoony	Brucea antidysenter	Simaroubaceae.
Reejjii	Vernonia ouriculifer	Asteraceae
Se'oo	Allophylus abyssinic	Sapindaceae
Somboo	Ekebegia capensis	Meliaceae
Ulaagaa	Ehretia cymosa	Boraginaceae
Ulmaayii	Claurisenia anisata	Rutaceae
Waddeess	Cordia africana	Boraginaceae
Wandaabi	Apodytes dimindiata	Icacinaceae
Laaftoo//S	Acacia abyssinica	Fabaceae
Qilxuu	Ficus Vasta	Moraceae
Rukeessa	Dracecna afromaunt	Agavaceae
Sokorruu	Acanthus eminence	Acanthaceae
Dhandhan	Myrsine africana L.	Myrsinaceae
Goshuu	Stnychnosspinosa	Myrtaceae
Gagaamaa	Olea capensis ssp. M	Oleaceae
Ambaltaa	Dracaena afromonta	Dracenaceae
Eebecha	Vernonia amygddali	Astraceae
Dabaaqqa	Rhwnatalensis	Anacardiceae
Urgeesssa	Premna scimperi	Agavaceae
Etsamanaay	Securidica longipedunculata	

woody species identified in agro forestry					
Cultivated	(home gar	Vernacula	Scientific name	Family	
Agro forestery		Avocado	Persea americana	Lauraceae	
Agro forestery		Banana	Musa sapientum	Musaceae	
Agro forestery		coffee	Coffee arabica	Rubiaceae	
Agro forestery		kezmir	Casinaroa edulis	Rutaceae	
Agro forestery		Apple	Malus domestica	Rosaceae	
Agro forestery		Gravillia	Gravillia robusta	Proteaceae	
Agro forestery		Wanza	Cordia Africana	Boraginaceae	
Agro forestery		Zeytun	Psidium guajava	Myrtaceae	
Agro forestery		Orange	Citrus sinensis	Rutaceae	
Agro forestery		Inset	Ensete ventricosum	Musaceae	
Agro forestery		Papaya	Carica papaya	Carcaceae	
Agro forestery		Odaa	Ficus sycomorus	Moraceae	
Agro forestery		Reejjii	Vernonia ouriculifera	Asteraceae	
Agro forestery		Saspaaniy	Sasbania saban	Fabiceae	
Agro forestery		Abbaabbe	Albizia gummifera	Fabaceae	
Agro forestery		Qobboo	Ricinus communis	Euphorbiaceae	
Agro forestery		Kasaavaa	Manihot esculenta	Euphorbiaceae	
Agro forestery		Bargaamo	Eucalyptus camaldul	Myrtaceae	
Agro forestery		Botoroo	Streosparmum kunthaianum		
Agro forestery		muka kini	Azandirachta indica	Maliaceae	
Agro forestery		Khat	catha edulis	Celastraceae	
Agro forestery		Sugercane	Saccharum officinaru	Poaceae	
Agro forestery		Gosuu	Stnychnosspinosa	Myrtaceae	
Agro forestery		Loomii	citrusaurantiifolia	Rutaceae	
Agro forestery		Mango	Mangifera indica	Anacardiaceae	

woody vegetatio recorded in cultivated land		
Badeessaa	Syzygiumguineense	Myrtaceae
Odaa	Ficus sycomorus	Moraceae
Bottoo	schefflera abyssinica	Araliaceae
Anbabees	Albizia gummifera	Fabaceae
Waddeess	Cordia africana	Boraginaceae
Ambaltaa	Dracaena afromonta	Dracenaceae
Bargaamo	Eucalyptus camaldul	Myrtaceae
Bayaa	Olea welwitschii	Oleaceae
Bakkannis	Croton macrostachyu	Euphorbiaceae
Korchii/Be	Erythrina abyssinica	Fabaceae
Gosuu	Syzygium guineense	Myrtaceae

Land use	local name	Botanical name	Family
Grazing la	Baddeess	Syzygium guineense	Myrtaceae
Grazing la	Odaa	Ficus sycomorus	Moraceae
Grazing la	Anbabees	Albizia gummifera	Fabaceae
Grazing la	Goosuu	Syzygium guineense	Myrtaceae
Grazing la	Harbu	Ficus sur Forssk.	Moraceae
Grazing la	Botoroo	Stereospermum kan	Boraginac
Grazing la	Ceekaa	Calpurina aurea	Fabaceae
Grazing la	Danbi	Ficus thoningi	Moraceae
Grazing la	Laaftoo	Acacia abyssinica	Fabaceae
Grazing la	Qilxuu	Ficus vasta	Moraceae
Grazing la	Hadheess	Teclea nobilis	Rutaceae
Grazing la	Ambaltaa	Dracaena afromonta	Dracenace
Grazing la	Qilinxoo	Ficus dicranostyla M	Moraceae