



## Review Article

# Population Growth and Land Use Land Cover Change Scenario in Ethiopia

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**Abstract:** Land use and land cover change (LULC) is widespread, accelerating, and significant processes driven by human actions but also producing changes that impact humans. These changes can alter the availability of different biophysical resources including soil, vegetation, water, animal feed and finally it leads to a decreased availability of different products and services for human, livestock, agricultural production and damage to the environment as well. Understanding land use land cover change with relation to population growth at various scales is vital for development of management strategies to tackle further decline of natural resources. In connection to this, a seminar paper was done to assess the relationship between population growth and land use land cover change in Ethiopia. Recently published articles, books, proceedings, dissertations and government reports were used as a secondary data source for this review paper. The result reveals that in Ethiopia there were considerable LULC changes in the second half of 20th century particularly in the highland part of the country. Forest and woodlands coverage of the country was declined from 40% in the early 20th century to 15%. Similarly, the population was rapidly growing from 41.2 million in 1985 to 63.5 million in 2000 and it was reached 96.6 million in 2015. Based on these results it can be concluded that, LULC change and population change have a strong relationship; as population increases the need for cultivated land, grazing land, fuel wood; settlement areas also increases to meet the growing demand for food and energy, and livestock population. Similarly, rapid population growth exerts pressure on the existing land resources through increasing the demand for food, wood for fuel and construction purposes, and other necessities.

**Keywords:** Population Growth, Land Use/Land Cover, Ethiopia

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## 1. Introduction

World population has never exceeded 10 million people for most of human history. The death rate was higher than birth rate for many centuries, and the rate of population growth was scarcely above zero. Population growth began, when humans started to farm and raise animals around 8000 B. C. [1]. There are now 7.2 billion people on the planet, roughly 9 times the 800 million people estimated to have lived in 1750, at the start of the industrial revolution. The world population continues to rise rapidly, by around 75-80 million people per year. Soon enough there will be 8 billion by the 2020s, and perhaps 9 billion by the early 2040s [2].

One of the poorest regions in the world is Sub Saharan Africa is undergoing a demographic transformation. It is home

to around 900 million people, a number that is projected to grow to 1.2 billion by 2025, and 2.4 billion people who will likely be added to the world by 2050 and to almost 2 billion by 2100. The region's population is growing at a rate of more than 2 percent – the fastest in the world. Thirty-one of the 51 countries in SSA are projected to at least double their population by 2050 [3].

Ethiopia has experienced slow population growth for many years [4]. But from 1984 to 1994 census of population shows increase in population size from 41.2 million in 1985 to 63.5 million in 2000 [5]. The high rate of population growth has declined only marginally over the years, from a peak of 3.0 percent per annum in 1990 to 2.7 percent in 2005, and is projected to decline further to 2.6% (2005-2010) and an average of 2.4% during the period 2010-2015 [4] Ethiopia now stands as the second most populous country in

Sub-Saharan Africa, after Nigeria. It is projected that the population will increase to 96.6 million by 2015, and 175.4 million by 2050 [6].

For several thousands of years human beings have modified natural environments to obtain food and other essentials. The status, properties and function of ecosystem today is affected by the rates, extents and intensities of human pressure on land than before [7]. To satisfy the resource need of a growing population land is the center of agricultural production; basic land-use change is required, expanding food production through forest clearing, to intensify production on already cultivated land and developing infrastructure needed to support increased population [8].

Land use denotes the human employment of the land and is a synthesis of physical, chemical and biological systems and processes on the one hand and human/social processes and behavior on the other [9] while land cover denotes the physical and biotic character of the land surface. LULC change is a dynamic, widespread, continuous and accelerating process driven by human population pressure, Climate change, socio-economic and political factors which in turn impel changes that would impact natural ecosystems [10].

Different research findings on LULC changes have clearly shown that Global land use has significantly changed during the past decades and cultivated lands are expanded with the expense of forest, natural grassland, and savanna [11, 12] highlights LULC changes are a major environmental challenge in Ethiopia, where agricultural activity serves as the backbone of the economy. Numerous studies have shown notable LULC changes in different parts of the country through deforestation and reforestation activities since the late

twentieth century [13-15]. The rapid population increases have often led to LULC changes caused through deforestation aimed at increasing agricultural production [16] and production of other materials for consumption. Studies conducted at longer time scales showed LULC change had and still has tremendously been influenced by both the increase and decrease of a given population [17]. This paper will attempt to review the major findings on the relationship between population growth and LULCC in Ethiopia.

In this paper I was tried to review the causes of LULCC, the relationship between population growth and LULCC and the dynamics of population growth and its impact on LULCC in Ethiopia. This review paper has four parts; introduction, methodology, reviews major findings and discussion and finally conclusion.

## 2. Methodology

### 2.1. Study Area Description

#### 2.1.1. Location of the Study Area

Ethiopia is a country located in the Horn of Africa. It is geographically located 3° to 14.8° N and 33° to 48° E. The country lies completely within the tropical latitudes and is relatively compact, with similar north-south and east-west dimensions. Ethiopia is the largest and populous country in the world, and the second-most populated nation on the African continent. It occupies a total area of 1.13 million sq km (437,794 sq miles). With the 1993 secession of Eritrea, its former province along the Red Sea, Ethiopia became landlocked.

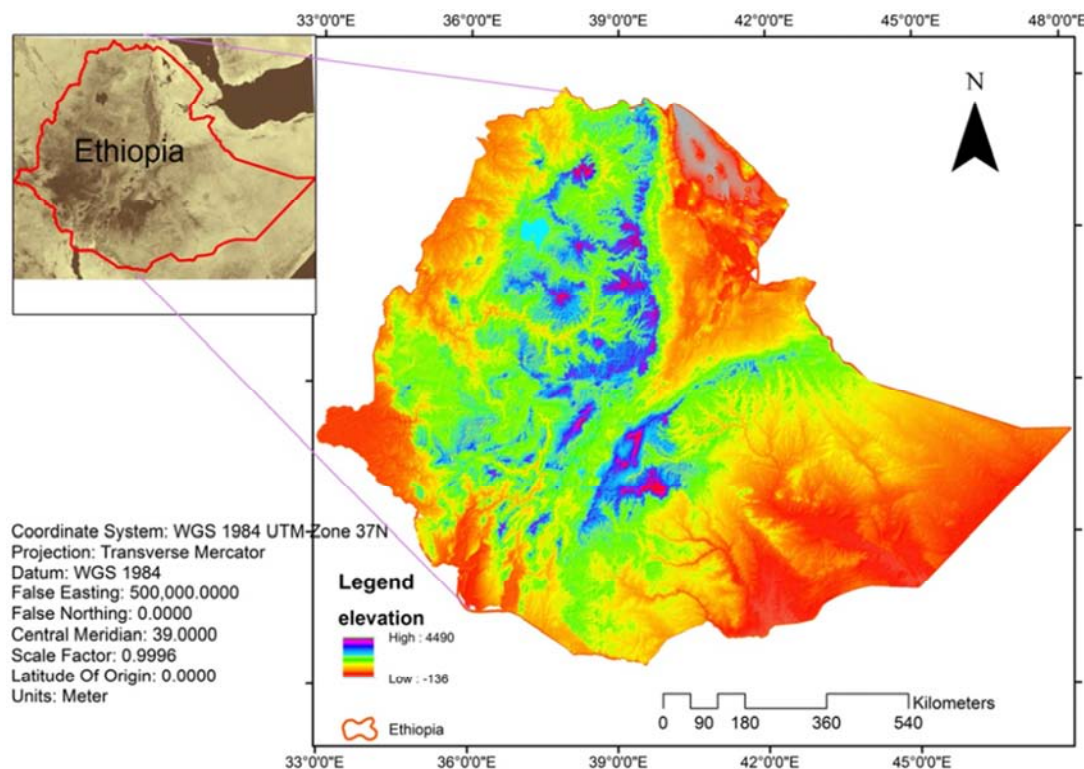


Figure 1. Study area map.

### 2.1.2. Climate

Ethiopia's climate is generally affected by the Inter Convergence Tropical Zones (ICTZ). The ICTZ pass over Ethiopia twice a year and this migration alternatively causes the onset and withdrawal of winds from North and south. The countries climate varies according to the different topographical regions. The highland region of the country (central plateau) has a moderate climate with minimal seasonal temperature variation. The mean minimum during the coldest season is 6°C, while the mean maximum rarely exceeds 26°C. High temperature variation exists in the lowlands parts of the country; it maximum reaches around 60°C. The average annual rainfall of the country in the highlands is 122cm and in the lowlands the precipitation is less than 10 cm. Heavy rainfall occurs in most of the country during June, July, and August and the Northern provinces receive less rainfall.

### 2.1.3. Population and Demographics

According to the 2019 revision of the World Population Prospects the total population of Ethiopia was 109,224,414 in 2018, compared to 18,434,000 in 1950. The population of Ethiopia represents 1.23 percent of the world's total population which arguably means that one person in every 82 people on the planet is a resident of Ethiopia. Ethiopia's population growth rate is well above the global average and is among the highest in Africa. Birth and death rates for the country are also well above those for the world. The proportion of children below the age of 15 in 2010 was 41.5%, 55.8% was between 15 and 65 years of age, while 3.3% was 65 years or older. The average age is 25.1. The projected population for the year 2025 will be 118,354,000.

### 2.1.4. Land Use

According to CIA world Fact book (2013) of Ethiopia's total land area of 1.13 million sq km (437,794 sq miles),

agricultural land consists of 36.3%, forest: 12.2% other: 51.5% Forestland, most of it in the southwestern part of the country, accounted for 4 percent of the total land area, according to the government. Most agricultural producers were subsistence farmers with small holdings, often broken into several plots. Most of these farmers lived on the highlands, mainly at elevations of 1,500 to 3,000 meters. The population in the lowland peripheries (below 1,500 meters) was nomadic, engaged mainly in livestock raising.

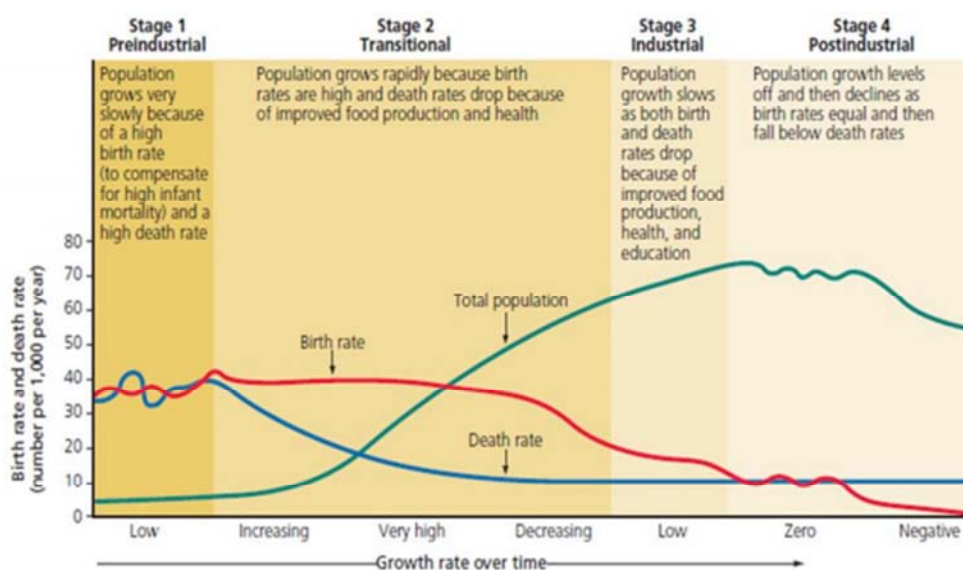
### 2.2. Methods

This report paper is completely a review paper which completely depends on the secondary data. Different published reports of different journals mainly supported in providing data for this paper. Since the paper is a review paper, no specific method has been followed in preparing this paper. I have been prepared this seminar paper by studying comprehensively from various articles published in different journals, books, proceedings and dissertations. All the information collected from the secondary sources have been compiled systematically and chronologically to enrich this paper.

## 3. Review of Findings

### 3.1. Population Growth Trends and Patterns

Before 1750 world population growth was very slow, preceded by a dramatic population increase. The unprecedented growth of world population after this time arose because birthrate outnumbered death rate. For many centuries, the birth rate and the death rate were fluctuated. This fluctuation formed the four stages of demographic transition [1].

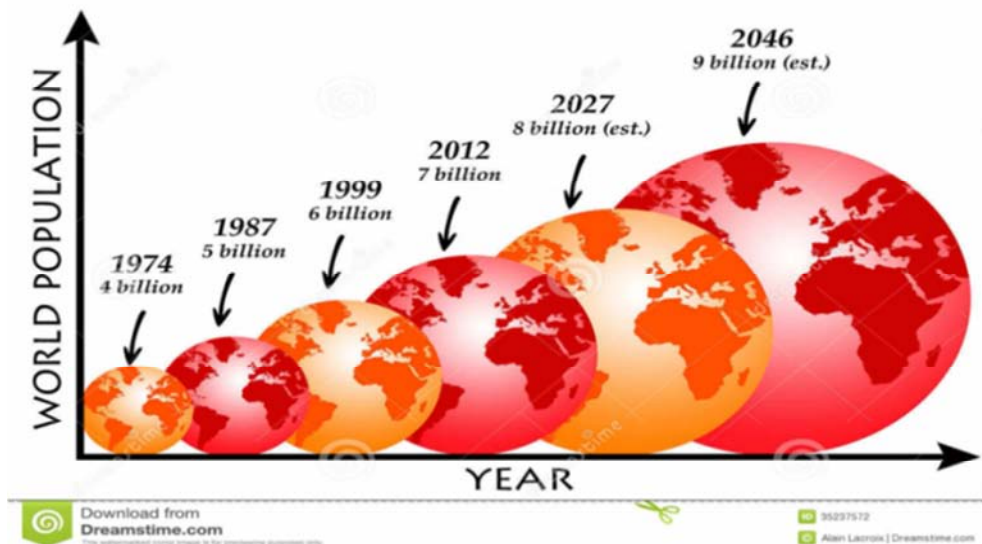


Source: (Wrigley, 1969).

Figure 2. Demographic Transition stages.

One reason for this change is the industrial revolution in Britain and this caused advance in public health and hygiene brought about by the scientific-technological economic revolution that began in the mid-eighteenth century particularly altering the course of global population history

through dramatic reductions in mortality rate. The population of our planet doubled between 1960 and 1999, increasing from three billion to six billion people. And currently it reaches around 7.2 billion [2].

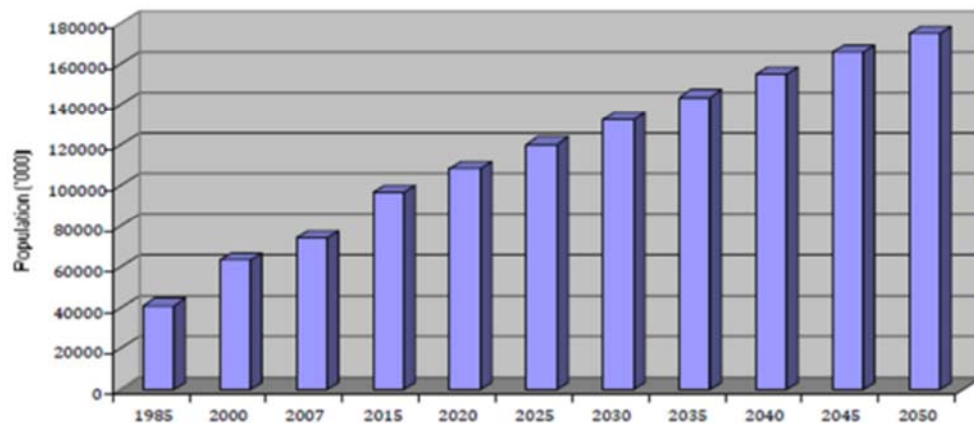


Source; Population Reference Bureau, 2017

**Figure 3.** World population growth.

In Ethiopia, at the beginning of the 20th century the population was estimated to be 11.8 million and its growth rate was then only 0.2 percent per year. In 1950, the population size increased to more than 19 million and its growth rate had

reached 2.1 percent per year [4]. The growth of the population followed a slow rate of increase until 1970 and accelerated thereafter. In 2007, the population reached to 73.9 million [20] and the annual growth rates were also increased from 1.65% in 1950-1960 to 2.5% in 1994-2007.



Source: UN, Population Division, 2009

**Figure 4.** Estimated projected population of Ethiopia.

### 3.2. Population Size and Environment

World population size is permanently connected to land, air, and water environment. Each and every individual uses environmental resources and contributes to environmental degradation. While the scale of resource use and the level of wastes produced vary across individuals and across cultural contexts, the fact remains that land, water, and air are

necessary for human survival [8].

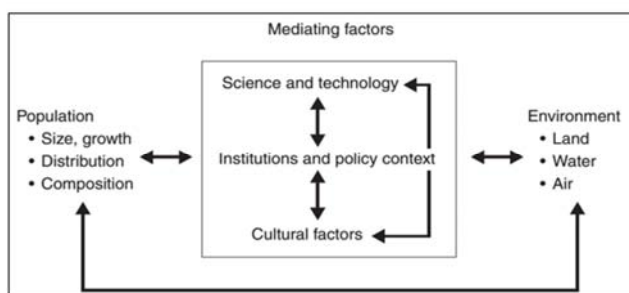
Population pressure has both positive and negative impact on the environment in a given area or in global level. Since environment and population are closely interrelated they cannot be studied separately. Population and environment have a complicated relationship. There are different debates in the interaction of population and environment. The



controversy on the population and environmental interrelationships has been between those who consider rapid population growth, increases demand for resource and environmental degradation, and those who emphasize opportunities rather than problems [21].

Debate about population has been going on at least since Aristotle, who cautioned that populations could outstrip their subsistence base, leading to poverty and social discord [22]. The British economist Thomas Malthus' essay on the Principle of Population (Malthus T, 1960) suggested that unrestrained population growth would outstrip the ability of the Earth to provide sufficient food. In the contrary [23], argues that technological change as means of innovation under population pressure, suggesting that increasing population density might encourage technological changes that allow food production to keep pace with population growth. Boserupian theory focuses on the relationships between these three factors: population, environment, and technology. According to [24], historical population growth leads to improvement of the living condition. He suggested that population growth induces sufficient technological change to expand food output faster than population.

According to [25], "Population pressure and environment relationships are better understood if conceptualized as being mediated by economic, social, cultural, and institutional factors." In addition to this, [8] explained how technological change has impacted the since the pre-historic time to the modern time and how institutions and policy plays key role in determining the final effect of humans on the environment.



Source: MacKellar et al., 1995

**Figure 5.** Relationship between population and Environment.

### 3.3. Population Change and Demand for Land Use

According to [27], Land is the earth's terrestrial surface which is full of resources for most human activities and needed for such activities. Land use changes over the past 6,000 years are associated with the growth of human population [28]. For many years, the growth of agricultural production related to the expansion of population, together took place through the expansion of land under cultivation.

Historical records indicate that different population

densities and different population growth rates produce different land use patterns and changes over time. More people means more food, which can come only from either expansion of agriculture into new lands, or use of existing agricultural land more intensively [29]. As [27] explained rapid population growth exerts pressure on the existing land resources through increasing the demand for food, wood for fuel and construction purposes, and other necessities. Farmers convert the remaining patches of forest in to field and fallow their lands for shorter period's thereby increasing soil erosion.

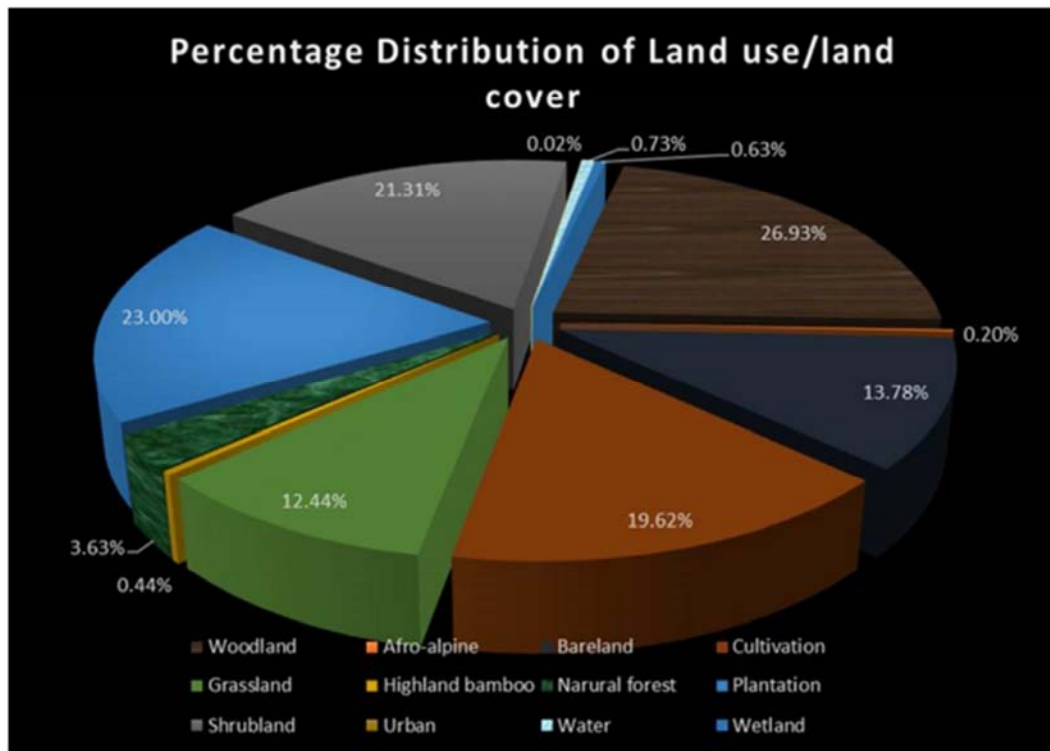
### 3.4. Land Use/Land Cover Changes

LULC are defined by many scholars and organizations. According to [9], Land use is the total of all arrangements, activities and inputs that people undertake in a certain land cover type". In contrast, Land cover "is the observed physical and biological cover of the earth's land as vegetation, rocks, water body or man-made features". Similarly, [30] presented the term land cover to the observed biophysical cover of the earth's surface (Water surface, soil, rock, vegetation and manmade features) and land use refers to peoples activity on the land cover. In addition to these [31], explained it:

"Land use change is defined to be any physical, biological or chemical change attributable to management, which may include conversion of grazing to cropping, change in fertilizer use, drainage improvements, installation and use of irrigation, plantations, building farm dams, pollution and land degradation, vegetation removal, changed fire regime, spread of weeds and exotic species, and conversion to nonagricultural uses".

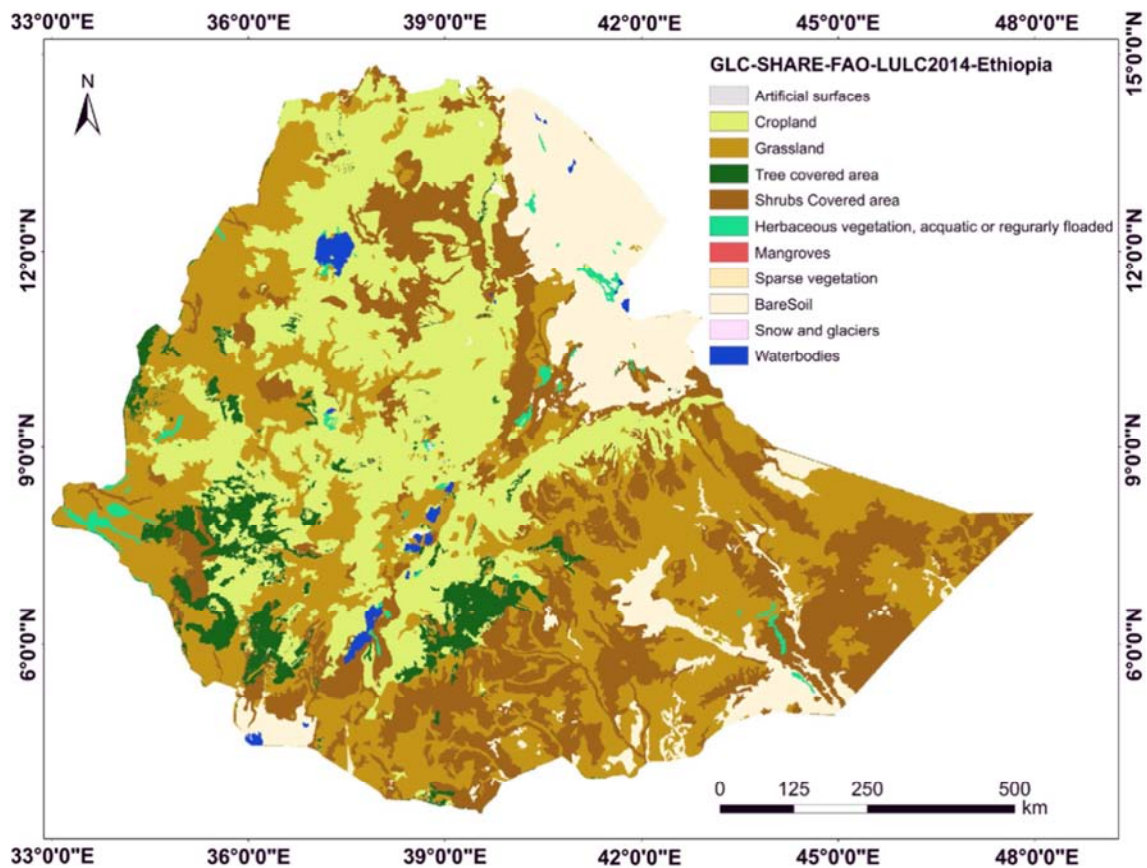
LULCC also known as land change is a general term for the human modification of Earth's terrestrial surface [32]. LULC change is commonly divided into two broad categories: conversion (a change from one LULC category to another e.g. from forest to grassland) and modification (a change within one LULC category e.g. from rain fed cultivated area to irrigated cultivated area). Land cover modifications entail the changes that affect the character of the land without changing its overall classification and can either be human induced, for example, tree removal for logging; or have natural origins resulting from, for example, flooding, drought and disease epidemics. Land cover conversion is the complete replacement of one cover type by another such as deforestation to create cropland or pasture.

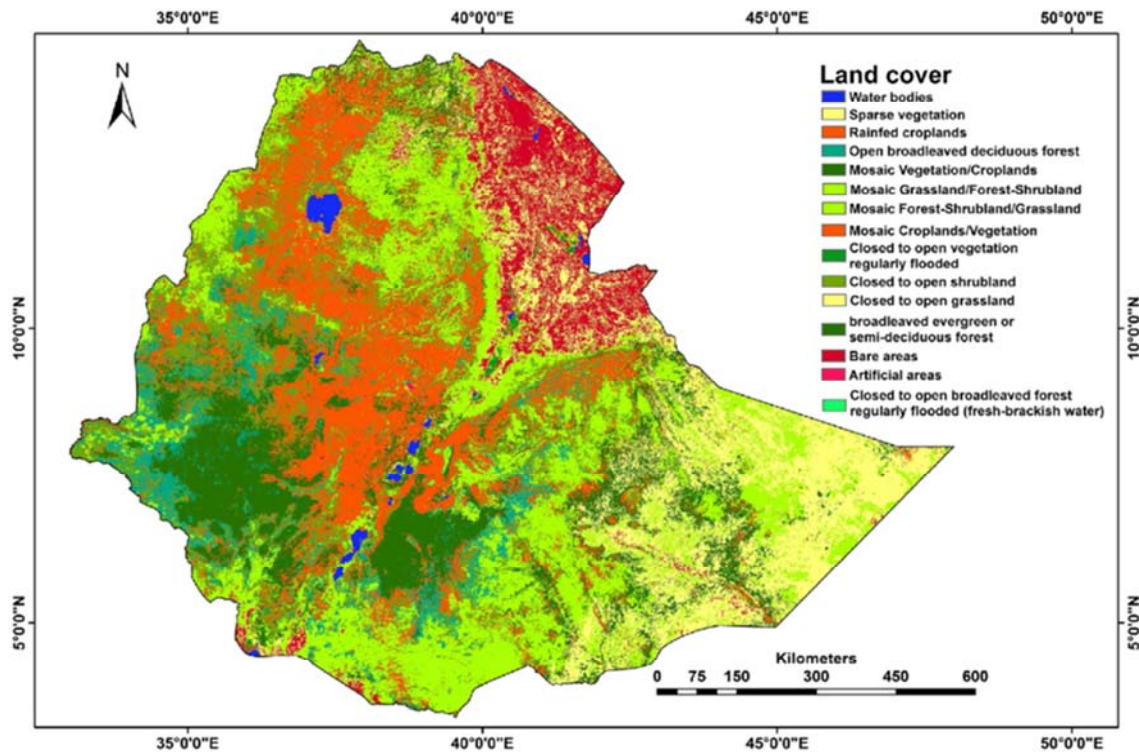
According to [33] 88% of the Ethiopian population is located in the 45% of the country's highland, with an altitude of greater than 1500m. Because of the Ethiopian highlands receive high rainfall (between 600 and 2700mm) annually, huge diversity in biological resources: forest, woody, and grass lands, shrubs, and varied wildlife exists. But, it is eliminating.



Source: (Tefera, 2011)

**Figure 6.** Percentage Distribution of LULC change in Ethiopia.





Source (FAO, 2014)

**Figure 7.** LULCC map of Ethiopia (a) using MODIS 1km resolution (b) Landsat images.

Researches carried out in Ethiopia have shown that there were considerable LULC changes in the second half of 20th century because of deforestation and gradual change of cultivation land beyond expected limits were the major causes of land degradation, particularly in the highland part of the country [34]. At the beginning of 20th century forest and woodlands coverage of Ethiopia was 40% of the total area of the country. But currently this figure is estimated at less than 15% with an approximate deforestation rate of 160,000 to 200,000 ha yr<sup>-1</sup> [35]. The expansion of cultivated, grazing and both urban and rural settlement were the typical reasons for the rapid degradation of forest cover. Besides, too much reliance on woody biomass for fuel, the expansion of agricultural activities at the expense of vegetation cover and demand for wood for construction materials contributed to uncontrolled land cover change and deforestation in Ethiopia [36, 37] mentioned that LULC change is one of the main problem related with agricultural production in Ethiopia. The total area of the country 1,130,000 km<sup>2</sup> is experiencing huge land use/land cover change in natural vegetation, farming practices and human settlement. The highland part of the country which contributes 44% of the county has severe problem.

#### Causes of Land use Land Cover Change

Land use and land cover changes may occur due to diverse factors, which may be generally divided into natural and human induced or anthropogenic causes. United States Environmental Protection Agency identified the general causes of land use and land cover changes, which are: (I) natural processes, such as climate and atmospheric changes,

wildfire, and pest infestation; (2) direct effects of human activity, such as deforestation, urban and agricultural expansion, and road-building; and (3) indirect effects of human activity, such as water diversion leading to lowering of the water table. Even though, natural processes may also contribute to changes in land cover, the major driving force is human induced land uses. These anthropogenic causes of land use and land cover change, which are critical and presently growing in alarming rate, and can be grouped into two broad divisions: proximate and underlying causes. Proximate (direct) causes are immediate actions of local people in order to execute their desires from the draw on of the land [39]; whereas driving causes are causes which drives behind the immediate causes. These two major categories of causes work at different levels. Proximate causes operate at the local level (individual farms, householders, or communities); on the other hand, the sources of underlying causes are at regional and national levels such as districts, provinces, or countries. Underlying causes are external and beyond the control of local communities [17].

#### 3.5. Population Growth and Land Use Land Cover Change

Researchers abroad indicated that LULC change and population change have a strong relationship; as population increases the need for cultivated land, grazing land, fuel wood; settlement areas also increases to meet the growing demand for food and energy, and livestock population. population growth and density are indirect factors for LULC conversion through the growing needs for additional lands for farming and grazing as well as demands for tree products (fuel and

construction wood). In this regard, recent studies concluded that land cover conversions due to demographic pressure are more serious largely in tropical regions such as Latin America, Africa and Southeast Asia [17].

Many researches in Ethiopia also show the impacts of population pressure on LULC changes. In the Ethiopian highlands the land cover conditions have been modified or significantly transformed by the rapidly increasing population pressure and growing livestock population. Human population has grown fast on the limited land area and almost every piece of land is converted into cultivated land to produce food. [35] identifies population growth as the key drivers of LULC changes along with cutting of woody plants for fuel wood and making charcoal and expansion of cultivated land. [40] highlights that there is a correlation between population growth and LULC change over the study periods and have shown that there was strong linkage between population growth and LULCC.

Additionally, population pressure has been found to have negative effect on riverine vegetation, scrublands and forests [41-43] also highlights growing of population is one of the most critical drivers of the observed land cover dynamics because the livelihood of almost the entire rural population depends on it.

## 4. Summary

From the findings it can be concluded that the growing population pressure results associated problems, such as the increasing demand for land for agricultural products and the expansion of settlement. The increasing demand for land for agricultural products results conversion of forests to agricultural areas and settlements. The statistical results also shown that there was strong correlation between population growth and LULC change over the study period, which indicates there was strong linkage between population growth and LULCC. The evidence from different survey analysis indicated that among the broad group of proximate causes, Agriculture was the main causes of LULC change and from the underlying causes of LULC change demographic were the main causes of LULCC.

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