Analysis of Urban Expansion through the Geospatial Application of Remote Sensing and GIS: a case of Sebeta Town

Bereket H/Mariam Dadi

A Thesis is submitted to

The department of Geomatics Engineering

School of Civil engineering & Architecture

Presented in Partial Fulfillment of the Requirement

for the Degree of Master's in Geo-informatics Engineering

Office of Graduate Studies

Adama Science and Technology University

July, 2021

Adama, Ethiopia

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Advisor: -TilahunErduno (PhD)

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DECLARATION

I hereby declare that the Thesis entitled "Analysis of Urban Expansion through the Geospatial Application of Remote Sensing and GIS: a case of Sebeta Town" is my original work and has not been presented for a degree in any other university, and all sources of material used for this thesis have been duly acknowledged for all published and unpublished sources based on the scientific guidelines of the University.

______________________	______________________	______________________
Name of Student	Signature	Date

Recommendation

we, the advisors of this thesis, hereby certify that we have read the revised version of the thesis entitled "Analysis of Urban Expansion through the Geospatial Application of Remote Sensing and GIS: a case of Sebeta Town" prepared under our guidance by Bereket Hailemariam submitted in partial fulfillment of the requirements for the degree of Masters of Science in Geo-informatic Engineering Therefore, we recommend the submission of revised version of the thesis to the department following the applicable procedures.

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Major Advisor	Signature	Date
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Co-advisor	Signature	Date

APPROVAL SHEET

we, the advisors of the thesis entitled **“**Analysis of Urban Expansion through the Geospatial Application of Remote Sensing and GIS: a case of Sebeta Town” and developed by Bereket Hailemariam hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

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Major Advisor	Signature	Date
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Co-advisor	Signature	Date

We, the undersigned, members of the Board of Examiners of the thesis by Bereket Hailemariam have read and evaluated the thesis entitled “Analysis of Urban Expansion through the Geospatial Application of Remote Sensing and GIS: a case of Sebeta Town” and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Geo-informatics Engineering.

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Final approval and acceptance of the thesis is contingent upon submission of its final copy to the Office of Postgraduate Studies (OPGS) through the Department Graduate Council (DGC) and School Graduate Committee (SGC).

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List of Acronyms

ERDAS	Earth resource Data analysis System
GPS	Global Positioning System
GIS	Geographical Information System
LULC	Land Use/Land Cover
RS	Remote Sensing
USGS	United State of Geological Survey
TIRS	Thermal Infrared Sensor
TIFF	Tagged Image File Format
TM -	Thematic Mapper
ETM+	Enhanced Thematic Mapper Plus
OLI	Operational Land Imager
LISS	Linear Imaging Self Scanner
FAO	Food and Agricultural Organization
LCM	Land Change Modeler
CSA	Central Statistical Agency of Ethiopia
ECA	Economic Commission for Africa
GDP	Gross Domestic Products
UTM	Universal Transverse Mercator
ECO	Oromia Engineering Corporation
OUPI	Oromia Urban planning Institute
GII	Geospatial Information Institute

ABSTRACT

Rapid and unmanageable urban expansion is becoming the characteristic of cities as well as the towns in developing countries like Ethiopia. Sebeta town is one of the victims of such type of problem and expanding improper way because of rapid population growth, rural to urban migration and massive expansion of industries, rising demand of land for residential need and for others. Hence, this study analyzes urban expansion of Sebeta town using the application of remote sensing and GIS and shows the patterns of improper urbanization that provide paramount information for the town planner or decision makers. To achieve the intended objectives, the study used Landsat image of (1986, 2000, 2010&2020) and identify, quantify and map of land use land cover of Sebeta town. The pattern of land use land cover change detection from the year 1986, 200, 2010 and 2020 was analyzed using maximum likely hood supervise classification algorithm. According to the output of initial year (1986) agricultural land had high area coverage and settlement had very small covered, in 2000 agricultural land covers the highest percentage from the total land mass of the town and followed by vegetation instead of settlement forest area was diminished. In the year 2010 the result is slightly changed from the outputs of 1986 & 2000, settlement and vegetation is on the same level, but agriculture area was decreased. Finally, in 2020 high coverage of settlement and a huge loss of agriculture areas have been seen. According to change detection analysis between 1986 and 2000, 2000 and 2010, 2010 and 2020, 1986 and 2020, Settlement or built-up area shows an increment by38.9 % (1986_2020) and Agriculture area and vegetation shows decrement by 33.81%, 12.61% respectively. Hence an average growth rate of or an increment of settlement is 1.14% per year, on the other side agricultural area is decrease 0.994%per year, this implies settlement dominantly is consuming agricultural area. The rapid population growth of the town is one of the major causes for urbanization rural to urban migration from the nearby rural village and Land use land cover change detection plays a great role for urban expansion monitor and urban planning. Thus, the town government stack holders should use the application remote sensing and GIS for planning activities.

Keywords: Urban Expansion, Land use Land cover change, Remote Sensing, GIS

CHAPTER I: INTRODUCTION

The motivation of this study is giving the awareness of a number of environmental and subsequent socio-economic problems caused by the rapid urban expansion as well as the alarming rate of population growth. The first chapter of the study deals with briefly state the problems related to urban expansion, rapid urbanization consequence and briefly illustrate the importance of using Geospatial technologies like remote sensing and GIS for better understanding of urban growth change process.

1.1Background of the study

Urban expansion leads to the change of land use land cover in many places around the world in developed and developing country, especially in developing country like Ethiopia the change is enormous and the negative consequence of environmental impact is huge(UN, 2005).According to UN, urbanization is simply defined as "the movement of people from rural to urban areas with population growth equating to urban migration" (United Nations, 2005).It is also a social process which involves the changes of behavior and social relationships as result of people living in urban area (Bhatta, 2010).Urbanization has been a dynamic complex phenomenon taking place all around the world. This process without the sign of slowing down has led to the significant changes in land cover land scape pattern. Dramatic urbanization, especially in the developing countries, will continue to be one of the important issues of global change influencing the human dimensions (Deng, 2009). Rapid population growth and related need for housing and other facilities have resulted in an increasing urbanized land cover, mostly along the major roads and rural countryside, which is typically scattered and inefficient in resource utilization the scattered urban growth and disaggregated landscape structures as a result of human activities also influence the function and structure of the ecosystem. Dispersed urban development can pose a challenge for planning infrastructure and services.

In recent decades, urbanization, the most extreme anthropogenic land cover/use transformation has been a universal and important socioeconomic phenomenon around the world. Urban growth has been accelerating with the significant increase in urban population. The world urban population was only nearly 3% of the global population in the 1800s. But increased to about 30% in 1950 (wu& David, 2002). As urbanization has occurred, lands making up the natural resource base, such as agriculture, forest wet lands, have been replaced by urban land (Jantz, 1990).

although urban areas cover a very small percentage of the world's land surface in comparison and socio-economy, such as loss of natural vegetation and farm land (TANET,2005) local and regional climate change (Kaufmann, 2007), decline in biodiversity (Zimmermann, 2010), hydrological circle alternation (Barron,2013) etc. Without effective planning, there is no doubt that the pressure for sustainable development will continue to increase (Dawan&Yamagchi, 2009Alambin, (2001). The majority of urban growth due to human activities is currently proceeding more quickly in the developing countries like Ethiopia. The current population of Ethiopian is 104, 814, 08 based on the latest United Nations estimates. However, the existing population of Ethiopia estimated to be 112 million by 2020, which makes it one of the largest populous country in Africa, source, world population prospects (2017).

Ethiopia's population is persistently growing by 2million people, or 2.5percent, each year. As the population increases, a greater percentage of land is deforested and over-farmed. Forest coverage has declined from 40 percent in 75 years ago to only 3 percent today (Solomon, 2018). Consequently, many vegetated areas have now been transformed in to dry lands and desert due to improper use of forest and land resource. This situation has become rampant and therefore making Ethiopian vulnerable to environmental degradation and desertification.

The rapid urban growth and the alarming rate of population growth have encountered so many subsequent socio-economic and environmental problems. Such types of environmental problems have charmed the attention of people of the world for the past few decades. Peoples are now eagerly conscious of different types of these environmental disorders (ORAAMP, 2010).

Generally speaking, environmental problems can be classified in three parts. These include, the problem arising and related with poverty and development, the problem those arising is a negative effect of the very process of development and the problem associated with manmade pollution (ORAAMP, 2010). According to ORAAMP, 2010population growth, industrialization and urbanization are the three main problems caused by the rapid urban growth and unplanned urban expansion. If these problems are not well considered and studied by the responsible stack holders it affects human day to day life style as well as disorder the nature. Hence based on the mentioned environmental problem take into consideration the study focuses on the improper urban expansion of the Sebeta town by using geospatial technologies.

Sebeta is one of the towns of Oromia special zones, surrounding finfine/Addis Ababa located in Oromia regional state and located at a distance of 20km from finfine city along the ways to Jimma, southwestern Ethiopia. Thus, Sebeta is one of town vulnerable to population growth, industrialization and urbanization in alarming rate. So that, today it is common to see unmanageable settlement, loss of agricultural areas and vegetation area as well as open space.

The main objective of the study was to analyze, detect and evaluate the spatial composition as well as rapid urban expansion of Sebeta town through the application of remote sensing and GIS tools. Geospatial change detection analysis of urban expansion helps for many purposes related to planning activities of unprecedented urbanization of the town and this study address the land use change as well as its effect applied between 1986 and 2000, 2000 and 2010, 2010 and 2020, 19786 and 2020.Acccourding to the outputs takes place in 34 years the settlement or built-up area is an increment of in 38.9% (1986_2020) and Agriculture area and vegetation are decrease 33.81%, 12.61% respectively.

1.2Statement of the problem

Sebeta town is expanding improper way because of rapid population growth. As a result of this there is a rising demand of land for residential need. Between the year 2000 and 2020G.C a large number of hectares of fertile and productive agricultural land area were lost to urbanization, industrialization, and quarrying has been a dramatic change in its land use composition. Improper urban development caused an adverse impact not only on agriculture and other land but also on the environmental condition and the livelihoods of the area in the long run (Bhandari, 2010). The motivation of the study is giving the awareness of number of socioeconomic (loss land resource) and environmental problems cause by the alarming rate of urbanization progress. It is obvious that urbanization and urban expansion activities have a profound effect up on the natural environment. People are becoming the main agent of environmental degradation deforestation, reduction of green spaces, erosion, as they depend on the natural environment for their survival. In this regard, urban centers like Sebeta have exposed to such environmental problem. This is due to the fact that the rate of population growth, urbanization and industrialization are relatively higher. Sebeta has been attracting people all around the nearby rural kebeles surrounding Sebeta Hawas wereda and south west Shewa zone wereda and kebeles as it is close to the capital city of country or Addis Ababa city.

There are three major problems revealed for cause of rapid urbanization created in the town Firstly, according to the 1994 national census of Ethiopia (CSA) the town had 14,700. And also, the 2007 national census of Ethiopia reported a total population of Sebeta was 49, 331. Whereas, currently CSA projected the population of the town for the year 2020 is equal to 92,798 (CSA proj. 2020).as we can see from the population data of the year 1994-2007 in13 years an increment of 34,631 while, for the year 2007-2020 it also in 13 years an increment of 43,467 fast population growth as it shown.

Thus, it is one of the main factors for rapid urban expansion of the town. Secondly Rural to urban migration from the nearby Sebeta town surrounding rural kebeles, Sebeta Hawas wereda and south west Shewa zone wereda and kebeles, which the town is near to the capital city of the country or close to Addis Ababa and since the town is very attractive to live there.

The last one the town has witnessed the continues influx of people and increasing demand of developmental land for purposes such as residential, commercial centers, industrialization commercial agriculture, institutional uses, sudden settlement, illegal construction and others has led to various kinds of environmental issues (kassa, 2014).

Additionally, the ever–growing Sebeta urbanization and urban sprawl have made significant areas of around the town dominated by crowded and settlements with bad living conditions. These settlements are suffering from problems of lack of Safe housing and portable water supplies, social unrest (armed robbery, gambling etc.), Electrification, and high level of pollution, poverty, HIV and Inadequate or lack of transport services and poor linking of the roads is creating commuting problems leading to crowdedness and discomfort for users.

Most of the studies on urban growth of Sebeta town were made by International Organizations like, (UN –Habitat) and World Bank as well as so many researchers done their best. Their focus is mainly population growth of the town and to some extent town expansion as well as its impact on environment in relation to economic development and population growth.

Therefore, they did not show detail studies more about spatial expansion, urban pattern development, composition and rapid expansion of town. This study used to develop a change detection procedure suitable for analyzing urbanization in a LULC change based on the supervise classification surface data sets by carry out change detection method. Therefore, the study will focus on urban LULC change and the main motivation the project will be to improve capacity building of Sebeta city municipality to adjust their plan related to LULC that could be upgrade with little alarming bell hint.

Generally, this research will attempt to show the rapid urban expansion from Landsat image (1986-200 years) by using remote sensing and GIS technologies to acquire information from Landsat images for providing knowledge on the trend of land utilization and urban growth that can be useful for evaluating the effects on sensitive areas and planning unmanaged urban growth in Sebeta town.

1.3 Objective of the research

1.3.1 General objective

The main objective of this study is to analyze the effects of Land Use Land Cover change on urban growth as well as the rate of urbanization in Sebeta town over the four decades period of1986, 2000, 2010 and 2020 through the application of GIS and remote sensing.

1.3.2 Specific objective

The specific objectives of the study area are to: -

-Identify LULC pattern changes of Sebeta town from the year 1986-2020

-Identify and locate a rate of rapid urban expansion of the Sebeta town over 34 years.

- Quantify rate of urban expansion and Show map of the out puts of the study area.

1.4 Research questions:

-What are the output changes and patterns of Sebeta town LULC types from the year 1986-2020?

-What is the rate of urban expansion over 34 years and its impact on environment on study area?

-How can this study quantify and allocate the problem caused by alarming rate of urbanization?

1.5 Significance of the study

This study provides relevant information about the alarming rate of urbanization and its implication in Sebeta town well as evaluating and analyzing of urban growth by using GIS and remote sensing technologies and to understand urbanization of around Sebeta in the past

34years. The study generally gives attention to urban growth and its impact for responsible stake holder and government official of Sebeta town.

It furnishes the most important and firsthand information regarding issues of the alarming rate of urbanization resulted by urban growth in the study area. Knowing land use land cover change can assist planner for multipurpose as well as in time decision will become an essential bases for all land administration and urban planning functions such an planners, state and local government officials, decision maker, responsible stake holder, legislators to determine better land use policy.

1.6 Scope of the study

The scope of study is spatially determined to Sebeta town among the town in special zone surrounding finfine of Oromia regional state based on the drawback of problem statement mentioned on the above. Thematically, the study focused on the analyzing and evaluating over the four decades period of 1986, 2000,2010 and 2020 by the use of GIS and remote sensing for the result of urban growth change in relation to environmental issues and Hand-held GPS for sampling data to ground truth.

1.7 Limitation of the study

This study is not completely free from limitation. Hence this project faced many constraints from data gathering to analysis, among these constraints some of them are listed as follows.

First limitation of the study is the use of Landsat imageries with course resolution of 30m for urban land use land cover classification due to expensiveness and unavailability of finest imageries which is ideal to urban features.

The other one due to the course resolution of imageries, ground truth and GPS data sampling need to be performed in order to get better accuracy and mapping land use land cover change is difficult during interpretation and image classification due to similarity of spectral signature of the features.

1.8 Organization of the thesis

There are five major chapters presented to thesis project. Chapter one contains Introduction, Background of the study area, problem statement, objectives, description of the study area, significance, scope the study and limitation of the study area which is clearly states the information to the reader about urban expansion has been provided. Chapter two is devoted to different world's approaches, mechanisms and methods of urban expansion or urban growth has been reviewed very well from sources of materials and studies which have assisted the researcher to produce organized sources of materials for the selected topic. Chapter three is deals with location of the study area, sources of materials, data source, software used and methodology. Chapter four discuss about the result and discussion of the study and finally Chapter five deals with conclusion and recommendation.

CHAPTER II: LITERATURE REVIEW

This chapter deals with the definition of urbanization in detail for the past, current and future of urbanization at world, Africa and as well as in Ethiopia. Urban background, planning history and previous studies made on Sebeta town is also reviewed under this study.

Apart from the definition of urbanization, this chapter also deals with Analyzing and investigating LULC changes, special dynamics at various scales, it is necessary to review ideas, concepts and practices that have been performed so far. This chapter reviewed related literatures applying to GIS remote sensing, the applications for spatio-temporal LULC studies, what exists so far, gaps and what needs to be done. The techniques of LULC mapping and changes analysis and its implications on urban dynamics have been reviewed.

2.1 Definition of urbanization and urban growth

Urbanization: the definition of urbanization and urban areas vary from place to place and country to country (Mason, 1989; Frey and Zimmer, 1998; Sudhira, 2008; Rui, 2013; Wray, 2013; UN, 2014). The word 'urban' has its root in a Latin word 'Uranus' meaning city dwellers (Sudhira, 2008), and urbanization can be defined as the increasing proportion or percentage of peoples living in urban areas. It is precisely defined as "the increasing share of a nation's population living in urban areas (and thus a declining share living in rural areas)" (Satterthwaite, 2010). Urbanization is a process leading to the formation of towns, cities and agglomeration of people and their socio-economic activities in areas classified as urban based on different criteria.

According to Buettner (2014) there are four broad criteria that countries use to differentiate urban areas from rural areas: administrative criteria, the proclamation of localities as urban; population-related criteria refer to population size and density, for size localities with threshold population of ≥ 10,000 are designated as urban and for density localities with at least 400 persons per km2 are considered as urban; economic criteria are specified as significant presence of non-agricultural activities; and criteria based on urban functions may be defined as the existence of paved streets, water supply and sewer systems or electric lighting and so forth. United Nation Population Division also makes use of a minimum total population of 2000 people to classify urban areas from rural areas (Ofem, 2012) and a number of countries apply the criteria, e.g., Ethiopia. However, still other countries set their own minimum total number of populations to differentiate urban area from the rural counter parts, e.g., Nigeria uses 20,000 (Ofem, 2012) while India and Japan use 5,000 threshold population (Frey and Zimmer, 1998). As a result, a place with a specified total population identified as urban area by one country may be considered as rural area by another country and as such the level of urbanization in country may decrease or increase depending on threshold population. This is what makes the comparison of urbanization among countries difficult and should be understood based on the country's definition of urbanization. Mostly the urban areas are defined by national statistical offices for census purposes based on different criteria: total population, proportion of population engaged in non-agricultural activities and the presence of other infrastructures. Therefore, the term urban area may refer to any settlement from smallest towns to largest megacities (Mason, 1989). According to European Union Regional Policy (2011), urban area refers to both Cities and towns with an administrative unit or a certain population density and the population of towns is mostly smaller between 10,000 and 50,000 inhabitants whereas cities have larger population greater than 50,000 inhabitants. A country is said to be urbanized when more than 50% of its population is living in urban areas.

Urban Growth: refers to the rate or pace of urbanization and associated physical expansion of cities and towns (Johns Hopkins University, 2006). The precise definition is given as "the process through which a city changes its spatial structure as a result of an increase in population and normally but not necessarily accompanied by the expansion of its urbanized area." (REIS, 2015). Various theories and models explain the growth and evolution of urban expansions. Cheng, (2003) state urban growth as a complex system of physical expansion and functional change i.e., physical expansion refers to the change in space– transition from non-built-up to urban whereas functional change refers to the change in major land-uses activities.

2.1.1 World urbanization

United Nations World Urbanization Prospect (2014) indicated that the percentage of urban population in 1950 was 30 percent which increased to 54 percent in 2014 and estimated to be 66 percent by 2050. More recently, world's urban population is estimated to be about 54.5 percent (Demography, 2016). As such with the current pace of urbanization the third millennium is expected to be urban (Weber, 2005). Studies indicate that big differences of urbanization between developing and developed world expected to happen by 2050 and world urban growth will shift towards developing nations. There will be rapid and unprecedented increase in developing countries but it will remain stagnant even a decrease in developed world. About 90% of world urbanization will be from developing countries by 2050 (Baudot, 2005; Moir, 2014) and only three countries India, China and Nigeria will account 37% of world urban growth between 2014 and 2050. It is also indicated that the annual urban population increase of only six large cities in developing countries (New Delhi, Mumbai, Dhaka, Lagos, Kinshasa and Karachi) will be greater than Europe's entire population (Moir, 2014). Angel, (2011) indicate that under the current rate of growth world urban population will double in 43 years but urban expansion will double in 19 years.

While the highest urban population is found in developed world, rapid urbanization and expansion have been the characteristics of cities and towns in developing world in the past 20 years from 1995-2015, taking a considerable area of their surroundings (UN-Habitat, 2016). Contrary to this, a vast majority of the population in the third world remain residing in rural areas. By now Asia and Africa are the least urbanized, sharing 48 and 40 per cent of their population urbanized, respectively. As the pace of urbanization becomes rapid, it gives little time for government and municipalities to plan and fulfill infrastructures and services needed by increasing number of people(SHIFERAW, 2017).

2.1.2 Urbanization in Africa

Urbanization and urban expansion are increasing at an alarming rate in developing courtiers particularly in Africa due to increasing flux of population concentrating in urban centers. The share of urban growth for developing countries from 2000–2025 is estimated to be 90% which was 57% from 1975–2000 (Johns Hopkins University, 2006). According to Mundia& Murayama (2013) Africa will have 11 mega cities with a population of more than 10 million and about 3, 000 towns with population of more than 20, 000 by 2020. Africa is urbanizing rapidly and expected to triple in the coming 50 years (FREIRE, 2014; MOIR, 2014). Eastern Africa will experience higher than African average urban growth (RUAF Foundation, 2010). Africa is changing the trend of urbanization happened before in other part of the world for two reasons first it is urbanizing fast, second urbanization in Africa is not producing the economic growth and capital investment it is expected to generate.

As (FREIRE, 2014) indicated that Africa's urbanization faces four major challenges:

1. Rapid population growth with low level of economic activity based on inadequate capital

2. Low density, sprawl and informality in peri-urban fringe.

3. Poor coverage of infrastructure services such as water, energy and sanitation that makes difficult to improve welfare in both in urban and rural.

4. Weakness in administration, institutions and overall planning capacity.

Therefore, despite economic rise in some African countries in recent times, urbanization in Africa has been described as 'pathological' or 'dysfunctional' i.e., urbanization without growth (UN-Habitat, 2011). The United Nation Human Settlement Program (2011) indicate Africa's urbanization has been viewed as 'abnormality' or 'exceptionalism' by economists which means that unlike the rest of the world, urbanization in Africa has not been accompanied by sustained economic growth or reduced poverty.

As a result, African countries are expected to face the challenge and critical problems associated with rapid urbanization in the years to come.(SHIFERAW, 2017)

2.1.3 Urbanization in Ethiopia

Despite being the cradle of human being, a mosaic of mankind- a home for more than 80 ethnic groups, and its ancient civilization with a long history of state formation, all didn't help the country for urbanization and remained to be predominantly agrarian society. Before the establishment of Addis Ababa as a permanent capital city, different towns and cities rise and fall at various times in connection with the rise and fall of the royal kings and associated power shift in the country. Urbanization in Ethiopia goes back to the ancient and medieval history of the country with the construction of hundreds of stelas in Aksum (around first century A.D) and the rock hewn churches of Roha or Lalibela (11th century) (Aalund, 1985). Urbanization also continued with the establishment of Gonder (17th century) and the walled city of Harar (Aalund, 1985; Marcus, 1994). Particularly, Aalund, (1985) indicated that the population of Gonder reached 70,000 at its pick whereas the population of Harar was about 35,000 in 1875 and 42, 000 in 1885. However, the percentage of urbanization is still less than a quarter of the total population, far behind even in African standards. Ethiopia is one of the least urbanized country in the world with only 16.1% of its population lived in urban areas in 2007 and estimated as 20.4% for 2017 and 25.4% for 2027 (CSA, 2013). Currently, urbanization in Ethiopia is changing following economic growth and establishment of industries not only in Sebeta town and regional cities but also in a number of other smaller towns in the country. Until recent times, there was no comprehensive guiding urban plan in the country. Now, the government of Ethiopia prepared a strategic urban plan that covers the whole regions of the country based on their capacity and suitability for future development.

2.1.4 Urban planning of Sebeta Town

Planning and managing cities are an increasingly complicated proposition in both developed and developing countries. Regardless of the context – growth or decline, developed or developing countries – urban and decision planners -makers need to know how best to use limited resources to address the complex urban challenges (and opportunities) that are presented. Urban planning seeks to be efficient (make optimal use of resources), effective (create desired and meaningful impacts and outcomes), and also seeks to enhance equity (of opportunity, rights and power, especially with regard to gender). To achieve these '3Es' of good planning practice, decision-makers need a solid foundation of information and direction that can be provided by urban planning. The existing structure plan of Sebeta town set out its vision and targets for the prospect year 2010, Prepared in 2000, and the plan got statutory approval by the city government. However, the structure plan faced so many challenges during it implementation that should be solved immediately. So, in order to tackle these challenges, the spatial aspect of the city structure plan has been modified by the Oromia Urban Planning Institute in 2006 E.C. Even though it has been modified, the challenges have not been yet solved forever (OUPI, 2006).

2.1.5 Previous studies made on Sebeta Town

Sebeta town is fast growing town from Oromia liyu zone and putting pressure on the surrounding rural kebeles. Most of the studies on urban growth of Sebeta town were made by International Organizations like, UN -Habitat and World Bank as well as so many researchers done their best. Their focus is mainly population growth of the town and to some extent town expansion as well as its impact on environment in relation to economic development and population growth.

Therefore, they did not show detail studies more about spatial expansion, urban pattern development, composition and configuration of town growth.

For this reason, this study intended to show those changes happened in the past 34 years as well as to fill the gap with detail explanation on the pattern of the development. It also serves as a complement of the past studies. Additionally, there is a complaint from the surrounding people about mal adaptive or unmanageable expansion of Sebeta town for consuming farmer's agricultural land or farm land and environmental dis order.

Hence this study attempts to show how the recent spatial expansion, pattern and composition of the town looks like how much of the Agricultural land lost, bare land or open space, vegetation coverage and green area is consumed by settlement or built-up area of Sebeta town as well as its surrounding rural kebeles.

2.2 Urbanization and Development

Urbanization is the basis for development and the driver of economic growth. Urbanization is both inevitable and desirable (Spence, 2009) in order for countries and cities achieve their aspiration in economic development. According to Spence (2009) nearly all countries were urbanized or at least 50% urbanized before achieving middle income economic level and all high-income countries are 70–80 percent urbanized.

The past records of urbanized countries indicate that no country has achieved sustained economic growth without urbanization- countries with high per capita income tend to be more urbanized while countries with low per capita income remain least urbanized (UN-Habitat, 2011; Freire, 2014). Satterthwaite (2010) state that No nation has prospered without urbanization and there is no prosperous nation that is not predominantly urban (Satterthwaite, 2010).

According to UN-Habitat (2011) cities are vehicles of social changes where new values, ideas and believes can forge a different growth paradigm for inhabitants and urbanization brought fundamental economic growth in developed world. In all cases, it indicates that urbanization is the basis for economic transformation. However, this seems a paradox for most of low-income countries for the obvious reason that urbanization and economic growth is very low but the rate of urbanization is at its highest pace. This is especially true for Ethiopia to achieve its plan to be a lower middle income

Country by 2025 (World Bank, 2015) as the country's urbanization level is currently 20.4%

For 2017 and 25.4% for 2027 (CSA, 2013). The fact that rapid urbanization accompanied by

Low economic growth in developing countries means it puts pressure on local, city and National governments to fulfill even the bare necessities of life for city residents.

2.3Application of Geospatial technologies:

Remote sensing has been the best cost-effective system of data acquisition for a wide range of application since the launch of landsat-1 in 1972(Lo and Yeung, 2005). Both Geographic Information System and Remote Sensing usage of the term "Remote Sensing" connects the advance and technical means of collecting earth's information's from distance. On the other hand, a geographic information system (GIS) is a computer system capacitated to collect, store, manage, and manipulate all types of geographical data, thereby to visualize, analyze, and interpret the relationships, patterns, and trends of spatial phenomenon.

Urban growth and the physical expansion of cities can be detected, mapped and analyzed using remotely sensed data obtained from mostly Landsat multispectral scanner (MSS) thematic mapper (TM) enhanced thematic mapper plus (ETM+) and spot (Ward,2000).

Hence, remote sensing integrated with GIS helps in mapping and monitoring LULC dynamics. While remote sensing will capture the LULC types such as: urban/built up area, forest, bare lands, wetlands or water surface in Sebeta town; the GIS evaluated analyses aerial extents, and temporal changes. A space-born satellite such as Landsat sensor delivers images that have a medium spatial-resolution, which can adequately provide series of images of earth's information. (Lille sand and Kiefer, 1994; Eastman, 1995).

Additionally, Landsat provides an unparalleled data archive (i.e., since 1970s) and hence gives adequate date on ability to assess spatiotemporal changes (Jensen, 2005). For this study, historical Landsat 4-5 Thematic Mapper (TM), Landsat 7 Enhanced Thematic Mapper plus (EMT+), and contemporary Landsat 8 Operational Land Imager (OLI)/Thermal Infrared Sensor (TIRS) were used and evaluated LULC changes and modeling Sebeta town growth between 1986 and 2020.

2.4 Remote Sensing for Land Cover Change

Remote Sensing (RS) 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. It provides a 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. RS have been proven to be a very useful tool for land cover change detection.

Over the past decades, RS has played a large role in studying land cover change detection. With the availability of historical RS data, the reduction in data cost and increased resolution from satellite platforms, RS technology appears poised to make an even greater impact on monitoring land cover change .Change detection's studies of land cover are becoming demanding tasks with the availability of a suite of wide range sensors operating at various imaging scales and scope of using various techniques as well as increasing avenues for monitoring effective and accurate land cover change. Considerable research has been directed at the various components of land cover change including the accuracy assessment which is drawing an equal attention by scientists nowadays. In general, change detection of land cover involves the interpretation and analysis of multi-temporal and multi-source satellite images to identify temporal phenomenon or changes trough a certain period of time (NANG,2012).

2.5 Land use/Land cover: concepts and definitions

It is possible to review the concepts of Land Cover (LC) dynamics before embarking on the study. According to the Food Agricultural Organization (FAO 2016) land cover is the observed (bio) physical cover on the earth's surface such as forest herbaceous / grassland shrub land built-up area an agriculture wetlands barren area open water etc.

Land cover refers the biophysical coverage of land like natural areas, forests, buildings, lakes and roads. The term land cover describes the types of resources/features present on the surface of the earth. It is the observed (bio) physical over on the earth's surface.

Land use refers to the socioeconomic use that is made of land for different purpose such as agricultural use, commerce, residential use, recreational area; at any place, there may be multiple and alterative land uses. It reflects the character of a society's interaction with its physical environment, fact that becomes obvious when it is possible to see different economic and social systems occupying the similar environments (AYELE, 2017).

On the other land user (LU) encompasses the human activities which take place on the land consisting of agriculture forestry and even expanding to the context in which the land is managed (lillesand, 2008) examples of land use are arable land pastures field built-up areas recreation wild life habitat plantations etc.

LULC change is detection and monitoring along term dynamic in response to various local or global anthropologenic or climate change. Information classes are thematic categories of interest that under consideration for image classification (natural resource Canada 2013) these are categories of land cover types such as vegetation, built up grassland water bodies wet land and other. LULC mapping is a process that digitally classifies electromagnetically digitally discernable information classes into a series of thematic categories.

Urban sprawl is a term used to describe uncontrolled expansion of urban areas (urbanization) due to population m the LULC classification schemes is adopted from the one modified by new jersey department of environmental protection (NJDEF,2010)

The scheme creates broader framework developing information class that guided the digital image classification same of these LULC types used in this study are five categories listed as follows:

Settlement or built-up areas: Urban area is a human settlement with high population density where match of the land is covered by infrastructures including business district residential areas roads and other infrastructural facilities such as road network (highways and other major roads) power and communication etc.

Forest: a dense growth of trees, together with other plants, covering a large area of land or a piece of land with many trees. It includes natural forests and forest plantations. It is used to refer to land with a tree canopy cover of more than 10 percent and area of more than 0.5 ha. Forests are determined both by the presence of trees and the absence of other predominant land uses. They are an ecosystem which includes many plants and animals. Temperature and rainfall are the two most important things for forests.

Vegetation areas: These are areas dominated by density populated trees and woodlands, which is the land scape is covered by small trees or urban green space vegetation.

Farm lands Or Agricultural land: Agricultural lands are land cover devoted to the represent cultivated crop or arable lands. It is land covered with various teff, corn, maize, beans, and another crop production

Grass/Barren lands: This land covered grasses (openarea) or no grass and mainly covered with bare rock gravel pits pavement and soils or other earthen material etc. it is Vast portion of land (infertile) where plant growth may be spares, stunted and /or contain limited biodiversity. It is also lands affected by toxic or infertile soil, mining areas and climatic conditions are often key factor in poor plant growth and development.

2.6 Land use Land cover (LULC) mapping

Knowledge of land use land cover is important for many planning and management activities as well as essential elements for modeling and understanding the earth as a system. Land Use Land Cover (LULC) maps of an area provide information to help users to understand the current landscape orLULC mapping is a process that digitally classify electromagnetically discernable information classes of the imagery into a series of thematic categories

. Annual LULC information on national spatial databases will enable the monitoring of temporal dynamics of agricultural ecosystems, forest conversions, and surface water bodies.

2.7Land use land cover (LULC) change detection

The physical alteration of earth's terrestrial surface as result of human activities is commonly the so-calledLand use land cover (LULC) change around the world. This modification of land by humans to obtain livelihood and other essential has been there for thousands of years; the extent, intensity and rate of LULCC are far greater now than were in the past. These changes are driving forces for local, regional and global level unprecedented changes in ecosystem and environmental processes. Thus, land use land cover change plays an important role in the study and analysis of global changed scenario today as the data available on such changes is essentials for providing critical input to decision making of ecological management and environmental planning for future. Land use land cover modeling is a process that quantifies current land resource sand hoe they are changing into a series of thematic categories, such as forest, water, vegetation, build up and paved surface (YIRSAW, 2017).

Several studies have voted for land use and land cover change modeling (Balakeristanan and said 2012: Rawat & Kumar, 2015: Butt, 2015 Cheruto, 2016. For instance , in an effort ot quanitify the lulc changes in makueni country, Kenya over the period of 2000-2016. Cheruto (2016) found significant land transformation.

Generally, land use and land cover changes have a wide range of impacts on environmental and landscape attributes including the quality of water, land and air resources, ecosystem processes and functions (Rimal, 2011). Therefore, the use of remote sensing data and analysis techniques provide accurate, timely and detailed information for detecting and monitoring changes in land cover and land use.

2.8Causes of urban Expansion in Sebeta

Sebeta urban growth is taking place through threemajor ways. These are include :- Natural(Birth) rate, rural to urban migration and massive number of industrialization

1. The natural growth rate of the urban population

A considerable proportion of Sebeta urbanization attributed to high natural birth rate of annual increase (shack, 1973: CSA. 2007).

According to CSA(2007), Ethiopia and for that matter Sebeta birth rate, is too high even among developing countries. This is due to early universal marriage, kinship and religious beliefs that generally encourage large families, a resistance to contraceptive practices, and the absence of family planning services for most of the population (SESHINGKAR AND GRIMM, 2004).

It is traditionally believed that families with many children have greater financial security and are better situated to provide foe their elderly members (TODARO, 1997). As the population grows, urban sprawl encroaches into sparse, low-density pushing city limits further and further out. It also results in increase in urbanization, unemployment, income inequalities, social vice (armed rubbery), city congestion, ecological stress, and population mal-distribution. This finally causes urban sprawl there would be higher demand for land.

2.**Massive number of industrializations:** the expansion and development of industries lead to expansion of towns since there would be the demand for the use of land resource, which finally causes urban sprawl; Hence the town is high amount potential for industrial development, it is not possibly to say at its infancy stage. The existing limited manufacturing industries are largely concentrated in all direction of the town (southeastern, north east and west) fringe of the town. Most of the existing industries are Agro-processing industries, mainly dairy farm, and tanneries as well as mineral water, Garment, Manufacturing industries. This is another factor that caused urbanization in Sebeta, which is massive amount of agricultural land occupied so many industries.

3. **Rural- urban migration**: The rapid growths of urban population in Sebeta town and in many surrounding kebeles have been largely due to rural –urban migration. Almost half of Sebeta

population growth is attributed to rural -to-urban migration (ORAAMP, 2001; CSA, 2007; Bimerew, 2015). Many people migrate from rural folks to settle tin the city of better living.

The ultimate reason for the drift to large numbers of people from rural to the urban area are the relative improvement of different facilities and better living conditions in the urban areas compared to the rural areas is the main "pulling" factor (Tiffen, 1995). These facilities include tertiary education, market centers, good jobs, recreational facilities, and many more However, the tide of migration to urban areas which is triggered by rural "push" factors is consit6ently higher than the capacity of new job openings and the provision of housing and others social services and amenities (Bimerew, 2015).

Consequently, there is a spread urban unemployment, rampant infestation of diseases, over-crowded housing and server shortage of public amenities in Sebeta.

This review has evaluated studies investigated the benefit obtained from remote sensing and Geographic Information system (GIS) for urban LULC changes. It has looked into several studies that have been devoted to digital classifying electromagnetically discernable information classes of satellites image into a series of thematic categories for LULC mapping. Additionally, it reviewed some studies attempted to quantify changes in LULC over time.

Similarly, numerous efforts were made to underscore environmental implications of uncontrolled and unplanned expansion of urban areas into neighboring land resources for various cities around the world. Furthermore, the review noted population growth as a main drive behind Sebeta town urbanization and factors contributing to its urban sprawl into the surrounding Kebeles.

2.9 Conceptual frame work

Urban expansion has highly contributed to the modification and improper horizontal expanding of urban areas in Ethiopia. The main Contributor to urbanization is the rapid population growth and rural to urban migration in search of better job opportunities and employment services in the urban areas and the like. As a result of this a number of problems occur in the mentioned areas due to the effect of the movement population to the urban fringes following to the sprawling urban land uses in the urban fringes which are mainly agricultural area and vegetation areas.

The encroachment of urban land uses in urban fringes results to crowding out of agricultural lands impacting directly or indirectly on the inhabitants and the immigrants in these areas. The impacts on land uses include loss of farmlands, loss of labor in the agricultural sector and creation of jobs in other sectors mainly non-agricultural sectors among others (MULU, 2018).

Conceptual frame work flow chart

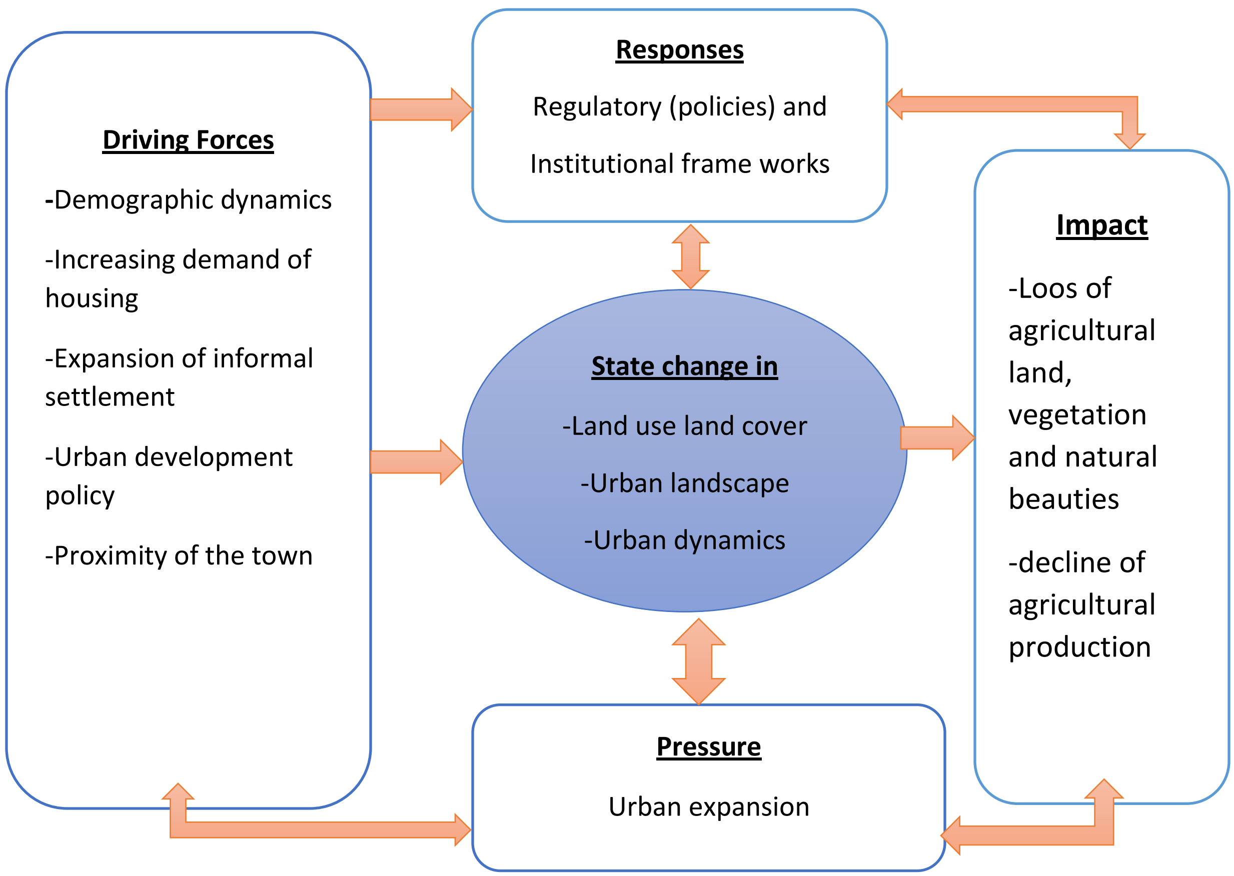


Figure1. 1 conceptual frame work flow chart

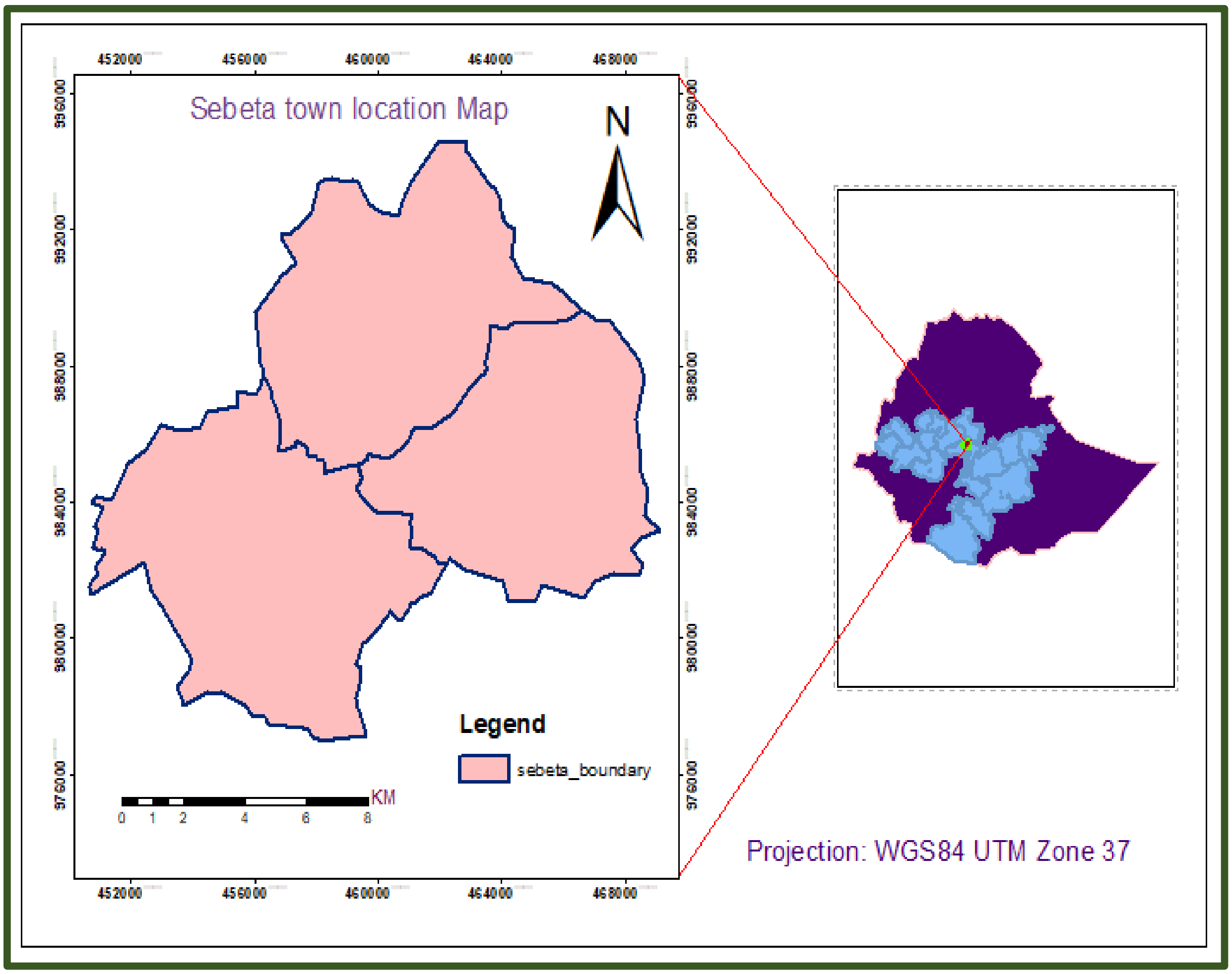
CHAPTER III: MATERIALS AND METHODOLOGY

3.1Description of the study area

3.1.1Geographic location

Sebeta is one of the towns of Oromia special zones, surrounding finfine, located in Oromia regional state. Sebeta town is located at a distance of 20km from finfine city along the ways to jimma, southwestern Ethiopia. The geographical location of Sebeta town is found at 8’52”30” N-9’00”00” N latitude and 38’35”00” E 38’40”00 E longitude. With regard to relative location, it shares common boundaries with Finfinnee /Addis Ababa in the north, northeast and east, Burayu town in the north and rural villages of Sebeta city has a coverage area of approximately with the current topographic map of the town is estimated to **175.0311** km^2

Figure1. 2Location map of study area (source: own computation)



3.1.2 Topography

One of the most important aspects the study area is the land scape and its topography is characterized by a plain rolling and with some mountain range in the southern part as well as with the altitude ranges from 2051m to 3202 meters above sea level.

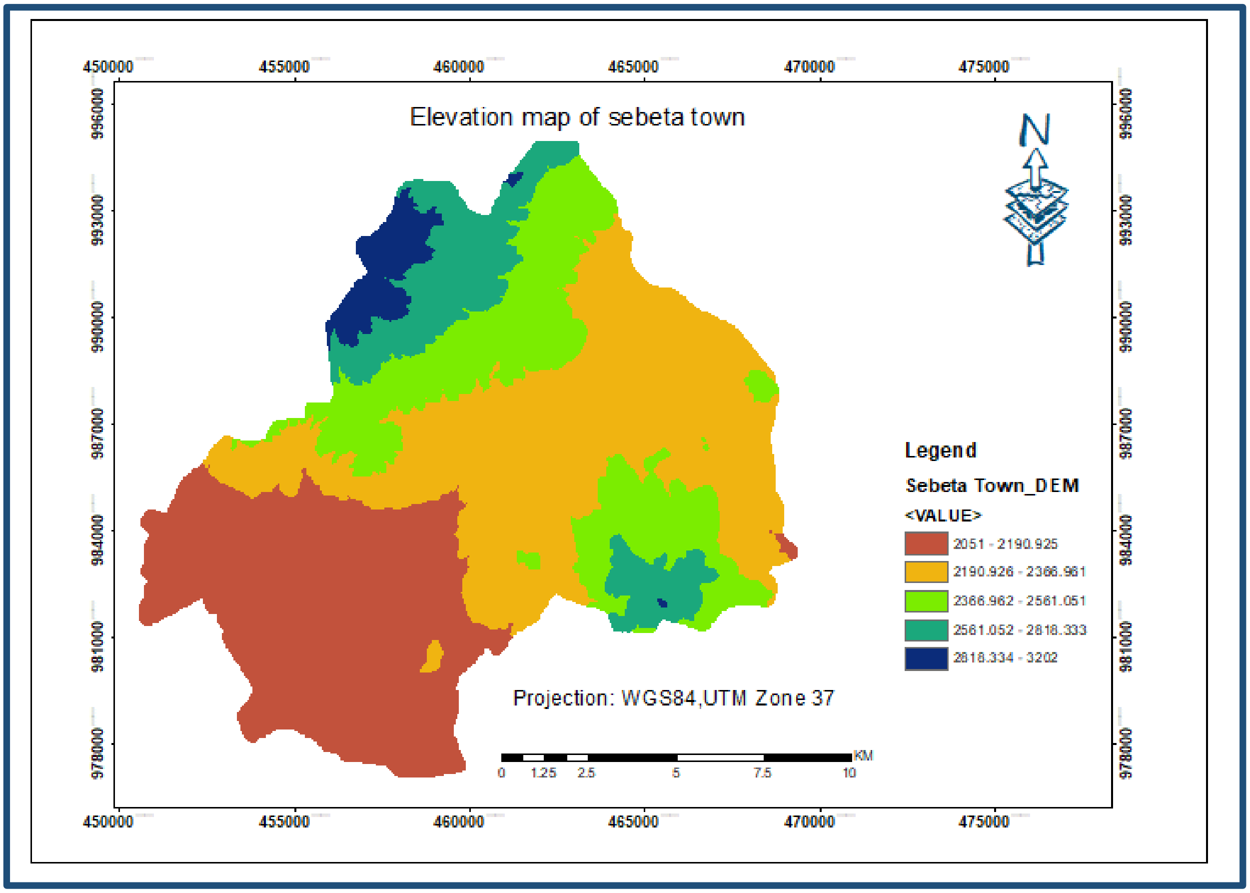


Figure1. 3 Elevation map of the study area (source: own computation)

3.1.3 Geology

The Geological formation of the study area is generally categorized into two major group's namely high classified (tertiary volcanic or plateau basalts) and lower classified (quaternary units or rift volcanic and sediment). The classification is based on the age of eruption, distribution and occurrences of the geological formation.

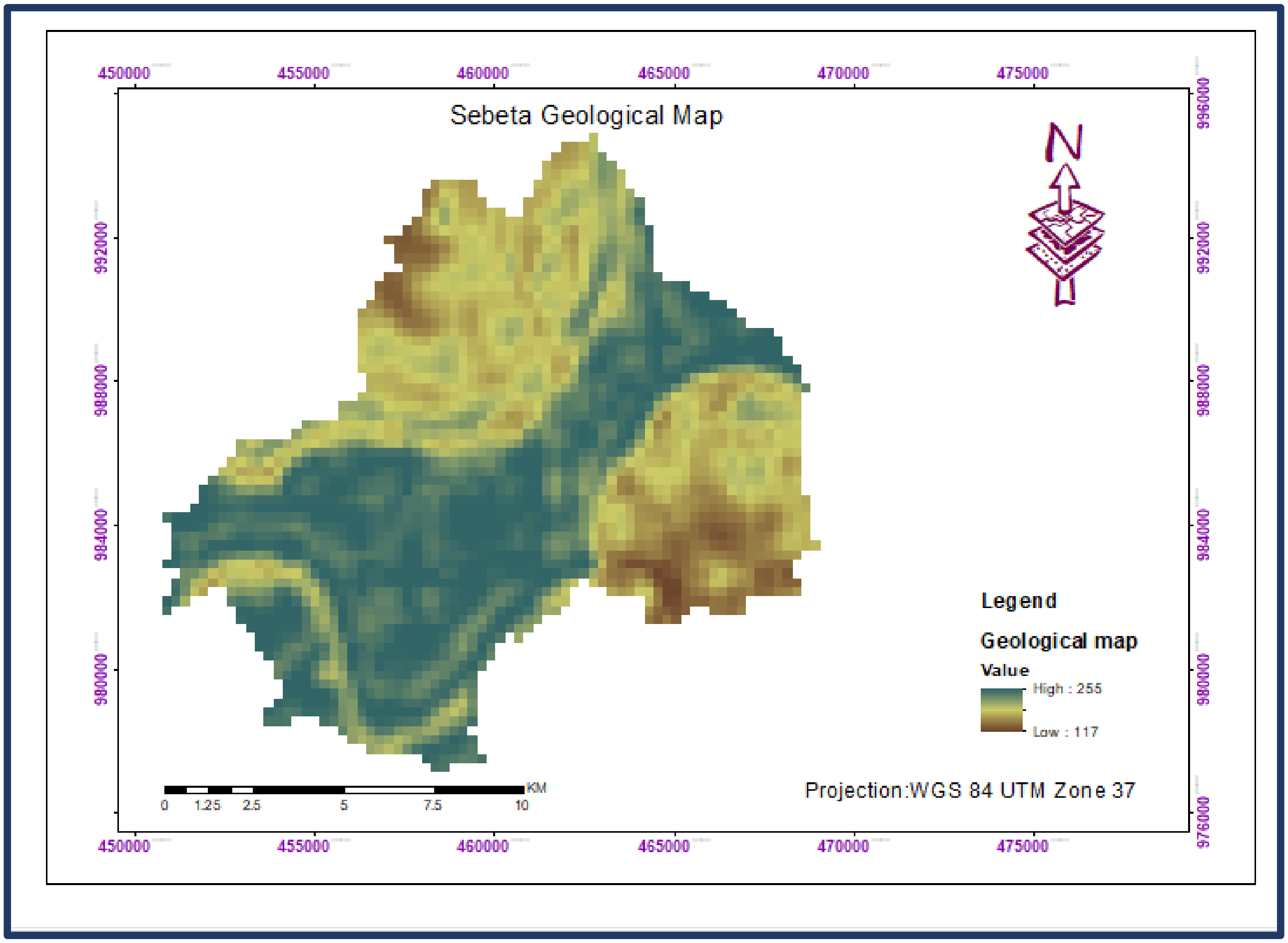


Figure1. 4 Geological maps (source: own computation from ECO data)

3.1.4 Soil

Soils are the world's natural resource and a soil map is a spatial representation of these resources. Therefore, soil map is fundamental and should be the starting point when planning every type of Land use. In the study area there are five major types of soils which are stated as follow.

Table1. 1 Soil Data and soil types

Pt No.	Soil Name	Area in Hectare	Percentage (%)
1	Vertisol	22462.0	39.978
2	Cambisols	16849.6	29.989
3	Luvisol	11237.2	20.000
4	Lepto sol	5624.8	10.011
5	Niti sol	12.4	0.022

1. **Vertisols or vertosol**is **a** soil type in which is a high content of expansive clay minerals.
   Vertisols are soils having, after the upper 20 cm have been mixed, 30 percent or clay in all horizons to a depth of at least 50 cm.
   In the study area Vertisols are found almost to the southeastern and Northern direction associated with Vertisol and Luvisol.

2.Cambisols are soils with initial stage of soil formation or weakly developed soils relating to their parent material. Beginning transformation of soil material is evident from weak, mostly brownish discoloration and/or structure formation below the surface horizon. The Cambisols in the study area is found distributive in limited places. The soil texture is loamy to clay and identified on undulating to rolling plateaus in the study area with stony phase and limited in depth.

3.Leptosolsare soils with an incomplete solum and/or without clearly expressed morphological features. They are particularly common in hilly to mountainous area of the North West and East fringe of the study area and it covers a small proportion of the area.

4.Luvisols are soils whose dominant characteristic is a marked textural differentiation within the soil profile, with the surface horizon being depleted of clay and with accumulation of clay in a subsurface. Luvisols have typically a brown to dark brown surface horizon over a reddish brown to strong brown.

5. Ntisolin the world reference base for soil resource is a deep, red well drained soil with a clay content of more than 30% and a blocky structure.

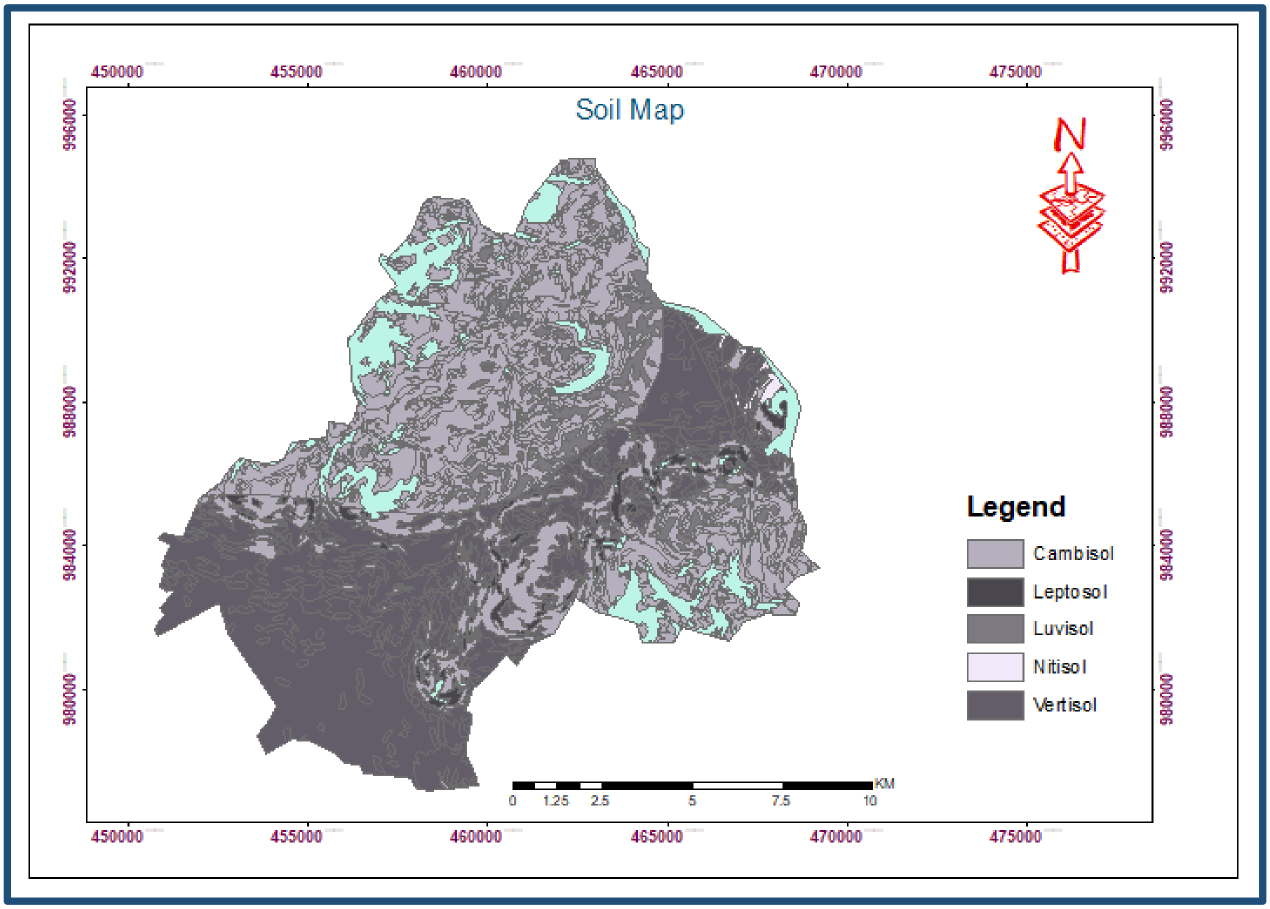


Figure1. 5 Soil map of Sebeta town (source: own computation from ECO Raw data)

3.1.5 Climate

The climate zone of the town is weyn adega and the annual rainfall of the town varies from 900mm-1300mm per year. The high rainfall season is during kiremt that starts in June and end of in September.

In Sebeta, the wet season is mostly cloudy, the dry season is partly cloudy, and it is comfortable year-round. Over the course of the year, the temperature typically varies from 50°F to 76°F and is rarely below 44°F or above 82°F.

3.1.6 Road Network

The proposed road network on the structure plan consists of different road types.

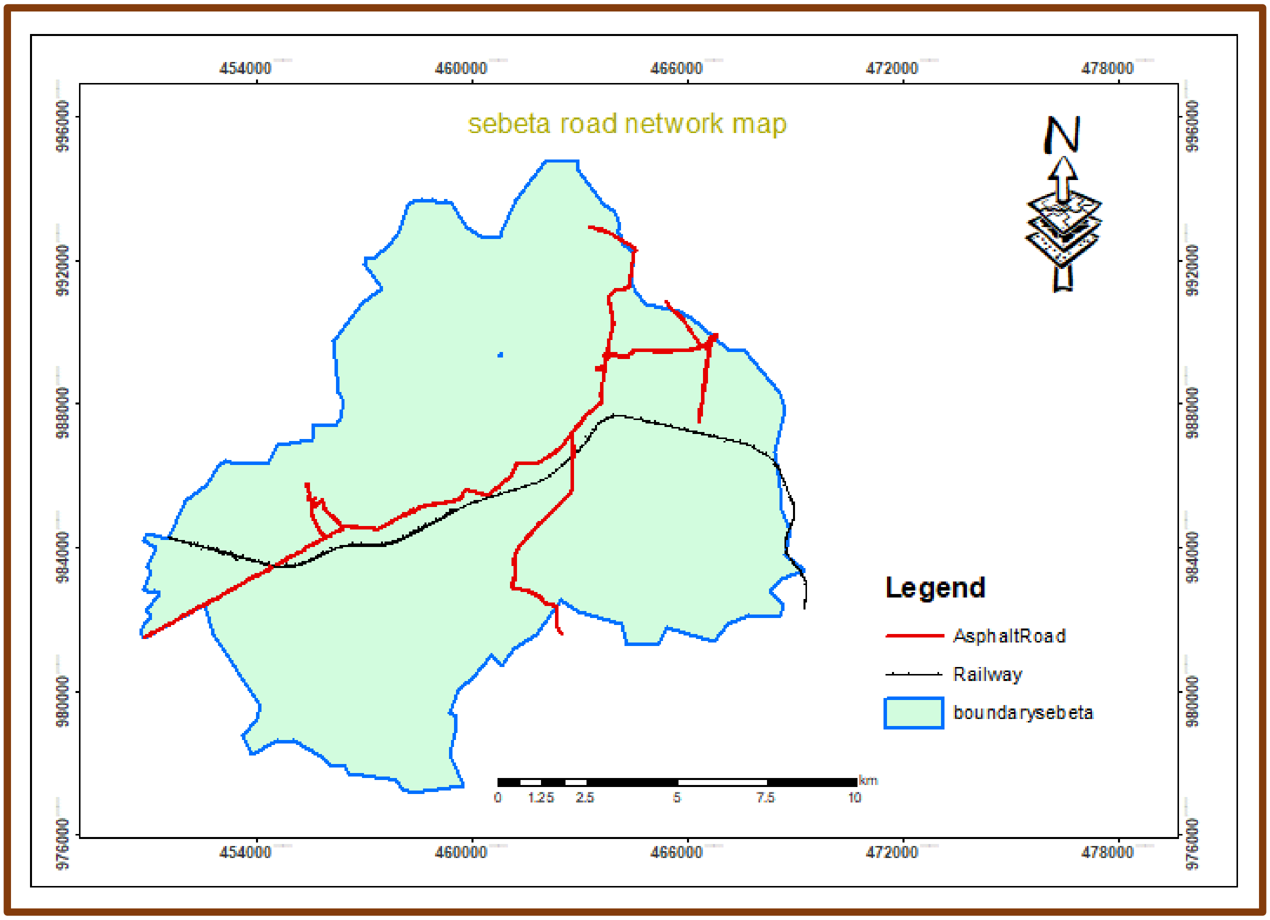


Figure1. 6 Road network map (source: own computation from Oromia Institution plan)

3.2 Socio economic characteristics of the study area

3.2.1 Demography

Demographic study is the major and fundamental component in planning and undertaking the sustainable Development strategies. Actual demographic and population studies represent the starting point for planning at all scales. It helps, as an example in land use planning, deciding the total land requirements and a basis for allocating land between various computing uses such as residential housing, shopping, and education and health services.

3.2.3 Population

According to the central statics agency Sebeta town has a coverage area of approximately with the current topographic map of the town is estimated to 17503.108 hectares or**175.0311** km^2 with elevation ranges from 1,500 to 3,000 meters above sea level as well as its location within the tropics of Africa, the geographical nature and settings and differences in altitude have resulted in wide range of terrain, climate, soil, mountains, flora and fauna (plants and animals).

The city is situated on a fertile area known for natural resources that surrounded by different chain of hills and mountains such as wochecha, hoche and seasonal marshy plains including furi-gara-bollo, gajja, ballachis and jamo (OUPI,2015).

Currently, the town has ten kebeles which is clearly stated in the table below.

Table1. 2 Sebeta town Kebeles distribution

Sr.No	Kebele Name	Sr.No	Kebele Name
1	Sebeta 01	6	Daletti 06
2	Alemgena 02	7	Sebeta 07
3	Wal-hate or Wallette 03	8	Kerabu 08
4	Furi 04	9	Sebeta 09
5	Dima 05	10	Atabala 10

According to the 1994 national census of Ethiopia (CSA) the town had 14,700. And also, the 2007 national census of Ethiopia reported a total population of Sebeta was 49, 331, out of this 24,356 were males and 24,975 were females. Whereas, currently CSA projected the population of the town for the year 2020 is equal to 92,798 from this 47,441 are females and 45,357 are males (CSA proj. 2020). The graphical representation of the population the three years (1994, 2007&2020) mentioned above is listed as follows.

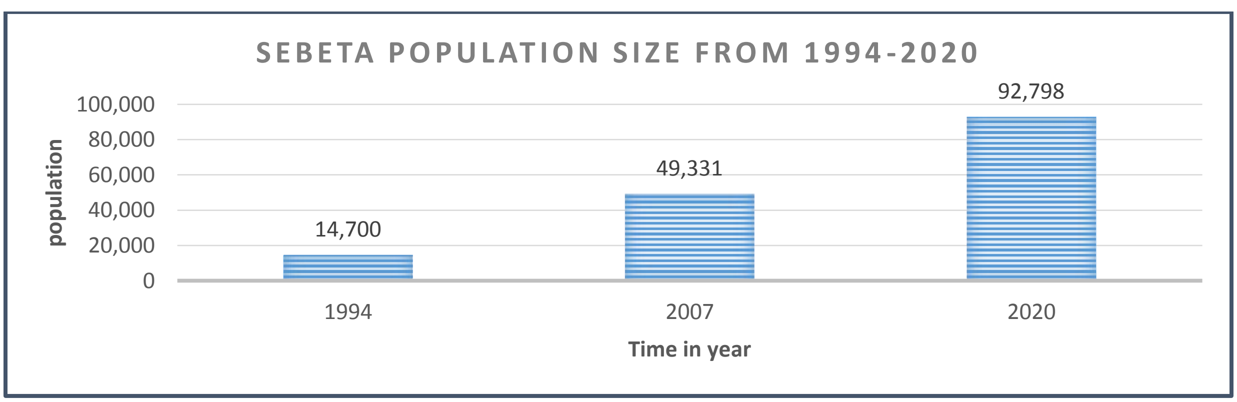


Figure1. 7 Population of the study area computed from CSA

3.2.4 Economy of the Town

The main economic bases of the town are industrial development, private investment, urban agriculture, commercial activities, and micro and small enterprise development. Hence the town is an initial able amount potential for industrial development, it is not possibly to say at its infancy stage. The existing limited manufacturing industries are largely concentrated in all direction of the town (southeastern, north east and west) fringe of the town. Most of the existing industries are Agro-processing industries, mainly dairy farm, and tanneries as well as mineral water, Garment, Manufacturing industries so on that create job opportunity for a lot of peoples living in the town.

3.3 Materials sources and data acquisition

3.3.1 Data sources

To meet the objectives of this research, different kinds of data were collected from both primary and secondary data resource include satellite imagery and field data.

The primary data: - remotely sensed data such as multi -temporal and multi-spectral image collected and the primary data used in this study was collected by means of field reconnaissance, field observation, topography and condition of environments was observed and noted very well.

Secondary data: - Secondary data was also obtained from census records and unpublished official documents and reports will be gathered from central statistical authority (CSA) of Ethiopian in order to assess the pattern of urban expansion of Sebeta town.

3.3.2 Data acquisition

For this study 1986, 2000, 2010- and 2020-year Landsat image was selected, the reason of selecting this year is that there is huge amount of land resource was invaded after the electrical result of the 1997E.C and 2005 E.C(2004-2010 G.C) Ethiopia national election. Hence based on the above reason remotely sensed data such as multi -temporal and multi-spectral image from the year 1986 up to 2020 in four decades was collected for this study. Landsat thematic mapper “TM” is applying to take Landsat images from 1986, 2000,2010 and 2020. The data for the research is a sensor of thematic mapper (Landsat Collection 1 level 1). Landsat images of 1986, 2000 and for the research is a sensor of thematic mapper (Landsat Collection 1 level 1).Landsat images 1986,2000,2010 and 2020 will download from the united states geographic survey

(USGS) the images will acquire between the periods January –March as this a clear sky season in the region only images with high quality standard (9) zero cloud cover with good cloud qualities will be considered the mage with good cloud qualities will then stack together (band combination) in ERDAS imagine and will prepare for classification after downloading the images delivered after pre-processing for their systematic as well as terrain distortions geo-rectifying and referencing into UTM spatially reference system the Landsat images will be taken at visible and infrared wavelength with best spatial resolution and 185m*185m swath the images shall of high quality as well as should be taken during clear sky days

Data Types	Data Format	Data sources
Study area Boundary	Shape file	Sebeta City Administration
Soil Map and Geological map	Shape file	Oromia Engineering Corporation (ECO)
Road Network and structure plan	Shape file	Oromia Urban planning Institute (OUPI)
Spot2017	TIFF	Geospatial Information Institute
Satellite image1986 (L.S 4-5TMC1L1)	TIFF	United State of Geological Survey (USGS)
Satellite image2000 (L.S 7 ETM+C1L1)	TIFF	United State of Geological Survey (USGS)
Satellite image2010 (L.S 8 OLI/TIRS C1L1)	TIFF	United State of Geological Survey (USGS)
Satellite image2020 (L.S 8 OLI/TIRS C1L1)	TIFF	United State of Geological Survey (USGS)
Population or census data	Excel data	central statistical authority (CSA)
Unpublished official documents and reports	MS Word	From Google or internet Sources

Table1. 3 Data Acquisition and data types

Software	Application
ARC GIS pro .10.7.1	Image processing and map preparation
ERDASS EMAGINE 2014	Image preparation, classification and processing
MS EXCEL	Statistical analysis and chart and graphs preparation
MS WORD	Word processing
Hand GPS or mobile topography smart phone application	Easting(X) and Northing (Y) coordinate data collection for ground truth

Table1. 4Software packages should be used

3.4 Image classification

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 set of criteria, then the pixel is assigned to the class that corresponds to those criteria. For the first part of the classification process, the computer system must be trained to recognize patterns in the data. Training is the process of defining the criteria by which these patterns are recognized. The result of training is a set of signatures, which are criteria for a set of proposed classes. Image classification is the process of grouping pixels based on their digital numbers (DN'S) into spectral and / or informational classes that capture some features that are interested in mapping there are two distinct types of classification these are supervised and unsupervised classification source natural resource Canada (2013). There are two ways to classify pixels into different categories.

3.4.1 Unsupervised classification

Unsupervised classification is a classification where pixels with common characteristics are grouped into a finite set of spectral classes based on their digital numbers or brightness values it is conducted by classifier without the use providing training sample classes the process of unsupervised classification involves a step by step approach–these are choosing bands that highlight differences in information classes deciding on how many groups (classes) to be classified choosing appropriate grouping algorithm (e.g.) simple clustering k-means, etc.)Classifying the image (bands) and labeling classes and evaluating the results.

3.4.2 Supervised classification

In supervised classification image analyst “supervises” the selection of spectral classes that represent patterns or land cover feature that the analyst can recognize here the image processing software is guided by the user to specify the land cover classes of interest the sample of these land cover classes are called “training sites “ the image classification software will be used in the training sites to depict the appropriate classes in the entire image the classification of land cover is based exactly on the spectral signature that are define in the training set based on the knowledge of the user by examining these signature that best accentuates difference in land cover.

Training is the processes of defining criteria by which spectral patterns are recognize developing informational class for each spectral class each pixel in the image data set categorized in to the spectral class that closely resembles based on a mathematical decision rule (Maxwell, 1976). It is absolutely important when the training area is a homogenous sample of the respective class so that the comparison (between spectral and LULC) would be easier (aria 1993) two or more training area per class was considered to accommodate within class variability the process of training would end –up be creating information classes(i.e. LULC types) (lillesand and kiefer , 2014 Eastman 1995) a statistical characterization for each information class would then be developed using ERDAS IMAGINE software (2014 version) to develop signature file known as signature analysis” once a statistical characterization has been achieved for each information class the image is then classified by examining the reflectance for each pixel and making a decision about which of the signature it resembles most (Eastman 1995).

The” maximum likelihood” classification algorithm is one of the most widely used classification techniques in remote sensing the maximum likelihood classifier is a conventional statistical classification technique that allocates each pixel to the class with which the highest likelihood (Mather &Koch 2011) hence these classification techniques were used to map the LULC of the study area

3.4.3 Band combination

It is known that band combination is best experience to show Landsat image pixels very well or clearly visible remotely sensed Landsat image data from satellite the following table illustrates band combinations.

Table1. 5 Band combinations distribution

Band Combinations for Landsat 5, Landsat 7 and Landsat 8			
	Landsat 5	Landsat 7	Landsat 8
Composite name	bands	bands	bands
Color infrared (Vegetation)	4,3,2	4,3,2	5,4,5
Natural color	3,2,1	3,2,1	4,3,2
False color (Urban)	7,5,3	7,5,3	7,6,4 (5,4,3)
False color	7,4,2(5,4,3)	7,4,2(5,4,3)	
Agriculture			6,5,2
Land/water			5,6,4
Vegetation analysis			6,5,4

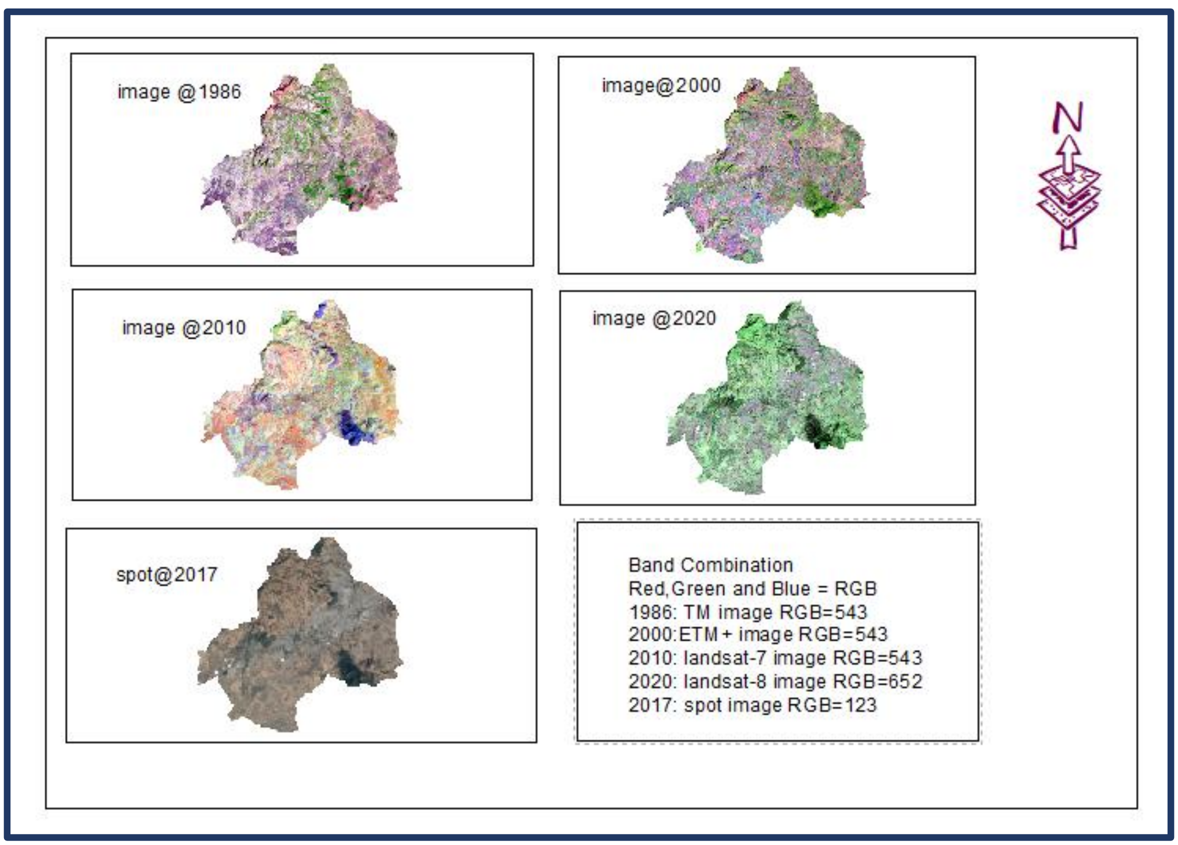


Figure1. 8 Satellite images map of the study area

3.4.4 Classification scheme

The classification system is developed referring different literature sources like (Anderson, 1976) classification scheme. The classification of land use categories is grouped in to five major classes as mentioned below.

Sr.no	Land use category	Description
1	Forest	A dense growth of trees, together with other plants, covering a large area of land or a piece of land with many trees.
2	Built up Area or settlement	Includes all developed areas roads, buildings, housing units, Commercial and resident areas, under construction areas etc.
3	Farm or Agriculture land	Includes all areas employed for agricultural activities farmland parcels both with and without crop.
4	Vegetation area	Refers to areas covered by vegetation of any type, including riverine trees or vegetation and other pockets of green areas.
5	Barren land	Refers to open spaces without any function, bare soils, rocky areas, quarries and gravel pits, grazing land, open areas in side vegetation and resident areas,

Table1. 6land use land cover classification scheme

3.5Accuracy assessment

Accuracy assessment is a mandatory activity after any satellite image classification analysis to know whether the classification process met its objective or not. Accuracy assessment is a term that is used to confirm a classified map and ground truth data or a reference data that are assumed to be true to determine the accuracy level of classification result.

Assessment of classification accuracy is critical for a map generated from any remote sensing data. Although accuracy assessment is important for traditional remote sensing techniques, with the advent of more advanced digital satellite remote sensing the necessity of performing an accuracy assessment has received new interest (Congalton, 1991).

Accuracy assessment is the degree of correspondence between observation and reality or a classified map and ground truth data or a reference data (Levin, 1999).

According to Levin (1999) reference data for accuracy assessment can be obtained from existing map and field data checks. The most common applied method of accuracy assessment are two statistical indices should be used for accuracy assessment kappa analysis and error matrix. Kappa analysis is multivariate technique used to measure how the accuracy of map is above and beyond the accuracy expected by chance KAPPA (Cohen 1960 conglaton 1991) KAPPA as powerful technique in its ability to provide information about the accuracy of image classification and is calculated as by subtracting the chance of agreement from the actual agreement of the error matrix KAPPA ranges from 0 to one.

Table 1.7 Interpretation of agreement for Kappa coefficient

Value of kappa -hat	Interpretation of agreement
0.81 < K<1.00 or 81% - 100%	Almost perfect agreement or excellent
0.61<K<0.80 or 61% - 80%	Substantial agreement or very good
0.41<K<0.60 or 41 – 60%	Moderate agreement or good
0.21<K<0.40 or 21% - 40%	Fair agreement or satisfactory
0.0<K<0.20 or <20%	Slight agreement
K<0.0 or 00%	Poor agreement

On the other hand an error matrix is accuracy assessment defined as the proportion of agreement between classified maps and the once assumed to be the correct map an error matrix consists of a serious of rows and column the headings of the rows in the columns are the classes of interest the columns contain the reference data will the rows contain the classified information the intersection the rows and columns summarize the number pixels clusters of pixel in particular category (class) (Jensen 2015) the diagonal of the matrix the n umber represent the number of pixel in particular category (class) (Jensen 2015).

The diagonal of the matrix the numbers represent the number of pixels that were correctly identified the ratio of correctly classifies pixels by the total number of pixels produces an index that measures overall classification Accuracy.

Other accuracy indices were producer and user accuracies the producer accuracy is a measure of omission error. Errors of omission occur when a feature is left out of the category being evaluated.

It is a statistic that specifies the probability of aground reference data being correctly classified. This statistic is calculated because the producer may want to know how well an area can be classified. It is calculated by dividing the diagonal number from a class’s column by the sum of the entire column including the number found within the diagonal (Jensen 2015) on the other hand the user accuracy is measure of the commission error.

Errors of commission occur when a feature is incorrectly included category being evaluated an error of commission in one category will be counted as an error in commission in another category this statistic indicates the probability of how well the classified sample represents what is found on the ground which is calculated by dividing the diagonal of a class by the sum of the numbers within the row of that class (Jensen 2015)

3.6 Post classification image

Most classification Have a problem with “salt and pepper” also known as speckles that is a single or small group of miss-classified pixel. It is often desirable to smooth the (Mather&Koch 2011) common smoothing operation is a majority filter in majority filter the moving window replaces central pixel with majority class in specified neighborhood. The smoothing process would not only ‘clean up’ the image making visually less noisy but also shape all edge and improve the accuracy of classification. This study deployed ERDAS imagine package to determine the filter window. Finally, smoothed images will beclipped in to appropriate sizes the study area.

3.7Change detection

Making a subsequent comparison to classified image from different dates is called change detection purely consists of making a comparison of change between “from” and “to” class for each pixel over time. It is good when all the applicable steps are applied sequentially these are area change and rate of change spatial distribution of changed types change trajectories of land – cover types and accuracy assessment of change detection results in this study three separate LULC maps (1986, 2000,2010and 2020) will be created the map from 1986will compare with the maps of 2000 and 2010will compare with the maps of 2020 change of each category of LULC Change areas are simply those areas which are not classified the same feature at different time (jensen2015) different writers have reviewed change detection application such as ecosystem mapping land use change analysis forest management vegetation phenology seasonal change in pasture production risk assessment and other environmental change singh,1989).

3.6General Representation of the methodology

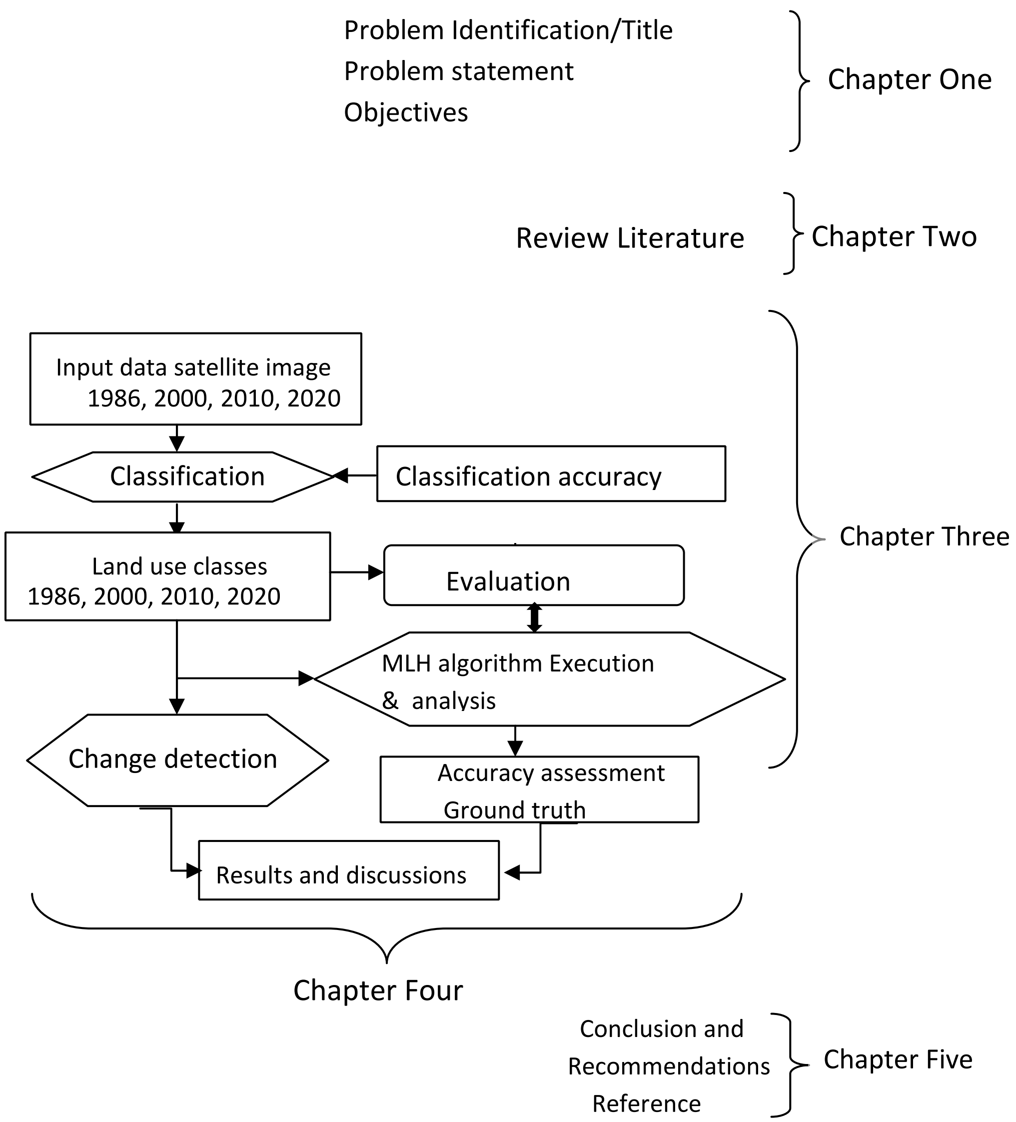


Figure1. 9General Research structure frame work

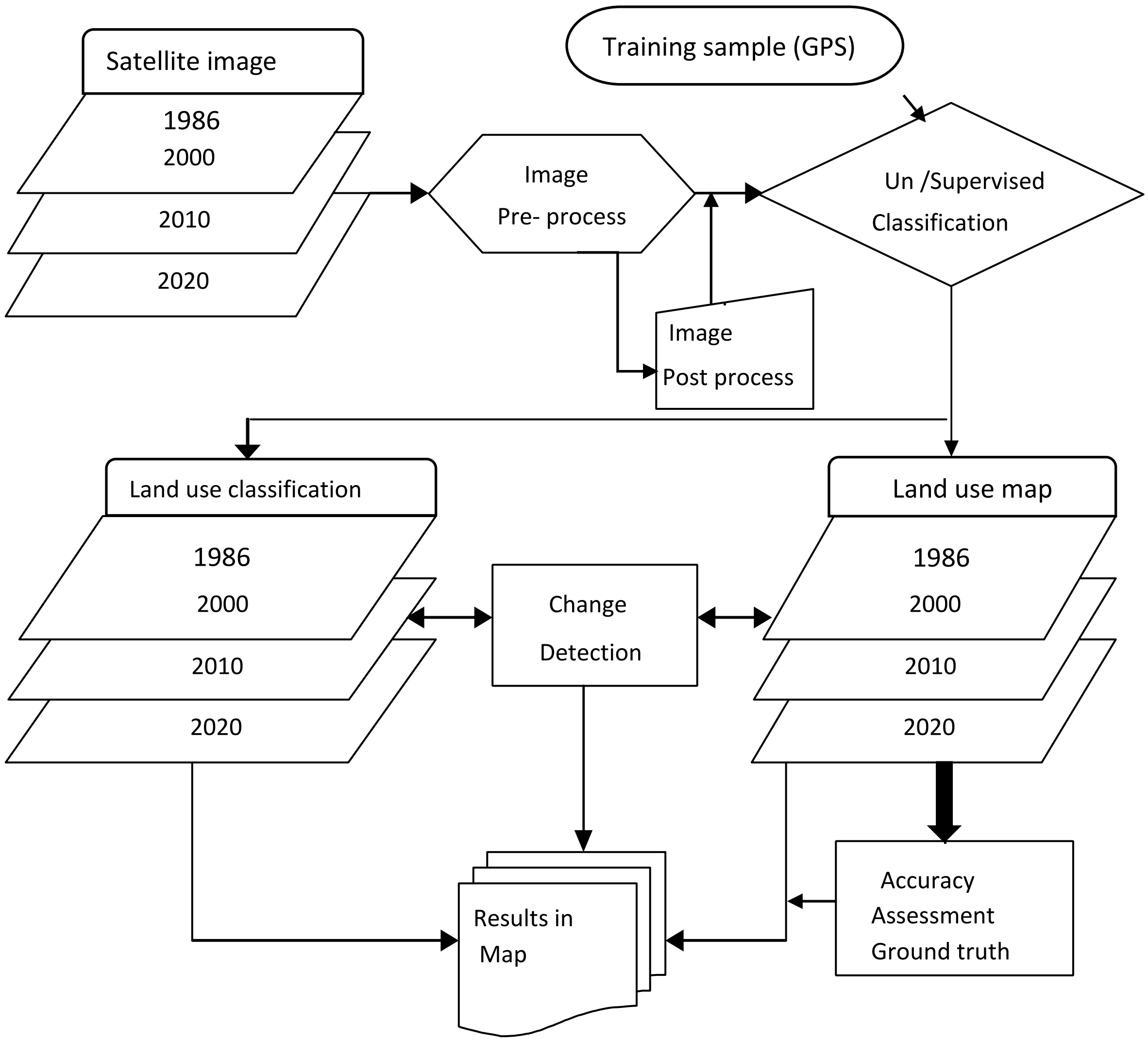


Figure1. 10 Technical scheme Flow Chart

CHAPTER IV RESULT AND DISCUSSION

4.1 Classification and Results of LULC maps (1986-2020)

Land use land cover maps were produced after running maximum likely hood supervise classification algorithm for the year 1986, 2000, 2010 and 2020 as show in the figure below (Figure1.11-Figure 1.21) These maps show Settlement or built-up area is represented with sunlight sky color, Forest is represented with dark green color, Vegetation is represented with light green color, Agriculture area is represented with gray color and finally open area or bare land is represented with yellow color.

The change in areal coverage for each category from the year 1986 up to 2020 is clearly visible on the maps presented. At the beginning in the year 1986 Sebeta town very small and scattered settlement whereas Agriculture area is huge amount that means half the total coverage.

Hence, at the last in the year 2020 Sebeta town has a very small Agriculture area which is very decrease and small amount of that of the year (1986, 2000 & 2010) that means it is consumed by Settlement or built-up area. Whereas on the contrary settlement is huge amount it means almost near to half of the total coverage area compared to that of (1986, 2000 & 2010) and dominate agricultural area as well as others that means a rapid urban expansion is take place in the town.

Generally, based on the land use land cover held as four decades results the settlement or built-up area is increasing at alarming rate and forced to unmanageable urbanization. Rapid urban expansion leads to a loss of huge amount of land resource and vulnerable environmental impact like soil erosion, degradation and air pollution and environmental disorder.

According to the analyzed land use land cover held on four decades (1986,2000,2010and 2020) of the thesis output the settlement or built-up area has been represented graphically and show the increment pattern of urban expansion.

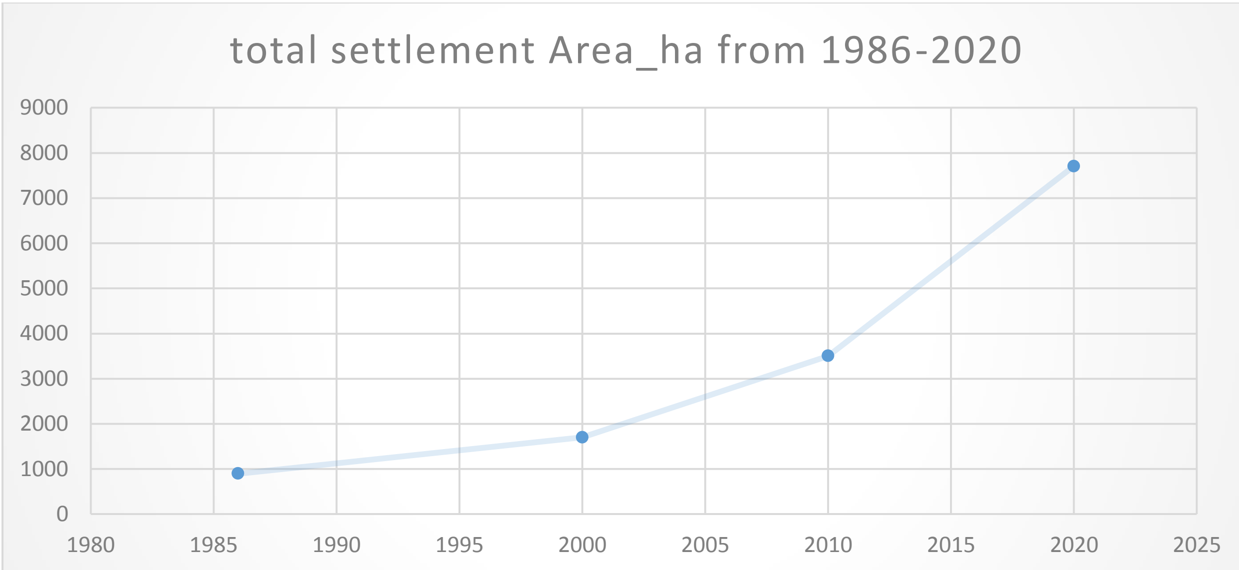


Figure1. 11 Graphical representation of settlement area from 1986-2020

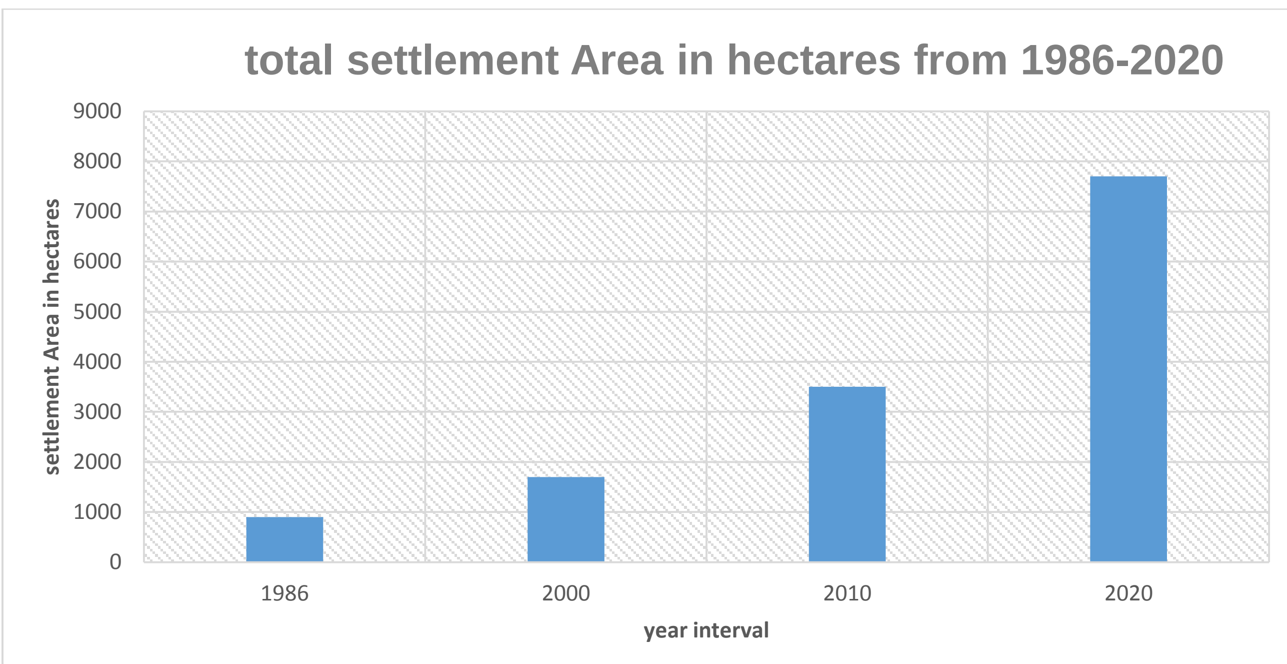


Figure1. 12 Chart representation of settlement area from 1986-2020

The land use land cover classification category for the year 1986 as it is generated and classified, the vegetation coverage is 34.8 % from total, settlement is small 5.12%, Forest area is 4.77%, bare land or open area (grass land) is 8.37% and agriculture area is 49.79% which is huge amount that means half the total coverage.

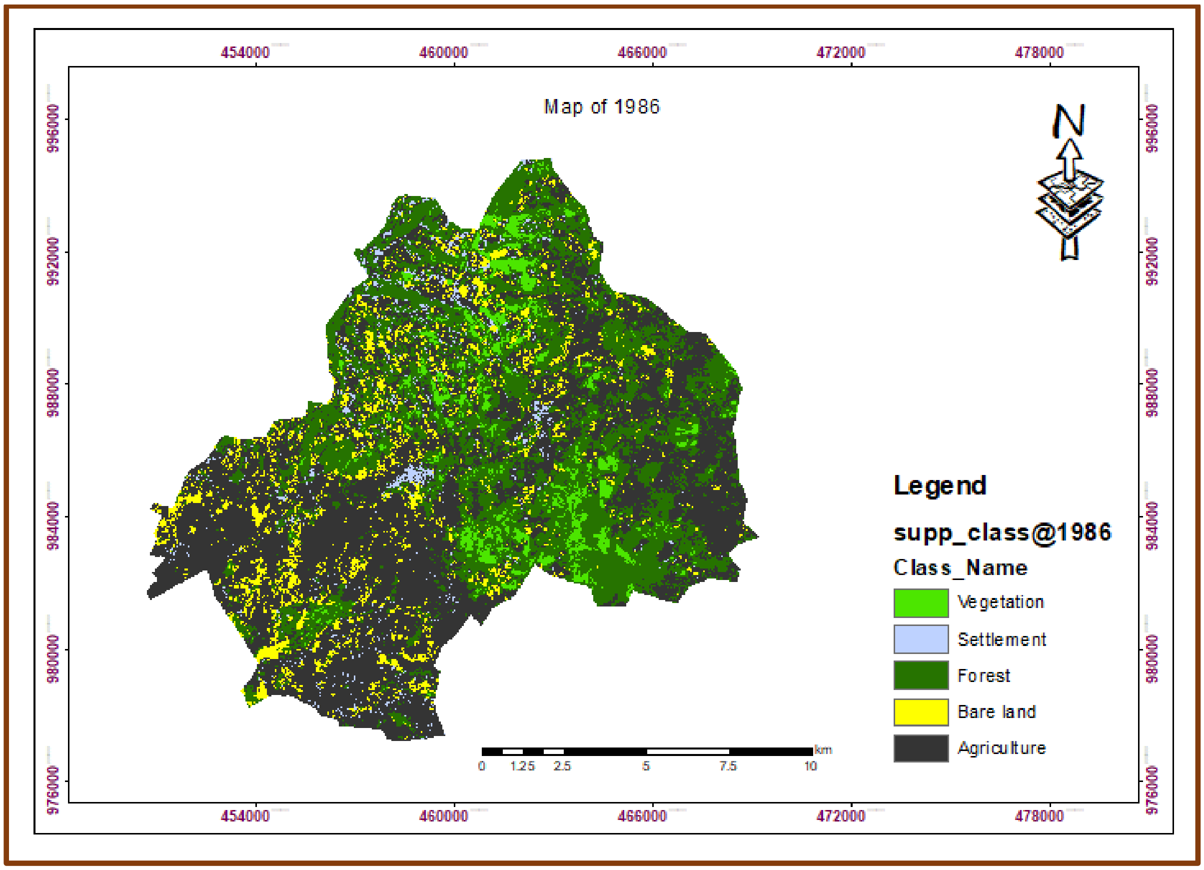


Figure1. 13 land use land cover classification map of 1986

The land use land cover classification category for the year 2000 as it is generated and classified, the vegetation coverage is 22.24 % from total, settlement is9.71%, Forest area is 4.89%, bare land or open area (grass land) is 19.81% and agriculture area is 43.35% which is big amount of the total coverage.

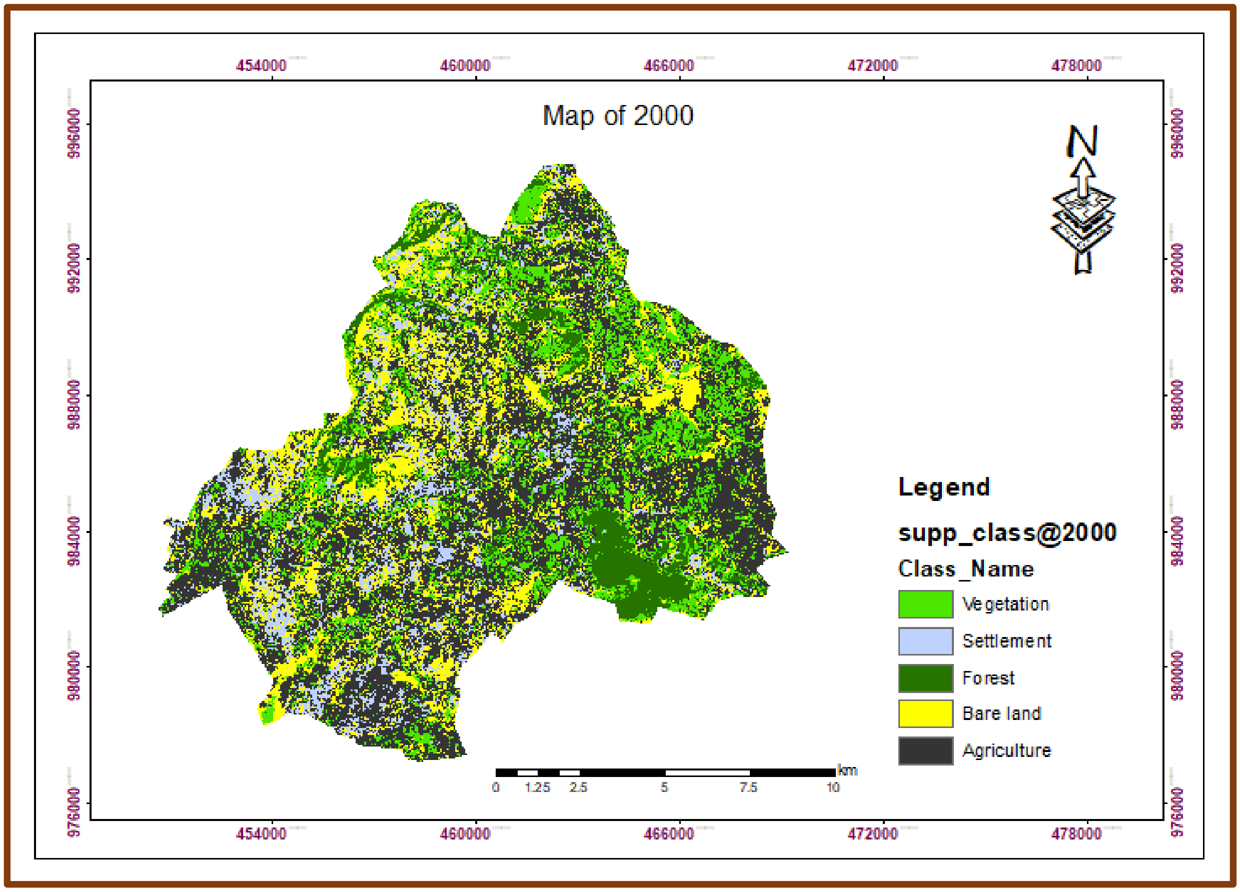


Figure1. 14 Land use land cover classification map of 2000

The land use land cover classification category for the year 2010 is generated and presented as follows, vegetation coverage is 20.34 % from the total area, settlement is 20.0% big change from the year (1986 & 2000), Forest area is 3.38%, bare land or open area (grass land) is 19.37% and agriculture area is 36.9 % which is decrease the amount of that of the (1986 & 200) that means it is consumed by Settlement or built-up area.

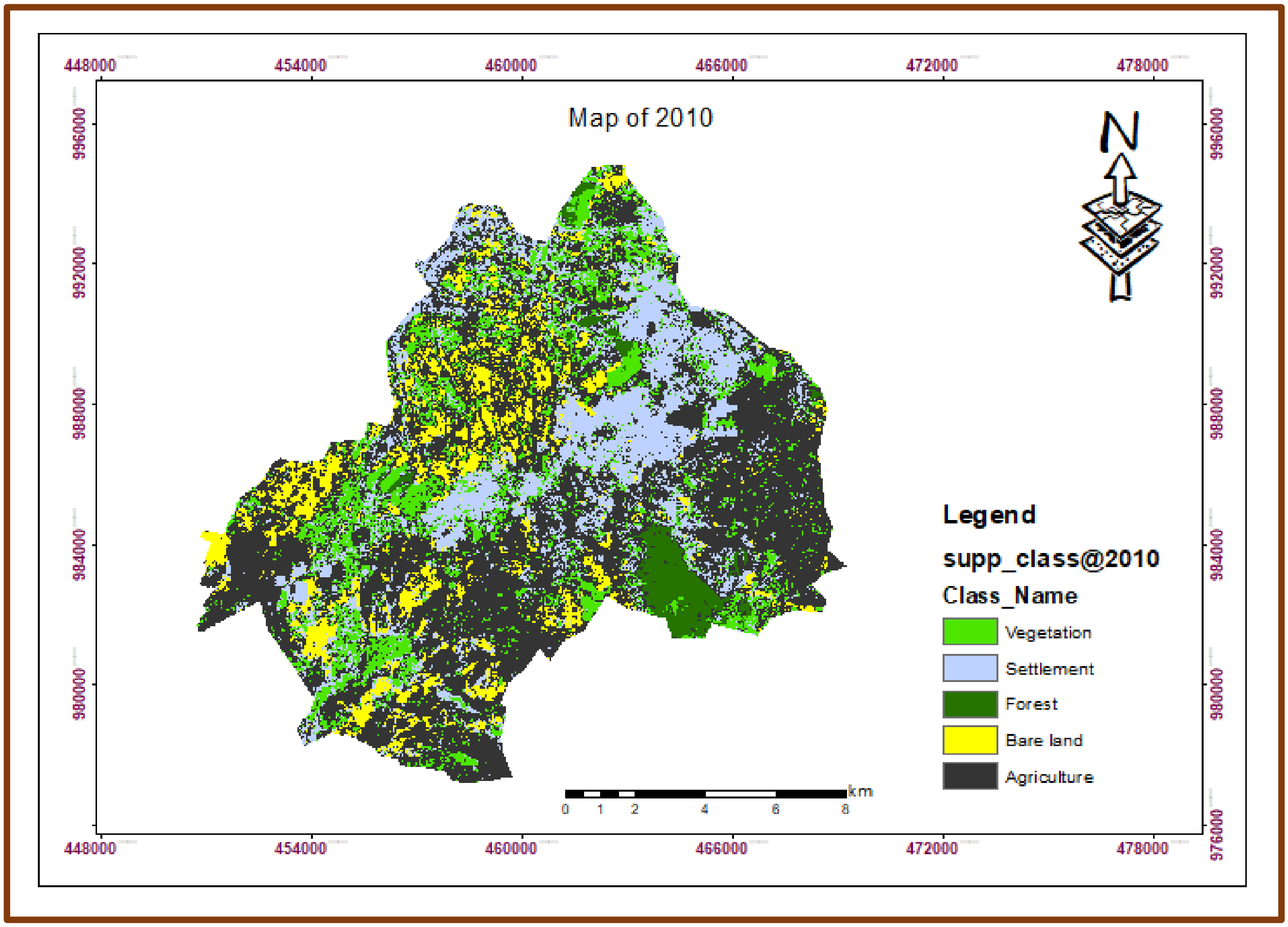


Figure1. 15 Land use land cover classification map of 2010

The land use land cover classification category for the year 2020 is generated and presented as follows, vegetation coverage is 22.19 % from the total area, settlement is 44.02% huge increment compared with the year of (1986, 2000 & 2010), Forest area is 4.2%, bare land or open area (grass land) is 13.61% and agriculture area is 15.98 % which is very decrease and small the amount of that of the (1986,2000& 2010) that means it is consumed and dominated by Settlement or built-up area.

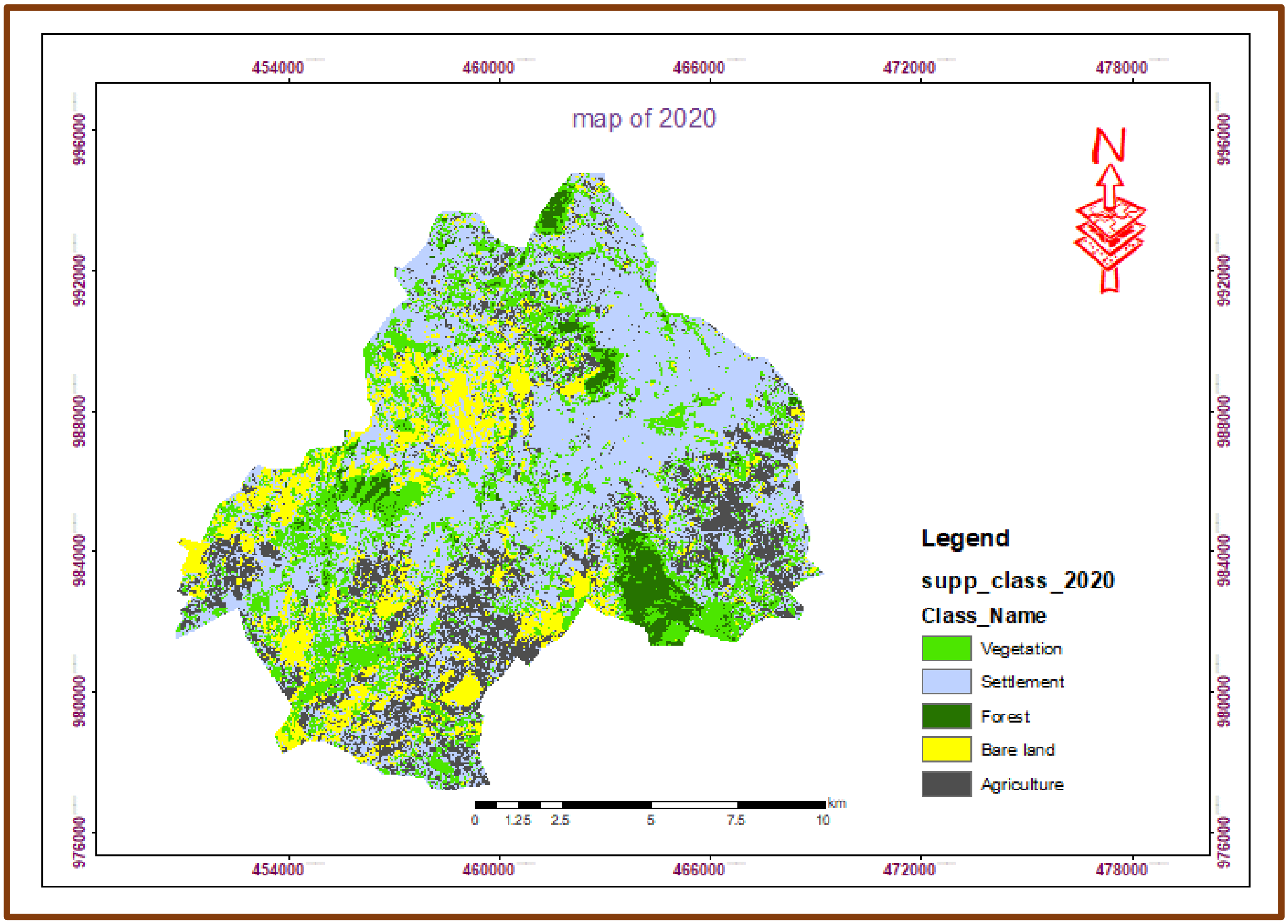


Figure1. 16 Land use land cover classification map of 2020

4.1.1 Results of area coverage land use category in tabular form

As we can see the outputs of land use land cover change coverage area for the four decades selected report from the table five land category result is different in a given different sample years. According to the output in the first year (1986) Agricultural is high area coverage and settlement is very small covered, secondly (2000) again Agricultural is the leading and vegetation is following, instead of settlement forest area is diminished. In the year 2010 the result is slightly changed from the outputs of 1986 & 2000, settlement and vegetation is on the same level, but agriculture area is decrease. Finally, in 2020 a dramatic change is happening that means a high coverage of settlement and huge loss of agriculture coverage as it is shown in the below.The total amount of land use land cover classification for each category areain hectares and percentage from the year 1986-2020

Land use category	1986		2000		2010		2020	
	Area_ha	% age	Area_ha	% age	Area_ha	% age	Area_ha	% age
Vegetation	6090.31	34.8	3892.943	22.24	3559.69	20.34	3883.42	22.19
Settlement	896.947	5.12	1699.877	9.71	3503.25	20.02	7705.1	44.02
Forest	835.756	4.77	855.15	4.89	590.85	3.38	735.66	4.2
Bare land	964.812	5.51	3467.901	19.81	3390.90	19.37	2381.53	13.61
Agriculture	8715.28	49.79	7587.227	43.35	6458.42	36.90	2797.4	15.98
Total	17503.105	100	175503.098	100	17503.11	100	17503.11	100

Table1. 8LULC classification of 1986_2020 Area in hectares and percentage

4.2 Accuracy Assessments

The results of land use land cover classification produced from remotely sensed data are confirmed by accuracy assessment. In order to calculate the level of accuracy, an error matrix and the kappa coefficient is performed to show the difference between supervise classification map from the year (2010&2020) selected location of study area and their corresponding actual ground truth. The error matrix is an array of values assigned to particular category of actual reference data and classified maps of each year to be evaluated. Accuracy assessment is the degree of correspondence between observation and reality or a classified map and ground truth data or a reference data (Levin, 1999) and Assessment of classification accuracy is critical for a map generated from any remote sensing data. Although accuracy assessment is important for traditional remote sensing techniques, with the advent of more advanced digital satellite remote sensing the necessity of performing an accuracy assessment has received new interest (Congalton, 1991).

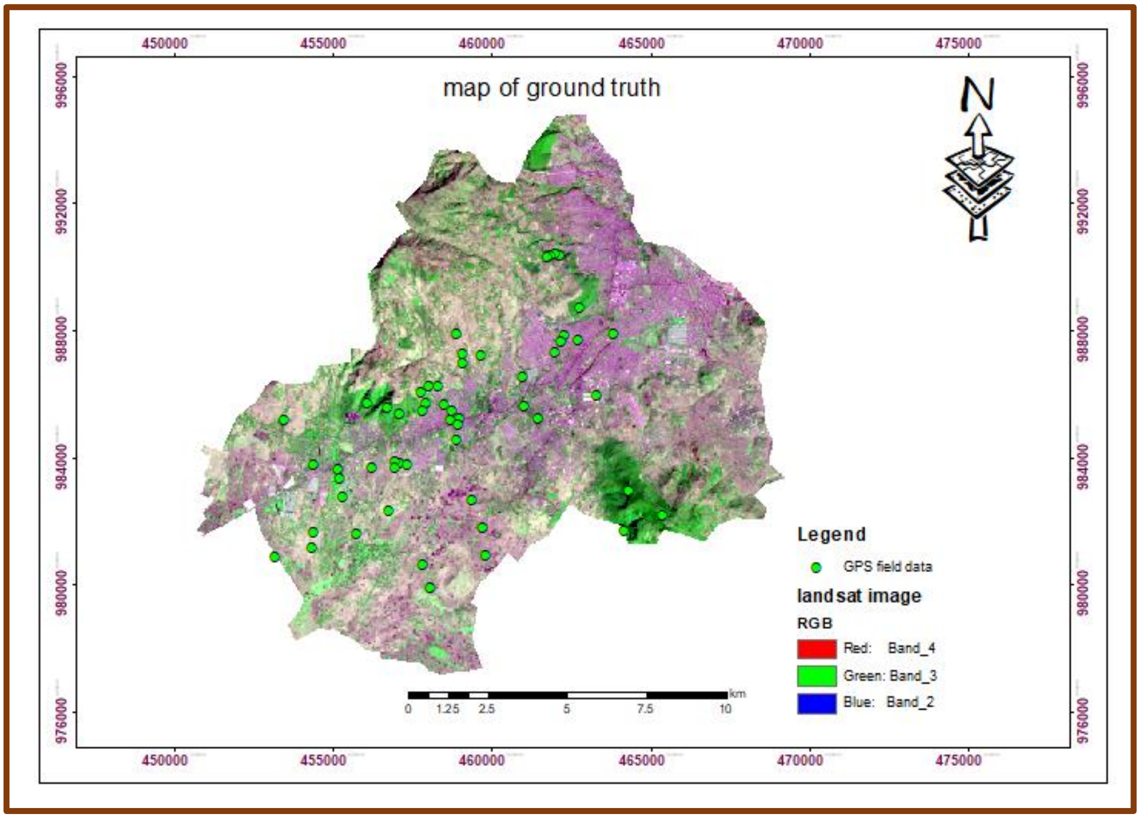


Figure1. 17 Land use land cover classification map of ground truth

The most commonly known method of accuracy assessment includes, producer's accuracy, user's accuracy, overall accuracy and kappa coefficient (Lu, 2004). All of this techniqueis applied for all years in order to check the performance of supervise classification activities.

Producer's accuracy: measures the percentage of correctly classified pixels from sample data or reference data taken from the field.

User's accuracy: measure the probability of each **classified** pixels category on the map represented on the ground.

Overall accuracy:also,the so-called percent correct classified (PCC) it is simply measuring the overall accuracy of the data and calculated the sum of diagonal divided by the total number of samples.

Kappa coefficient: it is a better estimate than of overall accuracy because it is a capable of controlling PCC index and incorporates off diagonal values to calculate the coefficient.

An error matrix and kappa of 2010 classified map of study area

```
                CLASSIFICATION ACCURACY ASSESSMENT REPORT
                -----------------------------------------
Image File : e:/thesis map/class_2010/supp_class@ls@sb.img
User Name  : pg dipartmant
Date       : Sat May 08 11:39:33 2021


ERROR MATRIX
-------------

                                Reference Data
                                --------------
Classified Data Unclassifi
--------------- ----------      ----------      ----------      ----------
   Unclassified          0               0               0               0
                         0               0               0               0
                         0               0               0               0
                         0               0               0               0
         Forest          0               0               0               0
     Vegetation          0               0               0               0
                         0               0               0               0
     Settlement          0               0               0               0
                         0               0               0               0
    Agriculture          0               0               0               0
      Bare land          0               0               0               0

Column Total             0               0               0               0

                                Reference Data
```

Classified Data	Forest	Vegetation		Settlement
Unclassified	1	1	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
Forest	7	0	0	0
Vegetation	3	2	0	0
	0	0	0	0
Settlement	0	0	0	9
	0	0	0	0
Agriculture	0	7	0	1
Bare land	0	1	0	1
Column Total	11	11	0	11

Reference Data

Classified Data		Agricultur	Bare land	Row Total
Unclassified	0	0	0	2
	0	0	0	0
	0	0	0	0
	0	0	0	0
Forest	0	0	0	7
Vegetation	0	0	0	5
	0	0	0	0
Settlement	0	0	1	10
	0	0	0	0
Agriculture	0	10	0	18
Bare land	0	1	10	13
Column Total	0	11	11	55

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

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Unclassified	0	2	0	---	---
	0	0	0	---	---
	0	0	0	---	---
	0	0	0	---	---
Forest	11	7	7	63.64%	100.00%
Vegetation	11	5	2	18.18%	40.00%
	0	0	0	---	---
Settlement	11	10	9	81.82%	90.00%
	0	0	0	---	---
Agriculture	11	18	10	90.91%	55.56%
Bare land	11	13	10	90.91%	76.92%
Totals	55	55	38		

Overall Classification Accuracy = 69.09%

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

KAPPA (K^) STATISTICS

Overall Kappa Statistics = 0.6171

Conditional Kappa for each Category.

Class Name	Kappa
Unclassified	0.0000
	0.0000
	0.0000
	0.0000
Forest	1.0000
Vegetation	0.2500
	0.0000
Settlement	0.8750
	0.0000
Agriculture	0.4444
Bare land	0.7115

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

An error matrix and kappa of 2020 classified map of study area

CLASSIFICATION ACCURACY ASSESSMENT REPORT

Image File : e:/thesis map/class_2020/supp_class@gsp.img
User Name : pg dipartmant
Date : Sat May 08 10:51:11 2021

ERROR MATRIX

Reference Data

Classified Data	Unclassifi			
Unclassified	1	0	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
Forest	0	0	0	0
	0	0	0	0
Vegetation	0	0	0	0
Agriculture	0	0	0	0
Bare land	0	0	0	0
Settlement	0	0	0	0
Column Total	1	0	0	0

Reference Data

Classified Data		Forest		Vegetation
Unclassified	0	1	0	1
	0	0	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
Forest	0	8	0	2
	0	0	0	0
Vegetation	0	2	0	6
Agriculture	0	0	0	0
Bare land	0	0	0	1
Settlement	0	0	0	1
Column Total	0	11	0	11

Reference Data

Classified Data	Agricultur	Bare land	Settlement	Row Total
Unclassified	0	0	0	3
	0	0	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
Forest	0	0	0	10
	0	0	0	0
Vegetation	1	0	0	9
Agriculture	5	0	0	5
Bare land	4	10	0	15
Settlement	1	1	11	14
Column Total	11	11	11	56

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

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Unclassified	1	3	1	---	---
	0	0	0	---	---
	0	0	0	---	---
	0	0	0	---	---
	0	0	0	---	---
Forest	11	10	8	72.73%	80.00%
	0	0	0	---	---
Vegetation	11	9	6	54.55%	66.67%
Agriculture	11	5	5	45.45%	100.00%
Bare land	11	15	10	90.91%	66.67%
Settlement	11	14	11	100.00%	78.57%
Totals	56	56	41		

Overall Classification Accuracy = 73.21%

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

KAPPA (K^) STATISTICS

Overall Kappa Statistics = 0.6706

Conditional Kappa for each Category.

Class Name	Kappa
Unclassified	0.3212
	0.0000
	0.0000
	0.0000
	0.0000
Forest	0.7511
	0.0000
Vegetation	0.5852
Agriculture	1.0000
Bare land	0.5852
Settlement	0.7333

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

4.3 Change detection

Change detection is the identification of variation in land use land cover category based on the observation of a specific area in a different time by using multi temporal data sets from satellite image.in the study by using this method for each year classified images (1986 and 2000),(2000 and 2010)and (2010 and 2020) were analyzed.

4.3.1 Land use land cover change between 1986 and 2000

Based on output below the LULC change from 1986 to 200 for settlement is increasing by 4.59 % and on the opposite Vegetation and agriculture is reduced by 12.56% and 6.44% respectively as shown in the following table.

Land use category	1986		2000		Change 1986_2000	
	Area_ha	% age	Area_ha	% age	Area_ha	%age
vegetation	6090.31	34.8	3892.943	22.24	-2197.367	-12.56
Settlement	896.947	5.12	1699.877	9.71	802.93	4.59
Forest area	835.756	4.77	855.15	4.89	19.394	0.12
Bare land	964.812	5.51	3467.901	19.81	2503.089	14.3
Agriculture area	8715.28	49.79	7587.227	43.35	-1128.053	-6.44
Total	17503.105	100	175503.098	100	------------	--------

Table1. 9LULC of 1986_2000 Change detection Area in hectares and percentage

4.3.2 Land use land cover change between 2000 and 2010

Accordingly depending on output below, the LULC change from 2000 to 2010 for settlement is increasing by 10.31% and on the contrary Vegetation and agriculture is reduced by 1.9% and 6.45% respectively as shown in the following table

Land use category	2000		2010		Change 2000_2010	
	Area_ha	% age	Area_ha	% age	Area_ha	%
Vegetation	3892.943	22.24	3559.69	20.34	-333.253	-1.9
Settlement	1699.877	9.71	3503.25	20.02	1803.373	10.31
Forest area	855.15	4.89	590.85	3.38	-264.3	-1.51
Bare land	3467.901	19.81	3390.90	19.37	-77.001	-0.44
Agriculture area	7587.227	43.35	6458.42	36.90	-1128.807	-6.45
Total	175503.098	100	17503.11	100	-------------	-----------

Table1. 10LULC of 2000_2010 Change detection Area in hectares and percentage

4.3.3 Land use land cover change between 2010 and 2020

According tothe result below, the Land use Land Cover change from 2010 to 2020 for settlement is increasing by 10.31% and on the contrary Vegetation and agriculture is decreased by 1.85% and 20.92% respectively as shown in the following table

Table 1.11LULC of 2010_2020 Change detection Area in hectares and percentage

Land use category	2010		2020		Change 2010_2020	
	Area_ha	% age	Area_ha	% age	Area_ha	%
vegetation	3559.69	20.34	3883.42	22.19	323.73	1.85
Settlement	3503.25	20.02	7705.1	44.02	4201.85	24
Forest area	590.85	3.38	735.66	4.2	144.81	0.82
Bare land	3390.90	19.37	2381.53	13.61	-1.009.37	-5.76
Agriculture area	6458.42	36.90	2797.4	15.98	-3661.02	-20.92
Total	17503.11	100	17503.11	100	------------	-------------

4.3.3 Land use land cover change between 1986 and 2020

As we can see from the result below, the Land use Land Cover change from 1986 to 2020 or change detection for 34 years in total the settlement is increasing by 38.9 % which is a big change andfast urban expansion, on the contrary Vegetation is reduced to12.61% and agriculture is decreased by 33.81%thatmeans agriculture area is consumed by the settlement shown in the following table.

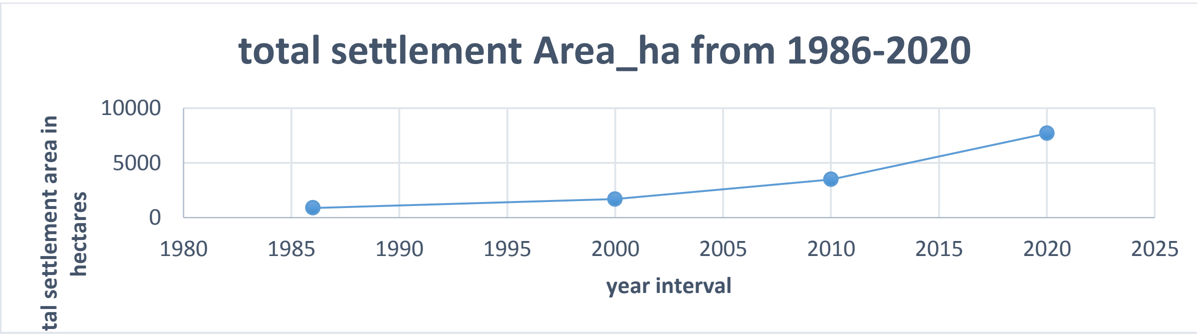
Table1. 12LULC of 1986_2020 Change detection Area in hectares and percentage

Land use category	1986		2020		Change 1986_2020	
	Area_ha	% Age	Area_ha	% age	Area_ha	% age
vegetation	6090.31	34.8	3883.42	22.19	-5701.89	-12.61
Settlement	896.947	5.12	7705.1	44.02	6808.153	38.9
Forest area	835.756	4.77	735.66	4.2	-100.096	-0.57
Bare land	964.812	5.51	2381.53	13.61	1416.718	5.24
Agriculture area	8715.28	49.79	2797.4	15.98	5917.88	-33.81
Total	17503.105	100	17503.11	100	------------	---------

4.3.4 Graphical representation of settlement area or built-up area from 1986-2020

As we can see from the graph the area of settlement is increasing starting from 1986 up to 2020 at an interval of a decades or ten years averagely and in the last two decades that means between 2000-2010 and 2010-2020 the change is high or the rate of urban expansion is dynamically changed with respect to the initial year as shown from the graph.

Figure1. 18 Graphical representation of settlement area from 1986-2020



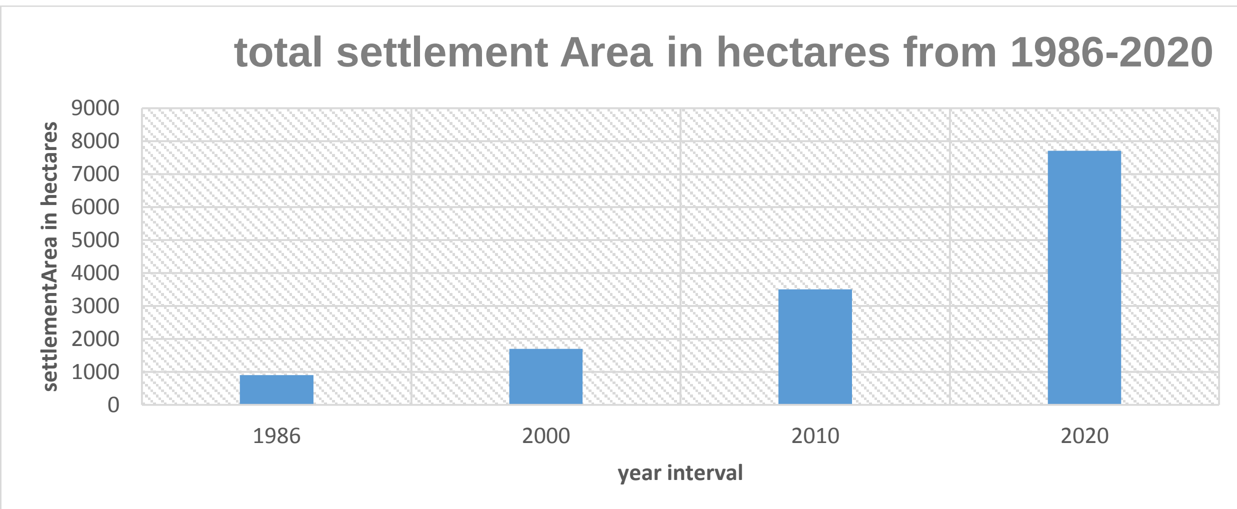


Figure1. 19 Chart representation of settlement area from 1986-2020

4.4 Settlement class total area Dynamics change from1986 up to 2020

Dynamic change: the degree of expansion is an important indicator that can show the dynamic change or rate of spatial expansion in the given period of time. Hence the rate of spatial expansion of settlement area between two years are calculated by the following formula

$$DC=(\frac{A2-A1}{A1} * \frac{1}{T2-T1})*100$$

Where DC is the dynamic change rate of urban expansion, T1and T2 are specific time period A1 is settlement area at a time T1 and A2 is settlement area at a time T2.

Thus, the dynamic change settlement area from the year 1986 up to 2000 is calculated as

DC (1986-2000) =$(\frac{1699.877-896.947}{896.947} * \frac{1}{2000-1986})$*100

DC (1986-2000) =6.39%

The dynamic change settlement area from the year 2000 up to 2010 is calculated as

DC (2000-2010) =$(\frac{3503.25-1699.877}{1699.877} * \frac{1}{2010-2000})$*100

DC (2000-2010) =10.61%

The dynamic change settlement area from the year 2010 up to 2020 is calculated as

DC (2000-2010) =$(\frac{7705.1-3503.25}{3503.25} * \frac{1}{2020-20110})$*100

DC (2000-2010) =11.99%

This indicates that the settlement area of Sebeta town increases its spatial extent by 6.39% from 1986_2000, 10.61% from 2000_2010 and 11.99% from 2010_2020in a given year.

Figure1. 20 Chart representation dynamics change of settlement area from 1986-2020

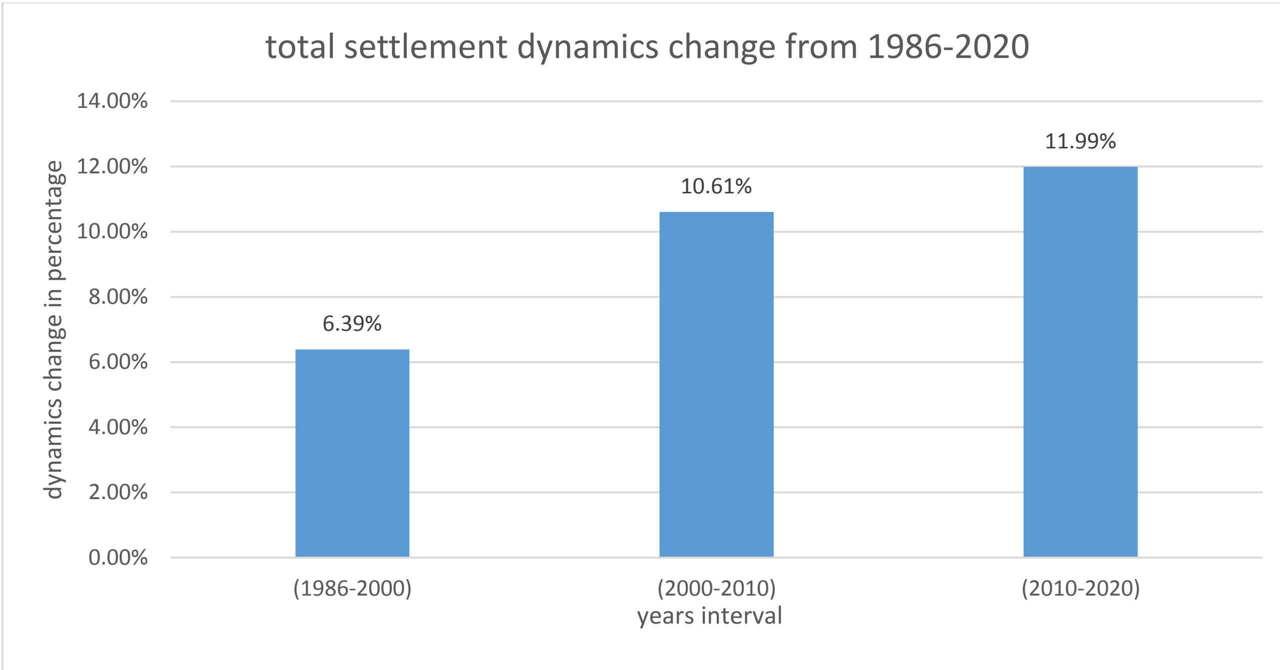
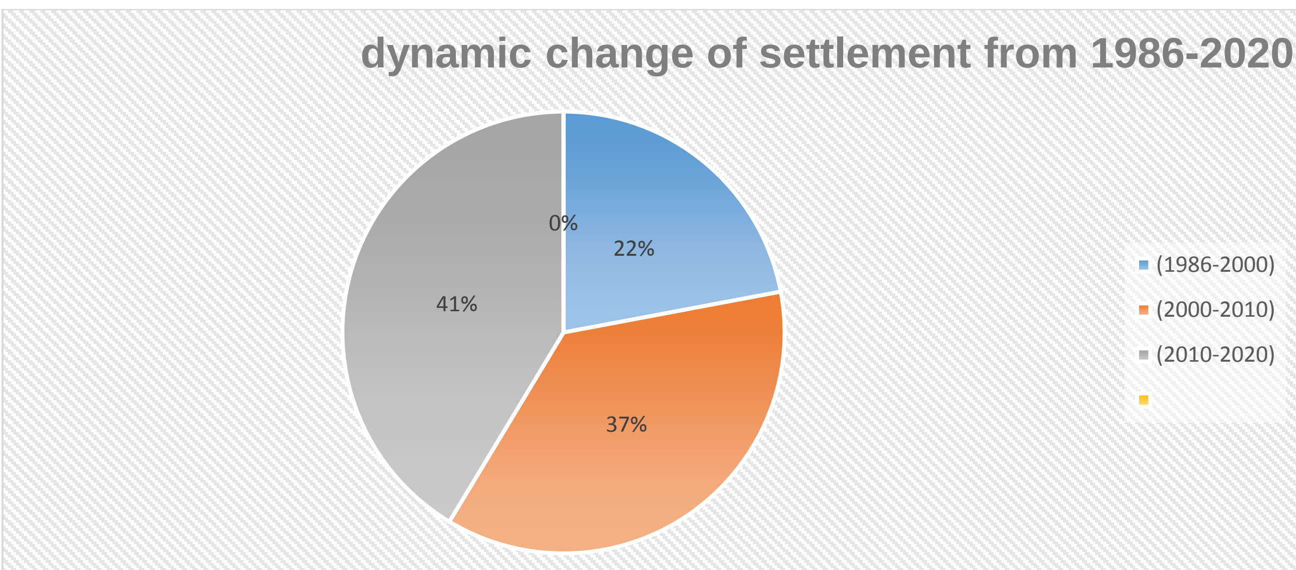


Figure1. 21Pie Chart dynamics change representation of settlement from 1986-2020



CHAPTER VCONCLUSION AND RECOMMENDATION

5.1 Conclusion

Depending on the overall thesis works, it is possible to summarize or conclude the following points based on remotely sensed satellite image of the study area and conducted in land use land cover change detection which is providing the spatial information of land use land cover condition of Sebeta town.

The main objectives of the study were to analyze, detect and evaluate the spatial composition as well as rapid urban expansion of Sebeta town using the application of remote sensing and GIS tools.in order to achieve the objective, four decades of years ,1986,2000,2010 and 2020 were selected. After that, satellite image was acquired from USA Geological survey and processed to produce supervise classification map categories in order to serve as an input. Accordingly, five land use land cover categories were identified from Landsat image. These are Vegetation Settlement, Forest Agriculture area and bare land or grassland. The accuracy assessment of the data was based on ground truth which is identified and selected samples on the location of land use land cover feature is field based by using hand held GPS and other supportive data integrated with knowledge of personal experience on the study area.

Geospatial change detection analysis of urban expansion helps for many purposes related to planning activities of unprecedented urbanization of the town and this study address the land use change as well as its effect applied between 1986 and 2000, 2000 and 2010, 2010 and 2020, 19786 and 2020.Acccourding to the outputs takes place in 34 years the settlement or built-up area is an increment of in 38.9% (1986_2020) and Agriculture area and vegetation are decrease 33.81%, 12.61% respectively.

Generally speaking, based on the result the major reason of decreasing Agricultural land was related with alarming rate population growth and rapid construction of built-up areas or unmanageable urbanization towards the agricultural land resources with help of remote sensing and GIS application.

5.2 Recommendation

To insure the balanced physical urban growth and population growth there is a need to proper plan of the towns. In order to accomplish this issue, it is possible to know the nature of urban expansion or urban growth change, the level of service available to supply, urban demographic pressure and a number of resources available at the town for the proper and effective plan for the future of the town. Responsible stack holder or urban planning authority or any town planner should take in to consideration the consequences happened by unprecedented urban expansion and disturbed public services. The stack holders should have to use and develop the application of remote sensing and GIS to monitor and regulates unplanned urban expansion of the town.

Accordingly based on the finding of a thesis analysis of urban expansion through remote sensing and GIS application the following recommendations are proposed.

-The result of the study shows the expansion of settlement is fast in the town, especially in the last ten years with growth rate of 24%. This causes unmanageable and fast urbanization of the town it may continue in the coming decades.

-The fast-growing settlement affects LULC not only the town it may affects out of the boundary of the town that means putting pressure on the nearby rural kebeles and there should be strategic planning acquired to monitor and control this expansion of the town from the concerned governmental and non-governmental bodies or responsible concerned stack holder.

-Land use land cover change detection plays a great role for urban expansion monitor and urban planning. Thus, the town government stack holders should use the application remote sensing and GIS for planning activities.

-The expansion of the town seems like horizontal towards edges of town in every direction without monitoring and planning. Therefore, planners should consider and give emphasis to vertical development of the town.

-The rapid population growth of the town is one of the major causes for urbanization rural to urban migration from the nearby rural village and sounding kebeles in order to seek job opportunity or any employment services. Hence to control this it is better to creating good working environment in the rural areas.

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Appendix

GPS sample data taken from field for ground truth

Pt. No	Easting(X)	Northing(Y)	Remark
1	458477.95	985671.65	bare land area
2	457751.47	986050.56	bare land area
3	457904.59	985743.47	bare land area
4	457802.44	985493.52	bare land area
5	458301.18	986261.1	bare land area
6	458013.39	986279.3	bare land area
7	456757.8	982328.13	bare land area
8	455717.6	981608.03	bare land area
9	454346.01	981677.27	bare land area
10	454324.18	981200.25	bare land area
11	455283.46	982786.94	bare land area
12	459376.55	982685.72	Agriculture area
13	459698.77	981791.09	Agriculture area
14	459768.67	980949.73	Agriculture area
15	457798.95	980641.71	Agriculture area
16	458043	979928.5	Agriculture area
17	459048.62	987253.69	Agriculture area
18	459082.21	987002.24	Agriculture area
19	459648.46	987228.05	Agriculture area
20	458861.04	987923.44	Agriculture area

21	456226.11	983674.76	Agriculture area
22	456956.13	983710.9	Agriculture area
23	465338.86	982185.16	forest area
24	464296.33	982988.35	forest area
25	464137.32	981687.58	forest area
26	457071.17	985382.08	forest area
27	456685.36	985568.06	forest area
28	456046.93	985706.51	forest area
29	462723.96	988709.68	forest area
30	462135.12	990391.94	forest area
31	461953.38	990407.91	forest area
32	461829.55	990383.42	forest area
33	461702.88	990330.45	forest area
34	462674.46	987730.46	settlement
35	463824.86	987900.37	settlement
36	462265.33	987865.73	settlement
37	462183.4	987658.8	settlement
38	461967.32	987308.63	settlement
39	458944.05	985265.6	settlement
40	458740.36	985466.35	settlement
41	458654.07	985195.72	settlement
42	458901.39	985054.35	settlement
43	458877.76	984590.99	settlement

44	463256.94	985960.6	settlement
45	457098.89	983846.62	vegetation
46	456947.46	983912.35	vegetation
47	457341.49	983768.77	vegetation
48	455140.81	983636.91	vegetation
49	455205.38	983336.65	vegetation
50	454354.27	983792.66	vegetation
51	453442.13	985213.7	vegetation
52	461445.09	985263.57	vegetation
53	460990.24	985644.07	vegetation
54	453148.14	980894.65	vegetation
55	460953.14	986556.71	vegetation