ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY (AAIT)

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING)

ASSESSING THE EFFECTS OF LAND SURFACE TEMPERATURE ON VEGETATION COVER CHANGE USING GEOGRAPHIC INFORMATION SYSTEM AND REMOTE SENSING TECHNIQUES: A CASE STUDY OF SOUTH GONDER, ETHIOPIAN

BY

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This is to certify that a Thesis prepared by **Muluye Engdaw** entitled: "Application of geographic information system and remote sensing for assessing the impacts of vegetation cover change on land surface temperature: a case study of south Gonder, Ethiopian" and submitted in partial fulfillment of the requirements for the degree of Master of Science in **School of Civil and Environmental Engineering** (Geodesy and geomatics stream) with the regulations of the University and meets the accepted standards with respect to the originality and quality.

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DECLARATION

I, the undersigned, declare that this thesis work is my original work carried out under the supervision of Ass. Prof. Tulu Besha Bedada. It has not been presented for a degree in any other universities and all sources of materials used for the thesis work have been properly acknowledged.

Place: Addis Ababa

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Muluye Engdaw

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Acronyms and Abbreviations

CFS	Climate Forecast System
CSA	Central Statistics Agency
DEM	Digital Elevation Model
DN	Digital Number
ERDAS	Earth Resources Data Analysis System
EROS	Earth Resources Observation and Science
EVI	Enhanced Vegetation Index
FAO	Food and Agricultural Organization
GCPs	Ground Control Points
GHG	Green House Gas
GIS	Geographic Information System
GPS	Global Positioning System
Ha	Hectare
HDF	Hierarchical Data Format
LC	Land Cover
LST	Land Surface Temperature
LULC	Land Use/Land Cover
LULCC MoA	Land Use/Land Cover Change Ministry of Agriculture

MODIS	Moderate Resolution Imaging Spectro radiometer
NASA	National Aeronautics and Space Administration
NCDC	National Climatic Data Center
NDVI	Normalized Difference Vegetation Index
NOAA	National Oceanic and Atmospheric Administration
OLI RDE	Operational Land Imager
RDE	Rural Development of Ethiopia
RS	Remote Sensing
SRTM	Shuttle Radar Topography Mission
TIRS	Thermal Infrared Sensor
TM	Thematic Mapper
USGS	United States Geological Survey
XLSTAT	Statistical software for Microsoft Excel

Abstract

To assessed remotely data remote sensing and GIS methods was basic to accuse and analysis of the thematic area, like the impacts of vegetation cover change of land surface temperature. But there is a problem on calculating and evaluating the influence of change in vegetation cover on the change of climate. Then, this study was conducted the impacts of vegetation cover change on land surface temperature using remote sensing and GIS methods. The study area was in south which is high populated and more highland. Data was extracted from land satellite images like Landsat 5, Landsat 8 Operational Land Imager/ Thermal Infrared Sensor (OLI/TIRS). Thematic Mapper Sensor (TM) and Climate Moderate Resolution Imaging Spectroradiometer (MODIS) (and also ground truth data was used to verify remotely sensed data, additionally Pearson Correlation coefficient was conducted to calculate and to analyze the relationship of vegetation cover with LST. The final output presented that vegetation cover occupied an area of 227979.09 ha (15.6%),154424.43 ha (12.5%), and 195231.59 ha (13.3 %) in 1985, 2000 and 2018, respectively where 3.1% of vegetation cover has been lost in the last 33 years in in the study area.

Keywords**:** remote sensing**,** GIS, South Gondar zone, Vegetation Cover, Land Surface Temperature.

CHAPTER-ONE

Introduction

The expressions land use and land cover are closely interrelated. A settlement, an example of land cover but if we include buildings whether they are being used for commercial, residential or industrial practices, it reveals the land use element (Ghurah, 2018). Land cover alludes to the physical (natural) features of the land surface, taken in the distribution of agricultural land, soil, pastures land, water and other natural landscapes. Land use alludes to the method in which land has been utilized by humans and their environments (such as agriculture, settlements, industry, etc) (Ghurah, 2018).

Deforestation was always followed by a change in land use and land cover, from forest to grassland and cropland. A particular increase in cropland was observed in the second half of the 20th century, largely at the expense of grassland and forestland – a fact that is widely acknowledged in the scientific literature. During specific periods throughout history entire landscapes were abandoned for a variety of reasons, such as famines, pests or political turmoil, causing the land to regenerate and develop secondary bush and tree vegetation, which was later again slashed and burnt for cultivation; at present, however, this hardly occurs any more (Hurni, 2010).

The term 'land' includes renewable natural resources, i.e. soils, water, vegetation and wildlife, in their terrestrial ecosystems. Land degradation, in turn, includes all processes that diminish the capacity of land resources to perform essential functions and services in these ecosystems, i.e. deforestation, loss of biodiversity, soil degradation and disturbance of water cycles. Sustainable land management consists of technical and institutional measures initiated by individuals or societies to maintain land productivity and other functions of land resources for present and future generations. (Hurni, 2010).

Mapping, quantifying and monitoring of LULC is necessary to generate information for planning and for making the land more productive. The accurate quantification of vegetation cover change is therefore critically important for reducing uncertainties in carbon emission estimates, and for evaluating the effectiveness of environmental policies aiming at reducing emissions from deforestation and forest degradation (Xiao, 2014). Quantification of vegetation cover is also important to prevent soil erosion, preserve biodiversity, maintain agro-ecological zone and increase the productivity of the land.

Normalized Difference Vegetation Index (NDVI) is an index that provides a standardized method of providing information which vegetation and non-vegetation from satellite images. It is an alternative measure of vegetation amount and condition. It can also be associated with vegetation canopy characteristics such as biomass, leaf area index and percentage of vegetation cover (Babalola and Akinsanola, 2016). NDVI can provide primary information on the surface physical properties and climate (Kayet *et al*., 2016).

The LST is highly influenced by the LULC, and very sensitive to vegetation and soil moisture; specifically, the amount of vegetation is factor on the relationship between vegetation cover and LST. For example, high LST has seen in areas with less vegetated LULC and vice versa (Rasul and Ibrahim, 2017). **(**Babalola and Akinsanola 2016) in their study reported that forest cover had shown a considerably low radiant temperature in all the years considered, because dense vegetation can reduce amount of heat stored in the soil and surface structures through transpiration. There is strong negative correlation between LST and NDVI values (Rehman *et al*., 2015**;** Chaithanya *et al*., 2017; Suresh and Mani, 2017). Vegetation with dense cover has the lowest mean LST and highest mean NDVI; while non-vegetated areas have the highest LST and lowest mean NDVI (Sun et al., 2011) which implies that lower LST is usually measured in areas with higher NDVI values (Sundara *et al*., 2012). In this study, the impacts of vegetation cover change on climate parameter variability.

LST in the south Gondar zone where examine scientifically by remote sensing approach. Remote sensing data will widely use in environmental and climatic studies. The use of satellite-based remote sensing data will widely applies to receive cost-effective Land Cover (LC) data over large geographic regions. The mapping, quantifying and monitoring of Land Cover (LC) is essential to understand the current state of landscape. In recent years, remote sensing data is useful for assessing vegetation cover change through time (Batool *et al*., 2015). Moderate Resolution Imaging Spectroradiometer (MODIS). LST is the skin temperature of the earth surface. It gives information on the heat of the earth, which depends on different LULC type. It provides information on time-to-time variation of earth surface energy changed. It is an important factor for monitoring vegetation and climate change (Kayet *et al*., 2016). The use of satellite-based remote sensing data are widely applies to receive cost-effective Land Cover (LC) data over large geographic regions. Remote Sensing (RS) and Geographic Information System (GIS) are now providing new tools for advanced ecosystem management. The collection of remotely sensed data facilitates the synoptic analyses of Earth - system function, patterning, and change at local, regional and global scales over time; such data also provide an important link between intensive, localized ecological research and regional, national and international conservation and management of biological diversity (Willkie and Finn, 1996). In this study, the impacts of vegetation cover change on LST.

1.2 Statement of the Problem

Vegetation cover alter includes a long history in Amhara Region where subsistence cultivating and settlements have changed the complete scenes. Vegetation corruption in Amhara Locale is increment from day-to-day due to populace development and overgrazing weight (Dessalew, 2016). Vegetation cover alter within the locale have come about in overwhelming soil erosion and land corruption and subsequently, decrease in yearly abdicate for trim and grass in specific within the good countries of the locale (Mulatie et al., 2016). Nowadays, exceptionally few remnants of common vegetation are found solely within the southern and southwestern parts of the nation (Abineh et al., 2015). Within the think about zone, there are patterns of deforestation for diverse arrive utilize purposes. In any case, there has not been comprehensive ponder related to the rate of deforestation and its impacts on the climatic factors especially on the land surface temperature.

Understanding such relationships would benefit to put in place effective conservation plan for informed decision-making. On way of analyzing the relationship of vegetation cover change with the land surface temperature is using site specific Normalized Difference Vegetation Index (NDVI) from the red and infrared bands of electromagnetic spectrum. Suresh and Mani (2017) reported that there was strong negative correlation between NDVI and LST. More importantly, the relationships that could exist among these interrelated components have to be identified in order to make accurate and realistic predictions on the changing conditions of vegetation and its relationship with climatic parameter (LST).

The problem of vegetation cover alter may be an exceptionally genuine natural issue in south Gondar zone and broad ranges of vegetation cover have been deforested. Be that as it May, as specified prior, the rate and areal degree of the vegetation cover change have not however been well examined within the study zone. In expansion, the LST changeability isn't surveyed within the consider region. Hence, for an economical vegetation asset administration and examination of climate, it is essential to appraise for vegetation cover alter and climate changeability on huge spatial and transient scales. In this respect, the study is where conducted utilizing Landsat imageries, and MODIS LST to oblige huge spatial and temporal changes of vegetation cover, and LST of the consider range. Subsequently, the point of this ponder should survey the spatial and transient vegetation cover alter and its impacts on LST within the study zone.

1.3 Objective of the study

1.3.1 General objective

The general objective of this study is to assess the effects of land surface temperature on vegetation cover change using geographic information system (GIS) and remote sensing techniques.

1.3.2 Specific Objectives

- To analyze vegetation cover alter of the study area (1985-2018).
- To examine the trend of land surface temperature of the study period.
- To examine the relationship of vegetation, cover with land surface temperature during the study period.

1.4. Questions of the study

- What are the major exhibited vegetation cover change over the study period of (1985 to 2018)?
- What is study the trend of land surface temperature over the study period?
- What is the relationship of vegetation cover with land surface temperature during the study period?

1.5 Significance of the Study

This paper would grant information, which is basic to protect the agro-climatic condition, guarantee supportability in resource utilization and true blue arrive utilize orchestrating and choice making for approach makers, agrarian masters, foresters, non-governmental organizations (i.e., timberland organization accomplices), organizers and arrive executives. Other than, the show ponder would grant firsthand information for the other examiners who have an interested to conduct progress consider related to scene modify and scene unsettling impact from farther identifying data. At long final, examiners would be taught nearly the vegetation cover modify and its impacts on climate so that they might post and utilize their common resources in a viable way. In expansion, this investigate would be utilized as benchmark and input for other spatiotemporal thinks about within the future.

1.6. Scope of the study

The scope of the consider would spatially have obliged inside the Amhara National Regional State, South Gondar zone, Ethiopia. The consider would center because it was on assessing vegetation cover modify, and evaluating arrive surface temperature in South Gondar zone. The ponder to boot centers on because it was vegetation and non-vegetation classes in the midst of the consider period. Primarily ArcGIS and ERDAS envision geo-processing instruments would have carried out this think about and other computer program were utilized to more altering and investigation. The previously mentioned geo-processing apparatuses was utilized LANDSAT adj. pictures of 1985, 2000 and 2018. In terms of zone scope, the consider is restricted to south Gonder and the examination is carried out for 33 a long time, which is between 1985 and 2018. For classification and exactness evaluation, the ground control focuses where utilized that were collected by GPS.

In expansion, this investigate provide how GIS and Farther Detecting can be utilized as potential expository instruments to identify and analyze vegetation cover alter and examinations the impact of vegetation on arrive surface temperature in south Gonder zone. After the completion of the genuine work, the analyst would set the suitable proposals.

1.7 Limitation of the study

The paper was obliged by cloud scope in the midst of data planning and require of tall assurance blocked off identifying data for analyzing vegetation cover inside the consider zone since the ponder zone outstandingly wid.

1.8 organization of the thesis

The study was organized into six chapters. The primary chapter clarify the foundation of the ponder, explanation of the issue, common and particular goals, noteworthiness, and confinements of the consider and scope of the study.

chapter discuses writing survey which covers on almost vegetation cover alter, deforestation in Ethiopia, cause of climate changeability, and impacts of vegetation cover alter on LST. The third chapter centers on strategy of the ponder. The fourth chapter bargains with the finding or result. The fifth chapter was expounding (details) of the exchange the ultimate chapter moreover expounds conclusion and proposal.

CHAPTER-TWO

2. Literature Review

2.1. General about vegetation cover change

Land use and land cover changes affect many natural processes such as soil erosion, sediment production, flood, and physical and chemical properties of the soil (Nouri, 2018). One of the main effects of land cover type on these processes in the basins is that it can affect the soil erosion of the basins. Soil erosion is a natural process that contributes to the evolution of the Earth's surface and is governed by the underlying geology and soil characteristics, rainfall, topography, vegetation, land use and management practices (Nouri, 2018).

Land use/land cover change has become a main element in current policies for managing natural resources and examining environmental changes. Monitoring the earth from the space is now essential for understanding the human actions on the natural resources base over time. Watching and monitoring the land from space produce real information of human uses and practices on the earth. In recent decades, satellites data and records have become vital in mapping land features, infrastructures, natural resources managing and ecological changes studies (Ghurah, 2018)

LULC changes are transiently and spatially energetic (Eunice, 2013). It has been recognized as an imperative driver of natural alter on all spatial and worldly scales. It too influences forest cover, and biodiversity). Arrive use/cover alter discovery is exceptionally basic for way better understanding of scene energetic amid a known period of time having economical administration. Understanding scene designs, changes and intelligent between human exercises and normal phenomenon are fundamental for legitimate arrive administration and choice advancement (Rawat and Manish, 2014). Land cover mapping and monitoring can serve as important indicators of landscape and environmental status, distributions, and patterns. A common and an effective way to better understand temporal changes, as well as the spatial variability of an area, is through the study of land cover change.

Normalized Vegetation File (NDVI) appears that the presence of vegetation covers other than fragmentary vegetation cover (Rasul and Abrahim, 2018). It is additionally broadly utilized file in characterization and evaluation of vegetation cover alter. NDVI is broadly recognized as a great for providing vegetation properties and related changes for huge spatial scale (Lamchin et al., 2014). NDVI could be a quantitative pointer of the relative riches and movement of green vegetation cover.

Vegetation cover has an inexhaustible part to hold nearby climate alter and climate changeability (Andualem, 2016). Vegetation has vital part to ensure the characteristic environment and to progress the living environment of human creatures. Hence, surveying spatiotemporal deviations of vegetation cover could be a key pointer to realize common natural changes (Lamchin, 2014).

2.2 Fundamental causes of vegetation cover change

Vegetation has a considerable impact on surficial energy exchange processes and acts as an interface between land and atmosphere. It affects local and regional climate and the hydrologic balance at the surface. Vegetation dynamics have been recognized to be of primary importance in the global change of terrestrial ecosystems (Yan, 2017). In most parts of the world, spatially in creating nations farming is the money related implies of the populace in turn fundamentally the foremost driver of arrive utilize alter (Tesfa et al., 2016).

> As a side effect and negative one of the population growth, technological advances, and economic improvement, vegetation and land degradation have reached striking and shocking rates on our plane. Currently, foresters, deforestation, uncontrolled urbanization, pollution and agricultural intensification threaten land sustainability as well as human life itself (Lech-hab, 2015).

2.3 Impacts of Vegetation Cover Change

The current study was carried out in North Ethiopia. After many years of ecological conservation, there has been a noticeable increase in forest coverage. During this period of ecological conservation, the economic value of ecological restoration and soil quality under different vegetation restoration models were studied (Gilliam, 2007).

Deforestation and land degradation, however, are impairing the capacity of forests and the land to contribute to food security, and to provide other benefits, such as fuelwood and fodder in Ethiopia. Ethiopians are facing rapid deforestation and degradation of land resources.

The increasing population has resulted in extensive forest clearing for agricultural use, overgrazing, and exploitation of existing forests for fuelwood, fodder, and construction materials.

Forest areas of the country have been reduced from 40% a century ago to an estimated less than 3% today (Bishaw, 2007).

To reduce these problems, rural afforestation and conservation programs on farms and community lands have been practiced in Ethiopia for the past three decades. The Ministry of Agriculture, in collaboration with national and international organizations, has made efforts to implement agroforestry and community tree planting programs. Rural tree planting on farm and community lands was identified as the most important topic of international development. The United Nation Development Program, in consultation with the Food and Agricultural Organization **(**Bishaw, 2007**)**

2.4 Impacts of Vegetation Cover Change on Land Surface Temperature

Climate change has widely impacted human society and the natural environment, and an increasing number of studies have researched global warming (Song Z. a., 2018).

Land surface temperature (LST), the temperature of the Earth's skin, plays an important role in heat and energy exchange between land surfaces and the atmosphere (Kerr, 2004). Knowledge of LST is a cornerstone of others earth system science (Song L. a., 2018).

2.6 Remote Sensing and geographic information system for Analyzing Land Surface Temperature

Using remote sensing data in conjunction with Geographic Information Systems (GIS) proved effective for mapping urban areas, modeling urban growth and monitoring the dynamic changes of LULC. (Aboelnour, 2018). Remote sensing (RS) provides medium and high spatial, spectral and temporal resolution data with consistent and repetitive coverage of the earth's surface, and a high capability to extract change information from satellite data (Aboelnour, 2018). However, LULC change and LST can be monitored by traditional surveys and land-based observation stations, as well as satellite data, because it is a time and cost-effective technique that can provide more information with respect to land use's geographical distribution. Satellite RS techniques, therefore, have become prevalent in monitoring change detection in both rural and urban regions (Aboelnour, 2018).

The RS (Remote Sensing) community implements the LU/LC system for mapping the features of the earth's surface. LU/LC indicates that how much area is covered by a different type of land and how this landscape is using by the people (Islam, 2022).

Presently a day the commitments of RS and GIS have since been utilized to assess and demonstrate LST in numerous districts with a few climatic conditions by different researchers employing a differences of warm infrared (TIR) sensors. For occasion, LST and Normalized Distinctive Vegetation Record (NDVI) were assessed to compare the spatial event of dry spells over the geo-botanical zone of Mongolia utilizing the NOAA- Progressed Exceptionally Tall Determination Radiometer (AVHRR) (Bayarjargal, 2006).

CHAPTER THREE

3. METHODOLOGY

3.1 Description of the Study Area

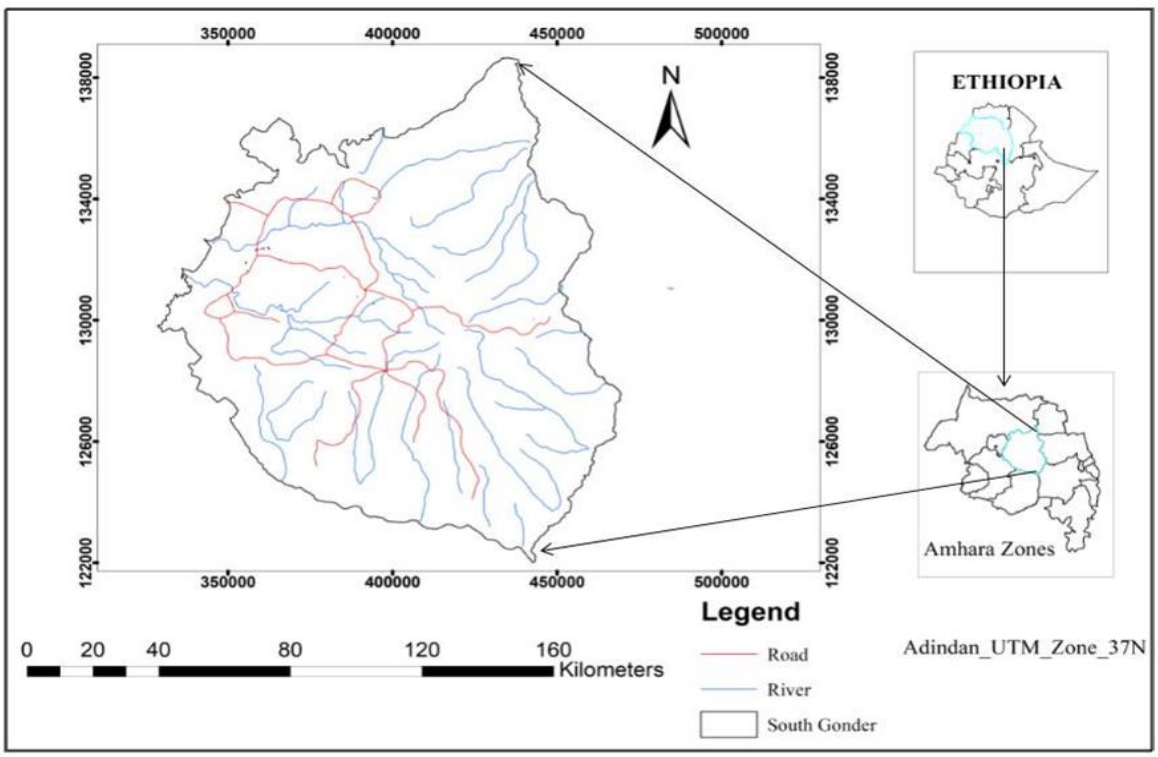
3.1.1. Location

The study area lines northwestern state of Amhara in Ethiopia. It is located just east of the city of Bahir Dar and Lake Tana in the Ethiopian highlands. Elevation of scene topography varies from 1150 to 4225 meters above sea level (masl). The study area is focused on the zone of South Gondar but includes portions of the neighboring zones North Gondar, Wag Himra, North Wollo, South Wollo, East Gojam, and West Gojam as well as the northeastern corner of Lake Tana. It is roughly centered on Mount Guna in South Gondar and approximately half of the area included in the scene delivers water to the Blue Nile Basin. The scene includes the municipality of Debre Tabor, which lies at 2410 meters above sea level and experiences a highly seasonal monthly average rainfall ranging from 6 mm in January to 501 mm in July, and mean monthly temperature ranging from 15.0°C – 18.7°C the South Gondar region had a population of around 2 million, the vast majority of whom have occupations in agriculture and belong to the Ethiopian Orthodox Church (Min, 2016).

3.1.2. Demographic

The populace of south Gonder 3,500,000. This Zone includes a add up to populace of 2,051,738, and an increment of 16% over the 1994 census, of whom 1,041,061 are men and 1,010,677 ladies. With an area of 14,095.19 square kilometers, south Gondar features a populace density of 145.56; 195,619 or 9.53% are urban occupants. A add up to of 468,238 family units were counted in this Zone, which comes about in a normal of 4.38 people to a family, and 453,658 lodging units (wikipedia, n.d.).

south Gondar Amharic was talked as a to begin with dialect by 99.7%; and 0.3% talked other essential dialects. 96.14% practiced Ethiopian Standard Christianity, and 3.68% of the populace said they were Muslim (Agency, 2007). The access of social services in south Gondar have 4%



to electricity and road density of 66.1 kilometers per 1000 square kilometers ((Agency, 2007). Elevation of scene topography varies from 1202 to 4109 meters above sea level.

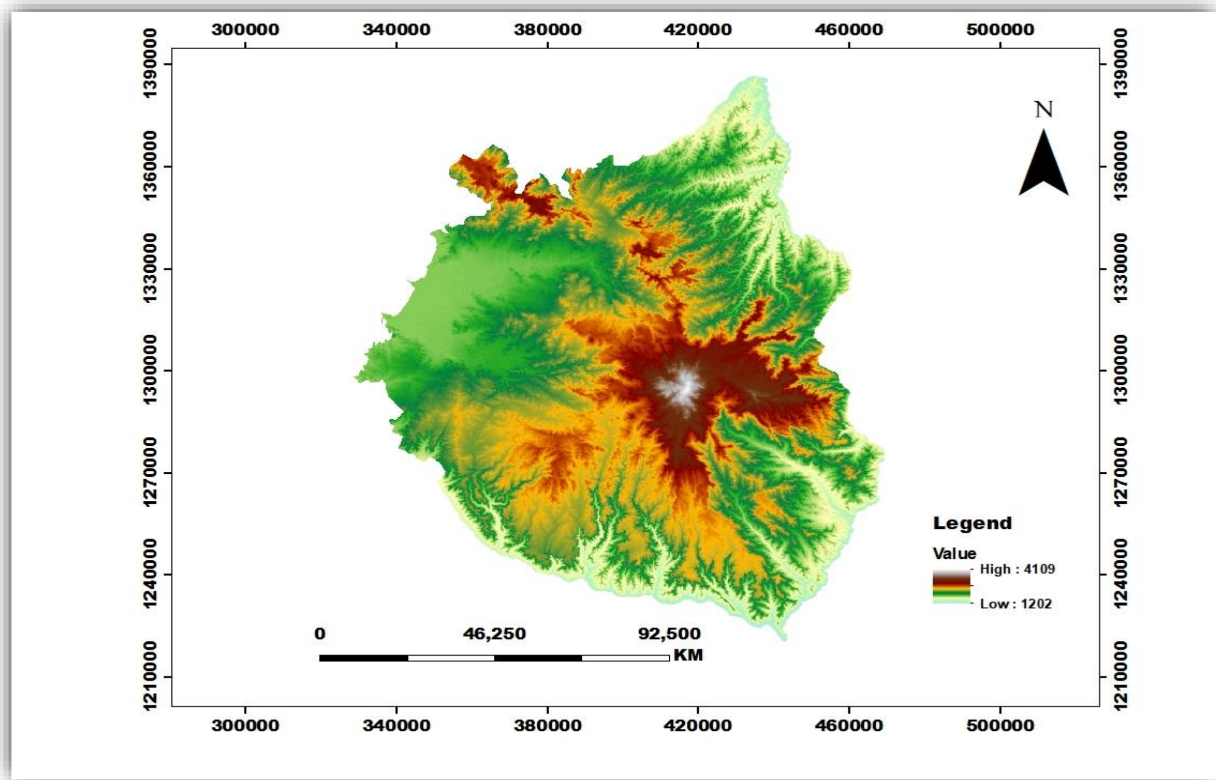


Figure 3.2: Elevation map

3.1.4. Climate

The climate of south Gonder zone is more influenced by altitude and latitude than others. The zone has bimodal rainfall pattern, summer is the main rainy season with its peak in July (June to August) and the short rainy season from February to April. The average temperature in the zone is 19.93°C and mean annual rain fall of 1151 mm.

3.1.5. Economy of the Zone

The economy of south Gonder is more depended farming exchange, benefit industry and fabricating and horticulture (cash trim preparations).. Grain, potato, natural products and diverse edit generation are the driving financial exercises other than exchanging. In this respect, zone organization invites those financial specialists who need to contribute on the over financial base counting the inns industry. In expansion to these south Gonder has tourism fascination ranges, to be specific, sopastopole found Gafat around Debretabor (head Tewdros Weapon made zone), Gunna Mountain and others. There are too private and open banks. The presences of these banks are encouraging financial development of south Gonder (Min, 2016**)**.

3.2 Data source and Material

In this study to examination the impacts of vegetation cover change on land surface temperature both Essential (Essential information were produced using GPS instrument), and auxiliary information (gotten from toady pictures, the consider range topographic maps Other than, the distributed materials counting books, diaries, inquire about articles and census reports were checked on) sources was utilized within the study area.

3.2.1. Acquiring of Satellite images

To achieve the goals of this study, three accessible satellite images were gotten from United States Geographical Study (USGS) databases online assets. Landsat Topical Mapper(TM), Improved Topical Mapper (ETM+) and Operational Arrive Imager-Thematic Infrared Sensor (OLI-TIRS) information had a few points of interest for vegetation cover alter location. The determination of these Arrive sat TM pictures are 30 meters but the choice of the landsat adj. image dates was affected by the quality of the picture particularly for those with constrained or moo cloud cover. Dry season and cloud-free pictures were utilized in this consider. Since this study centered on the impacts of vegetation cover alter on LST, dry season images offer assistance to isolated evergreen vegetation’s from precipitation subordinate vegetation’s like grass and other agrarian crops. The partisan symbolism utilized for this study comprises of multispectral Landsat information that incorporates Landsat 8 OLI 2018 and Landsat 5 TM for the year 1985, 2000, and 2018 (Table 3.1). Landsat 8 OLI and Landsat 5TM were utilized for land utilize land cover classification in order to know the extent of deforestation in South Gondar zone for the last 33 years. Landsat TM was contained on Landsat 4 and Landsat 5 pictures that have seven ghostly groups with a spatial resolution of 30 meters for groups 1 to 5 and 7. Landsat 8 OLI/TIRS images have eleven spectral bands with a spatial resolution of 30 meters for Groups 1 to 7 and 9. The resolution for Band 8 (panchromatic) is 15 meters. Thermal groups 10 and 11 are valuable in giving more accurate surface temperatures and are collected at 100 meters (htt)

3.2.**2. Moderate Resolution Imaging Spectroradiometer (MODIS)**

(MODIS) instrument has been designed to provide im- HE MODERATE Resolution Imaging Spectroradiometer proved monitoring for land, ocean, and atmosphere research. The design of the land imaging component combines characteristics of the Advanced Very High-Resolution Radiometer (AVHRR) and the Landsat Thematic Mapper, adding spectral bands in the middle and long-wave infrared (IR) and providing a spatial resolution of 250 m, 500 m, and 1 km. Spectral channels for improved atmospheric and cloud characterization have been included to permit both the removal of atmospheric effects on surface observations and the provision of atmospheric measurements (Justice, 1998). This study also used MODIS data to extract land surface temperature to analysis the relationship between vegetation cover change and LST.

. *Table3.1. source of satellite image*

Sensor	Acquisition time	Spatial resolution	Path/Row	Source
Landsat 5 TM	03/01/1985	30m	170/051,169/051,170/052, 169/052	USGS
Landsat 5 TM	08/01/2000	30m	170/051,169/051,170/052, 169/052	USGS
Landsat 8 OLI	10/01/2018	30m	170/051,169/051,170/052,169/052	USGS

MODIS (LST)		1 KM 2000-2018		USGS

Table 3.2 shows that software used and the purposes of Landsat images in this study

S.No	Data	Purpose	Source
1.	Study Area Boundary	Preparation of boundary shape files	Ethiopian Geo-spatial Institute agency
2.	Landsat Imageries (Spatial Resolution: 30m)	Generation of LULC maps , NDVI maps and LST	**United States Geological Survey** (**USGS**) databases online resources
3.	Ground Control points by GPS	To do Accuracy Assessment	was conducted by Researcher
S.No	**Software**	**Purpose**	**Source**
1.	Arc Map 10.5	Preparation of geospatial data And for more editing and also Map preparation To extract LST data and maximum likelihood	ESRI
2.	ERDAS IMAGINE 2015	To test Accuracy Assessment To classification To enhancement To correction	Leica
3.	Microsoft Excel (XLSTAT)	To draw graph	Microsoft office
4.	Microsoft word 2016 and 2013	To prepare documentation	Microsoft office

3.2.2. Ground Truth Data

Ground truth information has been collected through a hand-held GPS. Ground truth data were utilized in observational data examination, endorsement, applying coordinated classification methodology, thresholding, and NDVI regard inside the think about range.

In like way, 500 GPS focuses 300 focuses none vegetation cover and 200 point for vegetation were utilized to endorse the result of 1985, 2000 and 2018 Landsat images.

3.3. Methods of Data Analysis

The following flow diagram (Figure.3.2) summarizes the overall methods, procedures, approaches and materials used to carried out the study, to figure impacts of vegetation cover change of land surface analysis.

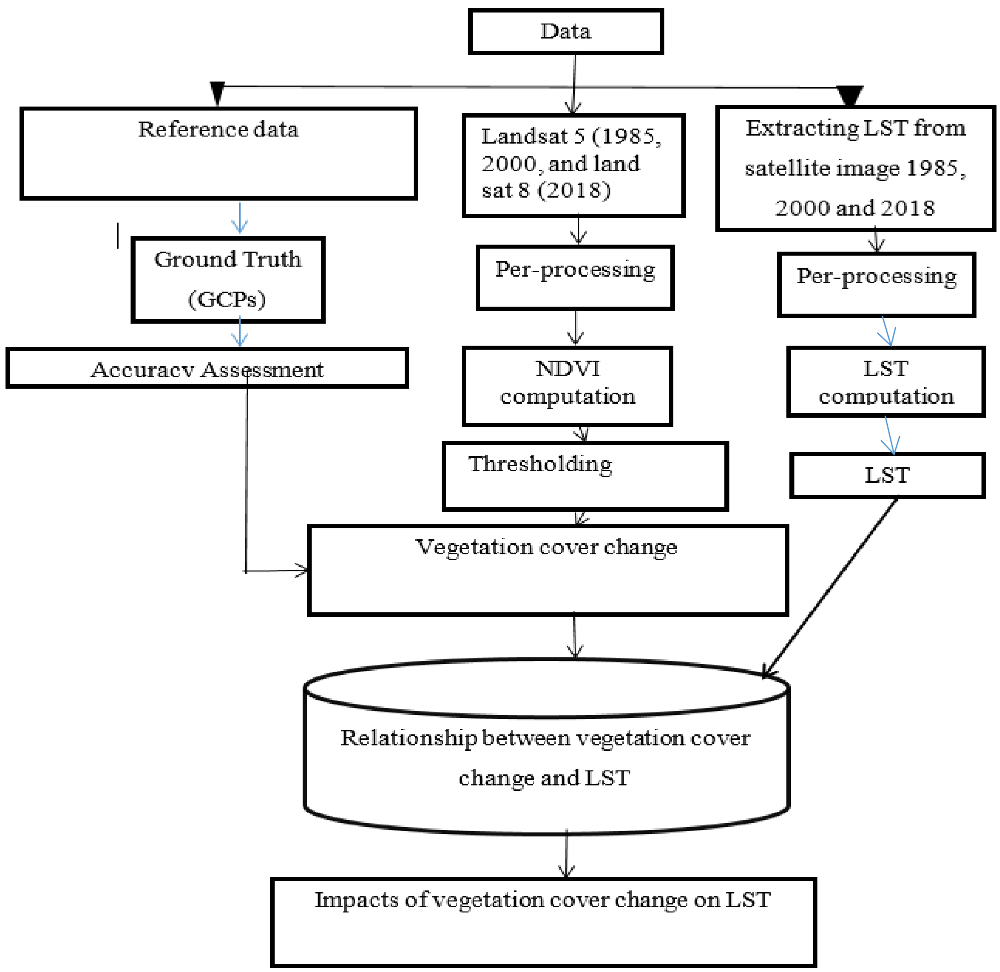


Figure.3.2**.** Flowchart showing the methodology followed in research work

3.3.1. Landsat Images Pre-processing

Land sat images gotten for this study were in their exchange organize TIFF within the to begin with stage which found as a separate single band pictures which will contain assist blunders which degrade their convenience. Subsequently, sometime recently utilizing this information, each picture has been pre-processed to reduce the sum of mistake that influence the ultimate result of the ponder. The term pre-processing comprises a number of picture handling exercises carried out to move forward the quality of the image and data that will be extricated from the image (Alemayehu, 2017).

3.3.2. Atmospheric and Radiometric Correction

artisan images are valuable for checking changes in arrive utilize and arrive cover. But major issue with these pictures is that districts underneath clouds are not secured by sensor. The picture mutilation due to cloud cover could be a classical issue of unmistakable band of inaccessible detecting symbolism. Particularly, for non-stationary obsequious, it is commonly found within the soil asset perception application. Evacuating cloud cover from adherent symbolism is exceptionally valuable for helping picture translation. Thus, cloud location and evacuation is exceptionally crucial in preparing of fawning symbolism. Encourage it is more troublesome to measure and translate changes on multitemporal pictures beneath diverse light, barometrical or sensor conditions without radiometric calibration (Biday, 2010). n this study also these methods used to enhance the Landsat and change the image format based on the objective.

. 3.2.3 Normalized Difference Vegetation Index (NDVI)

DVI could be a common and broadly utilized record. It is a vital vegetation index, broadly connected in investigate on worldwide natural and climatic alter. The vegetation reaction to environment is exceptionally delicate and not as it were influences the environmental adjust and climate but has too been found to be compelling boundary against common catastrophes. NDVI is calculated as a proportion contrast between measured canopy reflectance within the ruddy and close infrared groups separately (Bhandari, 2012)

The Terra MODIS NDVI items were extricated from MOD16A2 collection 6 datasets, which were composed of 16-day worldwide and given by the Soil information Look, with a spatial determination at 0.05◦. It is determined from the ruddy and near-infrared reflectance proportion as follows (Song, 2018)

$$NDVI = \text{NDVI} = \frac{\text{NIR}-\text{R}}{\text{NIR}+\text{R}} \qquad \textbf{(1)}$$

Where, **NDVI** = Normalized Difference Vegetation Index, **NIR** = Near Infra-Red and **R**= Red

In NDVI Thresholding was calculated since, Thresholding was used to identify maximum and minimum value of the NDVI, that means it is important to separate vegetation and non-vegetation based on the numerical values of NDVI.

3.3.6 Land Cover Change Detection

Land-cover (LC) composition and alter are vital variables that influence ecosystem condition and work. This information is regularly utilized to create landscape-based measurements and to evaluate scene condition and screen status and patterns over an indicated time interim the utilize of satellite-based farther sensor information has been broadly connected to supply a cost-effective implies to create LC inclusions over huge geographic districts (Lunetta, 2006).

change detection works by utilizing the lesson boundaries from the base arrive cover image to infer an expected lesson normal unearthly reaction and also change detection method developed by Earth sat, Inc. and measures the differences between an existing land cover image and a recent single date multispectral image (Civco, 2002).

3.3.7 Image Differencing

Image Differencing includes measuring worldly impacts utilizing multi worldly information sets, when one is interested in knowing the changes over huge regions and at visit interim fawning information are commonly utilized. Results of the advanced examination to a huge degree depend on the calculations utilized (Minu, 2015). alter discovery utilizing obsequious information is an important application of remote detecting science, and Remote detecting alter location includes the application of worldly obsequious datasets for any region to identify changes of pixels values quantitatively (Das, 2017). n image difference-measure (IDM) that precisely predicts human judgments is the Heavenly Chalice of perception-based picture processing. An IDM takes two pictures and parameters that indicate the seeing conditions (Lissner, 2011). Similarly, this method was applied in this study on the classified image to determine the changed area. In the differenced image, spectral changes are highlighted as relatively high positive or negative values. Unchanged pixels are associated with values close

3.3.8 Accuracy Assessment

Accuracy assessment or approval may be a critical step within the preparing of remote detecting information. It builds up the data esteem of the coming about information to a client. Beneficial utilization of geodata is as it were conceivable on the off chance that the quality of the data is known. The by and large exactness of the classified image compares how each of the pixels is classified versus the positive arrive cover conditions gotten from their corresponding ground truth information. Producer's precision measures blunders of exclusion, which could be a degree of how well real-world arrive cover sorts can be classified. User's precision measures blunders of commission, which speaks to the probability of a classified pixel coordinating the arrive cover sort of its corresponding real-world area (Congalton, 1991) (Campbell, 2011) (Unger Holtz, 2007).

In Accuracy assessment kappa coefficient is basic which was utilized to statistically determine, in the event that the remotely detected classification is better than an irregular classification, and on the off chance that two or more error matrices are altogether distinctive from each other.

$$K = \frac{N \sum_{i=1}^{r} xii - \sum_{i=1}^{r} (xi+ * x+i)}{N^2 - \sum_{i=1}^{r} (xi+ * x+i)} \qquad \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_} \textbf{(2)}$$

Where, k is kappa statistics, N is totals samples, xii is the number in row i and column i, xi+ is row total. X+I is column total.

The kappa insights esteem may be a degree of the agreement between classification and reference information (Wang, Accuracy assessments of land use change simulation based on Markov-cellular automata model, 2012); (Abebe, 2019). (Landis, 1977) positioned the kappa values, extending from − 1 to 1, into three bunches: (1) more prominent than 0.80 spoken to solid understanding (2) between 0.40 and 0.80 spoken to direct understanding, and (3) less than 0.40 spoken to destitute understanding between the classification and reference information. Concurring to the Kappa coefficient lies ordinarily extended from to 1.00 (Wongpakaran, 2013), where the last mentioned demonstrates significant understanding, and is regularly increased by 100 to provide a rate degree of classification precision.

$$OA(\%) = \frac{SCC}{TS} * 100 \qquad \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_} \textbf{(3)}$$

Where, OA is overall accuracy, SCC is sum of correctly classified, TS is total sample. A set of reference pixels representing geographic points on the classified image is required for the accuracy assessment.

3.3.9 Computation of Land Surface Temperature

The MOD11A1 Version 6 product provides daily per-pixel Land Surface Temperature and Emissivity (LST&E) with 1 kilometer (km) spatial resolution in a 1,200 by 1,200 km grid. The pixel temperature value is derived from the MOD11_L2 swath product. Above 30 degrees latitude, some pixels may have multiple observations where the criteria for clear-sky are met. When this occurs, the pixel value is a result of the average of all qualifying observations. Provided along with the daytime and nighttime surface temperature bands are associated quality control assessments, observation times, view zenith angles, and clear-sky coverages along with bands 31 and 32 emissivity's from land cover types (Wan, 2015).

$$Temperature\ (°c) = (DN * 0.02) - 273.15 \quad \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_} \quad \textbf{(4)}$$

To estimate the cruel month to month LST for each year, within the ponder period (2000-2018), four 8-days composite pictures of each year were included and separated by 4 in raster calculator. After that operation, the cruel LST of dry season for each year within the ponder period were calculated utilizing raster calculator by adding the cruel month to month LST for each month within the year and isolating the entirety by 7. The number 7 suggests that the number of dry season months (October- April).

3.3.10 Trend Analysis

Trend investigation may be a measurable strategy performed to assess hypothesized straight and nonlinear connections between two quantitative factors. Regularly, it is actualized either as an investigation of change (ANOVA) for quantitative factors or as a relapse examination. It is commonly utilized in circumstances when information has been collected over time or at distinctive levels of a variable; particularly when a single autonomous variable, or calculate, has been controlled to watch its impacts on a subordinate variable, or reaction variable (such as in exploratory considers) (Dew, 2008). In specific, the implies of a subordinate variable are watched over conditions, levels, or focuses of the controlled autonomous variable to measurably decide the frame, shape, or drift of such relationship (Dew, 2008). Along these lines, to delineate a slant of a time course of action of LST, Mann-Kendall incline test was utilized to see whether there's a reducing or extending slant or not modify. It is one of non-parametric truthful test utilized for recognizing designs of climatic variables (solomon, 2013). It moreover utilized to survey the centrality of patterns in climatic time arrangement information such as temperature. Non-parametric tests are thought to be more reasonable for non-normally disseminated information which are experienced in climatic time arrangement (Soni, 2017).

3.3.11. Mann–Kendall (MK) trend test

the Mann-Kendall test may be a non-parametric test for recognizing patterns in time arrangement information. The test compares the relative sizes of test data rather than the information values themselves ((Yusuf, 2018).

The Mann-Kendall, as a hypothesis test, is a nonparametric, rank-based. The data is ranked according to measurement epoch in order to evaluate the presence of trends in time series data.

The MK test has been broadly utilized to test stationary statistics against slant measurements in hydrology and climatology. This test assesses whether values tend to extend or diminish over time through what is basically a nonparametric frame of monotonic slant relapse examination. The Mann-Kendall test investigations the sign of the distinction between later-measured information and earlier-measured information. A genuine issue in identifying and assessing patterns in hydrological information is the impact of serial reliance. On the off chance that an autocorrelation exists in a time arrangement, the MK test tends to dismiss the invalid theory of no trend more regularly than the desired level of centrality ((Zelen{\'a}kov{\'a}, 2017)).

Mann-Kendall test could be a non-parametric test for distinguishing patterns in time arrangement data. This test compares the relative sizes of information instead of the information values themselves (Shanmugasundram, 2012).

The Mann-Kendall test analyzes the sign of the qualification between later-measured data and earlier-measured data. Each later-measured regard is compared to all values measured earlier; coming almost in a include up to of $n(n-1)/2$ conceivable sets of information, where n is the in general number of discernments (Mondal, 2012). According to this test, the invalid speculation H0 accept that there's no slant (the information is free and arbitrarily requested).

This is tested against the alternative hypothesis *H*a, which assumes that there is a trend. If the p-value is greater than the level of confidence alpha, there is no significant trend. On the other hand, if the p-value is less than the level of confidence alpha, there is a significant trend (Thenmozhi, 2016). The Mann-Kendall statistic (S) is computed as follows:

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \text{sign}(yj - yi) \qquad \textbf{(5)}$$

The trend test is applied to a time series y_i, which is ranked from i = 1,2,3, ... n – 1 and y_j, which is ranked from j = i + 1, i + 2, i + 3, ... n. Each of the data points y_j is taken as a reference point, which is compared with the rest of the data point's y_i, so that,

$$\text{Sign}\ (yj - yi) = \begin{cases} +1, \text{ if}(yj - yi) > 0 \\ \{0, \text{ if}(yj - yi) = 0\} \\ -1 \text{ if}(yj - yi) < 0 \end{cases} \qquad (6)$$

Here y_j and y_i are the sequential data values, and *n* is the length of the data set (Wani *et al*., 2017).

3.3.11 Sen's Slope Estimator Test

strategy for assessing the incline of a backslide line that fits a set of (x, y) information components is based on a slightest squares survey and gage the honest to goodness slant of an existing float such as the whole of modify per year, Sen's slop nonparametric methodology is utilized. The Sen's technique can be utilized in cases where the slant can be anticipated to be coordinate such as:

$$f(t) = Q(t) + B \qquad (7)$$

Here Q is the slope, and B is a constant. Therefore, the Sen Slope estimator is computed as follows:

$$\boldsymbol{B}1 = \textbf{median}[\frac{(\textbf{j}-\textbf{i})}{\textbf{j}-\textbf{i}}] \qquad (8)$$

For all j > i and i = 1, 2, …, n-1 and j = 2, 3…, n; in other words, computing the slope for all pairs of data that were used to compute S. The median of those slopes is the Sen Slope estimator (Begum, 2013)

3.3.12 Statistical Analysis

Association of vegetation cover through LST was investigated utilizing Pearson Relationship Coefficient for each pixel to test the quality of the direct relationship of vegetation cover with LST (Lamchin, 2015). Pearson correlation measures the existence and strength (given by the coefficient r between -1 and +1) of a linear relationship between two variables. It should only be used when its underlying assumptions are satisfied. If the outcome is significant, we conclude that a correlation exists. (samuels, 2014).

It is the test insights that degree the measurable relationship between two nonstop factors and known as the finest strategy of measuring the affiliation between factors of intrigued. It gives data approximately the greatness of the affiliation, or relationship, as well as the course of the relationship (statisticssolutions, n.d.). Coefficient values can range from +1 to -1, where +1 indicates a perfect positive relationship, -1 indicates a perfect negative relationship and 0 indicates no relationship exists (statisticssolutions, n.d.).

The absolute value of the correlation coefficients (r) is divided into a weak correlation ($0<|r|\leq0.3$), a low correlation ($0.3<|r|\leq0.5$), a moderate correlation ($0.5<|r|\leq0.8$), and a strong correlation ($0.8<|r|\leq1$) (Li *et al*., 2014).

$$r_{xy} = \frac{\sum_{i=1}^{n}(xi-xm)*(yi-ym)}{\sqrt{\sum_{i=1}^{n}(xi-xm)^2 \sum_{i=1}^{n}(yi-ym)^2}} \qquad (9)$$

Where, rxy is the simple correlation coefficient of variables X and Y, xi is NDVI or vegetation cover of the i^{th} year/month, Yi is climatic elements (LST) of the i^{th} year/month; Xm is the average NDVI or vegetation cover for all years/month, Ym is the average LST for all years/month (Li, 2004).

CHAPTER FOUR

4. RESULTS

4.1 Normalized Difference Vegetation Index Results

The comes about of Normalized Differentiate Vegetation index (NDVI) the consider zone have expanded from +0.98 to -0.96 in 1985 and +0.96 to -1 in 2018 as showed up that in Table 4.1 underneath the numerical regard of these differing a long time proposes that the entirety of vegetation has decreased in 2018 as compared to the 1985. The most noteworthy values of the vegetation record decreased from +098 in 1985 to 0.96 in 2018. At that point the NDVI regard result shows up that vegetation cover was lessened from 1985 to 2018. The most extraordinary NDVI regard of 0.98 in 1985 decreased by 0.97 inside the year 2000. The diminishment of NDVI values induces that the hardship misfortune Incident hardship mishap of vegetation covers in South Gondar zone.

Table 4.1: *Statistical Normalized Difference Vegetation Index value of years 1985, 2000, and 2018.*

Years	**Minimum**	**Maximum**	**Mean**	**Std**
1985	-0.96	0.98	0.15	0.05
2000	-0.97	0.97	0.14	0.05
2018	-1	0.96	0.13	0.04

The cruel values diminished from 0.15 in 1985 to 0.13in 2018 as appeared in Table 4.1. the most noteworthy cruel esteem of NDVI appeared in 1985 Landsat picture this infers that the most elevated level of vegetation cover though the most reduced cruel esteem of NDVI in 2018 adj. picture is appears that the most reduced vegetation scope. As a result, the vegetation cover was way better in 1985 than 2018 fawning pictures within the consider range. And too the cruel NDVI esteem was diminish from 0.15 in 1985 to 0.14 and in 2000. The little cruel NDVI esteem happened in 2018. This lessening slant of cruel NDVI esteem demonstrated that vegetation cover decreased through time within the consider region. As shown in Figure 4.1, the darker green color within the picture uncovered the most noteworthy NDVI values and the most elevated vegetation cover. The darker ruddy color appeared the most reduced NDVI esteem and the least vegetation cover. This comparison result shows that highest vegetation cover was observed in 1985 whereas lowest vegetation cover was observed in 2000.

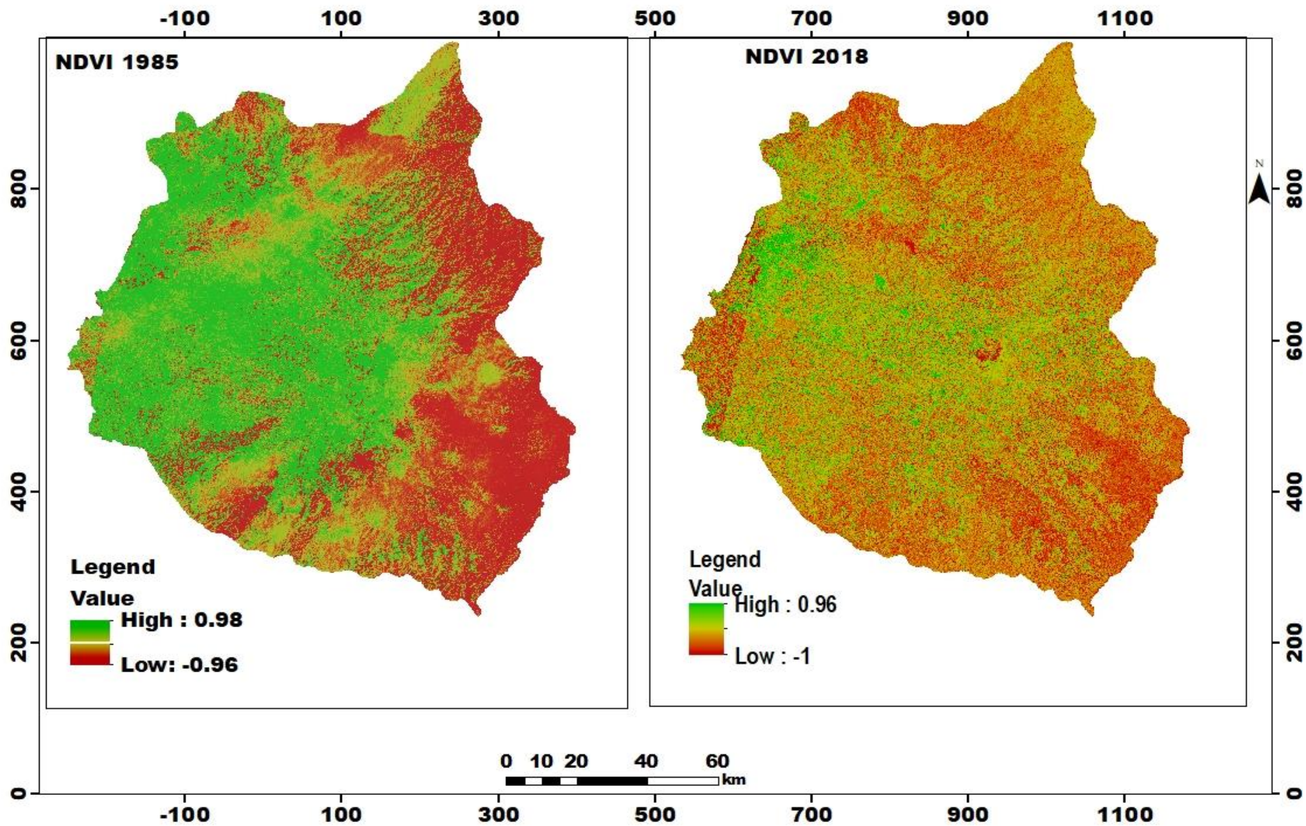


Figure 4.2: Normalized Difference Vegetation Index map of 1985 and 2018

The yield of the greatest and the cruel NDVI values demonstrated that there was a diminish in vegetation cover over the final 33years. Concurring to the NDVI esteem comes about, vegetation cover diminished through time within the think about range. NDVI esteem comes about have appeared that vegetation cover is watched in central, northern and southeastern portion of the think about range (Figure 4.1 and 4.2). Vegetation and non-vegetation cover changes have been watched within the west, southeastern and central portion of the consider area. However, moo vegetation cover has been seen within the eastern tall arrive zones and northeastern portion of the ponder range based on the study period of time.

4.2 Vegetation Cover Change Mapping

The numerical value study region was 227979.09 Hectors (ha) (15.6%) vegetation cover of the entire study about zone and the non-vegetated zone was 1236500.19 ha (84.4 %) of the ponder range in1985. The vegetation cover and non-vegetation cover in 2000 154424.43 ha (12.5%) and 1310017.14 (89.5%) separately, at that point Vegetation cover diminished in 2018 by 32,747.5 ha (2.2%) oppositely, the non-vegetated range expanded 32747.5ha (2.2 %) in 2018 this suggests that there's diminishing vegetation cover alter in 2018.

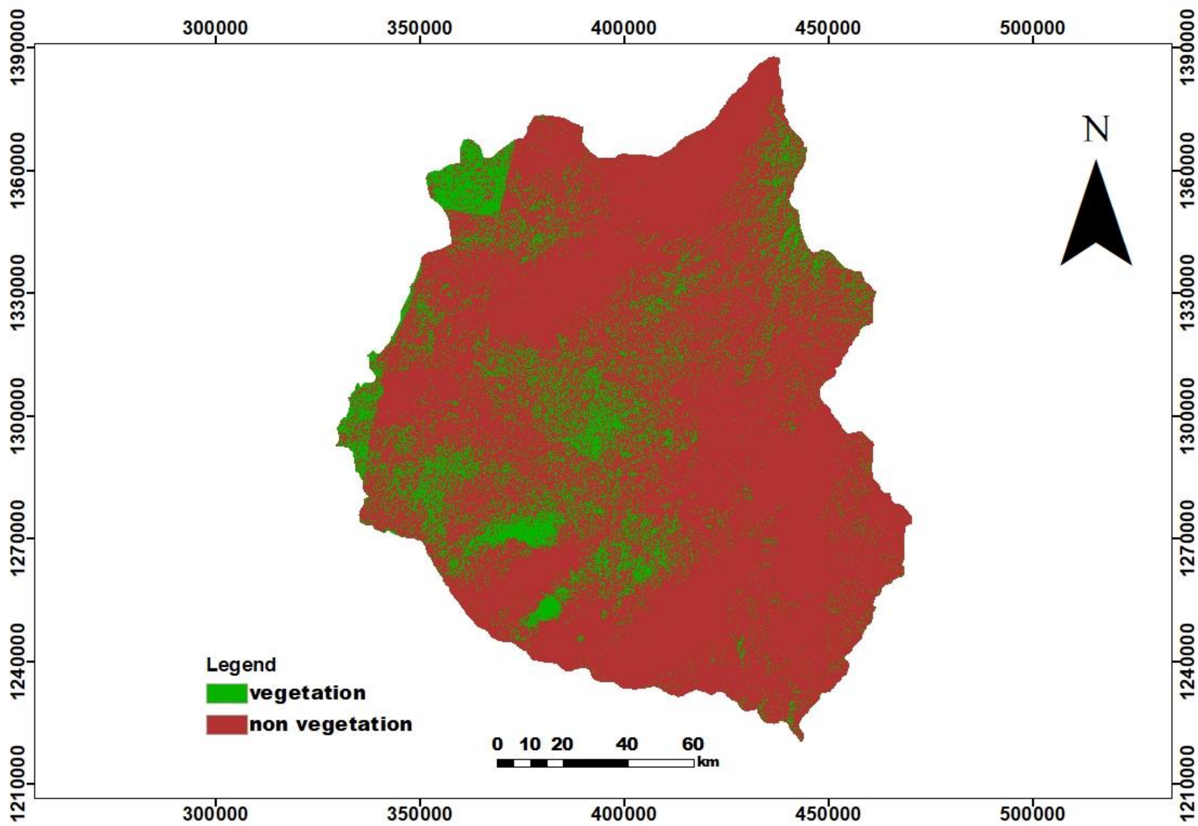


Figure 4.3: vegetation cover map of 1985

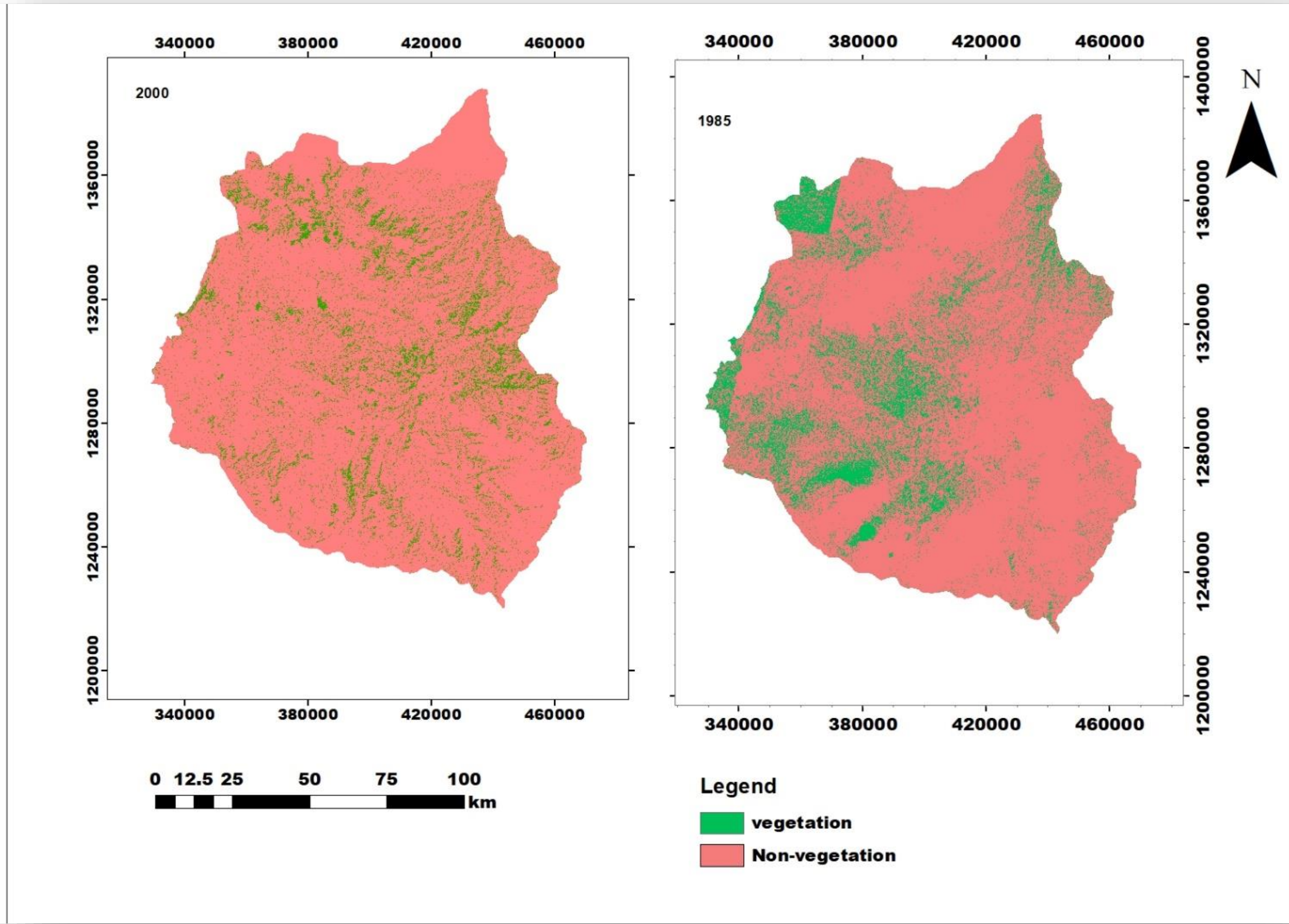


Figure 4.4: vegetation cover map of 1985 and 2000

***Table 4.2**: LULC showing the area in ha for the year 1985, 2000 and 2018*

LULC Classes	**1985**	**2000**	**2018**
Vegetation	227979.09	154424.43	195231.59
Non-vegetation	1236500.19	1310017.14	1269247.68
Total	1464479.28	1,464,441.57	1,464,479.27

The vegetation cover reduced by 73516.95 ha and the non-vegetated zone expanded by 32747.49 ha in 2000. The vegetation and the non-vegetation cover, in 2018, was 195231.59 and 1269247.68 ha, individually. From 1985 to 2000 an expansive range of vegetation cover has been misplaced. Other ways, a little region of vegetation has been misplaced from 1985 to 2018. The examination of vegetation cover alters for 33 a long time from 1985 to 2000 of the study about is appears that 73516.95 ha (5%) of vegetation cover arrive has been misplaced. In this manner, the examination of the result clearly demonstrated that vegetation covers diminished over the consider period of time, whereas no vegetation covers expanded.

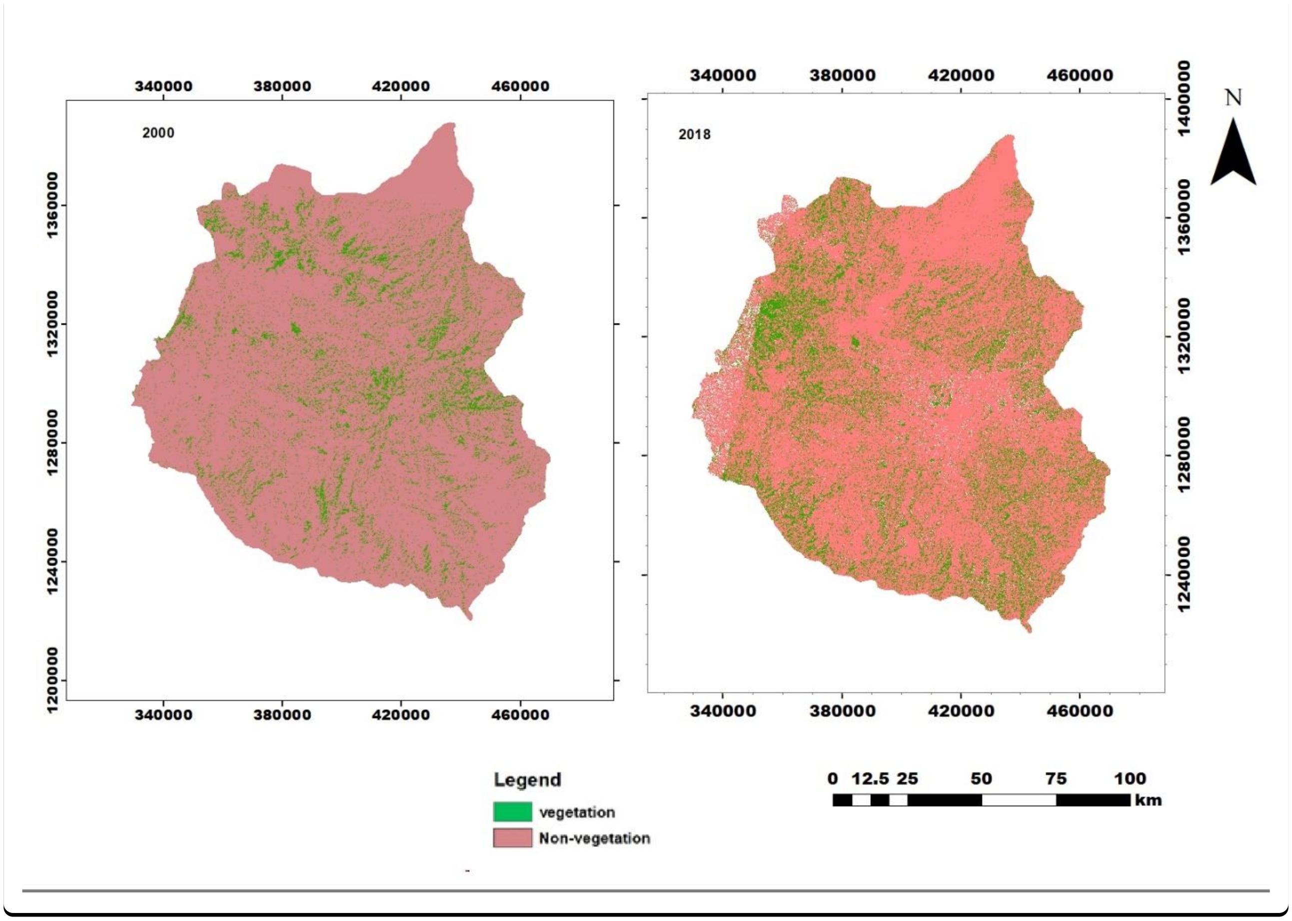


Figure 4.6: vegetation cover map of 2000 and 20118

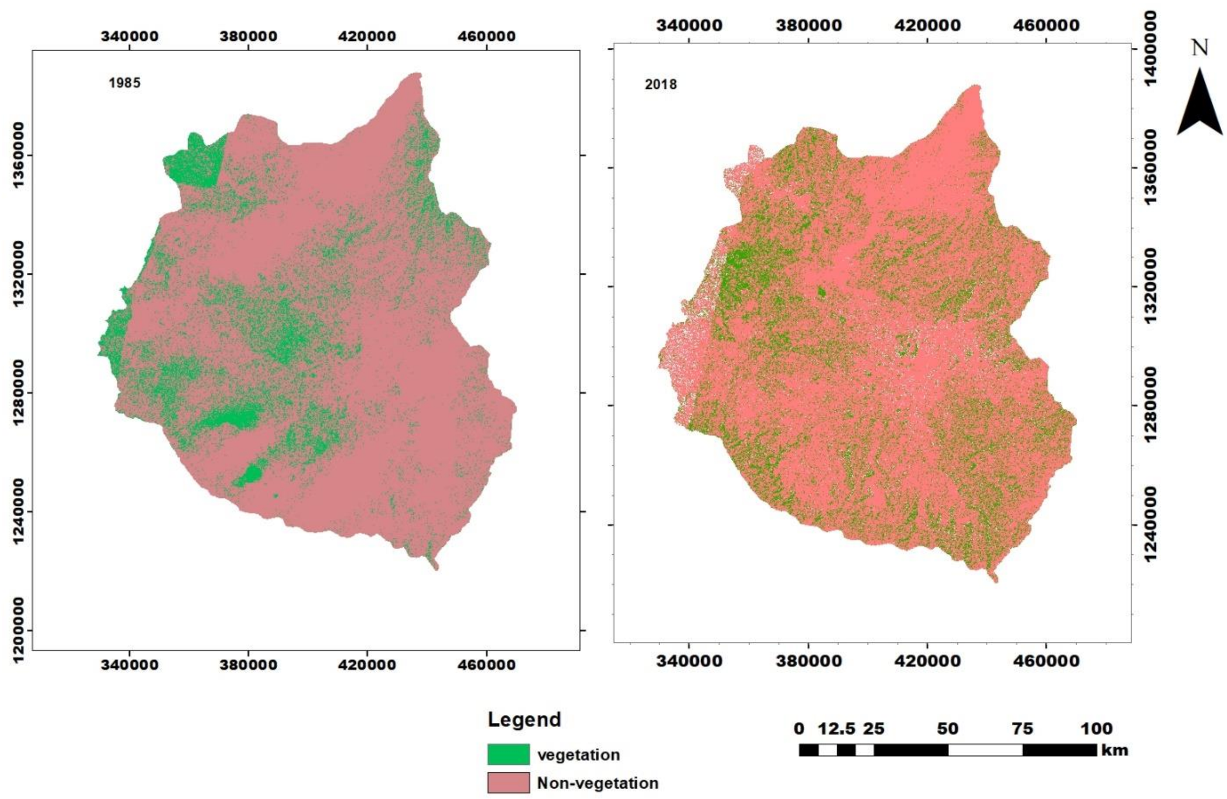


Figure 4.7: vegetation cover map of 1985 and 20118

And also, as appeared within the over Vegetation Cover Alter maps the zone secured by vegetation was 227979.09 ha in 1985 and 154424.43 ha in 2000 which implies that exclusion of 73516.95 ha (5%) vegetation cover inside 15 a long time. Additionally, the vegetation covers were 227979.09 and 195231.59 ha in 1985 and in 2018, individually like ways in 15 a long time 32747.49 ha (2.2%) misplaced *vegetation.*

Table 4.3: Vegetation cover change (area in ha) from 1985 to 201

	Change(1985to2000)	**Change (2000to 2018)**	**Change (1985 to 2018)**
Vegetation	-32747.49	-40807.1625	-73516.95

Negative (-) sign shows that decreasing of vegetation.

All through the final three decades, the vegetation cover within the consider region diminished from 227979.09 ha in 1985 to 154424.43 ha in 2018 described for 15.6% of the overall consider region, 12.5% of vegetation cover has been changed to the non-vegetated region meaning 3.1% of vegetation cover has been changed to the non-vegetated region. The picture differencing of limit comes about between 1985 and 2018 appear that NDVI demonstrated more prominent debasement in vegetation cover than recovery in vegetation cover (Table 4.4). The results of vegetation cover alter location between 1985 and 2018, 1985 and 2000, 2000 and 2018, are:

Table 4.4*: Change detection of vegetation cover change (area in ha)*

	Years	**1985 to 2018**	**1985 to 2000**	**2000 to 2018**
Vegetation Cover	Increased	94932.3	78913.06	70345.89
	Unchanged	1216500.12	132082.64	1249247.68
	Decreased	117084.6	105152.2	81916.02

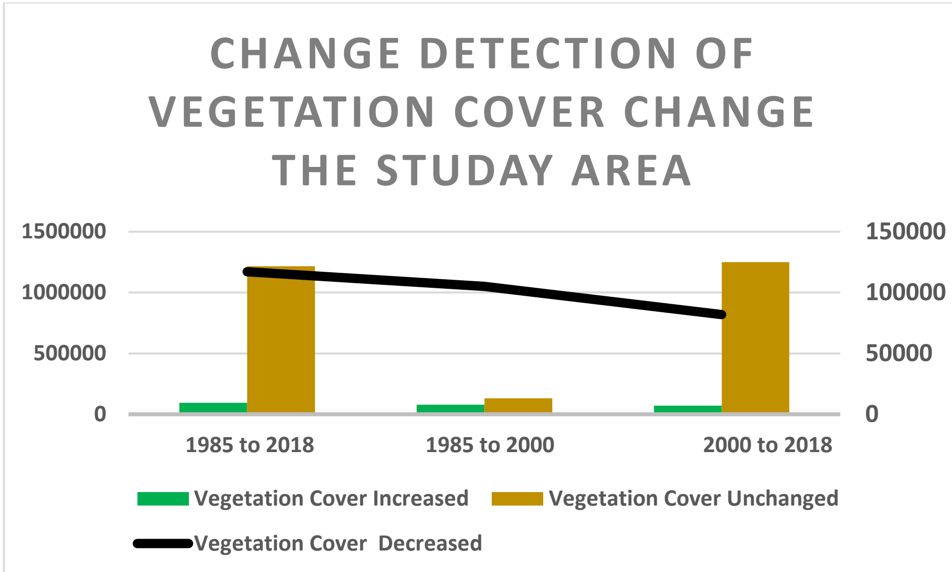


Figure 4.8 Change detection of vegetation cover change

Based on the comes about of alter discovery there was a more prominent vegetation corruption (117084.6 ha) than the region of vegetation rebuilding (94932.3ha) in 1985 to 2018.This result suggests that from the time of 1985-2018, reforestation region secured 6.5% % of the think about region, but the expelled region secured 8% of the consider range. The major alter was recognized between 1985 and 2018, appearing that around 8% of add up to vegetation cover of the studyt zone was misplaced. The degree of afforestation was secured an range of 70345.89 ha (4.8%) between 2000 and 2018. The investigation of picture differencing appeared that 78913.06 ha region were afforested, and 105152.2 ha were deforested between 1985 and 2000. Amid the period of 1985 to 2000, the afforestation secured 5.5 % of the overall zone and deforestation was detailed as 7.2% of the overall zone of the think about arrive location. As seen in Figure 4.7. The changed zone on the outline is relegated as ruddy and blue colours, but districts with small or no changes are appeared in light.

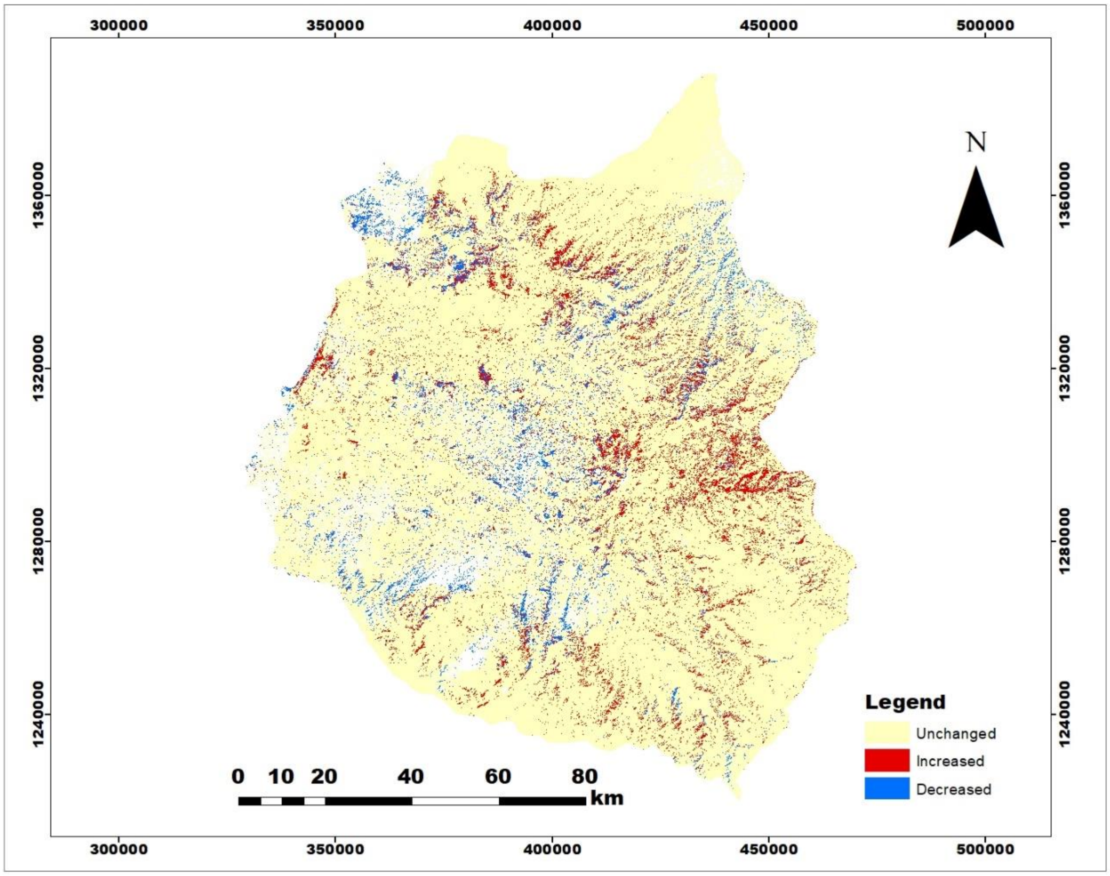


Figure 4.9: Change detection map from 1985 to 2018.

4.3 Accuracy Assessment

. The producer ‘s accuracies of both classes were reliably tall, extending from 80.2% to 95.5%. The user ‘s accuracies for both classes were accurately tall, extending between 86.7% and 95%, individually. The accuracy evaluation result appeared that the generally accuracy was 86.4% with kappa insights 0.72 for 1985. in general accuracy of classification image was 92.2% and the Kappa coefficient was 0.84 within the year 2018.

Table 4.5: Accuracy assessment for the year 1985, 2000 and 2018.

	1985		2000		2018	
	Vegetation	**Non_veg.**	**Vegetation**	**No_veg.**	**Vegetation .**	**No_veg**
User's accuracy (%)	87.5	85.7	89	87.3	88.5	95
Producer's accuracy (%)	80.2	91.1	82.4	92.3	92.2	95.5
Overall accuracy (%)	86.4		88		92.2	
Kappa statistics (%)	0.72		0.82		0.84	

4.4 Examination of Dry Season Land Surface Temperature

The Mann-Kendall trend test result appears that the run of least, greatest and cruel of Arrive Surface Temperature (LST) were from and 20.45ºC - 25.29ºC , 42ºC- 41.35ºC and 41ºC-33ºC individually, from 2000 to 2018. Based on the trend line as appeared in Figure 4.10, the least, greatest and cruel LST were changed by the variables of 0.016, 0.0317, and 0.0239 over South Gondar zone, individually. The Mann-Kendall drift test result suggested that there was no critical slant of LST within the think about region within the think about period, since p-value is more prominent than the critical level for all least, most extreme and cruel LST.

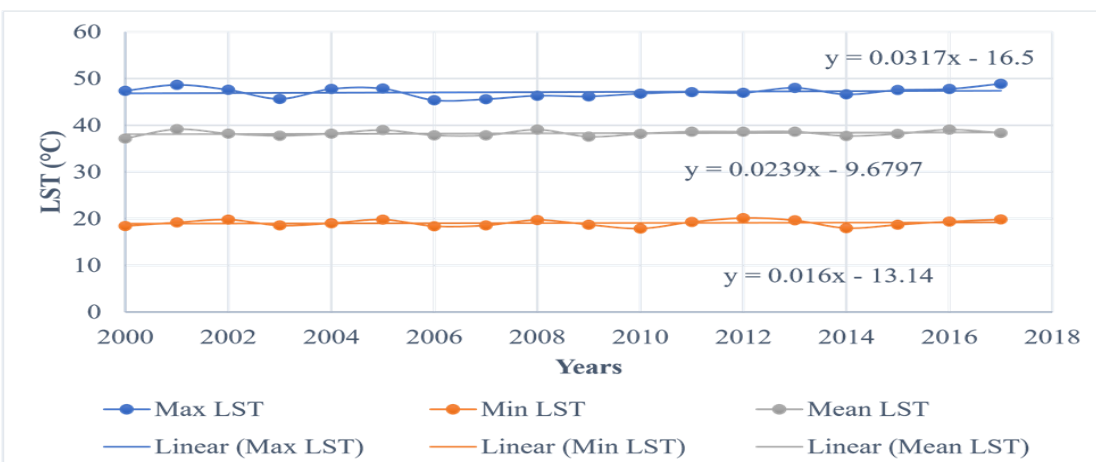


Figure 4.10: *Result of the trend line minimum, maximum and mean LST of the dry season*

Table 4.6: Mann-Kendall trend test of minimum, maximum and mean LST of the dry(ºC)

Variables	**Mean LST**	**Min LST**	**Max LST**
Obs.	18	18	18
Obs. Without missing data	18	18	18
Kendall's tau	0.13	0.14	0.16
Alpha	0.05	0.05	0.05
P-value	0.35	0.45	0.36
Min	39.45	22.29	42
Max	41.35	20.45	41.6
Mean	40.4	21.37	41.68
Std	0.57	0.68	0.67
Sen's slope	0.03	0.02	0.09

Ho, there's no trend within the time series examination of 18 a long-time min, max and mean of dry sea-son LST Ha, there's a trend within the time arrangement investigation of 18 a long-time min, max and mean of dry sea-son LST Calculated p-value is more noteworthy than the centrality level alpha = 0.05, one cannot dismiss the invalid speculation Ho. The chance to dismiss the invalid theory Ho but its genuine is 45%, 36% and 35% for the least, most extreme and cruel of dry season LST individually. then there was no measurably noteworthy alter of LST within the consider period of time, there's LST alter. The Sen's slant result appeared that the least, most extreme and min value LST were expanded by 0.02ºC, 0.09ºC and 0.03ºC per year with noteworthy level 0.05 and p-value 0.45, 0.36 and 0.35, individually. The cruel, least and greatest LST for 2000 were 39.26ºC 20.45ºC, and 41.35ºC. For 2018, 41ºC, 22.29ºC and 42.36ºC were cruel, least and greatest of LST, each value. Then 1.84ºC and 1.5ºC increments in least and most extreme.

Table 4.7*: Minimum, maximum and mean LST of 2000 and 2018*

year	**Min LST(ºC)**	**Max LST(ºC)**	**Mean LST(ºC)**
2000	25.45º	44.09	39.26

2018	22.29º	42.36	41

4.9 Connection of NDVI and Vegetation Cover with Land Surface Temperature

As looks in Table 4.8 the relationship between mean LST and mean NDVI of the dry season within the study range Land Surface Temperature (LST) is impacted to vegetation cover. The relationship coefficient gotten between LST and NDVI is found as -0.98 with critical level alpha 0.05 and p-value 0.14. Generally, the LST is strongly and negatively related with NDVI. Subsequently, regions with slightest vegetation cover are encountering more arrive surface temperature. whereas the comes about of the Pearson Relationship suggested that emphatically negative relationship existed between vegetation record of cruel NDVI and cruel LST of dry season, indeed in spite of the fact that there was no critical negative straight relationship existing between the factors, Since p-value (0.14) is more noteworthy than alpha (0.05). Then there was no critical relationship between vegetation cover (ha) and mean LST of dry season amid the study period over central, northern and south eastern parts of the consider range. But there was a strong and negative relationship between vegetation cover in (ha) and cruel LST with noteworthy level and p-value (0.29, 0.05), independently. In this case, the relationship coefficient was -0.89.

Table 4.8: *Relationship of Normalized Difference Vegetation Index and vegetation cover with Land Surface Temperature*.

NDVI *vs* LST				**Vegetation cover *vs* LST**			
P	R	R2	Alpha	P	R	R^2	Alpha
0.14	-0.98	0.95	0.05	0.29	-0.89	0.80	0.05

Within the examination, it was decided that the vegetation covers had appeared a considerably low land surface temperature in all the years. Since tall vegetation cover can diminish the amount of warm put away within the soil and surface structures through transpiration. The vegetation scope and land surface temperature outline (Figure 4.11) appears that zone with tall vegetation cover had appeared moo land surface temperature, On the other hand, areas with low vegetation cover had appeared high land surface temperature. Based on the result investigation, high vegetation coverage and low LST have been observed within the central, western and southern portion of the study range over the study period of time. And, low vegetation cover and high LST has been observed within the central parts and eastern portion of the consider zone amid the think about period of time.

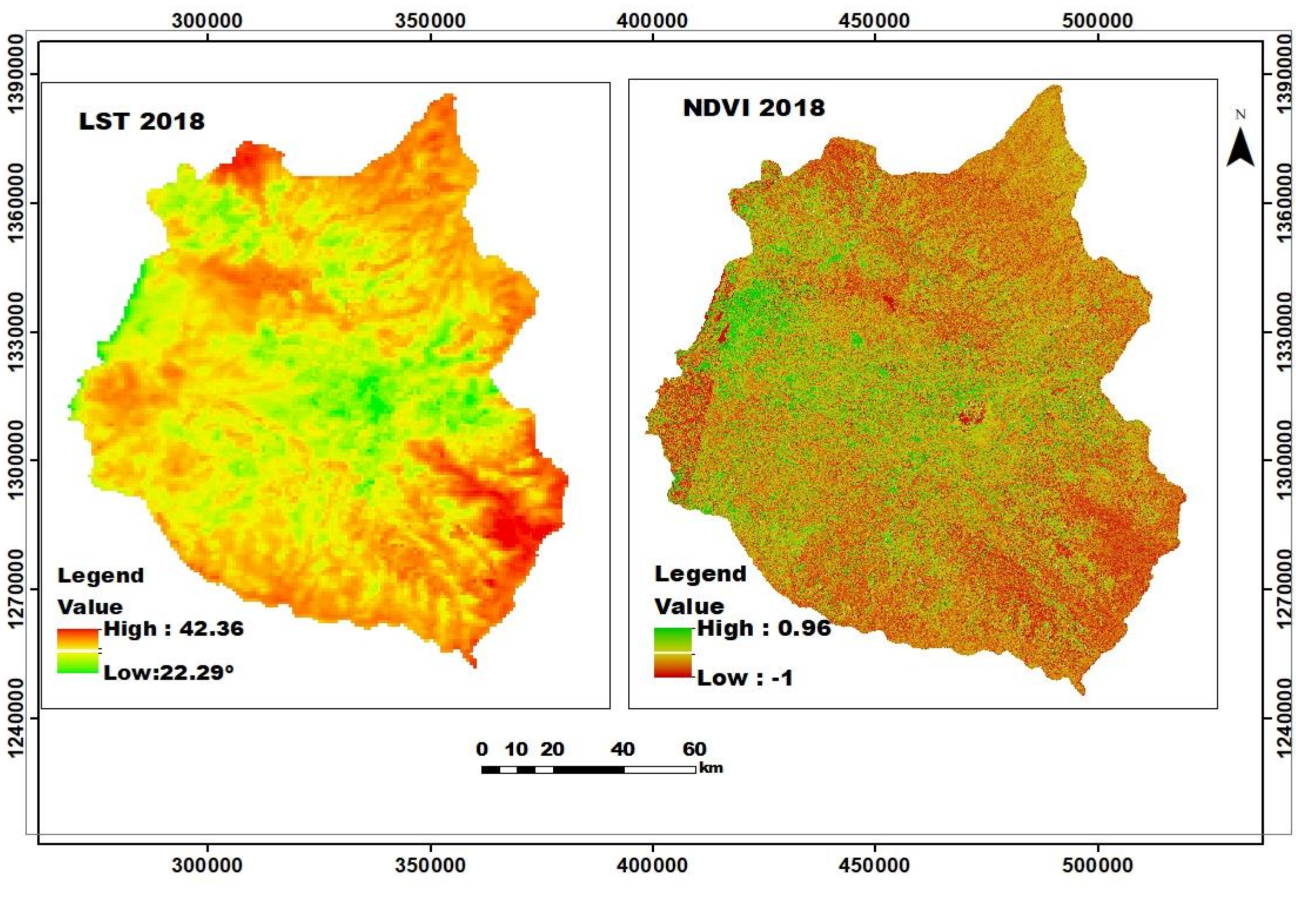


Figure 4.11**:** Normalized Difference Vegetation Index and Land Surface Temperature map of 2018.

4.10. The Influences of Vegetation Cover Change on Land Surface Temperature

Based on the result of Pearson Relationship result suggested that there was a negative relationship between mean NDVI of the dry season and vegetation cover with mean LST of the dry season within the study period. The coefficient of assurance (R2) of cruel NDVI with mean LST of the dry season and vegetation cover with cruel LST were 0.95 and 0.8, separately. The examination of this result appears that NDVI and vegetation cover (ha) features a negative effect on LST since areas with higher vegetation cover have appeared moderately lower LST than regions with lower vegetation cover (Figure 4.12).

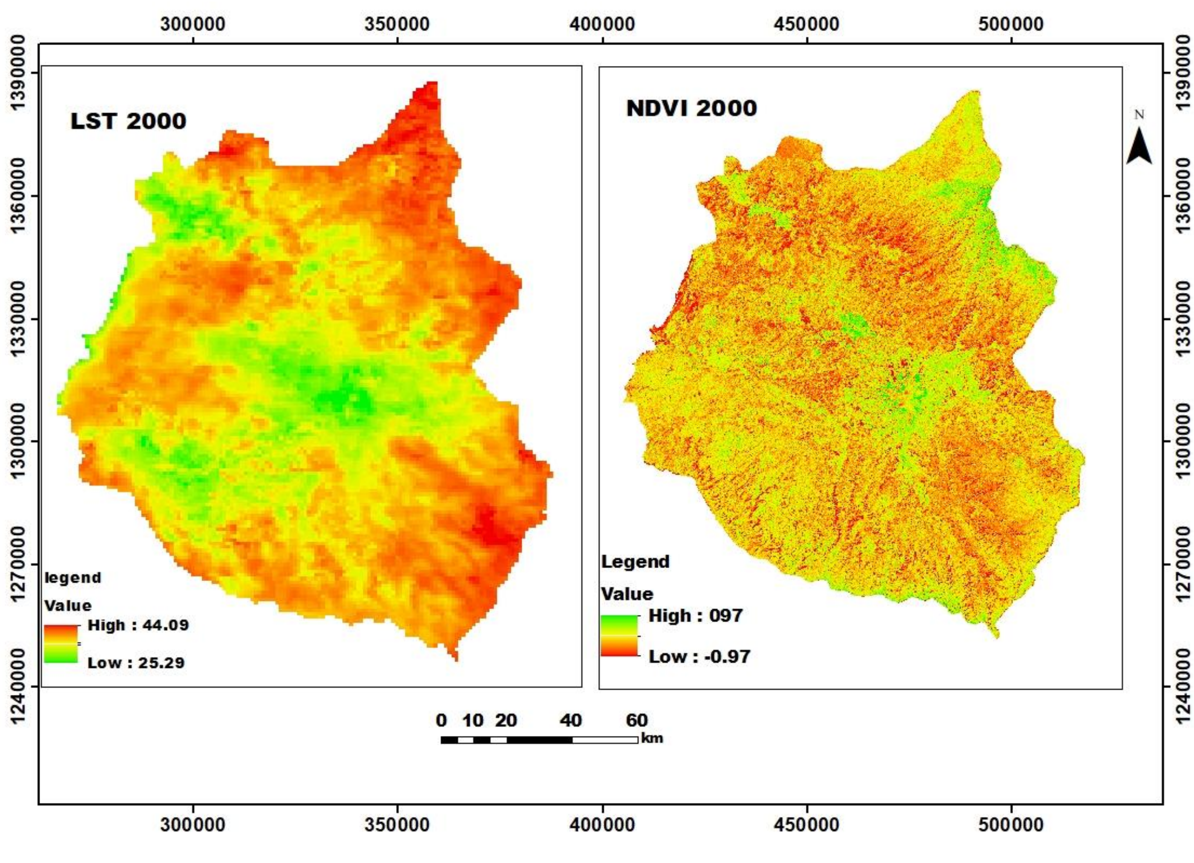


Figure 4.12: Land Surface Temperature and Normalized Difference Vegetation Index map of 2000.

The coefficient of assurance, R2, demonstrated that 80% of the changeability in LST is clarified by alter in vegetation cover within the central, North-eastern parts and northern parts of South Gondar zone over the study period of time. The LST of vegetated and non-vegetated areas for three years 2000, and 2018 are presented in Table 4.9

Table 4.9: *Zonal statistics of vegetated and non-vegetated areas with minimum, maximum and mean land surface temperature.*

	Year	2000	2018
Vegetation	Area (ha)	154424. 43	195231.59
	Max LST (°C)	42.63	41.04
	Min LST (°C)	22.32	20.46
	Mean LST (°C)	34.26	32.64
Non-vegetation	Area (ha)	1310017.4	1236500.19
	Max LST (°C)	46.39	44.5
	Min LST (°C)	24.41	21.45
	Mean LST (°C)	36.43	33.30

The output of Vegetation cover and LST inferred that vegetation cover was diminished over the study period when LST was expanded. Though vegetation cover increment when LST diminish the most extreme LST esteem in vegetation of 42.63°C in 2000 but in non-vegetation 46.39°C the same ways The greatest LST value in vegetation of 41.04°C in 2018 but in non-vegetation 44.5°C in 2018.

Table 4.10: Zonal statistics of vegetation cover with minimum, maximum and mean lands face temperature.

	Year	2000	2018
Vegetation	Area (ha)	154424. 43	195231.59
	Mean LST (°C)	34.26	32.64
	Max LST (°C)	42.63	41.04
	Min LST (°C)	22.32	20.46

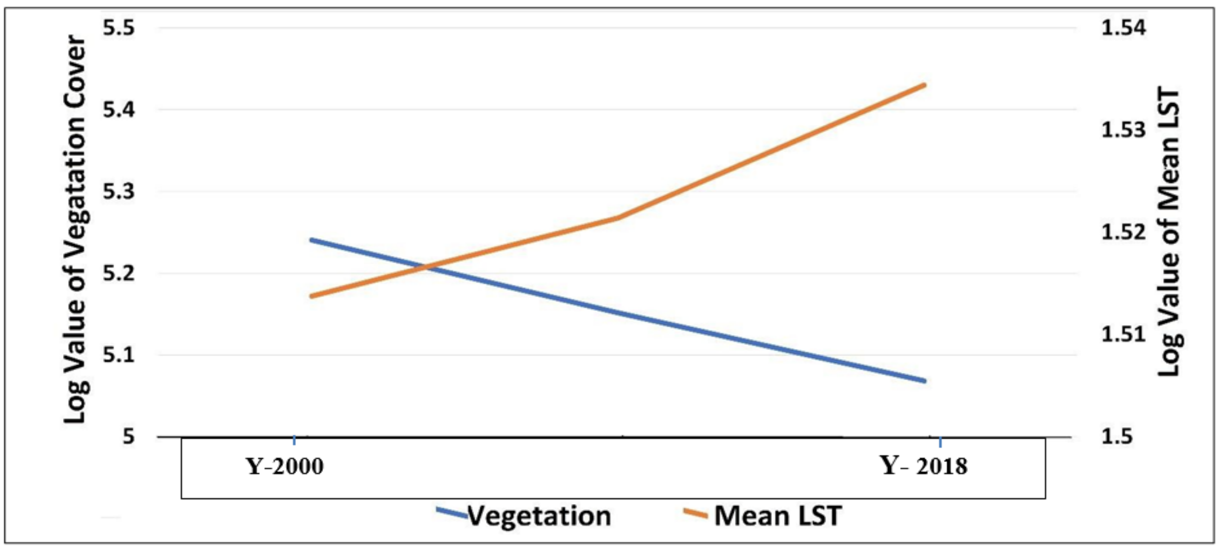


Figure 4.13: *Log value of vegetation cover with log value of mean land Surface temperature.*

The above figure shows that (Figure 4.13) the relation of LST and vegetation when vegetation increase LST will decrease. The maximum and the mean LST was expanded over the study period of time. The mean LST was 32.64°C and 33.30°C on the area of vegetation cover (195231.59 ha) and non vegetation cover (1236500.19 ha) within the year 2018.The mean LST of vegetation cover was come to 34.26°C in 2000. The result of the study appears that the vegetation cover and LST have negative relationship of each other over the study period of time. The vegetation cover diminished by 40807.16 ha in 2018 from 2000 whereas the cruel and the most extreme LST expanded by 1.62. °C and 1.59°C in this in 2000 year individually. The non-vegetated region expanded by 40807.16. The cruel LST and the maximum LST of non-vegetation cover moreover expanded by 3.14°C and 1.89°C in 2000 since the vegetation cover within the year 2000 was lower than the vegetation cover in 20018. From the examination of this result mean, greatest and minimum LST expanded with diminished vegetation cover during the ponder period of time in other way vegetation cover and LST have negative relationship.

CHAPTER FIVE

5. DISCUSSION

In this study, NDVI plan was utilized to evaluate vegetation cover alter from 1985 to 2018 in South Gondar zone.

The value of NDVI was calculated for Landsat images of 1985, 2000 and 2018 to assess the degree of vegetation cover alter over time and to dissect the impacts of vegetation cover alter on LST in South Gondar zone. Based on the examination of NDVI threshold comes about, vegetation cover has been observed in central-eastern, and south-eastern of South Gondar zone. The investigation of NDVI edge value result appears that the vegetation cover was tall in 1985 which accounts 15.6% of the study range. The vegetation cover has been diminished to 12.5% in 2000 from 1985. Almost 13.3% and 15.6% of the study range was secured by vegetation within the year 2000 and 2018, individually. A add up to of 3.1% vegetation has been lost within the past 33 a long time in south Gondar zone. This infers that vegetation cover has diminished through time. It is decreased by the reason of increase of population growth and agrarian action. Comparable comes about were found within the study of Solomon (2016). His findings reported that the major calculate for the depletion of vegetation in Ethiopia is due to high deforestation rate which is greater than the rate of afforestation and it is evident that as the population increases in a specific area there ought to have extra land for agriculture and settlement purposes too increases. This can be only possible to meet by cutting vegetation in general and natural forests in particular. Nurhussen (2016) also reported that due to increasing population growth rates, there have been increasing rates of conversion of forest and woodlands to other land uses in line with the present study.

The comes about of LST examination have appeared that the dry season minimum, maximum and mean LST have an expanding trend for the periods of 2000-2018 in spite of the fact that it isn't factually critical. Based this study, the least, mean and maximum LST extended in 20.45°C -22.29°C, 39.45°C -41.35°C and 41.35ºC-42°C separately within the study period of 2018 to 2000 within the study range. Then, there was LST alter within the range. Comparative result is reported in Belay and Getaneh (2017). Concurring to their study, seasonal and annual temperature is variable in Ethiopia. Their study reported that though there was no significant trend of temperature, the increased trend of temperature is observed in their study area Ethiopia.

Land surface temperature (LST), the temperature of the Earth's skin, plays an important role in heat and energy exchange between land surfaces and the atmosphere (Kerr, 2004). Knowledge of LST is a cornerstone of others earth system science (Song L. a., 2018). As the examination of Pearson Relationship result, in this think about, NDVI was negatively correlate with LST. Within the same way, vegetation cover was adversely connected with LST over the central, northern and south-eastern of the study range with significant level of 0.05, coefficient of determination 0.8, p-value 0.29 and relationship coefficient -0.89. The coefficient of determination R2 indicated that 80% of LST change is caused by vegetation cover change in the area which implies that vegetation cover has a negative impact on LST.

Like results are reported in Chaithanya et al. (2017) where areas with high vegetation cover had low LST. Based on the study, vegetation cover and LST are negatively correlate and their study reported that vegetation cover can reduce LST in the area. The result of the present study also in agreement with the study made by Rasul and Ibrahim (2017) and Rehman et al. (2015) where their discoveries uncovered that vegetation cover has negative affect on LST. Based on This study, vegetation cover was tall within the year 2000. The least, maximum and mean LST were generally lower in 2000 than 2018. In any case, vegetation cover has been diminished within the year 2018 whereas LST was expanded which implies that expanding vegetation cover can decrease LST within the study range. Generally, vegetation cover and land surface temperature negative relationships in this study.

CHAPTER SIX

6 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Based on the NDVI value of threshold results, vegetation cover has been watched within the central, northern and south-eastern parts of the ponder range. The investigation of edge result shown that vegetation cover was covered range of 15.6% in 1985 and 12.3% in 2000 which appears that (3.1%) of vegetation cover was lost within the last 33 years in South Gondar zone. NDVI and LST map has moreover appeared that zones with high vegetation cover had compared with low LST within the study zone. (P-value=0.29, R2=0.80 and with alpha 0.05) between vegetation cover and LST. Indeed so, the relationship between vegetation cover and LST was negative. Then, the investigation of this result appeared that 80% of LST alter is since of vegetation cover alter within the central, northern and south-eastern parts of the study area. vegetation cover can decrease LST. Based on the zonal insights result, the discoveries of this deliberate concluded that mean LST was expanded with declined vegetation cover within the area. This rapt that vegetation cover has negative impact on land surface temperature (LST) in general as seen Figure 4.10 land surface temperature (LST) and vegetation cover have negative correlation. To conclude, from this study it had been recognized that the vegetation cover of South Gonder has been declined.

6.2 Recommendations

1. The vegetation cover was declined in south Gondar zone over the ponder period of time. At that point, the concerned body ought to have taken afforestation and ensure vegetation within the area.

2. The study area could be a huge range it has distinctive geology, and agro-ecology. By this reason this, the same LULC has diverse reflectance within the fawning picture. Subsequently, the analyst suggested that LULC should be worn out woreda level.

3. There is a need for planning of arrangements and techniques to secure the study area of vegetation assets. This requires well-organized teach to require responsibility for the preservation of vegetation assets at a woreda level. Additionally, all citizens of south Gonder who are occupied within the study zone in order to preserve and manage the remaining vegetation assets in economical fundament.

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Appendices

Appendix:1. Partial view of western High land areas of South Gondar zone

Figure 1.1 1: Broad-leafed vegetation in eastern high land around Gunna Mountains

Appendix: 2 Ground control points which were generated during Filled survey For Ground Truthing

points	X	Y	Land use/cover
201	380759	1288782	non vegetation
202	378251	1287984	non vegetation
203	378353	1288011	non vegetation
204	378254	1287963	non vegetation
205	378509	1288165	non vegetation
206	387498	1279069	non vegetation
207	394161	1280419	non vegetation
208	394050	1280499	non vegetation
209	393756	1280576	non vegetation
210	387829	1279336	non vegetation
211	390532	1275995	non vegetation
212	397613	1286090	non vegetation
213	397531	1288295	non vegetation
214	401016	1289453	non vegetation
215	396630	1283684	non vegetation
216	397680	1286380	non vegetation

217	397789	1289872	non vegetation
218	399896	1281131	non vegetation
219	415439	1283600	non vegetation
220	415010	1283886	non vegetation
221	417797	1282307	non vegetation
222	417487	1281319	non vegetation
223	417736	1282957	non vegetation
224	415727	1283204	non vegetation
225	412738	1279653	non vegetation
226	405272	1299354	non vegetation
227	405751	1279318	non vegetation
228	405567	1279498	non vegetation
229	402280	1271889	non vegetation
230	403455	1274630	non vegetation
231	402171	1271923	non vegetation
232	400793	1263126	non vegetation
233	401597	1268830	non vegetation
234	400451	1263358	non vegetation
235	400785	1263143	non vegetation
236	406973	1272864	non vegetation
237	406747	1272276	non vegetation
238	405526	1270058	non vegetation
239	406953	1272864	non vegetation

2	350761	1308714	vegetation
3	334774	1302887	vegetation
4	332068	1300027	vegetation
5	336607	1299631	vegetation
6	340951	1299691	vegetation
7	360767	1289255	vegetation
8	369972	1289664	vegetation
9	370845	1289324	vegetation
10	368698	1280268	vegetation
11	358036	1275753	vegetation
12	358491	1273836	vegetation
13	364986	1276691	vegetation
14	363709	1281566	vegetation
15	374420	1280734	vegetation
16	370395	1286064	vegetation
17	355996	1287497	vegetation
18	358233	1270093	vegetation
19	357454	1266687	vegetation
20	363147	1272275	vegetation
21	362143	1270883	vegetation
22	364111	1251127	vegetation

23	354914.2123	1261037.751	vegetation
24	363279	1256522	vegetation
25	371068	1275687	vegetation
26	370515	1273358	vegetation
27	368801	1267352	vegetation
28	367360	1267802	vegetation
29	359631	1282896	vegetation
30	346442	1282984	vegetation
31	340799	1293723	vegetation
32	350834	1287000	vegetation
33	346455	1282991	vegetation
34	346027	1294956	vegetation
35	344652.5844	1278878.825	vegetation
36	346481.434	1280028.398	vegetation
37	345309	1275256	vegetation
38	357621	1293870	vegetation
39	341880	1308454	vegetation
40	341943	1308456	vegetation
41	348108	1300515	vegetation
42	343338	1305489	vegetation
43	331809	1300587	vegetation
44	370041	1289801	vegetation
45	368667	1280268	vegetation
46	357871	1275743	vegetation
47	364172	1277898	vegetation
48	376609	1279968	vegetation
49	370883	1285766	vegetation
50	358201	1269943	vegetation
51	363741	1252622	vegetation
52	358623	1260373	vegetation
53	371197	1275956	vegetation
54	368599	1267688	vegetation
55	358460	1283460	vegetation
56	346507	1283164	vegetation
57	355839	1295359	vegetation
58	341183	1308204	vegetation
59	343340	1305507	vegetation
60	369922	1344237	vegetation
61	356768	1299516	vegetation
62	341060	1311569	vegetation
63	407061	1332200	vegetation
64	408722	1338953	vegetation
65	409141	1338816	vegetation

66	405914	1339674	vegetation
67	408819	1338737	vegetation
68	408726	1338953	vegetation
69	408394	1333894	vegetation
70	412093	1336591	vegetation
71	407326	1335344	vegetation
72	408908	1336709	vegetation
73	411257	1337599	vegetation
74	410871	1337060	vegetation
75	418626	1340605	vegetation
76	418421	1340714	vegetation
77	431387	1342584	vegetation
78	431371	1342539	vegetation
79	425660	1338414	vegetation
80	431387	1342584	vegetation
81	428572	1336180	vegetation
82	428566	1336166	vegetation
83	421682	1333260	vegetation
84	421964	1333078	vegetation
85	422064	1333205	vegetation
86	422138	1333218	vegetation
87	424799	1328811	vegetation
88	424409	1320614	vegetation
89	414800	1344215	vegetation

Appendix3. GPS points

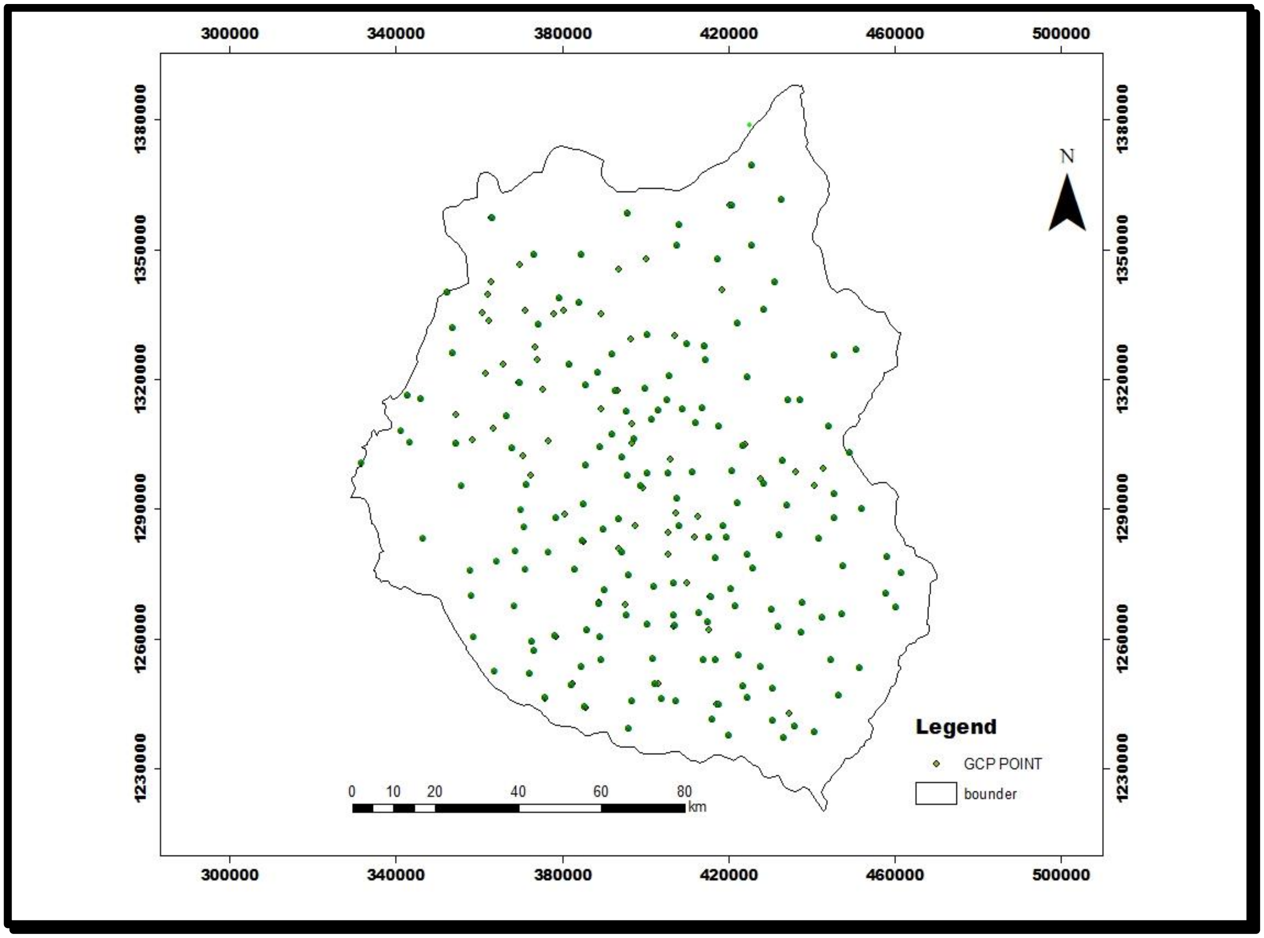

Figure 3.1: GPS points map.