بِسۡمِ ٱللَّهِ ٱلرَّحۡمَٰنِ ٱلرَّحِيمِ

Sudan University of Science and Technology

College of Graduate Studies

Application of Remote Sensing for Rangeland Resources Assessment in ElBaja area- White Nile State- Sudan.

تطبيقات الاشتعار عن بعد في تقييم الموارد الرعوية

منطقة الباجا – ولايه النيل الابيض -السودان

A dissertation submitted for partial fulfillment of the requirements for the Degree of M.Sc. in Rangeland Science

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Dedication

To my parents who

Always pray for my success,

And making me who Iam….

Sister, brothers and their family

For making every things wonderful

With great love and respect.

Safia

ACKNOWLIGMENT

First of all praise to God for giving me strength, patience and blessing, to complete this work, peace upon the prophet Mohammed, who helped and guided the mankind to path of education and research.

My sincere gratitude to my supervisor **Dr: Mahgoub Suliman Mohamedain** for her guidance, valuable suggestion, tolerance, generosity, encouragement and interest that have made this work possible.

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I would like to warmly thank all of my friends for friendship and creating a warm atmosphere throughout the time, I would like to thank all the people who contributed to this study.

Abstract

This study was conducted in ElBaja area in the White Nile state. The aim of study was to assess the current rangeland situation in El Baja area using ground survey, remote sensing and Geographic Information Systems techniques. The ground survey has been carried out to collect basic data about the rangeland resources and verifying the remote sensing data with the help of a handheld GPS. A transects of 100m length, quadrate size of 1×1 m and Parker loop (¾) were used to determine the vegetation attributes. Then a Landsat 8 satellite data for the same area has been downloaded, processed and classified. Moreover, an NDVI maps were also been produced from the satellite data. The result showed that rangeland ground cover was poor and dominated by *Schoenefoldia gracilis* with 50 plant/m^2 and high species composition in the area. From remotely-sensed data, for the same area the NDVI value of the grassland class showed a low value of 0.17. The study concluded that both ground survey and remote sensing data were useful in assessment of the rangeland status in the area. In addition to that, domination of the rangeland cover in the study area with *Schoenefoldia gracilis* species is an indicator for poor rangeland.

الملخص

أجريت الدراسة في منطقة الباجا بولاية النيل الأبيض. وكان الهدف من الدراسة تقييم الوضع الحالي للموارد الرعوية لمنطقة الباجا باستخدام تقنيات الحصر الأرضي وتقنيات الاستشعار عن بعد ونظم المعلومات الجغرافية. تم إجراء المسح الأرضي لجمع المعلومات الأساسية للموارد الرعوية بغرض التحقق من بيانات الإستشعار عن بعد وذلك بمساعدة جهاز الملاحة العالمي (GPS). أستخدم القاطع بطول (100) متر والإطار المربع (1×1) متر و حلقة باركر (¾ بوصة) لتحديد السمات النباتية تم تحميل صورة اللأقمار الصناعية، ومعالجتها وتصنيفها، كذلك تم إنتاج خريطة موشر الفرق للغطاء النباتي (NDVI). توصلت النتائج إلى أن التغطية الأرضية كانت قليلة في المراعي، ويسودها نبات ضنب الناقة *Schoenefoldia* "*gracils* "حيث كان أعلى كثافة وصلت إلى 50 نبات/م^2 وأعلى تركيب نوعي. سجلت دليل الفروق الخضرية لأراضي الحشائش أقلة نسبة حوالي 0.17. خلصت الدراسة إلى أن بيانات الحصر الأرضي والإستشعار عن بعد ذات فائدة في تقييم المراعي في منطقة الدراسة. بالإضافة إلى ذلك فإن سيادة نبات ضنب الناقة في غطاء المراعي يعتبر مؤشر لفقر المراعي.

List of Contents

List of Tables

List of Figures

Abbreviation:

RS: Remote sensing

GIS: Geographic Information system

GPS: Global positioning system

NDVI: Normalized difference vegetation index

NIR: Near infrared band

VI: Vegetation index

CHAPTER I

INTRODUCTION

1.1 Introduction:

Rangeland has been defined as grasses, and shrubs, dominates vegetation land that managed as a natural ecosystem. Rangelands also defined as a type of land resource, is characterized by non-forest, native vegetation (*NRCS*, 1997). Rangeland in Sudan occupies an area of 31.5 million hectares and provides about 70% of the total animal feed requirement for national rangelands (*El Wakeel*, 2013). Year-to-year variability of precipitation make rangelands unsuitable for crop production and livestock grazing presents as sustainable means of food and fiber production. Therefore, many rangeland managers want to some cost-effective method for assessment such as remote sensing that helps in classifying vegetation area based on the successional status of the species present, rather than general land cover classification. A rangeland resource requires many techniques of measurements and sampling used in range inventory and monitoring programs to determine the proper use of range resources. Because the inventory and monitoring are essential features of a range management process and plan, they could be as detailed as necessary to meet the objectives of the plan. Remote sensing, along with Geographic Information Systems (GIS), can provide a fresh approach to, development, and management of rangelands throughout the world, and has been recommended for at least 30 years as tool for rangeland resources development and management on a worldwide basis (*Tueller* 1982). The study area lays approximately between at 14º 19' 04" North, 032̊ 01’ 45"east. The climate of the area is tropical semi-arid desert ecological zones, the annual of low rains (150-300 mm annually). In addition, high temperature (38 c maximum average and 16-23 minimum average), El baja area in White Nile State represents large grazing area and lay within fragile environment and facing frequent drought period seasonal bush fires, change in species composition, expanding cultivation and overgrazing. The objective of study area was to assess of the current rangeland situation in El baja area using ground survey, remote sensing and GIS techniques for the year 2019.

1.2 Problem statement:

Rangeland resources are very important for livestock and human in the arid and semi-arid area, it provide significant environmental and agricultural services to people, such as clean water, wildlife habitat, recreational use and livestock grazing. El baja area in White Nile State represents large grazing area and lay within fragile environment and facing frequent drought period seasonal bush fires, change in species composition, increasing pressure on the range resource especially around water points, expanding cultivation, water scarcity, and overgrazing. Therefore, there is a need to assess the rangeland of the area using cost- effective techniques such as remote sensing.

1.3Objectives:

1.3.1 General objective:

To assess the current rangeland situation in Elbaja area using ground survey, remote sensing and GIS techniques for the year2019.

1.3.2 Specific objectives:

1. To assess situation in Elbaja area using remote sensing, ground survey and GIS techniques.
2. To provide data and guideline for assessment of the rangeland resources.

1.4 Research quotations:

1. What is the status of the current rangeland situation in Elbaja area?
2. Is the remote sensing and GIS techniques are good tools for rangeland assessment?

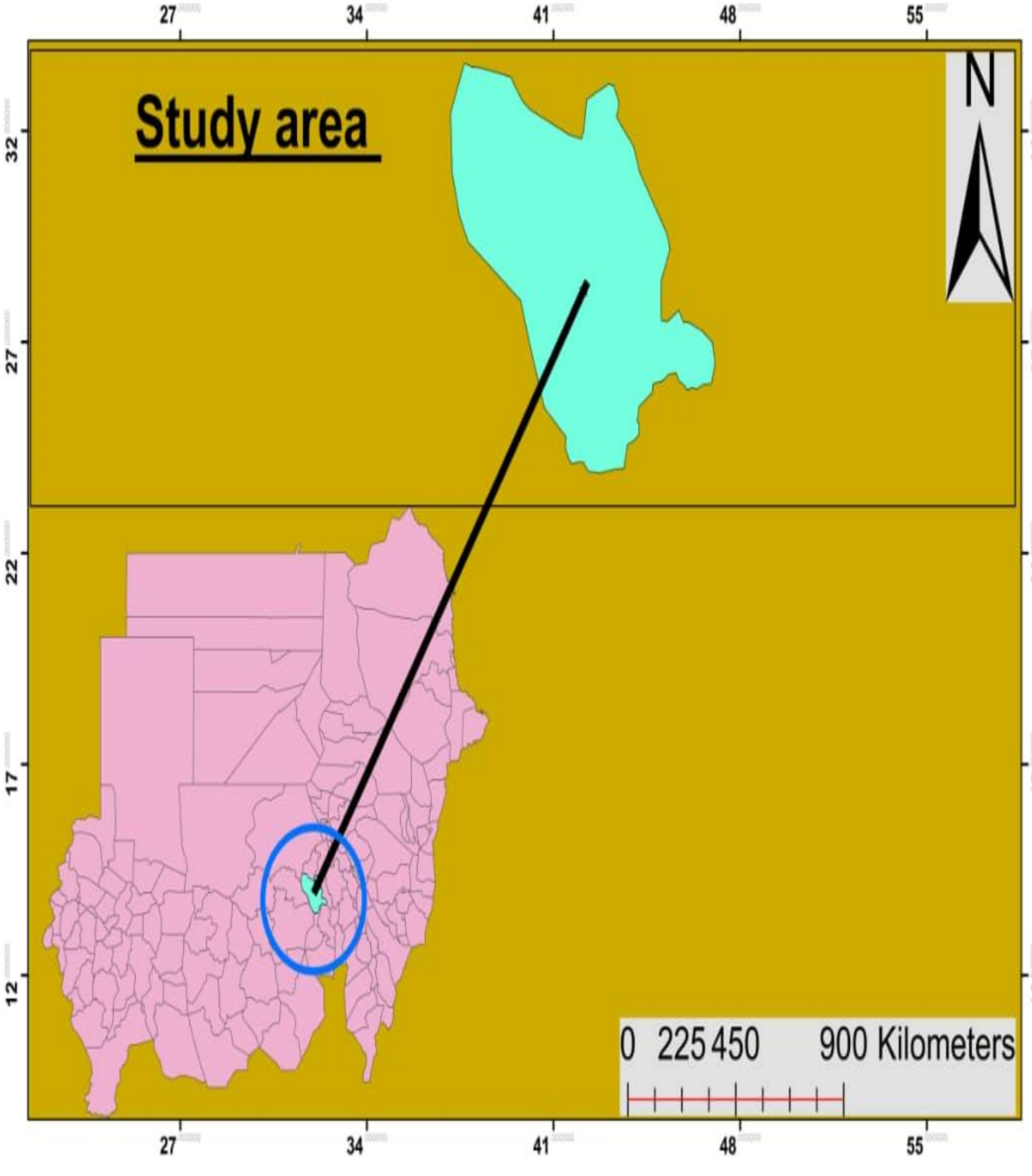

Figure (1.1) Study area, White Nile state.

CHAPTER II
LITERATURE REVIEW

2.1 Rangeland:

Rangeland covered vast areas of the globe and is considered a major source of feed for livestock and wildlife habitat. The rangeland plays a vital role in providing human with the goods and services, (*Holechek et al*; 2010).it considers are renewable natural resources multiple products according to their energy, therefor most be exploited by this energy to maintain them and sustain for future generations. To achieve this situation we need a sound management plan adopts the principle of sustainability and integration of natural resources in the manner, preserve and protect it for the different degradation causes. In Sudan, rangeland provides about 70%of the total animal feed requirement for national herd, (*El Wakeel,* 2013).

Range is normally considered any natural vegetation in low rainfall areas grazed by domestic livestock *(ICA*, 1959). Range is also defined as uncultivated grassland, or forested land with an herbaceous and shrubby understory, particularly those areas producing forage for grazing or browsing by domestic and wild animal (*Vallentine and Sims;* 1980).

2.2 Range management:

Range management is the science and art of optimizing the return from rangeland, and suitable to society through the manipulation of range ecosystem, Range management is at once a biological, physical and social science. It is biological because it deals with the response of the animals which harvest crop, physical because climatic, topographic and hydrological factor determine the kind and degree of use that can be made of the range and social because, the need of society determines the uses to which range resources (*Stoddart, et al* 1975).

Range management as the multiple of the rangeland component to obtain optimum combination of goods and services on sustained basis .Range management it provides for multiple-use of rangeland resource on sustained yield basis without degradation on the resources base, without diminution of the capacity of the rangeland ecosystem to reproduce itself on a sustained yield basis when resources are extracted from the ecosystem (*Tueller*, 1991).

2.3 Importance of rangeland:

Range resources include both tangible and intangible products such as grazing forage, wildlife habitat, water, natural beauty recreational opportunities and some areas for the ecological study of natural systems. Rangeland throughout the world produces a variety of importance natural resources. In addition to that, rangeland provide open space, wood fuels and numerous other products (*Tueller*, 1991).the use of rangeland is generally mixture with the use of other types of grazing lands and most range livestock and many big game animals use multiple sources of grazing capacity to meet their annual requirements(*Vallentine,* 1990).

2.4 Range assessment and evaluation:

Range inventory is systematic evaluation and analysis of all factors (vegetation, climate, soil, etc.) relating to the use of range that proceeding drafting a plant to manage resource effectively. In addition, range inventory can be defined as the estimation evaluation of the amount and the forage value of the vegetation present on the rangeland the basis according to which, the best use of forage can be determined (*Darag and Suliman,* 1988).

2.5 Vegetation Sampling Techniques:

For most filed measurements, one has to take a certain number of samples for parameter under measurement. Economically it is not feasible to measure or count 100% of the population. Random sampling with quadrats for perhaps only 1%of the overall area can give a close estimates. Transect is the line along which observations are made in systematic fashion, a line transect is not in which plants are recorded where they touch the tope. Often line transect is combined with quadrats run along its side, cover is measured along the line and density or frequency is noted in quadrat. The quadrat is an area of any shape that can be determined in vegetation so that cover can be estimated and observed, plant or species listed (*Darag and Suliman*, 1988).

2.5.1 Vegetation composition:

Species composition refers to the contribution of each plant species to the vegetation; it is generally expressed as percentage, (*Abdelsalam et al*, 2012). Vegetation composition is the proportion of various plant species in relation to the total plant species of a given area (*Christopher et al,* 2007, *cited by Abdelsalam*, 2013). According to Muir and McClaran, (1997) species composition is calculated by expressing the contribution of each species relative to the value determined for the entire site.

2.5.2 Density:

Density is a number of individual plants per unit area expressed as (plant/unit), (*Abdelsalam et al*, 2012). Density can be determined by counting the number of plants in quadrates, but quadrate size is critical. Density can give valuable indicators in an inventory and monitoring program to determine range condition and range trend because it remains quite steady from year to year, (*Abdelsalam et al*, 2016). Plant density information should be used to develop a natural rangeland management plan.

2.5.3 Vegetation covers:

Vegetation cover is the total area covered by the live plants, usually expressed by percentage, (*Abdelsalam et al,* 2016). Evaluating vegetation cover is an important factor in maintaining the sustainability of rangeland biotic resources, (*Robert*, 2007). Foliar cover: Area of ground surface covered by the aerial portions of the plants. Small openings in the canopy are excluded. Canopy cover: Area of ground surface covered by the outermost perimeter of the plant foliage's natural spread, (*Christopher et al*, 2007). Basal cover: The percent of the ground (soil surface) that is covered by plant bases, (*Riginos and Herrick*, 2010). Ground cover is the percentage of material, other than bare ground, that protects the soil surface from being hit directly by a raindrop, (*Edward*, 2001).

2.5.4 Methods to determine cover:

Much effort and imagination have been devoted to developing methods to estimate cover, reflecting its long tradition as an important attribute for rangeland inventory or monitoring purposes. The following techniques are the standard methods of determining cover:

- **Point Sampling:**

Point sampling is one of the most common approaches to estimate cover of a site, since being conceived by New Zealand pasture scientists, Levy and Madden, in the 1920's. It is based on placing a number of points within an area, and determining the proportion of the points that hit vegetation. In this manner, total cover can be calculated as the percentage of hits, relative to the total number of points sampled. Cover of individual species can also be estimated by recording the plant species when intercepted by a point. Species composition is the contribution of hits for each species and is expressed as a percentage of the total number of points where vegetation was recorded as a hit. Ground cover, basal cover, canopy cover, and leaf area index can all be measured by point methods, depending on the ground rules established to guide decisions regarding which species will be recorded when multiple hits are encountered if overlapping canopies are vertically intercepted (*Hofmann et al*,1990). There are three common point sampling methods used in rangeland inventory or monitoring to determine cover:

- -Point Frame Method.
- -Point Transect Method.
- -Step Point Method.

- **Line sampling:**

Another common approach to determine cover involves extending a line (usually a tape) across the site and recording the proportion intercepting plant material. In theory, line methods are a specialized form of point sampling to determine cover, where an infinitely large number of points are systematically arranged in a consecutive sequence (*Hasel,* 1941).

- **Sampling in quadrats:**

Although other approaches are generally preferred, varieties of methods are available to determine cover quadrats. Depending on the technique, measurements can be made for ground cover, basal cover or canopy cover. Species cover and species composition can also be estimated with most methods **(***Malmsten, et, al.* 1930**)**..The general sampling principles involving sample unit shape, sample unit size, and sample size apply to these techniques, and need not be discussed with further. Because each quadrat represents a only a very small area of the site, sample variance is generally high, many quadrats must be taken to obtain a sample size that adequately represents the site (*Smith,* 1944).

- **Plot less sampling:**

Cover estimated by plot less methods has the advantage of integrating large areas within a single sampling point. Early range assessments relied on the ocular reconnaissance method to estimate cover, where observers traversed the site before subjectively assigning a cover value. This technique generally provided consistent results when practiced by experienced observers, and large areas were surveyed in one day; but extensive training is required and personal bias is difficult to quantify (*Bonham,* 1989).

2.5.5 Frequency:

Frequency, which is merely the presence or absence of the species in the plot, is one of the easiest characteristics to measure. Plants are recorded as present if any above ground part of the plant is rooted within the quadrate or under the frame, (*Ian et al*, 2001).

2.6 Remote sensing:

Remote sensing data represent the best information for monitoring vegetation and mapping of land degradation and it has significant promise for development of more dependable and economically feasible measures of vegetation production over large areas. Consequently, it assumes an essential part in rangeland monitoring and assessment, which are often difficult to access, and cost of ground monitoring is expense. *(Reeves et al* 2001) stated that using MOIDS data, it will be to characterize rangeland vegetation estimate herbage monitor the rates and trends of change in primary production. Reliable, objective frequent productivity estimates will be accessible for even the most difficult to each reach rangelands. This study was designed to investigate the use of remote sensing data that could help to secure information and data, which are more efficient and effective to assessment rangeland resources.

Remote sensing refers to the activities of recording/observing/perceiving (sensing) objects or events at far away (remote) places. In remote sensing, the sensors are not in direct contact with the objects or events being observed. The information needs a physical carrier to travel from the objects/events to the sensors through an intervening medium. The electromagnetic radiation is normally used as an information carrier in remote sensing. The output of a remote sensing system is usually an image representing the scene being observed. The remote sensing process involves two stages: data collected and data analysis. Data collected is accomplished with remote sensing devices that record data on digital data. The resulting data provide a view of a portion of the Earth's surface. However, require analysis and interpretation in order to provide meaningful information. This can involve either visual interpretation, which has been the predominant mode of digital analysis, which has been widely used in processing satellite imagery. Remote sensing remains both art and science because there is often on obvious, will documented choice of data collection devices or analysis and interpretation techniques that suited to particular applied problem, In addition The study used Multi-temporal Landsat 8 satellite for the dates, 3 December 2019 Imagery has been downloaded from the website, After basic image, processing techniques have been applied to interpret the imagery and estimate the biomass production and land cover of the study area.

2.6.1 Types of remote sensing systems:

Here are two main types of remote sensing systems: passive remote sensing and active remote sensing. Passive sensors detect natural radiation that is emitted or reflected by the object or surrounding areas. Reflected sunlight is the most common source of radiation measured by passive sensors. Examples of passive remote sensors include film photography, infrared, charge-coupled devices, and radiometers. Active collection, on the other hand, emits energy in order to scan objects and areas whereupon a sensor then detects and measures the radiation that is reflected or back scattered from the target. RADAR and Lid AR are examples of active remote sensing where the time delay between emission and return is measured, establishing the location, speed and direction of an object.

Remote sensing makes it possible to collect data on dangerous or inaccessible areas. Remote sensing applications include monitoring deforestation in areas such as the Amazon Basin, glacial features in Arctic and Antarctic regions, and depth sounding of coastal and ocean depths. Military collection during the Cold War made use of stand-off collection of data about dangerous border areas. Orbital platforms collect and transmit data from different parts of the electromagnetic spectrum, which (in conjunction with larger scale aerial or ground-based sensing and analysis) provides researchers with enough information to monitor trends such as El Niño and other natural long and short term phenomena. Other uses include different areas of the earth sciences such as natural resource management, agricultural fields such as land usage and conservation, and national security and overhead, ground-based and stand-off collection on border areas. The quality of remote sensing data depends on its spatial, spectral, radiometric and temporal resolutions *(http://www.ngelfire.com/co/pallav/satsensor.html*).

2.6.2 Application of remote sensing in rangeland:

Remote sensing has been used in range measurement primarily as a tool to map various rangeland ecosystems or plan communities, Effort have focused on using both photo interpretation and image processing analysis and interpretation techniques that are best suited to a particular applied problem.

2.6.3 Importance of remote sensing in natural resource management:

Range scientists have always been concerned about forage production. Multiple methods have been developed over years to determine forage production. The primary concern has been to determine carrying capacity and proper stocking for given unit of rangeland for a grazing season. Traditional methods have often been time consuming and filed sampling plots have not always been successful in terms of accurately measuring the amount of forage produced over large areas of rangeland. The application of remote sensing techniques is useful in measuring forage production, standing crop and forage removal by grazing and browsing animals. Remote sensing as a tool to classify and map vegetation and other features on a landscape, the remote determination of production and utilization is essentially a classification process.

2.6.3 Spatial distribution:

A spatial distribution is the arrangement of a phenomenon across the Earth's surface and a graphical display of such an arrangement is an important tool in geographical and environmental statistics. Graphical display of spatial distribution may summarize raw data directly or may reflect the outcome of a more sophisticated data analysis. Many different aspects of a phenomenon can be shown in a single graphical display by using a suitable choice of different colors to represent differences**. (***Dessaint, et, al***.** 1991**).**

2.6.4 Satellite:

In the context of spaceflight, a satellite is an object that has been intentionally placed into orbit these objects are called artificial satellites to distinguish them from natural satellite such as Earth's Moon, there are many satellite with the different type and characteristics are available, producing input that some of them may be obtained . Free while other can be expensive with characteristics that may suit range assessment required among these satellites that are mostly used.

2.6.5 Vegetation index:

A vegetation index is a spectral transformation of two or more bands designed to enhance the contribution of vegetation properties and allow reliable spatial and temporal inter-comparisons of terrestrial photosynthetic activity and canopy structural variations.

2.6.6 Normalized difference vegetation index:

Normalized difference vegetation index is a simple graphical indicator that can be used to analyze remote sensing measurements, often from a space platform, assessing while there or not being observed contains live green vegetation.

2.6.7 Geographic information system:

A geographic information system is a computer-based tool for mapping and analysing spatial data. GIS technology integrates common database operations such As query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies. GIS is considered to be one of the most important new technologies, with the potential to revolutionize many aspects of society through increased ability to make decisions and solve problems .

2.7Global positioning system:

2.7.1 GPS navigator

A GPS navigation device is any device that receives Global Positioning System signals for the purpose of determining the device's current location on Earth. GPS devices provide latitude and longitude information, and some may also calculate altitude, although this is not considered sufficiently accurate or continuously available enough (due to the possibility of signal blockage and other factors) to rely on exclusively to pilot aircraft. GPS devices are used in military, aviation, marine and consumer product applications.

GPS devices may also have additional capabilities such as:

1. Maps, including streets maps, displayed in human readable format via text or in a graphical format.
2. Turn-by-turn navigation directions to a human in charge of a vehicle or vessel via text or speech.
3. Directions fed directly to an autonomous vehicle such as a robotic probe.
4. Traffic congestion maps (depicting either historical or real time data) and suggested alternative directions.
5. Information on nearby amenities such as restaurants, fuelling stations, tourist attractions.

2.8. Principals of remote sensing:

2.8.1 Energy source:

Remote Sensors can be divided into two broad groups-passive and active. Passive sensors measure ambient levels of existing sources of energy, while active ones provide their own source of energy. The majority of remote sensing is done with passive sensors, for which the sun is the major energy source.

2.8.2 Characteristic of image:

The characteristics of imaging Remote sensing instruments operating in the visible and infrared spectral region can be summarized in terms of their spectral spatial and radiometric resolutions (*Ridley*, 1984)

2.8.3 Image processing:

Image processing and analysis techniques have been developed to aid the interpretation of remote sensing images to extract as much information as possible from the images.

2.8.4 Image enhancement:

Image enhancement is concerned with the modification of images to make them more suited to the capabilities of human. Regardless of the extent of digital intervention, visual analysis invariably plays a very strong in all aspects of remote sensing, (*Silver*, 2000).

2.9 Image classification:

Image classification refers to the computer-assisted interpretation of remotely sensed images. There are two general approaches to image classification: supervised and unsupervised classification. (*Eastman,et.al* 2001).

2.9.1 Unsupervised classifications:

In contrast to supervised classification where we tell the system about the character of the information classes are looking for, unsupervised classification requires no advance information about the classes of interest, it examines the data and breaks it into the most prevalent natural groupings. The analyst then identifies these clusters as land cover classes through a combination of familiarity with the region and ground truth visits. (*Mohamedain*, 2009)

CHAPTER III

MATERIALS AND METHODS

3.1 The Study Area:

3.1.1 Location:

This study was conducted in *Elbaja* area in the White Nile state, and it extend between Located at 14° 04'19" North and longitudes 032° 01'45"east.

3.1.2. Climate:

Most of El baja area lies within the sime-arid which is characterized by a dry tropical climate where the average annual rainfall is less than 600mm. the rainy season in El baja starts in July, becomes dominant in August continues up to October. The temperature ranges between (38ºC TO 16ºC) as a minimum, (*Abdelsalam,* 2008).

3.1.3. Topography:

The topography of the west part of White is generally flat, with gentle sloping ground away from river. They are of study is almost flat and leveled except o few humps and depressions. The altitude is about 380 meter above sea level. The texture of the soil in the area range from commonly sands stretches to muddy.

3.1.4 Water sources:

Water sources in the area mainly from surface dug pools (Hafir), in addition to water collected in natural depressions (Ruhud). This water used for human and animal is consumption. The water normally finished early in the dry season and before the next rain season. (*Abdalla*, 2008).

3.1.5 Soil:

The soil of the area is mixture of sand and clay, but with more cloys toward the riverbank. Sandy soil is the dominant type in *Elbaja* and it exists in form elongated fixed sand dunes, the sandy soil is characterized by its high infiltration rate, clay and silt soil are excising.

3.1.6 Vegetation:

The study area it found different trees, shrubs and herds species exist in *Elbaja* area the most dominant, the vegetation cover relatively good. The village is surrounded form North and East by intensive cover of trees and shrubs dominated by Seyal (*Acacia tortilis*), Laout (*Acacia* *nubica*), (Sidr) *Ziziphus spp*, (Kittr) *Acacia melifera*, in addition to other trees such as (Hegleig) *Balanites aegyptiaca*, and (Talih) *Acacia seyal* (*Abdalla*, 2008). The ground cover in El baja area dominated by (Bano) *Eragrostis spp*, (Gow) *Aristida spp,* (Danab Elnaga) *Schoenefoldia gracils*, (*Abdelsalam*, 2008).

3.2 Study Concept:

The general concept of the study is to make comparison between measurement in rangeland assessment process and to inventory how they cloud achieve the required accuracy that satisfies range management objectives and decisions. Two methods were used in the study area; one of them the ground inventories and the other was remotely sensing data which were analyzed by using Erdas imagine 2014 programs. The study used Multi-temporal Landsat 8 satellite for the dates, 3 December 2019 Imagery has been downloaded from the website, Global Visualization Viewer (*http://glovis.usgs.gov*.) After basic image, processing techniques have been applied to interpret the imagery and estimate the land cover of the study area.

3.3 Sampling Procedure:

The measurement took place in El baja area located in White Nile state the sampling in vegetation attribute selected randomly by us GPS random sampling considered effect only if the population to be sampled is homogenous will use parker loop 3/4 was used to determine plant composition at the study area. At each one of the six transects, plant species, litter, and bare soil was recorded at every 1- meter interval. Data was recorded a specified sheet and computed the average of species composition, litter and bare soil by using formulas. The quadrate of $1m^2$ sizes was in this study, to determine the most common vegetation attributes.

3.4 Vegetation Survey:

Six transects each of 100m lengths were located in each site and the following measurements were taken each.

3.4.1 Vegetation Composition:

Species composition refers to the contribution of each plant species to the vegetation. Vegetation composition was measured along 100m tape, where plant species were recorded at each 3/4 inch loop hit. 100 observation were recorded in a sheet along each transect at 1m interval. The species composition of the area was recorded using line transect. Vegetation composition determined by using the following formula:

$$\text{Vegetation composition} = \frac{Total\ hits\ of\ each\ species}{Total\ hits\ of\ all\ species} \times 100\%$$

Forage composition percentage obtained by dividing total hits of desirable species along transect by the total of plant hits.

3.4.2 Ground cover:

Ground cover is the percentage of material, other than bare ground such as plant cover, litter and rocks. These components were measured using par loop and determine by using the following formulas:

$$\text{Percent of bare soil} = \frac{Total\ hits\ on\ bale\ soil}{100} \times 100\%$$

$$\text{Percent of plant litter} = \frac{Total\ hits\ in\ plant\ litter}{100} \times 100\%$$

$$\text{Plant cover} = \frac{Total\ hits\ of\ plant\ species}{total\ number\ of\ hits}\ X\ 100\%$$

3.4.3 Density:

Density is a number of individual plants per unit area expressed as (plant/unit. It will use determine by accounting all plant in quadrat.

3.4.4 Frequency:

Frequency is the percentage of total quadrat that contain at least on rooted individual of a given species. It will determine by recording the species names which appear in quadrates. (*Slings by and Cook*, 1986).

The frequency calculated by using the following formula:

$$\text{Frequency of the species} = \frac{number\ of\ accurrence\ of\ th\ bale\ soil}{100} \times 100\%$$

3.5 Remotely Sensed Data:

3.5.1 Image Acquisition:

The study used Multi-temporal Landsat 8 satellite for the dates, 3 December 2019 Image has been downloaded from the website, Global Visualization Viewer (*http://glovis.usgs.gov*.) After basic image, processing techniques have been applied to interpret the imagery and land cover of the study area.

3.5.2 Image Processing:

Image processing and analysis techniques have been de area eloped to aid the interpretation of remote sensing images to extract as much information as possible from the images.

3.5.2.1 Band combination:

The "Stack layers" algorithm of the ERDAS IMAGINE 9.1 software has been used to combine layer 4, 3 and 2. According to Landsat data characteristics typically band 4 represents the red, band 3 the green and band 2 the blue portion of the electromagnetic spectrum, range from white to green or brown color depending on moisture and organic matter content and the water looks dark blue to back in color.

Before Enhancment Aftar Enhancment

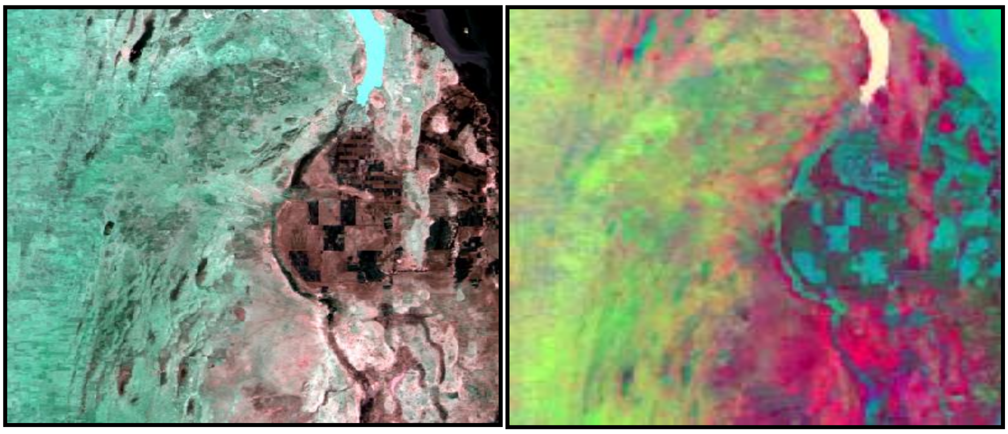

Figure (3.1) Image combination and enhancement

3.5.3 Image Enhancement:

The histogram equalization and brightness contrast have been used to enhance the images for visual interpreting .Figure (3.1).

3.5.4 Study Area Subset:

The study area has been defined using Global Positioning System, (GPS). The study area subsets were made using ERDAS IMAGINE function.

3.5.5 Image Classification:

Unsupervised classification was used for clustering the imagery in to their infinite classes. This type of classification is usually applied where there is less information in an area to be classified; in unsupervised classification, the computer program automatically groups the pixels in the image into separate depending on their spectral features.

3.5.6 Normalized Differences Vegetation Index (NDVI).

The Normalized Difference vegetation Index is measure of the amount and vigor of vegetation on the land surface and NDVI spatial composite images are developed to more easily distinguish green vegetation from bare soils.

indicating clouds and water, positive values near zero indicating bare soil, and higher positive values of NDVI range from sparse vegetation (0.1-0.5) to dense green vegetation (0.6 and above). Indirectly NDVI has been used to estimate the cumulative effective of rainfall on vegetation over a certain time, rangeland carrying capacity, crop yield for different crop types, and the quality of the environment as habitat for various animals, and diseases. (*Mohmedain*, et al, 2012).

Calculating the NDVI= = N – RED

$$NDVI = \frac{NIR - R}{NIR + R}$$

- NIR= Near- Infrared band.
- R= Red band.

The NDVI was used to estimate the ground cover and biomass productivity of the study area.

3.6 Data analysis:

The data collected from the field was analyzed for vegetation attributes data were organized tabulated and analyzed using standard range measurement equation and SAS.

And also has been input data and analyzed using of the study area subsets were made using ERDAS IMAGINE Inquire Curser function.

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Field Inventory

4.1.1 Ground Cover:

Cover provided by a combination of plants, Litter and bare soil. Ground cover is the most often used cover measurement to determine sites watershed stability. The results are obtained in Table (4.1) explained that high significant differences between the ground cover components (0.005). The percentages of litters, plant cover and bare soil were close to each other, which recorded 27.66, 26.17 and 25.33% respectively. While the other components of the ground covers recorded fewer percentages compered litters and bare soil. This result indicates that the open grazing system had a negative impact on vegetation cover and soil conservation the continuity of grazing may be lead to deterioration in the area as the result of overgrazing, this result was on line with (*Fashir* et al.2012) who found that open grazing system has affected plant growth and decreased soil stability. It was found that there is increase litter this result may be due to animal grazing behaviors, it can eat part of plant and leave the other parts which falling on the soil surface.

Table (4.1) Ground cover of the study area

Attributes	Percentage %
Bare Soil	25.33 a
Litters	27.66 a
Rocks	10.67 ab
Plant Cover	26.17 a
Animal Plates	1.17 b
Pr	0.005 **

** Means there are high significant differences.

Means with the same letter are not significant differences.

4.1.2 Vegetation Composition:

The vegetation composition is generally determine by the assessing the contribution of individual species in the given area. The data obtained through the parker loop in the different sites in table (4.2) shown *Schoenefoldia gracils* reached about (39.39%) of the total component of species follows by *Aristida spp* ,*Cenchrus ciliaris* and *Eragrostis spp* show similar percentage (18.18%) finally the *Panicum turgidum* reached about (6.06%). *Schoenefoldia gracils* consider the dominant plant species in this rangeland, more abundant and adapted in arid and semi-arid in area. (*Abdelsalam et al,* 2012) found that the *Schoenefoldia gracilis* had a good distribution in Kadugli rangeland, because it was found in all range sites. These results confirmed the good adaptation of this species in different soil types of Sudan rangelands.

Table (4.2). Vegetation composition (%):

Scientific name	Local name	Percentage %
Aristida spp	Gao	18.18
Schoenefoldia gracils	Danab Elnaga	39.39
Cenchrus ciliaris	Haskaneet	18.18
E*ragrostis spp*	Bano	18.18
Panicum turgidum	Tomam	6.06

4.1.3 Plant Density:

The density of an individual plant species was determined along 100 meters transect by quadrate 1m² sizes. In table (4.3) the result explains that the high density of species was *Schoenefoldia gracilis* (50 plant/m²). This result may lead to an idea of good distribution and more abundance of this species in the rangelands in the study area. This result agreed with Abdelsalam et al, (2016) who found that *Schoenefoldia gracilis* was a high species density at Kadugli range sites. It can be give here when rehabilitation of degraded rangeland, is needed to choose the species of *Schoenefoldia gracilis* as the best species for reseeding of the degraded rangeland.

Table (4.3) Plant density (plant/m²)

Scientific name	Local name	plant/m²
Eragrostis spp	Bano	9
Cenchrus ciliaris	Haskaneet	11
Schoenefoldia gracils	Danab Elnaga	50
Aristida spp	Gao	30

4-1-4 Plant Frequency:

Frequency is the percentage of total quadrates that contain at least one rooted individual of a given species in table (4.4) explained that *Schoenefoldia gracils* it found in all range sites about 50%. These results recommend that *Schoenefoldia gracils* as the best one for improvement activities in the area, because it can be consider as a key species and good indicator for the area. Plant Frequency alone may not be a sufficient basis for making land management decision because it is not directly related to more commonly applied vegetation attributes. But together with the plant density and vegetation composition can help the rangeland managers to make proper decisions up the rangeland toward the desired goals. (*Abdelsalam et al*. 2012)

Table (4.4) plant Frequency:

Scientific name	Local name	Percentage%
Aristida spp	Gao	21
Schoenefoldia gracils	Danab Elnaga	50
Cenchrus ciliaris	Haskaneet	9
Eragrostis spp	Bano	12
Dactyloctenium aegyptinm	Abu asabi	7

4.2 Remotely Sensing Survey:

4.2.1 Image Classification:

The study used Landsat 8 for the years 2019.Unsupervised classified was done of the imager, produce five classes named water, residential, forest, grassland and bare soil. The results are obtained in Table (4.5) explained that high significant differences the between ground cover components (0.005). The percentages of litters, plant cover and bare soil were close to each other, which recorded 28, 26 and 25 % respectively. While the other components of the ground covers recorded fewer percentages compered litters and bare soil. Rangeland resource requires many techniques of measurements and sampling used in range inventory and monitoring programs to determine the proper use of range resources. Because the inventory and monitoring are essential features of a range management process and plan, they could be as detailed as necessary to meet the objectives of the plan. Recently remote sensing with melti- temporal satellite data has become a strong tool for monitoring aspect such as vegetation cover, plant composition. Remote sensing data represent the best information for monitoring vegetation and mapping of land degradation and it has significant promise for development of more dependable and economically feasible measures of vegetation production over large areas. Consequently, it assumes an essential part in rangeland monitoring and assessment. , which are often difficult to access, and cost of ground monitoring is expense it will be to characterize rangeland vegetation estimate herbage monitor the rates and trends of change in primary production. Reliable, objective frequent productivity estimates will be accessible for even the most difficult to each reach rangelands this study was designed to investigate the use of remote sensing data that could help to secure information and data, which are more efficient and effective to assessment rangeland resources.

Table (4.5) The land cover class of 2019

Land cover class	Area/ha	percentage %
Water	5129.21	6.2
Residential	6626.93	7.9
Forest	11064.1	13.4
Grassland	26103.2	31.5
Bare soil	34164.3	41

4.2.2 Unsupervised Classification of 2019:

The unsupervised classification results of 2019 were shown in Figure, (4.1) there were clear differences between five categories in the land cover classes represent.

The image (4.1) showed that the bare soil was occupied the biggest area (41.1) as compared with the second area was Grassland was occupied (31.5), forest (13.4), residential (7.9) and water (6.2). The result showed a clear negative impact of open grazing on plant diversity, botanical composition and forage plant species, which will reflect negatively on range condition.

In this year the rangeland was degraded. The clear indicator of this situation is the percentage of bare soil about 41% of the land cover of the area. In this case was needed more management practices to improve the plant cover of the area, it need reseeding of indigenous plant species such as *Schoenefoldia gracils* In general the grassland decreased about 31%. This decreased in the vegetation cover could be attributed to human activities and climate factor in arid and semi-arid are which effect on the quality of the natural rangeland.

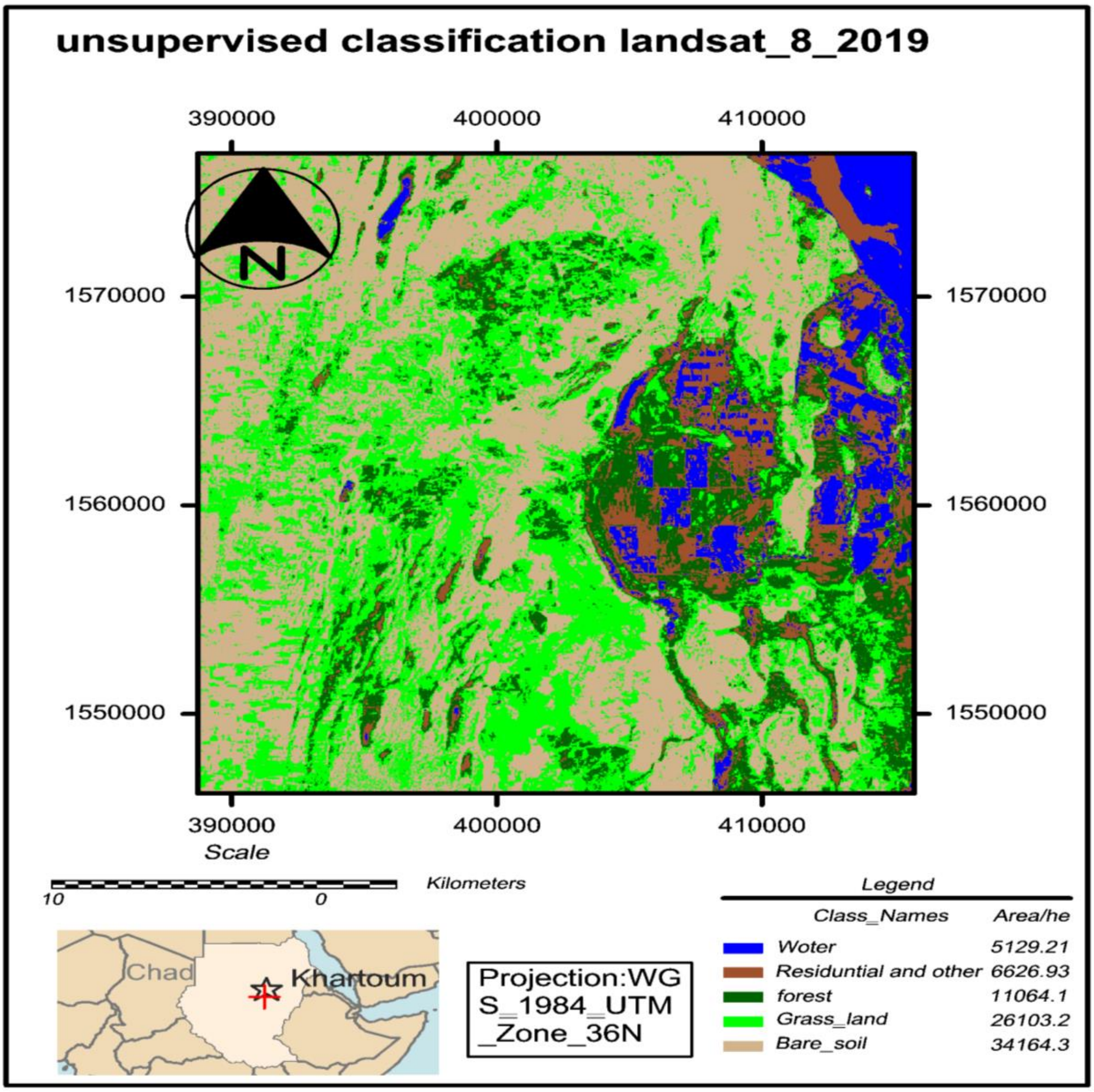

Figure (4.1) unsupervised clasification of the study area 2019

4.2.3 The Study Area NDVI 2019:

Normalized Differences Vegetation Index was used in this study because it was most widely used of all vegetation indices in vegetation monitoring (*Mohamed*, 2006 *and poromohammad and el* 2012). Used of all indices in vegetation monitoring The NDVI is sensitive to change in green leaf biomass and is required for vegetation maps. The result showed in figure (4.2) and table (4.6) the highest NDVI value was recovered water about 0.28 the second value bare soil 0.26, grassland about 0.17, forest 0.12, and finally residential 0.028.

Table (4.6) The NDVI 2019:

Rang site	NDVI value
Water	0.289078
Residential	0.028384
Forest	0.120583
Grassland	0.171367
Bare soil	0.266165

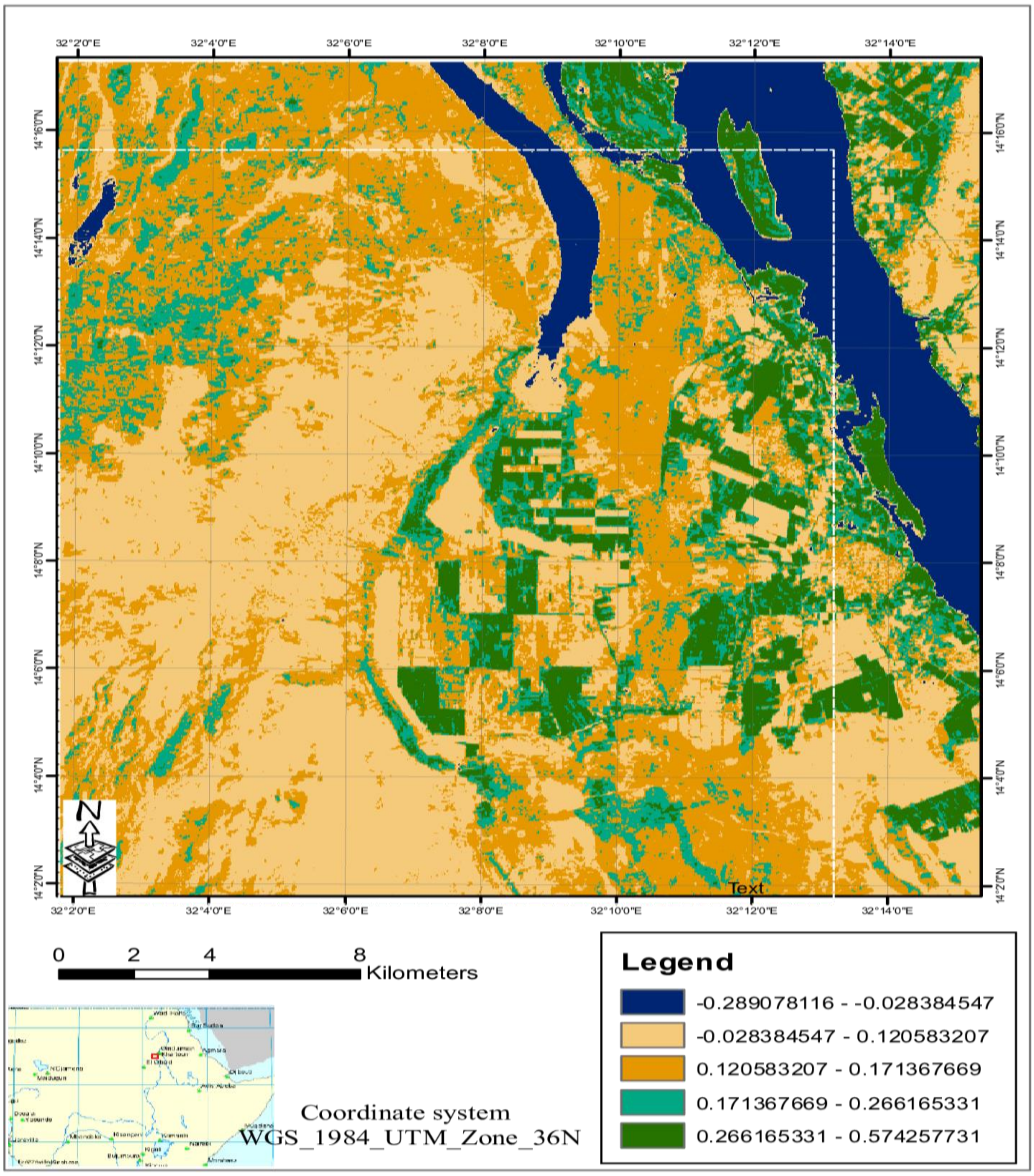

Figure (4.2) NDVI map of 2019

Chapter IIV

Conclusion and Recommendations

5-1 Conclusions:

The study conducted that the percentages of litters, plant cover and bare soil were close to each other, which recorded 28, 26 and 25. % respectively.

Schoenefoldia gracils consider the dominant plant species in this rangeland, more abundant and adapted in arid and semi-arid in area. This result recommend that *Schoenefoldia gracils* as the best one for improvement activities in the area. The NDVI value of the grassland was low, about 0.17. The study concluded that the low percent of these plants consider a strong indicator of the deterioration of this range site. This study recommended that to reseeding of indigenous plan. The study concluded that both ground survey and remote sensing data were useful in assessment of the rangeland status in the area. In addition to that, domination of the rangeland cover in the study area with *Schoenefoldia gracilis* species is an indicator for poor rangeland.

5-2 Recommendations:

The study recommends the following:

1. The use of remote sensing data and ground inventory methods in measurement and monitoring of rangeland resources.
2. *Schoenefoldia gracilis* (Danab Elnaga) can be considered a key species and can be used as best species for reseeding in all native grasslands.
3. Reseeding palatable plants and rehabilitates the degraded rangeland.

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Appendices

Appendix 1: Quadrate format for the ground survey

Sudan University of Science and Technology

College Of Graduate Studies

Quadrate Format

Data: ------------ Location: ---------------

Site No: ---------- Transect No: --------

Q NO	SPECIESE NAME	PLANT NO	Q NO	SPECIESE NAME	PLANT NO
1			1		
2			2		

Appendix 2: Loop format for the ground survey

Sudan University of Science and Technology

College Of Graduate Studies

Loop Format

Data: ---------   Location: ------------

Site No: ---------   Transect No: --------

Appendix 3: Anova table.

Table (4-7) Anova table.

Source	PF	anova ss	mean square	F value	Pr >F
Site	5	773.56	154.17	0.9	0.49
Cover	**5**	3698.22	739.69	4.42	0.005**

Pr >F=0.005 Means there are high significant difference

Appendix 4: GPS Coordinate System

GPS Coordinate System:

Point	N	E
1	14.01832	03217.304
2	1401972	03205027
3	1401972	032004998
4	1403644	03211097
5	1402019	03205046
6	1402163	03205096
7	1401797	03205519
8	1401752	03204651
9	1403170	0320652
10	1403473	03211251
11	1404595	03203509
12	1404368	03204869
13	1404532	03205563
14	1404612	03203362