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Assessment of the Vegetation Cover Change at Qala El-Nahal Locality - Gedaref State - Sudan

تقييم التغيرفي الغطاء النباتي بمحلية قلع النحل ـ ولاية القضارفـ السودان

A Thesis Submitted For Fulfillment of Requirement of a Degree of Doctorate of Philosophy (Ph. D) in Forestry

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Dedication

This is Dedicated to my Mother, Father, Sister’s, Brothers, Soul of my Husband and Forestry guard Elbahr in Qala El Nahal Locality.

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Abstract

This study was carried out at the South West of Qala El-Nahal Locality, Gedaref State where intensive, rapid horizontal expansions of mechanized rain-fed schemes of cash crops were practiced. The study aimed to assess the vegetation cover change at Qala El-Nahal Locality. The data were collected through remote sensing of satellite images for the years 1972, 1984 and 2018. The Point-Centered Quarter Method (PCQ) used for vegetation assessment. Also the soil samples were taken for soil texture, soil pH, Electrical conductivity and NPK. Also the questionnaire for social information was used. The collected data were analyzed by ERDAS Imagine 8.5 and ARC map 9.3, soil data were analyzed by ANOVA table for NPK and arithmetic mean for soil texture, pH, EC was adopted. The results showed; the vegetation cover in the study area was changed. The grasses changed from 81% in 1972 to 0.7% in 2018 and the forest land changed from12.9% in 1972 and disappeared in 2018. The study recommended that, to adopt reforestation programs to cover the deteriorated areas in Qala El-Nahal Locality.

المستخلص

أجريت هذه الدراسة في جنوب غرب محلية قلع النحل بولاية القضارف، حيث يمارس التوسع الافقي المكثف لمشاريع الزراعة الآلية المطرية للمحاصيل النقدية. هدفت الدراسة الى تقييم التغير في الغطاء النباتي لمحلية قلع النحل . تم جمع البيانات من خلال الأستشعار عن بعد لصور الاقمار الصناعية للأعوام 1972، 1984، 2018م. أستخدمت طريقة النقاط المركزية للمربعات لتقييم الغطاء النباتي. و ايضا أخذت عينات التربة لشكل وحموضة والتوصيل الكهربائي للتربة والمحتوى العضوي للتربة. وأيضا تم استخدام الإستبانة للمعلومات الإجتماعية. تم تحليل البيانات صور الاقمار الصناعية بواسطة ERDAS 8.5 and ARC map 9.3. تم تحليل المحتوى العضوي للتربة ANOVA table .وشكل وحموضة والتوصيل الكهربائي بواسطة الوسط الحسابي. أوضحت النتائج إن الغطاء النباتي قد تغير. الحشائش تغيرت من 81% في 1972 الى 0.7% في 2018، ارض الغابات تغيرت من 12.9% في 1972 وإختفت في 2018.

أوصت الدراسة بتبني برامج إستزراع الاشجار لتغطية المناطق المتدهورة بمحلية قلع النحل.

List of Abbreviations

ANOVA	Analysis of Variance
AOI	Area of interest
ASTR	Advanced Spaceborne Thermal Emission and Reflection Radiometer
DN’s	Digital numbers
DOS	Dark Object Subtraction
EC	Electrical Conductivity
CCTs	Computer-Computable Tapes
ERTS	Earth Resources Technology Satellite
EVI	Enhanced Vegetation Index
ESA	European Space Agency
GCP’s	Ground Control Points
GLCF	Global Land Cover Facility
LAI	Leaf Area Index
LDCM	Landsat Data Continuity Mission
MODIS	Moderate Resolution Imaging Spector-radiometer
MSS	Multi Spectral Scanner
NDVI	Normalized Difference Vegetation Index
OLI	Operational Land Imager
PAR	Photosynthetically Active Radiation
PCQ	Point Centered Quarter
TIRS	Thermal Infrared Sensor
RBV	Return Beam Vidicon
USGS	United States of Geological Survey
USDA	United States Department of Agriculture.
WGS	World Geological Survey

CHAPTER ONE
INTRODUCTION

1.1 Introduction

Land is an important source of all wealth and natural resources on which human activities are based. Land cover (LC) reflects the biophysical state of the earth's surface and immediate subsurface. It embraces various resources such as soil, vegetation, minerals etc., and (LC) studies dynamic in nature. (LC) play important roles for most trials which seek to understand the interactions and relationships between anthropogenic activities and the environment. The information of (LC) change and their configuration across spatial-temporal scales is indispensable for sustainable development (Turner, et al., 1990).

Vegetation is a general term given to plants. It is important because, it supports the critical functions in the biosphere, through regulating the flow of numerous biogeochemical cycles, influences the local and global energy balances. It also affects soil, including soil texture and structure which feedback to effect of the various vegetation characteristics. It serves as wildlife habitat and energy source for the vast array of animal species on the planet. Furthermore, it is the primary source of oxygen in the atmosphere, enabling the aerobic metabolism systems to evolve and persist. Generally, it plays vital role in maintaining environmental balance (Mohammed, 2012).

Climate induced variability in semi-arid vegetation is a matter of ecological interest and economical concern and the strong sensitivity to climate result in rapid land use change (Vanacker, et al., 2005) and vulnerability to human-induced degradation (Evans, et al., 2004). Climate is one of the most important factors affecting vegetation condition, for that evaluation of qualitative relationship between vegetation patterns and climate is an important object application of remote sensing at regional and global scales. The Normalized Difference Vegetation Index (NDVI) is established to highly correlate to green leaf density and can be viewed as a proxy for above ground biomass (Tucker, et al., 1986).

Vegetation is one of the most important parameters for human environmental assessment and monitoring due to their specific role in geo-sphere, biosphere and atmosphere interactions and plays an important role in global climate change. Consequences changes in vegetation amount result in long term changes in global and local climate, because the vegetation has special characteristic due to its distinct annual and seasonal changes so it's a sensitive indictor on the study of global and local environment change caused by climate or human activities.

It is observed that, the human influences upon the nature are tremendous, and produce significant changes. The magnitude of these changes increase as long as there is an increase in the scale of activities (Emilio, et al., 2008).

Land cover is a dynamic, due to population expansion, and increasing demands for food and shelter, different regions around the world currently had undergone wide and rapid changes in land cover. Mostly is centered in the tropics (FAO, 1995).

No doubt, the human welfare largely depends on a sustainable environmental management, which requires maintaining the world population at reasonable growing rate and controllable state to living and sustaining all the resources which could possibly feed the mankind. This requires a comprehensive understanding and changing the human attitudes towards the environment. That is because human-environment relation is built on a delicate balanced ecosystem (Suliman, 2001).

The most serious land cover changes are attributed to the conversion of forest land to crop land especially under rain-fed farming system (Mohammed, 2007).

Foley (1999) studies showed global expansion of cropland began since 1850, when about 6 million Km^2 of forest/wood lands and 4.7 million Km^2 of Savannah/grass lands/steppes were converted to cropping land, respectively, 1.5 and 0.6 million km^2 of cropland have been abandoned.

Additionally, modern agriculture has been successful in increasing food production; it has also caused extensive environmental damage leading to a net loss of approximately 7 to 11 million km^2 of forest in the past 300 years, this demonstrates that agriculture and other closely related land uses are the major causes of land cover change leading to land degradation in many parts of the world. Though in some cases steady restoration of grassland degradation was recorded due to a government effort in limiting the effect of human-induced land cover change (Cai, et al., 2015).

However, these changes in vegetation cover have attracted attention because of their great influences on increasing run-off, erosion, carbon dioxide (CO_2) concentration, regional and global climate change, hydrology, land degradation and biodiversity losses (Myer, 1988). These dynamics alter the availability of resources and could lead to a decreased availability of different goods and services, negatively affect the socio economic, environmental settings and live supporting system (Vistousek, et al., 1997). Nevertheless, several studies displayed that the land cover changes are derived by both natural factors as well as the anthropogenic activities on land (Agrawel, et al., 2002).

Land degradation is an obstacle to sustainable development due to its impact on the environment, food security, agroecosystem service provision and people's livelihoods (UNCCD, 2015).

The ongoing vegetation situation requires urgent measures to be taken, before destruction can take place. One of the most important approaches in this regard is the introduction of an easy, quick method of monitoring and rational or sustainable management of natural resources (Mohammed, 2012).

Global assessment of land degradation is not an easy process and it involves a wide set of approaches. Today, researchers have developed and applied different methods of land degradation assessment ranging from field observation and measurements, satellite remote sensing, modelling, the use of spatial indicators and indigenous knowledge method and expert judgement among others (WMO, 2005).

A number of international, national and regional programmes were developed with the sole aim to monitor the degree and the extent of land degradation. Some of the programmes were designed particularly to identify and map out the extent of land degradation using spatial and temporal ecosystem conditions, so as to take appropriate measures to combat the problem. Notable programmes designed to identify and map out the extent and predict the future of land deterioration (Baartman, et al., 2007).

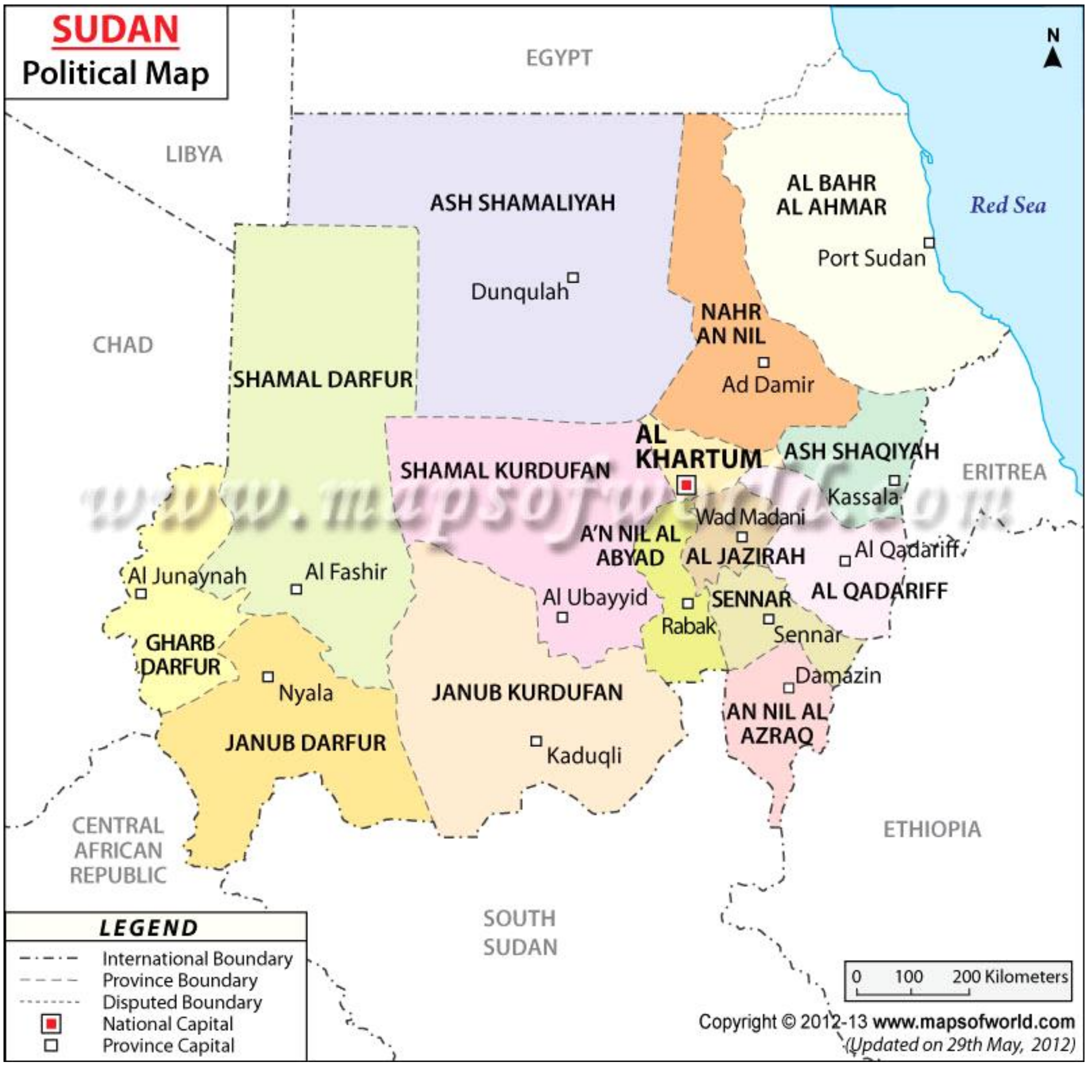
Previous studies showed that social and economic growth of Sudan is directly linked with the performance of the agricultural sector, where about 80 % of the population are engaged in agriculture and related activities (Mustafa, 2006), also he stated that; Sudan was considered a fragile country, suffering from long lasting internal conflicts, high social and economic disparities and unequal allocation of public resources.

1.2 Study Area

1.2.1. Location

1.2.1.1 Location of Gedaref State

Gedaref State located in the semi-arid of the Eastern part of Sudan and extends over an area of about 72,000km^2. The state is bordered to the east by Ethiopia and Eritrea. The four Sudanese states surrounding Gedaref State are Khartoum, Kassala, Gezera and Sinnar (Map, 1.1).



Map (1.1): Location of Gedaref State, Sudan. www.mapsoftwld.com/May/2012

The average minimum temperature recorded in Gedaref State was 14.9 C^o, during winter season (January and February). While the maximum recorded temperature in summer season, where April and May are the hottest months of the year and the temperature may reach 47 C^o. According to rainfall Gedaref State was classified into three climatic zones; arid (200 - 400 mm), semi-arid (400 - 600 mm) and the dry monsoon zone (600 - 800 mm) (Galal Eldin, 1984).

Development in Gedaref State started in early 1940 with the introduction of mechanization (Agabawi, 1969).

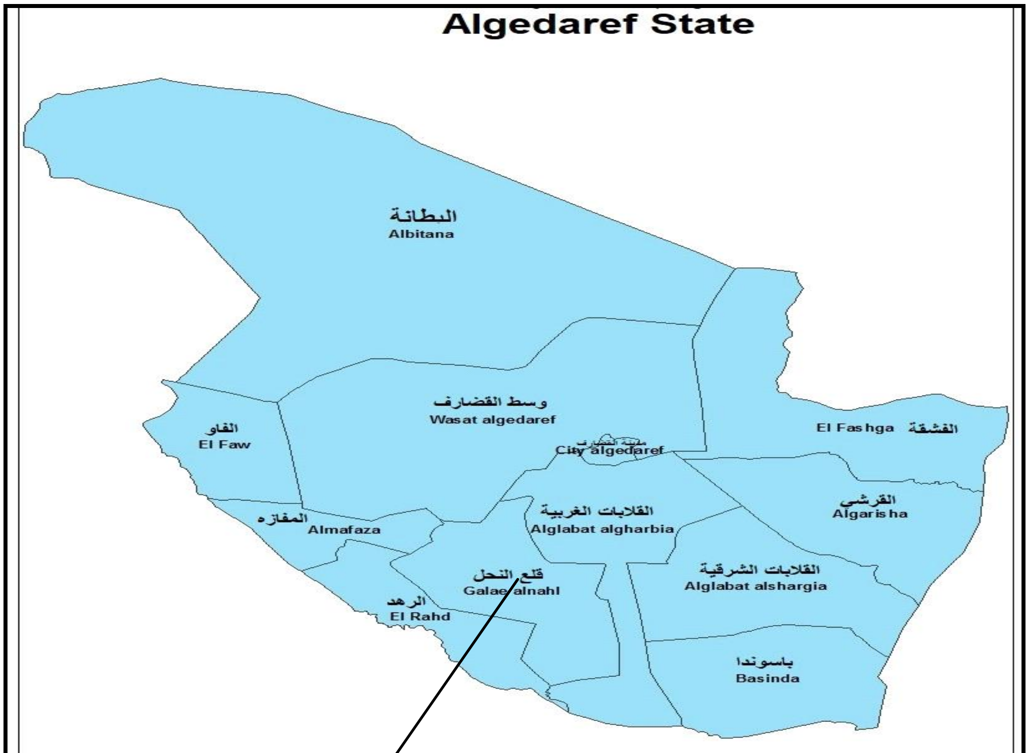
Gedaref State considered the first part of the Sudan in which mechanized rain-fed farming has been introduced in 1944 at El Ghadambaliya area north of the State and then extended to the south and south-west areas. The State was characterized by vast land suitable for agriculture and important strategic center for food security in Sudan (Ahamed, 2015).

The State was divided into twelve Localities: Al –Butana, Al- Fashaga, Gedaref City, Central Gedaref, Al- Faw, Al Mfaza, Al-Rahad , Qala Al-Nahal, Western Gallabat , Eastern Gallabat, Gurraisha and Basonda (map 1.2) Each locality divided into administrative units www.marefa.org/Dec/2017.

1.2.1.2 Location of the study area

Qala Al-Nahal locality was located in the Western-South part of Gedaref State (Map, 1.2). It was about 70 km from Gedaref city. The study area located in the western-South part of the locality, with the total area about 4000 km^2. The most important Administrative units are, Umm Sagatta, Sumsam and Qala El-Nahal where it was the capital of the locality. The area was famous for honey production, but now honey is rarely found in the area, because the bees have migrated to the area where vegetation cover is abundance. Shares the border with Central Gedaref, Al Rahad, Galabat and Al Mfaza localities. It is situated within the longitudes 35°

45´- 34° 45´E, and latitudes13°- 13° 45´N. With elevation about 603 m above the sea level (Fangama, 2002).



Map (1.2): Location of Qala El-Nahal Locality. Source: www.cbs.gov.sd/May2019.

1.2.2 Physical Attributes

1.2.2.1 **Topography and the climate of the study area**

The topographical features of the study area are undulating relief with several major drainage systems. Dominant soil cracked black mud in the plains, and gray tilted to the color brown in the highlands topped with a solid layer and are often mixed with gravel and rocks of the hills known locally as Azzazh. A well-defined rainy season lasts from June to September. The annual average precipitation is 670 mm and the average temperature is 40 °C in the summer season. The dominant soil in the study area is dark, heavy, deep clay belonging to the vertisol group, which cracks widely during the dry season and expands during the wet season due to the high content of clay. This type of soil becomes very sticky in wet seasons (Hussein, 2010).

1.2.2.2 Geology of the study area

The geology of the Gedaref region is composed of crystalline basement rocks; which are cropped out in the northern and south-western parts of the study area, namely Umm Sagatta, Qala En Nahal and El-Subagh areas (Abdulrhman, et al., 2015).

1.2.3 Natural resources in the study area

1.2.3.1 Population

According to population census - Qala El-Nahal Locality office the population growth increased during 2008 to 2018 table (1.2). The tribes in the area are Fur, Masaliet, Tama, Burgo, Falata, Dajo, Kordufan and Northern and Central Sudan tribes. The area experienced influx of refugees from Eretria and Ethiopia during their civil war (Fangama, 2002).

Table (1.2): Population of Qala El-Nahal Locality at Gedaref State (2008-2018)

Population in Qala El-Nahal Locality	Year		
	2008	2014	2018
Population (1,000) inhabitants	66.122	83.350	108.211

Source: population census - Qala El-Nahal Locality office, Gedaref State (2018)

1.2.3.2 Vegetation

According to Harrison and Jackson (1958), Gedaref area lies in the low rainfall wood lands savannah belt on clay. Vegetation cover in the study area included bushes, trees and different annual plant species. The dominant tree species were *Acacia seyal*, *A. senegal*, *A. nilotica* beside other tree species like *Commiphora africana*, *Bosia senegalensis*. As far as the annual plant species concern, *Sudan grass spp*., *Cymbopogon spp*. *Sorghum halepense*., *Chorch olitorius*, *Dactylocetenium aegyptium*, *Striga hermanthica*, *Ipomoea cordofana* (Leban, 1965).In the area the vegetation cover was divided into:

1) *Acacia mellifera*, *Sterculia setigra*.
2) *Acacia seyal-Balanites* Savannah. *Ziziphus spini-christi*, *Acacia mellifrea*.
3) *Anogeissus –Combretum* savannah wood land (Fangama, 2002).

1.2.3.3 Water resources: According to the (Elhadi, 2009), water sources in Gedaref State include; Surface Water, Subsurface and ground water.

1.2.3.4 Livestock: Domestic animals are about 20.000 head of the animal. They are owned by the farmers and refugees in Qala El-Nahal area (Fangama, 2002), while in 2014 the livestock increased to be 38.100 head (Osama, 2014).

1.2.4 Land use: According to Fangama (2002), there are four types of land use known in the study area, these are; agricultural land use, this includes mechanized and traditional rain-fed agriculture, the other land uses are range land, forest land and barren land.

1.2.5 Economic activities: In the study area agriculture is the main economic activity include (mechanized and traditional rain-fed farming, and irrigation farming), which cover 291.072 ha, animal rearing, and forest activities (Fangama, 2002).

1.3 Research problem

The study area has exposure to a serious vegetation change, biodiversity losses and socio-economic deterioration due to the many reasons such as: extensive and intensive farming, rapid population growth and refugee’s influx, increase number of livestock, rainfall scarcity and variability and frequent spells of droughts. These complex interrelated-interacting factors result the change in vegetation cover, land deterioration. As a consequence, the incomes decreased and the level of poverty increased. Only little information is known about vegetation change in this area. This situation created a great desire for introduction of efficient means to address the issue of vegetation cover change and sustain its use.

Due to all mentioned points it become important to conduct this study to identify the main drivers and factors for vegetation change in the study area and present the better solution.

1.4 Justifications

This research is very important to the relevant scholars, to carry out their works properly. Moreover, there is a need for fresh, accurate, reliable data and information, on vegetation cover change to enable the relevant scholars to do their works successfully, it is helpful to the farmers to assess the required inputs crop monitoring, also; it is important in the forestry management, inventory and planning, it is essential to have information in form of statistical data for land utilization, because the vegetation cover change influence various natural phenomena and ecological processes, including soil erosion, runoff, sedimentation; soil conditions etc. Furthermore, the urban areas are also dynamic, changing as a result of various human activities, natural conditions and development activities. Thus, vegetation cover is getting an increasing attention because of its multifunctional and central role to play in human life and the ecosystems.

1.5 Objectives

1.5.1 General objectives of the study:

1) To assess the vegetation cover change in the study area during the period 1972 to 2018.

2) To determine the soil capability and potentiality in the study area.

1.5.2 **The specific objectives of the study include the following**:

1) To determine the magnitude and dynamic of vegetation change in the study area; during the period (1972 to2018), using RS and GIS.
2) To determine the impacts of vegetation cover change on environment and socio-economic.
3) To determine the impact of soil on growing cash crops.
4) To determine the correlation between soil elements NPK, and soil PH, EC?

1.5.2 Research questions: In the light of the above-mentioned objectives, the research seeks to answer the following questions:

1. What is the condition of the vegetation cover in 1972, 1984 and 2018?
2. What are the causes of vegetation cover change?
3. How much areas of vegetation cover have been changed during (1972 to 2018)?
4. What is the best method to characterize the vegetation cover change?
5. How much the soil capability and suitability in the areas have been changed?
6. What is the status of socio-economic in the study area?

CHAPTE TWO

LITERATURE REVIEW

2.1 Introduction

The term (LC) generally referred to the kind and state of vegetation, such as forest or grass cover, but it has broadened in subsequent usage to include human structures such as buildings and other aspects of the natural environment, such as soil type, biodiversity, surface and groundwater (Meyer, et al., 1994).

2.2. Vegetation as the term and its function

Vegetation is a general term for plant life of a region. It refers to the ground cover provided by plants, and is, by far, the most abundant biotic element of the biosphere. The vegetation composition of particular area is a result of interaction of species with varying ecological tolerances and requirements. Any changes in the physical environment alter this balance of interaction cause changes in vegetation (Ikram, 1997).

Vegetation serves several critical functions in the biosphere, at all possible spatial scales, such as:

Firstly, vegetation regulates the flow of numerous biogeochemical cycles, most critically those of water, carbon, and nitrogen; it is also of great importance in local and global energy balances. Such cycles are important not only for global patterns of vegetation, but also for those of climate.

Secondly, vegetation strongly affects soil characteristics, chemistry and texture, which feedback to affect various vegetation characteristics, including productivity and structure.

Thirdly, vegetation serves as wildlife habitat and energy source for the vast array of animal species on the planet.

Vegetation is also critically important to the world economy in global production of food, wood, fuel and other materials and most importantly, global vegetation (including algal communities) has been the primary source of oxygen in the atmosphere, enabling the aerobic metabolism systems to evolve and persist. Vegetation is psychologically important to humans, who evolved in direct contact with, and dependence on vegetation for shelter and medicines www.sciencedaily.com/March/2017.

2.3 Definitions of land cover

Turner, et al., (1990); define land cover (LC) "as the biophysical state of Earth's surface and immediate subsurface. The term refers to the type of vegetation that covers the land surface, other aspects of the physical environment, such as soils, biodiversity, surfaces, and groundwater, as well as to human structures, such as buildings or pavement. Land use, according to these authors, involves both the manner in which the biophysical attributes of the land are manipulated and the intent underlying that manipulation—the purpose for which land is used.

According to FAO (1995); land use concerns, the function or purpose for which land is used by the population, it can be defined as "the human activities that are directly related to land, making use of its resources or having an impact on them." For a given area at a given spatial level, land use is described by specifying the mix and particular pattern of land-use types, the aerial extent and intensity of use associated with each type.

Meyer, et al., (1994); explain "land cover" as the term denotes the physical, chemical, or biological categorization of the terrestrial surface, For example, grassland, forest, or concrete, so the Land cover (LC) describes the physical state of the land surface and categories include cropland, forests, wetlands, pasture, roads, and urban areas etc.

Change in the patterns of land use affects land cover. Changes in Land Cover by Land Use sometimes not necessarily mean a degradation of the land, there are many shifting in Land Use patterns, driven by a variety of social or nature causes, Land use relates to land cover in various ways and affects it with various implications and the distinction between land use and land cover is not so straightforward to make in practice because, frequently, sources of data do not distinguish clearly between cover and use (Helen, 2017).

2.4 Land-use and land-cover changes

Land-use and land-cover changes refer to (quantitative) changes in the aerial extent (increases or decreases) of a given type of land use or land cover, respectively. However, land-cover changes may result either from land conversion (a change from one cover type to another), or land modification (alterations of structure or function without a wholesale change from one type to another), or even maintenance of land in its current condition against agents of change (Helen, 2003).

Changes in landscape, cropland, grasslands, wetlands, or human settlements are examples of cumulative change. Some cumulative changes reached continental, even global, proportions long before the 20th Century, including deforestation and the modification of grasslands (Turner, et al., 1992).

However, changes in (LC) driven by (LU) can be categorized into two types: modification and conversion. Modification is a change of condition within a cover type; for example, unmanaged forest modified to a forest managed by selective cutting. Significant modifications of (LC) can occur within these patterns of (LC) change.

Conversion is a change from one cover type to another, such as deforestation to create cropland or pasture and conversion (LC) changes such as deforestation have been the focus of many global change research agendas (Riebsame, et al., 1994), the conversion or transformation is one of the major concepts in the search for the relation between environment and natural resources, this is because depletion became one of the most urgent problems at present time. The natural resources depletion indicates a reduction in its value, regenerative capacity, productive as well as the reproductive capacity. There are many factors contributing to resources depletion, among these may be directly natural (i.e. drought, fires and pests) or human industries (i.e. mining, farming, economic development), indirectly (increased population and literacy) factors. All these factors, collectively or individually cause unrest and imbalance to the environment. Generally, the phenomenon of ecosystem disturbance is an indication of deterioration, disintegration and depletion of natural resources base (Cox, et al., 1979, 2001).

2.5 The history of the earth changing in the time

The Earth has experienced a constantly changing climate in the times since plants first evolved. In comparison to the present day, this history has seen Earth as cooler, warmer, drier and wetter, and CO_2 (Carbon Dioxide) concentrations have been both higher and lower (Dunlop, et al., 2008). These changes have been reflected by constantly shifting vegetation. For example forest communities dominating most areas in interglacial periods, and herbaceous communities dominating during glacial periods (Huntley, 2005).

It has been shown that past climatic change has been a major driver of the processes of specification and extinction (Sahney, et al., 2010). Since time immemorial, humans use land to meet their material, social, and cultural needs, they are modifying land resources in various ways, often with detrimental impacts on the environment and human well-being. Land cover may change under the influence of biophysical conditions only but, most frequently; it results from human-induced land-use change.

The change of vegetation coverage has important impact on the cycle of global energy and biochemistry of matter, and it is also an important index of regional ecological environment, so; the information of ground vegetation coverage and its change has great realistic significance on revealing rule of ground spatial change, the study of vegetation percentage applied to provide reference of the areas ecological environmental quality evaluation, plan and ecological safety assessment by investigating the change of the area surface cover (Pan, et al, 2000).

Changes in Earth's natural land cover have been taking place since time immemorial and have been associated with both natural phenomena and human interference. Since 1700, however, land-cover changes have been reported as being human-induced changes, and these have caused diverse, mostly adverse, impacts on both society and the environment. Several ancient writers have documented the destruction of natural areas from salinization, overgrazing, fire, and other human activities. In his 1864 seminal essay "Man and Nature; or, the Earth as Modified by Human Action," Marsh has described how people used and modified land to serve various purposes, altering, thus, the environment. After the 1960s and 1970s, numerous studies documented the detrimental impacts of human activities that began to cause worldwide concern and action. In 1987, the Brundt land report introduced the notion of sustainable development in the political arena; the quest for sustainable use of land resources became an important policy and planning goal. This was translated into a search for a policy and planning approach to direct land-use change towards sustainable pathways. The recognition of the importance of land-use and land-cover change in the context of global environmental change and sustainable development is perhaps best reflected in the launching, in 1993 of the Land-Use and Land-Cover Change (LUCC) Core Project/Research Program, under the authority of the International Geosphere-Biosphere Program (IGBP) and the International Human Dimensions Program (IHDP).

The physical surface of the earth is in constant change: abundant water resources give rise to new growth, cities expand and forest converted to farmland and others forms of the land cover. Main causes of these changes are transformations and the others are mainly the result of the changing of the seasons and any piece or the area of the land on the Earth's surface is unique in the cover (Turner, et al., 1990).

2.6. The role of minerals in vegetation covers distribution

Plants require N, P, K, Ca, Mg, and S, trace metals, CO_2, water, light, and other resources. The most commonly limiting resources of terrestrial habitats are N, P, and water. N limitation is common, because the parent materials in which soils form contain almost no N. Rather, the chemically stable form of nitrogen is atmospheric N_2, which is usable only by N-fixing plants via microbial symbionts. Non-N-fixing plants obtain N as nitrate, ammonium, or organic N. Some soils are either initially low in other mineral elements, especially phosphorus and calcium, or become low in these after millennia of leaching (David, et al., 2001).

Deforestation and subsequent tillage practices resulted in nearly a 20% increase in bulk density and a 50% decrease in soil organic matter for a soil depth of 0-30 cm over 20 years in the central Zagrous Mountain in Iran were reported by (Mohammed, 2012). Furthermore, study of soil physical and chemical properties in Goz Rom area –Renk showed that a continuous cultivation resulted in change of physical (texture and structure) and chemical (reduction of organic matter, nitrogen, magnesium, calcium, phosphorous, potassium and sodium) characters except chlorine compared with adjacent forest land (Mohammed, 2007).

Berhanu (1985) reported that most of Vertisols soil contain about 3-10% organic matter. He added that the conversion of organic nitrogen into available nitrogen (ammonium and nitrate nitrogen) depends on the rate of mineralisation, and is highly correlated with soil pH, moisture, temperature and the presence of nitrifying organisms. Mamo, et al., (1988), reported that the Ethiopian highland Vertisols tend to exhibit low total N and Oroanic Matter (OM) content. This low level of Nitrogen content is attributed to increased nitrification and loss of Nitrogen through water leaching and run-off (Mohammed, 2007). In most African Vrtisols, the organic matter content varies from 0.5 to 2.0 and from 2 to 4 in some vertisols in USAA (Yule, et al., 1980a),

Berhanu (1985) reported that 70% of the available P is in the surface horizons (0-30 cm). Phosphorus availability depends on soil pH. David, (1996) reported that phosphorus is generally limited due to its low content in parent material of most Vertisols and its high propensity. Soils with inherent pH values between 6 and 7.5 are ideal for P-availability, while pH values below 5.5 and between 7.5 and 8.5 limits P- availability to plants due to fixation by aluminum, iron, or calcium. Phosphorous is made available through fixation by clay mineral allophane, which is found in volcanic ash soils in wetter climates.

Generally the parent materials of the clay soils which cover the study area belong to two broad groups: alluvial, the sediments from rivers belonging to the Nile system and colluvio-alluvial deposits derived from local rock weathering degradation clay plains (Blokhuis, 1993).

The Vertisols are found in Australia (70.5 millium/ha), India (70 mha), Sudan (40 million ha), Chad (16.5 million ha) and Ethiopia (10 million ha), these five countries comprise over 80% of the total area of 250 million ha of Vertisols in the world. The dark clay Vertisol soils in Sudan represents about 16% from the total Vertisols in the world (Dudal, 1965).

According to Whiteman (1971); Qala El-Nahal geology is the Outcrops of the igneous and metamorphic rocks formation.

Laing (1953) reported that; Gedaref State is the vast plain of clay soils, where the clay fraction varies from 61% to 73%. The vertisol soil occurs in the tropics, subtropics and warm temperate zones (Dudal, 1965).

According to Thiagalingam (2003), soil pH significantly influences the availability of plant nutrients, also he stated that; at soil pH bellow 5.5, the solubility of aluminum, manganese, iron, zinc, copper and boron will increase, causing toxicity to plants and microorganisms. If the soil pH is higher than (> 8.5), elements like zinc, boron, manganese and iron will be low. Many studies found that the pH of Vertisols increases with depth, the topsoil being neutral or weakly acid. According to Berhanu (1985), about 61% of the Vertisols have pH values of 5.5- 6.7, about 21% have pH values of 6.7-7.3, and 9% have pH values of more than 8. The Vertisols show marked heterogeneity in terms of pH.

Soil Electrical Conductivity (EC) is used as a relative measure of total quantity of ions in the soil solution. Olson (2000), reported that soil EC has no direct effect on crop growth or yield, but, there are close relationships between EC and a variety of other soil properties that are related to crop growth and yield. Nevertheless, Soil EC influenced by a number of factors including: soil moisture content, concentration of ions in the soil, soil bulk density, type and amount of clay (Brune, et al., 1990).

Adviento, et al., (2006) described the EC less than 1 ds/m as non-saline and does not have a negative impact on most crop growth and soil organisms' activity. While Paul, et al., (2015) stated the P and K availability increases as soil acidity decreases.

Due to the population pressure and poverty, humans have encroached on forest reserves to meet and satisfy their increasing needs. The effect of these disturbances may result in the changing of particular vegetation cover types to others such as from a forest to savannah grassland and subsequently a desert. For instance analysis of satellite images of some forest reserves in Ghana between 1990 and 2000 revealed rapid deforestation rates with some losing as much as 90 % cover (Opoku, 2006).

2.7 Anthropogenic activities on vegetation cover change

Lambin, et al., (2008), argued that contemporary land cover change is generated principally by human actions directed at manipulating the surface of the earth for their personal benefits, such as agriculture, urbanization, grazing, etc. This leads to the degradation of vegetation cover, which is also a cause and consequence of climate change.

Concerning human pressure, results to the national level land cover change in Senegal; show moderate change with a modest decrease in savannas from 74% to 70% from 1965 to 2000, and an expansion of cropland from 17% to 21%; However, at the Ecological scale, rapid change in some and relative stability in others was observed (Tappana, et al., 2004).

The study on the assessment of the effects of anthropogenic activities on vegetation cover and natural regeneration in a moist semi-deciduous forest of Ghana indicated that: human activities interfere with forest cover could be directly or indirectly. Some of the direct human activities are the agricultural expansion, wood extraction (logging and wood for fuel) and development programs and the indirect human activities in the forest could be economic (poverty and industrialization), technological (land-use intensification) or demographic (population density and pressure). Beside above human activities a complex interaction between many factors such as, vegetation composition and structure and site quality. Moreover the patches could have persisted due to the fact that species with greater sensitivity to site conditions such as light exposure and soil minerals were disfavored resulting in little or no forest restoration and hence poor canopy closure. Thus, changes in vegetation cover over time and in space may have subsequent effects on natural regeneration of tree species and so the area exposed to the natural factor such as wind storm…etc. (Eric, et al., 2013).

Assessment of dominant land covers types affected by land degradation in sub-Saharan West Africa. Environmental problems in that dry land areas are aggravated when land degradation, mostly a human-induced process, combined with natural climatic fluctuations (Karlson, et al.,2016), and the end results include, among others, a temporary decline in the structure, density, species composition and or productivity of vegetation cover (Grainger, 1996). Furthermore this result in land cover change which is triggered by land use alterations and may vary significantly from one place to another depending on the prevailing conditions and the extent of man's acquisition of natural resources to satisfy his immediate needs (Foley et al., 2005, Van Dijk,et al., 2016).

Over the years, interest on the possible connection between land degradation and land cover change, predominant land uses leading to the change emerged in global environmental literature, with the realize that land surface processes influence climate and other environmental changes (Nicholson, 2013). Land cover change also determines the vulnerability of places and people to climatic, economic and socio-political trepidations (Kasperson, et al., 2005).

Gang, et al., (2014) documented that about 49% of the grassland ecosystem suffered degradation from 2000 to 2010 as result of climate change and human activities and 33% of this degradation is as a result of overgrazing, agriculture and urbanization. Also the global expansion of croplands since 1850 had converted about 6 million km^2 of forest/woodlands and 4.7 million km^2 of savanna/grassland/steppe vegetation.

Yahaya (2017); wrote that; a continued decline in closed forest and sparse vegetation and an increase in cropland reflect an indication of land degradation. This pattern of land cover change accelerated by the increasing human population, which are estimated to be growing at the rate of 2-3% in Africa by the year 2100, the increasing in population expected to upsurge the size of cropland for food security, which will exert more pressure on the ecosystem, major changes in the land cover have been caused by human activities and some extent natural climatic variations, especially along the marginal or fragile areas where the area of bare surface has increased.

According to European parliament and the European Council (2013) European economies and human wellbeing depend on natural resources, including raw materials and space (land resources), as well as environmental conditions favorable to the provision of clean air, water and healthy food. The (77th Environmental Action programme2020) presents the issue of land use and land resource management as an element of natural capital that is crucial to maintaining ecosystems and the services they provide. It also presented as an aspect of resource use efficiency, tackling unsustainable resource trends (Andreas et al., 2014).

Foley, et al., (2005) reported that; the modern agriculture has been successful in increasing food production. It has also caused extensive environmental damage leading to a net loss of approximately 7 to 11 million km^2 of forest in the past 300 years. This demonstrates that agriculture and other closely related land uses are the major causes of land cover change leading to land degradation in many parts of the world.

In some cases steady restoration of grassland degradation in the centeral Tibetan Palateau was recorded due to government effort in restrcting limiting the effect of human-induced land cover change as Cai, et al., (2015).

Recent studies of sub-Saharan West Africa have shown a decrease in tree density and changes in species diversity in the last half of the 20th century in spite of the greening trend (Herrmann, et al., 2016).

2.8 Anthropogenic environmental interactions

Environment is more a complex, the good understanding of the complexity of environment and environmental issues is a perquisite for resolving the environmental challenges that human faces (Stott, et al., 2000). Evidence showed that many environmental problems a raise such as (land cover change, biodiversity loss, pollution, climate change); meanwhile human still keep track of activities perpetuate the problems. As the world's population increased, and per capita consumption of natural resources increased, human will have an even greater effect on these environmental problems.

Most vulnerable groups in Gedaref State to climate change and climate crisis are basically the poor, landless, small scale farmers, large sized families and predominantly pastoralists (Alhadary, 2007).

2.9 Anthropogenic attitudes towards the natural resources

The attitudes of human towards the utilization of natural resources reflected in different ways such as cultivation activities beyond the favorable climatic zone in marginal and fragile ecosystems, soil salinization in irrigated cultivated areas, deforestation, overgrazing, fire setting, urban sprawl and sprawling city (Qalabane, 2014)

In developing countries where a large proportion of human population depends almost entirely on natural resources for their livelihoods, resulting in land-use and cover changes, the population growth has been a major factor that has altered natural vegetation cover, due to anthropogenic activities. The results of these have left significant effects on local weather in specific areas and the climate in general and expansion in growth, developmental activities and many other anthropogenic activities are responsible for destruction of vegetation because of irrational resources management. (Atifa, 2013)

2.10 Land-use /land-cover changes affect the global climate processes

Land use and land cover play critical roles in the interaction between the land and the atmosphere, influencing climate at local, regional, and global scales (Pielke, 2005).

Bonan (2001) documented that: land cover and land management affect the U.S. climate in several ways: Air temperature and near-surface moisture are changed in areas where natural vegetation is converted to agriculture. This effect has been observed in the Great Plains and the Midwest, where overall dew point temperatures or the frequency of occurrences of extreme dew point temperatures have increased due to converting land to agricultural use, also this effect has been observed where the fringes of California's Central Valley are being converted from natural vegetation to agriculture. Other areas where uncultivated and conservation lands are being returned to cultivation, for example from restored grassland into biofuel production, have also experienced temperature shifts. Moreover regional daily maximum temperatures were lowered due to forest clearing for agriculture in the Northeast and Midwest, and then increased in the Northeast following regrowth of forests due to abandonment of agriculture.

Large scale mechanized agriculture using tractors, disc harrows and seed drilling, is the driving force for land use land cover change in Gedaref State. Clearance of natural vegetation to provide new agricultural land has dramatic changes in natural resources and subsequent land degradation, agricultural mechanization introduced in Gedaref State in 1944 and in1954 the government began encouraging the private sector to take up mechanized farming in the area, a policy that continued after Sudan gained independence 1956. Economic activity in Sudan is principally rural-based and the majority of them are agro-pastoralists with varying degree involvement in traditional farming and pastoral pursuits (Mohamed, et al., 2011).

By blocking the extension of traditional shifting cultivation according to the population growth, the extension of large scale mechanized farming has gradually reduced the soil- restoring follow period to zero, while creating landless peasants by continued mono-cropping on traditional and large scale mechanized agriculture caused a decline in crop yields. For example one feddan of Dura produced 6sack in 1970s, but now produced 2sack/ feddan, also this decline in the productivity happened in Sesame production from 5sack/feddan to 1.5 sack/feddan (Ismail, 2009). Mohamed, et al., (2011) wrote: farmers of the northern and southern parts of the Gedaref State have mentioned that; the capacity of soil to preserve humidity has decreased remarkably due to shortage of rain and also observed the increase in the percentage of sand on the top soil layers.

Due to the late on rainy season and its uneven distribution in many parts of the country, the area under cropping was reduced when comparison with last season (Food Security Technical Secretariat **FSTS)** (2016).

Conversion of rain-fed cropland to irrigated agriculture has intensification impacts on temperature. For example, irrigation in California has been found to reduce daily maximum temperatures by up to 41°C (Bonfils, et al., 2007). Model comparisons suggested that irrigation cools temperatures directly over croplands in California's Central Valley by 37°C to 45°C and increases relative humidity by 9% to 20% (Sorooshian, et al., 2011). Observational data-based studies found similar impacts of irrigated agriculture in the Great Plains in Nebraska from 1982 to 2003 (Mahmood, et al., 2008).

Modeling studies show that introduction of irrigated agriculture can alter regional precipitation (Barnston, et al., 1984: Harding, et al., 2012). It has been shown that irrigation in the Ogallala aquifer portion of the Great Plains can affect precipitation as far away as Indiana and western Kentucky (De Angelis, et al., 2010).

Urbanization is having significant local impacts on weather and climate. Land-cover changes associated with urbanization are creating higher air temperatures compared to the surrounding rural area (Shepherd, et al., 2002).

Land-use and land-cover changes are affecting global atmospheric concentrations of greenhouse gases. The impact is expected to be most significant in areas with forest loss or gain, where the amount of carbon that can be transferred from the atmosphere to the land (or from the land to the atmosphere) is modified. Even in relatively un-forested areas, this effect can be significant.

A recent United State Geological Survey (USGS) report suggested that: from 2001 to 2005 in the Great Plains between 22 and 106 million metric tons of carbon were stored in the biosphere due to changes in land use and climate. Even with these seemingly large numbers, United State (U.S) forests absorb only 7% to 24% with a best estimate of 16% of fossil fuel CO_2 emissions (Zhu, et al., 2011).

The extensive studies brought further attention to the situation of land use land cover changes, these studies focused on social implications and the environmental degradation associated with tropical deforestation, also they focused on the awareness, attention of the world potentially devastating phenomenon continues (Skole, et al., 1994, and Kummer, et al., 2001).

2.11 The situation of vegetation covers in the world

Lambin, et al., (2003) studied the dynamic of land cover in tropical. He summarized the results on land cover a change as the area of cropland has increased from 300-400 million ha in 1700 to 1500-1800 million ha in 1990. The area under pasture increased from 500 million ha in 1700 to 3100 million ha in 1990. These increases led to the clearing of forests and the transformation of natural grasslands, steppes, and savannas. Forest area decreased from 5000-6200 million ha in 1700 to 4300-5300 million ha in 1990. The area under steppes, savannas, and grasslands declined from around 3200 million ha in 1700 to 1800-2700 million ha in 1990 (Ramankutty, et al., (2002b); Lambin, et al., 2003).

In other study of the Percentage of Vegetation Cover Change Monitoring in Wuhan Region indicated that; the spatial distribution of vegetation coverage of Wuhan area is the urban city’s vegetation coverage lower than other districts in the whole area, the percentage of vegetation cover decreased from 58.41% to 50.45% in 1996 to 2002 especially in Jiangxia, according to the economic development (Tao, et al., 2011).

There has been greater expansion of cropland areas since World War II than in the 18th and early 19th centuries combined. Significant changes in cropland occurred in South-east Brazil. Cropland expansion slowed down in the Midwestern USA, while there was abandonment in the eastern part. Cropland areas in northern Europe, the former Soviet Union, and China stabilized, and even decreased in some regions, while it intensified in northeast China. Some croplands were abandoned in Japan and clearing for cultivation continued in South-East Asia and Oceania (Ramankutty, et al., 2002b).

Eastern Europe is the most extensively cultivated region in the world, with more than half its land area in crop-cover. However, in absolute terms, the former Soviet Union has the largest cropland area (Ramankutty, et al., 2002b).

As a percentage of total land area, the greatest cropland expansion occurred in South Asia and South-East Asia - about 11% and 18% of their total land area, respectively, was cleared for cultivation during the 20th century. In these regions, cropland increases matched growing human population. Most regions with high populations have large cropland areas. The nature of this relationship has not changed over the 20th century because it is the greater demand from growing populations that has led to cropland expansion (Ramankutty, et al., 2002b).

Developed countries such as the USA and the former Soviet Union, with roughly 10% to 13% of the world population, contain nearly a third of the global cropland area. On the other hand, the populous and poorer nations of the world such as China, Mongolia, N. Korea, and South Asia, with roughly 45% of the global population, have only a quarter to a third of the global cropland area.

China Arable land covers about 14% (Li, 2000). It has to feed more than 20% of the global population with less than 10% of the global area under arable land. The average arable land per capita is 0.095 ha (Zhu, et al., 2004). This limited arable land is decreasing due to agricultural restructuring, rural industrialization, and rapid urbanization. Furthermore, some 40% of the arable land suffers from soil degradation due to water and wind erosion, salinity etc.

In Asia there are many areas where land-cover changes occur most rapidly; the Amazon basin is a hotspot of tropical deforestation and it mostly takes place at the edge of large forest areas and along major transportation networks. Deforestation occurs when forest is converted to another land cover or when tree canopy is reduced to less than 10%. Achard, et al., (2002); estimated the mean annual change of humid tropical forest between 1990 and 1997. Globally about 5.8 million ha is deforested each year. In tropical regions, forest is cleared for the expansion of cropland, wood extraction or infrastructure expansion (Geist, et al., 2002).

The study of vegetation cover changes in Burundi in from 1984 to 1990, reflected the decline of the anthropized classes in general and of the cultivated areas in particularly, the extension of the vegetation cover were explained by the evacuation of the inland populations after the creation of the park in 1980 and the existence of a rainfall surplus. The extension of bare soils raised as deforestation of the part of protected area by the Institute of Agricultural Sciences of Burundi for trials on non-native tree species. Between 1990 and 2000, the large spread of the anthropized classes in general and of the cultivated areas in particular and the decline of the vegetation cover resulted from existence of deficit rainfall and the mass invasion and the anarchic exploitation of the park by many displaced people during the 1993 civil war (Bamba, et al., 2008).

From 2000 to 2011, the decline of the anthropized classes in general and of the cultivated areas in particular and the important recovery of the vegetation cover are explained by the insecurity in a large part of the park following the presence of armed bands, the gradual repatriation of displaced from war in 1993 and excess rainfall , between 2011 and 2015, the extension of the anthropized classes and the reduction of the vegetation cover result from intensive exploitation of the park despite the decree of evacuation of the populations of 2011 and the continuous decrease of the rainfall since 2012. The extension of the burned areas is linked to the socio-political crisis triggered since April 2015. The degradation of the vegetation cover between 1984 and 2015 due to the extension of cultivated areas and the burned areas degradation due to the quick riparian population growth and a very strong dependence on the resources of the park on one hand. The park dependent riparian populations have increased from 35,590 inhabitants in 1984 to 146,799 inhabitants in 2015; representing an annual growth rate of 10%.

In Central Africa indeed, previous studies have established a negative causality between population pressure and changes in forest cover (Bogaert, et al., 2008).

Several regions around the word are currently undergoing rapid, wide-ranging changes in land cover. Much of this activity is centered in the tropics in such Countries as Brazil, Columbia, Indonesia, Mexico, the Ivory Coast, Venezuela and Zaire. These changes in land cover, in particular tropical forest clearing, have attracted attention because of the potential effect on erosion, increased run off and Flooding, increasing CO_2 concentration, climatological changes and biodiversity loss (Mas. 1999).

Information on forest cover and biomass changes and deforested areas obtained from successive inventories and remote sensing images carried out in 1990, 2000, 2005 and 2010 by Global Forest Resource Assessment (GFRA) indicated that the forest area declined from 76.4 M ha in 1990 to 70.0 M ha by the end of 2009. The on-going process of environmental degradation is a critical issue that affects the livelihoods of a large sector of the population (FAO, 2013).

Several studies showed that the climate in a big part of the world (particularly in the arid and semi-arid zones) characterized by erratic rainfall and high rate of vegetation dynamics. It has undergone rapid transformation in both poor to rich environments (Herlocker 1999 and Dahdough, et al., 2002). Moreover, the world land that totaling up to 3,600 million hectares, which is equal 70% of the world's arid lands are degraded. 10 million hectares of arable land deteriorates every year (Essahli, et al., 2008). This is as a result of human activity such as land miss use, mismanagement in addition to implementation of new development projects. Situation is alarming.

The ecosystems in these zones are pressurized to display gravy and gloomy future picture that drawn by both, nature and man. However, Hellen (1991) explained that; the deterioration of the semi-arid land is due to many interacting factors, among these are the irregular precipitation and human activity.

Gemedo, et al., (2006) added more other factors such as pests, diseases and invasion of undesired exotic plant species.

Forest degradation especially in developing countries in 2000, the total area of degraded forest in 77 countries was estimated at 800 million hectares (ha), 500 million ha of which had changed from primary to secondary vegetation International Tropical Timber Organization (ITTO, 2002).

Reduction in cover of forests at the community frontier in developing world contexts will have implications both in the global biodiversity and global warming contexts. This study has provided indicative data for monitoring the changes in tree cover in the long-term, which is vital so as to provide threshold indicated alarms based on the rates of conversion that are subsequently established (Munyati, et al.,2014).

In East Africa, the displacement of natural vegetation is expanding rapidly due to the change in land uses which is dominated by the expansion of farmlands, grazing areas and human settlements leading to the loss of biodiversity and land cover alteration (Maitima, et al., 2009). At a local scale, the significance of fire incidence was also found to be an important factor of land cover change (Wessels, et al., 2011).

In the North part of Botswana Woodland cover declined over the study period (2003, 2006, 2012 and 2013) by1514km2 (16.2%ofinitialclasstotal), accompanied by expansion of shrub land (1305km2, 15.7%) and grassland (265km2, 20.3%). Net LCC differed importantly in protected areas, with higher wood land losses observed in forest reserves compared to the Chobe National Park (CNP). Loss of woodland was also higher in communally-managed land for the study period, despite gains from 2003–2013. Gross (class) changes were characterized by extensive exchange between wood land and shrub land during both time steps and a large expansion of shrub land in to grass land and bare ground from 2003–2013, this data indicate broad-scale LCC processes in semi-arid savannas in Southern Africa are strongly coupled to environmental and anthropogenic forcing. Increased seasonal variability is likely to have important effects on the distribution of savanna plant communities due to climate-fire feedbacks (John, et al., 2017).

Benewinde, (2018) documented that in Burkina Faso the trends and land cover change assess revealed that, the vast conversion of natural vegetation cover into agriculture (15.9%) and non-vegetation area (1.8%) between (1999 to 2011) and trend indicated negative modification of natural vegetation between (2000 to 2011) occurring along the protected areas borders and in fragmented landscapes. Jukka (2016) reflected that; Peninsular Malaysia, Sumatra and Borneo land covers distribution in the Pearland's during (1990 to 2015) reveal continued Pearland's deforestation and conversion into managed lands cover types.

Developing countries have witnessed a growing in the agricultural production during recent decades (Aksoy, et al., 2005), where the agriculture in the world faces limitation and challenges in agricultural production through determination of strategies that includes technologies development, policies and institutions which led to think seriously in studying impediments to effective production (Ibrahim, 2014. Ibrahim, 2016).

The agricultural production in most countries are considered one of the major components in sustainable development and increasing needs through sustainable agriculture, forestry, and other land-use to get more food and energy production trying to face increasing of population, especially in arid and semi-arid areas of the world. In additional the agriculture is considered one of the main natural resources in arid regions of the world especially for food security and considered one of the major sources of livelihood in many countries regardless of the acute environmental situation and characteristics in the arid and semi-arid, where arid and semi-arid ecosystems span over 40% of the earth's total land surface, predominantly in Africa (nearly 13 million km^2) and Asia (11 million km^2), with a continuous increase due to desertification processes, induced mainly by anthropogenic activities and/or climatic change (Majed, et al., 2016).

White, et al., (2002) recorded that; there are three quarters of global food production occurs in dry land primarily rice, wheat, maize, sorghum, millets and potato (FAO, 1999), therefore increasing productivity in arid and semi-arid zones is vital to ensure global food security (Bantilan, et al., 2006).

2.12 The situation of vegetation covers in Sudan

Environment and natural resources of Sudan has undergone changes and degradation in land cover, rangeland conditions, forest cover and agricultural land use, which make it different from the past and that of future. The reasons behind these changes, part of it is natural and the major is crucial in the manner of management of the natural resources. Projections of rainfall under climate change conditions showed sharp deviations from baseline expectations. Results from some of the models show average rainfall decrease of about a 6mm/month during the rainy season. Changes in temperatures and precipitations adversely affect the development progress that has already been achieved in many sectors in Sudan (HCENR, 2007).

Drought is a recurrent climatic phenomenon and the historical landscape of Sudan is littered with references to severe droughts, Sudan as other countries along the Sahel belt, has suffered several long and devastating droughts in the past few decades, the most severe drought occurred in 1980-84, and was accompanied by widespread displacement and localized famine. Localized and less severe droughts (affecting between one and five states) were also recorded in 1967-73, 1987, 1989, 1990, 1991, 1993 and 2000. The severe droughts have had disastrous effects on livelihoods and environmental conditions. Also desertification affects 50.5 % of the total land area as a direct result of long term and cumulative environmental degradation resulting from inappropriate land use methods, over cultivation, and overgrazing (Suliman, 1999).

Suad (2017) stated that; 63% of the land in the Sudan vulnerable to natural resources degradation, 82% of the population lives in the productive lands (37%) which are less vulnerable to desertification and therefore impose high pressure on these lands.

Sudan is the most vulnerable countries to climate change and climate variability. This situation is aggravated by the interaction of multiple stresses occurring at various levels, such as endemic poverty; institutional weaknesses; limited access to capital, including markets, infrastructure and technology, ecosystem degradation, complex disasters and conflicts. These, in turn, have weakened people's adaptive capacity, increasing their vulnerability to projected climate change. In recent times, human activities have caused, and are continuing to cause great changes to the composition of the atmosphere (UNEP, 1992),

Economic activity in Sudan is principally rural-based, relying on agriculture and pastoralism. Thus the majority of rural Sudanese are generally characterized as agro-pastoralists (Mohamed, et al., 2011).

Masarra, (2012) stated that; there is continuous decline of closed forest and sparse vegetation, and an increase in cropland and indication of land degradation in Edd Al-Furssan Locality. Most of the areas were found under severe land degradation based on RESTREND model under croplands, increasing in croplands highlighted by the role of human land uses practices. This pattern of land use change has been attributed to the high demands of food to satisfy the increasing population, which is estimated to grow at the rate of 2-3% by 2100.

Hussein, et al., (2013) in the study of Eastern Sudan; stated that areas of natural vegetation have been reduced from 26.1% in 1979 to 12.6% in 1999 and further to 9.4% in 2007. The majority of this reduction converted to agricultural land.

Suad, (2017) stated that; both pastoralists and farmers confirmed sharp decline of natural resources during the last two decades by 100% and 92.9% for pastoralists and farmers respectively and there were six types of conflicts stated as conflict between pastoralists and farmers, conflict between pastoralists groups over scarce grazing land and water resources, conflict between pastoralists and village residents over access to water also frequently occur, conflict between farmers, conflict occurs at the Sudanese and Ethiopian border, and conflict with authority officials bodies. In the southern part of Gedaref state the conflict occurs due to blocking of livestock moving routes, inadequate availability of grazing resources, lack of water resource points for watering animals during summer time, inadequate rest places and the expansion of agriculture in lands not allocated and not suitable for agriculture such as of khors and wadies lands.

2.13 The Situation of vegetation covers in Gedaref State

The environment of Gedaref area used to be a stable and a balanced one, but this equilibrium between environments components had become unstable due to the interference of human activities. The loss of balance resulted from the effects of mechanized rain fed farming in demarcated and non-demarcated areas. The best land for cultivating grains and cotton is the land occupied by *Acacia seyal* trees (Harrison and Jackson, 1958). Many trees had exposed to the extiction including economic trees such as, *Acacia senegal*, *Balanites aegyptiaca*, *Commiphora pedunculata* and *Dalbergia melanoxylon,* Grasses as *Cymbopogon nevatus* and Hyparrhenia spp. which proved to be lacking to the ability to survive in the new environment.

Lebon (1965) classified the vegetation cover in Gedaref State to three major vegetation zones: semi desert vegetation cover in the north and the dominant trees *Acacia mellifera* (Kiter) and *Acacia orefota* (Lauat) followed by low woodland savannah in the central part of the state, this zone divided into three subgroups: Subgroup one the dominated by *Acacia mellifera* (Kiter) that forms dense forests with some grass like *Schima ischaemoids* (Dambulab). Subgroup two dominated by *Acacia seyal* (Talih) and some grass such as *Sehma ischaemoides* .Subgroup three: dominated by tall trees and grasses like *Anogessus schimperi* and *Hyparrhenia psendocymbaria* (Anzora) and high woodland savannah in the far south dominated by *Combertum harmanainum* (Habil) and *Bosswellia pyperifer*

(Luban). Common grasses include *Cymbopogon nervatus*, *Artistida mutabillis* and *Ctenium elegans*. On the shallower soils the trees of *Lannea stumper* and Sorghum grasses, *Cymbopogon spp* and abandoned crop-land.

The expansion of mechanization activities had also affected the tree cover in the State since the whole area was eventually devoted for crop production. Large-scale clearance of trees cover is expected to induce many changes. This is clearly seen in the decrease of animals and plants species. Perennials and biennials had been replaced by annual crops (Bebawi, 1983).

Another unfavorable influences on natural forest are refugees camp; according to Fangama (2015); the settlement of refugees in Qala El Nahal Locality created an environmental problem such as the misuse of natural forests, extensive cultivation, continuous cutting down of trees to satisfy their basic needs for energy and removal of trees form land for cultivation and housing purposes, so the total area cleared for settlement and agriculture are equals to 14290 ha, while the total trees cleared for housing and renovation, agriculture, settlement, firewood and charcoal were equals to 24844320 trees. On the other hand, the total consumption of firewood and charcoal were equals to 331800 $meters^3$ and 3981600 sacks of charcoal respectively.

In Expansion of mechanized rain-fed agriculture and land use/land-cover change in Southern Gedaref State; the Post-classification comparisons (Land-use/land cover change rates) reflected that: the period 1972 to 1979 showed an intensive clearance of natural vegetation due to a dramatic expansion of mechanized rain-fed agriculture, reached up to 4.52% per year and the total area under the plough represent 65.9% (120178.30 ha). According to the information collected from the farmers, the seventies were the golden time of the rain-fed mechanized agriculture for producing many crops in the region, and the high initial profitability encouraged many farmers to clear new areas from the natural vegetation. Moreover, opening new areas has double benefit, gaining a new fertile agricultural land and at the same time selling the harvested wood at local market as fire wood and or building materials. The LULC changes for the period 1979 - 1989 showed a decrease of the natural vegetation and the abandoned agricultural land appeared during this period represent (10.8%). It is clear that the agricultural expansion reached its culmination during this period, and farmers started to abandon parts of their land due to drops in crop yield or weed invasion (Sulieman, et al., 2009).

During the period 1989 -1999, the conversion of natural vegetation to agricultural land has slowed down and abandoned land increases. Therefore, about 40% of the area was under cultivation, whilst the natural vegetation (the already existing one and the parts which could naturally re-establish) covers up about a quarter of the area. However, the abandoned agricultural land could be managed as natural restoration sites. Following appropriate silvicultural strategies this could enhance the productivity of abandoned areas for producing firewood or building materials, whilst maintaining or enhancing habitat and conservation benefits of the natural re-growth could serve as one of the attractive options for farmers.

The decline rate of vegetation cover was terribly occurring throughout the last thirty years. Furthermore, vegetation cover change in Gedaref area from (1972 to 2003), due to the expansion of mechanized rain-fed agriculture and land cover (LC) of Southern Gedaref region has changed drastically since the introduction of mechanized rain-fed agriculture in the area, the agricultural expansion was on the expenses of the natural vegetation cover and the average natural vegetation clearing rate was around 0.8% per year, and the most rapid clearing occurred during the seventies when conversion rates increased to about 4.5% per year (Hussein, 2010), also the vegetation in the southern part of Gedaref State decreased from 65% in 1973 to 31% in 2003 (Ismail, 2009).

Specifically in Gedaref state large tracts of the forests and rangeland were converted to cultivation. The overall forest area and rangeland have reduced because of expansion in modern mechanized farming as a result of increasing human population to meet the increasing demand for food (Yousif, et al., 2017).

Climate of Gedaref State in term of rainfall of which inter-annual variability is very high and there is a significant rate of increase in the last three decades and the rate of increasing trend in the maximum temperature over the period (1941 to 2008) slightly stronger than the corresponding rate for the minimum, so there is increasing trend of climate change and its impact on livelihood of farmers and pastoralists in the region is exacerbating the vulnerability of different socio-economic activities of the societies (Mohamed, et al., 2011).

Tajouj (2011) stated that; in middle and higher latitudes, global warming will extend the length of the potential growing season, allowing earlier planting of crops in the spring, earlier maturation and harvesting, and the possibility of completing two or more cropping cycles during the same season.

Many crops have become adapted to the growing-season day lengths of the middle and lower latitudes and may not respond well to the much longer days of the high latitude summers. In warmer, lower latitude regions, increased temperatures may accelerate the rate at which plants release CO_2 in the process of respiration, resulting in less than optimal conditions for net growth. When temperatures exceed the optimal for biological processes, crops often respond negatively with a steep drop in net growth and yield.

Another important effect of high temperature is accelerated physiological development, resulting in hastened maturation and reduced yield.

2.14 Change detection and its impotence

Diallo, et al., (2009) provided different definition, arguing that change detection comprise processes that are used to determine the changes associated with land use/land cover characteristics based on geo-registered remote sensing data.

According to Radke, et al., (2005), change detection in images identifies the set of pixels that are significantly different between two consecutive images of the same scene. Moreover, Rimal (2005) reported that digital change detection technique is based on multi-temporal and multi-spectral remotely sensed data, which have great potential as tools for understanding landscape dynamics, including detection, identification, mapping and monitoring differences in land use/land cover change over time, irrespective of causal factors. However, change detection is useful in such diverse applications as land-use analysis, habitat fragmentation, urban sprawl, and assessment of deforestation as well as other environmental changes (Ramachandra, et al., 2004).

In remote sensing technology change detection refers to the process of identifying differences in the state of land features by observing them at different times. Remote sensing data can provide reliable information on vegetation cover and change detection described as a process that observes the differences of an object or phenomenon at different times and a proper change detection research should provide the following: area change and change rate; spatial distribution of the changed types; change trajectors of land-cover types; and accuracy assessment of change detection results (Lu, et al., 2010).

Timely and accurate change detection of Earth's surface features is extremely important for understanding relationships and interactions between human and natural phenomena in order to promote better decision making. Remote sensing data are primary sources extensively used for change detection in recent decades https://www.tandfonline.com3/5/2018.

2.15 Image Classification (Geo-spatial Classification)

There are two primary methods of image classification utilized by image analysts, unsupervised and supervised classification.

- Unsupervised image classification: is a method in which the image interpreting software separates the pixels in an image based upon their reflectance values into classes or clusters with no direction from the analyst. Once this process is completed, the image analyst determines the (LC) type for each class based on image interpretation, ground truth information, maps, field reports, etc, and assigns each class to a specified category by aggregation (ERDAS).

- Supervised image classification: is a method in which the analyst defines small areas, called training sites, on the image which are representative of each desired land cover category. The delineation of training areas representative of a cover type is most effective when an image analyst has knowledge of the geography of a region and experience with the spectral properties of the cover classes (Skidmore, 1989). The image analyst then trains the software to recognize spectral values or signatures associated with the training sites. After the signatures for each land cover category have been defined, the software then uses those signatures to classify the remaining pixels (ERDAS, 1999).

2.16 Examples of Change Detection over the world

Izaya, et al., (2010), estimated that 75 % of the world's forest has been deforested; they are converted into farming lands, built uplands, or for wood and paper production. In the U.S., only about 15 % of the original forest remains. In Virginia, almost all the forest was cleared for farms and towns as European settlers arrived in North America and began spreading westward. Similar patterns are found across the globe as farming, expanding cities, building dams, mining, logging, ranching and so many other human actions all the lead to the destruction of ecosystems. It is observed that forest fragmentation is a resulted of wide deforestation. In turn, deforestation became one of the major causes of forest degradation in the Amazon. In these forests, it is noticed that, the biomass collapses near the forest edges, (especially within 100 m, above ground) has potentially and important implications for carbon emissions in the region.

This phenomenon is tightly linked to spatial and temporal dynamics of forest edges in a landscape. However, the potential biomass loss and carbon emissions from forest edges (spatio-temporal changes) have never been studied for the landscapes in the Amazon.

In the northern part of India, where the environment is very harsh, the local communities began massive deforestation and the forestland being converted into non-forest.

This activity left behind many environmental problems, including, fragmentation, habitat damage, erosion, threatened biodiversity and climate change. To ease the problem, a study was conducted in Barak Basin, northeastern India-Assam States.

In Barak Basin, Northeastern Indian-Assam State he time series of the Imaging Spectro-radiometer (MODIS) Terra data Enhanced Vegetation Index (EVI) from 2000 to 2006 were combined into a composite image to observe the changes.

Samilpour, et al., (2000), reported in Eastern Guilan Province, North of Iran during the period (1989-2000). They investigated forestland in relation to anthropogenic activities, via remotely sensed techniques using NDVI, NDVI rationing, Tasseled Cap (KT) and change vector analysis when changes were detected.

In Europe, Spain experienced frequency forest destruction, either by human or nature. Fire is the factor for forest devastation in Spain since. García, et al., (2005) Studied forested area in central Spain, where they employed a set of 10 widely fragmentation indices. Tonya, et al., (2000) worked on forest fragmentation assessment in New Hampshire. They investigate forest fragmentation, and how the converted forestland affected and being affected by humans and natural factors, particularly the animal behavior, plant seed dispersal, hydrology and local weather conditions. Moreover, another study was carried out to investigate the changes in (LU) and (LC) over 40 years during the period (1969-2008). He utilized remote sensing approach using Taluk map of Kodaikanal (1969), and Landsat imageries of May 2003 and April 2008.

Land use and land cover classification was performed based on Survey of India Kodaikanal Taluk map and Satellite imageries. Moreover, GIS software also used to prepare the thematic maps.

Ground truth observations were also performed to check the accuracy of the classification. The study also investigated the changes in agricultural land, built-up area, biodiversity, harvested land and waste land. Even the Arab countries, which have very limited forest, are facing the issue of (LU) and (LC) change and the consequences. Among these countries, Jomaa, et al., (1998), employed three Landsat images of different dates; July (1987, 1994, 1998) which were analyzed to detect the changes in Hermel and Dahe El Baidar area in Lebanon. The images were Atmospherically Corrected by ATCOR2. The software ERDAS-IMAGINE was used for further analytical processes. A hybrid approach was carried out between the multi-temporal unsupervised classification and vegetation index differencing to simplify the search for change and no change pixels. The classification was performed on 12 bands images, i.e. the bands 1, 2, 3, 4, 5 and 7, and they were generated twice in the images to obtain the possible land cover change.

In the Sahelian region in Africa, large forestlands were converted to farming and overgrazing grassland (Suliman, 1988).

Gotfried, (2010) studied land use and land cover patterns in three areas in South Ghana, namely, Yensiso, Skesua and Amanase reflected a great reduction in vegetation.

In the United States, Xiaojun, et al., (2002) studied the drivers of land use and land cover change and their dynamics for the Atlanta, Georgia via Landsat (MSS, TM and ETM+ images) during the periods (1973, 1979, 1987, 1993 and 1999), they investigated how the sub-urbanization was developed. Similar study was conducted in the United States by United States Department of Agriculture (USDA), Forest Service's Forest Pest Management Program (FPM), California Department of Forestry's (CDF), Forest Resource Assessment Program (FRAP), and Forest Pest Management Program (CDF-FPM) on large-area change detection covered the state of California over a five-year period, the goal was to implement a long-term, low cost and high-quality monitoring program to identify trends in forest health (assess changes in vegetation extent and composition) and provide data for updating regional vegetation and fire perimeter maps.

The program provided current monitoring information across all ownerships and vegetation types represented in California.

Simone, et al., (2005) studied vegetation's with new concept and approach which can improve resources monitoring. He investigated forest fragmentation by studying forest structure and vegetation indices instead of forest area reduction (Quantitative). The study was conducted in Atlantic rainforest fragments in southeastern Brazil. Two Landsat 7 ETM+ images acquired in humid and dry seasons were used. Measurements of forest structure in nine forest fragments and in a continuous forest area in the Guapiac River Basin in Rio de Janeiro State were taken. Three vegetation indices (normalized difference vegetation index (NDVI), moisture vegetation index using landsat's band 5 (MVI5) and moisture vegetation index using landsat's band 7 (MVI7) were correlated with measurements of forest structure (frequency of multiple-stemmed trees, density of trees, mean and range of tree diameter, mean and range of tree height and average of basal area). Models describing the relationships between forest structure and vegetation indices using linear regression analysis were also developed.

The result of the study in nature and changes of vegetation across the area extends along the border between Nigeria and the Niger Republic, roughly located between latitudes 120 40'1N and 130 20'N, and longitudes 70 00'1E and long 90 00'E, within varying degree of vegetation resource management indicates that; the trends of vegetation changes in the area loss of ecological stability and highlighting the continuing land degradation in the border region, also decline in the amount of soil moisture, as a result of the long-term changes in precipitation patterns leading to frequent droughts, as the major cause of vegetation change, this finding is consistent with (Sop, et al., 2011).

Though several studies have been done to investigate the links between drought and vegetation productivity (Zhao, et al., 2010; Meroni, et al., 2017), less were known about how this relationship impacts the land surface temperature (LST) and causes warming anomalies in the Horn of Africa.

This nationwide project was developed by biologists to map biodiversity and identify 'gaps' in its protection. Several biological variables, such as vegetation, vertebrate distributions, and endangered species, are entered into a GIS, from which biodiversity maps are generated, which are then overlain with land management and ownership data. Unprotected components of biodiversity are identified as 'gaps'. Specifically, Arkansas GAP Analysis maps were created from Landsat Thematic Mapper satellite imagery and GIS maps of geology, topography, and soil and other physical features, and databases of species occurrence and habitat characteristics. Such a database for the entire State of Arkansas contains a wealth of important and viable environmental data and information from which additional research may be compared.

Poverty is another major driving force of vegetation degradation in Southwestern Mauritania area. Major physical and man-made(socio-economic activities and land use) driving forces of vegetation change in (north-south) area the expansion of agricultural land as the major causes of tree species changes, tree lopping for animal feed during the dry season, poor tree planting and management programmes among others and bush burning by the local farmers during the dry season for land preparations for the next farming season also accounts for a loss in vegetation by killing the young indigenous species, especially those found on the farmlands, which is consistent with Niang, et al., (2008).

Khan, et al., (2013) founded that human cultural habits and land use affect the vegetation condition which is also corroborated by Hiernaux, et al., (2009b).

CHAPTER THREE

MATERIALS AND METHODS

3. 1 Introduction

The study area Qala Al-Nahal locality located in the Western part of Gedaref State, It is about 70 km from Gedaref city. The total area of the locality is 4000 km², situated within the longitudes 36° 45´- 34° 45´E, and latitudes13°- 13° 45´N With elevation about 603 m above the sea level. It was considered a major market for agricultural, horticultural, forest, and livestock production in the region, as well as in the networks of land and railway links between the Eastern Sudan to the capital Khartoum through my city Sennar and Wad Madani. The climate of the study area was classified as semi-tropical (low latitudes) within the dry savannah climate with average temperatures of 40 ° C in summer and the lowest months with temperatures dropping to 16 ° C, while the rain abundant in August. The rainy season starts from July to November, with an average rainfall of 150 to 400 mm /year www.sciencedaily.com/April2019.

3.2 Field work

3.2.1 Sampling frame

Before the study area visit; the study area was determined by selecting the path/row (171/51), where the study area located in planet map in earth explore web side. Then the availability and the quality of the images were verified, after that the image was downloaded from (Land-sate 1, 5 and 8). The study area was stacked from the Image by (upper left and lower right) coordinates, which equal (14% =576.625km2) from the total study area and situated in South West of Qala El Nahal city. Then enhanced and classified in Unsupervised Classification image, Geo-referenced and Rectified using the Datum World Geological Survey (WGS 1984) and Projected Coordinate System Universal Transfer Mercator (UTM-Zone

36) Figure (3.1) the operation involved both ERDAS 8.5 and ArcGIS 9.3 as geotreatment's tools.

3.2.2 Sampling design and selection method

Unsupervised classification outputs have been used to stratify the study area into different numbers of strata depending on their spectral relativity and the stratified random sampling was used. The total sample units were then selected randomly from all strata, the selection from each stratum depending on the proportion of the stratum sampling units, the study area divided into 150 quarter sample and the sample size equal ($200m^2$) for the observation.

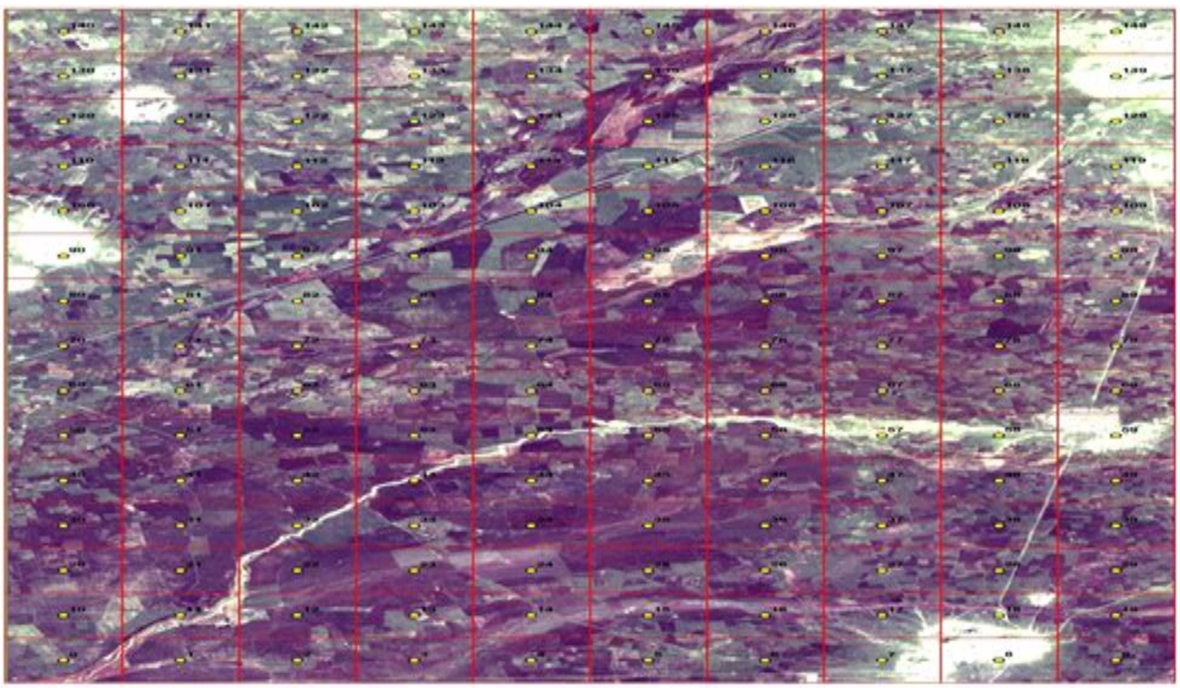


Figure (3.2.2.1): Unsupervised classification image for sampling unites 2014.

3.2.3 Field work activities

This field work carried out during January, 2014 to December, 2018. The first visit carried (in December, 2014) to check the location of the study area and measure (Vegetation and soil samples), the second visit (in December, 2015) also to measure (Vegetation and soil samples) too. Moreover, land features such vegetation; wadys and land use are documented by photos. The last visit (in April, 2018), questionnaires and observations were conducted.

3.3.1 Primary data

3.3.1.1 Remote sensing data

3.3.1.1.1 Source of data

A series of satellite data were used to assess the vegetation cover change of selected area in Qala El-Nahal Locality for the period 1972, 1984 and 20018, they were downloaded free of cost from earth explore.

3.3.1.1.2 Methods of image processing

Imageries were processed to determine the vegetation cover categories for the recent and the early images, and then pre- and post-classification methods were used to detect changes in vegetation cover classes in the area.

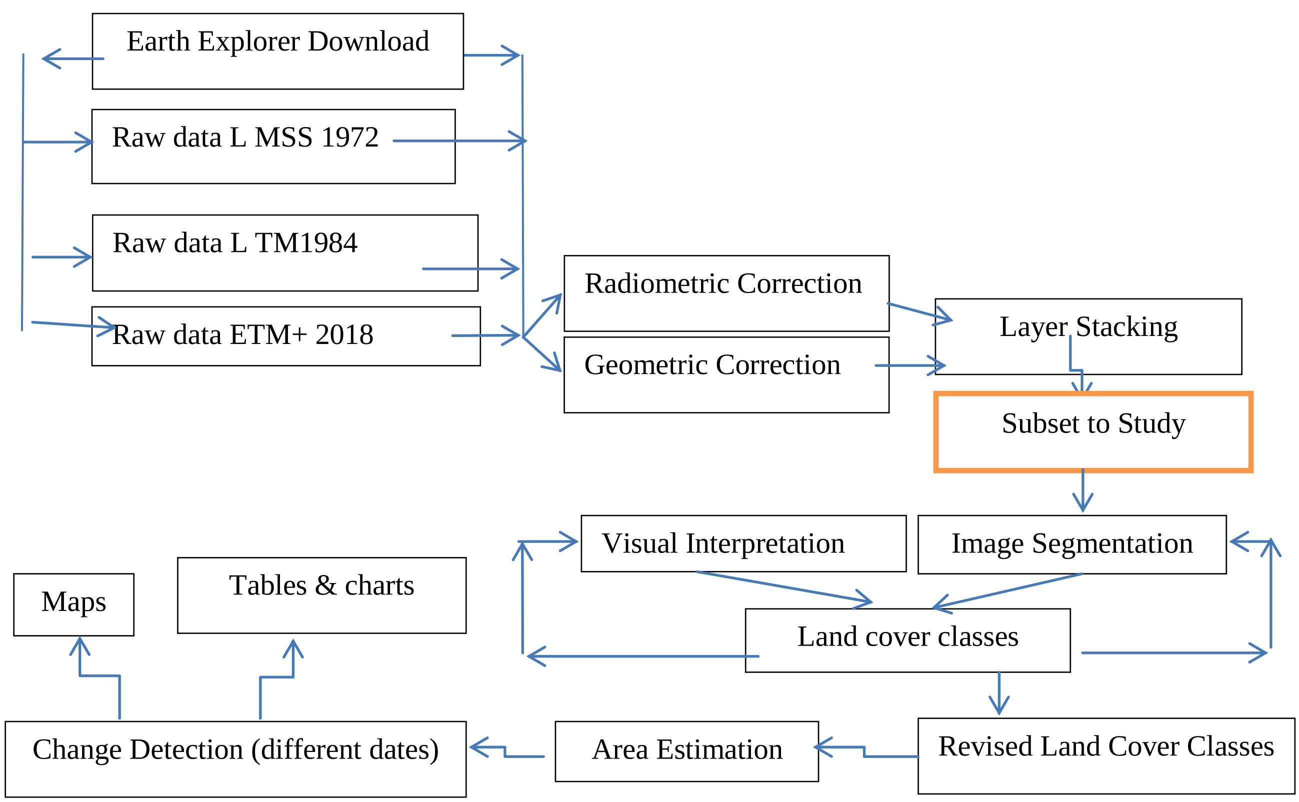


Figure (3.3.1.1.2.1): Stapes of change detection

The images Geometric and Radiometric correction were applied to reduce the systematic errors (distortion) and random distortion of data was corrected by selection of a sufficient number of ground control points (GCPs) with reference coordinates. Then the images were georeferenced by using UTM Map projection zones 36 and datum of World Geological System (WGS84). Dark Object Subtraction (DOS) is carried out after visual interpretation of histograms of each band for datasets 1972, 1984 and 2018.

3.3.1.1.3 Image Enhancement

The grey level stretching the edges technique is used to improve the contrast and spatial filtering for enhancing the edges of the images. Multi-band geo-tiff was stacked to be used in ERDAS Imagine and the study area was cutout from the image into a smaller and manageable file include the area under the study. Visual interpretation of various band combinations as a preparation for field work was done to learn about the separability of apparent of vegetation cover (VC) classes.

Unsupervised classification was applied and study area was revisited to check the vegetation cover classes, by the aid of Remote Sensing (RS) and Geographical Information System (GIS) techniques particularly the ERDAS IMAHINE version 8.5 and Arc GIS 9.3 the area was enhanced and analyzed, changes in vegetation cover for the different period(1972, 1984 and 2018) were detected and the actual change was obtained by the direct comparison between classified images, after that the data presented in form of maps, table and charts Figure (3.3.1.1.2.1).

3.3.1.1.4 Ground Truth Points in the study area

The importance of ground truth points concentrate on the correction of randomization by the selection of a sufficient number of ground control points (GCPs) with reference coordinates; this was done by the aid of map and ground control points (GCPs) measured in the field by Global Positioning System (GPS).

GCPs were localized in the satellite image and thus image coordinates were corrected.

The study area was divided into 150 samples 15 samples were selected random the early images (1972, 1984 and 2018) downloaded from Landsat Archive and same processes were carried for comparison the changes between the different periods for vegetation cover changes.

3.3.1.2 Soil properties

3.3.1.2.1 Sampling design and selection method

By Stratified Random Sample (SRS), soil samples were selected randomly by the aid of GPS and Auger, 15 Soil samples in three levels of deeps (0-15) cm, (15-30) cm and (30-45) cm were taken. The samples were analyzed in the Soil Department Laboratory (College of Agriculture, University of Khartoum) Khartoum-Sudan. The study investigate soil texture, soil pH (acidity or basicity in soils), Soil pH controls many chemical processes that take place in the soil and specifically affects plant nutrient availability by controlling the chemical forms of the nutrient. The optimum pH range for most plants is between 6 and 7.5. Many plants have adapted to thrive at pH values outside this range), also soil Electrical Conductivity (EC), the electrical conductivity of the soil extract is used to estimate the level of soluble salts and the soil macro nutrients especially the NPK (Nitrogen, Phosphorous and Potassium) in the soil.

3.3.1.2.2 Determination of the Soil properties in the study Area

Soil texture is one of the most important physical properties of soils; it is related to a number of important soil characteristics such as water holding capacity, soil drainage, and soil fertility. A quantitative determination method of texture gives us a precise measurement of the sand %, silt %, and clay % in a sample; this allows us to use the USDA texture triangle to assign the soil to one of the twelve official classes of soil texture was used. pH meter for soil pH, Electrical

Conductivity Meter for EC, Nitrogen through Digestion, Distillation and Titration by John Kjeldahl (1883) procedure, Phosphorous by Spectrophotometer and Potassium by the aid of Flame Photometer were adopted.

3.3.1.2.3 Analysis methods and presentation

One-way ANOVA table analysis was used for the essential soil elements such as nitrogen, phosphorus and potassium (NPK) to assess the significant differences between and within the soil samples and the arithmetic means to assess the accumulation of the soil elements (Texture, pH, EC, N, P and K) in the different depths to reflect the correlations between these attributes (NPK) pH and EC in the study area, they were presented in the charts.

3.3.1.3. Vegetation cover

3.3.1.3.1 Vegetation covers method of data collection

To study the vegetation dynamics and changes lead to use different techniques and tools, in this study the relevant technique was Mueller (1974) method, which called “The Point-Centered Quarter Method (PCQ)” for vegetation sampling was adopted. Vegetation samples were taken from the same locations from where soil samples were taken.

To achieve the objectives of study, which are; to know if there were any changes in vegetation cover between the 2018 and the past time1972 and to identify the rate, magnitude and the trend of changes and the main driving forces 15 samples were selected randomly.

3.3.1.3.2 Vegetation covers sampling and analysis technique

Randomly; well-located points within the vegetation stand. (100m) transect tape was used. The meter tape is stretched and at each 10 meters of the tape, sample points were marked at interval along the tape where an individual tree was sampled once at successive points. At each sample point, "X" was defined as an imaginary point to define four quadrants from sample point to the nearest tree were recorded. The process was repeated, and then the average for a point sample location was obtained. This average was considered the reading of the point (sample location) Figure (3.3). Moreover, other plant species such as grasses and shrubs were also identified and recorded to have an idea about the dominant ones in a particular location.

The records of each sample were arranged in Annex- A (Tables, 3.1, 3.2, 3.3, 3.4 and 3.5). Then the vegetation parameters are calculated according to the following procedure and equations.

Step1. Calculation of the total distance (dt): -

$$dt = \sum_{i-1}^{n} di = \ldots\ldots\ldots\ldots \text{ meters.}$$

Where dt is the total distance, di is the distance to tree number i, and n is the total number of trees.

Step2. Calculate the average distance between trees, ($\bar{d}$):

$$D = \bar{dt} / n \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{meters.}$$

Step3. Calculate the average area occupied per tree, (A):

$$A = \bar{d^2} = \ldots\ldots\ldots\ldots\ldots\ldots \text{ meters}^2.$$

Step4. Calculate the absolute density for all trees, (Da), in trees per hectare (ha).

$$Da = (10 \text{ m})^2 / A^2 = \ldots\ldots\ldots\ldots \text{ trees/ha.}$$

The data was presented in the tables and chart.

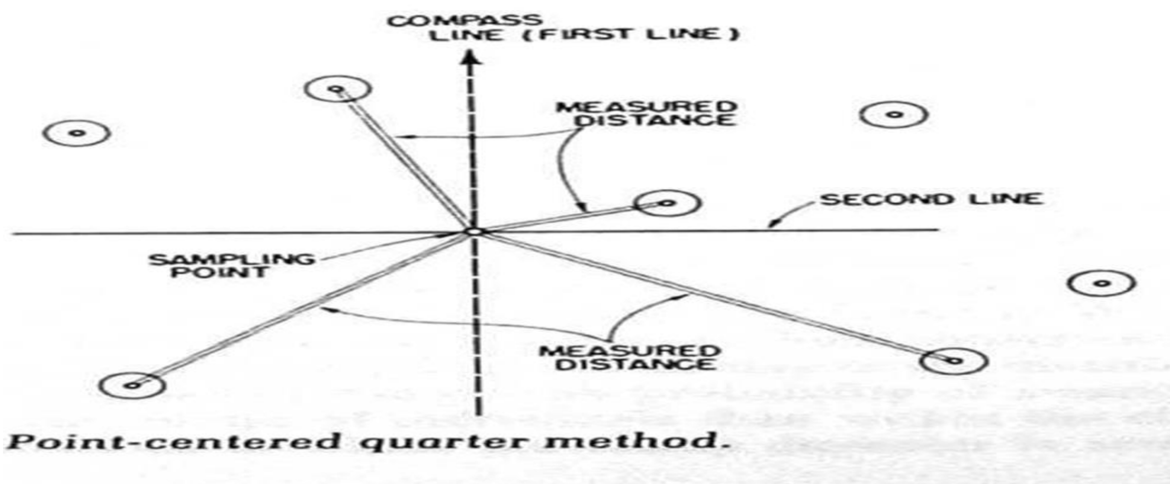


Figure (3.31.3.2.1): Sampling technique (Central quarter point method).

3.3.1.4 Metrological data (Rainfall and Temperature)

Rainfall and Temperature affect the viability and variability of vegetation in any area beside the anthropogenic activities; Rainfall and Temperature data were used to reflect the fluctuation in the average annual rainfall and temperature during (1972 to2018) and Evolutions of Standardized Anomaly Indices (SAI). Trend of rainfall and temperature from the average mean during (1972-1986, 1987-2001 and 2002-2017) for three time series were calculated. The Standard deviation and the average were used for data analysis and the results presented in liner chart.

3.3.1.5 Questionnaire data

Covered many issues such as the general information about the area, respondent or personal information, socio economic backgrounds of the respondent, climatic variability, situation of the early vegetation cover and the respondent recommendations to recover and conserve the vegetation in the study area. The target group is the head of the household mainly above the 40 years old, 150 out of 8050 household (2%) were selected randomly and descriptive analysis manly frequency table and chart were adopted.

3.3.2 **Secondary data**

Secondary data collected from literature review, previous studies, books, texts and websites.

3.3.3 **Methods of data analysis:**

3.3.3.1 Mueller (1974) method used to identify the types, dominant, density and the distribution of plant species in the study area.

3.3.3.2 One-way ANOVA table analysis used for the essential soil elements such as nitrogen, phosphorus and potassium (NPK) to assess the significant differences between and within the samples.

3.3.3.3 The average or arithmetic mean also used to assess the accumulation of the soil elements (Texture (Clay, Silt and Sand), PH, EC, N, P and K) in the different depths and to reflect the correlations between the (NPK), pH, EC in the soil.

3.3.3.4 Evaluation of Standardized Anomaly Indices (ASI) for Rainfall and (minimum and maximum Temperature) from Gedaref station (1972 to 2017) was used.

3.3.3.5 Descriptive analysis (frequency table) for social information.

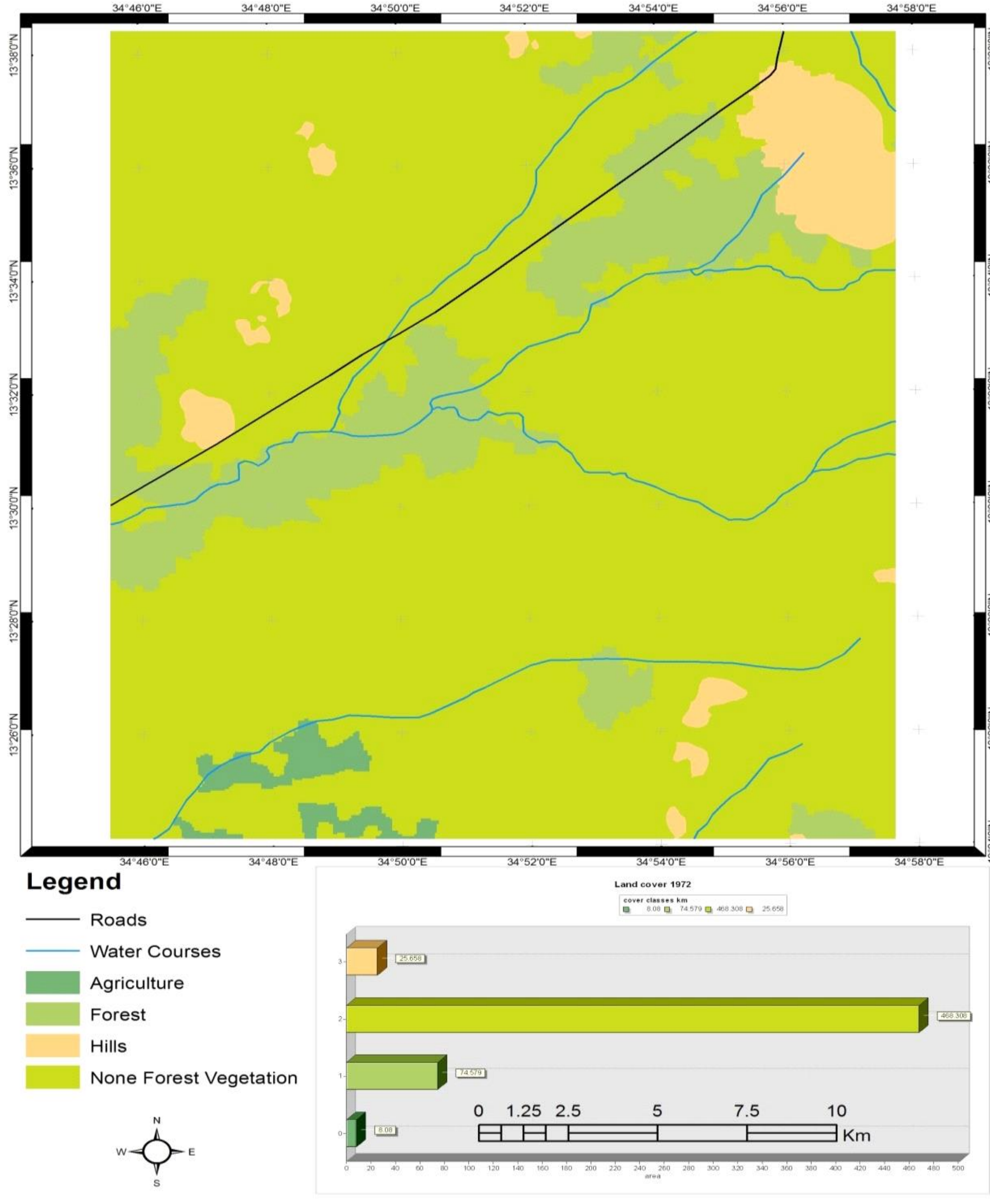
3.3.4 **Data presentation**

The data presented in images, tables and chart (columns and line).

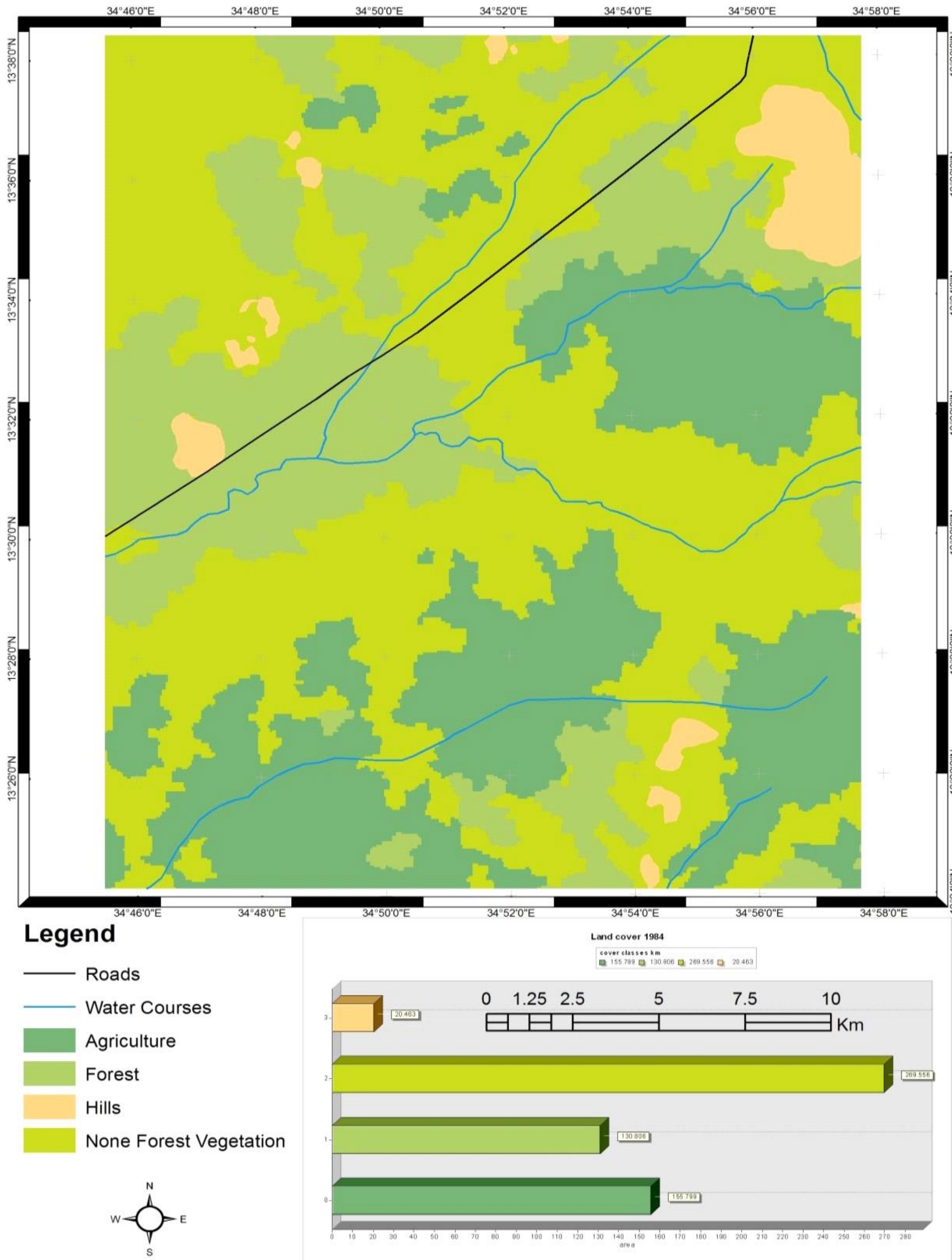
CHAPTER FOUR

RESULTS AND DISCUSSION

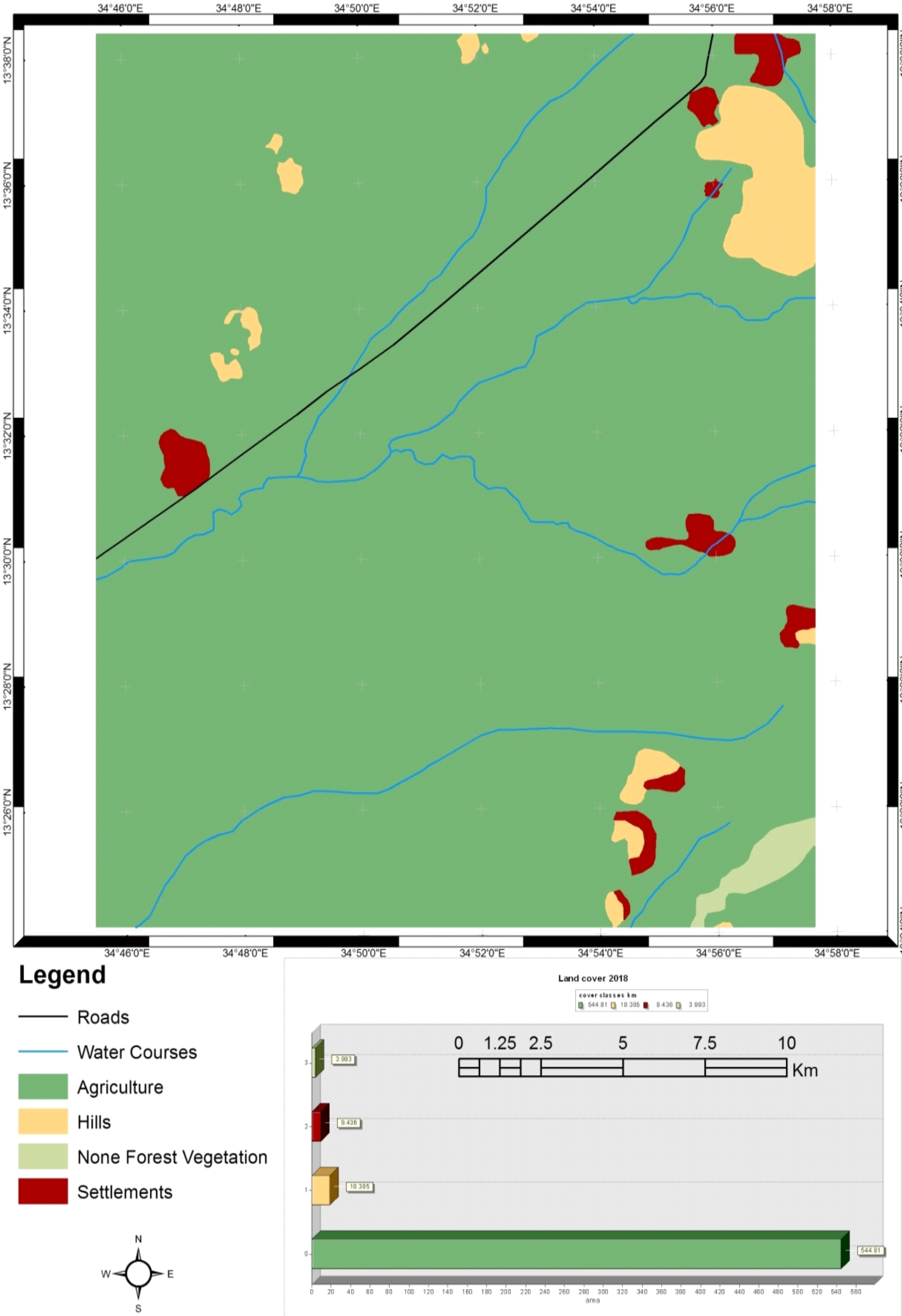
4.1 Results of Satellite images Analysis



Map (4.1.1): Land cover/ land use classes in the study area 1972



Map (4.1.2): Land cover /land use classes in the study area 1984



Map (4.1.3): Land cover/ land use classes in the study area 2018

Maps (4.1.1), (4.1.2) and (4.1.3) reflect the results of the satellite data during the periods 1972, 1984 and 2018 respectively. According to these figures, five level classes of land cove are produced; these are grass land, agricultural land, forest lands, hills area and settlement areas. These features of land cover land use were identified visually, with the different colors such as black, blue, dark, chartreuse, pale green, dark green and sandy. These colors represent roads, water course, settlement areas, grasses, forest land, agricultural land and the hills area respectively.

Table (4.1.1) and figure (4.1.1) show the result of the statistical analysis of the different land use land cover categories and their area in km^2. Table (4.1.2) illustrates the land cover classes in % from the total area. Table (4.1.3) and figure (4.1.2) reveal the accumulative changes in land cover classes (Km^2), while tables (4.1.4) and (4.1.5) show the area of land cover categories conversion from one category to another one in the study area.

Table (4.1.1): Land use land cover classes in the study Area at Qala El-Nahal Locality (Km^2) (1972,1984 and 2018)

Years	Grasses	Agriculture	Forest	Hills	Settlements	Total area/km^2
1972	468.308	8.08	74.579	25.658	0	576.625
1984	269.556	155.799	130.806	20.464	0	576.625
2018	3.993	544.81	0	18.385	9.436	576.625

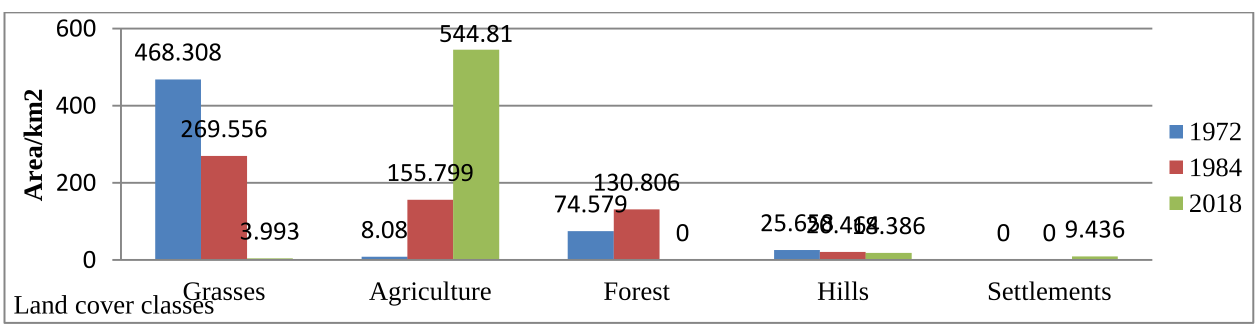


Figure (4.1.1): Land use land cover in the study area at Qala El-Nahal Locality (1972-2018).

Table (4.1.2): Land use land cover classes % from the total of the study area (1972-1984-2018)

Classes	Years					
	1972		1984		2018	
	Change/km^2	%	Change/km^2	%	Change/km^2	%
Grass land	468.308	81	296.556	46.7	3.993	0.7
Agricultural land	8.08	1.7	155.799	27.1	544.81	94.5
Forest land	74.579	12.9	130.806	22.7	0	0
Hills area	25.658	4.4	20.464	3.5	18.386	3.2
Settelment area	0	0	0	0	9.436	1.6
Total	576.625	100	576.625	100	576.625	100

Table (4.1.3): Accumulative changes in land cover classes (Km^2) in study area in the period (1972, 1984 and 2018)

Changes in land classes	Change in area (Km^2) and %					
	1972-1984 Change	Change %	1984-2018 Change	Change %	1972-2018 Change	Change %
Grass land	-198.752	-42.44	-265.563	- 98.52	-464.315	-99.15
Agriculture land	147.719	94.81	389.011	71.40	536.73	98.51
Forest land	56.227	42.98	130.806	-100	-74.579	-100
Hills area	-05.194	-20.24	-2.178	-10.64	-7.272	-28.34
Settlements area	0	0	9.436	100	9.436	100

Figure (4.1.2): Accumulative changes in land cover classes (Km2) in the period (1972, 1984 and 2018)

Table (4.1.4): Areas of common land-cover conversions by time interval during 1972- 1984

Land cover conversion			
Decreased area(Km2)	From	To	Converted area (Km^2)
198.752	Grasses land	Agricultural land	147.719
		Forestry	51.033
5.194	Hills area	Forestry	5.194

Table (4.1.5): Land Cover conversion during the period 1984-2018

Land cover conversion			
Decreased area(Km2)	From	To	Converted area (Km^2)
	Grasses	Agricultural land	256.127
		Residential areas	9.436
	Forest	Agricultural land	130.806
	Hills area	Agricultural land	2.078

4.1.1 Land use and land cover change results

The spatial distribution of land use classes in the study area in the different periods indicated that: the land use classes were changed during the periods (1972, 1984 and 2018) table (4.1.1, 4.1.2 and 4.1.3) and Figure (4.1.1 and 4.1.2) reflected that.

The grasses land in 1972 was about 81.3% (468.308 Km^2), it decreased to 46.7% (269.556 Km^2) in 1984, while dropped to 0.7% (3.993 Km^2) in 2018.

The agricultural land in 1972 was about 1.4% (8.08Km^2),it increased to27.1% (155.799Km^2) in 1984, while in 2018, it increased up to 94.5% (544.81Km^2).

The forest land was about12.9% (74.579Km^2) in 1972, and then it increased to reach about 22.7% (130.806Km^2) in 1984, while it completely (100%) was destroyed in 2018.

The hills area covered about 4.4% (25.658Km^2) in 1972; it decreased to reach 3.5% (20.464Km^2) in 1984, while it dropped to 3.2% (18.386Km^2) in 2018.

No residential area in 1972 and 1984, while there is a fraction of the settlement in the study area about 1.6% (9.436Km^2) in 2018.

Table (4.1.3) and figure (4.1.2), described the accumulative changes in land cover classes as follows: grasses land decreased to (-42.44%) (-198.752 Km^2) during (1972 to 1984) with decreasing rate 3.5% per year, while during (1984 to 2018) also decreased to (- 98.52%) equal (-265.563 Km^2) with decreasing rate 2.8% per year.

Generally grass land was decreased from (81%) (468.308 Km2) to (0.7%) equal (3.993 Km^2) during (1972 to 2018) with decreasing rate 2.2% per year.

The agricultural land was increased from (1.4%) (8.0814 Km^2) to (94.5%) equal (544.81Km^2) during (1972 to 2018) with decreasing rate 11.66% per year.

The forest land was increased from (12.9%) (74.579 Km^2) to (22.7%) (130.806 km^2) during (1972 to 1984) with rate 4.7% , while it was decreased to scattered trees during (1972 to 2018) with decreasing rate 3.8% per year.

Many studies were conducted a round the world to investigate (LU) and (LC) change. Among these, study by Ramankutty and Foley (1999). they studied that; the global expansion of croplands since 1850 had converted about 6 million km^2 of forest/woodlands and 4.7 million km^2 of savanna/grassland/steppe vegetation, within these categories, respectively, 1.5 and 0.6 million km^2 of cropland have been abandoned. Foley, et al., (2005), reported that; the modern agriculture has been successful in increasing food production; it has caused extensive environmental damage leading to a net loss of approximately 7 to 11 million km^2 of forest in the past 300 years. This demonstrates that agriculture and other closely related land uses are the major causes of land cover change leading to land degradation in many parts of the world. Gang, et al., (2014) documented that; globaly about 49% of the grassland ecosystem suffered from the degradation from 2000 to 2010 as a result of climate change and human activities and 33% of this degradation is as a result of overgrazing, agriculture and urbanization. Furthemore, some cases studied restoration of grassland degradation was recorded due to a government effort in limiting the effect of human-induced land cover change as Cai, et al., (2015). However, many studies were conducted over the world to investigate Land Cover change in sub-Saharan West Africa have showed a decrease in tree density and changes in species diversity in the last half of the 20th century inspite of the greening trend (Herrmann, et al., 2016). (Gonzalez, 2001) proposed the changes were directly attributable to land degradation (caused by climate change and human activities) due to the increasing in aridity, human population and changes in the natural vegetation species composition, while (Charney, et al., 1975; Kucharski, et al., 2013) proposed, increased surface albedo which may further enhance the dryness of the region and Hiernaux, et al., (2009b) stated that; the changes in land use, grazing pressure and soil fertility can influence changes in vegetation composition with a strong decline in species diversity.

Niang, et al., (2008) illustrated that; poverty is another major driving force of vegetation degradation in Southwestern Mauritania. Major physical and man-made(socio-economic activities and land use) driving forces of vegetation change in (north-south) area the expansion of agricultural land as the major causes of tree species changes, tree lopping for animal feed during the dry season, poor tree planting and management programmes among others and bush burning by the local farmers during the dry season for land preparations for the next farming season also accounts for a loss in vegetation by killing the young indigenous species, especially those found on the farmlands, which is consistent with. Moreover, Khan, et al., (2013) found that; human cultural habits and land use affect the vegetation condition which is also corroborated by Hiernaux, et al., (2009b), and (Brink and

Eva,2009) links in their study; a series of environmental disruptions over the last three decades in sub-Saharan West African considered as a result of land degradation, these disruptions are manifested in changes of the natural vegetation cover, where agricultural expansion and other human activities are degrading natural vegetation cover. For instance, a study by Hiernaux, et al., (2009a); found a decrease in tree cover due to fuel wood cutting, land cultivation and overgrazing. A 57% increase of agricultural land was recorded throughout the West African Sahel from 1975 to 2000 at the detriment of natural vegetation which decreased by 21%, It is estimated that about five million hectares of natural forest and non-forest vegetation are lost annually in the region.

However, as the result of population expansion in South Darfur State and Edd Al-Fursan area particularly as well as of climatic variability the demands on land have increased leading to intensive agriculture which was characterized by the over cultivation of land, overgrazing by animals and deforestation (Masarra, 2012). Furthermore, Southern Gadaref region has changed drastically since the introduction of mechanized rain-fed agriculture in the area, the agricultural expansion was on the expenses of the natural vegetation cover. The average natural vegetation clearing rate was around 0.8% per year, and the most rapid clearing occurred during the seventies when conversion rates increased to about 4.5% per year (Hussein, 2010). Other study by Fangama (2015); to detect the unfavorable influences on natural forests at refugees Camp in Qala Elnahal Locality, Gedaref State, the study resulted that; the natural forests were subjected to heavy damage caused by the settlement of large numbers of refugees in the area and the land and hills become naked. Also Serra, et al., (2008) mention that the dynamic change of LULC is mainly influenced by biophysical and human driving forces.

Also Yagoub, et al., (2017) reported that: the major trends were drastic conversions of natural vegetation into large-scale Mechanized Rainfed Agriculture (MRA) which increased from 1058241.2 ha in 1981 to 2459264.7 ha in 2013. This resulted in a progressive loss and degradation of rangeland areas in Gedaref state; rangeland was decreased from 4342154.2 ha in 1986 to 3473940 ha in 2013. Forest area and rangeland are reduced due to of expansion in modern mechanized farming as a result of increasing human population to satisfy an increasing demand for food.

4.2 Soil properties

4.2.1 Physical properties

4.2.1.1Soil texture

The results of soil particle analysis showed that; the clay texture is the dominant in the study area (56.52%), followed by silt (35.1%) and sand (8.38%) (Figure, 4.2.1.1) and)Plate,4.2.1.1.1), similarly to Laing (1953) wrote; Gedaref State is the vast plain of clay soils, where the clay fraction varies from 61% to 73%, the vertisol soil occurs in the tropics, subtropics and warm temperate zones (Dudal, 1965) this result reflect the clay fraction was decreased in the study area.

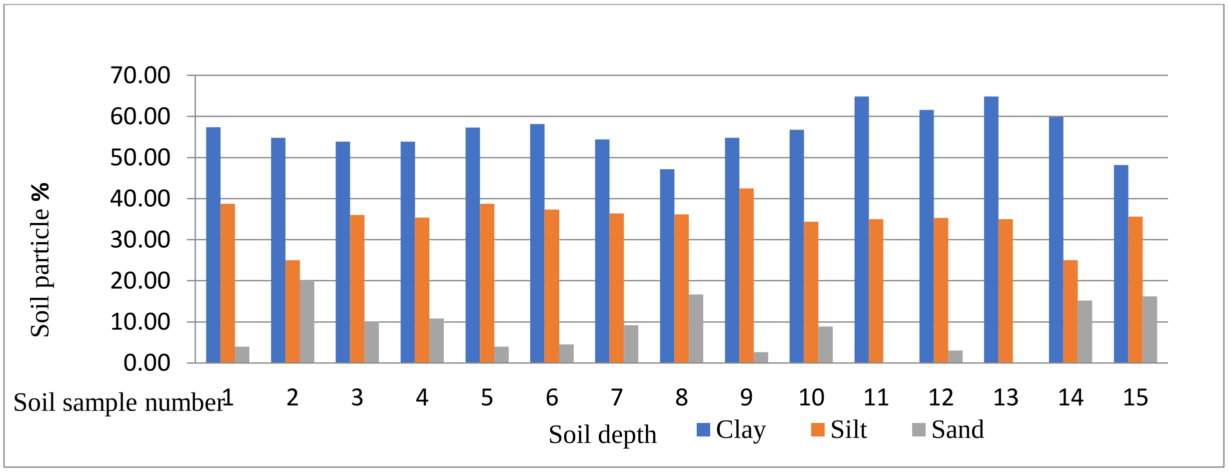


Figure (4.2.1.1.1): Soil texture in the study area (2014-2015)

Plate (4.2.1.1.1): Type of soils in the study area (2014-2015).

4.2.2 Chemical properties

4.2.2.1. Soil pH

Figure (4.2.2.1.1) Showed that; The average soil pH ranges between 7.25-8.28, that means from non-saline to moderately alkaline, while Figure (4.2.2.1.2) reflects the soil pH is high at soil sub-surface (30-45 cm) compared to the soil surface (0-15 and 15- 30 cm), this result nearly the same as Berhanu (1985) studies found that; the pH of Vertisols increases with depth, the topsoil being neutral or weakly acidic, where about 61% of the Vertisols have pH values of 5.5- 6.7, About 21% have pH values of 6.7-7.3, and 9% have pH values of more than 8. The Vertisols showed marked heterogeneity in terms of pH.

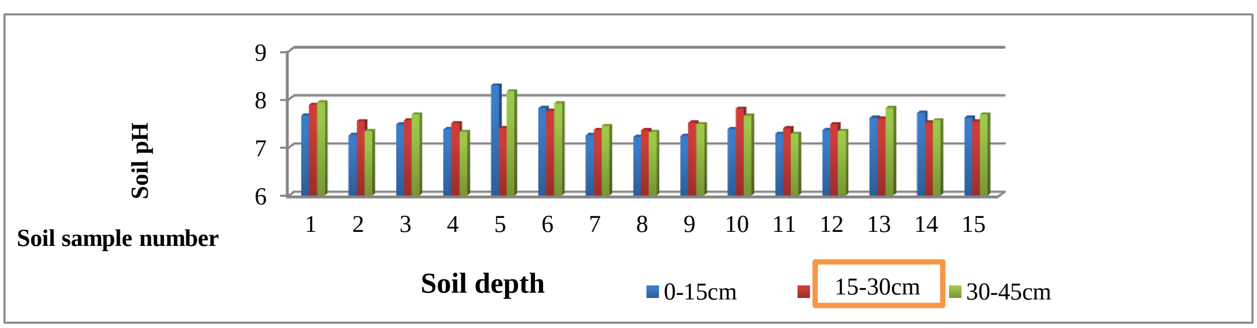


Figure (4.2.2.1.1): Average Soil pH for different soil samples in the study area (2014-2015)

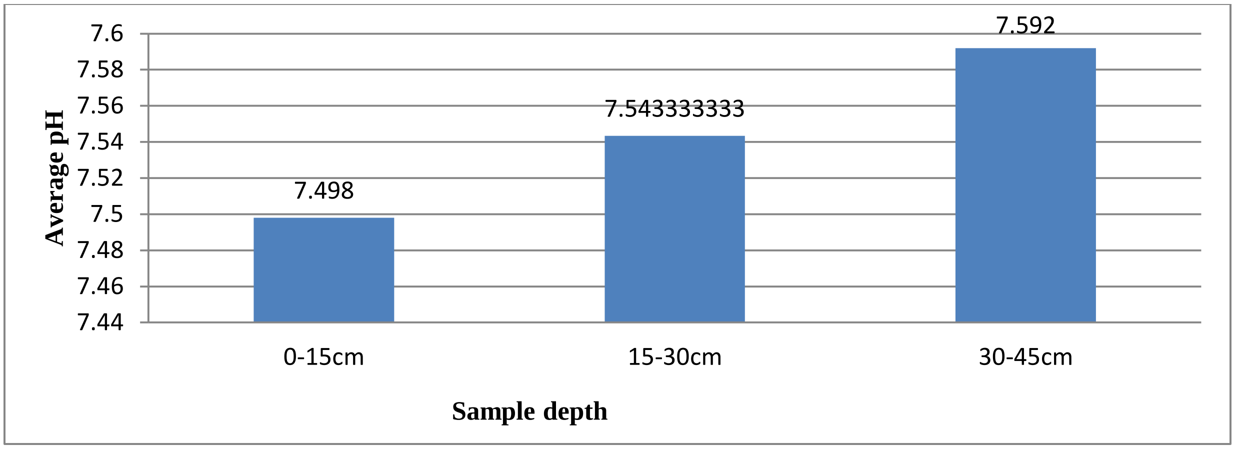


Figure (4.2.2.1.2): Average pH in different soil depths in the study area (2014-2015)

4.2.2.2 Soil Electrical Conductivity (EC)

The result of soil analysis reflected that the average EC ranges between 0.2 and 1.97 dS/m, so from non-saline to moderately alkaline Figure (4.2.2.2.1). EC usually used to estimate the level of soluble salts in the soil and varies depending on the amount of moisture held by soil particles as (Nassim, 2002). According to (USDA, 2011) stated that; the sands soil have a low conductivity, silts have a medium conductivity, and clays have a high conductivity. Consequently, EC correlates strongly to soil particle size and texture, so EC increases as clay content increases and EC less than 2 ds/m ($0 < 2$) non-saline, this evident support the study result (where the amount of EC was high at soil surface (0-15cm) and descending at (15- 30cm) and (30-45cm) depths Figure (4.2.2.2.2)).

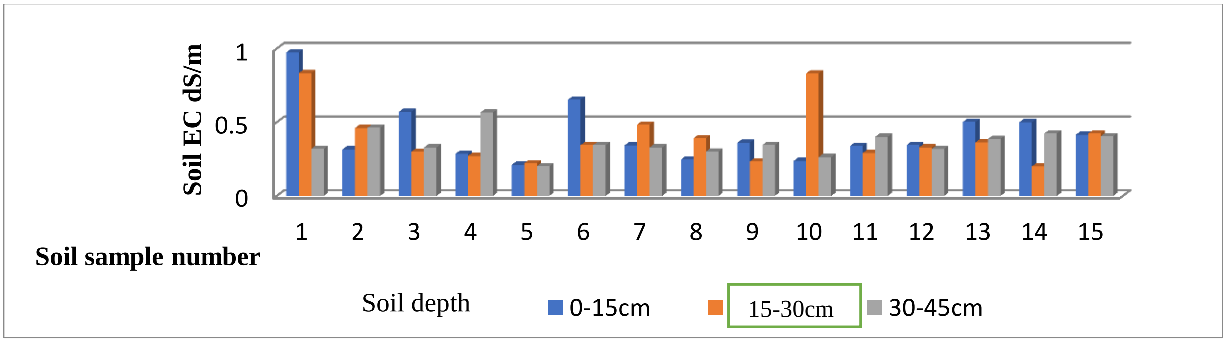


Figure (4.2.2.2.1): The average soil EC at different soil samples in the study area (2014-2015)

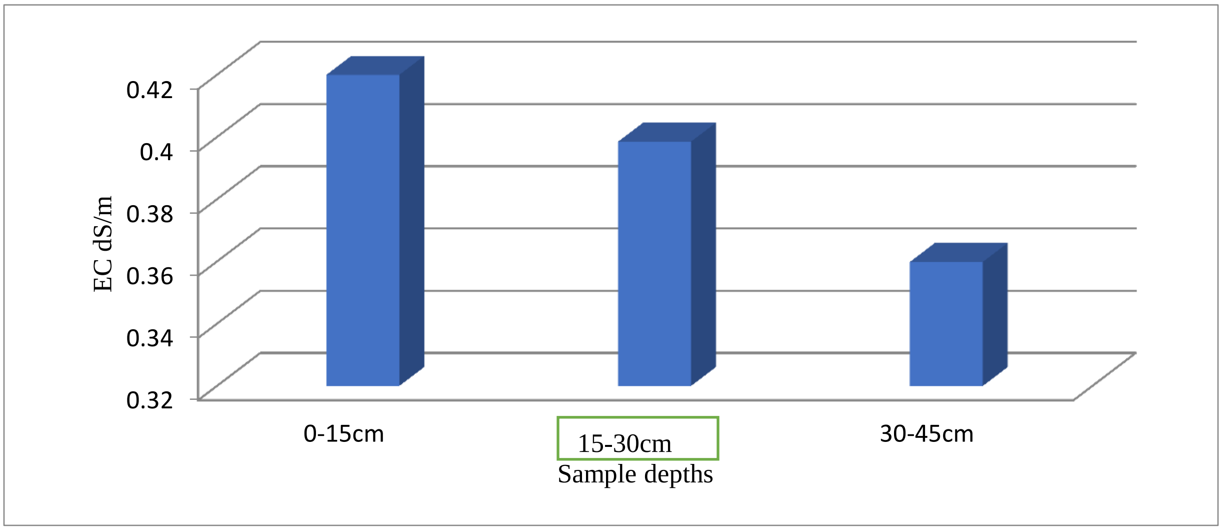


Figure (4.2.2.2.2): Average soil EC in soil depths in the study area (2014-2015)

4.2.3 Soil nutrient elements.

4.2.3.1 Nitrogen content

The calculated (F) value 0.02 compared with tabular (F) value 2.01 in significance value of (0.05) showed no significant differences in nitrogen between and within the soil depths Figure (4.2.3.1.1) this result similar and nitrogen content high at soil sub-surface layer (30-45 cm) compared to soil sub-surface layer (15-30 cm) and soil surface layer (0-15 cm) which reflected the lowest nitrogen content Figure (4.2.3.1.2) this result supported by (Mohammed, 2012) deforestation and subsequent tillage practices decrease soil organic matter at soil depth of 0-30 cm over 20 years in the central Zagrous Mountain in Iran, and continuous cultivation resulted in change of physical (texture and structure) and chemical (reduction of organic matter, nitrogen, magnesium, calcium, phosphorous, potassium and sodium) characters except chlorine compared with adjacent forest land as reported by Mohammed (2007).

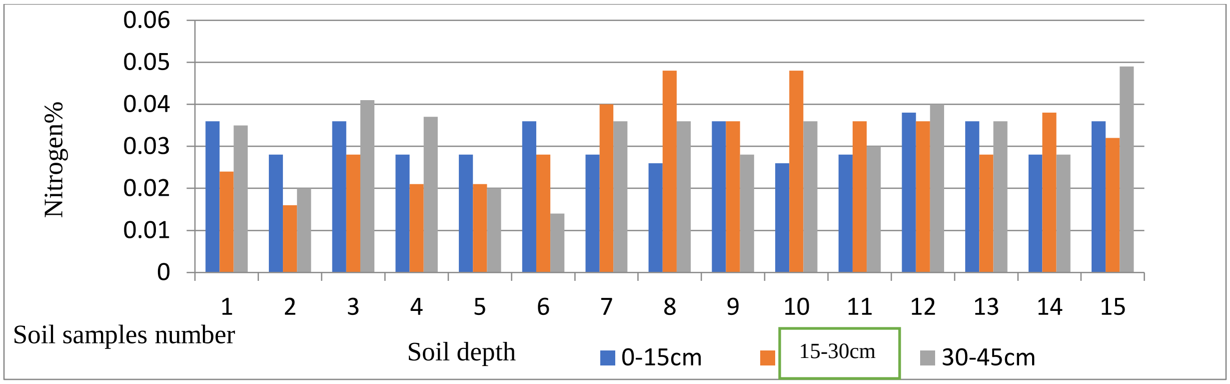


Figure (4.2. 3.1.1): Nitrogen content in different depths in the study area (2014-2015)

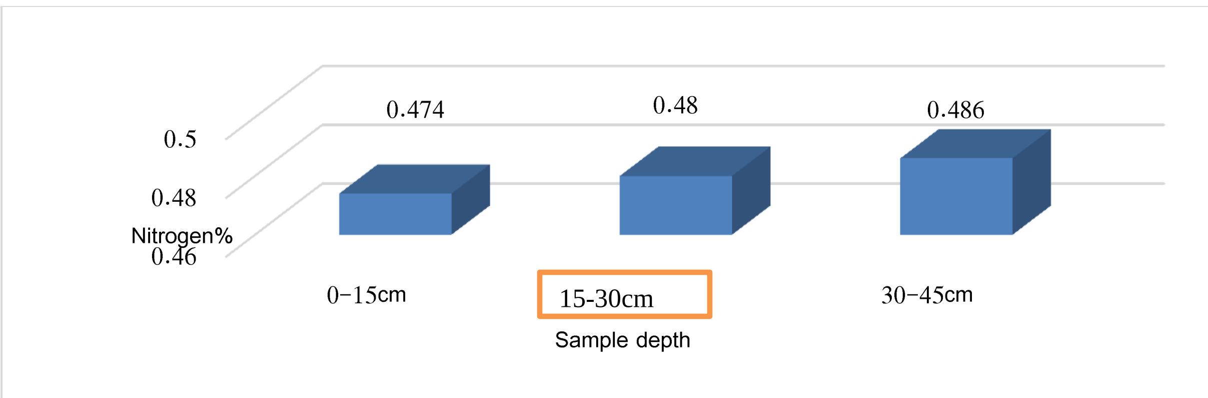


Figure (4.2.3.1.2): Average Nitrogen % in different soil depths in the study area (2014-2015)

4.2.3.2 Phosphorus content

The calculated (F) value 0.2 compared with tabular (F) value 2.01 in significance value of (0.05) showed no significant differences in Phosphorus content between and within the soil depths Figure (4.2.3.2.1.1). The result showed the average Phosphorus content in the study area ranging between 0.186 and 0.408 ppm. This result indicates that, more phosphorus content at soil surface (0-15 and 15- 30 cm), compared with sub-surface (30-45 cm) which reflected the lowest phosphorus content (Figure, 4.2.3.2.1.2), this results was nearly Berhanu (1985), report states that; 70% of the available phosphorus content in the surface horizons (0-30 cm). Phosphorus availability depends on soil pH. David, et al., (1996) reported that phosphorus is generally limited due to its low content in parent material of most Vertisols and its high propensity.

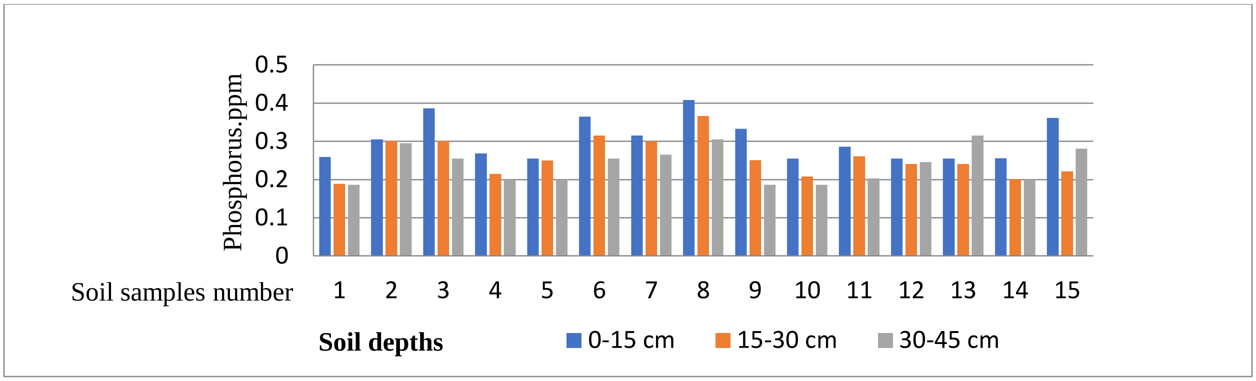


Figure (4.2.3.2.1): Phosphorus content in different soil depths in the study area (2014-2015)

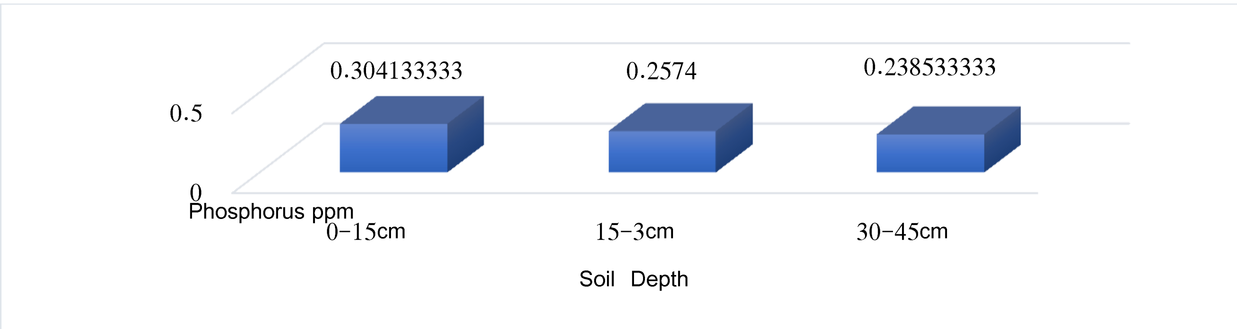


Figure (4.2.3.2.2): Average phosphorus content /ppm in different soil depths (2014-2015)

4.2.3.3 Potassium content

The calculated (F) value 0.0073 compared with tabular (F) value 2.01 in significance value of (0.05) showed no significant differences in Potassium between and within the soil depths Figure (4.2.3.3.1). The average Potassium content in the soil of study area ranged between 0.248-0.027 meq/l, it indicates that, more Potassium content at soil surface (0-15 and 15- 30 cm) compared with sub-surface (30-45 cm) Figure (4.2.3.3.2).

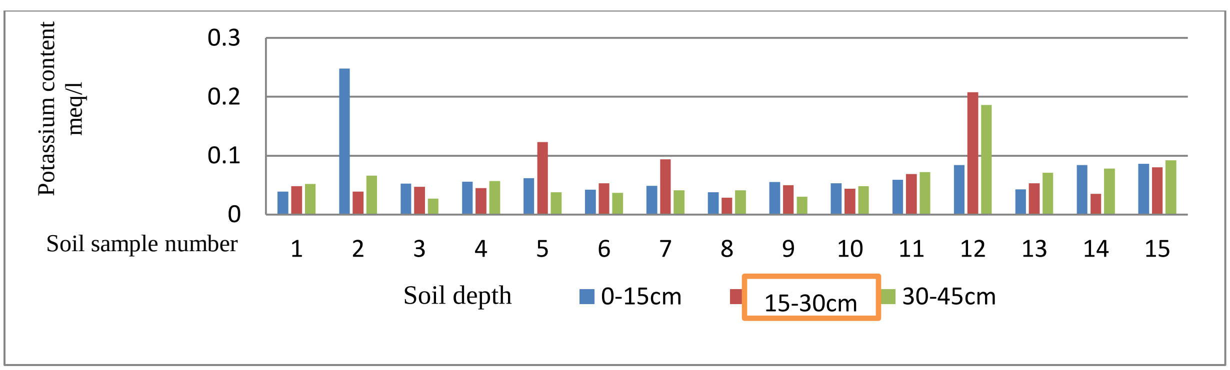


Figure (4.2.3.3. 1): Potassium content meq/l at different soil samples depths (2014-2015)

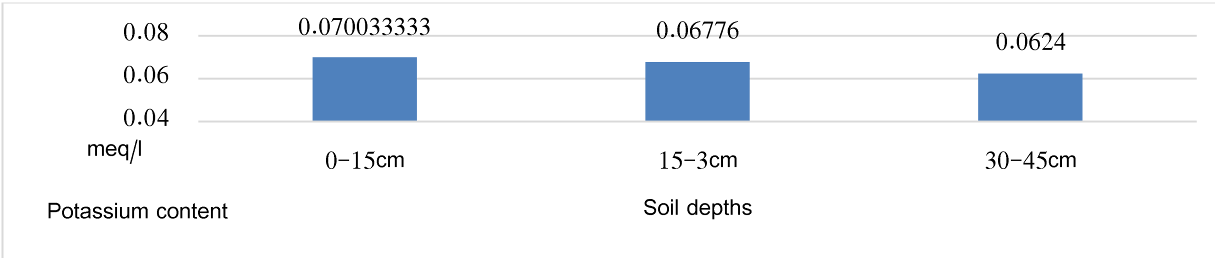


Figure (4.2.3.3.2): Average Potassium content meq/l in different soil depths (2014-2015)

The critical limit of exchangeable K varies from soil to soil and from crop to crop. However, the response could be better explained if we include non-exchangeable K also into fertilizer recommendations (Dudal, 1965).

Generally, Thiagalingam (2003) study reflected that; the fixation of added phosphorous is pH dependent, as acid soils with high iron and aluminum, the P will be unavailable, this statement indicates that the soil pH increases with the soil depth, while the phosphorus and potassium were decrease with depths this result illustrated by figures (4.2.1.2.2), (4.2.2.2.2) and (4.2.2.3.2) and was agreed with the result obtained by (Paul, et al., 2015) which states that P and K availability increases as soil acidity decreases. Finally, the soil of the study exposed to deterioration.

4.3 Vegetation cover

Vegetation covers in the study area composited from trees, shrubs and grasses.

4.3.1 Tree species and shrubs identification in the study area

A few trees and shrubs were identified in the study area.

Table (4.3.1.1): Frequency distribution of tree and shrubs in the study area (2014-2015)

Tree species	Frequency	%	Accumulative %
Acacia mellifera (Kitir)	19	32	32
Acacia senegal (Hashab)	9	15	47
Acacia seyal (Talh)	14	23	70
Acacia oerfota (Lawut)	4	7	77
Balanites aegyptiaca (Higleeg)	1	2	79
Capparis decidua ((Tondub)	2	3	82
Acacia nilotica (Sunt)	5	8	90
Dichrostachys cinerea (kadad),	6	10	100
Total	60	100	

Samples	Tree/ha
Point. No	Da=10m²/A²/trees/ha
1	268
2	132
3	137
4	177
5	185
6	0
7	247
8	0
9	0
10	173
11	189
12	177
13	0
14	0
15	0
Total	1659
Average	110

Table (4.3.1.2): Tree species density in the sample point in study area (trees/ha) (2014-2015)

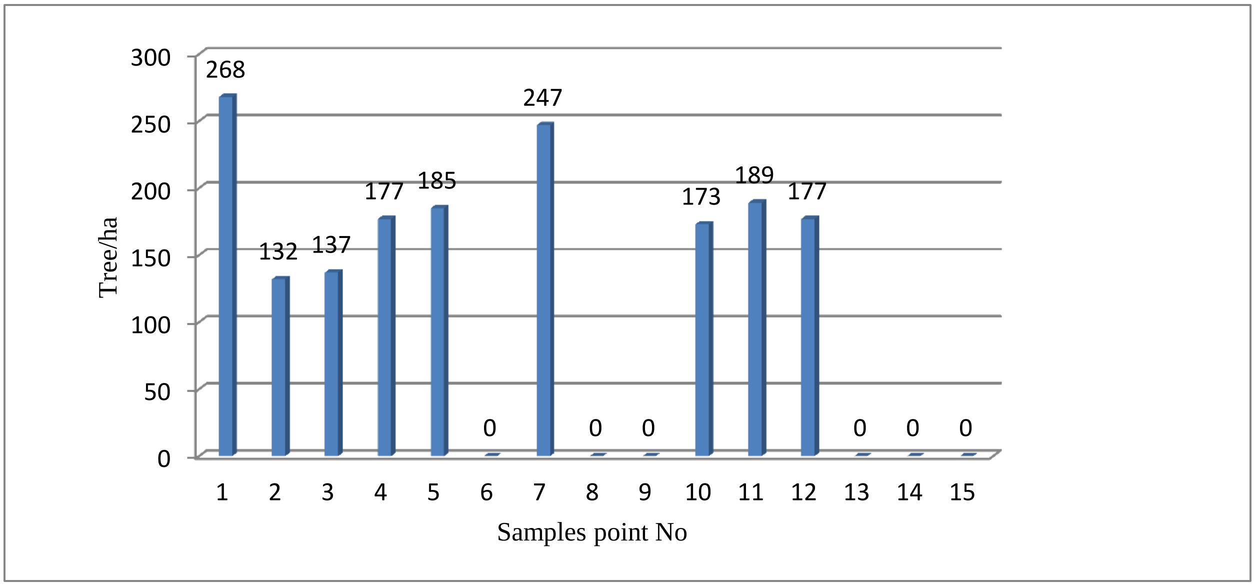


Figure (4.3.1.1): Tree species density in study area(Trees / ha) (2014-2015)

The results showed that; *Acacia oerfota* (lawut) was the dominant tree species especially in the Northern and the middle parts, followed by *Acacia senegal* (Hashab) concentrated in the middle and Southern parts and *Acacia mellifera* (Kitir) occupied the Northern and the middle part of the study area.

The statistical analysis showed, 8 trees species were identified in the study area namely are; *Acacia mellifera* (Kitir) was the dominant species followed by *Acacia seyal* (Talh), *Acacia senegal*, *Dichrostachys cinerea* (kadad), *Acacia nilotica* (Sunt) and *Acacia oerfota* (lawut), while *Capparis decdua* (Tondub) and *Balanites aegyptiaca* (Higleeg) being in the tail of the list. Also the result showed that; the frequency distribution of *Acacia mellifera* equal 32% from the total trees in the study area. On the other hand, *Capparis decidua* and *Balanites aegyptiaca* were recorded lower frequencies in the area which equal 2 % and 1 % from the total trees respectively (Table, 4.3.1.1).

Table (4.3.1.2) explained that; the tree density varies from no forest to 268 trees /ha, the high trees density was found in sample one in the Southern part of the study area, while no trees/ ha in samples 6, 8 and 9 in the middle part and sample

13, 14 and 15 in Northern part were cleared completely Table (4.3.1.2) and Figure (4.3.1.2).

Average density 110 trees /ha in the study area Table (4.3.1.2). Moreover, the results explained the tree stands were subjected to degradation, due to human activities such as expansion of mechanized rain-fed, cultivation of mono-cropping and over grazing of new natural seedlings, Plate (4.3.1.1 and 4.3.1.2).

The study reflected that: the horizontal expansion of mechanized rain-fed farming swallowed the forestland, where the trees were massively devastated, Plate, (4.3.1.1, 4.3.1.2 and 4.3.1.3).

Economic activities and the expansion of mechanized rain-fed schemes in the area caused forest fragmentation mainly in small isolated patches (Plate 4.3.1.4). The absence of trees around the natural drainage systems (khor Abu Ranja and Wadi El naiem) caused the expansion of watercourses (Plate 4.3.1.5 and 4.3.1.6), these results revealed the overall forest area and rangeland reduced because of expansion in modern mechanized farming as a result of increasing human population to meet the increasing demand for food and other basic needs. Yousif, et al., (2017) stated. The expansion of mechanized rain-fed agriculture schemes in the Southern Gedaref region changed (LU) and (LC) drastically on the expenses of the natural vegetation cover, the average natural vegetation clearing rate was around 0.8% per year, and the most rapid clearing occurred during the seventies when conversion rates increased to about 4.5% per year as Hussein (2010) wrote.

Plate (4.3.1.1): Massive trees devastation in the study area (2015)

Plate (4.3.1.2): Main activity in the study area (2015)

Plate (4.3.1.3): Traditional method of Sorghum harvesting in the study area (2015)

Plate (4.3.1.4): Fragmentation of tree stand in the study area (2015)

Plate (4.3.1.5): Expansion of wady Elnaiem and the removal of trees in the study area (2015)

Plate (4.3.1.6): Expansion of wady Abu ranja and the removal of trees in the study area (2015)

4.3.2 Grasses identification in the study area

Table (4.3.2.1). Grasses in the study area (2017)

No	Latin name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	total
1	*Dactylactenium aegyptium* (Abu asabe)	1	X	X	X	1	1	X	X	X	X	1	X	X	X	X	4
2	Pappaphorum spp (Um meleiha)	1	X	X	X	X	X	X	X	X	1	1	X	X	1	X	4
3	Avena fatua (Hamaraia)	1	x	x	x	x	x	x	x	x	x	x	x	x	x	X	1
4	Aristolochia bracteolate	1	X	X	X	X	X	X	1	X	X	1	X	X	1	X	4
5	*Phyllanthus madraspatensis* (Um regaiga)	X	1	X	X	X	X	X	X	X	X	X	X	X	X	X	1
6	*Setaria pallidefusea* (Lisseeg)	X	1	X	x	1	x	x	x	1	X	1	x	X	X	X	4
7	*Phragmites australis*(Bous)	X	1	1	X	X	X	X	X	X	X	X	X	X	X	X	2
8	*Ocimum basilicum* (Rihan)	X	1	1	1	X	1	X	X	1	1	X	1	1	1	1	10
9	*Chorch olitorius* (Mulokhya)	X	1	X	X	X	1	X	X	1	X	X	1	1	1	X	6
10	*Piciridium tingitanum* (Mulaita)	X	1	X	X	X	X	X	X	X	X	X	X	X	X	1	2
11	*Rhynchosia memnonia* (Erg Eldam)	X	1	X	X	X	1	X	X	X	X	X	X	X	X	X	2
12	Merremia emarginata (Eldaraya)	X	X	1	X	1	1	X	X	1	X	1	X	1	X	1	7
13	*Desmodium dichotomum* (Abu areeda)	X	X	X	1	X	1	1	X	1	X	X	X	X	X	X	4
14	*Vernonia amygdalina* (Abu mruwa)	X	X	X	1	X	1	X	1	1	1	X	X	1	X	1	7
15	*Sorghum halepense.* (Addar)	X	X	X	1	X	X	X	X	1	X	X	X	X	X	1	3
16	*Hibiscus esculentus* (Bamia)	X	X	X	X	X	1	1	1	X	X	X	1	X	X	1	5
17	*Cassia siesberana* (El soureb)	X	X	X	X	X	X	X	X	1	X	X	X	X	X	X	1
18	*Sida rhombifolia* (Um Barw)	X	X	X	X	X	X	X	X	X	1	1	X	X	X	X	2
19	*Srtiga hermonthica* (Buda)	X	X	X	X	X	X	X	X	X	X	1	X	X	X	X	1
20	*Sorghum purpureosericeum* (Annies)	X	X	X	X	X	X	X	X	X	X	X	X	X	1	X	1
21	*Indigofera aspera* (Lisan el teir)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	1	1
22	*Ipomoea cordofana* (Tabar)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	1	1
23	*Cassia tora* (Kawal)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	1	1
24	*Cassia siesberana* (El soureb)	X	X	X	X	X	1	1	1	X	X	X	1	X	X	1	5
25	*Cephalocroton cordofanus* (Dengle)	1	X	1	X	X	X	1	1	1	1	1	X	X	X	X	7
	Total	5	8	4	5	3	9	4	4	10	5	8	5	4	4	9	86

*(1) Refers to presence, while (x) refers to No presence in the study area (2017)

Table (4.3.2.1) revealed that; 25 grass species were identified in the study area. The dominant grass was *Ocimum basilicu* (Rihan) followed by *Vernonia amygdalina* (Abu mruwa) and *Desmodium dichotomum* (Abu arida). The two species (Rehan) and (Abu mruwa) associated with sorghum crop and considered as indicators for land degradation.

4.4 Rainfall and temperature in the study area (1972 to2017)

4.4.1 Rainfall

Figure (4.4.1.1) showed the significant fluctuation in the average annual rainfall variability.

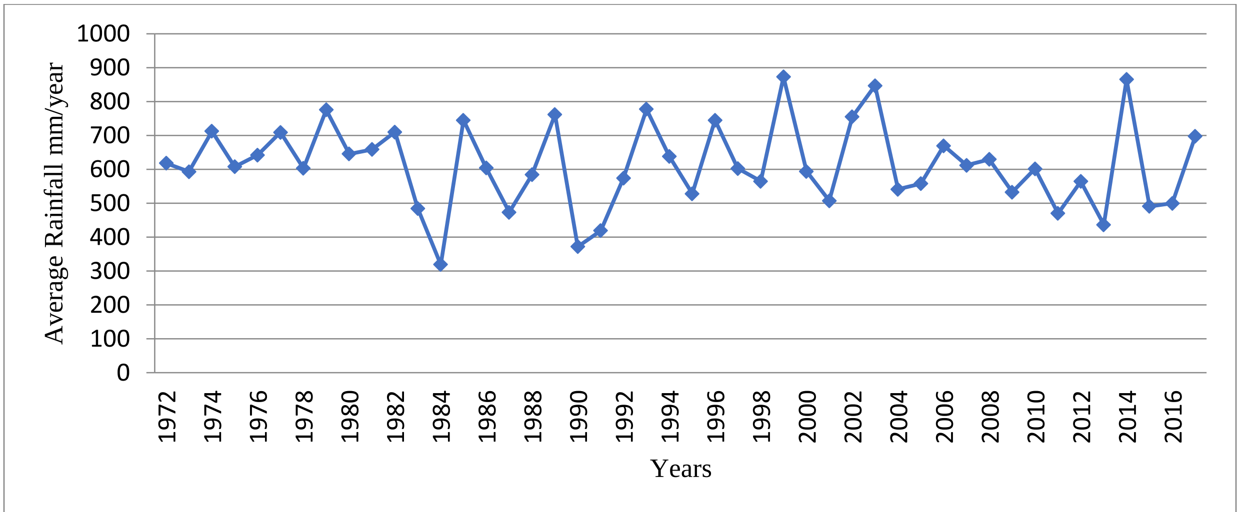


Figure (4.4.1.1): Fluctuation of the average annual rainfall in the study during (1972 to 2017)

Standardized Anomaly Indices (SAI) for rainfall indicate, near zero indicate normal climate condition, while those substantially above or below zero indicate relatively extreme values or condition, this result showed, a significant fluctuation in the average annual rainfall caused the problems (low quality and reduction in the productivity) as the respondents agreed in figure (4.5.5.2)in this study. This result supported by Mohamed, et al., (2011) reported that: people incomes in the study area depend mainly on rainfall agriculture, so the rainfall variability amount/ years affects the economies of the communities in the area (Figure 4.4.1.2).

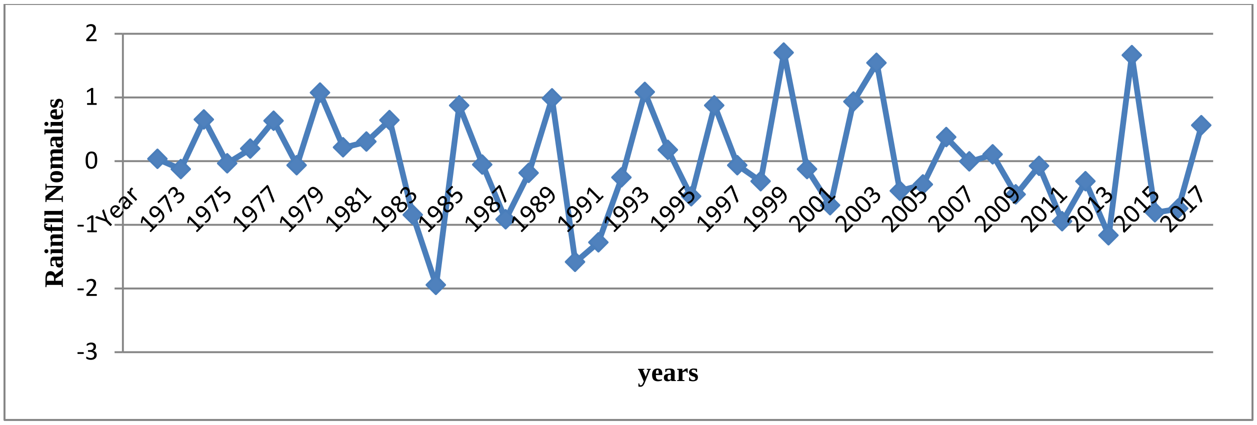


Figure (4.4.1.2): Anomalies Indices of rainfall in the study area (1972 to2017)

4.4.2 Temperature

Analysis of climatic records data reflected there was a significant increase in the temperature in the last two decades (Figure, 4.4.2.1.and 4.4.2.2). Increase in temperature in the study area lead the farmers to adopted new mechanism (changing the type of cultivated crops, changing the amount of cultivated area as the respondents said in figure (4.5.5.4). This result supported by Tajouj (2011) stated that; the (increasing in temperature) global warming extend the length of the potential growing season, allowing earlier planting of crops, earlier maturation and harvesting, and the possibility of completing two or more cropping cycles during the same season.

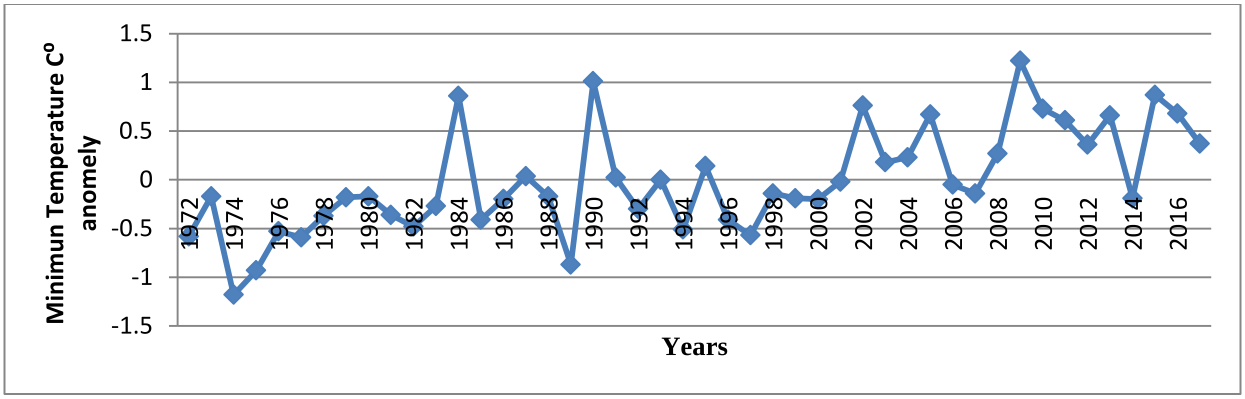


Figure (4.4.2.1): Anomalies Indices of minimum temperature in the study area from (1972 to 2017)

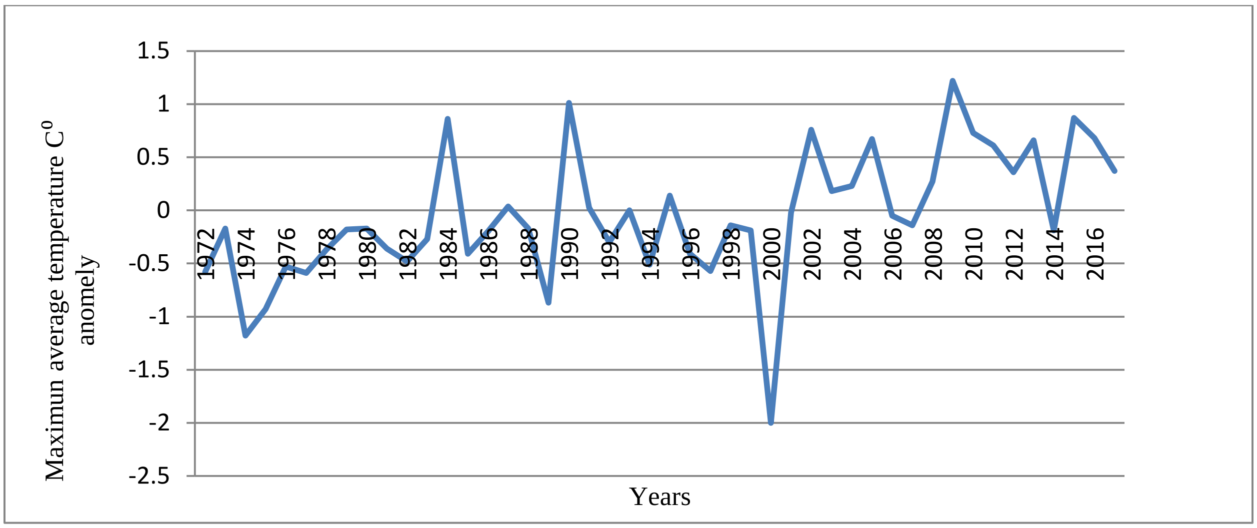


Figure (4.4.2.2): Anomalies Indices of annual maximum temperature in the study area (1972 to 2017)

4.5 Questionnaire

4.5.1 General information

All the villages in study area described in traditional structural form, ranging from straws, red bricks, mud, stone, round timber to zinc sheets. Furthermore, different ethnic groups were living in the area such as; Bargo, Barno, Dajo, Beny Amer, Kenana Arab, Nuba, Masalit, Flata, Hawssa and El Jaleen, the electricity net in the study area under the establishment, while water supply net for drinking and domestic uses temporary existing. The general education facilities were poor. Moreover, no asphalt roads and the major source of energy in the study area are the fire wood and charcoal. All the producers in the study area were commercialized their products in the local markets, where the price of the products was low.

4.5.2. Personal information

The results showed that: 41% of the respondents were centralized in the class (40-49), where 31% male and the rest 10% female. This class age represent the consuming power of natural resources intensively (Figure, 4.5.2.1).

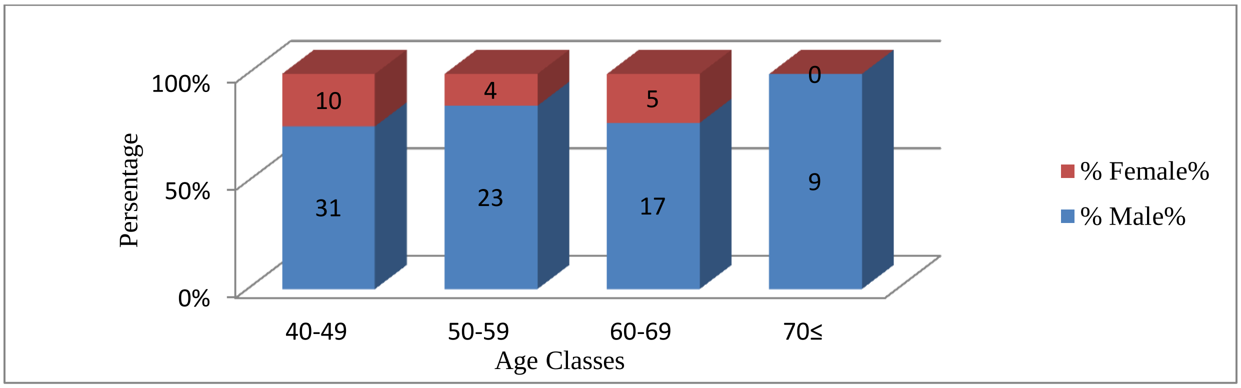


Figure (4.5.2.1): Respondent age classes and gender in the study area (2018)

The results reflected that: 17% of the respondents were illiterate, 28%, 24%, 21% and 10% educational level were Khalwa, primary, secondary school and university graduate respectively (Figure, 4.5.2.2).

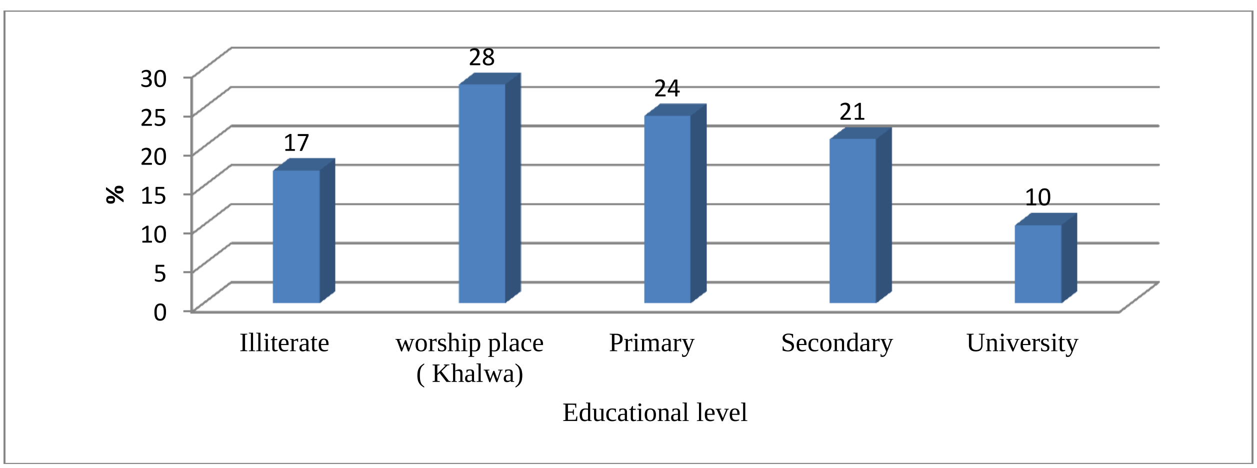


Figure (4.5.2.2): Educational level of the respondents in the study area (2018)

Figure (4.5.2.3), revealed that: 77% of the respondents were farmers, while 1% agriculture labor, 7% free business and, 7% employee and 8% were farmer and trader and animal breeders.

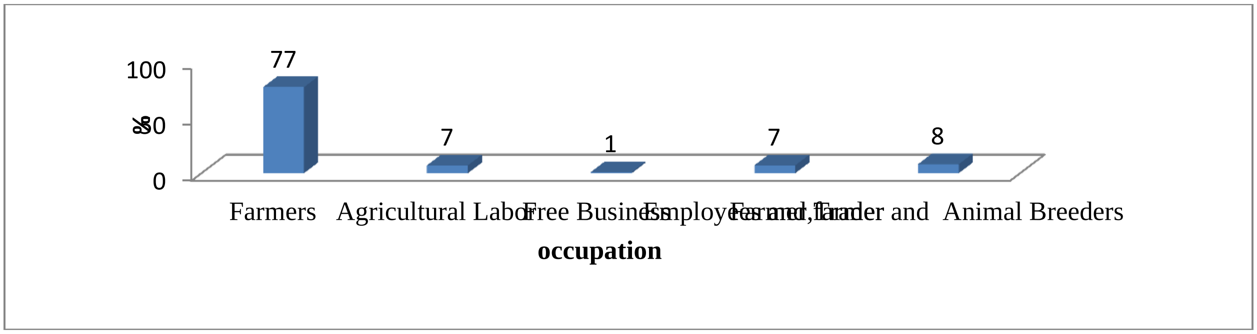


Figure (4.5.2.3): Occupations of the respondents in the study area (2018)

The results showed that; 85% of the respondents were married, due to the traditions customs in the study area they were married in early ages, on the other hand 11% were single, 4% were divorced and no widowed (Figure, 4.5.2.4), this result supported by (CBS and UNICEF, 2010) report stated that: in Sudan, 10.7% of women were married before 15years and 38% were married before 18 years and this figures vary among the states and generally higher in rural than urban areas.

According to the Sudan Household Health Survey (SHHS) of 2010, child marriage rate was 42.0% in rural areas compared to 29.1% in urban areas.

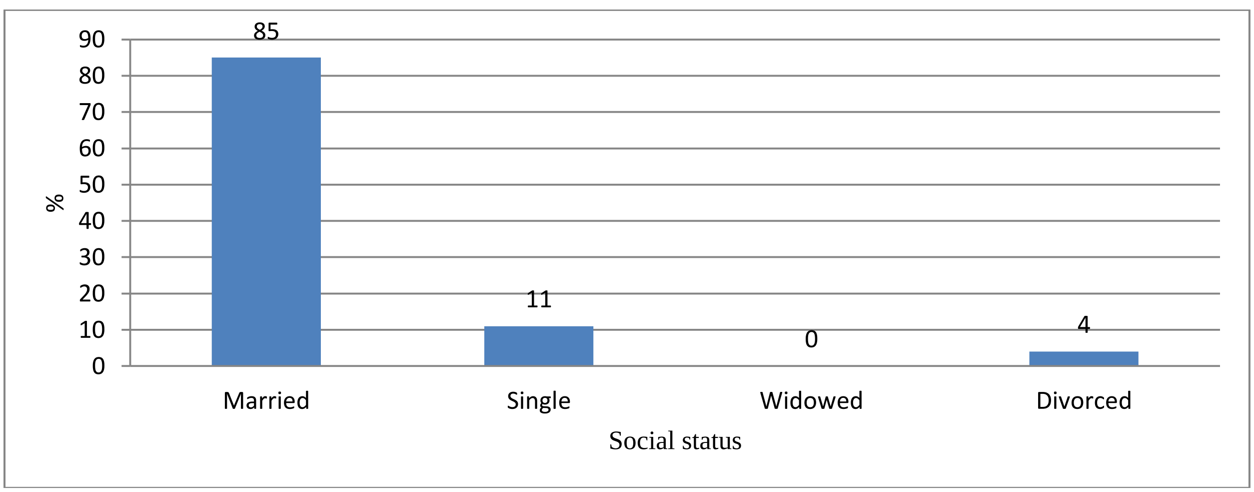


Figure (4.5.2.4): Social status of the respondents in the study area (2018)

The results showed that; 55% of the respondents' family members ranging between (7 to 12), 27% ranging between (one to 6), 11% ranging between (13 to18) and 7% were more than18 members (Figure, 4.5.2.5).

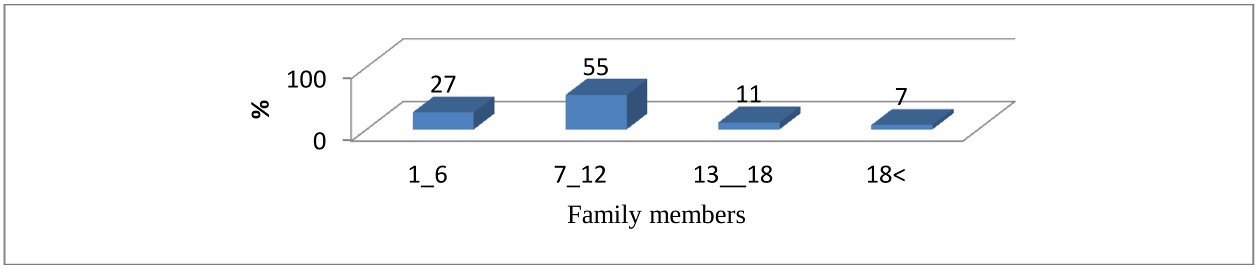


Figure (4.5.2.5): Average family members in the study area (2018)

4.5.3 Farmers

The results revealed that: 66% of the respondents were small scheme farmers. Because they are poor and they did not have enough money to increase their land, 17% were medium scheme, 9% were large scheme and 8% were rent the land for cultivation (Figure, 4.5.3.1). This result supported by Mohamed, et al., (2011) stated that; economic activity in Sudan principally rural-based and the majority of them were agro-pastoralists with varying degree involvement in both traditional farming and pastoralist.

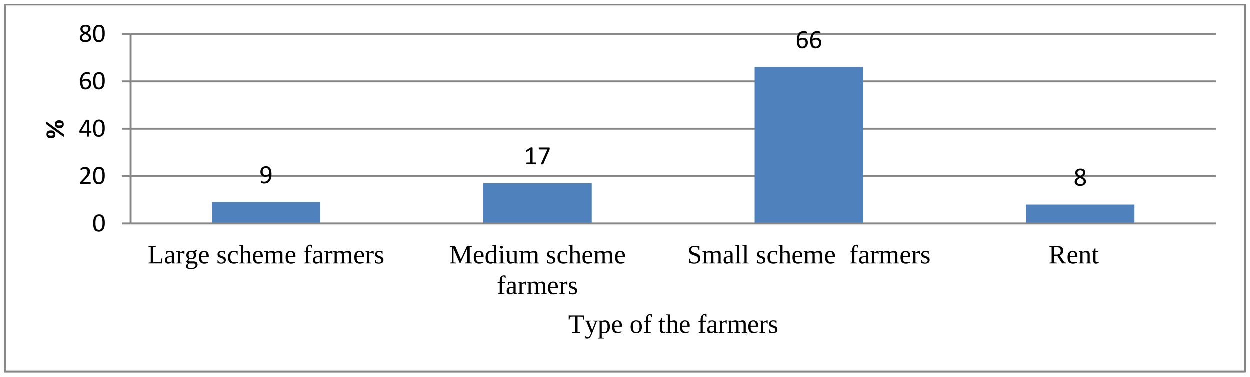
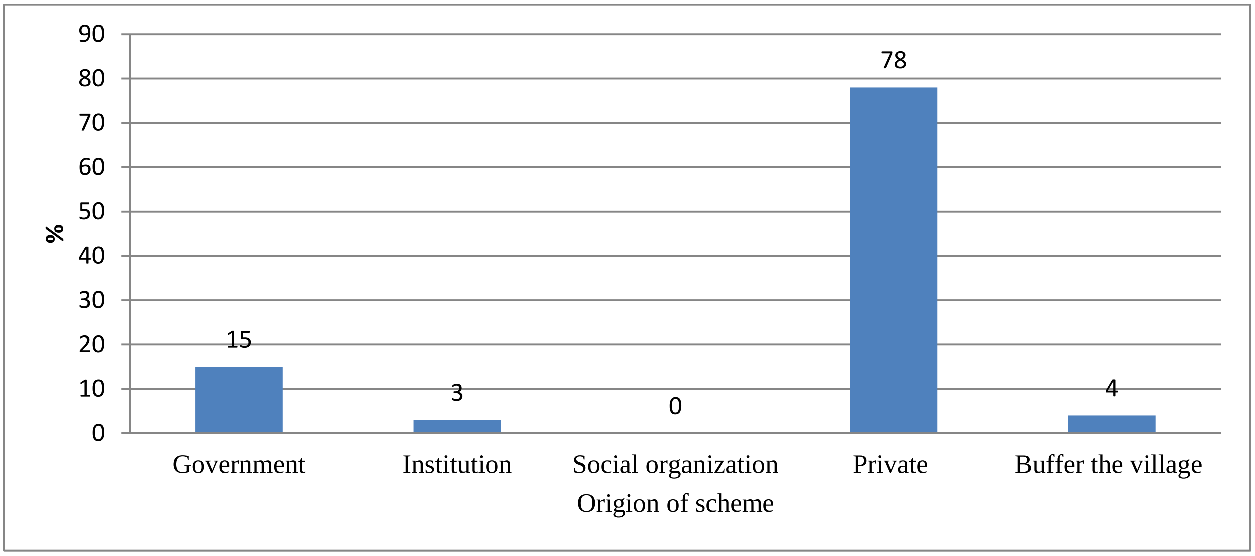


Figure (4.5.3.1): Type of farmers according to scheme owner in the study area (2018)

According to the results: 78% of the respondents land origin was private, 15% the government, 4% village buffer, 3% institution and no social organization (Figure,4.5.3.2).



(Figure (4.5.3.2): Types of the land for the schemes in the study area (2018)

The result revealed that: 76% of the respondents land tenure was private, 15% of them they rent the land, while 5% was partnership and 4% was a gift (Figure, 4.5.3.3).

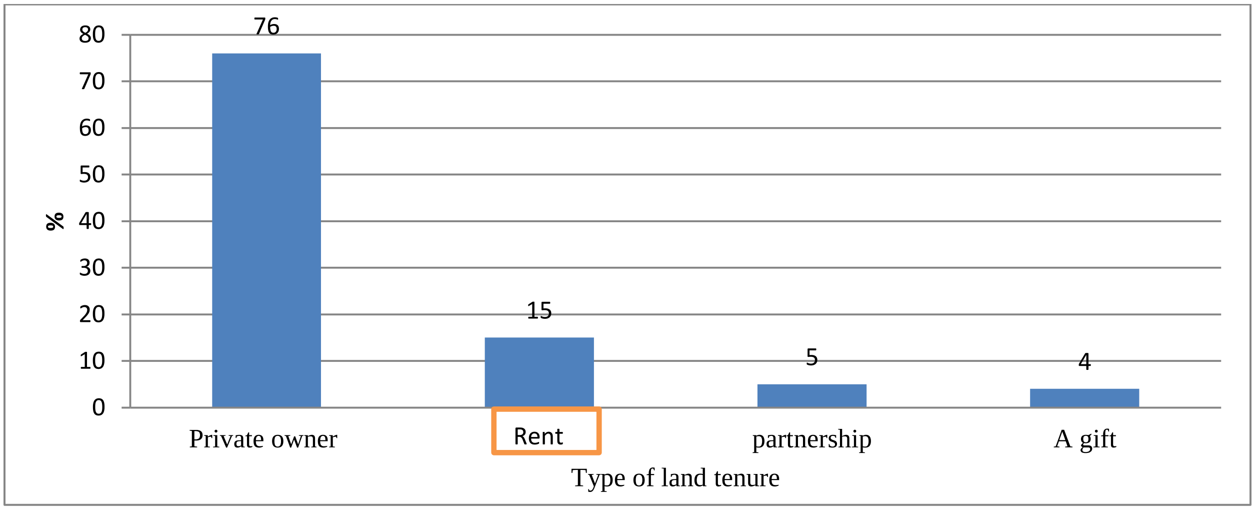


Figure (4.5.3.3): Types of land tenure in the study area (2018)

The result showed that: 39% of the respondents stated that land tenure approved by State government, 37% approved by Traditional administration, 12% approved by the hand, 7% approved by Federal Government and 5% of the respondents they didn’t̕ t know the entity that give them the land (Figure, 4.5.3.4).

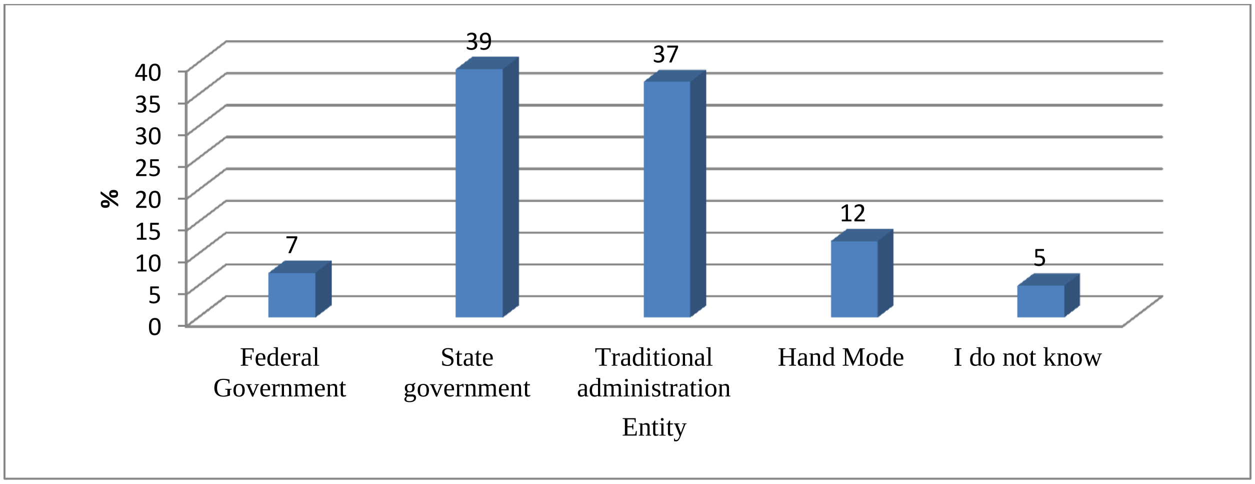


Figure (4.5.3.4): Entity approved the acquisition in the study area (2018)

The result showed that; 87% of respondents emphasized that; no land tenure problems in the study area, while only 13% confirmed in contrast, and stated the types of land tenure problems were (inheritance, between the farmers and mechanized agriculture administration, between the farmers and herders and lastely payment of fees). The mechanisms adopted to solve land tenure problems are,(through land rent and partnership, traditional Committee respectively and the formal way through Court (Figure, 4.5.3.5). this results supported by Suad (2017) stated that; the conflict incidents are solved either by local people’s committees or by police and courts arrangements and department officials sometimes act as administrative mediator in many cases solved many situations of conflict between farmers and pastoralists, range and pasture department.

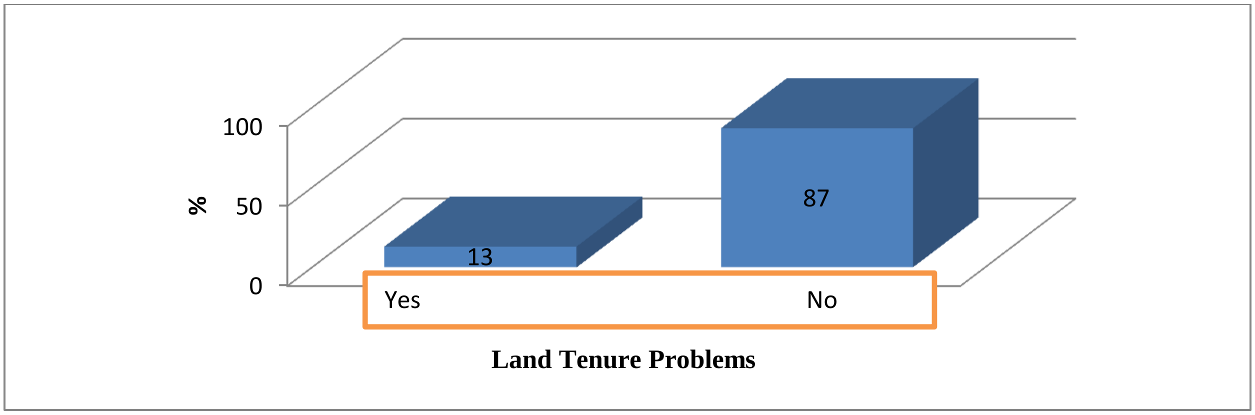


Figure (4.5.3.5): Land tenure problems in the study area (2018)

The result showed that: 29% of the respondents cultivated their land for (21 to 30) year, 25% cultivated their lands for (31 to 40) year, while 20% of them cultivated their lands above 40 years and 18% of them cultivated their lands for (11 to 20) year (Figure, 4.5.3.6). This agreed with Mohamed, et al., (2011) reported; in 1954 the government began encouraging the private sector to take up mechanized farming in the area, a policy that continued after Sudan gained independence in 1956.

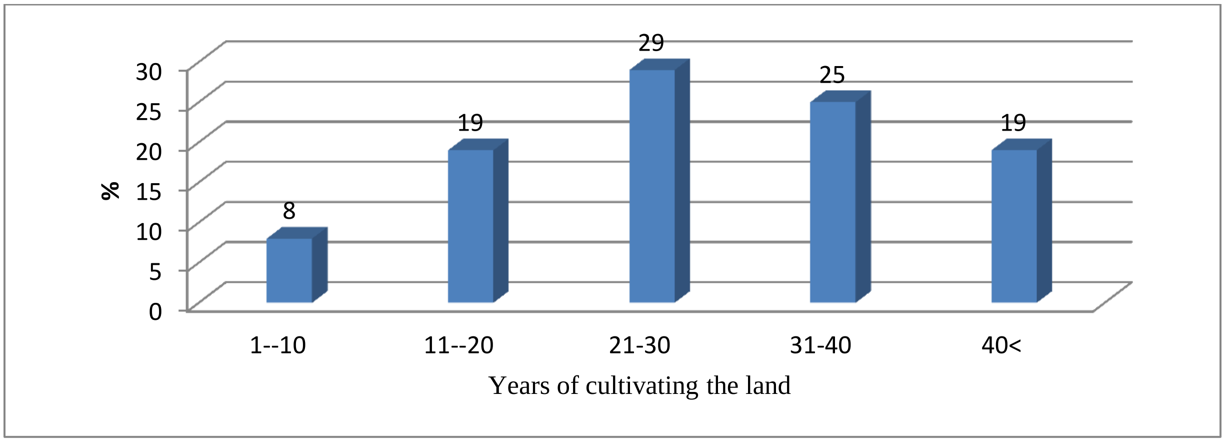


Figure (4.5.3.6): Years respondents cultivate the land in the study area (2018)

(Figure (4.5.3.7) stated that: 55% of respondents cultivated Dura, Sesame and Millet, 36% cultivated Dura, Sesame and Maize, 7 % cultivated Dura, Sesame, while 1% of the represented cultivated Dura, Sesame, cotton, and 1% was not a farmer respectively. This result nearly to the report of (FSTS, 2016 and 2017) stated that; the main five cultivated crops in the area (sorghum, millet, sesame, ground nut and cotton).

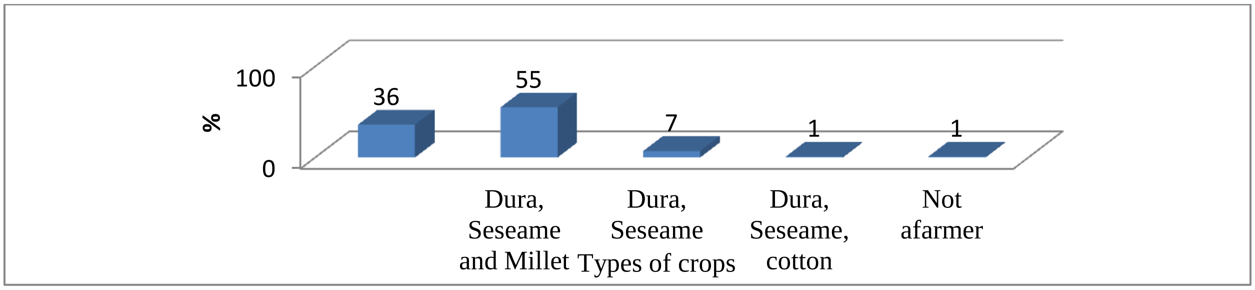


Figure (4.5.3.7): Types of cultivated crops in the study area (2018)

The result explained that; 69% of the respondents followed manual and machine cultivation tools, 24% followed cultivation machine and only 7% cultivated their lands manually (Figure, 4.5.3.8). This result reflect the modification of agricultural methods increased in cultivation and harvesting stages through the time.

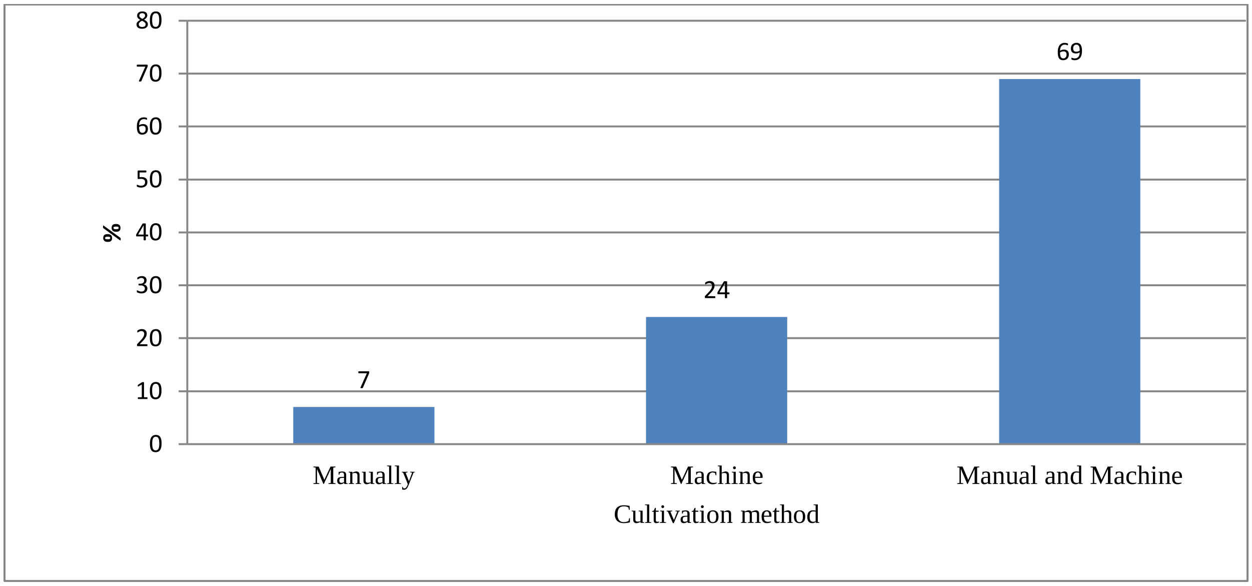


Figure (4.5.3.8): Methods of cultivation in the study area (2018)

The result explained that: 49% of the respondents used the wide range disc harrow, 39% of the respondents were used the normal disc harrows, 9% of the respondents were used the traditional machines, while 3% of the respondents were used zero tillage (Figure, 4.5.3.9). This result is supported by Yousif, et al., (2017) stated that; specifically in Gedaref state large tracts for forests and rangeland conversion to cultivated land and the overall forest area and rangeland were reduced because of expansion in modern mechanized farming due to increasing human population and increasing demand for food.

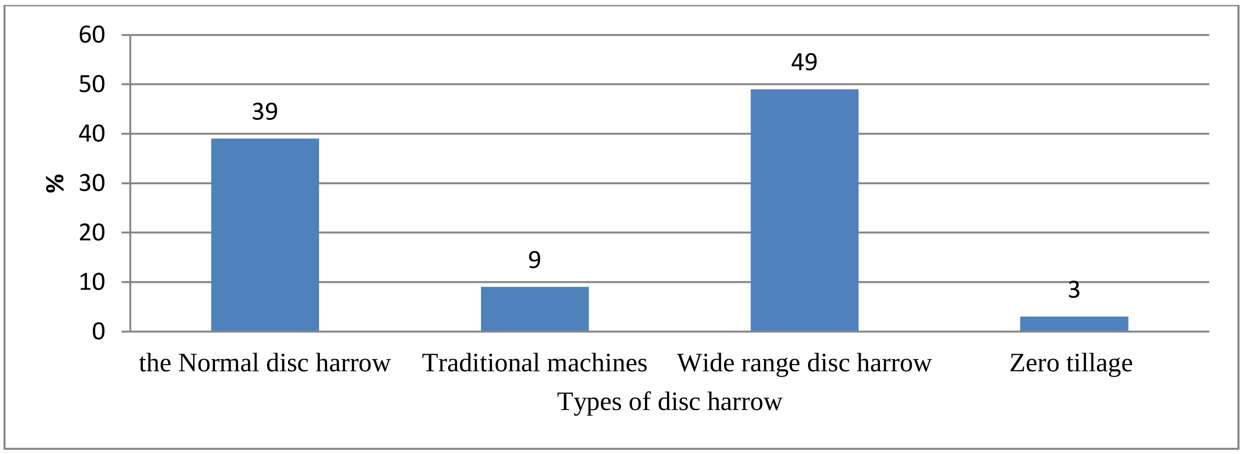


Figure (4.5.3.9): Types of disc harrows used in agriculture in the study area (2018)

The result Described that; 70% of the respondents used the manual tools for harvesting due to the schemes area and cultivation system in the study area, where 66% of the respondents were small scheme farmers as mentioned in (Figure, 4.5.3.1) and 20% of them used both manual and mechanized tools , while 10% were used mechanical tools only (Figure 4.5.3.10).

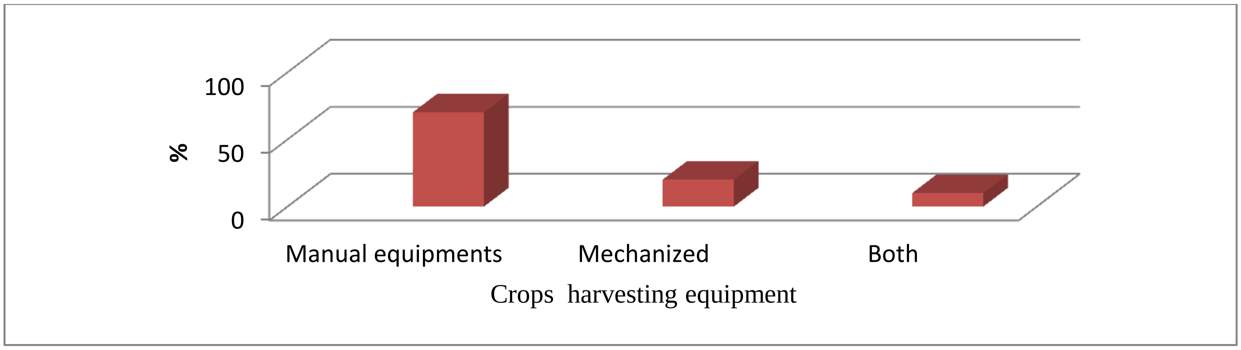


Figure (4.5.3.10): Crops harvesting equipment in the study area (2018)

The result revealed that; 84% of the respondents introduced the seasonal labors, while 13% of them were introduced permanent labor and 3% said by family members (Figure, 4.5.3.11).

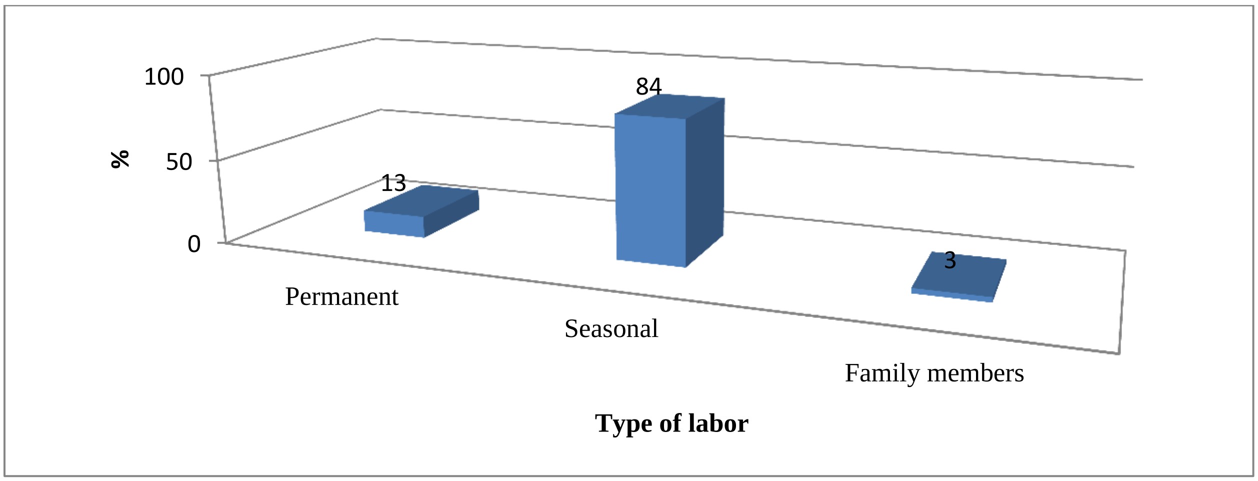


Figure (4.5.3.11): Type of labor in the study area (2018)

Table (4.5.3.1): Average cost of 5th feddan /SDG preparation in the study area in the season 2017

Average cost of 5th feddan /SDG	Frequency	%
1001-2000	84	57
2001-3000	63	41

3001<	3	2
Total	150	100

Table (4.5.3.1) showed; 57% of the respondents said that: 5th feddan cost/SDG ranges between 1001 to 2000 SDG, 41% said the cost ranges between 2001 to 3000 SDG, while 2% said the cost more than 3000 SDG. This average cost of 5th feddan increased due to the increase in the cultivation inputs such as fuel price and supply at the beginning of the season (FSTS. mid seasonal report, 2016).

Table (4.5.3.2): Average productivity of Sesame sack (100kg) /feddan in the study area in 2016

The range of productivity sack /feddan	Frequency	%
0-5	124	82
6<	26	18
Total	150	100

Table (4.5.3.2) showed: 82% of the respondents said; the average productivity of sesame ranges between less than one to 5 sack / feddan, while 18% of them said the productivity more than 6 sacks /feddan. This result approximately similar to Ismail (2009) he stated that; the average productivity of sesame declined from5 sacks/feddan to1.5 sack/feddan. The average productivity of sesame in feddan decreased due to the rainfall variability and land degradation this result supported by Mohamed, et al., (2011), he stated that: the decline in the productivity was the result of rain doesn't come on time anymore. After the farmer planted, the rain stops just as the crops start to grow and began to rain after the crops have already withered.

Table (4.5.3.3): Average productivity of Dura sack (100kg /feddan) in 2016

The range of productivity	Frequency	%
0-3	88	58
4<	62	42
Total	150	100

Table (4.5.3.3) showed that; 58% of the respondents said the average productivity of dura ranges between less than one to 3 sack/feddan, while 42% of them said the productivity was more than 4 sacks/feddan, this result reflected that there was a reduction in the productivity /feddan, this result closely to Mohamed, et al., (2011) reported that; the farmers in Gedaref State said the crop yield declined substantially from 12 sacks sorghum /feddan in the sixtieth to1.5 sack now a days.

Table (4.5.3. 4): Average productivity of Sesame (sack=100kg /feddan) in 2017

The range of production	Frequency	%
0-5	93	62
6≤	57	38
Total	150	100

Table (4.5.3.4) explained that; 62% of the respondents said the average productivity of sesame ranges between less than one to 5 sack /feddan, while 38% of them said the productivity more or equal 6 sack /feddan. The reason of this result was similar to the reason in table (4.5.3.2) in this study.

Table (4.5.3.5): Average productivity of Dura sack in 2017

The range of productivity	Frequency	%
0-4	52	34
5<	98	66
Total	150	100

Table (4.5.3.5) showed that; 34% of the respondents said the average productivity of dura ranges between less than one to 4 sack /feddan, while 66% of them said the productivity was more than 5 sacks /feddan. This result was due to the similar reason in table (4.5.3.3) in this study.

Table (4.5.3.6): Average price of the sack/seasons (2016 and 2017)

Season of productivity	Crops		Frequency	%
	Dura	Sesame		
2016	200-300 SDG	1200-1800SDG	150	100
2017	500 SDG	3000-3500SDG	150	100

Table (4.5.3.6) illustrated that; all the respondents said; the sack of dura price during the seasons (2016&2017) was (200-300 and500) SDG prospectively, while the sack of sesame price during the seasons (2016&2017) was (1200-1800 and 3000- 3500) SDG respectively. This result nearly to FSTS 2016 & 2017 reported that: the dura price increased due to increase in demand of the crop while sesame price decreased due to the supply for export.

Table (4.5.3.7): Soil deterioration in the study area 2018

Answer	Frequency	%
Yes	111	75
No	34	22
Neutral	5	3
Total	150	100

Table (4.5.3.7) revealed that: 74% of the respondents said the soil was deteriorated due to the lack of agricultural rotation, non-application of new agricultural technologies and non-application of new agricultural policies. In addition; most of the respondents they didn't applied the fertilizers, while 23% said there was no soil deterioration and only 3% were neutral.

Table (4.5.3.8): Application of pesticides in the study area 2018

Answer	Frequency	%
Yes	79	52
No	59	40
Neutral	12	8
Total	150	100

Table (4.5.3.8) explained that: 52% of the respondents applied the pesticide such as (round up, 2-4-D and clinic), 40% they didn't applied the pesticide, while 8% of them were neutral. The respondents gained the pesticide from the different sources, some of them gained from market and other sources, they disposed the empty containers of pesticide through; burning and disposed outdoor.

Table (4.5.3. 9): Reduction in the productivity during (2010 to 2018)

Answer	Frequency	%
Yes	97	65
No	38	25
Neutral	15	10
Total	150	100

Table (4.5.3. 9) explained; 65% of the respondents said there were a reduction in the productivity between 2010 to 2018 due to fluctuation in rainfall and low soil fertility, fluctuation and decreasing in rainfall beside the financial problem respectively, poor agricultural techniques and weeds, the delay in cultivation period and pests respectively, 25% were disagreed with that, while 10% of them were neutral. This result nearly as Mohamed, et al., (2011) wrote; blocking the extension of traditional shifting cultivation and the extension of large scale mechanized farming beside continued mono-cropping were gradually reduced the soil- restoring follow period to zero, while creating landless peasants in the process.

Table (4.5.3.10): Proposed methods to increase crop productivity in the study area

Methods to increase crop productivity	Frequency	%
Early cultivation and improved seeds	20	13
Changing the amount of land under cultivation	12	8
Agricultural rotations and improved seeds	27	17
The introduction of disc plough and improved seeds	32	22
Nothing was followed	59	40
Total	150	100

Table (4.5.3.10) revealed that; 13% of the respondents adopted the early cultivation and improved seeds application, then 8% of them were changing the amount of land cultivation, 17% of the respondents were adopted agricultural rotations and improved seeds application, while 22% of the respondents were introduced disc plough and improved seeds and 40% of them didn’t adopted anything. This result is nearly to Mohamed, et al., (2011) how wrote the major farming adjustments were taken by farmers were: planting of different crops, changing crop diversification, changing planting dates, changing the amount of land under cultivation, seasonal migration during the dead season to big cities, animal raising and selling the agricultural residues.

Table (4.5.3.11): Satisfaction with the crop production

Satisfaction with the crop production	Frequency	%
Yes	72	48
No	78	52
total	150	100

table (4.5.3.11) showed that: 48% of the respondents said the production was satisfied, while 52% of them stated the production was not satisfied, they fill the shortage gap by selling the forest residues , animal husbandry, family assistance, loans from the banks (micro finance) and free business.

Table(4.5.3.12): Use of the crops residues

Uses of the crops residues	Frequency	%
Selling the crops residues	113	76
Grazing the crops residues in the field	37	24
Total	150	100

Table (4.5.3.12) revealed that: 76% of the respondents were selling their crops residues as fodder; while 34% of them were lead the herders pay the money to avail crop residues after crop harvest for animals to graze it. This result was supported by (Mohamed, et al., 2011) how stated that; the framers adopted the selling crop residues to increase their incomes.

4.5.4 Situation of the climate during the cultivation period

The result revealed that; 91% of the respondents during their cultivation period agreed that; the climate was changed, in the minimum and maximum temperature degree, in the amount and fluctuation of rainfall and drought. The change in climate lead the respondents to adopt mitigation mechanisms, they changed the amount of cultivated land, changed the cultivation time. While 4% disagreed wih that and 5% were neutral. This result a proximately was similar to Mohamed, et al., (2011) reported that; there was increasing trend of climate change and effect on livelihood of farmers and pastoralists (Figure, 4.5.4.1).

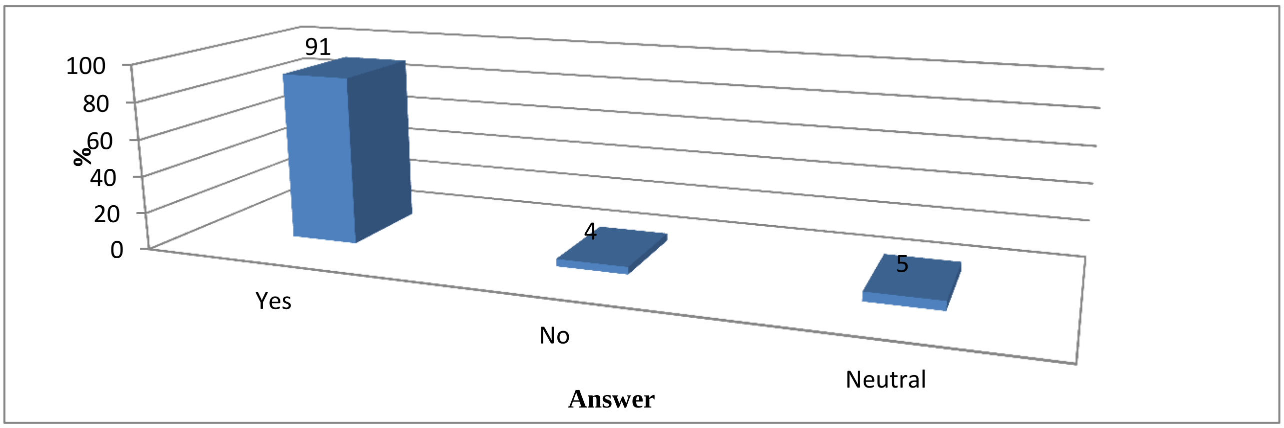


Figure (4.5.4.1): Situation of climate during the cultivation period in the study area

The result showed; 89% of the respondents during their cultivation period were suffered from the fluctuation of rainfall in the productivity (quantity and quality), while 5% of them were not suffered and 6% of them were neutral (Figure, 4.5.4.2).

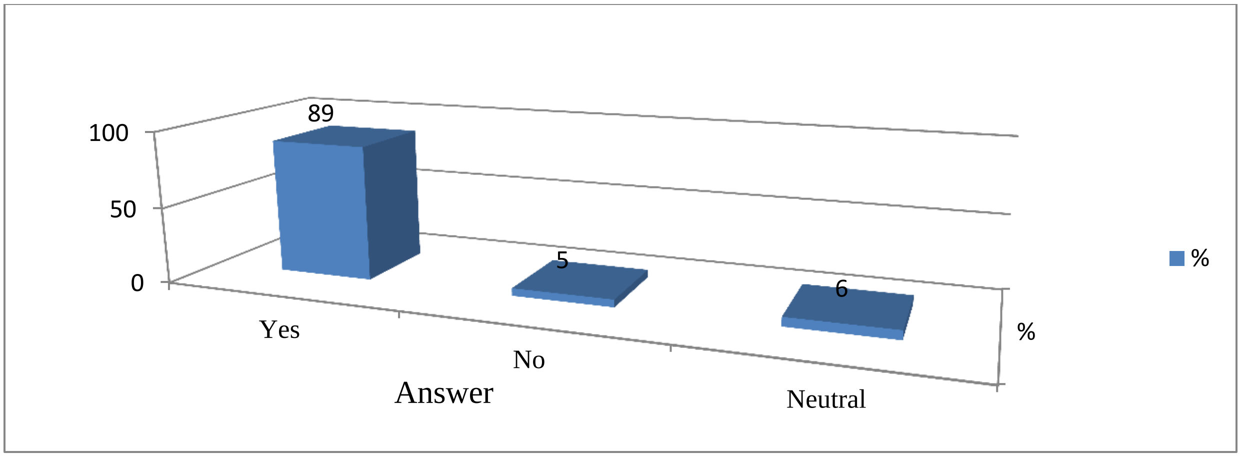


Figure (4.5.4.2): Impact of rainfall and fluctuations during the cultivation period

The result explained that; 94% of the respondents' said the temperature was changed, while 5% were disagreed with that and only 1% were neutral (Figure, 4.5.4.3).

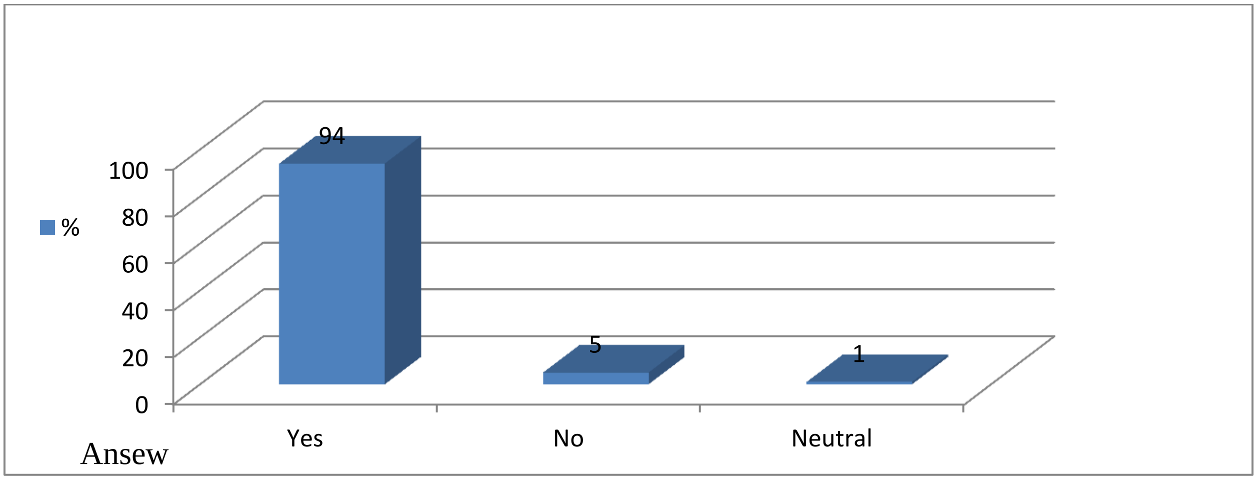


Figure (4.5.4.3): Situation of the temperature during the cultivation period

The result showed; 12% of the respondents described the situation of agriculture was excellent, 49% good, 21% medium and 18% described there was a decline in the agriculture (Figure, 4.5.4.4). This result was similar to Ismail (2009) how said; there was a decrease in the sorghum production compared to the past 30 years, one feddan produced 6 sacks in the 1970s and now it produced only 2 sacks, this drastic decline is also happened to the sesame production where feddan produced 5 sacks and now producing only 1.5 sacks.

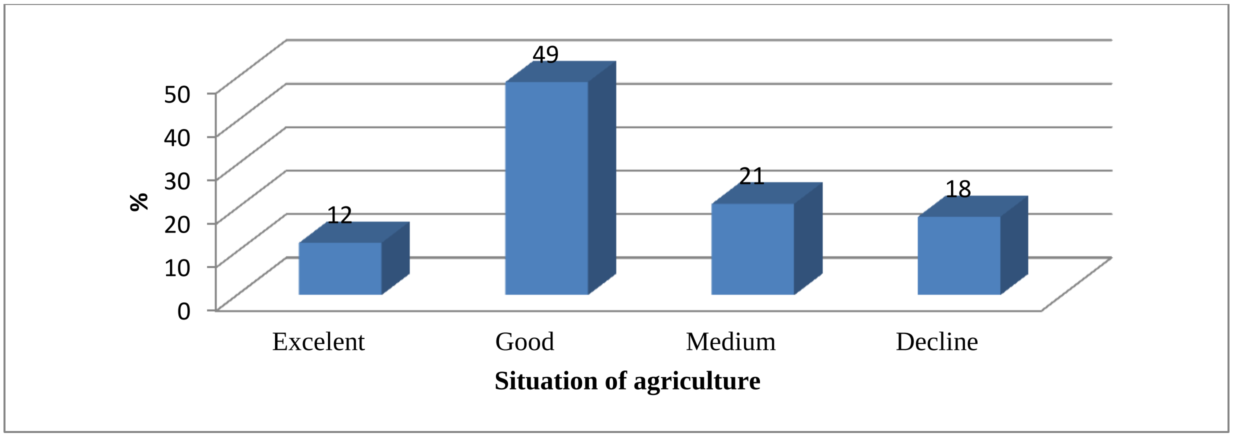


Figure (4.5.4.4): Situation of agriculture depends on the productivity during the last 30 years

Table (4.5.4.1): Suggestions to reduce the impact of temperature in the study area

Suggestions to reduce the impact of the temperature in the study area	Frequency	%
Cultivation of trees on the empty areas and natural water streams.	127	85
Shelter belts as a barrier between the cultivated areas	23	15
Total	150	100

Table (4.5.4.1) showed; 85% of the respondents were suggested that; cultivation of trees on the deteriorated areas and around the natural water streams, while 15% were suggested the shelter belts as a barrier between the cultivated areas.

Table (4.5.4.2): Suggestions to increase rainfall in the area

Suggestions to increase rainfall in the area	Frequency	%
Increase the vegetation cover	58	39
Application of agricultural policy	47	31
Use water harvesting technique for more green cover	45	30
Total	150	100

Table (4.5.4.2) showed; 39% of the respondents were suggested increase of vegetation cover, 31% of them suggested the application of agricultural and 30% were suggested the application of water harvesting techniques for more green cover were useful.

Table (4.5.4.3): Suggestions to increase crop productivity

Suggestions to increase productivity (Quality and quantity)	Frequency	%
Use the improved seeds	54	36
Application of new agricultural techniques and extension role	64	43
Crop diversification	18	12
Appling the pesticids and fertilizers	14	9
Total	150	100

Table (4.5.5.3) explained that; 36% of the respondents were suggested the use of improved seeds, 43% were suggested the application of agricultural techniques and extension role, 12% and 9% were suggested the Crop diversification and applying the pesticides and fertilizers respectively.

Table (4.5.4.4): Suggestions to increase the household income

Suggestions to increase the household income	Frequency	%
Crop production and animals rasing	72	48
Crop diversification	44	29
Micro finance	34	23
Total	150	100

Table (4.5.4.4) showed that; 48% of the respondents were suggested the agriculture production (Crops and Animals), 29% were suggested cultivation of Crop diversification under control condition was the best, while 23% of the respondents were suggested micro finance was the best way to increase the household income. This result was nearly similar to Mohamed, et al., (2011) how recommended that; the government should improve the farmer income opportunities, that will improve the livelihood of farmers and pastoralists.

Table (4.5.4.5): Suggestions for family stability in the study area

Suggestions for family stability in the study area	Frequency	%
Infrastructures development	93	62
Irrigated cultivation programs (using water harvesting)	57	38
Total	150	100

Table (4.5.4.5) showed that; 62% of the respondents were said; the adoption of developmental projects (infrastructures development) will enhance the condition in the study area, while 38% of them said the supplementary activities such as irrigated cultivation programs (using water harvesting) in the dead season were more profitable, because of the characteristic of the area and availability of surface water in the rainy season.

4.5.5 Situation of vegetation cover in the study area

All the respondents (100%) agreed that: trees before 30 years were abundant, but now are disappeared (Figure, 4.5.5.1). This result was similar to Sulieman (2008) how stated that; the vegetation in the Southern part of Gedaref State was decreased from 65% in 1973 to 31% in 2003 and also (Suad, 2017) stated that; both pastoralists and farmers respondents confirmed sharp decline of natural resources during the last two decades by 100% and 92.9% for pastoralists and farmers respondents respectively.

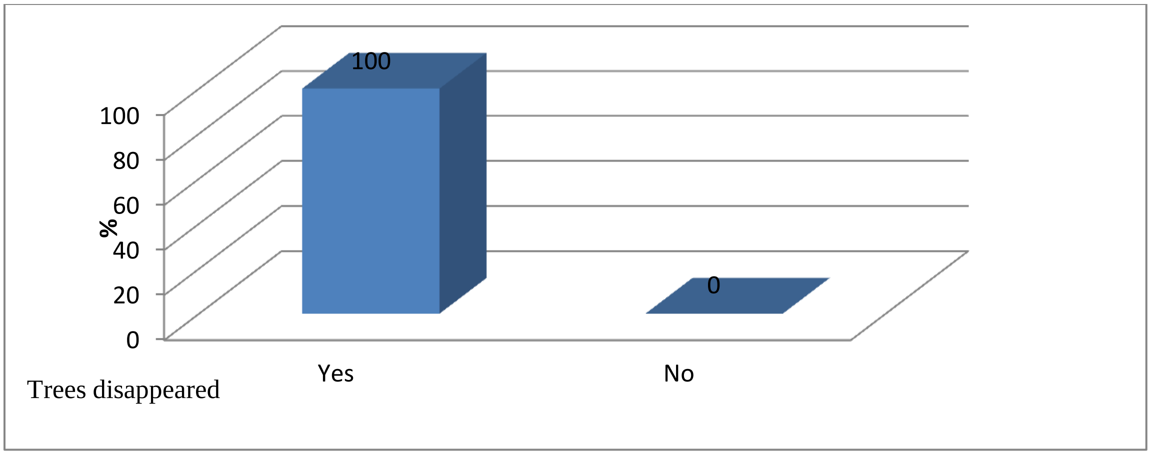


Figure (4.5.5.1): Status of trees species before 30 years

Table (4.5.5.1): Types of tree before 30 years ago in the study area

Scientific Name	Local name	Scientific Name	Local name
Delbergia melanoxylon	Abanus	*Commiphora africana*	El Gafal
Combretum hartimanniam	Habil	*Acacia polyacantha*	Kakamout
Grawia tenax	Godaim	*Ficus sycamorus*	Eljemaiz
Adansonia digitata L.	Tabaldi	*Sclerocarya birrea*	Alhemaid
Sterculia setigera	Tartar	*Cadaba farinosa*	Seraeh
Tterminalia brownii	Sobagh	*Grewia tenax*	Godiam
Cordia monoica	Andrab	*Lannea humilis*	Leon
Anogeissus leiocarpus	Sahab		

Table (4.5.5.1) revealed that: all the respondents were said all the trees in this table were abundant before 30 years, but now disappeared. This result was suported by Mohamed, et al., (2011) how wrote; changes in land-use in the central and southern parts of Gedaref State had taken place in the past half century, moreover, the farmer destroyed the woodland and pasture resources.

Table (4.5.5.2): Types of tree species towards to extinction

Scientific Name	Local name	Scientific Name	Local name
Blanites aegyptica	Heglig	*Acacia seyal*	Taleh
Acacia nilotica	Sunt	*Cadaba rotundifolia*	Karmat
Acacia senegal	Hashab	*Ziziphus spina chiristi*.	Sidir

Table (4.5.5.2) showed that, all the respondents were said; the trees in the table were towards to extinction.

Table (4.5.5.3): Invaders trees species presented in the last 30 years

Trees species presented	Frequency	%
Yes	150	100
Total	150	100

Table (4.5.5.3) revealed that: 100% of the respondents were agreed there were invaders trees species presented in the last 30 years.

Table (4.5.5.4): Invaders tree species in the study in the last 30 years ago

Scientific Name	Local name	Scientific Name	Local name
Acacia oreofota	La`ot	*Hyphaene thebaica*	Dom
Prosopis chilinesis	Misquite	*Moringa olivera*	Moringa
Acacia mellifra	Kitir	*Conocarpus lancifolius*	Damas
Calotropis procera	Usher		

Table (4.5.5.4) explained that: all the respondents were nominated the invaders tree species in the last 30 years ago in the study area.

Table (4.5.5.5): Shrubs were presented before 30 years ago

shrubs species	Frequency	%
Yes	150	100
No	0	0
Total	150	100

Table (4.5.5.5) explained that: some shrubs were presented in the study area before 30 years but now were disappeared. These shrubs were explained in table (4.5.5.6) below. This result was similar to Lebon (1965) how classified the vegetation cover in Gedaref State to three major vegetation zones: semi desert vegetation cover in the north where the dominant trees were *Acacia mellifera* (Kitir) and *Acacia eorfota* (Lawat) followed by low woodland savannah zone wher divided into subgroups; first group dominated by *Acacia mellifera* (Kitir) that forms dense forests with some grass like *Schima ischaemoids* (Dambulab). Second group dominated by *Acacia seyal* (Talih) and some grass such as *Sehma ischaemoides*, third group dominated by tall trees and grasses like *Anogessus schimperi* and *Hyparrhenia psendocymbaria* (Anzora) and high woodland savannah in the far south dominated by *Combertum harmanainum* (Habil) and *Bosswellia pyperifer* (Luban). Common grasses include *Cymbopogon nervatus*, *Artistida mutabillis* and *Ctenium elegans*. On the shallower soils the trees of *Lannea stumper* and Sorghum grasses, *Cymbopogon spp*.

Table (4.5.5.6): Disappeared shrubs in the last 30 years ago

Scientific Name	Local name	Scientific Name	Local name
Cymbopogon nervatus	Nal	*Phyllonthus niruri*	Um baleela
Sehima ischaemmoides	Dambalab	*Panicum turgidum*	Tomam
Rottboella cochichinensis	Razza	*Commelina amplexicaulis*	Beeyad
Acnthespermum hispidum	Hirab Husa	*Cyperus rotundus.*	Se'ida
Hyparrhenia psedocymbaria	Anzora		

Table (4.5.5.6) showed all the respondent explained that these were disappeared shrubs species in the study area.

Table (4.5.5.7): Invaders shrubs in the area in the last 30 years

Scientific Name	Local name	Scientific Name	Local name
Cassia tora	Alkawa	*Imperatacylindrical*	Boos
Crotalaria maxillaris	Suffari	*Brachairiae ruciformis*	Alagaiz galaso
Picridium tingitanum	Mulaita	*Ocimum basilicum*	Raihan
Calotropis procera	Oshar	*Sida rhombifolia*	Um Barw
Cuscuta hyalnia	Hamoul	*Vernonia amygdalina*	Abu mrrow
Echinochloa colona	Difra	*Sesbania pachycarpa*	Sorib

Table (4.5.7.7) reflected the types of invaders shrubs in the study area.

Table (4.5.5.8): Available shrubs in the study area

Scientific Name	Local name	Scientific Name	Local name
Cymbopogon proximus	Maharaib	*Merremia emarginata*	Derieaya
Srtiga hermonthica	Booda	*Cephalocroton cordofanus*	Dingal
Sorghum arundinaceum	Adar	Rhynchosia memnonia	Erg Eldam

Table (4.5.5.8) showed the shrub were available in the study area.

Table (4.5.5.9): Irrational activities affecting the vegetation cover in the study area

Answer	Frequency	%
Yes	150	100
No	0	0
Total	150	100

Table (4.5.5.9) revealed that: all the respondents were said irrational activities affecting availability of the vegetation cover in the study area and these activities were over cutting of trees, over grazing, expansion of agriculture and expansion of residential areas this result was supported by Yousif, et al., (2017) how stated that; in Gedaref State the overall forest area and rangeland have reduced because of expansion in modern mechanized farming as a result of increasing human population to meet the increasing demand for food.

4.5.6 Situation of rangelands in the study area

Table (4.5.6.1): Grazing areas in the study area

Grazing areas	Frequency	%
Routes	34	23
Grazing on the farm land after harvesting	39	26
Open land	41	27
Around the villages	36	24
Total	150	100

Table (4.5.6.1) showed; 23% of the respondents their animals grazing on the routs, 26% of the respondents were used farm land after harvesting for animal grazing, while 27% and 24% were used the open land and around the villages as grazing land respectively. This result was similar to Mohamed, et al., (2011) how wrote; the economic activity in Sudan principally rural-based, relying on agriculture and pastoralism, and the majority of them was characterized as agro-pastoralists.

Table (4.5.6 .2): Palatable plants in the study area 2018

Palatable shrubs to the animals	Palatable shrubs to the animals	Palatable shrubs to the animals
Sonchus oleraceous (Mulita)	*Vernonia amygdalina* (Abu mrooa)	*Acheyanthus aspera* (Erg aldam)
Eragrostis aspera (Humirra)	*Rottboellia exaltata* (Umblila)	Crops residuos
Dinebra retroflex (Dafra)	*Cymbopogon proximus* (Maharib)	*Schmidtia pappophoroides* (Um mlyaha)
Desmodium dichotomum (Abu Areeda)	*Combretum verticillatus* (Raba)	Oryza ssp (Rizia)

Vossia cuspidata Pistia striotes (Tiber)	*Sorghum purpureosericeum*(Anies)	*Cassia senna* (Sanamca)
(Elboos)	*Sesbania arabica* (Sorib)	*Achryanthes aspera* (Fakha)
Sorghum ssp (Eladar)	Ocimum americanum (Rihan)	*Aritida hordeacea* (Danab elkadis)
Schima ischaemoids (Dombulab)	*Leucas urticifplia* (Um galowt)	*Aeluropus lagapoides*(Njila)
Corchorus olitorus (Khodra)	*Echinocloa pyramidalis (Um shir)*	

Table (4.5.6.2) revealed that: all the respondents were said theses the most palatable plants to the animals in the study area.

Table (4.5.6.3): The palatable plants in the study area (2018)

Most palatable shrubs	Most palatable shrubs	Most palatable shrubs
Acacia mellifera (Kiter)	*Grewia tenax* (Gedam)	*Balanites aegyptiaca* (Higlig)
Merremia emarginata (Daraya)	*Acacia senegal* (Hashab)	*Capparis decidua* (Tundub)
Acacia orefota (Lauat)	*Acacia seyal* (Talih)	*Cephalocroton cordofanus*(Dingl)
Ziziphus spina-christi (Sider)	*Acacia nilutica* (Sunt)	*Boscia angustifolia* (Sarah)
Cordia monoica (Andrab)		

Table (4.5.7.4) showed that: all the respondents said the most palatable shrubs and trees to the animals in the study area.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

1. Conclusion

The study concluded that; the vegetation cover of the study area in South West Qala El Nahal Locality was exposed to negative change during the period 1972 to 2018. Grasses cover was changed to 80.3% from 81% to 0.7% during (1972 to 2018) where 78.7% was converted to agricultural land and 1.6% was converted to the residential area. Forest land was changed from12.9% to no forest during (1972 to 2018) where was12.9% converted to the agricultural land. Hills cover was changed to 1.2% from 4.4% to 3.2% during (1972 to 2018) where was converted to the agricultural land too, while the agricultural land increased to 92.8% from 1.7% to 94.5% during (1972 to 2018). The rate of changes in grasses land (-1.761%/year), agriculture (+2.02%/year), forest (-.28%/year) and hills cover (-.003%/year), while the settlements (0.049%/year) through the last 34 years. Also the forest land was deteriorated and the trees were completely destroyed especially in the Northern and middle parts in the study area, human factor was the main driving force for land use land cover conversion and the expansion of cultivation schemes were the primary force of vegetation clearing and environmental degradation. According to the conversion of land cover to cropland which was the major phenomena in the study area, *Balanites eagyptiaca* and *Capparis decidua* were most endangered species and removal of trees around the natural water drainage systems such as Wadi El Naieem caused the expansion of these drainage systems in length and width. The environmental impacts of vegetation cover change on the study area were: Fluctuation in the amount of rainfall, increases in the average temperature and wind speed in the beginning and the end of rainy season, were affecting the cultivation time and raise the invaders plant species, while the socio-economic impacts were reflected in the reduction of productivity / area in the different crops, that lead to intensive rapid horizontal expansion of the mechanized rain-fed agriculture schemes, this mainly resulting in low income generation in the local marketing when compared with the cost of production.

Soil was deteriorated and potentiality was reduced as result of irrational land use in the study area. Farmers' selling the crop residues to increase their income, the target group have ability to return the vegetation cover in the study area by many ways and to use the available resources to create the alternatives choices to enhance the human livelihood and environment.

- Recommendations

  - Introduction of afforestation program.
  - Participation of the local community in all conservation programs.
  - Introduction of rotation.
  - Moiling and strengthen the extension activity.
  - Introduction of water harvest and spread techniques.

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Appendixes

Appendix-(A)

Appendix: vegetation covers sampling tables

Table (3.1): Recording method of vegetation sampling, in the Area

Point. No	Quadrant. No.	Species Type	Distance (m)	Point. No	Quadrant. No.	Species Type	Distance (m)
Stand. 1	1			Stand. 6	21		
	2				22		
	3				23		
	4				24		
Stand.2	5			Stand. 7	25		
	6				26		
	7				27		
	8				28		
Stand. 3	9			Stand. 8	29		
	10				30		
	11				31		
	12				32		
Stand. 4	13			Stand. 9	33		
	14				34		
	15				35		
	16				36		
Stand. 5	17			Stand. 10	37		
	18				38		
	19				39		
	20				40		

Table (3.2): Distribution of tree species in the study area

Tree species	Frequency	Percentage %	Cumulative %
Total			

Table (3.3): Calculation of trees stands parameters in study area

	M	m/tree	m²/tree	Trees/ha
point no	dt = di/m	D = $\bar{dt}$ /n/m	A = $\bar{d^2}$/m	Da=10m²/A²/trees/ha
Total				
Average				

Table (3.4): The frequency distribution of tree species in study area

No	Tree species	Quadrant No.															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Total																	

Table (3.5): The frequency distribution of grasses in study area

	Tree species	Quadrant No.															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Total																	

Appendix (B) - Soil attributes Data

B.1 Physical attributes data

Table (B.1.1) Soil Particles

	Soil Particles			
Sample. No	Clay%	Silt%	Sand%	Site Type
1	57.35	38.72	3.94	Clay
2	54.84	25.00	10.16	Clay
3	53.90	36.00	10.10	Clay
4	53.85	35.36	1.79	Clay
5	57.34	38.72	3.94	Clay
6	58.15	37.36	4.49	Clay
7	54.41	36.37	9.22	Clay
8	47.15	36.16	14.69	Clay
9	54.84	42.50	2.66	Silt Clay
10	56.74	34.36	8.90	Clay
11	64.84	35.00	0.16	Clay
12	61.63	35.34	3.04	Clay
13	64.84	35.00	0.16	Clay
14	59.84	25.00	15.16	Clay
15	48.15	35.61	16.24	Clay

B.2. Chemical attributes data

B.2.1 Soil pH

Table (B.2.1) Soil pH

	Samples. PH			
Samples. No	0-15cm	15-3cm	30-45cm	Average
1	7.66	7.88	7.93	7.82
2	7.25	7.54	7.33	7.373333
3	7.47	7.56	7.68	7.57
4	7.37	7.5	7.32	7.396667
5	8.28	7.4	8.16	7.946667
6	7.81	7.75	7.91	7.823333
7	7.25	7.36	7.44	7.35
8	7.21	7.35	7.31	7.29
9	7.23	7.51	7.48	7.406667
10	7.38	7.8	7.65	7.61
11	7.28	7.39	7.28	7.316667
12	7.35	7.48	7.34	7.39
13	7.61	7.59	7.81	7.67
14	7.71	7.51	7.56	7.593333
15	7.61	7.53	7.68	7.606667

B.2.2 Soil EC dS/m

Table (B.2.2) Soil EC dS/m

		EC.(ds/m)		
Samples. No	0-15cm	15-3cm	30-45cm	Average
1	1.973	0.833	0.319	1.041667
2	0.316	0.461	0.463	0.413333
3	0.571	0.3	1.329	0.733333
4	0.285	0.271	0.566	0.374
5	0.211	0.222	0.201	0.211333
6	1.654	0.345	0.345	0.781333
7	0.343	0.484	0.329	0.385333
8	0.247	1.391	0.301	0.646333
9	0.361	0.233	0.346	0.313333
10	0.238	1.832	0.264	0.778
11	0.339	0.291	0.401	0.343667
12	0.345	0.329	0.318	0.330667
13	0.502	0.363	0.387	0.417333
14	0.5	0.2	0.424	0.374667
15	0.415	0.423	0.405	0.414333

B.2.3 Nitrogen

Table (B.2.3) Nitrogen %

	Samples. N%			
Samples. No	0-15cm	15-3cm	30-45cm	Average
1	0.036	0.024	0.035	0.031667
2	0.028	0.016	0.02	0.021333
3	0.036	0.028	0.021	0.028333
4	0.048	0.03	0.28	0.119333
5	0.028	0.021	0.02	0.023
6	0.036	0.028	0.014	0.026
7	0.048	0.04	0.036	0.041333
8	0.056	0.048	0.036	0.046667
9	0.036	0.036	0.028	0.033333
10	0.056	0.048	0.036	0.046667
11	0.048	0.036	0.03	0.038
12	0.048	0.036	0.04	0.041333
13	0.056	0.048	0.036	0.046667
14	0.048	0.038	0.028	0.038
15	0.056	0.32	0.2	0.192

B.2.4 Phosphorus

Table (B.2.4) Phosphorus /ppm

	P/ppm			
Samples. No	0-15cm	15-3cm	30-45cm	Average
1	0.259	0.189	0.186	0.211333
2	0.305	0.301	0.295	0.300333
3	0.386	0.301	0.255	0.314
4	0.268	0.215	0.2	0.227667
5	0.255	0.25	0.2	0.235
6	0.365	0.315	0.255	0.311667
7	0.315	0.3	0.265	0.293333
8	0.408	0.366	0.305	0.359667
9	0.333	0.251	0.186	0.256667
10	0.255	0.208	0.186	0.216333
11	0.286	0.261	0.203	0.25
12	0.255	0.241	0.246	0.247333
13	0.255	0.241	0.315	0.270333
14	0.256	0.201	0.2	0.219
15	0.361	0.221	0.281	0.287667

B.2.5 Potassium

Table (B.2.5) Potassium meq/l

	K. meq/l			
Samples. No	0-15cm	15-3cm	30-45cm	Average
1	0.0392	0.048	0.052	0.0464
2	0.248	0.039	0.066	0.117667
3	0.0523	0.047	0.027	0.0421
4	0.056	0.045	0.057	0.052667
5	0.062	0.123	0.038	0.074333
6	0.042	0.053	0.037	0.044
7	0.049	0.094	0.041	0.061333
8	0.038	0.0284	0.041	0.0358
9	0.055	0.05	0.03	0.045
10	0.053	0.044	0.048	0.048333
11	0.059	0.069	0.072	0.066667
12	0.084	0.208	0.186	0.159333
13	0.043	0.053	0.071	0.055667
14	0.084	0.035	0.078	0.065667
15	0.086	0.08	0.092	0.086

Appendix (C)-Ministry of Environment, Natural Resources and Physical Development Meteorological Authority- Khartoum, Sudan

Table (C.1) Gedaref Average Rainfall (1972 to 2017)

Year	A. Rainfall	Year	A. Rainfall	Year	A. Rainfall	Year	A. Rainfall
1972	618	1984	319	1996	744.9	2008	629.1
1973	592.8	1985	744.7	1997	602.5	2009	532.7
1974	712	1986	604	1998	564.7	2010	601.5
1975	607.7	1987	473	1999	872.6	2011	469.7
1976	642	1988	584	2000	593.8	2012	564.1
1977	708.8	1989	761.3	2001	507.1	2013	436.3
1978	602.8	1990	371.9	2002	754.5	2014	865.1
1979	775.3	1991	418.8	2003	846.7	2015	490.5
1980	645.4	1992	574	2004	541.3	2016	499.7
1981	658.7	1993	777.3	2005	557.7	2017	697.6
1982	710	1994	638.4	2006	669.3		
1983	484.3	1995	528	2007	612		

Source: Khartoum Meteorological Authority 2018

Table (C.2) Gedaref Maximum Temperature (1972 to 2017)

ear	ax. Temp.	ear	ax. Temp.	ear	ax. Temp.	ear	ax. Temp.
972	6.38333	984	7.975	996	6.58	008	7.325
973	6..83333	985	6.575	997	6.4017	009	8.35852
974	5.71667	986	6.80833	998	6.8667	010	7.83559
975	6	987	7.06667	999	6.8167	011	7.71147
976	6.44167	988	6.84167	000	6.8333	012	7.42575
977	6.38333	989	6.06667	001	7.0083	013	7.75608
978	6.61667	990	8.15	002	7.8733	014	6.81667
979	6.83333	991	7.3	003	7.2333	015	7.98524
980	6.84167	992	6.6917	004	7.275	016	7.78333
981	6.63333	993	7.0417	005	7.7667	017	7.44167
982	6.5	994	6.4583	006	6.975		
983	6.73333	995	7.175	007	6.86667		

Source: Khartoum Meteorological Authority 2018

Table (C.3) Gedaref Minimum Temperature (1972 to 2017)

Year	Max. Temp.	Year	Max. Temp.	Year	Max. Temp.	Year	Max. Temp.
1972	21.45833	1984	22	1996	21.625	2008	22.25833
1973	21.96667	1985	21.49167	1997	21.825	2009	22.87988
1974	20.89167	1986	21.06667	1998	22.3	2010	23.13954
1975	21.15	1987	21.91667	1999	21.86667	2011	22.42789
1976	20.78333	1988	21.58333	2000	21.75833	2012	22.21028
1977	20.71667	1989	20.8	2001	22.225	2013	22.92269
1978	21.10833	1990	22.05	2002	22.20833	2014	22.7
1979	21.30833	1991	22.03333	2003	22.21667	2015	23.15218
1980	21.34167	1992	21.1	2004	22.15	2016	23.3
1981	20.14167	1993	21.68333	2005	22.36667	2017	24.7
1982	20.0333	1994	21.74167	2006	21.94167		
1983	21.25833	1995	21.475	2007	22.26667		

Source: Khartoum Meteorological Authority 2018

Appendix (D) Questionnaire

Sudan University of Science and Technology
College of Graduate Studies
Questionnaire on Assessment of the Vegetation Cover Change at Qala El-Nahal Locality, Gedaref State, Sudan
<u>This information Just for the study</u>

4.4.1 General information about the study area

1.1 date:………………….. 1.2 State:………………………………

1.3 Locality:……………………1.4 Administration Unite:……………..

1.5 Village:…………………… 1.6 Residual Tribes in the village:

……………………………………………………………………………….

1.7 Houses building materials:…………………………………………..

1.8 Available services in the study area:

1- Electricity. 2- Domestic water Nate. 3- Education institutions.

4- Roads Nate. 5- Energy sources. 6- Markets.

4.4.2 Personal information's

2.1.a. Respondents gender in the study area

1- Male 2- Female

2.1. b. Respondents age classes (years) in the study area

1- 40-49. 2-50-59.

3- 60-69. 4-70≤.

2.2 Respondents educational level

1- Illiterate. 2- Khalwa.

3- Primary School. 4- Secondary School. 5- University.

2.3 Respondent occupations in the study area.

1- Farmer. 2- Agricultural Labor.

3- Free Business. 4- Employs and Farmer. 5- Farmer and Trader.

2.4 Social status of the respondents

1- Married. 2- Single.

3- Widowed. 4- Divorced.

2.5 Number of family members

1. 1-6. 2. 7-12. 3. 18≤.

4.5.3 Farmers

3.1 Type of the farmers according to scheme owner area/feddan (2018)

1- Large scheme farmers. 2- Medium scheme farmers.

3- Small scheme farmers. 4- Rent.

1.2. Types of the land for the schemes in this study area (2018)

1- Government. 2- Institution. 3- Social organization.

4- Private. 5- Buffer the village.

3.3 Types of land tenure in the study area (2018)

1- Private owner. 2- Rant. 3- Partnership. 4- A gift.

3.3 Entity approved the acquisition in the study area (2018)

1- Federal Government. 2- State government. 3- Traditional administration.

4- Hand Mode. 5- I do not know.

3.5. Land tenure problems in the study area (2018)

1. Yes. 2- No.

3.6. Years respondents cultivate the land in the study area (2018)

1. 1-10. **2.** 11-2. **3.** 21-3. **4.** 31-40.

3.7. Types of cultivated crops in the study area (2018)

1- Dura, Sesame and Maize. 2- Dura, Sesame and Millet. 3- Dura, Sesame.

4- Dura, Sesame, cotton. 5- Not farmer.

3.8. Methods of cultivation in the study area (2018)

1- Manual. 2- Mechanized. 3- Manual and Mechanized.

3.9. Types of disc harrows used in agriculture in the study area (2018)

1- The Normal disc harrows. 2- Traditional machines. 3- Wide range disc harrows. 4- Zero tillage.

3.10 Crops harvesting equipment's in the study area (2018)

1. Manual equipment's. 2. Mechanized. 3. Both

3.11 Type of labor in the study area (2018)

1. Permanent. 2. Seasonal. 3. Family members.

3.12 Average cost of 5th feddan /SDG preparation in the study area in season 2017

1. 1001-2000. 2. 2001-3000. 3. 3001<

3.13. Average productivity of Sesame sack /feddan in the study area in 2016

1. 0-5. 2. 6 ≤.

3.14. Average productivity of Dura sack (100kg /feddan) in 2016

1. 0-3. 2. 4 ≤.

3.15. Average productivity of Sesame (sack=100kg /feddan) in 2017

1. 0-5. 2. 6 ≤.

3.16 Average productivity of Dura sack in 2017

1. 0-4. 2. 5 ≤.

3.17 Average price of the sack/seasons (2016 and 2017)

1. **Season:** 2016 for **Dura** . 1. 200-300SD.
2. **Season:**2016 for **Sesame**. 1200-1800SD
3. **Season:** 2017 for **Dura**. 1. 500SD.
4. **Season**:2017 for **Sesame**. 3.000-3.500SD

3. 18 Soil deterioration in the study area 2018

1. Yes. 2.No

3.19 Application of pesticides in the study area 2018

1. Yes. 2.No. 3. Neutral.

3. 20. Reduction in the productivity between 2010 to 2018

1. Yes. 2.No. 3. Neutral.

3.21 Proposed methods to increase crop productivity in the study area

1. Early cultivation and improved seeding.
2. Changing the amount of land under cultivation
3. Agricultural rotations and improved seeds
4. The introduction of plough improved seeds
5. Nothing was followed

3.22 Satisfaction with the crop production

1. Yes. 2.No.

3. 23- Use of the crops residues

1. Selling the Agricultural residues as fodder.
2. Grazing the agricultural residues in the field by money

5.5.4 Situation of the climate during the cultivation period

4.1. Situation of climate during the cultivation period in the study area

1. Yes. 2.No. 3. Neutral.

4.2 Impact of rainfall and fluctuations during the cultivation period

1. Yes. 2. No. 3. Neutral

5.3 Situation of the temperature during the cultivation period

1. Yes. 2. No. 3. Neutral

4.4 Situation of agriculture depends on the productivity during the last 30 years

1. Excellent. 2. Good. 3. Medium. 4. Decline.

4.5 Suggestions to reduce the impact of temperature in the study area

1. Cultivation of trees on the empty areas.
2. Shelter belts as a barrier between the cultivated areas

4.6. Suggestions to increase rainfall in the area

1. Increase the vegetation cover.
2. Application of Agricultural policy and deep plugging.
3. Use water harvesting technique for more green cover

4.7. Suggestions to increase crop productivity

1. Use the improved seeds. 2. Crop diversification
3. The application of agricultural techniques and extension role
4. Appling the pesticides and fertilizers

4.8 Suggestions to increase the household income

1. Crop production and animals rasing
2. Crop diversification. 3. Micro finance

5.10 Suggestions for family stability in the study area

1. Infrastructures development.
2. Irrigated cultivation programs (using water harvesting)

5.5.5 Situation of vegetation covers in the study area

5.1. Status of trees species before 30 years

1. Yes. 2. No.

5.2. Types of tree presented before 30 years ago in the study area

Scientific Name	Local name	Scientific Name	Local name

5.3 Types of tree species in the study area towards to extinction

Scientific Name	Local name	Scientific Name	Local name

5.4 Invaders trees species presented in the study area in the last 30 years

1. Yes.   2.No.

5.5 Invaders tree species in the study area

Scientific Name	Local name	Scientific Name	Local name

5.6 Shrubs were presented in the study area before 30 years ago

1. Yes.   2.No.

5.7 Disappeared shrubs in the study area in the last 30 years ago

Scientific Name	Local name	Scientific Name	Local name

5.8 - Invaders shrubs in the study area in the last 30 years

Scientific Name	Local name	Scientific Name	Local name

5.9 Available shrubs in the study area

Scientific Name	Local name	Scientific Name	Local name

5.10 Irrational activities affecting the vegetation cover in the study area

1. Yes. 2.No.

5.5.6 Situation of rangelands in the study area

6 .1 Grazing areas in the study area

1. Routes. 2. Grazing on the farm land after harvesting.

3. Open land. 4. Around the village.

6.2 Palatable plants in the study area 2018

Scientific Name	Local name	Scientific Name	Local name

6.3 The palatable plants in the study area (2018)

Scientific Name	Local name	Scientific Name	Local name

بسم الله الرحمن الرحيم
جامعة السودان للعلوم والتكنولوجيا
كلية الدراسات العليا
قسم الغابات
إستبانة حول تقيم التغير في الغطاء النباتي بمحلية قلع النحل ،ولاية القضارف،السودان
البيانات تستخدم لأغراض البحث فقط

1. **بيانات عامة:**

I. التاريخ:..

II. الولاية.-----------------------------------المحلية:-------------------------------

الوحدة الإدارية:-----------------------------القرية:-------------------------------

القبائل المستوطنة بالقرية:..

III. المواد المستخدمة في بناء المنازل.

IV. الخدمات المتوفرة.

a) الكهرباء. b)شبكة المياه. c) المؤسسات التعليمية.

d)شبكة الطرق e) مصادر الوقود. f)أماكن التسوق.

2. **البيانات الشخصية:**

1.1 النوع: 1/ ذكر-------------------------------2/ أنثى------------------------------

1.2 العمر:1 / 30-40 سنة. 2/ 41-50 سنة. 51/3-60 سنة. 60/4 فما فوق.---

II. المستوى التعليمي: 1/ أمي----------------2/خلوة------------------3/ أساس-----------

4/ ثانوي---------------5/جامعي----------------6/فوق الجامعي--------

III. المهنة الرئيسية: 1-مزارع...........2-تاجر......... 3- راعي...........

4- عامل زراعة............. 5-أعمال حرة..................6- أخرى..................

IV. الحالة الإجتماعية: 1/ متزوج/متزوجة------------2/عازب------------3/ مطلقة--------

4/ أرملة------------------------5/ عدد أفراد الأسرة----------------

3. **فئة المزارعين :-**

1) نوع المزارع حسب مساحة الأرض بمنطقة الدراسة

1- مشروع زراعي كبير و مساحته. 2-مشروع زراعي متوسط ومساحته.

3-صاحب مشروع زراعي صغير ومساحته 4- مستاجر.

2) نوع الأرض للمشروع الزراعي

1) حكومية 2)مؤسسة 3)جمعية شعبية .

4)خاصة. 5) حرم القرية

3) نوع حيازة الأرض:

1) ملك 2) إيجار 3) شراكة 4) هبة

4) الجهة التي أقرت الحيازة:

1) الحكومة الإتحادية. 2) الحكومة الولائية.

3) الإدارة الأهلية. 4) وضع اليد. 5) أخرى.

5) هل توجد مشاكل حول ملكية الارض؟ 1-نعم. 2-لا.

6) السنوات التي تزرع فيها الارض:

1/ 1-10. 2/ 11-20. 3/ 21-30. 4/ 31-40. 5/ فوق 40 عام

7) أنواع المحاصيل المزروعة:

1. ذرة، سمسم،ذرة شامية. 2. ذرة، سمسم، دخن. 3. ذرة، سمسم.

4. ذرة، سمسم، قطن. 5. ليس مزارع.

8) طريقة الزراعة:

1. يدويا. 2. استخدام الآلة. 3. تحميل.

9) أنواع المحاريث التي تستخدم في الزراعة.

1. المحراث العادي. 2. الآلات التقليدية.

3.المحراث الثقيل. 4. الزراعة بدون حراثة.

10) الأدوات المستخدمه فى الحصاد

1. الادوات التقليدية. 2. الحاصدة. 3. الادوات التقليدية و الحاصدة

11) نوع العماله التى تستخدم

ا-دائمه .... 2- موسميه ....3- أفراد الاسرة...................

12) متوسط تكلفة تحضير 5 فدان/جنيه السوداني للزراعة لموسم 2016.

13) متوسط تكلفة تحضير 5 فدان/جنيه السوداني لموسم 2017.

14) متوسط إنتاج الفدان بالجوال لموسم 2016: 1. محصول السمسم. 2. محصول الذرة

15) متوسط إنتاج الفدان بالجوال لموسم 2017 :1. محصول السمسم. 2. محصول الذرة

16) متوسط سعر الجوال لموسم 2016 1. محصول السمسم. 2. محصول الذرة

17) متوسط سعر الجوال لموسم 2017 1. محصول السمسم. 2. محصول الذرة

18) تدهور خصوبة التربة بمنطقة الدراسة 2018

1-نعم.................................... 2- لا..............................

19) تستخدم المبيدات في الزراعة.

1. نعم................................2.لا......................3. محايد

20) يوجد تدنى في الإنتاجيه خلال الفترة 2010 الى 2018

1- نعم .... 2- لا............. 3. محايد...................

21) الطرق المقترحة لزيادة الانتاج بمنطقة الدراسة

1. الزراعة المبكرة مع استخدام البزور المحسنة. 2.تغير المساحة المزراعية.

3.اتباع الدورة الزراعية والبزور المحسنة. 4.إدخال آلات الحراثة والبزور المحسنة

5. لا اتبع طريقة

22) الإنتاجية كافيه

1--نعم ....2- لا.....................3. محايد..........

23) استخدامات بقايا المحاصيل

1. بيع بقايا المحصول. 2. رعي بقايا المحصول مقابل عائد مادي.

4. <u>الأوضاع المناخيه بمنطقة الدراسة :-</u>

1) **1**. حالة المناخ خلال فترة الزراعة بمنطقة الدراسة

1- نعم .... 2- لا ....3. محايد................................

2) اثر تذبذب معدل الامطار خلال فترة الزراعة

1- نعم. 2- لا. 3- محايد.

3) حالة درجات الحرارة خلال فترة الزراعة

1- نعم................. 2- لا............... 3. محايد..........................

4) حالة الزراعة اعتمادا على الانتاجية

1. ممتازه......... 2- جيده......... 3- وسط............. 4- متدنية..............

5) إقتراحاتكم لتقليل درجة الحرارة بمنطقة الدراسة

1.زراعة الاشجار بالمناطق الخالية. 2.الحزم الشجرية بين المزارع.

6) إقتراحاتكم لزيادة معدل الامطار.

1. زروعة الاشجار 2.اتباع السياسات الزراعية واستخدام التقانات الحديثة.

3.استخدام تقنية حصاد المياه لزيادة المساحات الخضراء.

7) إقتراحاتكم لتحسين الإنتاجية.

1. استخدام البزور المحسنة. 2. تطبيق التقانات الزراعية الحديثة والدور الارشادي. 3.تنويع المحاصيل المزروعة. 4. استخدام الاسمدة والمبيدات.

8) إقتراحاتكم لذيادة دخل الفرد.

1.التنوع الزراعي (النباتي والحيواني). 2.تنوع التركيبة المحاصيل.

3.تفعيل التمويل الاصغر.

9) إقتراحاتكم للإستقرار الاسر بالمنطقة.

1.تحسين البنى التحتية.

2. إدخال برنامج الزراعة المروية باستخدم حصاد المياه

5. حالة الغطاء النباتى بمنطقة الدراسة:-

1. حالة الغطاء النباتي قبل 30 سنة افضل

أ/ نعم ( ). ب/ لا ( ). ج/ محايد ( ).

2. أنواع الأشجارالموجودة قبل 30 سنة بمنطقة الدراسة

الرقم	الاشجار	الرقم	الاشجار
1		6	
2		7	
3		8	
4		9	
5		10	

3. أنواع الأشجار المعرضة للإنقراض

الرقم	الاشجار	الرقم	الاشجار
1		6	
2		7	
3		8	
4		9	
5		10	

4. الأشجار الغازية التي ظهرت خلال 30 سنة

I. نعم. II. لا

5. أنواع الأشجار الغازية التي ظهرت خلال 30 سنة الاخيرة

الرقم	الاشجار	الرقم	الاشجار
1		4	
2		5	
3		6	

6. حشائش الموجودة قبل 30 سنة بمنطقة الدراسة

1. نعم. 2. لا. 3. محايد.

7. انواع الحشائش التي إختفت بعد 30 عام

الرقم	أنواع النباتات	الرقم	أنواع النباتات
1		6	
2		7	
3		8	
4		9	
5		10	

8. أنواع الحشائش الغازية بمنطقة الدراسة خلال 30سنة الاخيرة

الرقم	أنواع النباتات	الرقم	أنواع النباتات
1		6	
2		7	
3		8	
4		9	
5		10	

9. الحشائش المتوقرة بالمنطقة

الرقم	أنواع النباتات	الرقم	أنواع النباتات
1		4	
2		5	
3		6	

10. انشطة غير رشيدة يتعرض لها الغطاء النباتي بالمنطقة

أ/ نعم ( ). ب/ لا ( ). ج/ محايد ( )

6. <u>فئة للرعاة:-</u>

1) مناطق الرعي بمنطقة الدراسة.

الرقم	الطريق
1	مسار
2	بمناطق الزراعة بعد الحصاد
3	المناطق المفتوحة
4	حول القرية

2) النباتات المستثاغة بمنطقة الدراسة 2018.

الحشائش				الاعشاب			
1		5		1		5	
2		6		2		6	
3		7		3		7	
4		8		4		8	

3) الاشجار المستثاغة بمنطقة الدراسة 2018.

الحشائش				الاعشاب			
1		5		1		5	
2		6		2		6	
3		7		3		7	
4		8		4		8	

Appendix (E)

Field Work Land Features in Qala El Nahal Locality- Gedaref State Sudan (2014)

POINT_X	POINT_Y	POINT Name	Elevation	Stand. Condition	L C	LU	Status	Feature	Water
695232.	1486375.	0	397m	Cutting	Dura	Cultivated	In use	None	None
696786.	1486375.	1	399m	Cutting	Dura	Cultivated	In use	extension of khour	None
698340.	1486375.	2	399m	Cutting	Dura	Cultivated	In use	None	None
699894.	1486375.	3	400m	Cutting	Dura	Cultivated	In use	None	None
701448.	1486375.	4	398m	Cutting	Dura	Cultivated	In use	None	None
703002.	1486375.	5	399m	Cutting	Dura	Cultivated	In use	None	None
704556.	1486375	6	400m	Cutting	Dura	Cultivated	In use	near the road	None
706110.	1486375.	7	406m	Cutting	Dura	Cultivated	In use	near the road	None
707664.	1486375.	8	491m	Ban. Village	None	None	None	Ban. Hill	None
709218.	1486375.	9	405m	Cutting	Dura	Cultivated	In use	None	None
695232.	1487835.	10	406m	Cutting	Dura	Cultivated	In use	None	None
696786.	1487835.	11	468m	talih+ketter stand	None	None	None	BO.khour elnaim	Khour
698340.	1487835.	12	472m	Cutting	Dura	Cultivated	In use	None	None
699894.	1487835.	13	473m	Grassland	Dura milt	Cultivated	In use	None	None
701448.	1487835.	14	479m	Cutting	Dura	Cultivated	In use	None	None
703002.	1487835.	15	483m	Cutting	Dura	Cultivated	In use	None	None
704556.	1487835.	16	487m	Grassland	Dura	Cultivated	In use	Road	khour
706110.	1487835.	17	495m	Grassland	None	None	None	Road	khour
707664.	1487835.	18	506m	Grassland	None	None	None	Road	khour
709218.	1487835	19	533m	Cutting	Dura	Cultivated	In use	Road	BO.khour
695232.	1489295.	20	473m	Cutting	Dura	Cultivated	In use	None	None
696786.	1489295.	21	472m	Cutting	Dura	Cultivated	In use	None	None
698340.	1489295	22	473m	Cutting	Dura	Cultivated	In use	None	None
699894.	1489295.	23	467m	Cutting	Dura	Cultivated	In use	BO.khour elnaim	khour elnaim
701448.	1489295.	24	475m	Cutting	Dura	Cultivated	In use	None	None
703002	1489295.	25	475m	Cutting	Dura	Cultivated	In use	None	None
704556.	1489295.	26	478m	Cutting	Dura	Cultivated	In use	None	None
706110.	1489295.	27	487m	Cutting	Sesame	Cultivated	In use	None	None
707664.	1489295.	28	496m	Cutting	Dura	Cultivated	In use	None	None
709218	1489295.	29	486m	Cutting	Dura	Cultivated	In use	None	None
695232.	1490755.	30	473m	Cutting	Dura	Cultivated	In use	None	None

Appendix (E)

Field Work Land Features in Qala El Nahal Locality- Gedaref State Sudan (2014)

696786.	1490755.	31	473m	Cutting	Dura	Cultivated	In use	Road	None
698340.	1490755.	32	477m	Cutting	Dura	Cultivated	In use	Khour elnaim	khour elnaim
699894.	1490755.	33	477m	Cutting	Dura	Cultivated	In use	Road	None
701448.	1490755.	34	476m	Cutting	Dura	Cultivated	In use	None	None
703002.	1490755.	35	475m	Cutting	Dura	Cultivated	In use	BO.khour elnaim	khour elnaim
704556	1490755.	36	394m	Cutting	Dura	Cultivated	In use	BO.khour elnaim	khour elnaim
706110.	1490755.	37	395m	Cutting	Sesame	Cultivated	In use	None	None
707664.	1490755.	38	396m	Cutting	Sesame	Cultivated	In use	None	None
709218.	1490755.	39	396m	Cutting	Sesame	Cultivated	In use	None	None
695232.	1492215.	40	475m	Cutting	Dura	Cultivated	In use	None	None
696786.	1492215.	41	475m	Cutting	Dura	Cultivated	In use	None	None
698340.	1492215.	42	476m	Cutting	Dura	Cultivated	In use	Road	None
699894.	1492215.	43	483m	Cutting	Dura	Cultivated	In use	Khour elnaim	khour elnaim
701448.	1492215.	44	483m	Cutting	Dura	Cultivated	In use	None	None
703002.	1492215.	45	484m	Cutting	Dura	Cultivated	In use	None	None
704556.	1492215.	46	396m	Cutting	Dura	Cultivated	In use	None	None
706110.	1492215.	47	396m	Cutting	Dura	Cultivated	In use	None	None
707664.	1492215.	48	397m	Cutting	Dura	Cultivated	In use	None	None
709218.	1492215.	49	398m	Cutting	Dura	Cultivated	In use	None	None
695232.	1493675.	50	476m	Cutting	Dura	Cultivated	In use	None	None
696786.	1493675.	51	474m	Cutting	Dura	Cultivated	In use	Road	None
698340.	1493675.	52	477m	Cutting	Dura	Cultivated	In use	None	None
699894.	1493675.	53	481m	Cutting	Sesame	Cultivated	In use	None	None
701448.	1493675.	54	484m	Cutting	Sesame	Cultivated	In use	khour elnaimm	khour elnaim
703002.	1493675.	55	488m	Cutting	Dura	Cultivated	In use	None	None
704556	1493675.	56	493m	Cutting	Dura	Cultivated	In use	None	None
706110.	1493675.	57	498m	Cutting	Sesame	Cultivated	In use	khour elnaim	khour elnaim
707664.	1493675.	58	503m	Cutting	Sesame	Cultivated	In use	Road+khour elnaim	khour elnaim
709218.	1493675.	59	522m	Wady Elnaim Village	None	None	Abuse	Road	khours
695232.	1495135.	60	497m	Cutting	Sesame	Cultivated	In use	None	None

Appendix (E)

Field Work Land Features in Qala El Nahal Locality- Gedaref State Sudan (2014)

696786.	1495135.	61	482m	Cutting	Dura	Cultivated	In use	None	None
698340.	1495135.	62	486m	Cutting	Dura	Cultivated	In use	None	None
699894.	1495135.	63	486m	Cutting	Dura	Cultivated	In use	None	None
701448	1495135.	64	478m	Cutting	Sesame	Cultivated	In use	None	None
703002.	1495135.	65	486m	Cutting	Dura	Cultivated	In use	None	None
704556.	1495135.	66	487m	Cutting	Dura	Cultivated	In use	Road	None
706110.	1495135.	67	491m	Cutting	Dura	Cultivated	In use	None	None
707664.	1495135.	68	504m	Cutting	Dura	Cultivated	In use	None	None
709218.	1495135.	69	505m	Grassland	None	uncultivated	Abuse	Road	None
695232	1496595.	70	479m	Cutting	Sesame	Cultivated	In use	Gran.HI+R.W	None
696786.	1496595.	71	479m	Grassland	None	uncultivated	Abuse	None	None
698340.	1496595.	72	487m	Cutting	Dura	Cultivated	In use	Elwade Extension	None
699894.	1496595	73	486m	Grassland	None	uncultivated	Abuse	Elwade Bottum	None
701448.	1496595.	74	487m	Cutting	Sesame	Cultivated	In use	None	None
703002.	1496595.	75	497m	Cutting	Dura	Cultivated	In use	None	None
704556.	1496595.	76	499m	Cutting	Dura	Cultivated	In use	None	None
706110.	1496595.	77	504m	Cutting	Dura	Cultivated	In use	None	None
707664.	1496595.	78	501m	Cutting	Dura	Cultivated	In use	None	None
709218.	1496595.	79	530m	Bare soil	None	uncultivated	Abuse	Across the Road	None
695232.	1498055.	80	491m	Cutting	Dura	Cultivated	In use	South Alareed HI	None
696786.	1498055.	81	489m	Cutting	Dura	Cultivated	In use	R.w	None
698340.	1498055.	82	485m	Cutting	Sesame	Cultivated	In use	R.w	None
699894.	1498055.	83	488m	Cutting	Dura	Cultivated	In use	None	None
701448.	1498055.	84	491m	Cutting	Dura	Cultivated	In use	Khour Abu Ranja	Khour
703002.	1498055.	85	494m	Cutting	Dura	Cultivated	In use	Khour Abu Ranja	Khour
704556.	1498055	86	504m	Cutting	Dura	Cultivated	In use	None	None
706110.	1498055.	87	507m	Cutting	Dura	Cultivated	In use	None	None
707664.	1498055.	88	510m	Cutting	Milt	Cultivated	In use	None	None
709218.	1498055	89	527m	Cutting	Sesame	Cultivated	In use	Road	None
695232.	1499515.	90	497m	Alareed Hill	settlement	uncultivated	Abuse	Alareed.V	None
696786.	1499515.	91	488m	Cutting	Milt	Cultivated	In use	None	None

Appendix (E)

Field Work Land Features in Qala El Nahal Locality- Gedaref State Sudan (2014)

698340.	1499515.	92	490m	Cutting	Sesame	Cultivated	In use	None	None
699894.	1499515.	93	497m	Cutting	Milt	Cultivated	In use	R.w	None
701448.	1499515.	94	494m	Cutting	Milt	Cultivated	In use	None	None
703002.	1499515.	95	498m	Cutting	Sesame	Cultivated	In use	khourAbu Ranja	khour Abu Ranja
704556.	1499515.	96	502m	Cutting	Dura	Cultivated	In use	Khour Abu Ranja	Khour
706110.	1499515.	97	500m	Cutting	Milt	Cultivated	In use	None	None
707664.	1499515.	98	513m	Cutting	Sesame	Cultivated	In use	None	None
709218.	1499515.	99	506m	Unclear cutting Hash	Sesame	Cultivated	In use	Road	None
695232.	1500975.	100	479m	Cutting	Sesame	Cultivated	In use	AlareedHI	Hafire
696786.	1500975.	101	480m	Cutting	Dura	Cultivated	In use	None	None
698340.	1500975.	102	489m	Cutting	Sesame	Cultivated	In use	None	None
699894.	1500975.	103	491m	Cutting	Dura	Cultivated	In use	None	None
701448.	1500975.	104	488m	Cutting	Dura	Cultivated	In use	R.w	None
703002	1500975.	105	491m	Cutting	Dura	Cultivated	In use	None	None
704556.	1500975.	106	501m	Cutting	Dura	Cultivated	In use	Khour Abu Ranja	Khour
706110.	1500975.	107	503m	Hash.Talh.Kitter Stand	None	None	Abuse	Khour Abu Ranja	Khour
707664.	1500975.	108	509m	Hash.Talh.Kitter Stand	None	None	Abuse	Khour Abu Ranja	Khour
709218.	1500975.	109	472m	Cutting	Sesame	Cultivated	In use	None	None
695232.	1502435	110	573m	Cutting	Dura	Cultivated	In use	Elec.Tower	None
696786.	1502435.	111	486m	Cutting	Sesame	Cultivated	In use	None	None
698340	1502435.	112	492m	Cutting	Dura	Cultivated	In use	None	None
699894.	1502435.	113	490m	Cutting	Dura	Cultivated	In use	None	None
701448	1502435.	114	491m	Cutting	Dura	Cultivated	In use	None	None
703002.	1502435.	115	496m	Road	Bare	None	Abuse	R.w	None
704556.	1502435.	116	500m	Cutting	Dura	Cultivated	In use	None	None
706110	1502435.	117	507m	Cutting	Sesame	Cultivated	In use	None	None
707664.	1502435.	118	514m	Cutting	Dura	Cultivated	In use	None	None
709218.	1502435.	119	528m	Cutting	Sesame	Cultivated	In use	Abu RunjaVe	Khour
695232.	1503895.	120	480m	Cutting	Sesame	Cultivated	In use	Makrundo	None
696786.	1503895.	121	487m	Grassland	shrubs	Grazing	Abuse	Kartout.Ve	None

Appendix (E)

Field Work Land Features in Qala El Nahal Locality- Gedaref State Sudan (2014)

698340.	1503895	122	495m	Cutting	Dura	Cultivated	In use	None	None
699894.	1503895.	123	496m	Cutting	Sesame	Cultivated	In use	None	None
701448	1503895.	124	498m	Cutting	Dura	Cultivated	In use	None	None
703002.	1503895.	125	503m	Cutting	Dura	Cultivated	In use	nearR.w	None
704556.	1503895.	126	510m	Cutting	Dura	Cultivated	In use	None	None
706110.	1503895.	127	520m	Cutting	Milt	Cultivated	In use	None	None
707664.	1503895.	128	529m	Cutting	Sesame	Cultivated	In use	None	None
709218.	1503895	129	527m	Hillsشطة	shrubs	None	None	Mahrab	None
695232.	1505355.	130	487m	E	Bare	Road	Abuse	Frakh.Hill	None
696786.	1505355.	131	483m	Cutting	Sesame	Cultivated	In use	None	None
698340.	1505355.	132	485m	Cutting	Melt	Cultivated	In use	None	None
699894.	1505355.	133	484m	Cutting	Dura	Elec.tower	In use	None	None
701448.	1505355.	134	483m	E	Bare	Road	Abuse	Cult,land	None
703002.	1505355.	135	483m	Cutting	Dura	Cultivated	In use	None	None
704556.	1505355.	136	482m	Cutting	Sesame	Cultivated	In use	nearR.w	None
706110.	1505355.	137	481m	Cutting	Sesame	Cultivated	In use	None	None
707664.	1505355.	138	482m	Cutting	Sesame	Cultivated	In use	None	None
709218.	1505355.	139	488m	Hill	Mahreab	None	None	None	None
695232.	1506815.	140	494m	N. Reg	Sesame	Cultivated	In use	None	None
696786.	1506815.	141	498m	N. Reg	Sesame	Cultivated	In use	None	None
698340.	1506815.	142	503m	Cutting	Dura	Cultivated	In use	None	None
699894.	1506815.	143	509m	Cutting	Sesame	Cultivated	In use	None	None
701448.	1506815.	144	510m	N, Reg	Sesame	Cultivated	In use	None	None
703002.	1506815.	145	537m	Cutting	Sesame	Cultivated	In use	None	None
704556.	1506815.	146	537m	Cutting	Dura	Cultivated	In use	None	None
706110.	1506815.	147	432m	Cutting	Dura	Cultivated	In use	None	None
707664.	1506815.	148	456m	Cutting	Dura	Cultivated	In use	Near R. w	None
709218.	1506815.	149	466m	E	Bare	Food.Boal	Abuse	near school	None